School of Physiotherapy

Identification of developmental coordination disorder in primary school aged Kuwaiti children

Suad Eid Farhan Alanzi

This thesis is presented for the Degree of
Doctor of Philosophy
of
Curtin University

June, 2011

ABSTRACT

Developmental Coordination Disorder (DCD) is a heterogeneous disorder and each child may exhibit different features. Children with DCD have motor coordination impairments and their motor abilities, which are substantially below their age and intelligence levels, impact on their activities at home and/or at school. The motor impairments are not due to any medical or neurological disorder.

Many studies have been conducted to investigate the prevalence of DCD in many countries but not all of them comply with the DSM-IV criteria, resulting in different prevalence estimates. Researchers that have stringently applied the four criteria of the DSM-IV when making a diagnosis have found the prevalence to be 1.8% of seven year old children (N = 6990). A further factor that appears to influence prevalence is culture, and no studies to date have investigated DCD in Kuwait.

DCD is not well identified in Kuwait and children with DCD may be under-diagnosed and/or misdiagnosed with other developmental disorders such as Attention Deficit/Hyperactivity Disorder, and Learning Disorder. Another reason may be the different labelling that has been given to DCD. In Kuwait, the term "sensory integration disorder" is more common than DCD. The overlapping and interchangeable use of terms causes disagreement in research and clinical practice in assessing and treating children with motor coordination difficulties. This thesis investigates the prevalence of DCD in a representative sample of Kuwaiti children. A secondary aim was to ascertain the knowledge of health and educational professionals.

Study one investigated the prevalence of DCD in primary school-aged children (5-9 year old) in the State of Kuwait based on the DSM-IV criteria. The Movement Assessment Battery for Children – 2nd Edition (MABC-2) was administered to 297 Kuwaiti 5-9 year old children (147 boys and 150 girls) who were recruited from public and private primary mainstream schools in urban and rural areas. This was used to assess DCD Criterion A. Criterion B was assessed using the DCD Questionnaire – New Edition (DCDQ'07) which was completed by the children's parents. In order to achieve this aim, the validity of the MABC-2 and DCDQ'07 were also examined. In addition to prevalence, the motor performance of Kuwaiti children was compared with the performance of the UK children used for the MABC-2 norms. Gender, age, and school type (private or public) were investigated. The results of study one showed that the prevalence of DCD was 5.7% which is considered high when the DSM-IV criteria are stringently applied. The construct validity of the MABC-2 revealed that the drawing item was problematic. However, after re-standardization of the drawing item the construct validity of the MABC-2 was confirmed. There were significant differences between Kuwaiti boys and girls in aiming and catching skills. Also, Kuwaiti children were significantly behind the UK children in the total score of the MABC-2, manual dexterity, and balance. The reliability of the DCDQ'07 was confirmed, however, its validity was poor.

The second study used interviews to explore the DCD knowledge of educational and health professionals, and to explore the facilities available in both health and educational sectors for children with DCD. Twenty-two professionals from educational and health sectors were interviewed. The results of study two revealed that professionals from both sectors were unaware of the definition of DCD. Although professionals from the health sector were more able than the educational professionals to describe children with DCD, they were unaware of the consequences and prognosis. Facilities were not provided for children with DCD in either health or education sectors.

In conclusion, our findings have emphasised the importance of complying with the DSM-IV criteria in the identification of children with DCD, and the necessity of using reliable and valid assessment tools that are suitable for different cultures.

The differences in children's motor abilities between genders and between children from different countries were task-specific that may be influenced by biological, cultural, and environmental factors. Hence, consideration should be given for these differences in assessing children's motor ability. Individual intervention plans are required for children with DCD that should cover each child's needs. Researchers and clinician should consider the factors that cause such differences while identifying DCD.

DECLARATION

To the best of my knowledge and belief this doctoral thesis is a result of my own work that has been carried out since the offical commencement date of the doctoral degree approval. It contains no material previously published by any other person except where due acknowledgement has been made. This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

Suad ALAnzi

June 2011

ACKNOWLEDGMENT

بِسْمِ اللَّـهِ الرَّحْمَـٰنِ الرَّحِيمِ

اقْرَأْ بِاسْمِ رَبِّكَ الَّذِي خَلَقَ (١) خَلَقَ الْإِنسَانَ مِنْ عَلَقٍ (٢) اقْرَأْ
وَرَبُّكَ الْأَكْرَمُ (٣) الَّذِي عَلَّمَ بِالْقَلَمِ (٤) عَلَّمَ الْإِنسَانَ مَا لَمْ يَعْلَمْ (٥)

(Al Qur'an Al-Kareem, Surahat Al-Alaq, phrase 1-5)

In the name of Allah (God) Most Gracious Most Merciful I start my acknowledgment by reciting some phrases from the Qur'an, the Holly book, that encourage humans to read and learn. The meaning of Ayah is asking humans to recite in the name of the Lord who created humans from clinging substance, the most generous, taught by pen, taught human that never know.

This thesis would not have been possible unless my God wants "Shae' Allah", so I would like to thank Allah my God and my Lord for giving me this opportunity and easing, enlightening, and opening the path for me to learn; my God who provides me with mind to think, with eyes to see and read, with hands to write; my God who the first message for humanities is to read, and the Lord who created pen the first of his creations. I am grateful for my prophet Mohammad Bin Abdu Allah the messenger of Allah, the one who I love and admire, the one who scarifies to teach us carefulness for ourselves and for others, the one who teach us fundamental human relations and interrelationships and encourage us to take care of sick people and those who are in need.

It is a pleasure to thank those who made this thesis possible by providing me a scholarship without which I could not be here in Australia finishing this thesis; starting my great fullness to my Amir Sheikh Sabah Al-Ahmad Al-Sabah the Amir of the Sate of Kuwait, Sheikh Nawaf Al-Ahmad Al-Sabah the Crown Prince, and Sheikh Nasser Al-Mohammed Al-Sabah the Prime Minister. My gratefulness is also for my sponsors; the Civil Service Commission, the Ministry of Health, and to my beloved country "KUWAIT" in which states a mission of the rights of each Kuwaiti citizen to be provided with education; the funds of the work of this thesis was provided by Kuwait government. I would like to thank Kuwait Embassy and the Kuwait Culture Office in Canberra for their help and support through my journey.

I owe my deepest gratitude to my supervisor Professor Jan Piek for her kindness and support; for her belief in me and in my abilities. We have been in a long journey searching, learning, analyzing, and writing up. Thank you Jan for your patience and letting me keep adding new analyses each time I learn and discover from the Biostatistics unit. Jan was generous in giving and sharing her knowledge that I need for my thesis. I like your smile Jan and empathy that reminds me of my mother in Kuwait. Further thankfulness is to my co-supervisor Lynn Jensen for her support throughout my work. Also, I did not forget my previous Chairperson Professor Garry Allison and my Chairperson Dr. William Gibson.

It is an honor for me to thank the authors of the MABC-2, Sheila Henderson, David Sugden, and Anna Barnett, for providing me with the data of the UK-norms which without it I could not do generous analysis.

I would like to thank biostatisticians Dr. Yun Zhao from the School of Public Health and Peter McKinnon from the School of Physiotherapy for their help in teaching me, leading me, and solving my data analyses problems. Yun, Peter it was really appreciated help. I would like also to thank Dr. David Livesey; He has made available his support in a number of ways explaining many data analysis and replying to my emails answering all my questions related to data analysis.

I would like to show my gratitude to the School of Physiotherapy for their help and support through my journey; thanks all and specifically Marilla Hogan, Lesley Watts, and Suzanne James.

I am indebted to my colleagues in the Administration of Physical Therapy Services, the Physical Medicine and Rehabilitation Hospital, Fahad Centre, and Kuwait Physiotherapy Association. I would like also to send grateful thanks for Dr. Yusuf

AL-Nasef and Mr. Khalid AL-Marian for their support and ease my opportunity to get sponsorship for my masters and PhD.

It is an honor for me to appreciate and thank my parents, my three brothers, my ten sisters, my two sisters in law, my 12 nephews, and my 16 nieces. They always support me and admire the job I have done through my life. My parents, although they did not get an opportunity to study, insist we continue our study and never let any one of us to leave school. They provide us with all facilities helping us to be highly educated and knowledgeable. They raised us up in high moral standard respecting others, accepting differences, and belief in our abilities. Many warm thanks with big hugs and kisses for you mum and dad.

It is an honor for me to thank all Kuwaiti families who agreed to participate in the study of this thesis and let children to participate, to the Ministry of Education, Managers of Educational Districts, and Schools' principals and teachers for liaising the process of examining children, so as to the Ministry of Health.

I would like also to thank non-for-profit organizations, Kuwait Dyslexia Association and Center for Child Evaluation and Teaching for their helping and providing information about DCD and other developmental disorders in Kuwait. I would like to show my gratitude to charity "Mabarat Al-Ihsan" for their donation that used for printing DCDQ'07 forms and buying a tape- recorder for the interview.

This thesis had been edited by Emeritus Professor Allan Barton following the guidelines for the editing of research theses. The editing covered "Standard D" language and illustrations.

PUBLICATIONS, PRESENTATIONS, AND CONFERENCES (RELATED TO THE THESIS TOPIC) DURING DOCTORAL CANDIDATURE

1- Identification of developmental coordination disorder in primary school-aged Kuwaiti children. Presented at Australian Physiotherapy Association conference held in Sydney October 1-5, 2009.

LIST OF ABBREVIATIONS

Abbreviation	Meaning
AB1	Age Band one
AB2	Age band two
ABD	Atypical Brain Development
ADHD	Attention Deficit Hyperactivity Disorder
APA	American Psychiatric Association
BOTMP	Bruininks-Oseretsky Test of Motor Proficiency
BOT-SF	Bruininks-Oseretsky Test of Motor Proficiency- short form
ChAS-P/T	Children Activity Scales
CP	Cerebral palsy
DCD	Developmental coordination disorder
DCDQ	Developmental Coordination Disorder Questionnaire
DEPSA	Department of Educational Private Sector Affairs
DSLD	Developmental speech/language disorder
DSM-IV	Diagnostic and Statistical Manual- version 4
ELBW	Extremely low birth weight
EP	Extremely preterm
ICC	Intra-class correlation coefficient
ICD-10	International Classification of Diseases and Related Health Problems
IRCC	International Research Community of a Consensus
LD	Learning disorder/disability
MABC	Movement Assessment Battery for Children
MAND	McMarron Assessment of Neuromuscular Development
MBD	Minimal Brain Dysfunction
MOQ-T	Motor Observation Questionnaire for Teachers
NCV	Nerve conduction velocity
NDT	Neuro-developmental treatment
NPV	Negative Predictive Value
PCA	Principle component analysis
PDD	Pervasive Developmental Disorder
PPV	Positive Predictive Value
RD	Reading disorder
RECD	Department of Research and Educational Curriculum Development
SDDMF	Specific Developmental Disorder of Motor Function

SEM	Standard error of measurement
SLI	Specific language impairments
VLBW	Very low birth weight
WHO	World Health Organization

TABLE OF CONTENT

LIST OF FIGURES

LIST OF TABLES

1 Introduction

Children with disabilities generally receive good medical care in many countries, and specifically in Kuwait there is a Supreme Council for the Disabled. This council is supported by the government and has the responsibility to provide the facilities needed. The World Health Organization (WHO) also focuses on the care of such children. However, there is a group of children with special needs who are often deprived of these facilities: those with developmental coordination disorder (DCD). DCD occurs in 6% of children aged 5-11 years (American Psychiatric Association., 1994, p. 53). In spite of the motor difficulties in DCD, children with DCD might be misdiagnosed or under diagnosed (Missiuna, Gaines, et al., 2008; Missiuna, Moll, Law, King, & King, 2006). This is partly because of the overlap with other developmental disorders like Attention Deficit Hyperactivity Disorder (ADHD), pervasive developmental disorder (PDD), dyslexia, speech language impairments (SLI), and learning difficulties (LD) (Green & Baird, 2005; Visser, 2003). Several studies have examined the comorbidity between DCD and other disorders; reporting that up to 50% of children with DCD met the criteria of other disorders (Kadesjo & Gillberg, 1999; Martin, Piek, & Hay, 2006; O'Hare & Shabana, 2002; Rasmussen & Gillberg, 2000; Scabar, Devescovi, Blason, Bravar, & Carrozzi, 2006). Commonly, children are referred to clinics because of their behavioral and/or learning difficulties, not because of their motor difficulties which are discovered later and sometimes not at all (Wilson, 2005).

Children with DCD look like normal children and do not have any physical or intellectual disabilities. They have difficulties coordinating their movements and so performing activities, and children behave differently in trying to overcome their difficulties. Some of them avoid activities they find difficult, some become frustrated and so become somewhat aggressive, and some exhibit unusual behaviour or are 'naughty'. Children with DCD, because of their reaction towards their difficulties, avoid doing homework and participating in school activities and are sometimes described as careless and lazy (Barnett, Kooistra, & Henderson, 1998). They may be blamed for low academic achievement and poor performance in activities of daily living (ADL). Children with DCD appear to not make the effort to perform and withdraw from participation in physical activities compared to other children at the same stage of development (Missiuna, Rivard, & Bartlett, 2003).

DCD is a heterogeneous disorder, and not all children with DCD have similar impairments. They might have difficulties using utensils and gripping pencils, difficulties in dressing and toileting, or an inability to perform playground or gym activities (Missiuna, Moll, et al., 2006). The impairments may limit their activities as well as restrict their participation throughout their lives.

Kuwaiti children with DCD may not be receiving services provided by health sectors and educational sectors because of their normal physical appearance, which does not categorize them as having special needs. DCD may be under-diagnosed because this diagnosis may not be known by physicians. Also, they may think that children will 'grow out of it' in adolescence and adulthood. However, recent research shows that DCD exists in adolescents (Cantell, Smyth, & Ahonen, 2003; Visser, 2003) and even in adulthood, so not all children can grow out of DCD (Dewey & Wilson, 2001). Without this diagnosis, therapies including physiotherapy, occupational therapy, and speech-language therapy are not provided. These children need early intervention in order to prevent deterioration of their conditions, for example increasing movement difficulties during daily activities, continuing to adolescence and sometimes to adulthood (Cousins & Smyth, 2003; Missiuna, et al., 2003; Schoemaker et al., 2006). Motor impairment has several levels of consequences: poor self-image, concentration and behavioural problems (Sigmundsson, Hansen, & Talcott, 2003), and depression (Piek, Bradbury, Elsley, & Tate, 2008). Viholainen et al. (2006) found that delayed motor development impacts on language development and the speed of reading. They also highlighted the association between motor development and social, cognitive and emotional development and suggested that assessing the motor development of infants is a cost-effective strategy for public health service.

Children with DCD are as entitled to appropriate diagnosis and service as any other children in society. Specific assessment and screening tools need to be administered to detect children with movement difficulties. Paediatric assessment of motor development by a pediatrician, may not detect functional motor problems (De Kleine, Nijhuis-Van Der Sanden, & Ouden, 2006).

DCD has not been previously investigated in Kuwait, so identifying those children with DCD and determining the prevalence of this disorder will help in determining its impact on the academic achievements of those children and on their activities at home. These research data will form the foundation of ongoing strategies to optimize health care and educational services for this population. For example, they can receive adequate services to improve their impairments, reduce their activity limitations and encourage their participation in the community. The results of this research will inform the Ministries of both Education and Health about the features of the condition so that children will benefit from facilities and services considered to be available in both Ministries. A specific protocol can then be developed for the health services, highlighting the problems and symptoms as well as the treatment goals and plans in order to address the disorder directly. Referring these children to health services – physiotherapy, occupational therapy, and speech language pathology - will lead to strong communication between The Ministries of Education and Health, and may lead to the implementation of school-based physiotherapy. Recognizing children with DCD or at risk of the disorder may assist the Ministry of Education to improve the learning outcomes of children with problems and difficulties, as well as modulating their behaviour and so reducing the demand on teachers' attention. Educating school teachers, psychologists, and parents on DCD will improve their familiarity with the features of DCD and with the difficulties of students, and enabling them to detect them in earlier stages. By understanding the reasons behind low performance, in spite of normal physical appearance, they will be able to deal more appropriately with these problems. Evidence shows that children with DCD who participate in sport activities are less depressed and lonely, have higher social satisfaction (Poulsen, Ziviani, Cuskelly, & Smith, 2007) and self-esteem, and are better socially adjusted (Mandich & Polatajko, 2003). The results of this study will be disseminated so that the international community will be informed about Kuwaiti children with DCD.

The current research aims to determine the prevalence of DCD in primary school children and to measure their motor performance in relation to children from the UK using the Movement Assessment Battery for Children (MABC-2, Henderson, Sugden, & Barnett, 2007). Second aim was to ascertain the knowledge of professionals. Therefore two studies were conducted. The first assessed and screened the motor performance of Kuwaiti children aged 5-9 year using the MABC-2 and the Developmental Coordination Disorder Questionnaire (DCDQ'07) to detect children with movement difficulties. Hence, the validity of the MABC-2 and the DCDQ'07 was investigated. The second study explored professionals' knowledge about DCD by interviewing professionals from health and educational sectors.

2 Children with DCD

2.1 Introduction

Children with developmental coordination disorder (DCD) have motor coordination impairments and their motor abilities are substantially below their age and intelligence levels. The motor impairments are not due to medical or neurological disorder (DSM-IV 1994). Children with motor coordination impairments are described by the term “DCD” if they meet the DSM-IV criteria. However, many previous studies have not adhered strictly to these criteria (Geuze, Jongmans, Schoemaker, & Smits-Engelsman, 2001; Henderson & Barnett, 1998), therefore identifying many children who may have motor impairments (Johnston, Short, & Crawford, 1987; Kadesjo & Gillberg, 1999; Tsiotra et al., 2006) but not necessarily DCD.

About 6% of 5 to 11 year olds have been estimated to have DCD (American Psychiatric Association, 1994, p. 54). A similar prevalence has been found in many countries (Kadesjo & Gillberg, 1999; Pearsall-Jones et al., 2008) but some studies which followed the DSM-IV criteria have found fewer children with DCD (Lingam, Hunt, Golding, Jongmans, & Emond, 2009; Wright & Sugden, 1996). This reveals the importance of having clear inclusion and exclusion criteria for identifying children with DCD.

DCD is a heterogeneous disorder and each child may exhibit different features. The impairments can range from severe to mild and children may have gross motor impairments and postural dysfunction, and/or fine motor impairments (Missiuna, et al., 2003). In spite of this heterogeneity, the features and symptoms do not appear to be influenced by gender, culture, race, or socio-economic status (Zoia, Barnett, Wilson, & Hill, 2006). Children with DCD may be delayed in their developmental milestones and their difficulties can change with age. For instance, in the early stages there may be delays in getting into a sitting position, in crawling, and in walking, while in later stages there may be difficulties with running, playing ball, assembling puzzles, and understanding maps and directions (WHO, 1992). Children with DCD may have problems with hand manipulation and postural control (Miller, Missiuna, Macnab, Malloy-Miller, & Polatajko, 2001). They may present with gait disturbances, and have difficulty learning to run, hop and step up or down. Their performance in these activities may be slow, awkward, or untidy (Barnhart, Davenport, Epps, & Nordquist, 2003) and their poor coordination may be evidenced by bumping into obstacles or dropping things (WHO, 1992). They may also have difficulties in bicycle riding (Polatajko & Cantin, 2006).

Given the heterogeneity of the disorder, differences occur in the identification of children with DCD, in the prevalence and description of the motor impairments and their underlying causes, and in the consequences of these impairments on daily activities at home or school.

2.2 Definition and terminologies

DCD is defined by the motor coordination impairments that influence the performance of a child in daily living activities and/or academic achievement (Barnhart, et al., 2003; Polatajko & Cantin, 2006). The definition requires that a low score be obtained from a standardized test, that deviations be observed from the normal spectrum, and that the impairments influence daily activities and academic achievements (Visser, 2003). However, in the literature DCD has been labeled in different ways, with this variation in terminology for similar groups of children impacting on its classification and management (Henderson & Barnett, 1998).

Children with motor coordination problems have been described with terms such as “clumsy child”, “dyspraxia”, and “awkwardness”, these terms being specifically chosen to describe the children’s condition. For example, the terms “clumsy child” (Gubbay, 1975), “clumsy child syndrome” (Smyth & Glencross, 1986), or “developmental clumsiness” (van Dellen & Geuze, 1988) were applied to children who have poor motor coordination and difficulties in acquisition of motor skills showing specific characteristics of clumsiness. Other terms were based on features such as “awkwardness” (Miyahara & Register, 2000) like dropping or bumping into things (Miyahara & Möbs, 1995). Terms like “sensory integration dysfunction” describe the underlying nature of the disorder as an inability of the brain to organize and process sensory input to execute coordinated movements (Ayres & Robbins, 1979).

There are also other terms used in the literature based on the etiology of the condition (Henderson & Barnett, 1998) such as “proprioceptive information processing deficits” (Smyth & Glencross, 1986), "developmental dyspraxia" (Miyahara & Möbs, 1995), and children with "movement difficulties" (Henderson, May, & Umney, 1989).

Certain terms may be popular in particular countries and particular professions (Henderson & Henderson, 2003). For example "dyspraxia" is used widely among professionals in the UK (Peters, Barnett, & Henderson, 2001). The term “deficits in attention, motor control, and perception” (DAMP) was used for decades in Scandinavian countries (Gillberg, 2003).

Use of these terms is sometimes compatible but sometimes describes different groups of children (Henderson & Barnett, 1998). The overlapping and interchangeable use of terms causes difficulties in making comparisons between samples and therefore in definitions (Henderson & Henderson, 2003). Consequently, disagreement occurs in research and clinical practice in assessing and treating children with motor coordination difficulties (Gibbs, Appleton, & Appleton, 2007; Henderson & Barnett, 1998; Magalhães, Missiuna, & Wong, 2006). For example, intervention for children with developmental dyspraxia is based on the problems and symptoms associated with motor planning deficits, and remediation is based on activities that enhance motor planning (Miyahara & Möbs, 1995). As another example, children diagnosed as having sensory integration dysfunction are probably assessed and treated based on sensory integration methodology (Henderson & Barnett, 1998).

For the benefit of both clinicians and researchers in improving health services and facilities for children with DCD it is important to have an agreed terminology (Geuze, et al., 2001; Magalhães, et al., 2006; Peters, et al., 2001). It is also crucial for policy making and statistical collection nationally and internationally (Peters, et al., 2001). Therefore, the term DCD was approved by the international research community at a London consensus meeting held in Canada in 1994 (Magalhães, et al., 2006; Polatajko & Cantin, 2006; Visser, 2003) for the unity of terminology used in research and clinical practice. It has also been accepted by the Leeds Consensus Statement and recognized as a useful definition and diagnosis (Sugden, Kirby, & Dunford, 2008).

Subsequently the term DCD has become more popular (Magalhães, et al., 2006). Geuze et al. (2001) found that 26% of the publications from 1980 to 1999 used the term DCD in defining the research population, and the majority of the studies (41%) used the term “clumsy”. In a later study, out of 319 reviewed articles (1994 -2005), 52.7% were reported in the literature to use the term DCD (Magalhães, et al., 2006). However, although it was agreed by 43 authorities representing 11 professions that the term DCD should be used in research and clinical practice, other terms like “developmental dyspraxia” still exist (Polatajko & Cantin, 2006).

It has been reported that not all professionals are familiar with the term “DCD” (Gaines, Missiuna, Egan, & McLean, 2008; Peters, et al., 2001). Peters et al. (2001) investigated the knowledge of professionals of three terms, “DCD”, “developmental dyspraxia”, and “clumsiness”, finding that teachers and doctors were unaware of the term “DCD” but were familiar with “clumsy”. Gaines et al. (2008) conducted an educational outreach and collaborative care program to enhance the knowledge of physicians about DCD, a pre-program evaluation showing that 91% of participating physicians (N = 147) were unaware of the DCD condition.

To limit the diversity of terms for children with motor coordination difficulties, the procedure for classification should be specified in research and clinical practice. There should be clear criteria to define the condition and therefore apply the term "DCD".

2.3 Diagnosis of DCD

The term "DCD" was acknowledged in the American Psychiatric Association (APA) criteria set in the Diagnostic and Statistical Manual, Fourth Edition as a definition and diagnosis for children with motor coordination difficulties (American Psychiatric Association, 1994; First & Tasman, 2004), providing two inclusion and two exclusion criteria for DCD diagnosis. The term "DCD" was also recognized by the World Health Organization (WHO) in the International Classification of Diseases and Related Health Problems (ICD-10) (ICD-10, 1992) but under the umbrella of the "Specific Developmental Disorder of Motor Function" (WHO, 1992, pp. 250-251).

These two classification systems describe the DCD condition and set specific diagnostic criteria, but while both acknowledge the nature of the disorder, they show differences in the terms and emphasis (Sugden, et al., 2008).

There are also many similarities between ICD-10 and DSM-IV in classifying children with DCD (table 2.1). Both acknowledge that the disorder is developmental in nature (Sugden, et al., 2008). Both acknowledge the motor impairments as core deficits that cause the difficulties and also that it is not a result of a neurological disorder (American Psychiatric Association, 1994; WHO, 1992). Both employ the term "DCD", although ICD-10 used the term "DCD" under the umbrella of "Specific Developmental Disorder of Motor Function" (SDD-MF). However, the term DCD with the classification criteria of DSM-IV has been used more than ICD-10 in research (Geuze, et al., 2001).

There are two issues which make the ICD-10 less appropriate than the DSM-IV. First, the ICD-10 uses "SDD-MF" to describe groups of children, but this includes three different terms, the "clumsy child syndrome", "developmental dyspraxia", and

“DCD”. The term “clumsy child syndrome” is considered outdated (Chambers & Sugden, 2002), negative, meaningless (Miyahara & Register, 2000), and unacceptable (Miyahara & Register, 2000; Peters, et al., 2001). On the other hand, the term “developmental dyspraxia” is specific (Henderson & Barnett, 1998) and explains its medical nature (Henderson & Henderson, 2003). Yet these terms are used as synonyms (Gibbs, et al., 2007; Henderson & Barnett, 1998; Miyahara & Möbs, 1995).

Second, “ Specific Developmental Disorder of Motor Function” includes words “specific” and “function” that have several meanings (Henderson & Barnett, 1998; Henderson & Henderson, 2003). “Function” is a general term relating to activity in general, so a disorder of motor function is not necessarily due to motor control problems but may include other problems like muscle weakness or attention deficit that can cause impairment of motor function (Henderson & Henderson, 2003). For example, children with ADHD or with early stages of muscular dystrophy are clumsy, not because of their motor control deficit but because of other difficulties, attention deficit or muscle weakness respectively. Although the terms motor “function” and “coordination” are used interchangeably, they are not synonyms (Henderson & Barnett, 1998). Further, the word “specific” has been questioned because of its limitation in applying the diagnosis (Henderson & Henderson, 2003).

DSM-IV uses the term “DCD” directly to signify children with motor coordination difficulties. The Leeds Consensus (2006, http://www.dcd-uk.org/consensus.html, retrieved in May 6, 2010) stated that the DSM-IV-TR (2000) provides both a useful diagnosis and an acceptable working definition of DCD (Polatajko & Cantin, 2006). For these reasons the DSM-IV classification system was chosen for diagnostic criteria in our study.

Table 2.1: The definition of the DCD in the ICD-10 and DSM-IV

	Definition
ICD-10	"The main feature of this disorder is a serious impairment in the development of motor coordination that is not solely explicable in terms of general intellectual retardation or of any specific congenital or acquired neurological disorder (other than the one that may be implicit in the coordination abnormality). It is usual for the motor clumsiness to be associated with some degree of impaired performance on visuo-spatial cognitive tasks". (WHO, 1992, p. 250)
DSM-IV	"The essential feature of developmental coordination disorder is a marked impairment in the development of motor coordination (Criterion A). The diagnosis is made only if this impairment significantly interferes with academic achievement or activities of daily living (Criterion B). The diagnosis is made if the coordination difficulties are not due to a general medical condition (e.g. cerebral palsy, hemiplegia, or muscular dystrophy) and the criteria are not met for Pervasive Developmental Disorder (PDD) (Criterion C). If Mental Retardation is present, the motor difficulties are in excess of those usually associated with it (Criterion D). The manifestations of this disorder vary with age and development. For example, younger children may display clumsiness and delays in achieving developmental motor milestones (e.g. walking, crawling, sitting, tying shoelaces, buttoning shirts, zipping pants). Older children may display difficulties with the motor aspects of assembling puzzles, building models, playing ball, and printing or handwriting". (American Psychiatric Association, 1994, pp. 53-54)

2.4 The DSM-IV – DCD Diagnostic Criteria

DSM-IV has four diagnostic criteria for DCD, two inclusion (Criteria A and B) and two exclusion (Criteria C and D) criteria (table 2.2), and DCD is diagnosed only if the four criteria are met. However, the content and the classification schemes of these four criteria recommended by DSM-IV for identifying children with DCD have been debated in many reviews (Geuze, et al., 2001; Henderson & Barnett, 1998; Henderson & Henderson, 2003). It has been found in research that not all studies investigating DCD comply with these criteria for recruiting the sample to identify children with DCD or the control group (Geuze, et al., 2001). The criteria are neglected in research and difficult to apply (Geuze, et al., 2001; Henderson & Barnett, 1998).

Geuze et al. (2001) reviewed 176 publications between 1980 and 1999 to analyze how studies used the criteria for selecting children with motor difficulties. The term DCD was introduced in 1987 and it started to appear in the literature in 1992, used by 41 of the 176 publications. It was found that almost all studies quantified the inclusion criteria relating to motor impairments. The assessment tools used for this purpose were MABC (Henderson & Sugden, 1992), Gubbay's test (Gubbay, 1975), the McCarron test (McCarron, 1997), the Bruininks-Oseretsky test (Bruininks, 1978), and the Southern California Sensory Integration tests (Ayres & Robbins, 1979). However, the cut-off score for motor impairment was often unreported. The IQ was reported in 18% of the publications, but it was used as an exclusion criterion. Most of the studies did not specify the exclusion criteria.

Although many studies identifying children with DCD use Criteria A and B for selecting children, they do not report the methods used to exclude children with neurological conditions, PDD, and mental retardation (Missiuna et al., 2011; Wright & Sugden, 1996). Many other studies identify children with DCD based on the motor impairments, Criterion A only (Miyahara et al., 1998; Tsiotra, et al., 2006).

However, a recent cohort study conducted in the UK adhered to the DSM-IV criteria (Lingam, et al., 2009), reporting all the procedures used for including and excluding children with DCD. For example, the MABC was used for Criterion A, literacy and numeracy tests investigated academic achievement, a questionnaire derived from the Denver Developmental Screening Test II assessed activities in daily life, the medical and neurological conditions were classified from hospital and community health service notes and educational records, and finally the IQ was tested using the Wechsler Intelligence Scale for Children–III. However, the authors did not exclude children with PDD because they argued that there is an overlap between DCD and PDD. This study added essential evidence supporting the importance of using the DSM-IV criteria for identifying children with DCD.

DSM-IV was revised recently and DSM-V has been released on the APA website. The revision takes into account the research comments with regard to the difficulties in applying some of the criteria, such as excluding the PDD. Almost all the concerns with the four criteria described above have been resolved in the revised version of DSM-V, shown in Table 2.3 (www.dsm5.org/PropsedRevisions/pages/proposedrevision.aspx?rid=88#, retrieved February 3rd, 2010). Three changes have been made: Criterion A has been reworded; in Criterion C the phrase "DCD does not meet criteria for a PDD" has been deleted; and Criterion D which is related to the mental retardation has been deleted.

Table 2.2: The DSM-V criteria, the proposed version

Criterion	Description
A	Motor performance that is substantially below expected levels, given the person's chronologic age and previous opportunities for skill acquisition. The poor motor performance may manifest as coordination problems, poor balance, clumsiness, dropping or bumping into things; marked delays in achieving developmental motor milestones (e.g., walking, crawling, sitting) or in the acquisition of basic motor skills (e.g., catching, throwing, kicking, running, jumping, hopping, cutting, coloring, printing, writing).
B	The disturbance in Criterion A, without accommodations, significantly interferes with activities of daily living or academic achievement.
C	The disturbance is not due to a general medical condition (e.g., cerebral palsy, hemiplegia, or muscular dystrophy).

However, because the revision has not yet been endorsed, our study uses the DSM-IV criteria to identify children with DCD.

2.4.1 Criterion A

Criterion A requires that the child has marked motor coordination impairments. Usually, the diagnosis of DCD is based on a low score obtained from a standardized test which indicates a performance below the normal spectrum (Visser, 2003). The Leeds Consensus Statement recommends the use of standardized, norm-referenced, and culturally appropriate assessment tools with a 5th percentile cut-off (Leeds Consensus Statement 2006, http://www.dcd-uk.org/consensus.html, retrieved in May 6, 2010).

Henderson and Barnett (1998) argued that Criterion A does not quantify the degree of the impairment sufficiently to differentiate between normal and abnormal motor performance. They supported their argument by quoting the differences between medical professions and psychologists in choosing different percentiles; 10th percentile and 15th percentile respectively. However, the Leeds Consensus Statement 2006 (http://www.dcd-uk.org/consensus.html, retrieved in May 6, 2010) reported that at or below the 5th percentile of the standardized assessment tool is sufficient as a cut-off for motor impairment. Furthermore, the DSM-IV definition includes the term "substantially" which indicates that the score of the motor performance in standardized assessment tools is less than two standard deviations of the age norm (Henderson & Henderson, 2003).

This criterion is easy to operationalize because of the availability of a variety of assessments tools to measure motor impairment, but the reliability and validity of each assessment tool should be investigated if used in different cultures (American Educational Research Association., 1985; Deitz, 1989; Dunn, 1989).

2.4.2 Criterion B

Criterion B is a mandatory inclusion criterion for identifying children with DCD. It requires that the motor coordination impairments interfere negatively with activities of daily living or academic achievement. Geuze et al. (2001) found in their review that out of 34 publications using the term DCD for identifying children with motor impairments only one clarified that the impairments interfered with activities considered normal at their age. Furthermore, other studies did not clarify and specify the aspects of daily activities and school performance in which the children faced limitations, with consideration of this criterion depending on the objective of the study. For example, descriptive and intervention studies usually considered it important to meet this criterion, but the experimental studies did not (Geuze, et al., 2001).

Henderson and Barnett (1998) argue that this criterion is difficult to operationalize for two reasons. First, this criterion cannot be applied to children in pre-schools who have motor impairments because of the narrow range of academic achievements. They added that adherence to this criterion in diagnosing children with DCD may exclude younger children from being treated. It is true that early identification of children with DCD is important, but Criterion B still can be applied for identification through screening tools that are designed to assess the impact of the motor impairments on daily activities at school and at home, like the MABC-2 checklists (Henderson, et al., 2007) which is suitable for children as young as 3 years, and the DCDQ'07. Geuze et al. (2001) proposed labeling children with motor impairments in their early years as "at risk of DCD". Children with DCD "would not be diagnosed before five years of age" (Leeds Consensus Statement, 2006, http://www.dcd-uk.org/diagnosis_a-b.html. retrieved May 3, 2010).

Moreover, the description of Criterion B includes "or" which indicates that the impact of the motor impairments could be on either the activities of daily living or academic achievement.

Henderson and Barnett (1998) also argue that it is difficult to differentiate between children who cannot perform a skill because of motor impairment from those who have not been taught the skill, for example fastening buttons (Henderson & Barnett, 1998). Although daily activities like shoe-tying or button-fastening show motor coordination, it is difficult to measure them objectively (Henderson, et al., 2007).

This issue can be addressed during assessment of the motor performance in Criterion A because usually the child has a demonstration trial prior to testing trials. Moreover, assessing Criterion B depends on many activities that children usually practice in daily life such as "gross and/or fine motor skills, which may be apparent in locomotion, agility, manual dexterity, complex skills (e.g. ball games) and /or balance" (Leeds Consensus Statement 2006, http://www.dcd-uk.org/consensus.html, retrieved in May 6, 2010).

These activities are cultural and developmentally dependent (DSM-IV-TR 2000, 2004) and it is hard to be summarized in the DSM-IV. However, these kinds of activities can be measured through screening tools like questionnaires for teachers and parents that are reliable, valid, and suitable for different cultures, and these should be investigated (American Educational Research Association., 1985; Deitz, 1989; Dunn, 1989).

2.4.3 Criterion C

Criterion C requires that the motor impairment is not due to a general medical condition and does not meet the criteria of a Pervasive Developmental Disorder (PDD).

Excluding medical conditions from the diagnosis differentiates low motor performance resulting from deficits in motor control as in DCD from musculoskeletal deficits such as muscle wasting disorders (Henderson & Henderson, 2003) like muscular dystrophy. However, this is not easy to operationalize, especially if the sample is recruited from school-based populations that show good health (Geuze, et al., 2001).

Cerebral palsy (CP) is classified in the DSM-IV as a neurological condition coded on Axis III (DSM-IV-TR 2004, p.94). Some medical conditions can be diagnosed clearly like moderate to severe CP or muscular dystrophy in its later stages (Dewey & Wilson, 2001). However, it is difficult to differentiate DCD from mild CP and early stage muscular dystrophy causing clumsiness due to muscle weakness (Henderson & Barnett, 1998). It has been suggested that neurological examinations and brain images may help in differentiating between DCD and neurological disorders. However, pre-natal or peri-natal brain damage is associated with difficulties in motor control in CP and DCD (Hadders-Algra, 2001). It has been found that CP and DCD share some etiological and birth risk factors such as preterm and low birth weight (Pearsall-Jones, Piek, & Levy, 2010). In a monozygotic twin design, Pearsall-Jones et al. (2009) found that there is a relationship between motor impairment in DCD and perinatal oxygen perfusion problems. Also, cerebellar dysfunction was found in children with DCD (Kagerer, Contreras-Vidal, Bo, & Clark, 2006; O'Hare & Shabana, 2002; Piek, Dyck, Francis, & Conwell, 2007). Pearsall-Jones et al. (2010) commented that DCD and CP may fall on a continuum.

Another suggestion is to exclude children who have soft neurological signs from a DCD diagnosis. However, this is difficult to justify because there is no evidence for the relationship between neurological disorder and the presence of the soft neurological signs (Dewey & Wilson, 2001). It has been reported that 49% of children identified with DCD at age 5 years showed neurological abnormalities (Johnston, et al., 1987). Also, there is no standardized age-appropriate assessment tool that reliably and validly assesses soft neurological signs (Dewey & Wilson, 2001).

The second exclusion in Criterion C is PDD. Excluding children with DCD if they meet the criteria of PDD confounds the fact of co-morbidity between different developmental disorders (Geuze, et al., 2001). Although DSM-IV (American

Psychiatric Association, 1994) takes into account the comorbidity between DCD and ADHD but disregards the comorbidity between DCD and PDD, the classification system does not explain the reasons for accepting one and ignoring the other.

There is evidence that motor difficulties are demonstrated in both ADHD (Piek, Pitcher, & Hay, 1999) and PDD (Dyck, Piek, Hay, & Hallmayer, 2007; Green et al., 2009; Hilton et al., 2007). Dyck et al. (2007) found that 86% of children aged between 4 and13 years (N = 29) with autistic disorder (AD) demonstrate motor coordination deficits. Green et al. (2009) also found that 79% of children aged 9 or 10 (N = 255) with autistic spectrum disorder (ASD) scored below the 5th percentile in the MABC and 9.9% scored between the 5th and 15th percentile. Furthermore, Hilton et al. (2007) found that 89% of children aged between 6 and 12 years with Asperger syndrome (N = 51) scored below the 15th percentile and 65% scored below the 5th percentile of the MABC indicating that children with Asperger syndrome also have motor impairments. Significant correlations were found between MABC and the severity of the AS (Hilton 2007). It is suggested that DCD be identified in children with autistic disorder (Piek & Dyck, 2004) and that the association between DCD and PDD be considered as comorbidity with acceptance of a dual diagnosis of DCD and PDD (Dyck, et al., 2007; Green, et al., 2009; Hilton, et al., 2007). The new version, DSM-V, deletes this category from Criterion C and limits the exclusion to general medical conditions.

2.4.4 Criterion D

DSM-IV diagnostic Criterion D: "If mental retardation is present, the motor difficulties are in excess of those usually associated with it". This indicates that children with mental retardation (MR) may be diagnosed with DCD if the motor problems exceed what they would otherwise be. However, assessment tools that measure the motor ability usually require the child to understand the instructions, hence the low performance of children with low IQ may be due to poor understanding not poor performance (Green, et al., 2009). The relationship between intellectual ability and motor ability has not been well addressed (Henderson & Barnett, 1998).

Moreover, it is difficult to examine this criterion especially for children with motor coordination problems. As the intellectual ability is measured by performance and verbal components, it is difficult for children with motor coordination problems to respond appropriately to the performance components of the IQ test, which depends on visuo-spatial tasks that are affected in children with motor coordination problems (Henderson & Henderson, 2003). Therefore, it is suggested that DCD and MR should be separated from each other and considered as comorbid disorders (Geuze, et al., 2001). Nevertheless, the new revised version discards this criterion (www.dsm5.org/PropsedRevisions/pages/proposedrevision.aspx?rid=88#, retrieved February 3rd, 2010).

2.4.5 Summary

DSM-IV is used widely in the literature and its term "DCD" is endorsed to be used in research and clinical practice (Leeds Consensus Statement 2006, http://www.dcd-uk.org/consensus.html, retrieved in May 6, 2010). Although the capability to operationalize its criteria has been criticized, the new version (DSM-V) has taken into account these criticisms and has been modified to more capably select and identify children with DCD.

2.5 Prevalence

According to the DSM-IV classification, identifying DCD in children and measuring its prevalence in society requires applying the inclusion and exclusion criteria. It has been reported in DSM-IV that the prevalence is about 6% in children aged between 5 and 11 years (DSM-IV, 1994, p.54; DSM-IV- RT, 2004, p. 98). However, the DSM-IV manuals (1994 and 2004) did not provide information on how the prevalence was estimated, what kinds of assessment tools were used to fulfill Criteria A and B, and in which population this prevalence was measured.

Many studies have been conducted to investigate the prevalence of DCD but not all of them comply with the DSM-IV criteria, resulting in different prevalence estimates. Most of the studies complied with Criterion A only and measured the prevalence based only on the motor impairments (Kadesjo & Gillberg, 1999; Pearsall-Jones, et al., 2008; Tsiotra, et al., 2006). Although these studies assessed motor impairment and not DCD, the term "DCD" will be used while discussing these studies as this was the term used in the studies.

For example, the prevalence of DCD was measured for 329 Greek children aged between 10 and 13 years (175 boys and 154 girls) using BOTMP-SF (Bruininks, 1978) at a cut-off below the 12^{th} percentile (Tsiotra, et al., 2006). It was found that the prevalence of DCD was 19%. However, the authors did not add any further information on the inclusion and exclusion criteria for the sample. Also, they did not investigate Criterion B, so based on DSM-IV this study measured the prevalence of motor impairments, not DCD.

Furthermore, the prevalence of DCD for six to seven year old Swedish children (N = 409) was investigated using 11 items of the Folke Bernadotte test including fine and gross motor skill items. The findings show that 4.9% of children had severe DCD and 8.6% had moderate DCD (Kadesjo & Gillberg, 1999). The term "severe" and "moderate" used in this study are equivalent to "DCD" and "at risk of DCD" which are based on the performance in the motor assessment test scores (0-22) at a cut-off ≥15 for severe and 10 to 14 for moderate.

In another study, designed to investigate etiological factors for DCD and ADHD, the prevalence of DCD was investigated for 922 children aged between 6 and 18 years (Pearsall-Jones, et al., 2008). The motor impairment was measured by the DCDQ (Wilson, Kaplan, Crawford, Campbell, & Dewey, 2000) and revealed a DCD prevalence of 6%.

It can be seen from these results that the DCD prevalence varies between studies. However, the prevalence of DCD should be assessed by applying the inclusion and exclusion criteria of the DSM-IV, and the prevalence in these studies is in fact the percentage of motor impairments that represent Criterion A.

Other studies have considered both Criteria A and B in their estimation of the prevalence of DCD. Johnston et al. (1987) screened 717 children aged five years and 757 children aged seven years using the DIAL Fine and Gross Motor Screening test and the Gubbay Screening Test respectively to detect children with “poor coordination”. Out of the total number, 47 children aged five years and 48 children aged seven years were defined as poorly coordinated and then examined by the McCarthy Motor Scales to measure the prevalence of poor coordination, identifying 6.5% at five years and 7.2% at seven years. (The term “poor coordination” was used to describe children with DCD because at the time the study was conducted, the term “DCD” was not endorsed. The authors of the study complied with the DSM-III criteria.)

Similarly, Kaplan et al. (1998) administered two assessment tools, BOTMP (Bruininks, 1978) and MABC (Henderson & Sugden, 1992), and one questionnaire, the DCDQ (Wilson, et al., 2000), to 224 children with learning and attention problems and 155 typically-developing children aged between 8 and 17 years. The cut-off used for BOTMP was ≤ 42, and for MABC and DCDQ was below the 15th percentile. The prevalence of DCD was 27.2% for children with leaning/attention problems and 12.9% for typically-developing children.

Another study used the same method with the MABC test and checklist for identifying children with DCD (Wright & Sugden, 1996). Children aged between 6 and 9 years (N = 427) were screened by the MABC checklist and the identified children then assessed. Using the 5th percentile as a cut-off in the MABC test and checklist, the prevalence of DCD was 1.4%.

Although Johnston (1987), Kaplan et al. (1998), and Wright and Sugden (Wright & Sugden, 1996) used the same method for identifying children with DCD and complied with Criteria A and B, the differences in the observed prevalence may have been due to the differences in the natures of the assessment tools and the cut-off values used. Wright and Sugden (1996) administered the MABC test and checklist, while Kaplan et al. (1998) administered the BOTMP (Bruininks, 1978), the MABC (Henderson & Sugden, 1992), and the DCDQ (Wilson, et al., 2000). The BOTMP and the MABC are considered standard assessments for detecting motor impairment (Geuze, et al., 2001). However, the studies were conducted at different times; Johnston’s study is quite old and at that time the gold standard assessment tools were not available. Kaplan et al. (1998) used a cut-off below the 15th percentile which includes “DCD” and “at risk of DCD” which may explain the higher prevalence among the typically developing children.

Results similar to those of Wright and Sugden (1996) were obtained in a recent study where all four criteria of the DSM-IV were applied. Lingam et al. (2009) found that the DCD prevalence for seven year old children (N = 6990) using a 5th percentile cut-off with MABC was 1.8%.

Thus adhering strictly to the DSM-IV criteria and using a standardized assessment tool with a 5th percentile cut-off reduced the prevalence of DCD to 1.4% (Wright 1996) and 1.8% (Lingam, et al., 2009). Although many studies applied the inclusion Criteria A and B, not all of them complied with exclusion Criteria C. Some studies included children with autism (Kadesjo & Gillberg, 1999; Lingam, et al., 2009) and others included children with medical problems like cerebral palsy and spina bifida (Kadesjo & Gillberg, 1999), which may explain the higher in the prevalence of DCD.

There are other risk factors that impact on the increase of DCD prevalence, including preterm birth and low birth weight. A recent study investigated the prevalence of DCD in children born extremely preterm (EP) or with extremely low birth weight (ELBW) (Roberts et al., 2011). The MABC was administered to 132 eight year old children with EP/ELBW and 154 children of normal gestational age and birth weight. Children with medical, neurological, and mental disorders were excluded from the study. The prevalence of DCD was 16% for children with EP/ELBW and 5% for term-born children. However, the prevalence was assessed based on Criteria A, C, and D but not B, which may explain the increased number of children with DCD compared to the results of Lingam (2009).

The ratio of DCD between boys and girls was variously reported as 7.3:1 (Kadesjo & Gillberg, 1999) and 1.9:1 (Lingam, et al., 2009) and 1:1 (Pearsall-Jones, et al., 2008).

To sum up, strict compliance with the DSM-IV criteria resulted in a decrease in the reported prevalence of DCD. Although many studies claimed to assess the prevalence of DCD, many of them actually assessed motor impairments not DCD because Criterion A was considered and Criterion B was neglected.

2.6 Motor impairments

Identification of DCD requires measurement of the motor impairments that cause functional difficulties. Based on Criterion A of DSM-IV, children with DCD have marked motor impairments with motor performance substantially below the expected level of other children of the same age and intelligence. Because of the heterogeneity of DCD, there are variations in functional difficulties, not all children with DCD having the same pattern of deficits or motor impairment in specific skills, or having all the deficits and impairments (Geuze, 2005b). Not all difficulties are measureable. For example, poor handwriting is one of the common difficulties of children with DCD (Barnett & Henderson, 2005). This skill can be measured by many systems such as the Concise Assessment Scale for Children's Handwriting (Volman, van Schendel, & Jongmans, 2006). On the other hand, children with DCD have difficulties fastening buttons and tying shoe laces. These skills are not measurable and are more likely to be subjective, but they are fine motor skills which can be measured through other tests like placing pegs and lacing board that have similar mechanisms (Henderson, et al., 2007).

Fine motor skills for hand manipulation are essential for the children as they explore their surrounding environment (Henderson, et al., 2007). Children with DCD may have poor fine motor skills restricting their ability to perform daily activities such as using eating utensils, dressing and toileting themselves (Miller, et al., 2001; Missiuna, Moll, et al., 2006; Polatajko & Cantin, 2006; Rodger et al., 2003) or school activities such as being unable to grip a pencil (Miller, et al., 2001; Missiuna, Moll, et al., 2006; Polatajko & Cantin, 2006; Rodger, et al., 2003).

Gross motor deficits include awkward running patterns (Barnhart, et al., 2003) and poor balance due to impaired postural and movement control (Johnston, Burns, Brauer, & Richardson, 2002). Children with DCD in early childhood exhibit delays in motor development, getting into a sitting position, crawling, walking (WHO, 1992), and in later stages delays in balance skills (Geuze, 2003) and running (WHO, 1992). It has been found that children with DCD have difficulties with ball skills and in walking heel-to-toe (Cantell, et al., 2003). Similarly, adolescents with DCD show delays in gross motor skills like throwing, catching and jumping as measured by the MABC (Missiuna, Moll, King, Stewart, & Macdonald, 2008). Another study found low motor performance by children with DCD in manual dexterity, ball skills, and balance (Visser, Geuze, & Kalverboer, 1998).

Fine and gross motor impairments may originate from perceptual motor impairments in the sensory-motor domain (Geuze, 2005a) and can be determined by assessing many sensory-motor systems: kinesthetic, visual, balance and postural control, memory and attention, and motor systems (Geuze, 2005a). Because of the diversity of mechanisms of motor impairments in DCD explained by the heterogeneity of the disorder, the discussion here concentrates on the roles of postural control and sensory system integration in the motor impairments of children with DCD and their impact on the ability to perform functional activities.

Postural control and balance are essential for motor skills, which require postural stability and control of different parts of the body in order to execute movements (Geuze, 2005a). There are many deficits that contribute to poor postural and balance control, including those in muscle timing (Johnston, et al., 2002) and muscle activation (Geuze, 2003). Execution of directed movements such as reaching, writing, dressing, throwing, and kicking require postural control to stabilize and orient the body (Shumway-Cook & Woollacott, 2001). Postural and balance control also require integration of sensory information obtained from visual, somatosensory and vestibular systems (Geuze, 2005b).

Uncoordinated movements are found in DCD in many activities like throwing, catching, running, and reaching. Disturbance in movement function may be due to muscle timing activation. Johnston et al. (2002) investigated activation in shoulder, abdomen, and trunk muscles during goal-directed arm movements for 42 children with and without DCD aged between 8 and10 years. They found that children with DCD showed early activation of shoulder muscles which may disturb the control of scapular and humeral motion. They suggested that early scapular movements are due to early activation of upper trapezius and latissimus dorsi causing halting and obstructing smooth elevation, which leads to shoulder hitching in initiation of arm elevation rather than humeral flexion. The early activation of shoulder muscles may be to provide postural stability to compensate for absent or late trunk muscle activation.

Johnston et al. (2002) found that although the manner of trunk muscle activation in children with DCD was similar to children without DCD, fewer muscles were activated during the anticipatory period, with only two out of five muscles activating. The anterior trunk muscles activated later. This disturbance in muscle function led to an inability to stabilize the trunk and control body segments in space and orient them for executing movements as adequately as in children without DCD (Johnston, et al., 2002). This may explain the inability of children with DCD to throw balls accurately. Cherng et al. (2007) found significant positive correlations between ball skills in MABC and balance control in children with DCD.

Similarly, Geuze (2003) found that children with DCD had a deficit in muscle activation during static balance: increased activation of ankle muscles with co-activation of the upper and lower leg muscles causing leg stiffness and therefore difficulty in quickly correcting loss of balance. Early proximal muscle activation in children with DCD negatively affects balance control during standing (Cherng, et al., 2007).

Another deficit found in Johnston's study (2002) was slow response during a reaction time task resulting in poor movement execution during activities like tennis or baseball. The slow reaction time results also in poor postural stability in unstable environments, such as standing in a moving bus. As a consequence, children with DCD require a longer time to complete goal-directed movements because of inefficient muscle patterns between agonist and antagonist muscles. Many manual dexterity, ball and balance tasks require appropriate reaction times for precise completion (Johnston, et al., 2002), which may explain the awkward and clumsy movements in DCD.

Postural control is also influenced by impairment of integrative sensory systems. Geuze (2003) found that children with DCD have slow feedback processing of sensory information obtained from vision, proprioceptive, and vestibular systems, negatively impacting balance control. The influence of the sensory system organization was investigated in 40 children with and without DCD aged between 4 and 6 years (20 with DCD and a control group of 20 recruited from a medical centre) by assessing their ability to maintain standing balance on both feet in different sensory conditions: with, without, and with altered vision input; with, without, and with altered somatosensory input (Cherng, et al., 2007). The results showed that children with DCD have unstable standing balance. There were significant differences between children with and without DCD when visual and somatosensory inputs were altered to "unreliable". They found that balance control was interrupted more by the absence or degradation of more than one sensory input. Also, the balance was disturbed more if the sensory inputs were interrupted, for example visual frame of reference is altered by wearing a dome which reduces the accuracy of the visual input.

In comparing the balance control of children with and without DCD, it has been reported that they experience similar effects of visual input on balance and in utilizing input from the dominant sensory system during degradation or removal of input from other systems. Cherng et al. (2007) commented that the motor impairments are unlikely to be related to deficits in individual sensory systems, and suggested that the deficits may be in the central nervous system organization, specifically the somatosensory system.

Another study also investigated the sensory organization of postural control at different levels of sensory inputs of visual, somatosensory, and vestibular systems in children with and without DCD aged between 6 and 12 years (Grove & Lazarus, 2007). Children with DCD showed postural instability to different extents. Although children with DCD did not over rely on visual feedback for postural control, their postural instability increased when visual feedback was inaccurate. Another finding was that the postural control of children with DCD significantly correlated with vestibular feedback. Children with DCD were able to utilize visual and somatosensory feedback to control their posture similar to children without DCD, although postural control altered under challenging environmental conditions. However, they had impairment in utilizing vestibular feedback for postural control (Grove & Lazarus, 2007).

There have been similar findings that children with DCD with poor balance do not over-rely on vision in maintaining postural stability (Geuze, 2003; Tsai, Pan, Cherng, & Wu, 2009; Tsai, Wu, & Huang, 2008). Postural instability may result from either impairment in sensory re-weighting or adaptive postural response or perhaps both, and there is a fundamental relationship between these impairments (Grove & Lazarus, 2007). The postural instability is profound in novel situations or difficult tasks (Cherng, et al., 2007; Geuze, 2003; Grove & Lazarus, 2007).

On the other hand, a study found that children with DCD rely on vision in maintaining balance rather than retrieved information from the (feedback) proprioceptive system because of an inability to integrate sensory information between different sensory systems, vision and proprioception (Wann, Mon-Williams, & Rushton, 1998). However, in Wann's study not all children with DCD experienced the same problems because not all children with DCD have postural control problems. Moreover, Grove and Lazarus (2007) found individual differences in children with DCD. The contradictory findings in different studies revealed the influence of the heterogeneity of the DCD.

In summary, these studies indicate that postural control is influenced by muscle timing and activation which therefore impact on the coordination of movements, perhaps explaining the awkward and clumsy movements of children with DCD. Also, postural instability is affected by the integration of sensory systems. These studies provide evidence for the involvement of higher functional systems in the motor impairments seen in children with DCD. The authors suggested that poor postural control in children with DCD may be explained by the theory of cerebellar dysfunction (Cherng, et al., 2007; Geuze, 2003; Grove & Lazarus, 2007). As the fine and gross motor movements and posture depend on cerebellar functions, its dysfunction may cause poor control of movements and postural instability (Grove & Lazarus, 2007).

Grove et al. (2007) summarised the case for involvement of cerebellar dysfunction in the research findings:

- there were similarities in the results of the computerized platform posturography obtained from children with DCD and results obtained from children with spastic diplegia cerebral palsy
- disorganization of automatic postural control responses are indicators of CNS involvement
- oculomotor abnormalities are signs of cerebellar dysfunction

- the symptoms of children with DCD are not consistent with peripheral dysfunction.

Many other studies support the involvement of CNS deficits on the motor impairments of DCD (Gubbay, 1975; Kagerer, et al., 2006; Maruff, Wilson, Trebilcock, & Currie, 1999; O'Brien, Williams, Bundy, Lyons, & Mittal, 2008; O'Hare & Shabana, 2002; Pearsall-Jones, et al., 2008; Pearsall-Jones, et al., 2010; Pearsall-Jones, et al., 2009; Piek, Dyck, et al., 2007; Querne et al., 2008; Wilson et al., 2004) and Pearsall-Jones et al. (2008) suggested that DCD and cerebral palsy may fall on a continuum.

2.7 Consequences of motor impairments

DSM-IV Criterion B for identification of DCD requires the impact of motor impairments on the daily life activities (American Psychiatric Association, 1994; First & Tasman, 2004). Motor impairment and motor coordination difficulties have psychosocial consequences as well as effects on daily activities at home and school.

At home, children with DCD may have difficulty using utensils, dressing (doing up buttons, tying shoelaces) or toileting (Miller, et al., 2001; Missiuna, Moll, et al., 2006; Polatajko & Cantin, 2006; Rodger, et al., 2003). They may have difficulty in self-care such as nose-blowing, managing toothpaste, and brushing hair, and tying shoelaces (Rodger, et al., 2003).

In school, children may have poor pencil grip, handwriting, and drawing skills (Missiuna, Moll, et al., 2006; Polatajko & Cantin, 2006; Rodger, et al., 2003). They may be unable to use scissors correctly for cutting objects because of an inability to hold the paper properly for cutting and manipulating scissors (Rodger, et al., 2003). They may have difficulties in different learning areas such as writing, reading, reading comprehension and spelling which put them at risk of school failure (Dewey, Kaplan, Crawford, & Wilson, 2002). Eye-hand coordination can be below average making it difficult to copy from the blackboard (Barnhart, et al., 2003). They may have difficulties playing with constructive toys and building models (Polatajko & Cantin, 2006; WHO, 1992). They may also have difficulties performing playground, gym and sport activities (Miller, et al., 2001; Missiuna, Moll, et al., 2006; Polatajko & Cantin, 2006; Rodger, et al., 2003), and may be unable to play and communicate with their peers becoming frustrated and isolated, and leading to missed learning experiences (Henderson, et al., 2007).

Children with DCD may also have speech difficulties (Cheng, Chen, Tsai, Chen, & Cherng, 2009; Hill, 1998, 2001; Hill, Bishop, & Nimmo-Smith, 1998; Scabar, et al., 2006), perhaps being unable to use all facial and tongue muscles and producing unclear words (WHO, 1992).

Motor impairment also has consequences in social development such as poor self-image, concentration and behavioural problems (Sigmundsson, et al., 2003). Children as young as three years with motor difficulties have anxious/depressed behaviour (Piek, et al., 2008) while children and adolescents with DCD have higher levels of anxiety than typical children (Skinner & Piek, 2001). Sigurdsson, van Os, and Fombonne (2002) showed that boys with DCD may experience anxiety. The level of depressive symptomatology is significantly higher in children and adolescent twins with DCD compared with identical co-twins without DCD in both genders, suggesting an environmental impact (peer and social feedback) rather than genetic (Piek et al., 2007).

Behavioural and emotional problems may impact on their activities in daily life (Green, Baird, & Sugden, 2006). The long-term effects of emotional, behavioural, and social difficulties are significant mental health problems (Green, et al., 2006) and psychiatric disorders (Schoemaker & Kalverboer, 1994). Because of their poor performance, children may become anxious, lack personal satisfaction, and have less enjoyment in their life (Poulsen, et al., 2007). Children with DCD isolate themselves and do not participate in physical activities requiring group and team sharing work. This reduces their chances of meeting peers and making friends (Dewey, et al., 2002), making them more lonely (Poulsen, et al., 2007) and introverted and reinforces their negative view of their physical and social skills (Schoemaker & Kalverboer, 1994).

Children with DCD have poor physical competence that reduces their participation in physical activities (Cantell, Crawford, & Doyle-Baker, 2008). The motor ability of children with DCD negatively influences their tendency to participate in out-of-school activities; they prefer activities that are more isolated and do not require team work (Jarus, Lourie-Gelberg, Engel-Yeger, & Bart, 2011). Participation in physical activities depends on competence motivation (Skinner & Piek, 2001), and avoiding participation in physical activity and sport results in less chance to practice (Mandich, Polatajko, & Rodger, 2003; Schoemaker & Kalverboer, 1994; Skinner & Piek, 2001), producing a “negative involvement cycle” (Cantell, et al., 2008) with psychological and social difficulties (Poulsen & Ziviani, 2004). Children with DCD have a low level of the adaptive behaviour required for everyday performance which results in difficulty in coping with environmental demands (Wang, Tseng, Wilson, & Hu, 2009).

The long-term consequence can be hypoactivity, producing poor health, fitness and physical appearance. There may also be somatic symptoms: dizziness, tiredness, headache, stomach ache, and nausea (Dewey, et al., 2002). The children are at risk of being overweight or obese, with boys more affected than girls (Cairney, Hay, Faught, & Hawes, 2005). Social support is important in improving self-worth, which is influenced more by physical appearance than by social acceptance (Piek, Dworcan, Barrett, & Coleman, 2000).

To sum up, this is not a homogenous disorder, so the motor impairments and motor coordination difficulties and their consequences in children with DCD vary. Some children manage to grow out of these difficulties but some do not (Cantell, et al., 2003; Visser, et al., 1998).

2.8 Co-morbidity

Many studies have reported the coexistence of one or more disorders with DCD such as ADHD (Crawford & Dewey, 2008; Kadesjo & Gillberg, 1999; Kaplan, et al., 1998; Kopp, Beckung, & Gillberg, 2010; Pauc, 2005; Piek, et al., 1999; Pitcher, Piek, & Hay, 2003), PDD (Kadesjo & Gillberg, 1999; Kopp, et al., 2010), speech-language disorder (SLD) (Cheng, et al., 2009; Hill, 2001; Scabar, et al., 2006), LD (Jongmans, Smits-Engelsman, & Schoemaker, 2003), and reading disorder (RD) (Crawford & Dewey, 2008; Kaplan, et al., 1998; O'Hare & Shabana, 2002). The debate in the literature is related to whether the disorders share etiology or whether the disorders have different etiologies but share symptoms. Another issue is which label should be given to the relationship between disorders: is it “comorbidity”, “co-occurrence”, or “continuum”?

Before looking at the relationship between disorders, it is useful to describe the meanings of the three labels. The term “comorbidity” has been defined as “existing simultaneously with and usually independently of another medical condition” (http://www.merriam-webster.com/dictionary/comorbidity, retrieved on February 8, 2011). “Comorbidity” means the existence of at least two disorders which are independent to each other and with different etiology (Kaplan, Crawford, Cantell, Kooistra, & Dewey, 2006). Hence, according to the DSM-IV, if a child satisfies the criteria of two disorders, such as DCD and ADHD, both disorders should be diagnosed (American Psychiatric Association, 1994).

The prefix “co” in the term “co-occurrence” is defined as “with, together, and to the same degree” (http://www.merriam-webster.com/dictionary/co-occurrence, retrieved on February 8, 2011). "Co-occurrence" means that two disorders occur without a relationship between them, although they may share symptoms (Kaplan, et al., 2006).

The term “continuum” is “a coherent whole characterized as a collection, sequence, or progression of values or elements varying by minute degrees ....“good” and “bad”…stand at opposite ends of a *continuum* instead of describing the two halves of a line” (http://www.merriam-webster.com/dictionary/continuum, retrieved on February 8, 2011). The continuum indicates a probable linear relationship with differences in severity (Kaplan, et al., 2006).

The term “overlapping” will be used in this discussion instead of other terms to avoid any bias of using one term more than other.

The prevalence of overlapping DCD and ADHD has been estimated at more than 50% (Gillberg, 2003; Hemgren & Persson, 2009; Kadesjo & Gillberg, 1999; Kaplan, et al., 2006; Piek, et al., 1999; Pitcher, et al., 2003). The etiological factors for DCD and ADHD were investigated in twin design studies (Martin, et al., 2006; Pearsall-Jones, et al., 2008; Pearsall-Jones, et al., 2009). Although there were significant differences in symptoms of DCD and ADHD, significant overlap of symptoms was found between both disorders as well as the sharing of genetic components (Martin, et al., 2006). It has been found that children with DCD and ADHD or reading disorder have visual perceptual difficulties. Crawford et al. (2008) referred the existence of the visual perceptual problems in DCD to the co-occurrence of the attention deficit or learning disability, not the motor problems, as the visual perceptual task does not have a motor component. They suggested that DCD, ADHD, and RD are independent disorders and do not share etiology, and prefer to use the term “co-occurrence” to explain the relationship between disorders (Crawford & Dewey, 2008). A strong link was found between "fine motor" of DCD and "inattention" of ADHD (Martin, et al., 2006; Piek, et al., 1999).

Pearsall-Jones et al. (2008), Piek and Dyck (2004), and Pearsall-Jones et al. (2009) found different etiologies for DCD and ADHD. The etiology of DCD was more likely to be environmental, explained by prenatal and perinatal complications, for example associated with oxygen perfusion. The probability of DCD and CP falling on a continuum has been suggested (Pearsall-Jones, et al., 2008; Pearsall-Jones, et al., 2010; Pearsall-Jones, et al., 2009). It has been found that children with DCD, who have impairments in integration and weighting of sensory feedback, were similar to children with CP in the pattern of performance used to control their posture (Grove & Lazarus, 2007).

PDD is an exclusion criterion in the DSM-IV for the DCD diagnosis. However, overlapping between PDD and DCD was found. Many studies confirm the overlapping between DCD and PDD (Dyck, et al., 2007; Green et al., 2002; Kadesjo & Gillberg, 1999; Kopp, et al., 2010; Miyahara et al., 1997; Wisdom, Dyck, Piek, Hay, & Hallmayer, 2007). Miyahara et al. (1997) found 85% of 26 children with AS met the criteria of DCD (with SDD-MF as their label) based on the ICD-10. Green et al. (2002) found that all children with Asperger syndrome (AS) (n = 11) met the criteria of DCD (SDD-MF their label). The motor impairment was investigated below the 15^{th} percentile, but with the cut off below the 5^{th} percentile nine children with AS had motor impairments. The study shows that both groups performed poorly in the Gesture test, although the AS group showed more errors in the spatio-temporal test than the DCD group. There was association between poor performances in the MABC and poor Gesture tests (Green, et al., 2002). Children with AS performed significantly poorer in ball skills than in any other components of MABC (Miyahara, et al., 1997); the substantial differentiation between the groups was ball skills (Green, et al., 2002). Miyahara et al. (1997) and Green et al. (2002) attributed the poor performance of children with AS in ball skills to a failure of social interaction; ball skills require team work and because children with AS usually are unwilling to participate in group activities they miss the opportunity to practice and learn.

There was also overlap between DCD and developmental speech/language disorder (DSLD) (Cheng, et al., 2009; Hill, 2001; Rechetnikov & Maitra, 2009; Scabar, et al., 2006; Visscher, Houwen, Scherder, Moolenaar, & Hartman, 2007). It has been found that children with DSLD exhibit motor difficulties (Rechetnikov & Maitra, 2009), specifically difficulties in manual dexterity skills as measured by the MABC (Cheng, et al., 2009), and in ball skills and balance (Visscher, et al., 2007). Visscher et al. (2007) suggested that the underlying mechanism for the association between motor difficulties and DSLD may be a deficit in the basal ganglia as deficits in left basal ganglia result in deficits in language and speech and in motor coordination performance.

The etiology of DCD and specific language impairments (SLI) was investigated by administering four assessments (non-verbal intelligence, language assessment, MABC and the test of gesture production) for 72 children aged between 7 and 13 years with DCD, SLI, control group, and young children aged between 5 and 6 years (Hill, et al., 1998). Similar performance in the tests was found between children with DCD and SLI suggesting immaturity of brain development. Hill et al. (1998) explain that the similarities found in their study resemble the co-occurrence of acquired apraxia and aphasia. They suggest that the anatomical contiguity of the neural substrates is the cause of the deficits in language and motor functions. Similarly, Scabar et al. (2006) found unilateral and bilateral asynchronous rolandic spikes in children with DCD and children with SLI. Therefore, DCD and DSLD/SLI share etiology (Hill, 2001; Scabar, et al., 2006) and demonstrate comorbidity (Hill, 2001).

DCD also overlaps with LD. Jongmans et al. (2003) found that children with combined DCD and LD performed poorly on the MABC, particularly in placing pegs and dynamic balance “walking” tasks than children with only DCD. These items are substantially differentiated between groups with and without combined disorders. They suggested the probability of the involvement of cerebellar deficit or inter- and intra-hemispheric deficit in the co-occurrence of motor and learning difficulties. They prefer to consider separate diagnoses for DCD and LD.

In these studies investigating the overlap between DCD and other developmental disorders, opinions vary between sharing etiology, sharing symptoms, and origin of deficits, so the question of which term is most appropriate for explaining the overlap between development disorders is difficult to answer. A pure disorder without any overlap is unlikely to occur (Kaplan, et al., 1998). As can be seen from the above studies, children with different developmental disorders also have motor impairments that are similar to DCD, and children with DCD have one or more symptoms of other developmental disorders like attention deficits, reading difficulties, and learning problems. Crawford and Dewey (2008) suggested independent etiologies of the motor impairments in developmental disorders.

O’Hare and Shabana (2002) suggested that children with DCD should be assessed for literacy problems as they have difficulties in reading and writing. Children with developmental disorders like ADHD should also be assessed for motor difficulties with intervention provided (Piek, et al., 1999) and the same is true for the other disorders PDD, RD, DSLD, and LD.

The Neurological Screening Test showed that DCD is related to cerebellar dysfunction (O'Hare & Shabana, 2002). The concepts of minimal brain dysfunction (MBD) (Visser, 2003) and Atypical Brain Development (ABD) (Kaplan, et al., 1998) were proposed as underlying conditions in developmental disorders. These terms explain non-specific brain dysfunction which has an etiology similar to that of cerebral palsy (Visser, 2003). Pearsall-Jones et al. (2008) consider that DCD and CP may fall on a continuum.

To sum up, the heterogeneity of DCD makes it difficult to decide which term to use for explaining the overlap between developmental disorders, with the terms “comorbidity”, “co-occurrence”, and “continuum” explaining the overlap, each from a different direction. According to Green et al. (2002):

“An inevitable implication of these conceptions of co-morbidity is that syndrome coherence should not be sought at the functional level but should, instead, be looked for in biological factors which might determine patterns of co-morbidity in terms of the shared vulnerability of particular faculties to genetic and environmental insult, at a particular period of development” (Green, et al., 2002, p. 666).

2.9 Summary

The heterogeneous nature of DCD plays a crucial role in the inconsistencies in detecting the disorder (Missiuna, Rivard, & Bartlett, 2006) and influenced the way the disorder was diagnosed, and therefore labeled, before the endorsement of the term "DCD" by the international research community in London consensus held in Canada in 1994 (Magalhães, et al., 2006; Polatajko & Cantin, 2006; Visser, 2003). The DCD diagnosis is appropriate for children who meet the four criteria of the DSM-IV (1994).

Children with DCD do not form a homogenous sample, but have different features and symptoms resulting from different levels of motor impairments, different degrees of involvement and different consequences of these impairments.

Identification of DCD requires satisfying the DSM-IV inclusion and exclusion criteria, but the choice of reliable and valid assessment tools is also essential, and compliance with the cut-off (5^{th} percentile) for motor impairment suggested by the DSM-IV (Leeds Consensus Statement 2006, http://www.dcd-uk.org/consensus.html, retrieved in May 6, 2010) is also important. Many standardized assessment tools to assess motor impairments and many standardized screening tools to investigate the impact of the motor impairments on the activities of daily life at home and school are available. Several of these will be discussed in the next chapter.

3 Assessment tools for identifying DCD

3.1 Introduction

It is essential to have a uniform process for DCD identification. The Consensus Statement (Leeds Consensus Statement 2006, http://www.dcd-uk.org/consensus.html, retrieved in May 6, 2010) recommended using the DSM-IV criteria to diagnose children with DCD. DCD as defined in the DSM-IV-TR (First & Tasman, 2004) is considered an acceptable working definition (Polatajko & Cantin, 2006). The process requires assessment tools that are designed to detect motor impairment and its impact on the child's daily activities. There are several types of diagnostic and screening tools in the paediatric field for detecting abnormalities in children. However, it is important to choose a tool appropriate for the aim of the testing and the identification of DCD (Tieman, Palisano, & Sutlive, 2005), and tool that is valid and reliable for detecting children with motor dysfunction in different cultures.

Although there are several tests popular worldwide in both research and clinical settings for measuring motor impairments, there is no single 'gold standard' test to confidently identify children with DCD (Crawford, Wilson, & Dewey, 2001). However, the most popular tests are the Movement Assessment Battery for Children (MABC) (Henderson & Sugden, 1992) and its new version the MABC-2 (Henderson, et al., 2007); the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP) (Bruininks, 1978) and its second edition (BOT2) (Bruininks & Bruininks, 2005); and the McMarron Assessment of Neuromuscular Development (MAND) (McCarron, 1997).

There are also several screening tools developed to assess the child's performance in school or at home. Some of them require the teacher to observe the child's activities at school and complete the questionnaire, such as the Movement-ABC checklist

(MABC-checklist) (Henderson & Sugden, 1992), Children Activity Scales for Teachers (ChAS-T) (Rosenblum, 2006), and Motor Observation Questionnaire for Teachers (MOQ-T) (Schoemaker, Flapper, Reinders-Messelink, & Kloet, 2008). Others require parents to observe the child's activities at home and complete the questionnaire, such as the Developmental Coordination Disorder Questionnaire (DCDQ) (Wilson, et al., 2000) and its new version DCDQ'07 (Wilson et al., 2009), and the Children Activity Scales for Parents (ChAS-P) (Rosenblum, 2006).

The MABC has been reported to be a suitable diagnostic test for detecting motor impairments (Crawford, et al., 2001; Geuze, et al., 2001; Henderson & Barnett, 1998; Miyahara & Möbs, 1995). Similarly, several studies reported on the suitability of the DCDQ and its agreement with MABC-test (Civetta & Hillier, 2008; Crawford, et al., 2001; Schoemaker, et al., 2006). There are many reasons (discussed later) for considering the MABC and the DCDQ to be more suitable as tests of motor impairments. However, in the absence of a gold standard tool, researchers recommend using two assessment tools to confirm the DCD diagnosis (Wagner, Kastner, Petermann, & Bös, 2011). Furthermore, other researchers suggest that even if the assessment tool is reliable and valid, it is essential to investigate many aspects of its reliability and validity in different cultures (American Educational Research Association., 1985; Deitz, 1989; Dunn, 1989; Lansdown, Goldstein, Shah, Orley, & et al., 1996).

3.2 Movement Assessment Battery for Children (MABC) (Henderson & Sugden, 1992)

The MABC was developed from the earlier versions (1966 and 1972) of the Test of Motor Impairment (TOMI) which focused on identifying children with motor impairments. Henderson revised the TOMI in 1984 to the Test of Motor Impairment-Henderson (TOMI-H). The TOMI-H had fewer items than the TOMI and included a behavioural checklist as well as qualitative observations. Henderson and Sugden in 1992 established the MABC to identify children at risk of motor impairment between

4 and12 years. It has been translated into several languages such as Chinese, Dutch, Finnish, Italian, and Swedish and used in many countries around the world, for instance in North America (USA and Canada), in Europe (UK, Sweden, the Netherlands, and Bulgaria), in East Asia (China, Hong Kong, Japan, Singapore, and Bangladesh), and in the Middle East (Israel) as well as in Australia (Henderson, et al., 2007).

Independent studies have evaluated its validity (Brantner, Piek, & Smith, 2009; Cairney, Hay, Veldhuizen, Missiuna, & Faught, 2009; Crawford, et al., 2001; Smits-Engelsman, Henderson, & Michels, 1998; Van Waelvelde, De Weerdt, De Cock, & Smits-Engelsman, 2004), reliability (Chow & Henderson, 2003; Smits-Engelsman, Fiers, Henderson, & Henderson, 2008; Van Waelvelde, Peersman, Lenoir, & Smits Engelsman, 2007), and suitability in different cultures (Chow, Henderson, & Barnett, 2001; Engel-Yeger, Rosenblum, & Josman, 2010; Livesey, Coleman, & Piek, 2007; Miyahara, et al., 1998; Van Waelvelde, Peersman, Lenoir, Engelsman, & Henderson, 2008).

3.2.1 From MABC to MABC-2

Since 1992 the MABC has been used widely but as a result of comments and feedback from the literature and users, the test was revised in 2005 (Henderson, et al., 2007). Changes were made while balancing two factors: preserving many items and improving the test. Therefore, a few new items were added but were reorganized in a consistent and productive manner. Changes have been made to the material of the battery, the task content, the age bands, and scoring.

Specifically, the materials were changed from wood to plastic which has bright colours, is easy to clean, and conforms to health and safety requirements. The number of age bands was reduced from four to three and extended upward and downward to include a broader range of ages:

- age band one was extended from 4-6 years to 3-6 years old
- age bands two (7-8 years) and three (9-10 years) were merged into one age band for 7-10 years old
- age band four was extended from 11-12 years old to become age band three for 11-16 years old.

The task content was changed by altering the individual items while maintaining the previous basic constitution of the test as eight items in three categories (manual dexterity, catch and throw, and balance). The changes include adding new items (new layout or starting position), changing the shape of the drawing trail, and changing the target for throwing (from box to mat) (Henderson, et al., 2007). The instructions in the manual were changed also, to prevent any ambiguous administration or scoring.

The most significant change in the MABC-2 is the way it is scored. Scoring in the previous version was based on percentile points below the 25th percentile for both individual items and total score. In the new version scores are provided for the individual items within the test including both standard scores and percentiles. The raw scores for each item are converted to a scale score with a mean of 10 and standard deviation of 3. For each age group there are standardized scores. There are also standardized scores and percentile equivalents for the three components (manual dexterity, catch and throw, and balance) and for the total score. The new scoring allows the examiner to assess not only motor impairment, but also assess the full range of motor ability.

The strengths of the MABC-2 are that it covers a wider range of ages (3-16 years), it has clear instructions for the examiner on administration and scoring, and it includes both qualitative and quantitative measurements as well as intervention suggestions. The qualitative measurements include observations for each item while the quantitative measurements include the scoring of each item with raw and standard scores.

In addition, it has clear cut-off points: the 5th percentile to detect DCD, between the 5th and 15th percentile to detect children 'at risk of DCD', and above the 15th percentile to clarify children as motor competent (Geuze, et al., 2001; Henderson, et al., 2007; Sugden & Chambers, 2007).

There are no published studies investigating the construct and concurrent validity, reliability, and suitability of the MABC-2 for different cultures. However, the manual includes several studies on its reliability and validity (Henderson, et al., 2007), but using the old version. The authors of the MABC-2 commented that the item contents of MABC-2 and MABC are similar, so it is useful to use those studies as evidence for approving the MABC-2 validity and reliability (Henderson, et al., 2007).

A critical review by Brown and Lalor (2009) discussed the studies included in the manual: the studies did not use the new version, some studies did not include all age bands, and the manual included unpublished studies that have not been peer-reviewed. Moreover, one study did not state the type of validity used, and another had questionable methodology as it tested the discriminative validity without a control group. Brown and Lalor (2009) stated that there is a need for evidence to measure the construct validity, confirmatory factor analysis, and test-retest reliability of the MABC-2.

However, in general the MABC-2 is fairly similar to the MABC despite the changes that have been done. Moreover, like the MABC, it is a broad-based test that includes items measuring the underlying components of both fine and gross motor ability. The tasks were chosen carefully to avoid any gender advantages through experience or physique, for example boys are more experienced in kicking while girls are experienced in skipping, and to ensure they were not culture-specific (Henderson et al. 2007).

Recently, the factorial validity of the MABC-2 in a German population was investigated (Wagner, et al., 2011). The MABC-2 was administered to 323 children aged 7-10 years (169 boys and 154 girls) who were recruited from primary schools from urban and rural areas. The confirmatory factorial analysis was done using AMOS 18. The results confirmed the factorial validity of the MABC-2 for age band 2 (AB2) but the sub-structure was problematic because of insufficient discriminant and convergent validity. Wagner et al. (2011) concluded that although the MABC-2 is valid for clinical use, scores from other assessment tools should be combined with those of MABC-2 to determine the DCD diagnosis according to the ICD-10 criteria.

Given the shortage of published evidence on the reliability and validity of the MABC-2, the following discussion is based on the previous research using the MABC. Three issues are included: the reliability of the MABC, its validity, and its suitability for different cultures.

3.2.2 Reliability of the MABC

It is important for clinicians and researchers to determine the reliability of the test that is used for clinical judgment (Deitz, 1989). Reliability refers to the confidence obtained from a test score assessed by the number of measurement errors. It measures the consistency of the test and its ability to be repeatable on different occasions (American Educational Research Association., 1985; Deitz, 1989, p. 19). “Reliability is a prerequisite to validity, but it does not ensure validity” (American Educational Research Association., 1985; Deitz, 1989, pp. 144-145).

There are many types of reliability, each measuring different aspects. Published studies that investigate the reliability of the MABC are limited, measuring the correlation between the MABC items (Haga, Pedersen, & Sigmundsson, 2008), the test-retest reliability (Chow & Henderson, 2003; Croce, Horvat, & McCarthy, 2001; Van Waelvelde, et al., 2007), and the inter-rater reliability (Chow & Henderson, 2003; Smits-Engelsman, et al., 2008).

As the reliability of a test is important, the correlation between test items must also be checked: determining the correlation between test items assesses the direction and strength of the linear relationship between them (Allen & Bennett, 2008). The association between items is measured by the Pearson correlation.

The correlation between the MABC items was measured in a study conducted in Norway (Haga, et al., 2008). The MABC was administered to 91 children (46 boys and 45 girls) aged between 4 and 5 years who were recruited from 10 mainstream nursery schools. The correlation was assessed for the eight items of the MABC. The findings showed low correlations between the items. There was no significant correlation between the manual dexterity items, or between ball skills items. For the balance items, the significant correlation was between one-leg balance and jumping over cord. Although, there were correlations between some items from different components of the MABC, the correlation strength was weak to moderate. The findings of this study indicate that the skills are task-specific (Haga, et al., 2008; Sigmundsson, Pedersen, Whiting, & Ingvaldsen, 1998; Sigmundsson & Rostoft, 2003).

The test-retest reliability is “an instrument’s capacity to provide the same measurement on different occasions” (Dawson & Trapp, 2004, p. 287). Test-retest reliability is clinically essential because it measures the stability of the test over time (Deitz, 1989). The interval between test and retest should consider the age of the participants and the type of the test so that the practice, intervention, and maturation do not interfere with the changes that occur (Deitz, 1989). A long interval reduces the reliability of the test (American Educational Research Association., 1985; Deitz, 1989, p. 19). The measurements of the test-retest reliability are the intra-class correlation coefficient (ICC) and standard error of measurement (SEM).

Table 3.1: Summary of the studies investigating the test-retest reliability of the MABC

Author/year	Sample description	Procedure	Results
Croce et al. (2001)	106 children (67 boys and 39 girls): 20 at age 5-6 years, 20 at age 7-8 years, 46 at age 9-10 years, and 20 at age 11-12 years. Children recruited from primary school-based population, free from intellectual and orthopaedic conditions.	Children were tested twice with one week interval, by graduate students in adapted physical education who had 2 years experience administering the test,	Intra class correlations were significant for the total score at p<.001 and ranged between 0.92 and 0.98.
Chow & Henderson (2003)	75 children: 26 four-year-olds (13 boys, 13 girls), 25 five-year-olds (13 boys, 12 girls), and 24 six-year-olds (12 boys, 12 girls). Children recruited from schools representative of the Hong Kong population.	Children were tested twice by the same tester over a 2 to 3 week interval.	The ICCs for the individual items were significant at p<.001, the mean ICC = 0.77 and the range between 0.64 and 0.86.
Van Waelvelde et al. (2007)	33 children 4-5 years old (24 boys, 9 girls). Children were recruited from schools; teacher-chosen children with worse motor skills	Children were tested by one trained examiner three times, with exactly 3-weeks interval. The three tests were conducted on the same weekday and at the same time.	The reliability between the three tests was good for the total score of the MABC (ICC= 0.88) and balance skills (ICC= 0.82), moderate for manual dexterity (ICC= 0.75), and poor for ball skills (ICC = 0.45). Good agreement between the three testings in detecting children at risk of motor impairment at 15th percentile.

Table 3.1 describes studies examining test-retest reliability including sample, procedure, and results. The general findings of the three studies confirmed the consistency of the MABC over time (Chow & Henderson, 2003; Croce, et al., 2001; Van Waelvelde, et al., 2007).

The MABC measures motor ability as well as motor impairments so the ICC of the total score, component scores, and individual items should be reported and interpreted. In the Standards for Educational and Psychological testing (American Educational Research Association., 1985, p. 20), Standard 2.1 states that for the judgment of the tester to be sufficiently accurate, the complete measurements of the total score and sub-scores should be provided.

Croce et al. (2001) measured the ICC for the total score of the MABC for children in different age groups. However, the ICC results of the component scores and individual item scores are not reported. Their findings confirmed the high reliability of the total score of the MABC for children aged 5-12 years recruited from a school-based population over a one week period. However, this study did not give further evidence about the reliability of the MABC sub-scores or its individual items.

On the other hand, Chow and Henderson (2003) reported the ICC for the individual items of the MABC but not the total score or component scores. The results showed that the average reliability for all items was moderate. However, considering age and individual items, the reliability of some items was fair, the items being the one-leg balance non-preferred leg for the 4-year-old children, posting coins-preferred hand and rolling ball for the 5- and 6-year-old children, and one-leg balance non-preferred leg for the 5-year-old children. Therefore, this study adds evidence of the moderate reliability of the individual items of the MABC for children aged between 4 and 6 years, over a one week period, but not for its total scores or component scores.

Van Waelvelde et al. (2007) investigated the reliability of the total score, sub-scores, and individual items of the MABC in three repetitions over a three week period. The aim of the study was to determine reliability of the MABC to detect children who were suspected of motor impairments. The sample was not chosen randomly, but based on teacher judgment of the child’s motor skills. The results of the initial test using the MABC confirmed that these children had poor motor skills, their total scores being below the 15^{th} percentile. Therefore, the ICC results for the total score and balance were good, moderate for manual dexterity, and poor for the ball skills. The ICC results for the individual items were good to moderate for all items except for drawing, catching, rolling ball, and walking heel-raised which were poor. The study also aimed to measure the consistency of the MABC in detecting motor impairments: the coefficient of agreement between the three tests in detecting the motor impairments was good, $\kappa = 0.72$ with a 95% CI between 0.52 and 0.92.

The findings of these three studies indicate that the general reliability of the MABC over time for a school-based population was good for the total score and for many of the individual items but not for all age groups. Similarly, the reliability of the MABC for children suspected of poor motor skills was also good, but not for all individual items.

Table 3.2 : Summary of the studies investigating the inter-rater reliability of the MABC

Author/year	Sample description	Procedure	Results
Chow & Henderson (2003)	79 children: 27 four-year-olds (12 boys, 15 girls), 26 five-year-olds (13 boys, 13 girls), and 26 six-year-olds (13 boys, 13 girls).	Two trained observers; one is psychologist and the other a fourth-year student in occupational therapywho had not used the MABC before. Both testers assessed each child in one time.	The agreement between raters was high for the total (ICC = 0.96) and for the individual items (ICC ranged from 0.74 to 1.00). Good agreement between raters in classifying children with motor impairments at 5th percentile.
Smits-Engelsman et al. (2008)	9 children aged 4-12 years old (6 boys, 3 girls) with movement difficulties recruited from paediatric physical therapy centre. Children were tested and sessions were videotaped	131 paediatric physiotherapists rated the videotaped performance according to the test instructions	High agreement between raters in classifying children with motor impairments, at risk of motor impairment, and without motor impairments; kappa ranged from 0.96 to 1.00. The standard error of measurements ranged from 0.3 to 0.8.

The inter-rater reliability correlation coefficient measures the agreement between two examiners observing the same subject (Dawson & Trapp, 2004). This kind of reliability depends on the level of knowledge of the examiners about the test (Deitz, 1989).

Table 3.2 summarizes the studies examining the inter-rater reliability including sample, procedure, and results. Two studies investigated the inter-rater reliability of the MABC (Chow & Henderson, 2003; Smits-Engelsman, et al., 2008). However, there were differences between studies in the method of analyzing the reliability. Chow and Henderson (2003) investigated the inter-rater reliability for typical children who were tested by two testers at the same time. Two different outcomes were assessed, the ICC for individual items and the agreement between testers on the categorization of motor ability of children at the 5^{th} percentile of the MABC. The ICC of individual items showed excellent agreement between testers on individual items for children aged 4-6 years. The classification of children below and above the 5^{th} percentile confirmed high agreement (92.4%) between testers.

Smits-Engelsman et al. (2008) investigated the consistency between 131 testers on the classification of nine children aged 4-12 with different levels of motor ability (5 with motor impairments, 3 at risk of motor impairments, and one with normal motor ability). The testers were physical therapists with different levels of clinical experience and familiarity with the MABC. Similarly, the agreement between testers in classification of children with motor impairments was significantly high, $\kappa = 0.98$ to 1.00. The Standard Error of Measurements were ranged between .3 and .8.

In summary, the studies that investigated the reliability of the MABC suggest that the skills of the MABC items were task-specific and confirmed its reliability for assessing the motor ability of typical children over time (Chow & Henderson, 2003; Croce, et al., 2001) as well as assessing children with motor impairments (Van Waelvelde, et al., 2007). There is also good agreement between testers in classifying children with and without motor impairments (Chow & Henderson, 2003; Smits-Engelsman, et al., 2008).

3.2.3 The validity of MABC

The validity of the test refers to "the appropriateness, meaningfulness, and usefulness of the specific inferences made from test scores (American Educational Research Association., 1985, p. 9), so the validation is related to the inferences of its specific use, not to the test itself (American Educational Research Association., 1985). There are many types of test validation: investigating the appropriateness of the content, correlating with other instruments measuring the same skills (Dawson & Trapp, 2004), and differentiating between different groups (Dunn, 1989). It is essential for a test author to provide the test user with details of the construct validation processes that facilitate decisions on the appropriateness of the test for specific populations (American Educational Research Association., 1985; Dunn, 1989). Furthermore, any aspects that could influence the interpretation of the test (American Educational Research Association., 1985) should be considered during validation, like test format, administration of the test, and language.

As with the reliability, the MABC-2 manual based the validity of the test on earlier MABC studies. Because of the shortage of published studies on the validity of the MABC-2, the current discussion on validity is based on those MABC studies. The studies available (and discussed here) examined two types of validity of the MABC: the concurrent validity measured by correlations with other tests, and the suitability of the MABC measured by differentiations between different cultures.

3.2.3.1 Concurrent validity of the MABC

There are six available studies investigating the concurrent validity of the MABC. It has been correlated with Korperkoordinations Test fur Kinder (KTK) (Smits-Engelsman, et al., 1998; Van Waelvelde, et al., 2004), Bruininks-Oseretsky Test of Motor Performance(BOTMP) (Cairney, et al., 2009; Crawford, et al., 2001; Croce, et al., 2001), and McCarron Assessment of Neuromuscular Development (MAND) (Brantner, et al., 2009).

The studies used different methods to investigate the concurrent validity of the MABC, falling into two groups according to the method used for measuring concurrent validity. One group assessed the concurrent validity of the MABC in a population-based sample (Brantner, et al., 2009; Croce, et al., 2001), while the other group assessed the validity on a sample with motor impairments (Cairney, et al., 2009; Crawford, et al., 2001; Van Waelvelde, et al., 2004). One study assessed the validity with two samples, one population-based sample and the other with motor impairments (Smits-Engelsman, et al., 1998).

Croce (2001) investigated the concurrent validity of the MABC against the long and short forms of the BOTMP. The MABC and both BOTMP tests were administered to 106 children aged between 5 and 12 years. The correlations were significant between the MABC and BOTMP, the long form having Pearson Product-moment $r = 0.76$ and the short form with $r = 0.71$.

Similarly, Brantner, Piek, and Smith (2009) assessed 118 children aged between 4 and 6 years using the MABC and the MAND. Although the study aimed to investigate the concurrent validity of the MAND, the agreement between the MAND and the MABC could also measure the concurrent validity of the MABC. A significant correlation was found between tests in ranking the motor ability of children. The agreement between tests identifying children with and without motor impairment was 77%. There was 51% consistency between tests in classifying children with motor impairments.

The MABC and KTK tests were administered to 134 children aged between 5 and 13 years (Smits-Engelsman, et al., 1998). The correlation between tests measured by Pearson's product moment correlations was significant ($r = 0.62$). The proportion of children falling below the 50^{th} and 15^{th} percentile in both tests was compared to the norm sample of each test. The percentage of children scoring at these two percentiles on the MABC was similar to the American sample. However, the KTK percentage was higher than in the German sample.

In general, although each study compared the MABC to different assessment tools, all studies confirmed the concurrent validity of the MABC in identifying children with motor difficulties from population-based samples. High correlations between different tests in the identification of motor impairments are not expected because each standard test has a different purpose (Croce, et al., 2001). For example, although the MABC measures motor impairments as well as motor competence, the BOTMP measures motor ability, so good agreement is not expected (Croce, et al., 2001). However, Croce et al. (2001) found good agreement between the MABC and the BOTMP long and short forms.

The concurrent validity of the MABC was also assessed by administering the test to children who were identified as having motor impairments. Smits-Engelsman et al. (1998), as part of the above study, administered the MABC and the KTK to 74 children aged between 5 and 12 years who were thought to have motor impairments. The correlation between the tests was also significant (r = 0.65). Out of the 74 children, the MABC identified 59% who fell below the 15th percentile, while the KTK identified 68%.

The agreement in identifying children with DCD between the MABC and the BOTMP was investigated (Crawford, et al., 2001). Children aged between 8 and 17 years (No= 224) who had learning and/or attention problems were recruited from special schools and clinics. According to the BOTMP, 104 children met the DCD criteria. The MABC was administered to 72 children, 34 with DCD and 38 without DCD. The agreement between tests in identifying children with DCD was measured by kappa which showed fair to moderate agreement, kappa ranging from 0.416 for BOTMP total score to 0.073 with BOTMP fine motor. The sensitivity of the MABC as compared to the BOTMP in detecting DCD was 62% and the specificity was 71%.

Similarly, Cairney et al. (2009) recruited 24 out of 102 children in grade 4 at school who were identified as having DCD using the BOTMP-SF at 5th percentile. The MABC was administered to the 24 children. The percentage of the agreement between both tests in identifying children with motor problems at the 5th percentile of the MABC was 63% and at the 15th percentile was 88%.

The concurrent validity of the MABC was also investigated for specific individual items; catching, jumping/hopping, and walking heel-to-toe (Van Waelvelde, et al., 2004). The MABC, KTK, and ball catching test were administered to 133 children aged between 7 and 9 years recruited from mainstream schools, special education schools, and rehabilitation centres. Spearman Rank correlation coefficients were used to assess the validity of the MABC. For children aged between 7 and 8 years, significant correlations were found between the ball catching test and the total score of the MABC, sub-scores, and all items except jumping and walking heel-to-toe. For the 9-year-old children, the ball catching test significantly correlated with the total score of the MABC, sub-scores, drawing, catching, one-leg balance, and walking heel-to-toe.

The KTK-jump correlated significantly with all measures of the MABC for ages 7-8 and 9 years except for jumping at age 9 years. Similarly, the KTK-beam correlated significantly with all measures of the MABC for ages 7-8 years. For age 9 years, the correlations were with the total score of the MABC, balance sub-score, one-leg balance, and jumping. The strengths of the associations between all measures were medium to large; ranging from 0.3 to 0.76 (Van Waelvelde, et al., 2004).

The above studies investigating the concurrent validity of the MABC confirmed that the MABC is a valid instrument to detect motor impairments from population-based and from clinic-referred samples. It has in general good agreement with BOTMP, KTK, MAND, and a ball catching test.

3.2.3.2 The suitability of the MABC in different cultures

Although the concurrent, construct and discriminative validity of a test is important, its appropriateness to be used in different cultures other than the norm-standard is also essential. Cultural demands impact on the development of motor skills (Venetsanou, Kambas, Ellinoudis, Fatouros, & Giannakidou, 2011). In line with other aspects of reliability and validity, there is a shortage of published studies investigating the suitability of the MABC-2 in different cultures. In view of the similarities between the MABC and the MABC-2 based on the comments of Henderson (Henderson, et al., 2007), the discussion of the suitability of the test is based on the MABC. Several studies have examined the suitability of the MABC in different countries (Table 3.3); Australia (Livesey, et al., 2007), Belgium (Van Waelvelde, et al., 2008), Hong Kong (Chow, et al., 2001), Israel (Engel-Yeger, et al., 2010), Japan (Miyahara, et al., 1998), and Sweden (Rˆsblad & Gard, 1998). The differences between countries in the motor performance are stated first and then the influence of culture on these differences.

A study compared motor performance of children aged between 4 and 5 years from Australia with American children, the MABC norms sample. The comparison was made using individual items of the MABC (Livesey, et al., 2007), and showed that the Australian children performed significantly better than the American children in the drawing and walking heel raised tasks. However, the effect was small, and there were no other differences in the motor performance found between children from these countries.

Similarly, no differences in the motor performance of 6-year-old Swedish and American children were found except in rolling ball and one-leg-balance using non-preferred leg. The Swedish children performed significantly better than the American children in these two items (Rˆsblad & Gard, 1998).

Moreover, another comparison was done between Chinese children from Hong Kong aged between four and six years and American children on individual items of the MABC (Chow, et al., 2001). Chinese children performed better than the American children on posting coins preferred-hand, drawing, walking heel raised, and jumping items; while the American children were better on catching beanbag. There was a country-age effect; the Chinese children performed the drawing task significantly better than the American children, the greatest differences being for the younger children. Also, there was a country-gender interaction; Chinese girls performed better than American girls on one-leg balance using the non-preferred leg, whereas boys were similar for all items.

In contrast, the performance of the Japanese children was worse than the American sample on all items (Miyahara, et al., 1998). However, there were country-age interaction effects which indicated that the Japanese children in certain age groups were better than the American children in specific tasks. The Japanese children aged nine years performed the hopping task without error. At ten years of age, Japanese children performed one-leg balance better than American children. Between seven and eight years, Japanese children performed dynamic balance better than American children. The eleven-year-old Japanese children managed to cut out the elephant without errors better than American children. Japanese children in all age groups performed significantly worse on the drawing task.

The MABC was also administered to Israeli children aged 4-12 years (Engel-Yeger, et al., 2010), showing differences at ages nine and ten years where the performance of the Israeli children was worse than the American sample. However, the study did not add further details on the differences on the motor skills.

The above studies compared the motor performances of the children on the individual items of the MABC. On the other hand, one study made rigorous comparisons which included the total score of the MABC, sub-scores, and individual items. Van Waelvelde (2008) compared the motor performance of four- and five-year-old Flemish children to American children. The American children were significantly better on the total score, manual dexterity and all individual items except for catching a beanbag, rolling a ball and one-leg standing non-preferred leg. There was a country-age interaction effect: the four-year-old Flemish children performed significantly better than the American children on tracing task, one-leg balance, and manual dexterity sub-score, whereas the American children were significantly better in ball tasks and jumping cord. At five years the Flemish children were significantly better in posting coins and one-leg balance using preferred leg, whereas the American children were significantly better in walking heel-raised.

After examination of the studies that compared the MABC in different countries to the American sample, the conclusion is that the differences found were task and age specific. Although there were differences in the motor performance of the children from different cultures and the American sample, there were also similarities in many items of the MABC which confirm the task-specific effects. Therefore, the factors that might contribute to the differences between children from different countries may be related to cultural and environmental demands.

The cultural perspective may impact on motor development of the Chinese and Japanese children. Children from Hong Kong (Chow, et al., 2001) and Japan (Miyahara 1998) as young as 2 years old are trained to use chopsticks in eating. There is a similarity in the technique of using chopstick and using scissors. Therefore, Chow et al. (2001) and Miyahara et al. (1998) explained the significant performance of the Chinese children in drawing and Japanese children in cutting with scissors to cultural demands.

The environmental demands also contribute to motor development. Chow et al. (2001) commented that the Chinese children use public transport which requires jumping on and off buses frequently which may explain the superiority of the Chinese children on one-leg balance. Similarly, Miyahara et al. (1998) stated that the school tested in the Japanese study encourages unicycle riding activities inside the school and the unicycle is available for all students. The Japanese children were found to be superior in balance tasks.

However, in spite of the influence of the cultural and environmental demands on motor development, motor learning may also influence the differences between children from different cultures. Chinese and Japanese children were trained in these items from an early age, which may explain their superiority in these items.

Swedish children at an early age practice sporting activities like skiing and skating that require balance skills, suggesting that this may improve the Swedish balance performance on one-leg non-preferred leg (Rˆsblad & Gard, 1998). However, skiing and skating require balance ability on both legs, so this kind of interpretation requires further investigation.

The four- and five-year-old Australian (Livesey, et al., 2007) and Belgian children (Van Waelvelde, et al., 2008) also performed better than the American sample on one-leg balance. Authors did not explain whether children from these countries practice specific activities or whether their cultural and environmental demands impact on their leg balance.

In summary, motor ability is shaped by a number of factors including the biological, cultural, and practicing physical activities (Cintas, 1995).

Table 3.3: Summary of the studies investigated the suitability of the MABC in different cultures

Country	Author	Subjects
Australia	Livesey et al. (2007)	- 514 children aged 3-5 years: 128 three-year-olds (71 boys & 57 girls), 149 four-year-olds (82 boys & 67 girls), and 237 five-year-olds (127 boys & 110girls). - Children recruited from 23 metropolitan pre-schools from two Australian cities (12 from Sydney and 11 from Perth)
Belgium	Van Waelvelde et al. (2008)	- 506 children aged 4-5 years: 267 four-year-olds (141 boys and 126 girls) and 239 five-year-olds (119 boys and 120 girls). - Children were recruited from 44 schools in Flanders: 21 from typical small Flemish cities, 15 from small regional town, and 8 from larger towns. - Three of the smaller towns and one large town had a number of immigrant children.
Hong Kong China	Chow et al. (2001)	- 255 children aged 4-6 years; 85 children in each age group (number of children in each gender not reported). - Children were recruited based on selection criteria to represent the general population in Hong Kong in terms of geographical area, age, gender, parental education, and type of preschool facility. - Children were from three officially designated areas of Hong Kong (Hong Kong Island, Kowloon, the New Territories).
Israel	Engel-Yeger et al. (2010)	- 249 children (209 boys and 40 girls) aged 4 to 6 years recruited from kindergartens and public schools in Israel. - Exclusion criteria are: low IQ, neurological disorder, developmental disorder including DCD, and learning disabilities.
Japan	Miyahara et al. (1998)	- 133 children (66 boys and 67 girls) aged between 7 and 11 years recruited from one primary private school. The socioeconomic status of parents is high. - Exclusion criteria are physical and neurological impairments.
Sweden	Rˆsblad & Gard (1998)	- 60 children aged 6 years (32 boys, 28 girls). - Children were recruited from schools and kindergartens in a medium-sized town and from rural villages in the north-west part of Sweden.

3.2.4 Summary

The MABC was found to be useful and easy to use for children from different cultures with different languages. The cultural differences did not directly affect the general judgment of the children's motor performance or the motor impairments. However, findings should be interpreted carefully within different cultures, taking into consideration the activities of children related to their environment.

From all available studies that examined the MABC validity, reliability, and suitability in different cultures, it can be seen that no one found difficulties or problems in administering the test, and children did not face problems or harm from being tested. Therefore the MABC appears to be an easy, simple, and suitable test to be used with children.

The MABC is considered the test that is most suitable to detect children with or at risk of motor impairments (Geuze, et al., 2001). However, many suggestions have been made for the use of a standard test in different cultures. Chow et al. (2001) suggested the requirements of establishing "specific group norms" as a guide in the identification of Chinese children with movement difficulties. There is a need for cross-cultural comparison studies to test the impact of environment, school curriculum, and sport activities on motor performance (Rˆsblad & Gard, 1998). As the test is sensitive to cultural differences (Miyahara 1998), there is also a need to modify the norms for different cultures (Engel-Yeger, et al., 2010).

3.3 Developmental Coordination Disorder Questionnaire

As with the MABC, the developmental coordination disorder questionnaire (DCDQ) has recently been revised, with some questions reworded and reduced to 15 questions in the new version (DCDQ'07) (Wilson, Crawford, Roberts, & Kaplan, 2006). The DCDQ'07 is a parent report questionnaire developed by a Canadian group to identify children with motor problems, considering the parents' perceptions of the motor abilities of their children out of the clinical setting (Wilson, et al., 2000), and was designed as a screening instrument not as a diagnostic instrument. It was originally developed as a 35 item scale based on reviews of three different questionnaires: Parent Rating Scale of Everyday Cognitive and Academic Abilities, the Movement Assessment Battery for Children Checklist, and the Teacher Identification of Children with Movement Skill Problems. The questionnaire was revised by researchers, clinicians, and four families for clarity and ease of use of the questions, which were then reduced to 22 items. A sample of 332 families completed the 22-item questionnaire which was analyzed and five items were removed. The scores on the 17 items were added to obtain the total DCDQ score and measure four factors: control during movement, fine motor control, general coordination, and gross motor control/planning. The scoring system, based on the MABC, identifies three groups; DCD, suspect DCD, and non-DCD (Wilson, et al., 2000).

Wilson and colleagues (2000) conducted a longitudinal study between 1992 and 1997 comprising three different studies to measure the internal consistency and concurrent and construct validity of the DCDQ as compared with two standardized assessment tools, MABC and BOTMP. The results showed strong internal consistency and significant correlations between DCDQ and MABC and BOTMP. The factor analysis revealed four factors which significantly correlated with the sub-items of BOTMP and MABC. The authors reported that the DCDQ correctly identified 86% of children classified with DCD with strong specificity (95%).

In 2005 the DCDQ was revised so that it could discriminate between children with and without DCD as well as ensure its validity with children aged 5-7 years, and to develop cut-off scores for different age groups, different genders, and different degrees of attention problems (Wilson, et al., 2009). The revised version included 24-items. Fifteen items from the original 17-item of the DCDQ were included but two items were reworded from a negative to a positive direction. Other nine extra items were added as an alternative; six items of the original were reworded, two items from the original were reworded to be useful for younger children, and there was one new item.

The 283 questionnaires completed by parents of children recruited from public schools were analysed. Internal consistency was measured for the 24-item DCDQ which resulted in two items being dropped from the original DCDQ, four of the reworded items were substituted for those of the original, and the other new items were eliminated. The final form of the new DCDQ had 15 items.

Factor analysis was done for the 15-items and revealed three factors which were similar but more discrete than the 17-item DCDQ. The scoring system was changed to identify two groups (indication or suspicion of DCD, and probably not DCD) instead of three. The scoring system was categorized according to age into three groups; group one from 4 years and 6 months to 7 years and 11 months; group two from 8 years to 9 years and 11 months, group three from 10 years to 15 years (Wilson 2009).

The new 15-item version of DCDQ was examined and the results showed high internal consistency; the correlation was 0.93-0.94 (Wilson 2009). The result of the new scoring for three age ranges showed that the DCDQ’07 (15-item) has good overall sensitivity (81%) and specificity (65%). The sensitivity and specificity for each age group are as follows: for 4-7 years old, 75% and 71% respectively; for 8-10 years old, 89% and 67% respectively; and for 11-15 years old, 89% and 76% respectively (Wilson, et al., 2009).

As with the MABC-2, there is a shortage of publications examining the reliability and validity of the DCDQ’07, only two being available (Cairney, Missiuna, Veldhuizen, & Wilson, 2008; Tseng, Fu, Wilson, & Hu, 2010). Cairney’s study (2008) compared the DCDQ’07 with Children’s Self-perceptions of Adequacy in and Predilection toward Physical Activity (CSAPPA). The DCDQ’07 detects motor impairments while the CSAPPA measures the self-efficacy, so CSAPPA cannot be used to investigate the validity of the DCDQ’07. Tseng et al. (2010) used the MABC and the BOTMP to investigate the validity of the DCDQ’07, but the study did not include all aspects of validity. Therefore, other studies using the DCDQ (17-item) are included in the discussion below, especially on the items of the DCDQ’07 are similar to the DCDQ items. Table 3.4 shows the studies investigated the reliability and validity of the DCDQ and DCDQ'07.

Table 3.4: Studies investigating the reliability and validity of the DCDQ and DCDQ'07

Study	Assessment tools	Sample description
Cairney et al.(2008) Canada	- DCDQ'07 - CSAPPA	523 children (252 boys and 271 girls) were recruited from mainstream schools from grade 4-8. The age of the children is not reported.
Civetta and Hillier (2008) Australia	- DCDQ - MABC was administered to 57 children who identified as having DCD or at risk of DCD based on the DCDQ score.	185 children aged 7-8 years were recruited from mainstream primary schools and parents completed the DCDQ (99 boys and 86 girls). 57 out of the 185 children were tested with the MABC. Based on the score in the DCDQ; 10 have DCD, 18 are suspect DCD, and 29 do not have DCD.
Crawford (2001) Canada	- DCDQ - BOTMP	134 children aged 8-17 years, 64 meeting the DCD criteria recruited from special schools and clinics, and 70 a control group recruited from mainstream public schools. The gender of the children was not reported.
Loh et al. (2009) Australia	- DCDQ - MAND - Australian Disruptive Behaviors Scale	129 children from Perth recruited from primary schools; 91 boys and 38 girls aged from 9.62 years to 12.75 years. 32 out of 129 children were diagnosed with single or comorbid childhood disorder such as ADHD, LD, motor problems, and dyspraxia. 16 children with ADHD were under medication.
Schoemaker et al. (2006) The Netherland	- DCDQ - MABC	608 children were recruited from mainstream schools to form the population-based sample; 311 boys and 297 girls aged 4 to 12 years old. 55 children (48 boys and 7 girls aged from 4 to 12 years) from rehabilitation centres were included; children were referred by general practitioners because of motor problems.
Tseng et al. (2010) Taiwan	- DCDQ - MABC - BOTMP	1082 children (560 boys and 522 girls aged 6-9) were recruited from public schools and their parents completed the DCDQ. 114 (69 boys and 45 girls) of the 1082 were selected and been examined with the MABC and BOTMP.

3.3.1 Reliability of the DCDQ’07

Cairney et al. (2008) assessed the internal consistency of the DCDQ’07, finding high internal consistency for the total score ($\alpha = 0.94$) and sub-scores (α ranged from 0.84 to 0.91). There were moderate to high correlations between sub-scores, with correlations ranging from 0.58 to 0.75. Similarly, Tseng et al. (2010) investigated the internal consistency of the DCDQ’07 for the total score and found good consistency, $\alpha = 0.89$. Tseng et al. (2010) also investigated its test-retest reliability with 35 parents who completed the DCDQ’07 twice within two weeks interval. The findings showed high reliability between the two tests, the Pearson’s coefficient being significant (0.94).

3.3.2 Construct validity of the DCDQ’07

The construct validity of the DCDQ’07 was investigated using exploratory factor analysis (Tseng, et al., 2010), and confirmatory factor analysis (Cairney, et al., 2008; Tseng, et al., 2010). The exploratory factor analysis revealed three factors which explained 62.4% of the variance (Tseng, et al., 2010), consistent with Wilson’s results (2009). The results of the confirmatory factor analysis showed that the model fits in three factors (Cairney, et al., 2008; Tseng, et al., 2010).

3.3.3 Concurrent validity of the DCDQ’07

The concurrent validity was assessed for the DCDQ’07 by correlation with the CSAPPA (Cairney, et al., 2008). Poor agreement was found, with $\kappa = 0.18$. Significant correlations were found between individual items of both tests except between the enjoyment item of the CSAPPA and the fine motor/handwriting of the DCDQ’07, but the strengths of the correlations were poor to moderate. However, as previously explained, this study cannot provide strong evidence for the concurrent validity of the DCDQ’07 (15-item) because of the different purposes of the DCDQ’07 and the

CSAPPA. Therefore, studies using the DCDQ (17-item) are included here to discuss the concurrent validity.

The concurrent validity of the DCDQ was assessed by correlation with the MABC (Schoemaker, et al., 2006) and the MAND (Loh, et al., 2009). Schoemaker et al. (2006) investigated the concurrent validity for two samples, population-based and clinic-referred. The findings show a significant correlation between the DCDQ and the MABC in identifying children with motor impairments for the combined sample ($r = -0.65$). However, the correlation was low for the population sample ($r = -0.24$ for ages 4-8 years and –0.26 for ages 8-12 years), but high for the clinic-referred sample ($r = -0.65$).

Loh et al. (2009) investigated the concurrent validity of the DCDQ with the MAND using a Spearman rank order correlation and degree of agreement between tests that is measured by kappa. The results of the correlation coefficients indicated a significant but low correlation ($r = 0.37$). Both tests shared 14% of the variance.

In addition, low agreement was found between the DCDQ and the BOTMP as measured by kappa (Crawford, et al., 2001): the overall agreement was 65% and $\kappa = 0.294$ to 0.441.

3.3.4 Sensitivity and specificity

One study (Tseng, et al., 2010) investigates the sensitivity and specificity of the DCDQ'07. However, there are many studies investigating the sensitivity and specific of the DCDQ compared to the MABC (Civetta & Hillier, 2008; Schoemaker, et al., 2006), BOTMP (Crawford, et al., 2001), and MAND (Loh, et al., 2009). The strength of the sensitivity and specificity of a test depends on the reliability and validity of the test and its ability to detect motor impairments in population based sample. Also, the cut-offs impact on the sensitivity and specificity of a test for determining motor impairments.

Tseng et al. (2010) combined the MABC and the BOTMP to identify children with motor impairment using the 15^{th} percentile as a cut-off for the MABC and a standard score of 42 for the BOTMP. The sensitivity of the DCDQ'07 was 73% and the specificity was 54% for detecting children with motor impairments identified by both the MABC and BOT.

Based on the MABC, the motor impairments were measured at a cut-off of 15^{th} percentile (Schoemaker, et al., 2006). The sensitivity of the DCDQ for a population-based sample was 28.9% while for the clinic-referred sample was 81.6%. The specificity was 88.6% for the population-sample and 84% for the clinic-referred sample.

Another study investigating the sensitivity and specificity of the DCDQ using the cut-off score of the MABC of 10^{th} percentile for a school-based sample, found that the sensitivity was 72% and the specificity was 62% (Civetta & Hillier, 2008). Reducing the cut-offs to the 5^{th} percentile resulted in a decline in the sensitivity of the DCDQ to 69% and increased the specificity to 71%.

The DCDQ was also compared to the BOTMP to assess its sensitivity and specificity in a sample with and without DCD (Crawford, et al., 2001). The sensitivity was 38% and the specificity was 90%.

According to the MAND, the motor impairments were detected at 15^{th} percentile for a sample including typically developing children recruited from public schools and children with developmental disorders like ADHD, LD, dyspraxia, and motor problems (Loh, et al., 2009). The sensitivity of the DCDQ 17-item was 55% and its specificity was 74%.

To sum up, the strength of the sensitivity and specificity of the DCDQ and DCDQ'07 are influenced by many factors such as the type of standard instrument used, the cut-off, and the sample description. From these studies, it can be seen that the sensitivity decreases when reducing the cut-off and increases for a sample with motor impairments.

3.3.5 Discriminative validity

The discriminative validity measures the ability of a test to differentiate between groups with and without motor impairments (APA 1985). Tseng et al. (2010) investigated the discriminative validity of the DCDQ'07 15-item and found significant differentiation between groups with and without motor impairments, in line with Schoemaker (2006) when using the DCDQ 17-item.

3.3.6 Summary

The general result for those studies which utilized the 17-item questionnaire is satisfactory and indicates the usefulness of the DCDQ as a screening tool to detect children as young as 4 years with motor impairments. It has strong reliability (Civetta & Hillier, 2008; Schoemaker, et al., 2006; Tseng, et al., 2010) and good construct validity (Tseng, et al., 2010). However, there are some discrepancies between studies on its agreement with other assessment tools. For example, some researchers found fair to substantial agreement between DCDQ and MABC (Civetta & Hillier, 2008; Schoemaker, et al., 2006), whereas others found low agreement between DCDQ and MAND (Loh, et al., 2009) and between DCDQ'07 and combined MABC and BOTMP (Tseng, et al., 2010).

There are several factors that influence the accuracy of the measurements. The level of the cut-off impacts on the sensitivity; for example increasing the cut-off leads to an increase in the DCDQ sensitivity (Civetta & Hillier, 2008; Loh, et al., 2009). The sensitivity at the cut-off 15th percentile is better than the 5th percentile. However, the specificity and the positive predictive value improve by reducing the cut-off; specificity at 15th percentile was 62% and became 71% at the 5th percentile (Civetta & Hillier, 2008). It has been reported that comorbidity with other disorders like ADHD influences the sensitivity of the DCDQ (Loh, et al., 2009; Schoemaker, et al., 2006). The type of standardized assessment tool plays an essential role in the significance of the agreement, sensitivity, and specificity of the DCDQ and DCDQ'07.

Moreover, the cultural differences also have effects as the questionnaire includes types of physical activities which might be suitable for a Canadian population but not for others (Loh, et al., 2009). Even though Tseng et al. (2010) during the translation process substituted the activities in some of the questions that were not related to the Chinese culture, slight agreement was found, $\kappa = 0.103$ to 0.167.

Having evaluated the studies investigating the effectiveness of DCDQ and DCDQ'07 in detecting children with motor impairments, it can be concluded that DCDQ'07 is one of the more convenient questionnaires to be used in both clinical and research sessions. It has been found that DCDQ'07 is cost-effective as there is no need to purchase the forms: they can be downloaded from the internet. It is easy to complete, whether independently or through interview and can be completed within 10-15 minutes. It is easy to score and to interpret. It has reasonable sensitivity and specificity. The age range is from 4 to 15 years, within the range of our study.

3.4 Conclusion

Identification of children with DCD as early as possible is very important for children, parents, and professionals. Using standardized assessment and screening tools is essential to adequately identify those children with DCD and at risk of DCD without or with minimal errors.

It has been found that the MABC and the DCDQ are useful tools in the field of developmental disorders. They have become more popular among different professions and used internationally. Their reliability, construct validity, concurrent validity, and suitability in different cultures appear acceptable. Although some studies show poor sensitivity for the DCDQ, the purpose of using the DCDQ should be as a screening tool to initially identify children with motor impairments and also to confirm which children with motor impairments have problems with ADL.

Although the MABC and DCDQ have been revised recently with the new versions being released in 2007, there is a shortage of published studies investigating their reliability, validity, and suitability in different cultures. However, the reliability and validity of a test are controlled by the sample population including age group, ethnicity, and cultural and environmental demands. The standardization of a tool is based on a sample norm recruited from a specific population which therefore differs from other populations from the perspective of culture, environment, and personal demands. Therefore, each country should assess the reliability and validity of any tool when using it for the first time. The WHO through Family Health and Mental Health in the 1980's recommended that each country should establish its own norms (Lansdown, et al., 1996).

4 Rationale

4.1 Introduction

Motor development is influenced by biological as well as environmental factors (Sanhueza, 2006) Biological factors may cause motor developmental delay and/or motor impairment (Mayson, Harris, & Bachman, 2007), consequently limiting activity and restricting participation. It has been reported that some of the biological factors such as gestational age and birth weight lead to delay in motor development and consequently to motor impairments due to birth complications that negatively affect neurological systems (de Kieviet, Piek, Aarnoudse-Moens, & Oosterlaan, 2009; Foulder-Hughes & Cooke, 2003; Goyen & Lui, 2002; Hemgren & Persson, 2009; Holsti, Grunau, & Whitfield, 2002). Environmental factors, on the other hand, play an essential role in motor development and motor impairments. These factors are: culture; family background and expectations; school activities, demands and expectations (Gibbs, et al., 2007); socioeconomic status (Bradley, Corwyn, McAdoo, & Coll, 2001; Goyen & Lui, 2002; Sanhueza, 2006); and birth order and sibling communication (Krombholz, 2006).

Many studies investigating the impact of cultural practice on motor development of children have found differences in motor development between cultures (Cintas, 1995; Hamilton, 1981; Hopkins & Westra, 1990; Super, 1976). Asian children differ from American and European children, but there are no differences reported between American and European children in motor development (Mayson, et al., 2007). Mayson et al. (2007) reviewed studies in differences and similarities in motor development between Asian and European children, including differences in motor development such as the onset of rolling over, sitting alone, crawling, and walking.

They summarized the factors behind these differences as: Asian parents not exposing their infants to prone-lying or being positioned upright; some parents choosing specific clothing that might ease or interfere with the motor activities, and in later stage parents overprotecting their children due to fear of injury and preventing them from practicing some activities like bicycle-riding or ball manipulating.

Super (1976) compared differences between American and African cultures in the way the mother taught her child and how these practices could influence motor development. It was found that the motor skills of African children developed earlier than those of American children in sitting and walking but not in crawling. Super (1976) found that 90% of African mothers taught their children to sit, crawl, and walk and these activities were practised in a daily routine. African children spent most of their time with their mothers and caretakers who provided motor skills practice every day. The African mother bounced the child on her lap at about one month, placed the child at age five to six months in a hole in the ground or in nestled blanket that supported the back, held the child under the arm and moved the child forward to teach walking at age of seven to eight months, and assisted the child in crawling; African children spent only 10% of their waking time lying down. The American children, on the other hand, spent most of their time lying down.

The effects of cultural rearing practices were found also in Northern China between children who grew up in sandbags and those who did not (Mei, 1994). In this practice, a child at approximately 10 days of age is placed for at least one year in a sandbag that is full of fine sand so the child cannot turn or move any of the body except the arms. This environmental deprivation and movement restriction influences the motor development and leads to delays in attaining motor milestones. Significant motor developmental delay was found in sitting alone at 11 months and walking alone before the age of 14 months of children who had been put in sandbags (Mei, 1994).)

Motor development is affected by maternal handling. A study investigated three types of maternal handling (Hopkins & Westra, 1990) with three groups of mothers:

Jamaican mothers who started specific handling after birth including passive stretch, massage, and other interventions that promote active movement; Jamaican mothers who did not used any specific handling method; and British mothers. The findings showed that the expectations of Jamaican mothers who use specific handling for their children motor development were more accurate in predicting the age that children will achieve sitting and walking than other groups of mothers. Their children were more advanced in their motor development than other children (Hopkins & Westra, 1990).

Being the first-born child is also a risk factor for motor developmental delay and motor impairments for reasons such as missing sibling communication that enhances skills practice through playing (Abramovitch 1979; Krombholz 2006). Sibling communication and social interaction is important in building motor skills and enhancing child motor development (Reid, Stahl, & Striano, 2010).

Socioeconomic status (SES) impacts on motor development and motor impairment, and may be measured by level of parent education, level of income, and area of residence. Sanhueza (2006) found that the psychomotor development of children who live in low socioeconomic situations is below normal and is influenced by factors such as motivation and physical activities at home. A longitudinal study by Goyen and Lui (2002) investigated the relationship of motor development and motor impairment to the home stimulation environment of apparently normal infants, finding that children who lived in homes with a low stimulation environment had motor deficits in gross and fine motor skills.

Location of residence also has an impact on motor development (Giagazoglou, Kyparos, Fotiadou, & Angelopoulou, 2007). Giagazoglou et al. (2007) found that children who lived in an urban area, considered as high SES usually with an educated mother, developed fine motor skills better than children who lived in rural areas. Significant positive correlations were found between development of fine motor skills and the stimulation provided in the family environment. However, this was not the case for gross motor skills, where rural children were better than urban children. Urban areas have limited space and playing areas, which negatively impacts on gross motor skills as compared with rural areas that have wide open spaces and trees.

The environment of the school and the educational system are also important: an educational system that introduces activities for children as young as two years enhances fine motor skills (Chow, et al., 2001; Van Waelvelde, et al., 2008).

Having considered risk factors in motor development and motor impairment, we now look at the nature of the Kuwaiti environment, the life style in Kuwait and the educational system in order to understand their impacts on child development.

4.2 Lifestyle in Kuwait

The State of Kuwait is an Arabian Muslim country located at the northeastern corner of the Arab Peninsula (Appendix 1). It is 17,818 square kilometers in size (http://www.kuwaitemb-australia.com/files/Introduction_to_the_Kuwaiti_Market.pdf, retrieved on February 21, 2011). The population of Kuwait as estimated in 2005 was 2,457, 257 and Kuwaiti citizens numbered 963,591 (471,225 male and 492,346 female) (http://mopweb4.mop.gov.kw/portal/pls/portal/mop.pdf?no=21, retrieved on February 21, 2011). The country is divided into six governorates or “districts”; Asema (the capital), Hawalli, Ahmadi, Jahra, Farwaniya, and Mubarak AL Kabir (http://www.kuwait-info.com/a_state_system/state_system_governorates.asp, retrieved on February 2011).

4.2.1 Family structure

The family structure in Kuwait has changed with the growing development in Kuwait since the discovery of oil. Kuwaiti citizens now make up only one third of the total population. In the past it was more likely there were extended families but now these are in the minority; there is a tendency for transition towards smaller, nuclear families consisting of parents and children (Al-Thakeb, 1985). In spite of this shifting, affiliation of nuclear families with extended families is strong (El-Haddad, 2003). Families maintain their privacy within a closely-knit extended family circle (http://kuwait-embassy.or.jp/english/way/main.html, retrieved on February 22, 2010), family members gathering weekly (usually Fridays or Saturdays) for lunch together (Al-Mutawa, 1994). They are close and supportive of each other (http://kuwait-embassy.or.jp/english/way/main.html, retrieved on February 22, 2010). The good relationship and cooperation between nuclear and extended family prevents family members from feeling lonely and isolated. Family members help each other in illness, child care, and with personal and financial problems (Al-Thakeb, 1985).

Kuwaiti families are often large, with an average of 6 to10 children (Al-Mutawa, 1994; Al-Thakeb, 1985; Hamadeh, Al-Roomi, & Masuadi, 2008). There is no significant difference in the family size between urbanized and non-urbanized families, but there is between employed and unemployed mothers. A majority of Kuwaiti women have fulltime employment. In 2000, Kuwaiti females between the ages of 25 and 44 years had the highest rate (57.6%) for participation and economic activity in work in the Gulf area (El-Haddad, 2003). It has been found that the socio-economic status differs significantly between districts; families from Asima district, which is an urban area, have a higher socio-economic status than families from Jahra district, which is a rural area (Hamadeh, et al., 2008).

Modernization, wealth, and employment have resulted in the Gulf area, and particularly in Kuwait, in a dependence on foreign maids or servants as babysitters. This possibly negatively affects the behaviour of children, as not all housemaids are qualified by education, language, religion, and age to raise or take care of children (El-Haddad, 2003).

4.2.2 House type

The average home in Kuwait has 7-10 bedrooms, providing accommodation for newly married sons who share the house with their parents (Al-Mutawa, 1994). Although living with the extended family is considered a past tradition, some couples prefer to live in their parents' house because of living expenses. A study in 2008 found significant differences between urban and rural districts in the average number of rooms. Asima district, which is an urban area, has on average a higher number of rooms and bedrooms than Jahra district, which is rural. The Asima district showed a lower crowd index than the Jahra district; the crowd index is measured by dividing the number of persons by the number of rooms in a house (Hamadeh, et al., 2008).

Houses in Kuwait are modern in architecture with 2-4 levels. There are three types of accommodation in Kuwait, apartments, flats, and houses which may be owned or rented. The government provides couples with a house or an alternative, such as a land together with an allowance or subsidy.

The flat is a set of rooms on one floor, whereas the apartment or unit is smaller than the flat in size, number of rooms and other amenities. The unit may be part of a house or may be in a high rise (usually commercial) building. One house may contain several units and/or flats.

4.3 Educational system in Kuwait

As the sample was recruited from primary schools in Kuwait, an outline of the education system in Kuwait, how it developed, and the similarities and differences between public and private primary schools is presented here.

4.3.1 History of education in Kuwait

In the past, education was limited to a few Qur'an schools funded by wealthy Kuwaiti people. The basic teaching in those schools was reading, writing, and basic mathematics. The first modern educational institute was established in 1912, known as the AL-Mubarakiya school followed by another school in 1921 known as the AL-Ahmedia school which offered English courses. These schools were mainly for boys, but schools for girls were soon established (http://education.stateuniversity.com/pages/784/Kuwait-EDUCATIONAL-SYSTEM-OVERVIEW.html, retrieved February 17, 2010). In 1936, the government started to provide formal education for all citizens which became obligatory by law for all children between 6 and 14 years. The development of education accelerated rapidly in the 1950s (http://education.stateuniversity.com/pages/784/Kuwait-EDUCATIONAL-SYSTEM-OVERVIEW.html, retrieved February 17, 2010).Teachers were foreigners from Palestine, Egypt, Iraq, and Syria, whereas currently the government promotes Kuwaitization of the education process. The ratio of Kuwaiti teachers to expatriates in the 1980s was 1:3.8 and by the 1990s had increased to 1.7:1.

The mission of the Kuwait government is to provide education for all children including those with special needs, 13% of all public expenditure being allocated to education (Ministry of Education, 2007). In 1956, a school for the blind was established with 36 children and by 1973 the number of special needs schools had increased to include two schools (one for boys and one for girls) for each disability: deafness, blindness, mental disorders, and physical disabilities. The education infrastructure in Kuwait has become one of the most comprehensive, generous, and sophisticated in the Middle East (http://education.stateuniversity.com/pages/784/Kuwait-EDUCATIONAL-SYSTEM-OVERVIEW.html, retrieved February 17, 2010).

There are six districts in Kuwait covering both urban and rural areas (figure 4.1) that include schools from public and private sectors (figure 4.2). Funding by the Kuwaiti government covers all the public mainstream and special needs schools from kindergarten (pre-primary) to undergraduate level which is free for all citizens. Generally the system is divided into four levels: kindergarten beginning at age 3.6 to 4 years and of two years duration; primary (from 5.6 to 6 years for 5 years); intermediate (from 10.6 to 11 years for 4 years); and secondary (from 14.6 to 15 years for 3 years). In 2005/6 there were 664 public schools and 481 private schools (Ministry of Education, 2007).

The government shifted control of education from fully public to public shared with private sectors (http://education.stateuniversity.com/pages/784/Kuwait-EDUCATIONAL-SYSTEM-OVERVIEW.html, retrieved February 17, 2010) with several private schools being established in Kuwait, funded by private (foreign) sponsors with students paying tuition fees (http://www.kuwaitculture.com/About%20Us/today.htm, retrieved February 17, 2010). Many of the private schools are subsidized by the Kuwaiti government (http://education.stateuniversity.com/pages/784/Kuwait-EDUCATIONAL-SYSTEM-OVERVIEW.html, retrieved February 17, 2010).

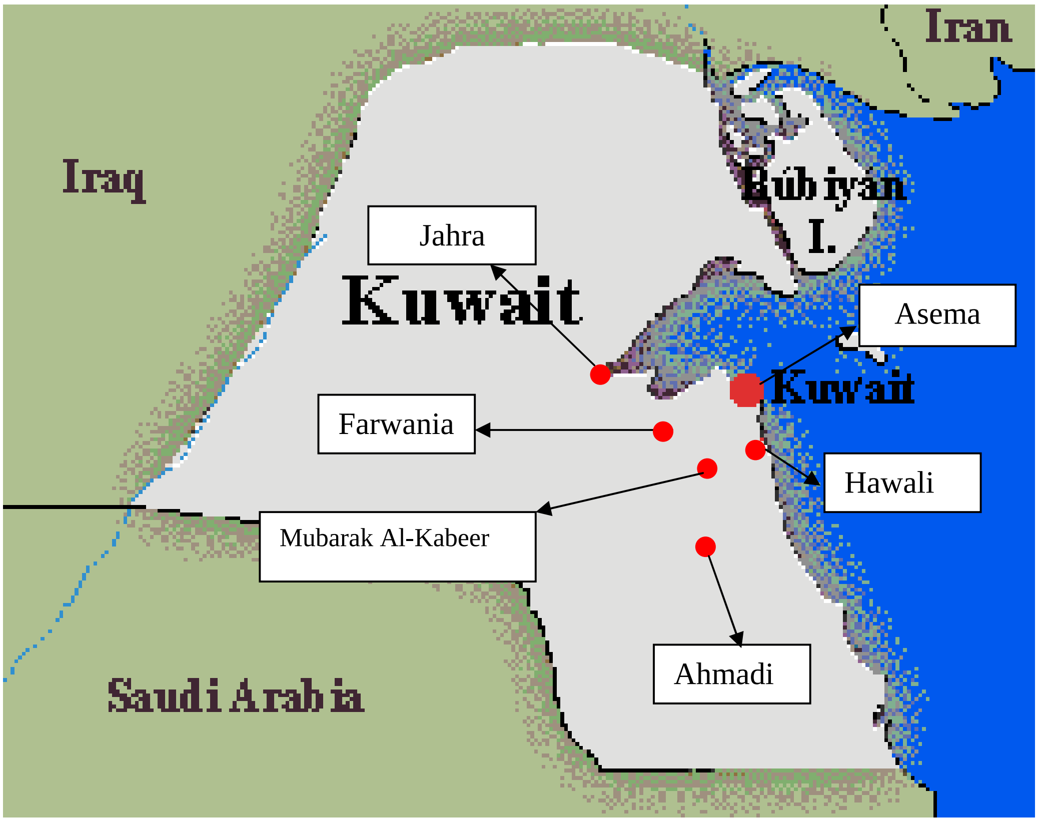

Figure 4.1: Kuwait map and the six districts

4.3.2 Primary public schools

Of the 664 public schools, 221 are primary. The average class size is 25 students per class at each level and the number of teaching hours is 858 per year. The gross intake ratio for the primary level in 2005/6 represented by the number of students attending the First Grade was 98%. Two-thirds of Kuwaiti students in the primary schools attend the public sector (Ministry of Education, 2007). The schools are segregated by sex but the majority of teachers in the primary schools are female with the males compared to females being 13% due to the feminization of primary schools, females teaching both male and female students (Ministry of Education, 2007). The educational staff consists of the principal, the principal assistants (usually two, one managing the academic and the other the administrative issues), social worker, psychologist (sometimes one psychologist shared between two or more schools), teachers, and administration staff.

Arabic is the main language in schools and English is taught from Grade One up for five to six sessions a week. The system of using a main teacher for each class is not used in the public sector; each teacher presents one subject even if also qualified in others. The school day is divided into three periods of teaching separated with two breaks of 15 minutes each. Besides the main subjects, there are activities such as physical education, music and art classes for one to three 40-minute sessions a week. Students may participate in competitive activities like football (soccer) or basketball for the school team which are compulsory and held after school. The Ministry of Education provides each school with a computer laboratory and enriches libraries with periodical books and journals (Ministry of Education, 2007). Recently, playground equipment has been built on a sand floor in the grounds of all primary schools for children to play during breaks.

4.3.3 Primary private schools

There were 481 private schools in 2005/6, each including primary to secondary levels. About 8-12% of all Kuwaiti children in primary level were in the private sector

(Ministry of Education, 2007). There are two types of private schools (figure 4.2): private Arabic schools which follow the public sector curriculum, and foreign private schools that have curricula of their countries, such as American or Canadian systems. Although the curriculum for each school differs, the general system is quite similar: the main language is English; almost all foreign schools are co-educational for both teachers and students; and each class has a form teacher and teacher assistant who present almost all subjects except art, physical education and music. Some of the schools teach the Qura'n and the Arabic language. Most of the schools have a swimming pool, recreational activities and play areas with playground equipment. The school day is one hour longer than in public schools, and after-school activities are also organized (Ministry of Education, 2007).

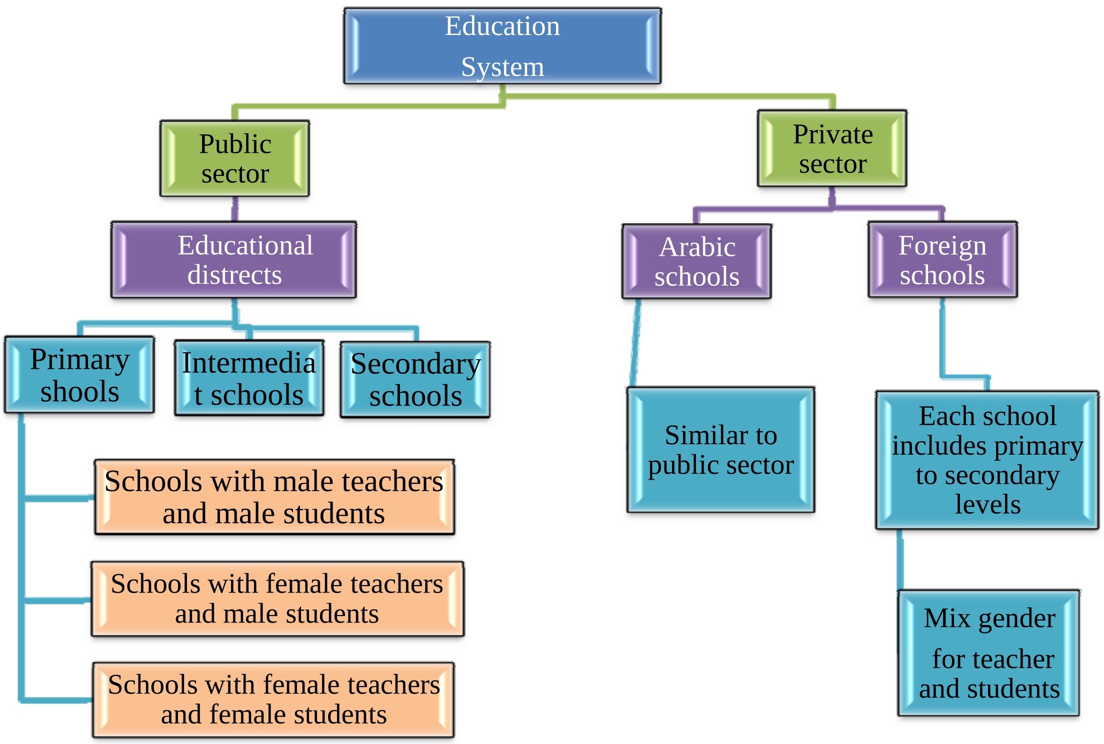

Figure 4.2: The educational system in Kuwait

4.4 Aims and problems

The primary aim of this project was to investigate the prevalence of DCD in Kuwaiti children compared with other countries. To do this it was necessary to determine the validity of assessment tools to detect children with DCD in the Kuwaiti culture. Secondary aims were to explore the professional knowledge of DCD and to investigate the facilities available for children with DCD in both health and educational sectors.

There are many institutions in Kuwait in both public and private sectors managing children with developmental disorders, but there is no information on the prevalence of children with developmental disorders in general or DCD in particular.

Some of the developmental disorders like LD, ADD/ADHD, PD, and dyslexia are well defined in Kuwait through private non-profit institutions like the Kuwait Association of Dyslexia and the Centre for Child Evaluation and Teaching. However, DCD is not well identified in Kuwait.

Children with DCD may be under-diagnosed and/or misdiagnosed with other developmental disorders such as ADHD, and LD because of the cormorbidities. DCD shares some symptoms with other developmental disorders like attention deficit disorder (Tseng, Howe, Chuang, & Hsieh, 2007), reading and writing problems (Dewey, et al., 2002), and speech difficulties (Scabar, et al., 2006), so they may be diagnosed as a result of their symptoms and features but not for their motor problems. A study found that children who were referred for intervention because of learning and attention problems also had motor problems and could be categorized as having or being suspected of having DCD (Dewey, et al., 2002). A study conducted in Australia found that more than half of 32 boys diagnosed with ADHD had motor difficulties which are compatible with DCD (Piek, et al., 1999).

Furthermore, evidence shows that not all health and education professionals are familiar with the term “DCD” and some professions have no knowledge of the DCD condition (Gaines, et al., 2008; Peters, et al., 2001). A study was conducted in Canada to determine the impact of educational outreach and collaborative care on physicians' perceived knowledge of DCD. It was found that 91% of 147 primary care physicians who participated in educational outreach programs were unaware of the DCD diagnosis. However, after completion of the training program, 29% of them were able to correctly diagnose children suspected of DCD (Gaines, et al., 2008). In Kuwait, no research has been conducted to show whether the term DCD is known or used by health and education professionals.

From the above discussion, the following questions arise:

- to what extent do Kuwaiti children in primary schools have DCD?
- are parents able to evaluate their children’s motor performance and pick up their children’s difficulties?
- are professionals in health and educational sectors aware of DCD and its consequences?

These aims were divided into primary and secondary objectives, addressed through two different studies in this project.

4.5 Objectives

The objectives of the study are to:

1) determine the validity of the Movement Assessment Battery for Children version two (MABC-2) and the DCDQ’07 for the Kuwaiti population;
2) determine the prevalence of Developmental Coordination Disorder (DCD) in 5 to 9 year-old Kuwaiti children;
3) compare the motor performance of Kuwaiti children with their counterparts in the United Kingdom (the MABC-2 norms).
4) compare the motor ability of Kuwaiti boys and girls in public and private schools;
5) determine the predictor factors of DCD;

6) identify professionals’ knowledge about DCD and its consequences.

4.6 Project Studies

Two studies were conducted:

Study One: assessing the motor performance of children using MABC-2 and the parent-completed DCD-Q and demographics questionnaire.

Study Two: assessing knowledge of DCD by interviewing professionals from the health and education sectors.

4.6.1 Study One

Study One investigated the prevalence of DCD in Kuwaiti children aged between 5 and 9 based on the DSM-IV criteria. Children were assessed with the MABC-2 to determine their motor impairments and parents completed the DCDQ’07 questionaire to determine the impact of the motor impairments on daily activities. Chapter Six discusses motor abilities of Kuwaiti children in order to investigate the profile of their motor performance on individual MABC-2 items for age bands one and two, assessed using raw MABC-2 scores. Comparisons between Kuwaiti boys and girls and between public and private schools were made in order to detect any differences in motor performance between children based on gender, age and type of school. Other comparisons of motor performance were made between Kuwaiti children and children from UK, the MABC-2 norms. (The term “UK” is used to indicate the MABC-2 norm sample).

Chapter Seven discusses motor impairments at two cut offs ($\leq 5^{th}$ percentile, and $> 5^{th}$ and $\leq 15^{th}$ percentile) which was assessed using the total MABC-2 score and compared to UK scores to fulfill the DSM-IV Criterion A. Because the MABC-2 has not been used in Arab countries and its reliability and validity has not been tested, the validity of the MABC-2 was tested as the first primary objective of this study. Furthermore, motor performance of Kuwaiti children, measured by the standardized total MABC-2 score and its three components (manual dexterity, aiming and catching, balance), was assessed and compared for gender, age group, and school type within the Kuwaiti sample. Another comparison was made between Kuwaiti children and UK children using the MABC-2 total score and its three components.

The primary aim of Study One was to determine the prevalence of children with DCD, which is discussed in Chapter Eight. Because detection of DCD requires applying DSM-IV Criteria A and B, the DCDQ'07 was used to fulfill Criterion B. Similar to the MABC-2, the DCDQ'07 has not previously been translated into Arabic and its validity and reliability were not tested in Kuwaiti. Therefore, the reliability and validity of DCDQ'07 were investigated (Chapter Eight). Then the prevalence of DCD was assessed from the results obtained from the MABC-2 and the DCDQ'07 total scores based on the DSM-IV criteria.

Finally, Chapter Nine discusses the risk factors for DCD. Parents were asked to fill in a demographics questionnaire with five questions. Three questions were on the child's birth history including gestational age, birth weight, and birth order. Two further questions related to socioeconomic status, type of the house in which the child lives and a brief description of the family members, information essential for the investigation of DCD predictor factors in Kuwait.

The general methodology for Study One is outlined in Chapter Five.

4.6.2 Study Two

The second study investigated the DCD knowledge of professionals, discussed in Chapter Ten. Studies conducted in Canada claim that not all professionals in the health sector are familiar with the term DCD and some have never heard of it or have limited knowledge about DCD (Gaines, et al., 2008; Missiuna, et al., 2003; Peters, et al., 2001).

Initially the child has direct communication with his/her teachers at school and with a social worker and/or psychologist to some extent. If the child has any kind of motor difficulties, teachers should identify these difficulties and help the child by referral to a school psychologist for further assessment. Although educational professionals may have some idea about dyslexia or learning difficulties, both of which may have comorbidity with DCD, their knowledge about DCD in particular needs to be identified. Furthermore, each health and education sector has different facilities for children with developmental disorders, and it is important to determine the services provided in both sectors. So Study Two involved interviewing professionals from the health and education sectors, the structured interview consisting of demographic questions as well as 16 questions related to DCD.

4.7 Summary

To conclude, research related to pediatrics is limited in Kuwait and there has been no study measuring the motor abilities of Kuwaiti children or determining the prevalence of DCD in primary school children in Kuwait. There are many standardized assessment tools that measure motor performance and detect motor impairments. Although the MABC is considered a gold standard for detecting motor impairments, neither its validity nor the validity of its new version, MABC-2, has been tested in the Kuwaiti culture. There are many risk factors that may influence motor ability such as gestational age, birth weight, birth order, home type, and nature of family members. There is also little information on professional knowledge about DCD. Two studies examined these issues.

5 Methodology of Study One

5.1 Introduction

This chapter describes the methodology of Study One which consisted of three stages, the first covering translation of the MABC-2 (Henderson, et al., 2007), the DCDQ'07 (Wilson, et al., 2006) and documents for parents such as the information sheets, parent consent forms, and child consent forms. Stage two was the recruitment of schools and children, and the third stage was the assessment of children and completion of the DCDQ'07 and demographics questionnaire by parents.

The main aims of Study One were to measure the prevalence of DCD in Kuwaiti primary school children between 5 and 9 years and to determine the validity of MABC-2 and DCDQ'07 for the Kuwaiti culture. The study also determined the differences between Kuwaiti children based on gender, age, and school type.

5.2 Stage one - translation process

The DCDQ'07 for parents, the information sheets, parent consent forms, and child consent forms were translated into Arabic through authorized organizations for international translation. The translation was done twice: one organization translated from English to Arabic; then another organization translated the Arabic version back to English, and this version was compared with the original. Back translations were used to ensure the accuracy of the translation, to maintain written language consistency with all the participants, and to prevent any impact of misunderstanding of the questions. The translators had no medical background, so the translation was word-by-word (literal translation) without any interference of the translator in the meaning of the questions. Although, cross-cultural translation is recommended by the WHO (World Health Organization, retrieved on May 5, 2011), literal translation is used in our study for several reasons. First, the DCDQ’07 has not been previously used in Kuwait, so literal translation was chosen to explore parents’ concern in regards to the meaning of the questions. Second, both English and Arabic versions of the DCDQ’07 were used and cross-cultural translation requires changes in the questions such as the type of the activities used in the questionnaire. Therefore, using different versions of questionnaire in same study may affect the accuracy and interpretation of the results.

The translation of the DCDQ’07 was in written Arabic as people in Kuwait read and write in the Arabic language and the DCDQ’07 was answered by parents. One of the advantages of the DCDQ’07 is that it can be answered by any person who knows the child. Therefore, if one of the parents could not read, help could be sought from other family members. Appendix 4 has the DCDQ’07 and its Arabic translations.

The MABC-2 instructions were translated by the examiner rather than using “back translation”, first because people in Kuwait do not speak pure Arabic but a Kuwaiti dialect which differs between Bedouin and non-Bedouin groups. The examiner, a Kuwaiti citizen familiar with all Kuwaiti dialects, used whichever was appropriate for each child. Therefore, there was no benefit using the authorized translation especially as Kuwaiti children are not familiar with the spoken Arabic language. Also, there are 32 pages of instruction in the MABC-2, and to translate these pages twice would be expensive and without benefit to the study.

5.3 Stage two - recruitment process

There were two parts in stage two: firstly school recruitment, then recruitment of the children.

5.3.1 Stage two, part one - school recruitment

Ethics approval was obtained from the Curtin University Human Research Ethics Committee (Appendix B). The research proposal and ethics form with the letter from

Curtin University were handed to the Ministry of Education in Kuwait for approval of the data collection from primary schools in both public and private sectors. The letter was forwarded to the Department of Research and Educational Curriculum Development (RECD). The study and its aims and method were discussed with the manager of the department of RECD where the study was approved, and the letters for all six educational districts, as well as for the Department of Educational Private Sector Affairs, were provided. The educational districts letter was handed to the manager of each district who was informed orally about the research aims and methods. A list of all primary schools in the district was obtained. Figure 4.1 Shows the Kuwait map including the number and type of schools in the six districts.

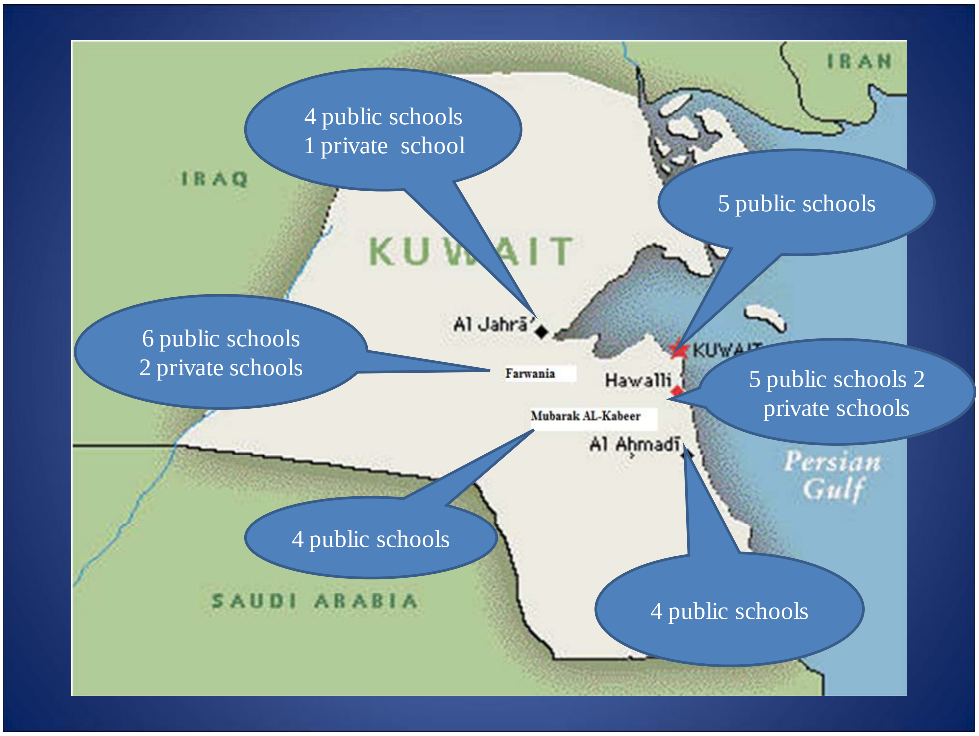

Figure 5.1: Kuwait map including the six districts and the number of schools recruited from each district

5.3.1.1 Public school recruitment

Four public primary schools were selected randomly from each of the six districts: one school with male teachers and male students, two schools with female teachers and female students, and one school with female teachers and male students. This was to ensure equal numbers of male and female students in each district. A letter was written to the principal of each of the selected schools. Each was provided with an approval letter and given a brief explanation of the study goals, methods, and significance. In total, 24 public schools were randomly selected (Table 5.1).

Out of the initial 24 public schools, four schools from three different districts declined to participate; either for parental or administrative reasons. Another four public schools were selected following the same procedure.

Table 5.1: Number and description of the schools approached and participating

	Number of schools approached	Type of schools	Number of schools participating	Total
District 1 Asema	5	2 schools: female students and teachers (F. S&T)	2 (F. S&T)	4
		1 school: male students and teachers (M. S&T)	1 (M. S&T)	
		2 schools: male students and female teachers (M.S &F.T)	1 (M.S &F.T)	
District 2 Hawali	5	2 schools: female students and teachers	2 (F. S&T)	4
		1 school: male students and teachers	1 (M. S&T)	
		2 schools: male students and female teachers	1 (M.S &F.T)	
District 3 Farwania	6	3 schools: female students and teachers	2 (F. S&T)	4
		2 schools: male students and teachers	1 (M. S&T)	
		1 school: male students and female teachers	1 (M.S &F.T)	
District 4 Jahra	4	2 schools: female students and teachers	2 (F. S&T)	4
		1 school: male students and teachers	1 (M. S&T)	
		1 school: male students and female teachers	1 (M.S &F.T)	
District 5 Mubark Al-Kabeer	4	2 schools: female students and teachers	2 (F. S&T)	4
		1 school: male students and teachers	1 (M. S&T)	
		1 school: male students and female teachers	1 (M.S &F.T)	
District 6 Ahmadi	4	2 schools: female students and teachers	2 (F. S&T)	4
		1 school: male students and teachers	1 (M. S&T)	
		1 school: male students and female teachers	1 (M.S &F.T)	
Total	28	13 schools: female students and teachers	12 (F. S&T)	**24**
		7 schools: male students and teachers	6 (M. S&T)	
		8 schools: male students and female teachers	6 (M.S &F.T)	

5.3.1.2 Private school recruitment

The approval letter from RECD was provided to the manager of the DEPSA and the aims and methods of the study were explained. From a list of all private schools in Kuwait with information on district and curriculum, eleven schools were selected, representing the six districts and type of curricula. A letter was sent to the managers of the selected schools, and out of the eleven schools, seven accepted the invitation to discuss the participation with the school committee. Five schools, following American, Canadian or British curricula, agreed to participate in the study. There are fewer private than public schools in each district, making it difficult to obtain representative private schools from all six districts including urban and rural areas. The participating schools were from only three governorates (Hawali, Jahra, and Farwania), although the children in private schools come from different areas, both urban and rural.

5.3.2 Stage two, part two - participant recruitment

Student names were provided to the researcher and Kuwaiti children aged between five and nine years were selected randomly from the class list after excluding children with medical and neurological problems such as physical or mental disabilities such as cerebral palsy, Down syndrome, and cardiopulmonary diseases like cystic fibrosis, as well as other developmental disorders like PDD. Children were included if their parents agreed to participate and provided written consent, and if they provided oral and written consent. Appendix B-2 shows information sheet and consent forms provided to parents.

To ensure appropriate stratification, from each public school, three children were randomly selected from each of grades 1 to 4. To ensure an equal number of children in each age group (5 to 9 years) a computerized class list was used during the selection process to check the age. Therefore, 12 or 13 children were selected from each school.

From each private school, ten children were randomly selected from each grade (one to four) from the computerized class list (five boys and five girls from each grade), so 40 children were selected from each private school.

For either public or private school, a child whose parents did not provide consent to participate was replaced by another child of the same age and grade, selected following the same procedures.

A pool of 1369 children, 1041 from public schools and 328 from private schools was used to recruit children from 29 schools (24 public and 5 private) across geographical areas to represent the Kuwaiti population in terms of age, gender, and school type. Although there was a pool of 1369 children this included all children who met the criteria at each school, and not all were asked to participate. Consent was obtained from parents of 309 children, of whom five were excluded for various reasons: two refused to participate during the test; one was absent during testing in his school and another suitable time could not be agreed upon with the school; one mother withdrew her child from the study; and one consent form was returned too late for the child to be included for testing.

Therefore, 304 children were included in the testing. During the data analysis and subsequent discussion, seven were excluded from the data analysis as three children (one male and two females) were co-twins and one boy was obese which prevented him from performing the tasks. The exclusion process for the twin children was done randomly and all were in the 'probably not-DCD' group. The remaining three children (two male and one female) had difficulties understanding the instructions of the examiners, and their responses were slow. These children might have had low IQ affecting their responses during examination and because the assessment measures of the study did not include an IQ test, it was not certain if they had an intellectual disability.

Therefore, the final sample consisted of 297 children (Figure 5.2). Three parents did not answer all the DCDQ'07 questions and they were excluded only from the data analysis of the DCDQ'07.

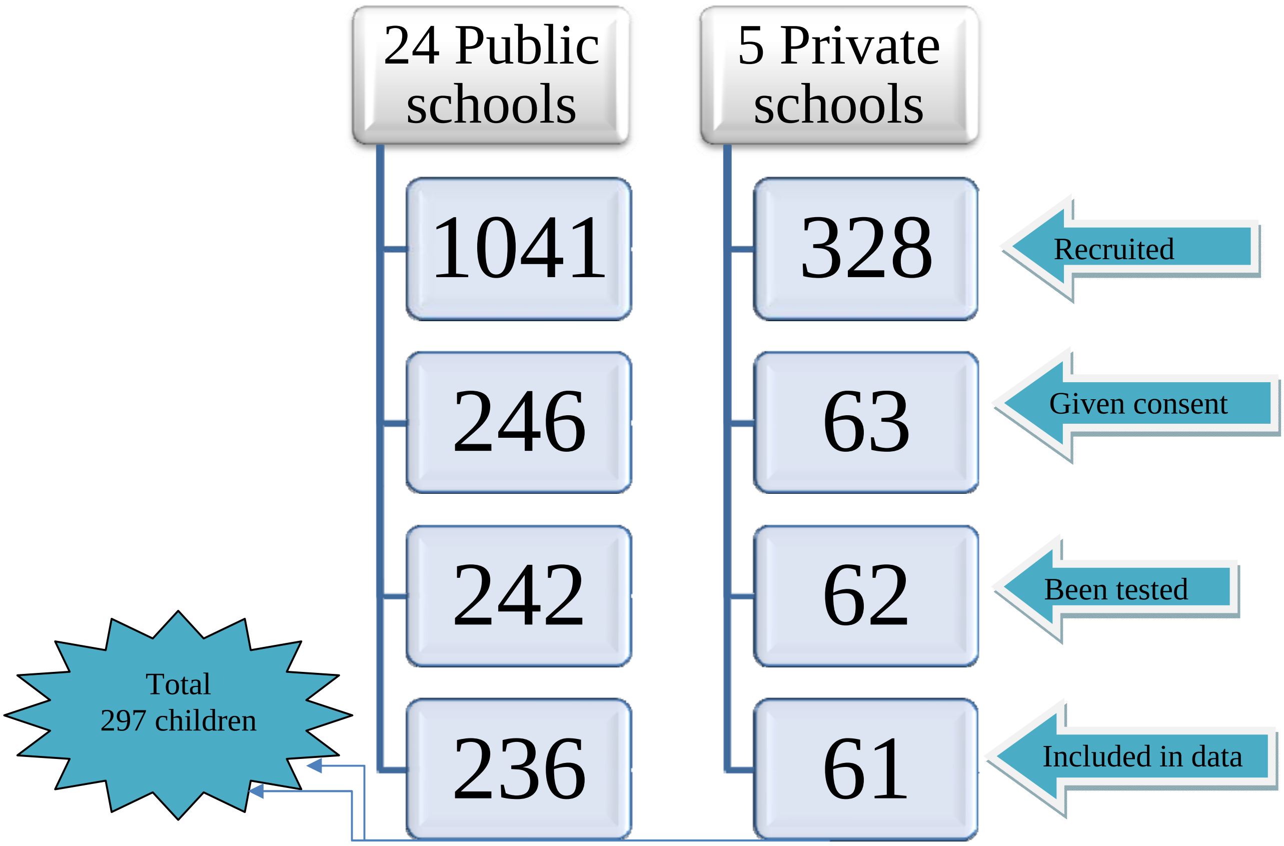

Figure 5.2: Description of the number of children recruited and participated from each sector.

5.4 Sample description

There were nearly equal numbers of boys and girls in each age group and nearly equal distributions of age groups in each band except for age 5 years. The majority of the sample was from public schools (79.5%), one reason being the difficulty in finding private schools willing to participate.

Children were categorized according to the MABC-2 age band, band one for children aged 5 to 6 years, and age band two for children aged 7 to 9 years. Almost 70% of the sample was in age band two. Although each age band has four age groups, our sample was unequal in the number of age groups in each age band. In age band one, only 5 and 6 year old children were included while age band two included three age groups (7, 8, and 9 years). The sample was equally distributed between male (49.5%) and female (50.5%) children.

From Figure 5.3, it can be seen that the sample was distributed approximately equally between age groups except for five-year-olds with a smaller percentage.

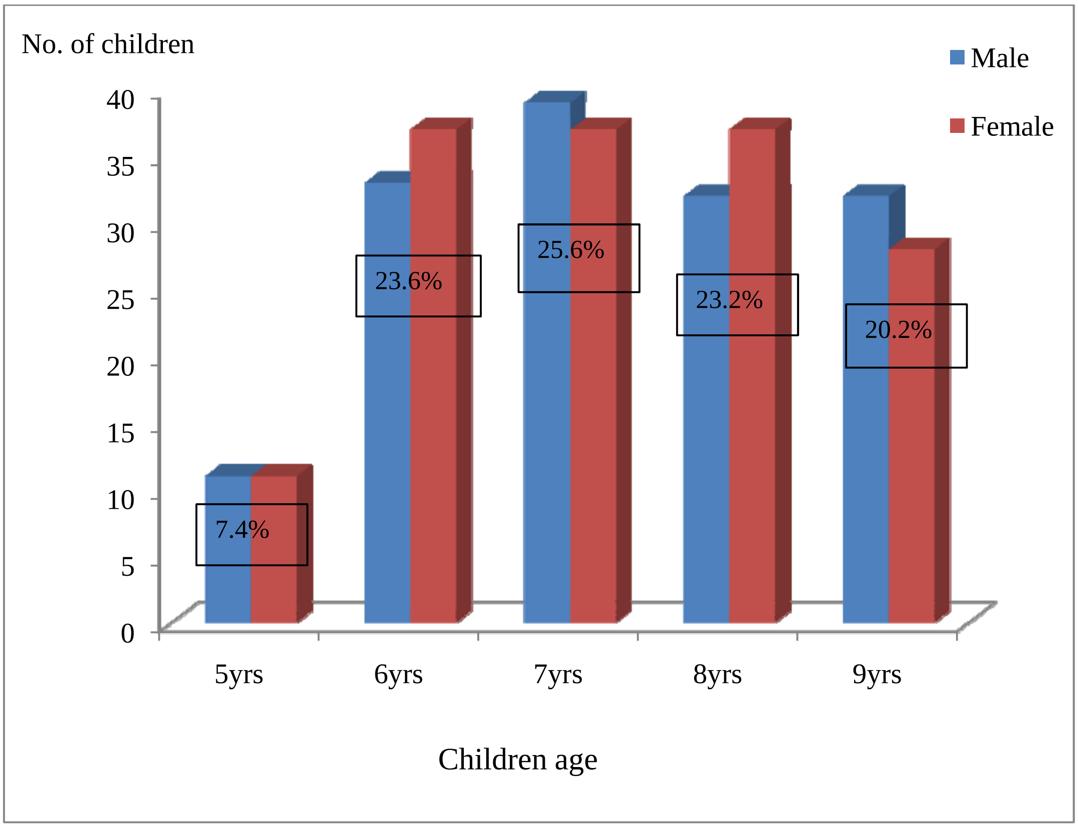

Figure 5.3: The distribution of the sample based on gender and age

Figure 5.4 shows the distribution of the children in each district by school type, showing that the sample distribution is nearly equal between districts for the public schools. However, the distribution of the private schools was not equal between districts, partly because not all districts have foreign private schools. The number of foreign private schools is also limited, making it difficult to have as many schools as the number proposed for this research.

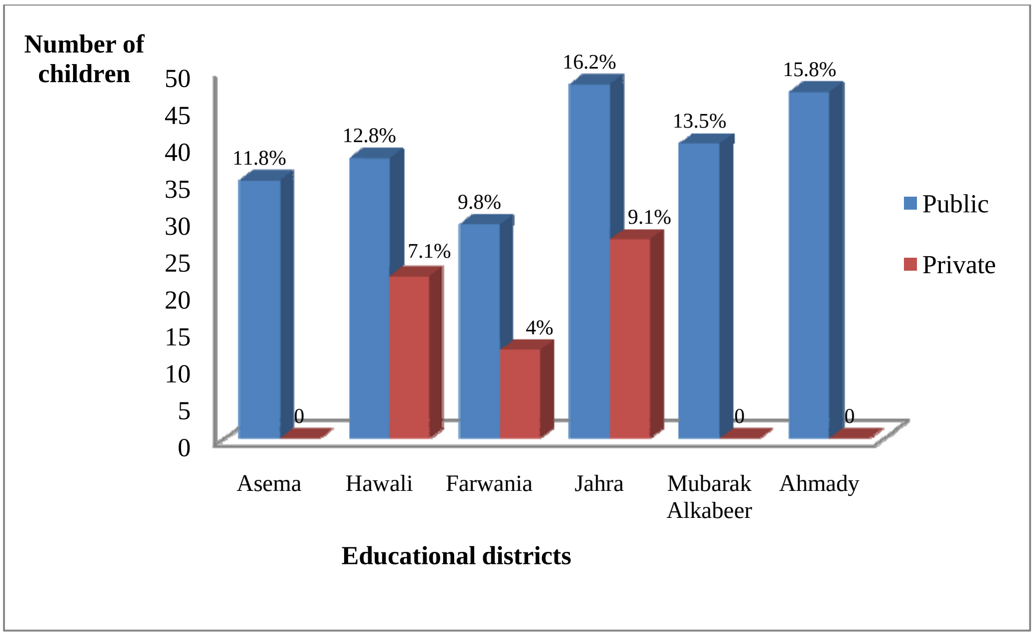

Figure 5.4: The sample distribution based on the six educational districts and type of the schools

Data missing from the demographic questionnaire included answers to the questions on gestational age (18 parents), birth weight (15 parents), birth order (7 parents) and home type (5 parents).

Based on the gestational age, the sample was divided into four groups: very preterm, ≤ 32 weeks' gestation; moderately preterm, 33-36 weeks' gestation; term, 37-41 weeks' gestation; and post-term, ≥ 42 (Wingate, Alexander, Buekens, & Vahratian, 2007). From the 279 children whose parents answer the gestational age question, 16 children were very preterm, 14 children were moderate preterm, and 7 children were post-term (Figure 5.5).

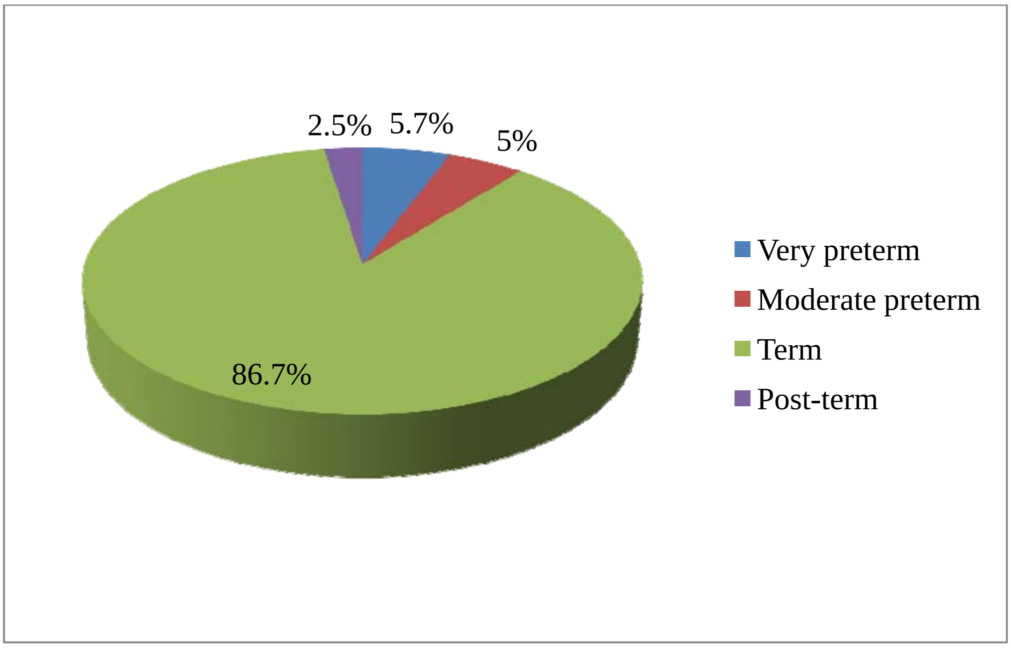

Figure 5.5: The sample distribution according to the gestational age

The birth weight is the weight of the newborn infant measured in the first hour of life. Normal birth weight ranges from 2500-4000 grams; any weight below or above that range is considered low birth weight or overweight respectively. Low birth weights are divided into three groups: extremely low birth weight (ELBW) below 1000 grams; very low birth weight (VLBW) of 1000 to 1500grams; and low birth weight (LBW) of 1500 to 2500grams (Blanc & Wardlaw, 2005a). Parents of 283 children answered the birth weight question, with twenty-seven children born with low birth weight: two ELBW, one VLBW, and 24 LBW (Figure 5.6).

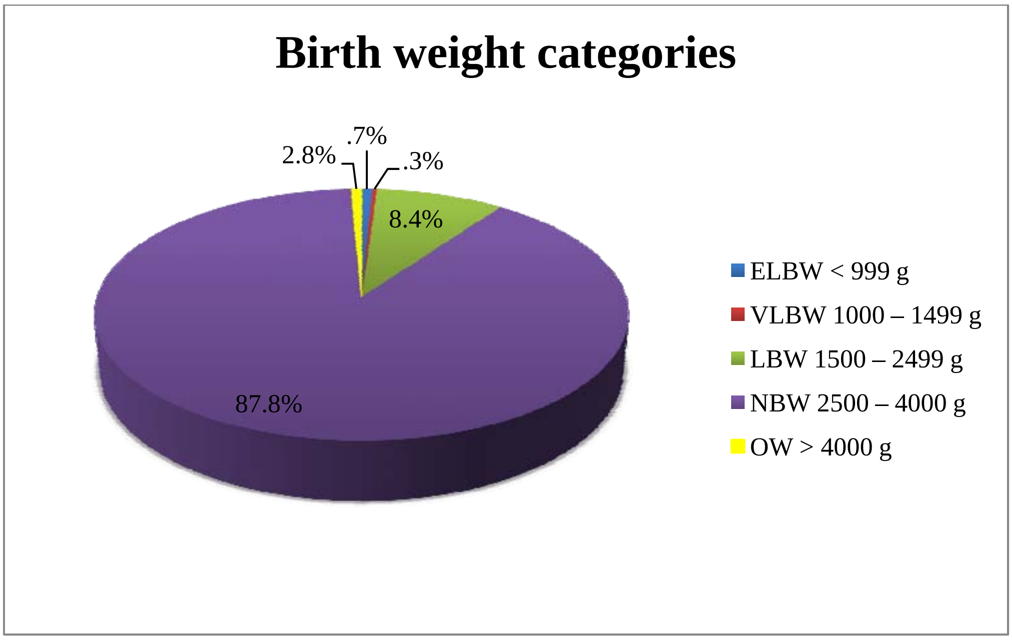

Figure 5.6: The sample distribution based on the children’s birth weight

Parents of 292 children answered the question related to the child birth order and, as can be seen from Figure 5.7, 69.5% of children were the first, second, or third baby in the family. The lower percentage of children being the fourth or subsequent baby may demonstrate that there are fewer families with four or more children, or it may be because of the random selection of the children that drawing from an uneven pool of children.

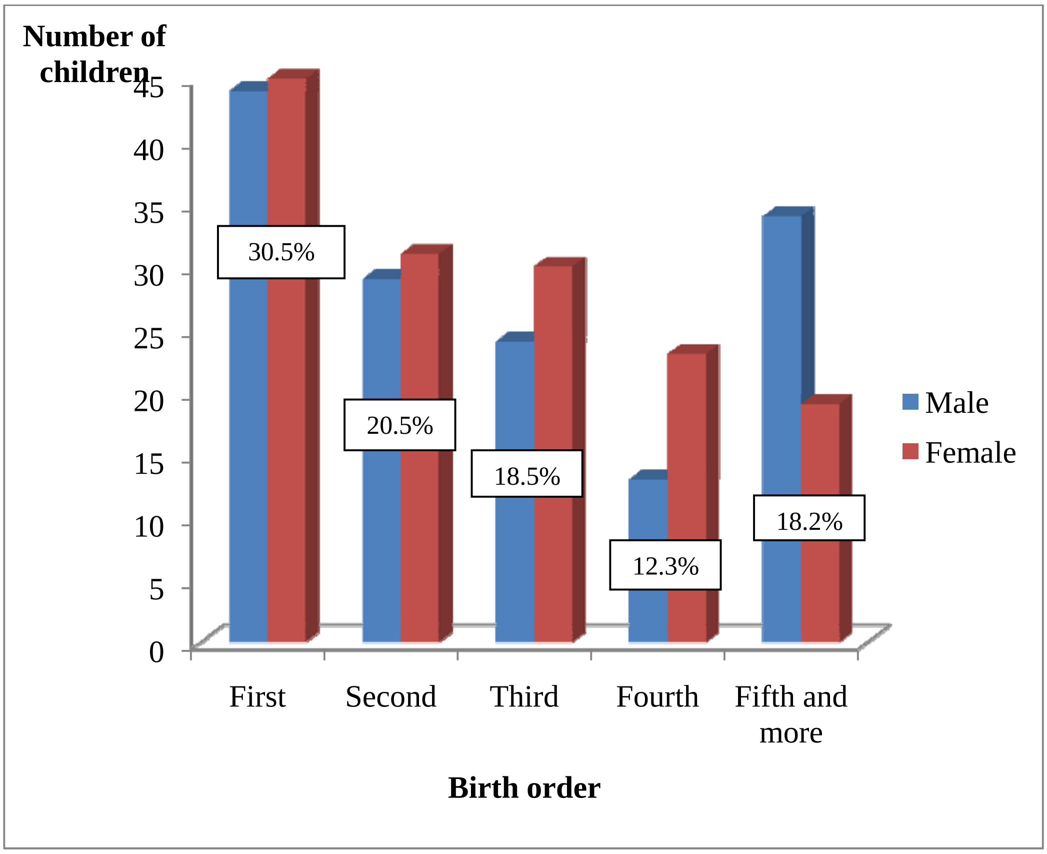

Figure 5.7: The sample distribution based on the birth order

For the house type question, 293 parents answered, with half the children living in houses and a minority in units (Figure 5.8).

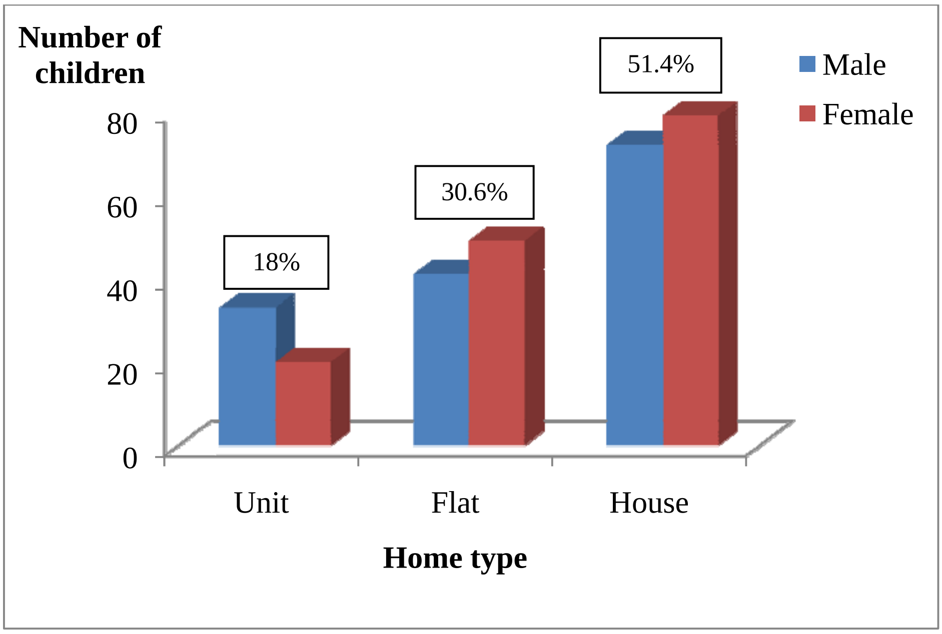

Figure 5.8: The sample distribution according to the house type

Based on the Kuwaiti culture (described in Chapter 4, “Rationale”), the wide range of family types was categorized into four groups: small nuclear family, large nuclear family, and extended family. The family (parents plus children) is 'small' for ≤ 7 members, and 'large' for ≥ 8 members. Parents in extended families mentioned that the extended family included grandparents, uncles, aunts, and their children. Three-quarters of the families were “small”, whether nuclear or extended, and 70% of “large” families were nuclear (Figure 5.9).

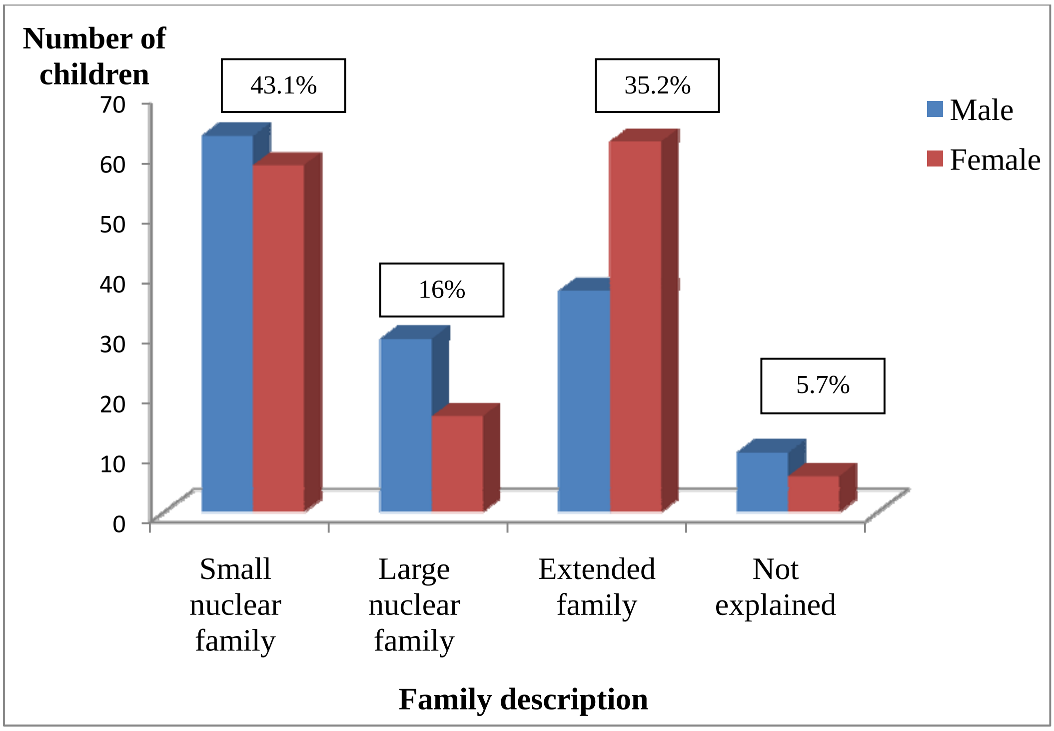

Figure 5.9: The sample distribution according to the family description

5.5 Materials and measurements

5.5.1 MABC-2 (Henderson, et al., 2007)

The assessment tests three bands of ages, the first 3-6 years, the second 7-10 years, and the third 11-16 years. The test is divided into three sections:

- manual dexterity, consisting of three parts: posting coins, threading beads, and drawing
- aiming and catching, with two parts: catching a beanbag/tennis ball and throwing a beanbag on to a mat
- balance, consisting of three parts: single limb stance for static balance, walking in a straight line (heel-to-toes or on toes), and jumping/hopping on a mat for dynamic balance.

Table 5.2: The MABC-2 test items in each age band

Test	Age band 1	Age band 2	Age band 3
Manual dexterity 1	Posting coins	Placing pegs	Turning pegs
Manual dexterity 2	Threading beads	Threading lace	Triangle with nuts and butts
Manual dexterity 3	Drawing trail 1	Drawing trail 2	Drawing trail 3
Aiming & catching 1	Catching bean bag	Catching with 2 hands (tennis ball)	Catching with one hand (tennis ball)
Aiming & catching 2	Throwing beanbag onto mat (the target is the hole mat) at distance of 1.8m	Throwing beanbag onto mat (the target is the orange circle) at distance of 1.8m	Throwing at wall target (margin line 2.3m from wall)
Balance 1 static	One-leg balance	On board balance	Two board balance
Balance 2 dynamic	Walking heel raised	Walking heel to toes forward	Walking heel to toes backward
Balance 3 dynamic	Jumping on mats	Hopping on mat	Zig-zag hopping

All the tests are similar in their aims for each age band, but become more complicated with increasing age (Table 5.2). The tests were administered individually in a comfortable and well ventilated room, taking 20 to 40 minutes depending on the age and severity of the condition of the child, by the primary investigator who was adequately trained.

The MABC-2 manual describes a standard score for each item for each age group, total score, age-adjusted standard, and percentile. The total score falls into one of three colours in a "traffic light" system: the green zone indicates normal performance, the amber zone indicates 'at risk of DCD', and the red zone indicates motor impairments.

The reliability and validity of the MABC-2 was discussed extensively in Chapter Three “Assessment Tools for Identifying DCD”.

5.5.2 DCDQ’07 (Wilson, et al., 2006)

The DCD Questionnaire is designed for parents to report the performance of their child in everyday functional activities, in comparison with that of peers, to assist in the identification of DCD (Appendix C). The test is designed for children aged between 5 and 15 years and has 15 questions divided into three categories, control during movement, fine motor and handwriting, and general coordination. Each question is scored from one to five, giving a total score of 15 minimum to 75 maximum, with higher scores indicating better performance. Total scores are grouped according to chronological age. The DCDQ’07 was translated into Arabic and administered in either English or Arabic (Appendix 3). See Chapter Three “Assessment Tools for Identifying DCD” for a discussion of its reliability and validity.

5.5.3 Demographic questionnaire

In addition to the DCDQ questionnaire, parents were asked general questions about their child’s birth history (Appendix D), with questions related to birth history and socioeconomic status.

5.6 Stage three – assessment of children and parents reports

The MABC-2 was administered following the directions specified in the manual, in Arabic for children in public schools, and in English for children in private schools. The researcher, who had been trained in the procedure, administered the test to all the children. The MABC-2 is designed specifically for children and has been shown to be a non-threatening procedure, causing no harm or discomfort to them. The procedure took place inside the schools, an environment familiar to the children.

As soon as parental consent had been received, children were scheduled for assessment. In each school a private room was prepared with the MABC-2 equipment. The room had good light and fresh air and was quiet, with no distractions. Each child was individually assessed wearing sports clothes and shoes. The test took approximately 30-45 minutes for each child, using the tasks for age bands one or two depending on the child's age. The children were encouraged throughout the session according to the instructions in the MABC-2 manual. For each task, the child was given oral instructions and a demonstration, and allowed one practice trial prior to the actual test. Each item was attempted twice, with the best performance taken as the test score. This was recorded as time taken in seconds for some test items, or number of errors counted in others.

Parents who had agreed to let their children participate in the study and had signed the consent form were provided with the DCDQ'07 questionnaire (either Arabic or English versions) as well as instructions on how to answer the questions and the telephone number of the investigator for further enquiries. The DCDQ'07 is designed to be completed by a person who knows the child well, and may be one of the parents or other family member like grandparent, or mature sister or brother.

The demographics questionnaire was also provided. Parents were encouraged to complete and return the questionnaire forms within one week. Parents who did not return their questionnaire within one week were telephoned or text-messaged to remind them.

5.7 Ethical issues

The investigator is a citizen from Kuwait where the data collection took place and she is familiar with the religion, beliefs and values, and cultural heritage of her people. Children, their parents, professionals, school principals, managers of GEA, and the Minister of Education were provided with explicit written information describing the study. Written permission was obtained from the Ministry of Education as well as from the managers of GEA's to enter the schools for recruitment and to assess the children. Parents were required to give formal written consent and children also gave written assent. Children and their parents were informed that they could withdraw from the study without prejudice. At the conclusion of the study, all parents were provided with feedback about their children's performance as well as a home program instruction and exercise description to use with their children for improving their motor performance. No names or identification of the children, parents or professionals were used during data management or when reporting the results of the study. All information is stored securely in a locked cabinet in the School of Physiotherapy, Curtin University to protect subject confidentiality. The results of this study will be reported but no participant will be able to be identified. This study was approved by the Human Research Ethics Committee of Curtin University (reference number HR 107/2008).

6 The Motor Performance of Kuwaiti Children

6.1 Introduction

Children must acquire complex skills in order to interact with their environment, for survival as well as for social interaction. Early experience of motor tasks is essential for motor development, and the first years of life are crucial because of the plasticity of the immature brain (Sanhueza, 2006). Although the attainment of motor skills is the same for children worldwide, there are variations in the rates of achieving specific tasks (WHO Multicentre Growth Reference Study & de Onis, 2006b). Human development is affected by many factors (genetic, maturation, and environment) and these influence the activities of children in daily life (Geuze, 2005a). Motor development in particular is affected by cultural factors, including parental expectations, children's experience, and socioeconomic status (Mayson, et al., 2007).

Many studies have confirmed the impact of ccultural differences on motor development; differences have been found in children performing tasks of manual dexterity, ball skills, and balance skills in different countries (Chow, et al., 2001; Engel-Yeger, et al., 2010; Livesey, et al., 2007; Miyahara, et al., 1998; Rˆsblad & Gard, 1998; Van Waelvelde, et al., 2008).

Gender is another factor that may influence a child's motor development. It has been reported that girls tend to attain growth milestones earlier than boys, although the difference has been considered too small to be a gender difference (WHO Multicentre Growth Reference Study & de Onis, 2006a). Girls between 5 and 7 years performed motor tasks involving the upper extremities sooner than boys, but the differences disappeared as they grew older (Largo et al., 2001). However, in many MABC studies, significant gender differences were found in manual dexterity, ball skills, and balance (Chow, et al., 2001; Engel-Yeger, et al., 2010; Junaid & Fellowes, 2006; Livesey, et al., 2007).

Another factor that may impact on the motor performance of children is the school environment. Schools with rich environments of wide spaces allow children to practice their gross motor activities and enhance their motor development (Giagazoglou, et al., 2007). It has been found in MABC studies that motor performances of children who attended socially advantaged schools were better than children who attended disadvantaged schools (McPhillips & Jordan-Black, 2007b). Advanced educational systems enhance children's motor ability in manual dexterity tasks (Van Waelvelde, et al., 2008).

Because no studies have been conducted previously examining the motor performance of Kuwaiti children, we concentrate in this chapter initially on children between 5 and 9 years in individual motor tasks using raw scores for the eight MABC-2 items. Our study was designed to explore differences in motor abilities, the hypothesis being that there would be differences between:

- Kuwaiti boys and girls
- Kuwaiti children in public and private schools
- Kuwaiti and UK children.

6.2 Method

6.2.1 Participants

The 297 children who participated in the study included 237 recruited from primary public schools and 60 from private schools in Kuwait representing urban and rural districts. They were 5 to 9 years old (mean 92.88 months, SD 14.24).

Table 6.1: Mean age and SD for the Kuwaiti children in each age group

Age in years	Number	Boys	Girls	Mean age in months (SD)
5	22	11	11	70.09 (0.868)
6	70	33	37	78.00 (3.636)
7	76	39	37	89.68 (3.652)
8	69	32	37	101.35 (3.678)
9	60	32	28	112.90 (2.956)
Total	297	147	150	92.88 (14.24)

Table 6.1 describes the sample for each age group in terms of the number of children of each gender as well as the mean age and standard deviation for each age group.

The comparison data were provided by the publisher with the approval of the MABC-2 authors (Henderson, et al., 2007) and included 416 children made up of 170 aged between 5 and 6 years and 246 aged between 7 and 9 years. The sampling was based on a 5 by 12 matrix, five levels of parental educational levels and the 12 geographical regions of the 2001 Census to ensure a representative UK sample. Gender, age, race/ethnicity, and population density (rural, suburban, and urban) were considered while recruiting children. The differences between actual and expected proportions of children based on either their parental education level or their race/ethnicity were not significant.

Table 6.2: Mean age and SD for the MABC-2 norm (UK) children in each age group

Age in years	Number	Boys	Girls	Mean age in months (SD)
5	91	43	48	65.65 (3.576)
6	74	43	31	77.08 (3.622)
7	83	40	43	89.48 (3.426)
8	82	34	48	101.73 (3.545)
9	67	28	39	113.04 (2.926)
Total	397	188	209	88.21(17.16)

Using the inclusion and exclusion criteria in the current study, there were 397 UK children, mean age 88.21 months and SD = 17.16 (Table 6.2). The data of 19 children from the sample norms were deleted due to medical problems to ensure equivalence between the two samples. The medical problems were ADHD, dyslexia, vision or hearing or speech difficulties, and learning or sensory disabilities. The gender and age of the excluded children were three boys aged five, two boys aged six, four boys and three girls aged seven, three boys and one girl aged eight, and one boy and two girls aged nine years.

6.2.2 Analysis

All data were analyzed using PASW Statistics 18. The MABC-2 test data were recorded as raw scores, standard scores, and percentiles. Both raw scores and standard scores were used, the latter for testing the assumption of normality for two reasons. First, the normality test was carried out for the MABC-2 standard total score and its components which are obtained from the score. Second, because the sample consists of different age groups, the standard scores are needed to provide the same performance significance across individuals in different age groups.

The raw scores were used for testing the hypothesized differences between children in the same age group, the standard scores not being essential in this case. The raw score is useful for comparing a child's performance on each MABC-2 item and explaining the actual performance of the child. Also the MABC-2 standardization from a western country has not been tested in this non-western country where the data were collected, so standardization may not be valid.

Parametric analyses were used for all variables and nonparametric analyses were also used for the variables that violated Levene's test to confirm the parametric results. In all cases the findings were confirmed. For the violated variables in Levene's test $p < 0.001$ was used (Allen & Bennett, 2008).

Because the data were obtained from children in two age bands, and each age band had a different number of items, the data were analyzed for each age band separately: age band one (AB1) and age band two (AB2) for each of the hypotheses.

There were four data analyses:

- Before conducting the analyses gender and age effects, and correlations between gender, age, and the MABC-2 were investigated using ANOVA. These analyses are important to ensure that the effects of gender on the total score of the MABC-2 are the same between male and female. If differences were found, the analyses cannot be done for the whole sample and the sample should be split into two data. The analyses should be done separately for males and females data. Same reason is for age effects and correlations of gender and age to the MABC-2.
- Testing the assumption of normality for the total MABC-2 and its three components: manual dexterity, catch and throw, and balance.
- Testing the difference between boys and girls and the differences between public and private schools: 2 (gender) × 2 (age) × 2 (school type) MANOVA for AB1 and 2 (gender) × 3 (age) × 2 (school type) MANOVA for AB2.
- Testing the difference between children from Kuwait and UK: 2 (country) × 2 (gender) × 2 (age) MANOVA for AB1 and 2 (country) × 2 (gender) × 3 (age) MANOVA for AB2 were used.

For the MANOVA test, univariate analyses were evaluated at $p < 0.05$. Statistical researchers suggest adjustment of the p value at Bonferroni adjusted alpha level with multiple comparisons to control family-wise error. The adjustment requires dividing the family-wise alpha level ($\alpha = 0.05$) by the number of dependent variables (Allen & Bennett, 2008). However, evidence shows that Bonferroni adjustment of p values, although it decreases the chance of type I error, increases the chance of type II error. One way to avoid this, the sample size should be increased (Feise, 2002). Others suggested that the Bonferroni adjustment is not useful in biomedical research particularly in interpreting the results as clinical meaningful, and that it not be used in testing specific hypotheses (Perneger, 1998).

Holm's test is another way to adjust the p value. The equation used here resembles the Bonferroni adjustment, but Holm's test is done in sequential steps that reject the null hypothesis sequentially until a point is reached where there is no rejection of the null hypothesis. In this method, there is a chance of type II error especially as the number of dependent variables in our data was large (10-11 variables). In applying Holm's test, the non-adjusted p value would be too small to be significant according to this test.

Therefore, $p < 0.05$ was used to evaluate the univariate analyses in our data for many reasons. First, the sample size required for three-way MANOVA with 10 dependent variables at $\alpha = 0.05$ and power = 0.9 is 300 for small effect, 135 for moderate effect, and 78 for large effect (Guilford and Benjamin, 1978), our sample size being large enough (297) to avoid the chance of type I error.

Second, our objective was to investigate aspects of motor ability of Kuwaiti children compared to UK children, intended as a base line study of Kuwaiti children's motor ability, so any type II error should be avoided.

6.3 Results

6.3.1 Gender and age effects

The ANOVA found that the main effects of gender ($F_{(1,297)} = 1.602$, $p = 0.207$) were not significant indicating that there were no significant differences in the total scores of the MABC-2 between boys and girls. The main effects of age ($F_{(4,297)} = 5.438$, $p < 0.0001$) were significant indicating that there were significant differences in the total scores between each age group which indicate that the motor ability is age-specific.

The Pearson correlation test showed that there were no significant correlations between gender and the total score of the MABC-2 ($r = 0.089$, $p = 0.125$), between age groups and the total score ($r = - 0.089$, $p = 0.145$), or between gender and age groups ($r = - 0.21$, $p = 0.715$).

The ANOVA findings indicated that it was safe to do the analysis for the whole sample.

6.3.2 Assumption testing

The normality test for the Kuwaiti sample (ensuring that the sample was normally distributed) was done by gender and by age for the MABC-2 total score and its three components (manual dexterity, aiming and catching, and balance). From the total score of the sample collected, the population was normally distributed according to the Shapiro-Wilk and Levene test, $p > 0.05$. The skewness and kurtosis were within the normal range (-1 to +1). Figure 6.1 shows the sample distribution based on the total score.

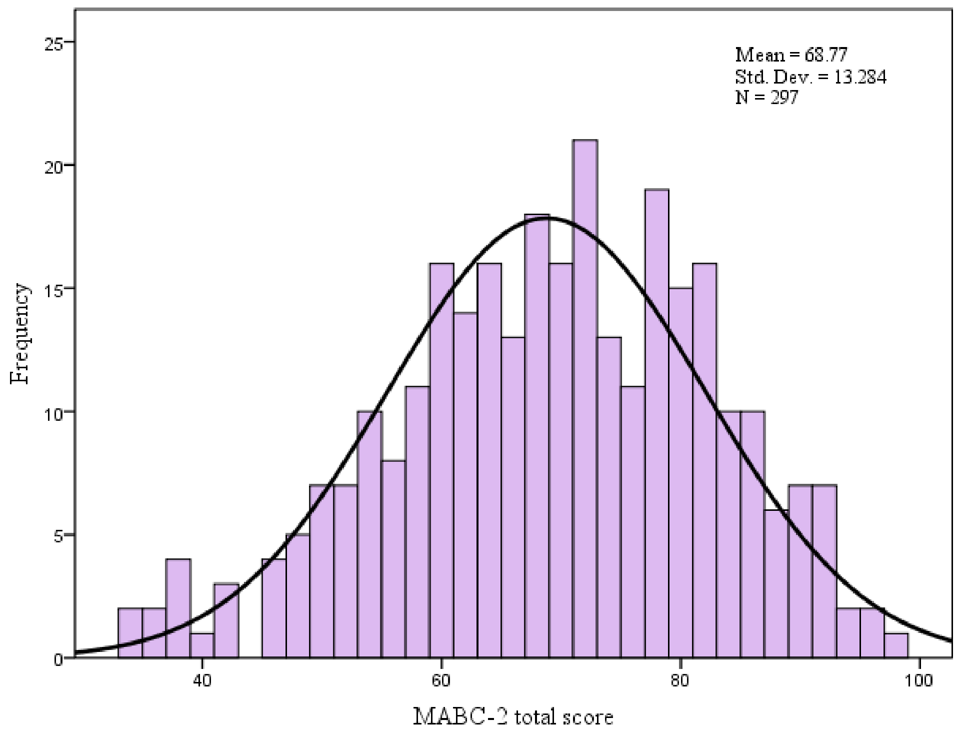

Figure 6.1: Sample distribution based on MABC-2 total score

For the three component scores Levene's Test was satisfied for all sub-sections, $p > 0.05$ for both gender and age groups. Although the Shapiro-Wilk was not satisfied for manual dexterity at age 6, nor for aiming and catching or balance at ages 6, 7, or 9, all skewness and kurtosis measures were within normal range (-1 to +1) and the Box plots show approximate normal distribution.

The data analyses used in this chapter were ANOVA and MANOVA; both tests are robust to moderate violation of the normality assumption so there was no concern about the mild violation of the three components, particularly as the sample size was large.

6.3.3 Testing Hypotheses One and Two: The Effects of Gender, Age and School Type on Motor Performance

6.3.3.1 Age Band One

The 2 (gender) × 2 (age) × 2 (school type) MANOVA assessed the raw scores of the 10 MABC-2 items for age band one. Prior to conducting the MANOVA test, six assumptions were checked. The independence and cell size assumptions are methodological and were met. The univariate normality was assessed by the Q-Q plot and Box plots. The correlations between the dependent variables were not strong indicating that the multicollinearity was not of concern. There was no concern about the outliers; the critical χ^2 value (df = 10 $\alpha = 0.001$) was 29.588 and the Maximum Mahalanobis Distance was 26.99. Based on the scatter-plots, there were linear relationships between dependent variables. The homogeneity of variance-covariance matrices was not violated; the Box's M was not significant ($p = 0.658$) at $\alpha = 0.001$.

Levene's Test of Equality of Error Variances was satisfied ($p > 0.05$) for most variables, indicating that the homogeneity of variance assumption was satisfied in these cases. However, the homogeneity was violated for two items, "one-leg balance best leg" and "jumping on mat". However, the departure of these two variables was not large ($p > 0.001$), so this violation was not a concern.

Table 6.3: Non-parametric analysis results for "one-leg balance best leg" and "jumping on mat"

	Gender	Age	School type
One-leg balance - best leg	H (1, 92) = 0.317, p = 0.573	H (1, 92) = 0.634, p = 0.426	H (1, 92) = 0.008, p = 0.931
Jumping on mat	H (1, 92) = 0.647, p = 0.421	H (1, 92) = 2.961, p = 0.085	H (1, 92) = 0.929, p = 0.335

To confirm the MANOVA finding, the non-parametric Kruskal-Wallis Test was used. The asymptomatic probabilities of χ^2 at k-1 degrees of freedom are shown in Table 6.3 which confirmed the MANOVA results.

Table 6.4: MANOVA test for raw scores for AB1 of MABC-2 (10 items)

	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Observed Power
Gender (G)	2.942	10.00	75.00	0.004	0.282	0.964
Age (A)	1.952	10.00	75.00	0.051	0.207	0.831
School type (S)	1.413	10.00	75.00	0.191	0.159	0.665
G*A	1.630	10.00	75.00	0.114	0.179	0.742
G*S	1.169	10.00	75.00	0.325	0.135	0.563
A*S	0.696	10.00	75.00	0.725	0.085	0.334
G*A*S	0.701	10.00	75.00	0.720	0.085	0.336

The MANOVA test (Table 6.4) found that the interactions between gender, age, and school type were not significant, indicating that the effect of gender on motor performance does not depend on age or school type. It can also be seen that the main effect of gender was significant, but there were no significant age or school-type main effects.

Table 6.5: Univariate test of the raw scores of MABC-2 items for gender

Test item	F Gender (G)	Males (n=44) M (SD)	Females (n=48) M (SD)
Post coins - preferred hand	2.624	20.09 (1.71)	19.31 (1.64)
Post coins - non-preferred hand	0.362	22.25 (2.63)	21.19 (2.39)
Threading beads	0.005	50.20 (8.62)	46.10 (8.50)
Drawing	0.032	1.80 (1.85)	1.85 (1.91)
Catching beanbag	5.021*	8.27 (1.85)	7.92 (2.05)
Throwing beanbag onto mat	8.949**	7.14 (1.44)	6.63 (1.89)
One leg balance - best Leg	2.468	20.45 (9.39)	22.17 (8.10)
One leg balance - other Leg	0.409	14.95 (9.28)	15.92 (9.17)
Walking heels raised	3.982*	12.82 (3.78)	13.94 (3.04)
Jump on mats	0.683	4.41 (0.97)	4.58 (0.77)

*p < 0.05, **p < 0.01

The results of univariate analysis of the 10 raw scores for gender indicate that there are differences between boys and girls in three items (Table 6.5). The significant differences were in “catching beanbag”, “throwing bean bag”, and “walking heels-raised”. Boys caught and threw significantly more beanbags than girls, whereas girls were able to walk significantly more steps with heels raised than boys.

To sum up, the results of 2×2×2 MANOVA tests supported to the hypothesis that there is a significant difference between the motor abilities of Kuwaiti boys and girls aged 5-6 years. However, the results rejected the hypothesis that there is a difference between public and private schools.

6.3.3.2 Age Band Two

The 2(gender) × 3(age) × 2 (school type) MANOVA included the raw scores of the 11 items for the MABC-2. Again, six assumptions should be met. The independence and cell size assumptions are methodological and were met. The univariate normality was assessed by the Q-Q plot and Box plots and was assumed. The correlations between the dependent variables were not strong indicating that the multicollinearity was not of concern. The critical χ^2 value (df = 10 α = 0.001) was 31.264 and the Maximum Mahalanobis Distance was 39.84 indicating outliers but they are not of concern and can be ignored because the sample size is large enough and the departure of the critical value is not large. Based on the scatter-plots, there were linear relationships between dependent variables. The homogeneity of variance-covariance matrices was not violated; the Box M was significant (p = 0.004) at α = 0.001 indicating that the assumption of homogeneity of variance-covariance matrices has been violated. However, the sample size is large and the sample groups are equal with size more than 30, so the MANOVA is robust against this violation (Allen & Bennett, 2008, p. 159).

The results of Levene's Test of Equality of Error Variances was satisfied ($p > 0.05$) for four variables ("placing pegs with preferred hand", "threading lace", "drawing", and "catching with two hands") indicating that the homogeneity of variance assumption was satisfied in these cases. The homogeneity was violated for the other items ($p < 0.05$). As the p value for all violated variables was larger than 0.001, the violation was not a concern.

Table 6.6: Non-parametric analyses results for the violated items

	Gender	Age	School type
Placing pegs non-preferred hand	H (1, 205) = 5.04, p = 0.025	H (1, 205) = 43.95, p = 0.000	H (1, 205) = 0.07, p = 0.786
Throwing beanbag on to mat	H (1, 205) = 19.19, p = 0.000	H (1, 205) = 19.55, p = 0.000	H (1, 205) = 0.02, p = 0.891
One-board balance - best leg	H (1, 205) = 2.54, p = 0.111	H (1, 205) = 19.09, p = 0.000	H (1, 205) = 6.27, p = 0.012
One-board balance - other Leg	H (1, 205) = 2.31, p = 0.129	H (1, 205) = 9.34, p = 0.009	H (1, 205) = 1.16, p = 0.281
Walking heel-to-toe forwards	H (1, 205) = 9.42, p = 0.002	H (1, 205) = 25.66, p = 0.000	H (1, 205) = 0.70, p = 0.401
Hopping on mats other leg	H (1, 205) = 6.24, p = 0.012	H (1, 205) = 8.55, p = 0.014	H (1, 205) = 1.85, p = 0.173

To confirm the ANOVA finding, a non-parametric procedure was carried out with the Kruskal-Wallis Test. The asymptomatic probabilities of χ^2 at k-1 degrees of freedom are shown in Table 6.6 which confirms the MANOVA results.

Levene's test was violated for the "hopping on mat best leg" because the p value was less than 0.001. Therefore, the corresponding univariate ANOVA at a stricter alpha level ($p < 0.001$) was used for this task.

Table 6.7 shows the means and standard deviations of the 11 raw scores for Kuwaiti children on public and private schools.

Table 6.7: Means and SD of raw scores for AB2 of MABC-2 (11-item) for the Kuwaiti children

Test item	Gender		Age			School type	
	Males (n=100)	Females (n=95)	7 years (n=76)	8 years (n=69)	9 years (n=60)	Public (n=151)	Private (n=44)
PP-PH	31.99 (5.49)	29.38 (4.76)	33.46 (5.50)	30.36 (4.67)	27.75 (3.99)	30.77 (5.38)	30.25 (5.12)
PP-NPH	37.99 (7.39)	35.23 (5.06)	40.43 (7.45)	35.59 (5.12)	33.45 (4.18)	36.83 (6.83)	36.00 (5.20)
LB	34.86 (12.47)	33.04 (13.13)	39.19 (12.96)	33.77 (13.15)	28.20 (9.42)	34.11 (13.21)	33.50 (11.38)
Drawing	2.46 (2.22)	2.38 (2.28)	3.07 (2.30)	2.32 (2.34)	1.78 (1.90)	2.67 (2.23)	1.57 (2.12)
CTH	7.64 (3.02)	5.44 (2.67)	6.20 (2.76)	6.85 (3.09)	6.68 (3.332)	6.62 (3.18)	6.41 (2.58)
TBM	7.29 (1.78)	6.19 (1.95)	6.07 (1.80)	6.86 (2.08)	7.42 (1.70)	6.80 (1.88)	6.59 (2.15)
OBB-BL	15.65 (9.30)	17.63 (8.97)	13.28 (8.04)	16.95 (9.48)	20.08 (8.82)	17.46 (9.27)	13.73 (8.32)
OBB-OL	9.89 (7.05)	11.53 (7.98)	8.62 (5.76)	11.38 (8.54)	12.30 (7.77)	10.99 (7.74)	9.64 (6.79)
WHTT	10.20 (4.82)	12.13 (3.99)	9.09 (4.81)	11.61 (4.32)	12.98 (3.40)	11.19 (4.57)	10.98 (4.43)
HM-BL	4.34 (1.09)	4.53 (1.02)	4.09 (1.34)	4.56 (0.91)	4.68 (0.68)	4.45 (1.02)	4.36 (1.16)
HM-OL	3.47 (1.43)	3.93 (1.41)	3.28 (1.62)	3.85 (1.26)	4.00 (1.29)	3.75 (1.42)	3.48 (1.47)

PP-PH = placing pegs -preferred hand; PP-NPH = placing pegs - non-preferred hand; LB = lacing board; CTH = catching with two hands; TBM = throwing beanbag onto mat; OBB-BL = one-board balance - best leg; OBB-OL = one-board balance - other Leg; WHTT = walking heel-to-toe forwards; HM-BL = hopping on mats - best leg; HM-OL = hopping on mats - other leg

The MANOVA test for the school type, gender, age, and interaction between them showed that the effect of the school type does not depend on gender or age. There were significant main effects of school type, gender, and age on motor performance of Kuwaiti children aged between 7 and 9 years (Table 6.8).

Table 6.8: MANOVA test for the raw scores for AB2 of MABC-2 (11-items)

	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Observed Power
Children gender (G)	6.488	11	173	0.000	0.292	1.000
Children age (A)	3.808	22	346	0.000	0.195	1.000
School type (S)	2.043	11	173	0.027	0.115	0.901
G*A	1.170	22	346	0.272	0.069	0.859
G*S	0.618	11	173	0.812	0.038	0.332
A*S	1.234	22	346	0.216	0.073	0.882
G*A*S	0.717	22	346	0.822	0.044	0.590

Based on the descriptive (Table 6.7) and univariate analyses (Tables 6.8 and 6.9), children in private schools performed the drawing task with significantly fewer errors than children in public schools, whereas children in public schools could stand significantly longer on one leg using the best leg than children in private schools.

Boys performed better than girls in catching and throwing, while girls were better in placing pegs with preferred and non-preferred hands. There were significant differences between age groups indicating age-related improvements in all tasks except drawing, catching, and one-board balance other leg.

Table 6.9: Univariate effects of school type for the 11 raw scores of MABC-2

	F		
Test item	Gender	Age	School type
Placing pegs - preferred hand	12.167**	20.789***	0.253
Placing pegs - non-preferred hand	6.861*	14.782***	0.288
Lacing board	1.717	8.996***	0.001
Drawing	0.203	2.262	6.940**
Catching with two hands	22.558***	0.074	0.805
Throwing beanbag onto mat	16.556***	11.109***	1.729
One-board balance - best leg	0.766	6.763**	8.252**
One-board balance - other leg	0.647	2.237	2.255
Walking heel-to-toe forwards	3.429	12.129***	0.459
Hopping on mats - best leg	0.038	8.002***	0.473
Hopping on mats - other leg	2.933	4.873**	0.841

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

To sum up, the results of the 2×3×2 MANOVA conform to the hypotheses: there were differences in the motor abilities between boys and girls and between public and private schools for Kuwaiti children aged 7 to 9 years.

6.3.4 Hypothesis Three: Differences between Kuwaiti and UK Children

6.3.4.1 Age Band One

The 2(country)×2(gender)×2(age) MANOVA test was done for the raw scores of MABC-2 items for five and six years old children from Kuwait and UK for the country, gender, age, and interactions between them after checking the six assumptions. The independence and cell size assumptions are methodological and were met. The univariate normality was assessed by the Q-Q plot and box-plots and was assumed. The correlations between the dependent variables were not strong indicating that the multicollinearity was not of concern. The critical χ^2 value (df = 10, $\alpha = 0.001$) was 29.588 and the Maximum Mahalanobis Distance was 52.62 so outliers are of no concern because the sample size is large enough. Based on the scatter-plots, there were linear relationships between dependent variables. The homogeneity of variance-covariance matrices was violated; the Box's M was significant ($p = 0.000$) at $\alpha = 0.001$ indicating that the assumption of homogeneity of variance-covariance matrices has been violated, but the sample size is large and the sample groups are equal and the size more than 30, so the MANOVA is robust against this violation (Allen & Bennett, 2008, p. 159).

Levene's Test of Equality of Error Variances was violated for all items ($p < 0.05$) except for "one leg balance on other leg" and "jumping on mats". However, the p values of the Levene's test for those items were greater than 0.001. To confirm the MANOVA finding, a non-parametric procedure was done using Kruskal-Wallis Test. The asymptomatic probabilities of χ^2 at k-1 degrees of freedom which confirm the MANOVA results are shown in Table 6.10.

The p values of Levene's Test for "drawing", "catching", "one leg balance best leg", and "walking heel raised" were < 0.001, thus the corresponding univariate ANOVA at a stricter alpha level ($p < 0.001$) was used.

Table 6.10: Non-parametric analyses results for the violated items

	Country	Gender	Age
Post coins - preferred hand	H (1,257) = 19.06, p = 0.000	H (1,257) = 1.99, p = 0.158	H (1,257) = 1.01, p = 0.315
Post coins - non-preferred hand	H (1,257) = 9.19, p = 0.002	H (1,257) = 0.59, p = 0.441	H (1,257) = 8.05, p = 0.005
Thread beads	H (1,257) = 2.52, p = 0.113	H (1,257) = 8.81, p = 0.003	H (1,257) =12.18, p = 0.000
Throw to floor target	H (1,257) = 13.78, p = 0.000	H (1,257) = 6.64, p = 0.010	H (1,257) = 10.74, p = 0.001

Table 6.11 shows the mean and SD of the raw scores for the 10 items for five- and six year-old children from Kuwait and UK.

Table 6.11: Means and SD for the raw scores for AB1 of the MABC-2 (10-items) for Kuwait and UK

	Country		Gender		Age	
Items	K (n= 92)	UK (n=165)	Male (n=130)	Female (n=127)	5 years (n=113)	6 years (n=144)
PC-PH	19.68 (1.71)	18.44 (3.15)	19.03 (2.87)	18.73 (2.71)	19.09 (3.13)	18.72 (2.48)
PC-NPH	21.70 (2.56)	20.55 (3.79)	21.09 (3.55)	20.83 (3.34)	21.55 (3.88)	20.50 (2.99)
TB	48.07 (8.76)	47.75 (14.87)	50.08 (14.38)	45.59 (11.02)	51.18 (15.84)	45.26 (9.51)
Drawing	1.83 (1.87)	0.57 (1.08)	1.18 (1.50)	.86 (1.56)	1.06 (1.57)	0.99 (1.51)
CBB	8.09 (1.95)	7.47 (2.53)	7.98 (2.13)	7.39 (2.54)	6.84 (2.65)	8.35 (1.84)
TBM	6.87 (1.70)	5.91 (2.07)	6.54 (1.96)	5.96 (2.00)	5.77 (2.10)	6.63 (1.84)
OLB-BL	21.35 (8.73)	21.09 (9.86)	19.87 (9.97)	22.53 (8.73)	19.62 (9.78)	22.41 (9.04)
OLB-OL	15.46 (9.18)	15.42 (10.15)	14.35 (9.93)	16.54 (9.57)	13.36 (8.88)	17.06 (10.20)
WHR	13.40 (3.44)	13.52 (3.23)	13.12 (3.51)	13.85 (3.03)	13.23 (3.52)	13.67 (3.12)
JOM	4.50 (0.87)	4.61 (0.87)	4.50 (.93)	4.65 (.80)	4.54 (0.89)	4.60 (0.86)

PC-PH = post coins - preferred hand; PC-NPH = post coins - non-preferred hand; TB= threading beads; CBB = catching beanbag; TBM = throwing beanbag onto mat; OLB-BL = one leg balance - best leg; OLB-OL = One leg balance - other leg; WHR = Walk heels raised; JOM = jumping on mats.

Table 6.12: MANOVA test for country, gender, age, and interaction between them for age band one

	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Observed Power
Country (C)	9.492	10.00	240	0.000	0.283	1.000
Gender (G)	4.122	10.00	240	0.000	0.147	0.998
Age (A)	3.420	10.00	240	0.000	0.125	0.991
C*G	0.640	10.00	240	0.779	0.026	0.332
C*A	0.568	10.00	240	0.839	0.023	0.293
G*A	1.230	10.00	240	0.272	0.049	0.633
C*G*A	0.963	10.00	240	0.477	0.039	0.504

The MANOVA test for country, gender, age, and their interactions revealed that the effect of country on motor performance does not depend on the gender or age of the children (Table 6.12). There were differences in the motor performance between children from Kuwait and the UK, between ages 5 to 6 years and between boys and girls.

Table 6.13: The univariate of the country for raw scores of 10 items in MABC-2

	F		
Items	Country	Gender	Age
Posting coins - preferred hand	14.215***	1.151	3.622
Posting coins - non-preferred hand	8.857**	0.819	6.693**
Threading beads	1.878	4.049*	13.405***
Drawing	55.800***	3.760	9.638**
Catching beanbag	1.150	4.070*	14.359
Throwing beanbag onto mat	7.055**	9.438**	5.488**
One leg balance - best leg	0.126	4.979*	4.020*
One leg balance - other leg	0.628	3.279	7.735**
Walking heels raised	0.596	3.068	1.427
Jumping on mats	1.935	2.483	1.115

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

Table 6.13 shows the univariate effects of country, gender, and age on the motor performance of Kuwaiti and UK children. Significant differences were found between the two countries; children from the UK were superior in “posting coins” and “drawing” tasks, whereas Kuwaiti children were significantly better at “throwing beanbag onto mat”.

Girls performed significantly better than boys in “threading beads”, whereas boys performed significantly better in “throwing” tasks. The age-related improvements were noticed in “posting coins with preferred and non-preferred hand”, “drawing”, and “throw beanbag to floor target”.

To sum up, 2×2×2 MANOVA results support to the hypothesis that there are significant differences in the motor ability between Kuwaiti children and UK children at age five and six years old. Differences were found for items posting coins, drawing, and throwing. There were also differences between boys and girls, and between each age group, but as there were no significant interaction these differences were consistent for the two countries.

6.3.4.2 Age Band Two

MANOVA was carried out for the 11 raw scores of age band two to identify the effect of country, gender, age, and interaction between the three factors, the six assumptions being tested as before. The independence and cell size assumptions are methodological and were met. The univariate normality was assessed by the Q-Q plot and box-plots and was assumed. The correlations between the dependent variables were not strong indicating that the multicollinearity was not of concern. The critical χ^2 value (df = 10 α = 0.001) was 29.588 and the Maximum Mahalanobis Distance was 52.62 indicating outliers, ignored because the sample size is large enough. Based on the scatter-plots, there were linear relationships between dependent variables. The homogeneity of variance-covariance matrices was violated; the Box’s M was significant (p = 0.000) at α = 0.001 indicating that the assumption of homogeneity of variance-covariance matrices has been violated. However, the sample size is large and the sample groups are equal and the size more than 30, so the MANOVA is robust against this violation (Allen & Bennett, 2008, p. 159).

The results of Levene's Test of Equality of Error Variances were satisfied for "place pegs with preferred hand" and "one leg balance tasks" and were violated for the other nine variables. However, the p values for "catching" and "throwing" were larger than 0.001, thus there was no concern about the violation of these two items.

Table 6.14: Non-Parametric analysis results for the violated items

	Country	Gender	Age
Catching with two hands	H (1,437) = 0.03, p = 0.856	H (1,437) = 45.59, p = 0.000	H (1,437) = 13.22, p = 0.001
Throw to floor target	H (1,437) = 0.12, p = 0.729	H (1,437) = 21.20, p = 0.000	H (1,437) = 23.43, p = 0.000

To confirm the MANOVA finding, a non-parametric procedure was done using Kruskal-Wallis Test. The asymptomatic probabilities of χ^2 at k-1 degrees of freedom are shown in Table 6.14 which agrees with the MANOVA results.

A stricter alpha level ($p < 0.001$) was used for the corresponding univariate ANOVA for the seven items; placing pegs with non-preferred hand, "lacing board", "drawing", "one-board balance other leg", "walking heel-to-toe", and "hopping". Tables 6.15 to 6.18 show means and SD for the raw scores of MABC-2 (11-items) for children aged seven to nine years old from both Kuwait and UK.

Table 6.15: Means and SD of raw scores for AB2 of the MABC-2 (11-items) for country, gender, and age

Items	Country		Gender		Age		
	K (n=195)	UK (n=232)	Boys (n=202)	Girls (n=225)	7 years (n=152)	8 years (n=148)	9 years (n=127)
PP-PH	30.66 (5.31)	28.42 (6.03)	30.50 (5.72)	28.48 (5.74)	32.41 (6.37)	28.41 (4.91)	27.09 (4.49)
PP-NPH	36.65 (6.49)	33.02 (6.99)	35.71 (7.44)	33.75 (6.46)	38.16 (7.79)	33.28 (6.19)	32.13 (4.95)
LB	33.97 (12.80)	27.18 (7.02)	31.32 (10.68)	29.36 (10.49)	34.27 (10.98)	29.85 (10.72)	26.02 (8.05)
Drawing	2.42 (2.25)	0.54 (1.04)	1.50 (1.97)	1.31 (1.91)	1.83 (2.10)	1.28 (1.92)	1.03 (1.65)
CTH	6.57 (3.05)	6.41 (2.96)	7.42 (2.92)	5.65 (2.83)	6.11 (2.76)	7.19 (2.66)	6.12 (3.50)
TBM	6.75 (1.94)	6.75 (1.99)	7.17 (1.88)	6.38 (1.97)	6.22 (1.96)	6.88 (1.86)	7.25 (1.97)
OBB-BL	16.62 (9.17)	19.74 (9.59)	16.36 (9.59)	20.07 (9.13)	15.48 (9.17)	18.78 (9.52)	21.17 (9.05)
OBB-OL	10.69 (7.54)	12.33 (9.49)	9.80 (7.78)	13.18 (9.14)	9.37 (7.23)	11.87 (8.74)	13.88 (9.57)
WHTT	11.14 (4.53)	14.04 (2.54)	12.01 (4.39)	13.35 (3.21)	11.59 (4.55)	12.97 (3.65)	13.76 (2.75)
HM-BL	4.43 (1.06)	4.82 (0.53)	4.56 (0.91)	4.72 (0.76)	4.49 (1.04)	4.70 (0.75)	4.76 (.60)
HM-OL	3.69 (1.43)	4.34 (1.04)	3.82 (1.36)	4.24 (1.16)	3.76 (1.41)	4.20 (1.12)	4.19 (1.17)

PP-PH = placing pegs -preferred hand; PP-NPH = placing pegs - non-preferred hand; LB = lacing board; CTH = catching with two hands; TBM = throwing beanbag onto mat; OBB-BL = one-board balance - best leg; OBB-OL = one-board balance - other Leg; WHTT = walking heel-to-toe forwards; HM-BL = hopping on mats - best leg; HM-OL = hopping on mats - other leg.

Table 6.16: Means and SD of raw scores for AB2 of the MABC-2 (11-items) for country-gender interactions

	K		UK	
	Boys (n=100)	Girls (n=95)	Boys (n=102)	Girls (n=130)
PP-PH	31.99 (5.48)	29.25 (4.76)	29.05 (5.60)	27.92 (6.33)
PP-NPH	37.99 (7.39)	35.23 (5.06)	33.47 (6.82)	32.66 (7.13)
LB	34.86 (12.47)	33.04 (13.13)	27.84 (7.08)	26.66 (6.94)
Drawing	2.46 (2.22)	2.38 (2.28)	0.56 (1.03)	0.53 (1.04)
CTH	7.64 (3.02)	5.44 (2.67)	7.20 (2.82)	5.80 (2.95)
TBM	7.29 (1.78)	6.19 (1.95)	7.06 (1.97)	6.52 (1.99)
OBB-BL	15.65 (9.30)	17.63 (8.97)	17.05 (9.86)	21.85 (8.86)
OBB-OL	9.89 (7.05)	11.53 (7.97)	9.71 (8.47)	14.38 (9.76)
WHTT	10.20 (4.82)	12.13 (3.99)	13.79 (3.01)	14.24 (2.09)
HM-BL	4.34 (1.09)	4.53 (1.02)	4.77 (.63)	4.86 (0.45)
HM-OL	3.47 (1.43)	3.93 (1.41)	4.17 (1.20)	4.47 (0.87)

PP-PH = placing pegs -preferred hand; PP-NPH = placing pegs - non-preferred hand; LB = lacing board; CTH = catching with two hands; TBM = throwing beanbag onto mat; OBB-BL = one-board balance - best leg; OBB-OL = one-board balance - other Leg; WHTT = walking heel-to-toe forwards; HM-BL = hopping on mats - best leg; HM-OL = hopping on mats - other leg.

Table 6.17: Means and SD of raw scores for AB2 of the MABC-2 (11-items) for country-age interactions

Items	7 years		8 years		9 years	
	K (n=69)	UK (n=83)	K (n=66)	UK (n=82)	K (n=60)	UK (n=67)
PP-PH	33.46 (5.50)	31.53 (6.93)	30.36 (4.67)	26.83 (4.54)	27.75 (3.99)	26.51 (4.84)
PP-NPH	40.43 (7.45)	36.28 (7.61)	35.59 (5.12)	31.41 (6.38)	33.45 (4.18)	30.94 (5.31)
LB	39.19 (12.93)	30.18 (6.74)	33.77 (13.15)	26.70 (6.89)	28.20 (9.42)	24.06 (6.01)
Drawing	3.07 (2.30)	0.80 (1.17)	2.32 (2.34)	0.44 (0.86)	1.78 (1.90)	0.36 (1.01)
CTH	6.20 (2.76)	6.02 (2.77)	6.85 (3.09)	7.46 (2.23)	6.68 (3.33)	5.61 (3.59)
TBM	6.07 (1.80)	6.34 (2.08)	6.86 (2.08)	6.89 (1.68)	7.42 (1.70)	7.10 (2.19)
OBB-BL	13.28 (8.04)	17.31 (9.68)	16.95 (9.48)	20.24 (9.36)	20.08 (8.82)	22.13 (9.21)
OBB-OL	8.62 (5.76)	9.99 (8.25)	11.38 (8.54)	12.27 (8.94)	12.30 (7.77)	15.30 (10.81)
WHTT	9.09 (4.81)	13.67 (3.03)	11.61 (4.32)	14.07 (2.52)	12.98 (3.39)	14.46 (1.74)
HM-BL	4.09 (1.34)	4.83 (0.51)	4.56 (0.91)	4.80 (0.58)	4.68 (0.68)	4.84 (0.51)
HM-OL	3.28 (1.62)	4.17 (1.06)	3.85 (1.26)	4.49 (1.01)	4.00 (1.29)	4.36 (1.03)

PP-PH = placing pegs -preferred hand; PP-NPH = placing pegs - non-preferred hand; LB = lacing board; CTH = catching with two hands; TBM = throwing beanbag onto mat; OBB-BL = one-board balance - best leg; OBB-OL = one-board balance - other Leg; WHTT = walking heel-to-toe forwards; HM-BL = hopping on mats - best leg; HM-OL = hopping on mats - other leg.

Table 6.18: Means and SD of raw scores for AB2 of the MABC-2 (11-items) for gender-age interaction

Items	7 years		8 years		9 years	
	Male (n=77)	Female (n=75)	Male (n=65)	Female (n=83)	Male (n=60)	Female (n=67)
PP-PH	33.53 (6.13)	31.25 (6.45)	29.31 (4.78)	27.70 (4.92)	27.92 (4.25)	26.36 (4.61)
PP-NPH	39.65 (8.36)	36.64 (6.89)	33.71 (6.28)	32.94 (6.139)	32.82 (4.75)	31.51 (5.09)
LB	33.88 (9.06)	34.67 (12.7)	31.51 (12.60)	28.55 (8.87)	27.82 (9.51)	24.40 (6.11)
Drawing	2.09 (2.39)	1.56 (1.72)	1.15 (1.57)	1.37 (2.162)	1.12 (1.54)	0.96 (1.75)
CTH	6.60 (3.06)	5.60 (2.325)	8.03 (2.51)	6.53 (2.59)	7.80 (2.95)	4.61 (3.28)
TBM	6.47 (1.94)	5.96 (1.95)	7.72 (1.51)	6.22 (1.85)	7.48 (1.91)	7.04 (2.02)
OBB-BL	13.65 (9.19)	17.36 (8.82)	16.86 (9.35)	20.28 (9.44)	19.28 (9.56)	22.85 (8.28)
OBB-OL	7.61 (6.05)	11.17 (7.91)	10.20 (8.15)	13.18 (9.02)	12.17 (8.66)	15.42 (10.15)
WHTT	10.55 (5.09)	12.67 (3.64)	12.46 (4.00)	13.37 (3.31)	13.42 (3.14)	14.07 (2.32)
HM-BL	4.36 (1.12)	4.63 (0.94)	4.68 (0.77)	4.71 (0.74)	4.68 (0.68)	4.84 (0.51)
HM-OL	3.51 (1.43)	4.03 (1.35)	4.14 (1.13)	4.25 (1.20)	3.88 (1.42)	4.46 (0.80)

PP-PH = placing pegs -preferred hand; PP-NPH = placing pegs - non-preferred hand; LB = lacing board; CTH = catching with two hands; TBM = throwing beanbag onto mat; OBB-BL = one-board balance - best leg; OBB-OL = one-board balance - other Leg; WHTT = walking heel-to-toe forwards; HM-BL = hopping on mats - best leg; HM-OL = hopping on mats - other leg.

Table 6.19: MANOVA test for country, gender, age, and interaction between them

	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Observed Power
Country (C)	19.689	11	405	0.000	0.348	1.000
Gender (G)	13.129	11	405	0.000	0.263	1.000
Age (A)	7.686	22	810	0.000	0.173	1.000
C*G	2.002	11	405	0.027	0.052	0.905
C*A	1.636	22	810	0.033	0.043	0.971
G*A	2.003	22	810	0.004	0.052	0.993
C*G*A	1.221	22	810	0.221	0.032	0.889

The MANOVA test for country, gender, age, and interaction between the three factors revealed that the effect of country on motor ability depends on the gender and age and gender also depends on age. The interaction between the three (country, gender, and age) was not significant (Table 6.19); country, gender, and age have an effect on the motor performance indicating differences between Kuwaiti children and UK children.

The univariate effects (Table 6.20) show that there were significant differences between children in both countries in eight items; UK children performed significantly better than Kuwaiti children in all eight. However, children from both countries had similar performance in three items, “catching”, “throwing”, and “one-board balance using other leg”.

Similarly, gender differences were found in all tasks except three, “lacing board”, “drawing”, and “hopping on mat best leg”. Girls were significantly better than boys in “placing pegs preferred hand”, and “one-board balance”. Boys were significantly superior in “catching” and “throwing” tasks.
There were also significant differences between age groups indicating age-related improvements in all tasks.

There were interactions between country and gender, country and age, and between gender and age. Therefore, further analyses were done using simple effect analysis to explore the effects from both sides.

Table 6.20: The univariate effects of country, gender, age, and interaction between each of them

	F					
Items	Country (C)	Gender (G)	Age (A)	C*G	C*A	G*A
PP-PH	17.571***	11.902**	39.137***	3.363	1.925	.344
PP-NPH	33.687***	6.510*	37.695***	2.942	.806	1.587
LB	53.227***	2.460	28.896***	.303	2.695	2.649
Drawing	128.565***	0.028	9.600***	0.047	2.051	2.234
CTH	.120	49.225***	6.990**	1.963	1.850	5.266**
TBM	0.030	20.497***	11.663***	2.441	.841	3.671*
OBB-BL	10.163**	13.630***	13.720***	2.165	0.536	0.008
OBB-OL	3.242	13.522***	9.390***	3.075	0.492	0.037
WHTT	71.591***	11.413**	16.245***	4.707*	7.249**	1.968
HM-BL	22.121***	2.752	5.123**	0.290	5.574**	0.699
HM-OL	25.930***	9.839**	6.470**	0.458	1.864	1.559

PP-PH = placing pegs -preferred hand; PP-NPH = placing pegs - non-preferred hand; LB = lacing board; CTH = catching with two hands; TBM = throwing beanbag onto mat; OBB-BL = one-board balance - best leg; OBB-OL = one-board balance - other Leg; WHTT = walking heel-to-toe forwards; HM-BL = hopping on mats - best leg; HM-OL = hopping on mats - other leg.

*p < 0.05, **p < 0.01, ***p < 0.001

Simple Effect Analyses

1- Country-gender interaction

The significant interaction was for the one item “walking heel-to-toe”. Simple effect analysis for country-gender interaction looked at the effect of country on each gender. Another simple effect analysis for gender-country interaction provided the effect of gender on each country.

- Country-gender effect, “walking heel-to-toe”

Gender has a statistically significant effect on “walking heel-to-toe” in Kuwaiti children, $F(1,433) = 15.88$, $p = 0.000$. Kuwaiti males were worse than females (the mean difference was - 2.01). However, gender does not influence “walking heel-to-toe” for UK children, $F(1,433) = 0.865$, $p = 0.353$. Figure 6.2 shows the effects of country and gender on the “walking heel-to-toe” item.

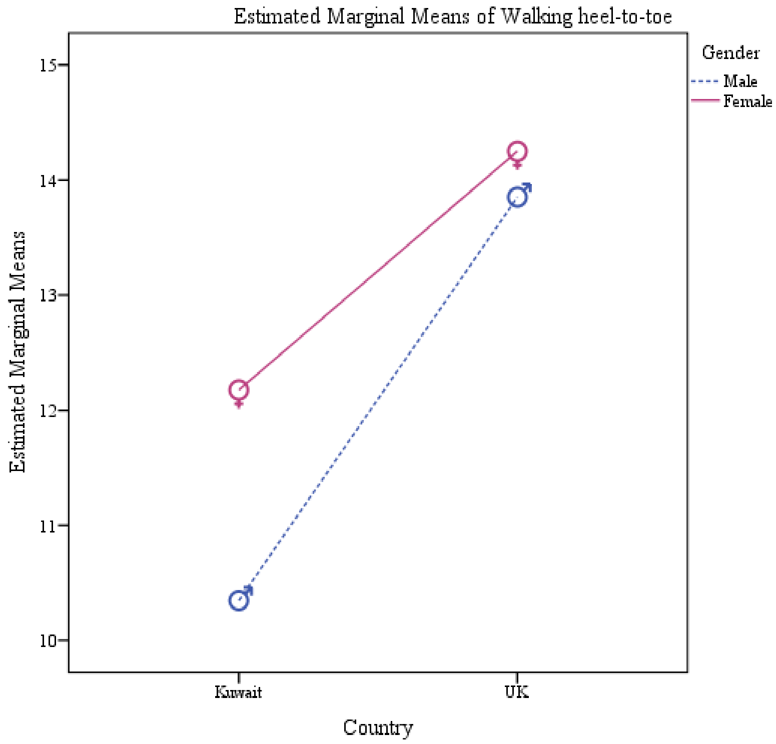

Figure 6.2: Gender by country effects on the “walking heel-to-toe” item

- <u>Gender-country effect, “walking heel-to-toe”</u>

The country has a statistically significant effect on “walking heel-to-toe” in male children, $F (1,433) = 53.969$, $p = 0.000$ and female children, $F (1,433) = 20.069$, $p = 0.000$. The UK male and female children were better than the Kuwaiti children; the mean differences were 3.707 and 2.140, respectively (Figure 6.3).

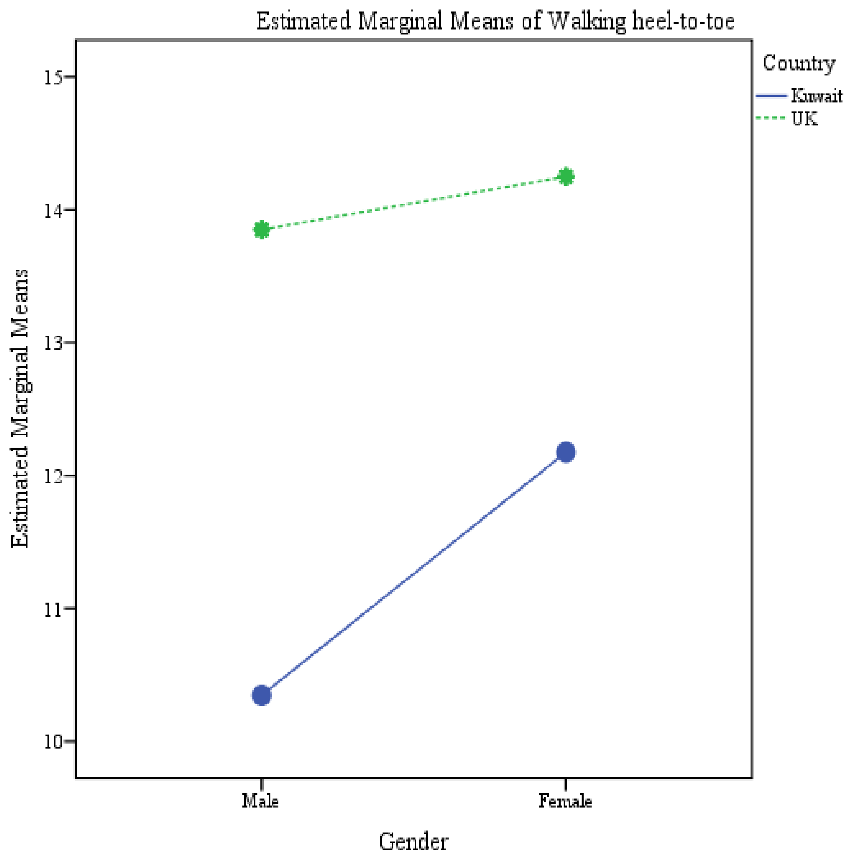

Figure 6.3: Country by gender effects on the “walking heel-to-toe” item

2- Country-age interaction

The significant interactions were in two items, “walking heel-to-toe” and “hopping on mats best leg”. Simple effect analyses were done for country-age interaction to look at the effect of country in each age group and separately for age-country interaction to look at the effect of age in each country.

- Country-age effect, "walking heel-to-toe"

Age has a statistically significant effect on the "walking heel-to-toe" in Kuwaiti children, F (2,431) = 23.815, p = 0.000, but not for UK children, F (2,431) = 0.947, p = 0.389 (Figure 6.4). The mean differences in the "walking heel-to-toe" between Kuwaiti children at age seven and eight was -2.767, at age seven and nine was -3.996, and at age eight and nine was -1.230.

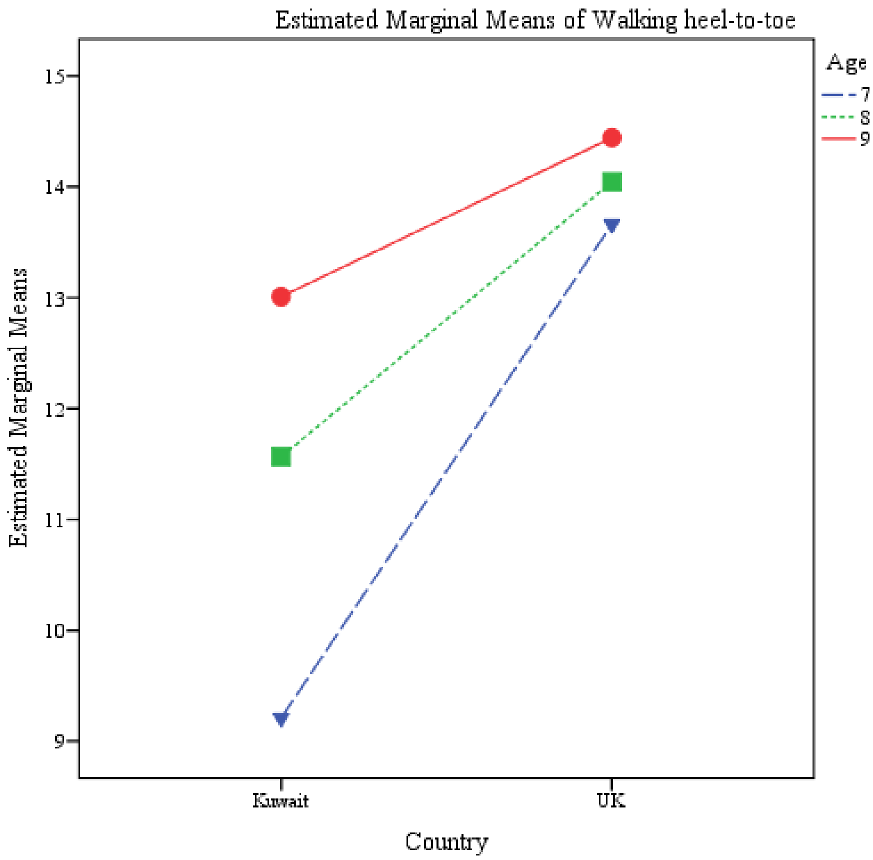

Figure 6.4: The age by country effects on the "walking heel-to-toe" item

- <u>Age-country effect, “walking heel-to-toe”</u>

The country has a statistically significant effect on “walking heel-to-toe” at age seven, F (1,431) = 71.395, p =0.000, at age eight F (1,431) = 16.509, p = 0.000, and at age nine, F (1,431) = 5.673, p =0.018 (Figure 6.5). The children from UK were better than children from Kuwait in each age group; the mean differences at ages seven, eight and nine being 4.688, 2.320, and 1.479 respectively.

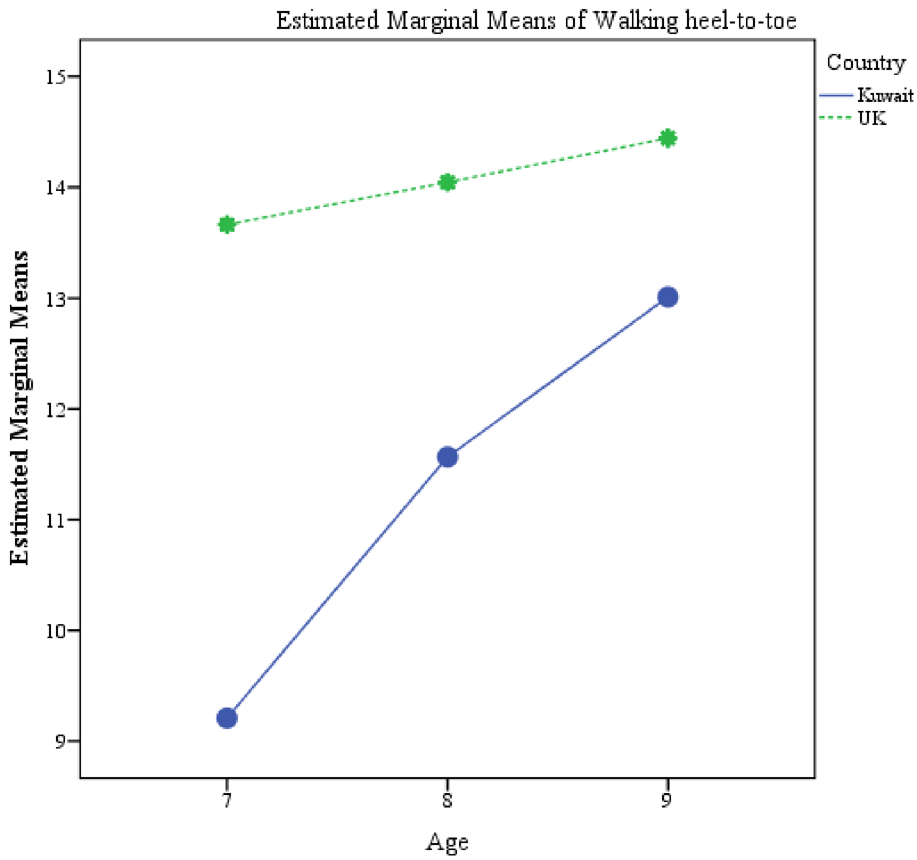

Figure 6.5: The country by age effects on the “walking heel-to-toe” item

- <u>Country-age effect, "hopping on mats best leg"</u>

Age has a statistically significant effect on this task in Kuwaiti children, $F_{(2,431)} = 11.802$, $p = 0.000$, but age does not influence "hopping on mats best leg" for UK children, $F_{(2,431)} = 0.033$, $p = 0.968$ (Figure 6.6). The differences in this item were significant between Kuwaiti children at ages of seven and eight, the mean difference being -0.513, and significant between seven and nine with mean difference -0.631, but not significant between eight and nine, $p > 0.05$.

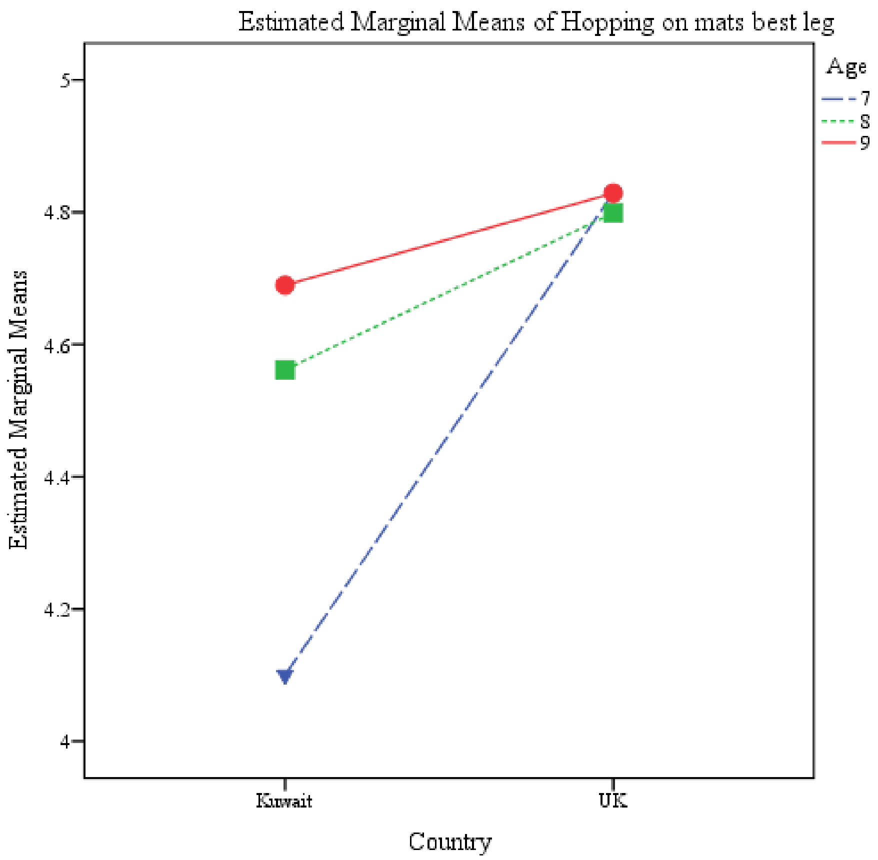

Figure 6.6: Age by country effects on the "hopping on mats best leg"

- <u>Age-country effect, "hopping on mats best leg"</u>

The country has a statistically significant effect on "hopping on mats best leg" at age seven, F (1,431) = 35.822, p = 0.000 but not at age eight, F (1,431) = 3.205, p = 0.074 or nine, F (1,431) = 1.096, p =0.296 (Figure 6.7). UK children were better than children from Kuwait at age seven; the mean difference was 0.779.

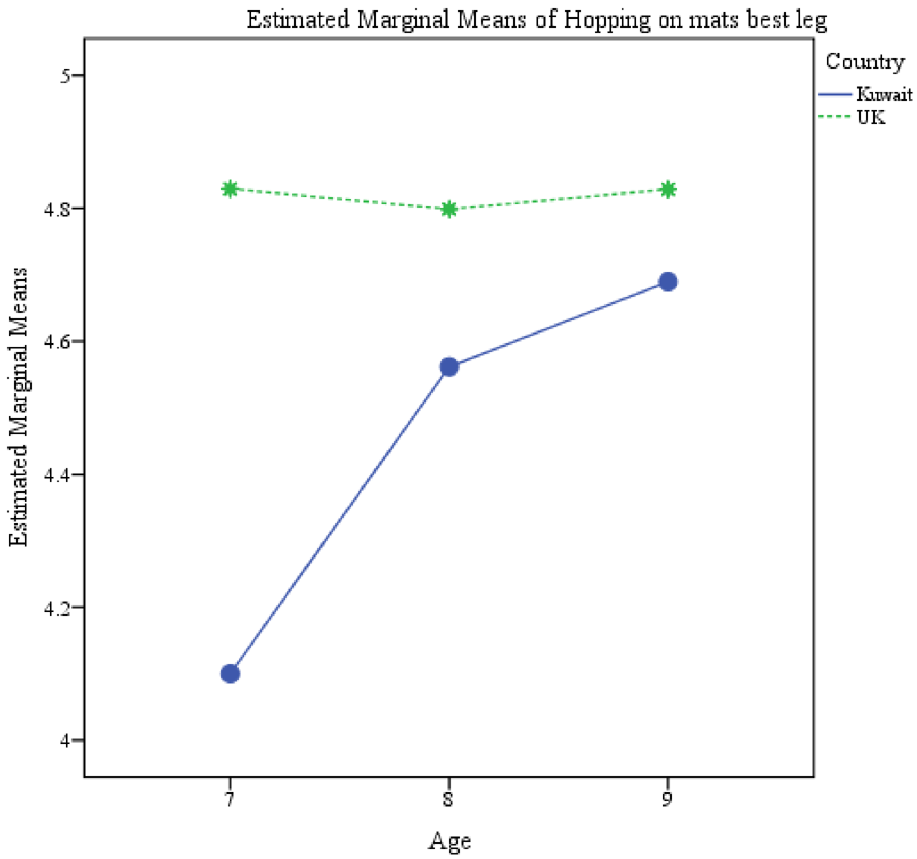

Figure 6.7: The country by age effects on the "hopping on mats best leg" item

3- Gender-age interaction

Significant interactions were in two items "catching with two hands" and "throwing beanbag onto mat". The simple effect analysis was done for gender-age interaction to look at the effect of gender at each age group. Another simple effect analysis was done for age-gender interaction to look at the effect of age on each gender.

- <u>Gender-age effect, "catching with two hands"</u>

Age has a statistically significant effect on "catching with two hands" in male children, F (2,431) = 6.188, p = 0.002 and in female children, F (2,431) = 8.458, p = 0.000 (Figure 6.8). The mean differences between male children at age seven and eight was -1.516, and between seven and nine was -1.256, but between eight and nine was not significant. The mean differences between female children at age seven and eight was -0.920, between seven and nine 0.951, and between eight and nine 1.870.

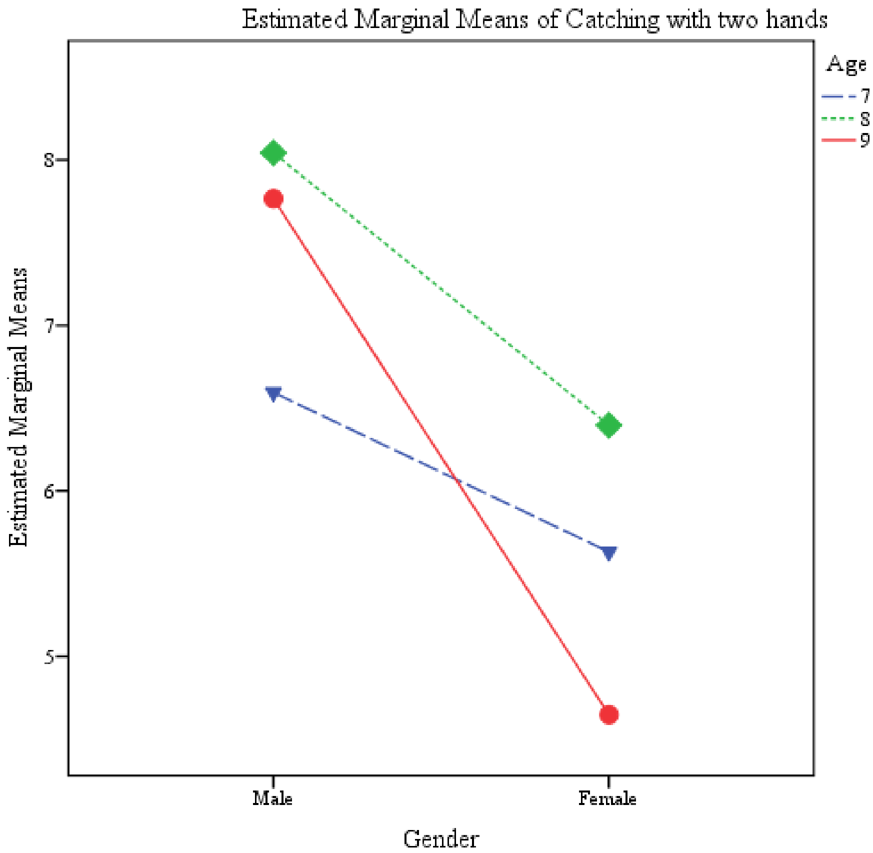

Figure 6.8: The age by gender effects on the "catching with two hands" item

- <u>Age-gender effect, “catching with two hands”</u>

Gender has a statistically significant effect on “catching with two hands” at age seven, F (1,431) = 4.927, p = 0.027, eight, F (1,431) = 11.900, p = 0.001, and nine, F (1,431) = 41.369, p = 0.000 (Figure 6.9). The male children were significantly better than female children at all ages tested; the mean differences were 0.982, 1.578, and 3.188 respectively.

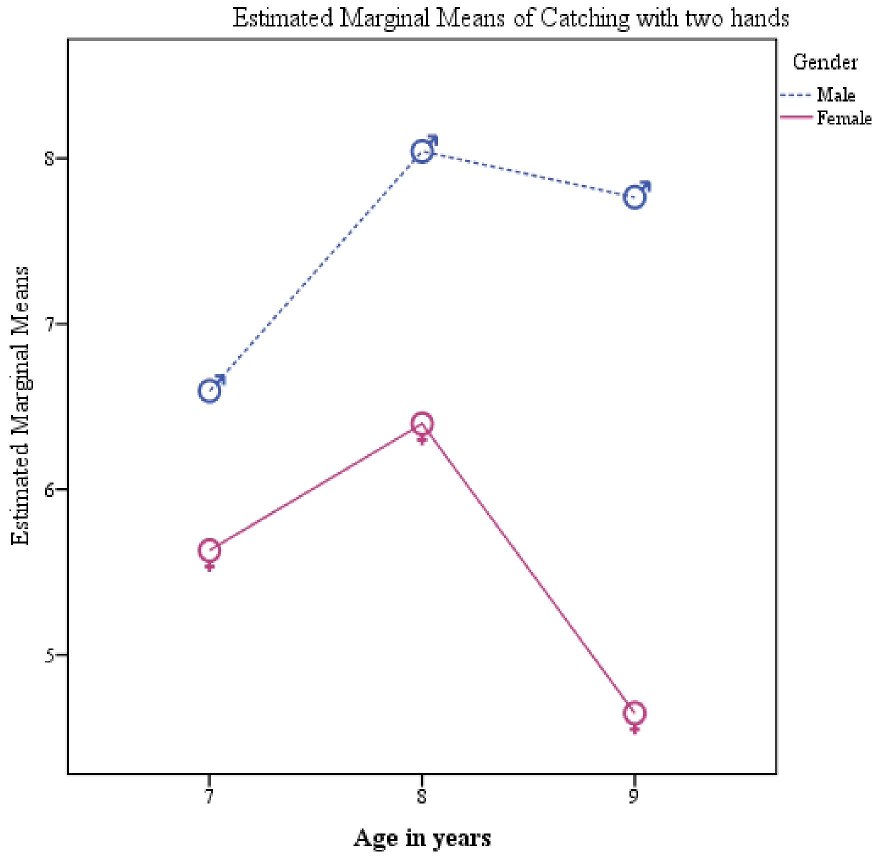

Figure 6.9: The gender by age effects on the “catching with two hands” item

- <u>Gender-age effect, “throwing beanbag onto mat”</u>

Age has a statistically significant effect on “throwing beanbag onto mat” in male children, F (2,431) = 9.575, p = 0.000 and female children, F (2,431) = 6.902, p = 0.001 (Figure 6.10). The mean differences between ages seven and eight was -1.274, between seven and nine was -1.015, and between eight and nine was not significant, p > 0.05. The mean differences between female children at age of seven and nine was -1.107, between eight and nine was -0.845, but between seven and eight was not significant, p = 0.366.

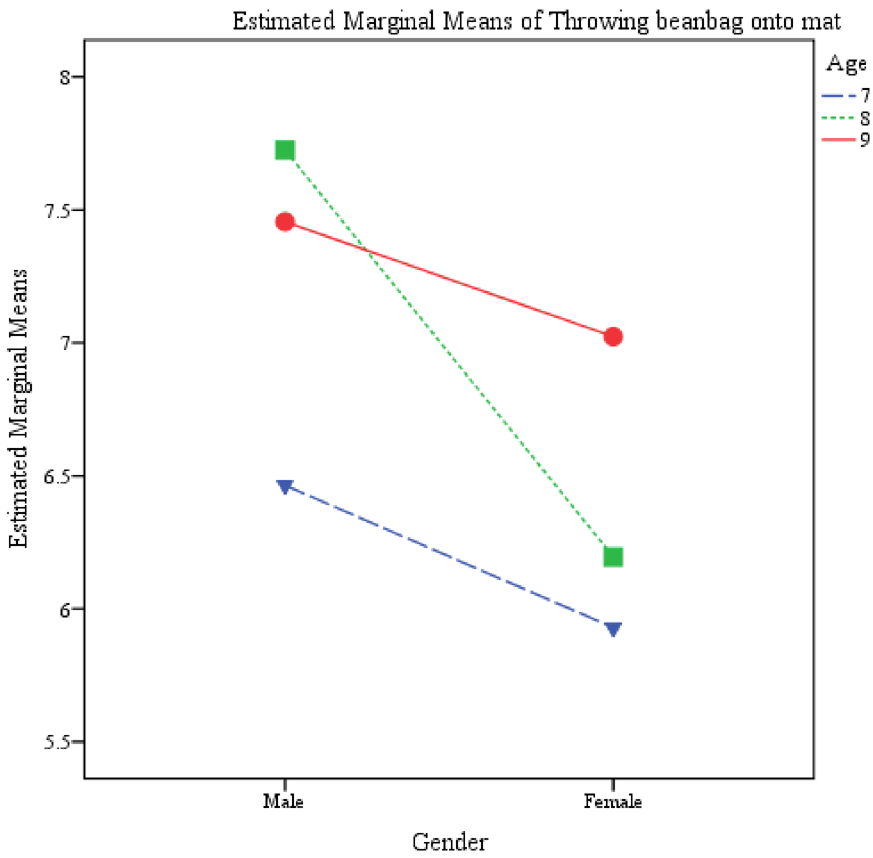

Figure 6.10: The age by gender effects on “throwing beanbag onto mat” item

- Age-gender effect, “throwing beanbag onto mat”

Gender has a statistically significant effect on “throwing beanbag onto mat” at age eight, $F(1,431) = 25.492$, $p = 0.000$ but not at seven, $F(1,431) = 3.231$, $p = 0.073$ or at nine, $F(1,431) = 1.756$, $p = 0.186$ (Figure 6.11). The male children were better than female children at age eight; the mean difference was 1.542.

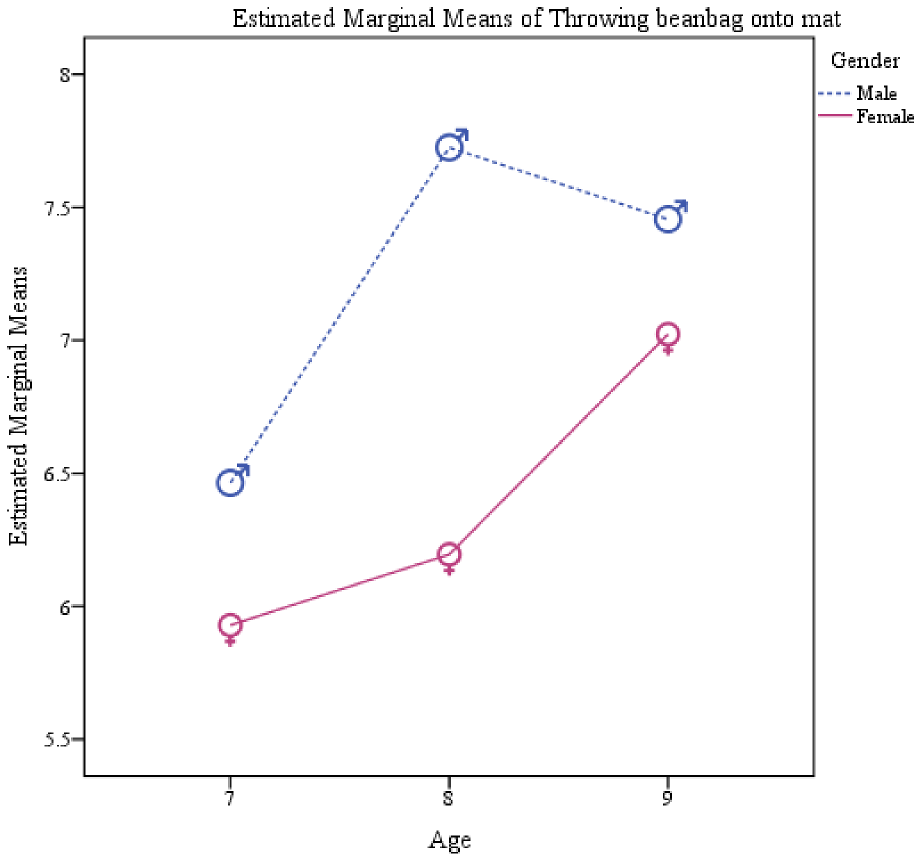

Figure 6.11: The gender by age effects on the “throwing beanbag onto mat” item

Table 6.21: Summary of simple effect analysis results

Interaction	Item	Results
Country-gender interaction	Walking heel-to-toe	• Gender differences in Kuwaiti sample, girls > boys. • UK boys and girls were better than the Kuwaiti boys and girls.
Country-age interactions	Walking heel-to-toe	• Age differences in Kuwait, 7yr < 8yr < 9yr. • UK children better than Kuwaiti children in all age groups.
	Hopping on mats	• Age differences in Kuwaiti sample, 7 yr < 8 & 9 yr and 8 yr = 9 yr. • UK 7 year old children better than Kuwaiti 7 year old children; no differences between other age groups.
Gender-age interactions	Catching with two hands	• Differences between males at ages 7 & 8 and 7 & 9; 8=9. • Differences between females in all age groups. • Male children better than female in all age groups
	Throwing beanbag onto mat	• Differences between males at ages 7 & 8 and 7 & 9; 8=9. • Differences between females at ages 7 & 9 and 8 & 9; 7=8. • Male children better than female at age eight only.

To sum up, the results of the 2×2×3 MANOVA test conform to the hypothesis that there are significant differences in motor abilities of Kuwaiti and UK children between 7 and 9 years old. However, there were no differences in “catching”, “throwing”, and "one-board balance other leg". An influence of country on the gender and age differences was shown in the simple effect analyses (Table 6.21).

6.4 Discussion

Our sample was likely to be representative of the Kuwaiti population, with all six Kuwaiti districts included and four different schools from each district randomly chosen to ensure an equitable representation of schools and children. All children were Kuwaiti citizens, whether in public or in private schools. The method of selection of children in each grade was based on the age to allow two age groups in each grade to be involved in the study. However, the study was limited by the school timeline and the small numbers of children of age five years and from private schools.

The MABC has been revised recently and our study introduces it for the first time in an Arab country. The motor skills of Kuwaiti children aged between 5 and 9 years were investigated from the individual MABC-2 items using the raw scores. Comparisons of motor performance of Kuwaiti children in individual items of were made based on differences in gender and school type. Other comparisons were made with UK children, the MABC-2 norm. The discussion was organized according to these three differences, gender, school type, and country.

6.4.1 Gender Differences

Evidence is conflicting on differences between boys and girls in motor development. We hypothesized that there is a difference in the motor abilities of Kuwaiti boys and girls in individual MABC-2 items.

However, authors of MABC (Henderson & Sugden, 1992) and MABC-2 (Henderson, et al., 2007) claimed that their items are free from gender bias. Our findings show significant gender differences in the motor ability of Kuwaiti children for age band one (5 to 6 years) and age band two (7 to 9 years) with large effects for both age bands (R^2 = 0.28 and R^2 = 0.29 respectively). Similar results were found in Australia, Canada, China, Israel, and Norway with the MABC (Chow, et al., 2001; Engel-Yeger, et al., 2010; Junaid & Fellowes, 2006; Livesey, et al., 2007; Sigmundsson & Rostoft, 2003). However, a study in Belgium found no differences between boys and girls in the motor performance as measured by MABC (Van Waelvelde, et al., 2008).

Although the difference between boys and girls in our study was significant, it did not show up in all MABC-2 items. We found that Kuwaiti boys and girls aged between 5 and 6 years were similar in all but three items. Boys were advantaged in catching and throwing, while girls were better at “walking heel raised”. At ages between 7 and 9 years, boys outperformed the girls in catching and throwing while girls were better at posting coins. These findings indicate specific task differences between genders.

All studies that have investigated gender differences in motor performance with the MABC have found specific task differences also (Chow, et al., 2001; Engel-Yeger, et al., 2010; Junaid & Fellowes, 2006; Livesey, et al., 2007; Sigmundsson & Rostoft, 2003). Having found gender differences in motor performance, it is appropriate to look at factors behind the differences: biological, cultural, and environmental.

Thomas and French (1985) argued that there is no difference between boys and girls in motor performance until they reach adolescence. They referred the differences in adolescence to biological factors. Prepuberty, boys and girls have similar muscle-fat ratios which change after puberty, when boys develop more muscles needed for motor tasks. However, several studies have found gender differences in motor ability at younger ages (Chow, et al., 2001; Livesey, et al., 2007), even as young as 6 months (Piek, Gasson, Barrett, & Case, 2002). Our results provide further evidence of gender differences in young children, suggesting biological or innate influences as reported by Piek et al. (2002).

However, if the gender differences are biological, why do they show up in specific tasks, in specific age groups, and in specific cultures but not others? The influence of each factor on motor development is age-related (To, Cadarette, & Liu, 2001). The effects of biological factors decline with age and the psychosocial factors become more influential. That is, because the biological factors are absolute, so their influence is more obvious in the first few years of life, up to three years. On the other hand, the psychosocial and environmental factors change over time, and so have changing impacts on the child's development - but they do not appear to influence the child's development before the age of two years (To, et al., 2001). This explains the conflicting evidence. Studies investigating gender differences in very young children (less than two years) found no gender bias in the attainment of developmental milestones (WHO, 2006a), while studies including older children (more than three years) found differences between boys and girls (Chow, et al., 2001; Livesey, et al., 2007). Nevertheless, the gender differences are task-specific.

The inconsistency in research findings has led to questioning about the involvement of other factors, such as environmental and cultural, explained in terms of socially gender-appropriate behaviour and the impact of training in physical activities.

In our study, "catching with both hands" and "throwing beanbag" were performed better by boys in both age bands, which is consistent with other reports (Chow, et al., 2001; Livesey, et al., 2007; Thomas & French, 1985). There is evidence that boys are more developed in the skills of catching and throwing balls (Ennis & Lazarus, 1990; van Beurden, Zask, Barnett, & Dietrich, 2002). Ennis and Lazarus (1990) found that boys developed catching skills better than girls. They measured the mechanisms of catching a ball and the gender differences in developing these mechanisms. The mechanisms are the ability to adjust the angle of approach, grasp, foot position, and body position. They suggested that the gender differences may be due to spatial ability where boys were advanced in adjusting their body at point of contact, in the manner of grasping, and adjusting their angle to approaching the ball. Watson and Kimura (1991) also found that boys were better in spatial ability. They found that boys were not only advantaged in throwing and intercepting but they were also more accurate in tasks involving intrapersonal and extrapersonal spaces; the space between target and the body. They also found no correlation between the advantage level of boys and their sport history and experience.

Thomas and French (1985) believed that the childhood gender differences in throwing were related to the fact that boys participated in competitive games and practice longer than girls. Practice and experience enhance task performance (Sigmundsson & Rostoft, 2003), so task-specific training is important because of the involvement of neuro-motor and perceptual-motor subsystem in the task that needs to be turned on (Haga, et al., 2008). Hence, environmental factors play a role in motor development. Involving children in gender-specific learning environments that enhance non-mastered skills could reduce differences in motor performance between boys and girls (van Beurden, et al., 2002).

We also found gender effects in one of the balance items which indicate task-specific differences, consistent with other studies (Chow, et al., 2001; Livesey, et al., 2007). The gender differences were in "walking heel raised" where girls performed better than boys but at the younger age (5-6) only, in line with Humphriss, Hall, May, and Macleod (2011). However, Chow et al. (2001) and Livesey et al. (2007) also found that girls were better than boys in "one leg balance".

Although "walking heel raised" and "one-leg balance" are both balance skills, the former involves dynamic balance while the latter is static balance. No correlation was found between static and dynamic balance because the mechanisms are different (Humphriss, et al., 2011). Both skills need sufficient muscle strength to support the body during executing the task. To understand the mechanism of static standing, for example, a study examined its relationship with quadriceps-hamstring ratio and the effect of gender differences. It has been found that girls had significantly stronger quadriceps compared with their hamstrings while boys had stronger hamstrings compared with their quadriceps, explaining why girls are significantly better in static balance than boys (Holm & Vllestad, 2008). This example gives further evidence for the role of biological factors in gender differences. However, muscle strength is also developed by training, which explains environmental influence.

We believe that isolating factors from each other in order to understand gender differences in motor performance and development is impossible because of their close relationship. Motor development involves an integration of biological, environmental, and cultural factors. Motor performance is a movement execution, and movement results from interactions between the individual, the task, and the environment (Shumway-Cook & Woollacott, 2001). Biological factors are represented by the interaction of three systems within the individual: cognitive, perceptive, and motor. Tasks represent individual demands on functioning within a living environment and interpreted as stabilizing, mobilizing, or manipulating actions. Finally, there are both internal and external environments that influence the movements. Cultural factors contribute to both the task and the environment through personal and social needs (Shumway-Cook & Woollacott, 2001).

The gender differences found in our study were large enough to recommend that gender differences be considered in clinical sessions. As Livesey et al. (2007) commented, gender differences should be considered when testing motor performance and there is a need for separate norms for boys and girls. There is no study assessing the gender differences in motor development in Kuwait or the influences of culture and environment on children’s motor development. Kuwaiti culture might play a role in sex-appropriate behaviour. Further studies are suggested to examine the influence of the Kuwaiti environment on children’s motor abilities. Studies should involve younger (kindergarten) and older children, as well as additional motor activities.

6.4.2 School Type Differences

In Kuwait, there are many differences between public and private schools based on curriculum, number of children per class, teacher gender, class teacher, teacher assistance, and in-school and after-school activities which are expected to enhance the motor ability. The private school curriculum includes more sports activities like swimming and also encourages after-school activities, and it would be expected that these children might be more competent than those in public schools. Therefore we hypothesized that there would be a difference in the motor abilities of Kuwaiti children in public and private schools.

Our findings show that the impact of the school type on the motor ability of Kuwaiti children was significant only in older children (7 to 9 years). Although the effect of the difference between public and private schools was large, the differences were in two items only. Children in public schools were significantly better on “one-board balance using best leg”, whereas in private schools children were significantly better at “drawing”.

It is unlikely that difference in the balance item is due to the school curriculum because there are three MABC-2 balance items and the difference occurred only in one. Any impact of school curriculum should affect other items like “one-board balance using other leg”, “walking heel-to-toes” and “hopping”. The only possible explanation may be related to the mechanism of one-leg balance. We need to know the difference in the mechanisms of each balance item to understand the relationship between school activities and the development of these balance items in order to speculate why children in public schools were better in one-board balance than those in private schools and not other balance items.

The current study included five private schools, each following an American, British, or Canadian curriculum. One of the study limitations was the small number of private schools participating. The number of children was also too small to generalize the findings. Further studies are needed to assess the differences in the curricula and their impact on the children’s motor abilities.

There was another significant difference between public and private schools, the “drawing” task. In spite of the small number of children in private schools, children in private schools made significantly fewer errors in drawing than children in public schools. It should be noted that the differences in the drawing task were marked between children in grades two to four (7 to 9 years old) where the demand for writing is more than in grade one (5 to 6 years old).

One of the explanations for this difference may be related to the school curriculum. English is the main language in the private schools so the direction of the writing is from left to right, similar to the direction used in the drawing task, while in public schools the writing is in Arabic which has the opposite direction, from right to left. Using the pen in the opposite direction could cause confusion and errors.

Similarly, Miyahara et al. (1998) found that the Japanese children were worse than American children in the drawing task, which may be explained by the fact that Japanese writing is in a vertical direction and without continuity of pen-paper contact (Miyahara, et al., 1998).

The school differences of writing in one language more than the other found in the upper ages (7 to 9 years) may result in differences in fine motor performance. However, there was no effect of school curriculum in primary schools in Kuwait on children at grade one (5 to 6 years) for writing which might explain the role of practicing writing in enhance writing ability.

Similarly, Chow et al. (2001) found that practicing writing as young as 3 years old impacts on the performance of Chinese 4 to 6-year-olds, who performed better than the American children in the MABC drawing task. They added that Chinese children are trained to use chopsticks as early as two years which emphasizes the importance of practicing on the performance of hand coordination.

However, the mechanisms of handwriting are based on many aspects: direction of hand movements, movement control, eye-hand coordination, postural control, fine motor control, visual-motor integration, and cognitive and working memory process (Volman, et al., 2006). Hence, the drawing task is not based on only the direction of movement. Deficits of one or more of these mechanisms could lead to poor quality of drawing and increased errors. Hence, the information gathered from our data is not enough to speculate the causes of the differences between public and private schools on the drawing task. Further studies are needed to investigate this as well as investigating the suitability of the standardized items in Kuwaiti culture.

6.4.3 Country Differences

The final hypothesis investigated whether there was a difference in motor abilities between Kuwaiti children and UK children on the MABC-2 individual items, and our study found differences all ages. At 5 to 6 years, UK children were better at “posting coins” and “drawing”, whereas Kuwaiti children were better at “throwing bean bags onto mat”. UK children at 7 to 9 years were significantly better than Kuwaiti children on all items except “catching with two hands”, “throwing beanbag onto mat”, and “one-board balance other leg” where children from the two countries were similar.

UK children in both age bands performed the “drawing” task with significantly fewer errors than Kuwaiti children ($p < 0.001$) which may indicate the role of the school curriculum in children's ability, as discussed previously.

There were country-age effects on the performance of “walking heel-to-toe” and “hopping on mats best leg” at 7 to 9 years old, with differences between age groups in these two items in Kuwaiti children but not in UK children, whose performance was similar between age groups. UK children between 7 and 9 years were better than Kuwaiti children at “walking heel-to-toe” and at age seven year in “hopping”. This may be explained by differences between cultures, environment, and life style.

It is difficult to interpret the findings of the poorer performance of the seven-year-old Kuwaiti children for two reasons. First, our study was cross-sectional, showing that seven-year-olds had lower performance and we do not know whether children at ages of eight and nine would have been the same and then caught up. This needs a longitudinal study to investigate the motor ability of Kuwaiti children in these two items in particular, but with other items and a wider range of age groups, younger and older than in our study.

Second, the lower performance seen in Kuwaiti age groups was task-specific. Both items are balance items that need good body balance control and coordination. The walking pattern matures by three years and peaks with the adult pattern evident at seven years. “Hopping” is mastered at age 6.5 years (Shumway-Cook & Woollacott, 2001). “Walking heel-to-toe” is more advanced than normal walking and requires more balance and coordination of body segments. It has been found that the development of walking and hopping are determined by the development of balance control rather than chronological age (Sundermier, Woollacott, Roncesvalles, & Jensen, 2001). Postural control is essential for motor development, so Kuwaiti children may have a delay in developing balance control and poor performance could be seen in these skills.

Kuwaiti culture and lifestyle may impact on the development of balance control for these skills. From a cultural perspective, Kuwaiti children now differ from those in previous generations who grew up playing many games that require hopping, one-leg balance, walking with eyes closed, and jumping rope. Modernization and technical evolution has resulted in children spending most of their time in stationary positions in front of computers for both study and play. It may be argued that all children worldwide, including UK children, also spend much time with computers and they did not show these differences. Cultural perspectives and lifestyles differ between these countries and some cultures encourage children to be involved in sport activities. However, these considerations need further investigation to find the factors for poor performance of Kuwaiti children in these two skills, particularly for children at seven years of age.

Several studies have found the performance of children from different countries differed from the American children, the original MABC norms, and are explained by cultural differences. Chinese children were superior to the American children in manual dexterity and balance, while the American norm was better in ball skills on the MABC (Chow, et al., 2001). Chinese children were better particularly in “posting coins with preferred hand”, “drawing”, “walking heel raised”, and jumping tasks, and this shows the impact of Chinese culture. Chinese children start writing as early as three years and eat with chopsticks as young as two years. They also use public transport more, so frequently jump on and off buses. These cultural activities may contribute to the superiority of Chinese children in these activities in particular.

Gender-age related differences were found between Japanese children and American children (Miyahara, et al., 1998). The American children were superior at all MABC tasks regardless of gender and age. Japanese children performed significantly better than American in four tasks depending on gender and age. Nine-year-olds were better in the “hopping” task, ten-year-olds were better at the “ball-balance” task, seven- and eight-year-old girls were better at both dynamic balance tasks, and eleven-year-old girls were better at “cutting out the elephant”. Unicycle riding is a popular activity in Japan and the sample children were recruited from a school that encourages unicycling at the school, to which the superiority in balance tasks may be attributed. The task “cutting with scissors” is fairly similar to the task of “eating with chopsticks”, which is the eating method in Japan.

The Flemish children also performed better in manual dexterity tasks than American children of the MABC norm (Van Waelvelde, et al., 2008). There are differences in the educational systems between America and Flanders. Flemish children start preschool earlier at two years old. At age four to five, they have a more formal curriculum that emphasises training of different skills including writing. Flemish children are competent in graphic skills at the age of five which may explain the superiority of Flemish children in manual dexterity.

On the other hand, two studies found similarities between children and the MABC norms in all items except two, although the effect size was small (Livesey, et al., 2007;

Rˆsblad & Gard, 1998). Australian children performed better than the American norms in the drawing task and "walking with heels raised" (Livesey, et al., 2007). The Swedish children performed similarly to the American children in all tasks of the MABC except in two items, one item in ball skills and one in balance skills. Swedish children were better than American children in "one-leg balance using non-preferred leg" which may be influenced by cultural differences as they ski and skate at an early age (Rˆsblad & Gard, 1998).

It can be seen from several studies that used the MABC to evaluate the motor ability of children from different countries that country differences were present, due to differences in both culture (Chow, et al., 2001; Miyahara, et al., 1998) and educational systems (Van Waelvelde, et al., 2008). Other differences that occur between western countries (Livesey, et al., 2007; Rˆsblad & Gard, 1998) shed light on the possibility of the influence of the environment in the motor development of specific tasks.

6.5 Summary

Investigation of child motor development is challenging because of the complexity of the interaction and integration of several factors such as biological, environmental, and cultural. There is no available study of the motor performance of Kuwaiti children so we have no knowledge of their motor ability. In this study, the motor performance of Kuwaiti children between 5 and 9 years old was investigated through the MABC-2 individual motor tasks. Comparisons were made between gender, age, school type (showing differences between Kuwaiti children by gender and age) and with UK children showing task-specific differences. The differences between Kuwaiti children in public and private school were in the upper age group (7-9 years).

Assessing ability in individual motor task requires fundamental measurement of individual skills, essential as a reference for establishing physical activities programs and planning for suitable intervention. Our findings, which emphasize gender and cultural differences, suggest that Kuwaiti children are in general behind their counterparts in the UK in development, possibly influenced by culture and/or environment. These findings require future investigations to know the factors influence motor ability of Kuwaiti children.

7 Identification of Movement Difficulty Using the MABC-2

7.1 Introduction

Evaluation of motor performance of children is essential for clinicians and researchers to understand the concept of development of children. It also helps in detecting motor delay and motor impairments. Poor motor development in early childhood may have negative consequences in later childhood (Lansdown, et al., 1996; To, et al., 2001). Therefore, intervention can be established to enhance the optimal motor development. Motor performance can be measured using the raw scores of the MABC-2 items for the performance of children in individual tasks, but cannot identify the motor impairments. Motor impairment is determined by the total score at the 5^{th} and 15^{th} percentiles, based on population norms.

Therefore, this chapter investigates the motor competency of Kuwaiti children aged between 5 and 9 years at the two cut-offs, $\leq 5^{th}$ percentile and between $> 5^{th}$ and $\leq 15^{th}$ percentile. The chapter also investigates the validity of the MABC-2.

The differences in motor performance of Kuwaiti boys and girls, and between children in public and private schools on the standardized MABC-2 are described. The motor performance was measured for the total score, and also for the components (manual dexterity, aiming and throwing, and balance) which could not be assessed using the raw scores as they are calculated using standard scores of individual items.

The differences in motor abilities between Kuwaiti children and UK children on the MABC-2 total score and its three components are reported.

We hypothesised that:

1. There are differences in the number of Kuwaiti children identified in the 5th and 15th percentiles compared with studies in other countries.
2. The MABC-2 is a valid tool identifying children with DCD in the Kuwaiti population.
3. There are differences in motor performance of Kuwaiti children between public and private schools, by gender, and between different age groups based on the total score and the three components; manual dexterity, aiming and throwing, and balance.
4. There are differences in motor ability of Kuwaiti children aged 5 to 9 years and UK children based on the total score of the MABC-2 and its three components.

7.2 Data Analysis

Standard scores were used for this chapter instead of raw scores, for three reasons. First, the aim was to identify the movement difficulties of Kuwaiti children aged 5 to 9 years. Movement difficulty is measured by the performance in the MABC-2 total score which requires a summation of the three components, manual dexterity, aiming and catching, and balance. Each of these three components is obtained from the summation of two or three individual items. Because the measurement for each item is different, the raw scores are converted to standard scores.

Second, assessing motor competency and identifying movement difficulties require equalizing the total score to a range of percentiles (from 0.1 to 99.9) that indicate three different levels of motor competency. According to the MABC-2 manual, the motor competency can be grouped into three levels according to the percentile score: significant movement difficulties equal to or below the 5th percentile, at risk of movement difficulties above the 5th percentile and equal to or below the 15th percentile, and no movement difficulties above the 15th percentile.

Third, in the previous chapter we investigated the motor performance of Kuwaiti children in the MABC-2 individual items to obtain the fundamental measures of individual skills. Here, we are interested also in evaluating the skill profile for each child obtained from particular components.

Therefore, the data used for the analyses in this chapter were the MABC-2 total score and the component scores for manual dexterity, aiming and catching, and balance.

- For hypothesis one, the percentage of children in each group was calculated and reported separately for total sample, gender, age groups, and UK sample. Pearson Chi-Square was also calculated for each variable.
- For hypothesis two, principle component analysis (PCA) was also carried out on the MABC-2 scores for age bands one and two, public school, and private school.
- For hypothesis three, gender, age, and school type (2×5×2) ANOVA was done for the total score. Gender, age, and school type (2×5×2) MANOVA was done for the three MABC-2 components.
- For hypothesis four, country, gender, and age (2×2×5) ANOVA was done for the total score. Country, gender, and age (2×2×5) MANOVA was done for the three MABC-2 components.

7.3 Results

The results were organized according to the hypotheses.

7.3.1 Percentages of Kuwaiti Children in the MABC-2 Categories

Figure 7.1 shows the percentage of Kuwaiti boys and girls in each category: out of the 297 children, 53 children (28 boys and 25 girls) had significant movement difficulty ($\leq 5^{th}$ percentile) and 78 children (41 boys and 37 girls) were at risk of having movement difficulty ($5^{th} <$ and $\leq 15^{th}$ percentile).

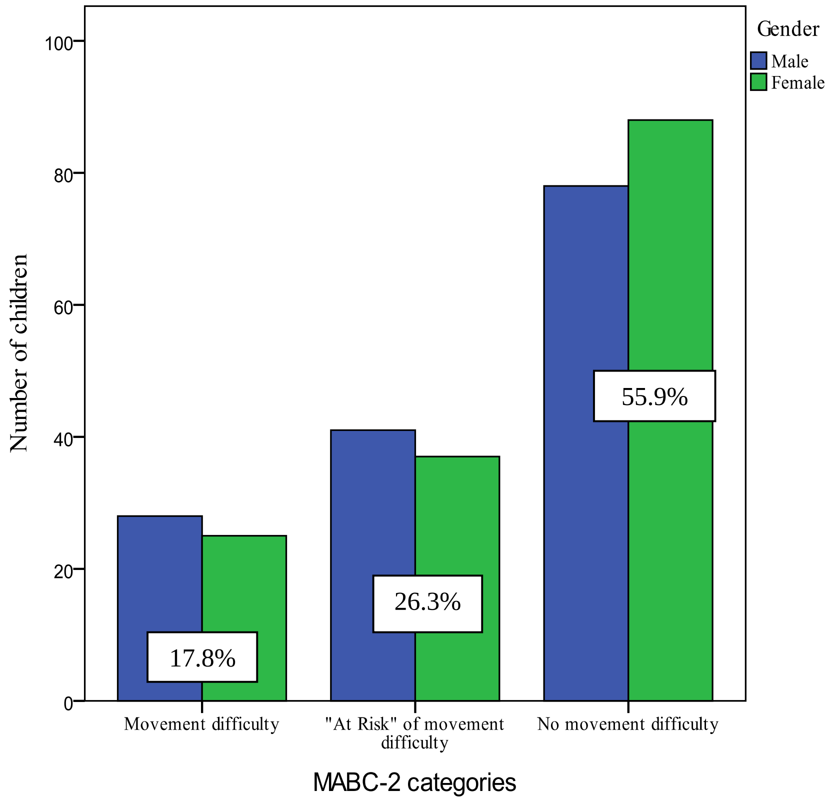

Figure 7.1: Categorization of Kuwaiti sample according to MABC-2 percentiles

From Figure 7.2 the percentage of Kuwaiti children in each category is also significantly higher than the percentage of UK children; Pearson Chi-Square (2) = 64.173, $p < 0.001$.

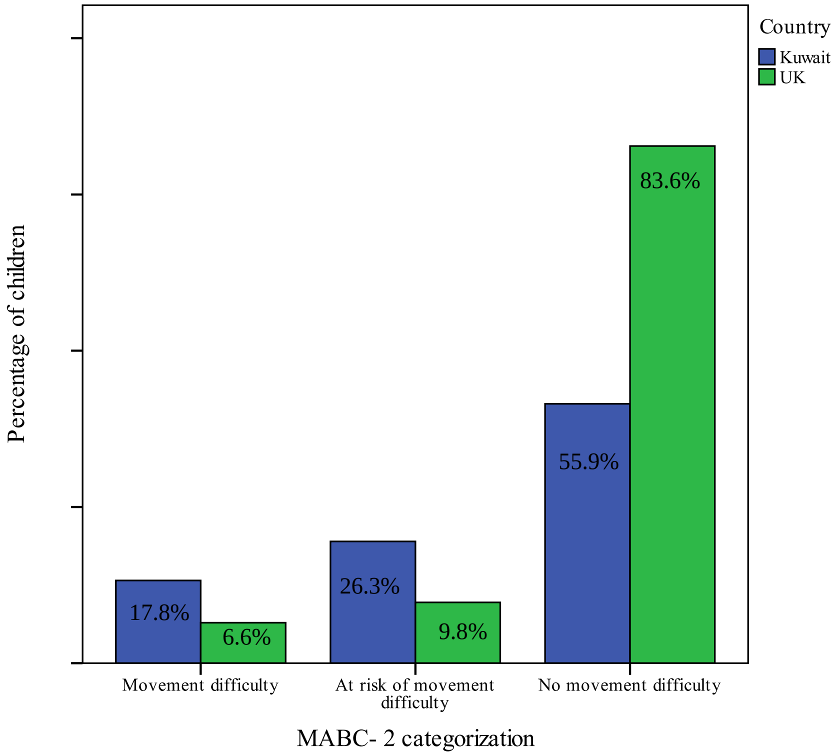

Figure 7.2: Percentages of Kuwaiti and UK children in each MABC-2 category

Figure 7.3 shows the percentage of Kuwaiti children based on their age in the three categories: more children are “at risk” of movement difficulties at age six, seven, and eight years, while there are more children with movement difficulties at seven years; Pearson Chi-Square (4) = 10.128, p = 0.038.

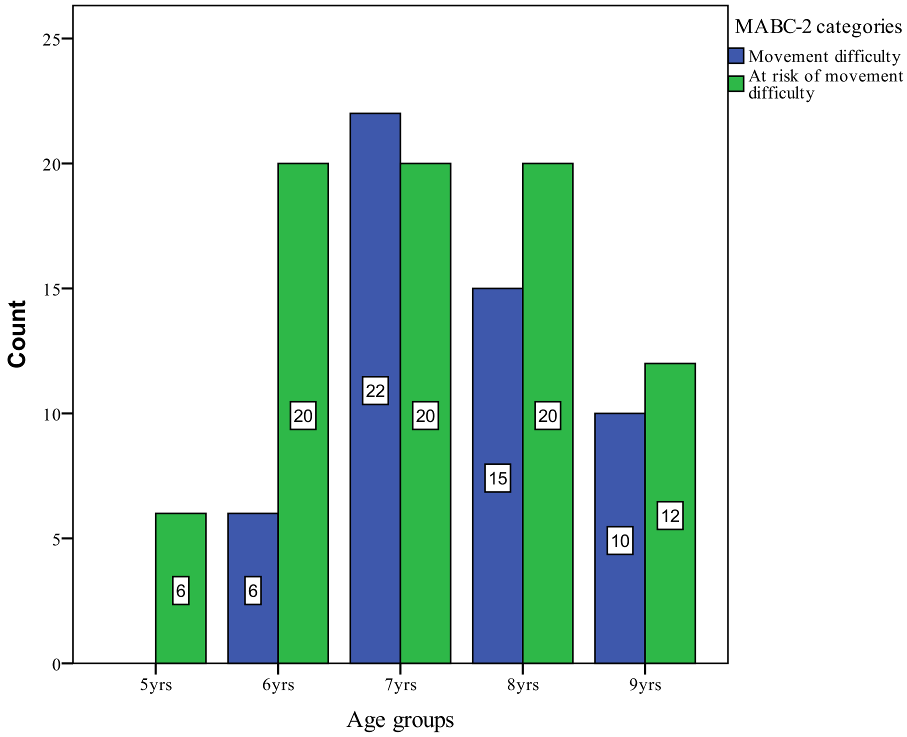

Figure 7.3: Number of Kuwaiti children in MABC-2 categories one and two by age group

Based on these results, the questions that arise are whether the percentage of Kuwaiti children aged between 5 and 9 years with movement difficulties or at risk of movement difficulties are indeed higher than what is reported, and whether the MABC-2 is a valid tool for the Kuwaiti culture? It may not be sufficiently culturally sensitive for use in a non-western culture; it has not been used on Kuwaiti children before nor have its reliability and validity been tested. Further analysis was required to assess the construct validity of MABC-2 to decide if Kuwait has a higher incidence of children with movement difficulties, so principle component analysis was used to measure its internal consistency.

7.3.1.1 Principle Component Analysis

Principle component analysis (PCA) was performed to explore the underlying component structure of the MABC-2 items (Appendix E). PCA was performed separately for each age band (AB1 and AB2) as each has a different number of items (10 and 11 respectively). The sample population was 297 (AB1 = 92 and AB2 = 205) but for AB2 there were missing values for 11 children who failed to perform both trials during the test; the omissions were in the manual dexterity 1 & 2, catching, and throwing tasks. The score recorded “F” in the raw score which was treated as a missing value.

Age Band One for Children Aged Five to Six Years

Prior to running the PCA there are five assumptions to test. The independence and sample size assumptions were met; the sample size was large. For the normality assumption, although the Shapiro-Wilk tests were significant for all variables, the histogram, Q-Q plot, Box plot, skewness and kurtosis were normally distributed for almost all variables except “drawing”, “walking heel raised”, and “jumping”. However, the PCA is fairly robust against violations of the normality assumption and the normality tests are sensitive to even trivial departures from normality (Allen & Bennett, 2008). The linearity assumption was met as all the variables had linear relationships with each other. The multicollinearity was also met; the squared multiple correlations between variables did not reach the problematic value (r = 0.85). All assumptions were met, so the PCA could be run safely.

An examination of the Kaiser-Mayer-Olkin measure of sampling adequacy suggested that the sample for AB1 was poor (KMO = 0.58, below the commonly recommended value of 0.6). Bartlett’s Test of Sphericity was significant (χ^2 (45) =169.08, $p<0.001$) indicating that the sample was randomly drawn from the population.

The correlation matrix indicated low to moderate correlations between variables except for the “one-leg balance best leg” which has a large correlation with the “one-leg balance for the other leg” (r = 0.78). The diagonal of the anti-image correlation matrix (MSA) were all over 0.5 except for the “drawing” task (0.44). Based on this result, the drawing task should be removed before continuing the PCA. The MSA for the “posting coins with the non-preferred hand” was only just below 0.5 (0.498) and was not excluded.

After the “drawing” task was removed, the KMO increased (0.59), and all MSA values increased. These MSA values were not good, ranging from 0.50 to 0.71 but were not low enough to justify the removal of variables, especially as the number of variables is small. Based on the results obtained from the extraction communalities, all nine variables were above 0.3 except for "throwing beanbag onto mat" which was very low (0.21) and therefore removed.

Based on the PCA results after deleting “drawing” and “throw to floor target” items, the Kaiser-Mayer-Olkin measure of sampling is factorable (KMO = 0.60) and Bartlett’s Test of Sphericity was significant (χ^2 (28) = 151.15, p <.001). The MSA values for the eight variables increased, all being above 0.5 and ranging from 0.54 to 0.74. The communalities were all above 0.3 indicating that each item shared some common variance with other items (range between 0.52 - 0.82) and there was no extraction for any items.

Given these overall indicators, the PCA is suitable for the eight items. From the initial eigenvalues, there are three components to be retained (Figure 7.4). In total they explained 63.23% of the variance; the first component accounted for 28.9% of the variance, the second component for 20.5% of the variance, and the third component for 13.9% of the variance (Table 7.1).

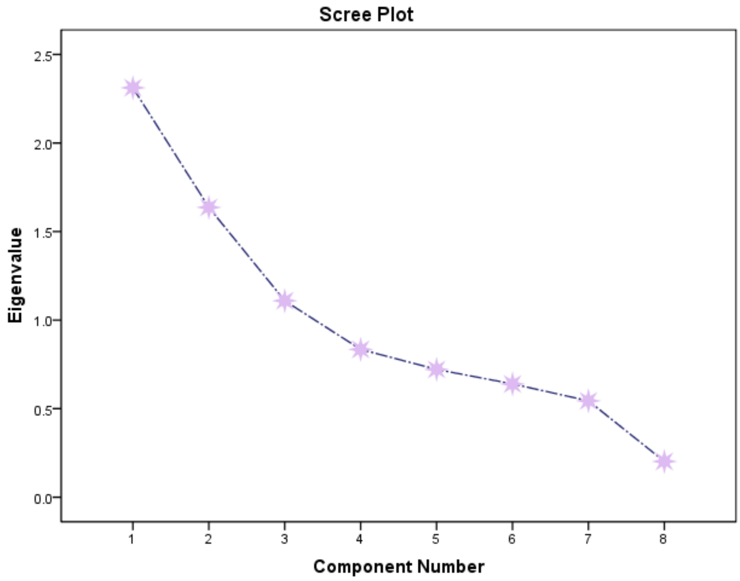

Figure 7.4: Scree plot explaining the three factors

Based on the PCA, the eight items loaded on three components with moderate to high loadings ranging from 0.50 to 0.85. Using varimax rotation, all items had primary loadings greater than 0.5. One item ("one leg balance - other leg") had a cross-loading of 0.33. However this item had a strong primary loading of 0.81.

Table 7.1: Component loadings and communalities based on PCA with varimax rotation for 8 MABC-2 items

	Balance	Manual dexterity	Bilateral activities
One leg balance - best leg	**0.87**		
One leg balance - other leg	**0.81**		0.33
Walking heel raised	**0.72**		
Post coins - non-preferred hand		**0.75**	
Post coins - preferred hand		**0.72**	
Threading beads		**0.70**	
Catching beanbag			**0.77**
Jump on mats			**0.73**
Eigenvalue	2.31	1.64	1.11
% Variance	28.90	20.46	13.87
Total %Variance		**63.23**	

Note. Components loadings <0.3 are suppressed. Component loadings > 0.45 are in boldface.

From Table 7.1, it can be seen that three items loaded on component one relating to "balance". There are three items loading on component two relating to "manual dexterity". Each of these components has items related to each other and measure one aspect of motor ability similar to the MABC-2. However, the last two items "catching beanbag" and "jumping". which are heavily loaded on component three, measure different aspects of motor ability; ball skill and dynamic balance respectively. This component was named "bilateral activities" as the mechanism of the task is required to use both limbs (right and left) to perform the task whether using lower limbs as in a jump or upper limbs as in catching.

Internal consistency for each component was examined using Cronbach's alpha. The alpha was moderate for balance (0.74) but low for manual dexterity (0.34) and bilateral activities (0.36). There was a substantial increase in the alpha level for "balance" and "manual dexterity" by eliminating one item from each of them. For component "balance", the item "walking heel raised" was eliminated and the reliability was repeated and showed high alpha scores; it was renamed "static balance". For component "manual dexterity", the reliability test was done after eliminating the item threading beads which showed an increase in the alpha value (Table 7.2).

Table 7.2: Descriptive statistics for the three components (N = 92)

	No. of items	Mean (SD)	Skewness	Kurtosis	Alpha after deletion
Manual dexterity	2	41.38 (3.46)	0.77	1.58	0.43
Static balance	2	36.80 (16.90)	-0.05	-1.26	0.88
Bilateral activities	2	12.59 (2.36)	-1.38	1.65	0.36

Based on the mean of the items which had their primary loadings on each component, composite scores were created for each component (Table 7.2). The higher score is an indicator of a better measure of motor ability. It can be seen from the Table that manual dexterity was the component that best describes motor ability for Kuwaiti children aged 5 to 6 years with a positive skewed distribution. The static balance was the second measuring component with a negative skewed distribution.

Having looked at the relationships between the MABC-2 items through the PCA, it was appropriate to test the correlation between the items in order to investigate the direction and magnitude of the associations between them. The correlation analyses were run for the eight items for age band one (Table 7.3), showing that there were significant positive correlations between the "manual dexterity" items "post coins using preferred and non-preferred hand" and "threading beads". However, the "drawing" task had no correlation with the three items on the manual dexterity or with other items ($p > 0.05$) supporting the PCA results. There was a significant correlation between the "drawing" task and the "jumping" task but the association between them was small. (It was negative because of the way each is scored: the small score is better for the "drawing" task, while the large score is better for the jumping task.)

The "throwing" task had a significant correlation with "catching with both hands" but with a small association. The "throwing" task had also a significant correlation with "one leg balance using best leg" task but the association was also small.

Although the "jumping" task had moderate significant correlations with "one-leg balance best leg and other leg", there was no correlation with the "walking heel raised" task. There was a moderate significant correlation between "walking heel raised" and "one-leg balance best leg and other leg". This finding confirmed the PCA; the "jumping" task did not load with other balance tasks.

Table 7.3: Correlations between MABC-2 items

		PC-PH	PC-NPH	TB	D	CBB	TBM	OLB-BL	1LB-OL	WHR	JOM
PC-PH	PC	1	**.292****	**.333****	-0.024	-0.113	-.173	-.105	-.055	-.031	-.033
PC-NPH	PC	**.292****	1	**.293****	-.048	-.188	-.030	-.043	.022	-.106	.069
TB	PC	**.333****	**.293****	1	-.048	-.190	-.117	-.035	-.114	.045	-.048
D	PC	-.024	-.048	-.048	1	.010	-.056	-.055	-.098	-.020	**-.222***
CBB	PC	-.113	-.188	-.190	.010	1	**.209***	.135	.182	-.017	**.297****
TBM	PC	-.173	-.030	-.117	-.056	**.209***	1	**.208***	.132	.186	.037
OLB-BL	PC	-.105	-.043	-.035	-.055	.135	**.208***	1	**.779****	**.390****	**.309****
OLB-OL	PC	-.055	.022	-.114	-.098	.182	.132	**.779****	1	**.297****	**.297****
WHR	PC	-.031	-.106	.045	-.020	-.017	.186	**.390****	**.297****	1	.138
JOM	PC	-.033	.069	-.048	**-.222***	**.297****	.037	**.309****	**.297****	.138	1

PC = Pearson Correlation; PC-PH = post coins - preferred hand; PC-NPH = post coins - non-preferred hand; TB= threading beads; D = drawing; CBB = catching beanbag; TBM = throwing beanbag onto mat; OLB-BL = one leg balance - best leg; OLB-OL = One leg balance - other leg; WHR = Walk heels raised; JOM = jumping on mats.
**Correlation is significant at the 0.01 level (2-tailed)
*Correlation is significant at the 0.05 level (2-tailed);
Number of children = 92

To sum up, these analyses showed that three distinct components were the basis of motor performance of Kuwaiti children aged 5 to 6 years using MABC-2, and these components were mildly to highly internally consistent. Two items out of ten, drawing and “throwing beanbag onto mat”, were excluded before the PCA, and another two items, “threading beads” and “walking heel raised”, were excluded during the reliability measurements in order to improve the internal consistency. Although all the variables were loaded on to three components similar to the standardized tool, the task “jump on mat” did not load on the same component with other balance tasks as found in MABC-2.

Age Band Two for Children Aged Seven to Nine Years

Prior to running the PCA for age band two, there were five assumptions to test. The independence and sample size assumptions were met; the sample size was larger than 100. For the normality assumption, although the Shapiro-Wilks tests were significant for all variables, the histogram, Q-Q plot, Box plot, skewness and kurtosis were approximately normally distributed for almost all variables except drawing, lacing board, and hopping. However, the PCA is fairly robust against violations of the normality assumption and the normality tests are sensitive to even trivial departures from normality. The linearity assumption was met; all the variables had linear relationships between each other. The multicollinearity was also met; the squared multiple correlations between variables did not reach the problematic value ($r = 0.85$). All assumptions were met, so the PCA could be run safely.

From the PCA for the eleven variables in age band two, an examination of the Kaiser-Mayer-Olkin measure of sampling adequacy suggested that the sample for AB2 was good (KMO = 0.76, above the commonly recommended value of 0.6). Bartlett’s Test of Sphericity was significant ($\chi^2 (55) = 672.28$, $p < .001$) indicating that the sample was randomly drawn from the population. These two results indicate that there is a relationship between variables.

The correlation matrix showed a moderate correlation between variables and the diagonal of the anti-image correlation matrix for the variables were all above 0.5; the MSA values for all variables were moderate to large (ranging from 0.68 to 0.92).

Based on the results from the extraction communalities, all variables were above 0.3 indicating that they fit well with the component solution. However, the value of the drawing in the extraction communalities was 0.39, lower than the rest of the variables (range 0.51 to 0.84). Looking further into the PCA and the results obtained from the component matrix and rotated component matrix, it was found that the “drawing” item was moderately cross-loaded on to two components, with the “hopping” items (-0.51) and with “placing pegs” items (0.34). Therefore, based on the extraction communalities and rotated component matrix, the “drawing” item was considered problematic. As it was also found to be problematic in age band one it was excluded from the analysis in order to determine whether the results improved.

After deleting the “drawing” item, although the Kaiser-Mayer-Olkin measure of sampling adequacy declined slightly (KMO = 0.75), it is above the commonly recommended value of 0.6 and Bartlett’s Test of Sphericity was significant (χ^2 (45) = 628.28, $p < 0.001$). The MSA values were similar to before, moderate to large (ranging from 0.68 to 0.92). The communalities for all variables increased, moderate to high with values above 0.3 (ranging from 0.51 to 0.85) indicating that no variables were extracted. Given all indicators, the PCA was carried out with 10 variables. The eigenvalues increased from 62% of the variance to 72.5%.

PCA was conducted for the 10 variables and the eigenvalues identified four components after extraction based on the eigen above 1. The four component solution explained 72.5% of the variance; the first component explained 36.2% of the variance, the second 14.1%, the third 11.9%, and the fourth 10.3% (Figure 7.5).

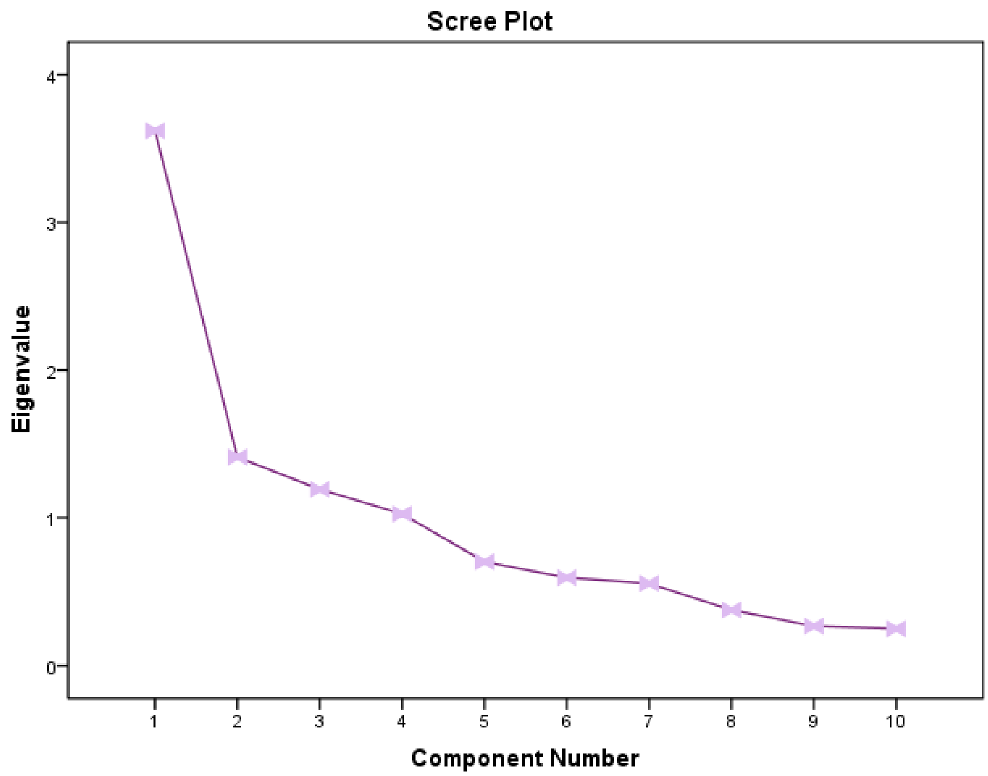

Figure 7.5: Scree plot showing the four components explained by variance

Using the varimax rotation and with the four components explaining 72.5% of the variance, all variables were moderately to highly primary loaded over 0.5 and two variables were cross-loaded, “walking heel-to-toe” and “lacing board” (Table 7.4).

Table 7.4: Component loadings based on PCA for 10 MABC-2 AB2 items

	Component			
	Balance	Hopping	Manual dexterity	Aiming and catching
One-board balance - other leg	**0.92**			
One-board balance - best leg	**0.88**			
Walking heel-to-toe	**0.50**	0.37	-0.34	
Hopping - best leg		**0.86**		
Hopping - other leg		**0.82**		
Lacing board		**-0.57**	0.41	
Placing pegs - preferred hand			**0.88**	
Placing pegs - non-preferred hand			**0.83**	
Catching with two hands				**0.84**
Throwing beanbag onto mat				**0.79**
Eigenvalue	3.62	1.41	1.19	1.03
% Variance	36.21	14.12	11.93	10.27
Total % Variance	**72.53**			

Note. Component loadings <0.3 are suppressed. Component loadings > 0.45 are in boldface.

Component one was labeled "balance"; component two, "hopping"; component three, "manual dexterity"; and component four, "Aiming and catching". Internal consistency for each component using scale reliability was calculated. Cronbach's alphas were moderate: 0.78 for balance, 0.84 for hopping, 0.55 for manual dexterity, and 0.54 for catch and throw. There were substantial increases in alpha, to 0.85 and 0.76 respectively, on eliminating item "walking heel-to-toe" from the component balance and item "lacing board" from the component manual dexterity. Therefore, the internal consistency of the four components was high for all components except for "aiming and catching", which was moderate.

Table 7.5 shows that manual dexterity was the measuring component for the motor ability of Kuwaiti children aged 7 to 9 years, with positive skewed distribution. Balance became the second measuring component with a positive skewed distribution, and "aiming and catching" was the third measuring component with negative skewed distribution.

Table 7.5: Descriptive statistics for the four components (N = 205)

	No. of items	Mean (SD)	Skewness	Kurtosis	Alpha
Manual Dexterity	2	67.48 (10.79)	1.03	1.67	0.76
Aiming and catching	2	13.19 (4.25)	-0.14	0.30	0.54
Balance	2	27.02 (15.63)	0.68	-0.54	0.85
Hopping	2	8.05 (2.41)	-1.44	1.77	0.84

Further analysis determined the correlation between the items of MABC-2 for age band two to assess the strength and direction of the association and relationship between items (Table 7.6).

Table 7.6: Correlation between MABC-2 items in age band 2

		PP-PH	PP-NPH	LB	D	CB	TFT	OBB-BL	OBB-OL	WHTT	HM-BL	HM-OL
PP-PH	PC	1	.623**	.312**	.256**	-.088	-.172*	-.259**	-.176*	-.345**	-.242**	-.208**
	N	201	197	199	201	201	201	201	201	201	201	201
PP-NPH	PC	.623**	1	.317**	.336**	-.124	-.162*	-.314**	-.276**	-.339**	-.283**	-.256**
	N	197	200	198	200	200	200	200	200	200	200	200
LB	PC	.312**	.317**	1	.363**	-.079	-.122	-.277**	-.201**	-.377**	-.406**	-.360**
	N	199	198	203	203	203	203	203	203	203	203	203
D	PC	.256**	.336**	.363**	1	-.194**	-.181**	-.221**	-.147*	-.281**	-.358**	-.248**
	N	201	200	203	205	205	205	205	205	205	205	205
CTH	PC	-.088	-.124	-.079	-.194**	1	.416**	.094	.063	.133	.247**	.268**
	N	201	200	203	205	205	205	205	205	205	205	205
TBM	PC	-.172*	-.162*	-.122	-.181**	.416**	1	.233**	.175*	.176*	.240**	.307**
	N	201	200	203	205	205	205	205	205	205	205	205
OBB-BL	PC	-.259**	-.314**	-.277**	-.221**	.094	.233**	1	.743**	.473**	.344**	.392**
	N	201	200	203	205	205	205	205	205	205	205	205
OBB-OL	PC	-.176*	-.276**	-.201**	-.147*	.063	.175*	.743**	1	.421**	.233**	.293**
	N	201	200	203	205	205	205	205	205	205	205	205
WHTT	PC	-.345**	-.339**	-.377**	-.281**	.133	.176*	.473**	.421**	1	.419**	.386**
	N	201	200	203	205	205	205	205	205	205	205	205
HM-BL	PC	-.242**	-.283**	-.406**	-.358**	.247**	.240**	.344**	.233**	.419**	1	.737**
	N	201	200	203	205	205	205	205	205	205	205	205
HM-OL	PC	-.208**	-.256**	-.360**	-.248**	.268**	.307**	.392**	.293**	.386**	.737**	1
	N	201	200	203	205	205	205	205	205	205	205	205

PC = Pearson Correlation; N = number; PP-PH = placing pegs -preferred hand; PP-NPH = placing pegs - non-preferred hand; LB = lacing board; D = drawing; CTH = catching with two hands; TBM = throwing beanbag onto mat; OBB-BL = one-board balance - best leg; OBB-OL = one-board balance - other Leg; WHTT = walking heel-to-toe forwards; HM-BL = hopping on mats - best leg; HM-OL = hopping on mats - other leg.

**Correlation is significant at the 0.01 level (2-tailed);

*Correlation is significant at the 0.05 level (2-tailed)

The results show that the “drawing” task had significant correlation with other manual dexterity items. However, the associations were small to moderate. The “drawing” task also had a moderate correlation with all MABC-2 items, which might explain its cross-loading.

The hopping tasks had significant correlation with other balance tasks but the association was moderate. The “hopping with either best or other leg” tasks had small to moderate correlations with all items and these, with the “drawing” task, were the only items which had correlations with all items, explaining why it was problematic in loading with one component in the PCA.

To sum up, based on the indicators of these results, there are four distinct components (manual dexterity, aiming and catching, balance, and hop) measuring the motor ability of Kuwaiti children aged 7-9 years old using eight items of the MABC-2 with moderate to high internal consistency. Although the items were factored into three components (manual dexterity, aiming and catching, and balance), all items loaded under each component similar to the original MABC-2, except for the “hopping” items.

PCA for School Type

Based on the results of PCA for age bands one and two and the results of the previous sections, the “drawing” task appears problematic. Moreover, the results of the MANOVA test for age band two showed significant differences between public and private schools in the “drawing” task; children in private schools performed better than in public schools. Similarly, a significant difference was found in the “drawing” task between Kuwaiti children and MABC-2 norms. Therefore, it was suggested the data be split according to the type of the school and to run the PCA for public and private schools separately for comparison, but for age band two only because the number of children in age band one from private schools was too small for PCA.

Public schools

The PCA was completed for the public school for the 11 MABC-2 items at age band two. The Kaiser-Mayer-Olkin was good (KMO = 0.77) and Bartlett's Test of Sphericity was significant (χ^2 (55) = 523.27, p <0.001) indicating that the sample was randomly drawn from the population and there is a relationship between variables.

The correlation matrix showed moderate to excellent correlation between variables; MSA values ranged from 0.68 to 0.90. All variables were above 0.3 in the extraction communalities which ranged from 0.39 (for the "drawing" task) to 0.85. Using the varimax rotation, the variables were loaded into four components that explained 68.6% of the variance. From Table 7.7, it can be seen that the "drawing" task negatively loaded in one component with the hopping and lace-threading tasks. "Threading lace" loaded in two components (negatively loaded with hopping and positively loaded with "placing pegs" tasks).

Table 7.7: Component loadings of the 11 MABC-2 items for public schools (AB2)

	Component			
	Hopping	Balance	Manual dexterity	Aiming and catching
Hopping - best leg	**0.85**			
Hopping - other leg	**0.80**			
Lacing board	**-0.61**		0.38	
Drawing	**-0.52**			
One-board balance - other leg		**0.91**		
One-board balance - best leg		**0.86**		
Walking heel-to-toe	0.41	**0.47**	-0.31	
Placing pegs - preferred hand			**0.87**	
Placing pegs - non-preferred hand			**0.81**	
Catching with two hands				**0.81**
Throwing beanbag onto mat				**0.81**

Note. Component loadings <0.3 are suppressed. Component loadings > 0.45 are in boldface.

After removal of the "drawing" task, the PCA results showed no differences in KMO and MSA values but the extraction communalities were increased, ranging from 0.51 to

0.85. The eigenvalue increased to 72.56% of the variance. Table 7.8 shows that variables heavily loaded into four components. The reliability of each component was moderate to high and Cronbach's alpha was: hopping = 0.84, balance = 0.76, manual dexterity = 0.74, and aiming and catching = 0.53.

Table 7.8: Component loadings of the 10 MABC-2 items for public schools (AB2)

	Component			
	Hopping	Balance	Manual dexterity	Aiming and catch
Hopping - best leg	**0.87**			
Hopping - other leg	**0.83**			
lacing board	**-0.58**		0.40	
One board balance - other leg		**0.92**		
One board balance - best leg		**0.86**		
Walking heel-to-toe	0.43	**0.45**	-0.34	
Placing pegs - preferred hand			**0.88**	
Placing pegs - non-preferred hand			**0.82**	
Catching with two hands				**0.82**
Throwing beanbag onto mat				**0.81**
Eigenvalue	3.60	1.45	1.17	1.03
% Variance	36	14.5	11.7	10.3
Total % Variance		**72.5**		

Note. Component loadings <0.3 are suppressed. Component loadings ≥ 0.45 are in boldface.

Private Schools

The PCA was done for the private schools for 11 MABC-2 items at age band two. The Kaiser-Mayer-Olkin was good (KMO = 0.67) and Bartlett's Test of Sphericity was significant (χ^2 (55) = 188.86, p <0.001) indicating that the sample was randomly drawn from the population and there is a relationship between variables.

The correlation matrix showed moderate correlation between variables; MSA values ranged from 0.40 to 0.81. All variables were above 0.3 in the extraction communalities ranging from 0.39 (for threading lace) to 0.87. Using the varimax rotation, the variables were loaded into three components that explained 62.25% of the variance.

From Table 7.9, it can be seen that the four items of the manual dexterity were loaded on one component which is similar to MABC-2 (“placing pegs”, “threading lace”, and “drawing”). “Catching with two hands” and “throwing beanbag onto mat” items were loaded in one component similar to MABC-2. The balance items (“one-board balance” and “walking heel-to-toe”) were loaded in one component also similar to the MABC-2. However, the hopping items were loaded into two components; “hopping with best leg” highly loaded negatively with manual dexterity and mildly loaded with the aiming catching component. The reliability of each component was moderate to high. Cronbach’s alpha for the manual dexterity items was 0.54; for aiming and catching including hopping items, 0.60; and for balance, 0.78.

Table 7.9: Component loading of the 10 MABC-2 items for private schools

	Component		
	Manual dexterity	Balance	Aiming and catching
Placing pegs - preferred hand	**0.74**		
Hopping - best leg	**-0.70**		0.36
Placing pegs - non-preferred hand	**0.64**	-0.44	
Lacing board	**0.61**		
Drawing	**0.50**	0.32	-0.33
One-board balance - other leg		**0.92**	
One-board balance - best leg		**0.89**	
Walking heel-to-toe	-0.45	**0.55**	
Catching with two hands	0.34		**0.78**
Throwing beanbag onto mat			**0.77**
Hopping - other leg	-0.43	0.32	**0.47**
Eigenvalue	3.92	1.53	1.41
% Variance	35.6	13.86	12.79
Total % Variance	**62.25**		

Note. Component loadings <0.3 are suppressed. Component loadings > 0.45 are in boldface.

Based on the results obtained from the PCA for age band 2 in public and private schools, the results of the public schools were similar to the results obtained from combined data from both school types; the drawing task was problematic. However, this was not the case in the private schools.

Summary

Given all indicators gathered from principle component analysis for age bands one and two, it can be concluded that the MABC-2 is a suitable assessment tool for measuring motor ability of Kuwait children aged 5 to 9 years. Based on further exploratory analysis for private and public schools separately, the “drawing” task was not problematic in private schools.

7.3.1.2 Restandardization of the Drawing Item

According to the PCA, the “drawing” item was problematic, but deleting this item from MABC-2 data was problematic as the MABC-2 total score consists of the summation of the three components (manual dexterity, aiming and catching, and balance), and the manual dexterity component consists of the summation of the standard score of the three items (“posting coins/placing pegs”, “threading bead/lacing board”, and “drawing”). Although the PCA showed that the “drawing” was problematic, the values of the MSA and communalities extraction were not below the commonly recommended values (0.6 and 0.3 respectively), and deleting the value of “drawing” item might not be the correct decision. Therefore, restandardization was considered more appropriate as it is based on the actual performance of the child (mean and SD) and standard Z score. The “drawing” item was restandardized with the same method of standardization used for the MABC-2 and based on the equation $Z = (\chi - \mu)/\delta$.

The mean and SD for each age group were used to calculate the equivalent standard score for each value of the raw score for the “drawing” item, which is the number of errors using the formula $Z = (\chi-\mu)/SD$. Therefore, for each number of errors there is a standard score which can be used to change the raw score to a standard score. This procedure is similar to that used in the MABC-2 manual, and maintains the actual performance of the child in the task.

After applying this procedure to all age groups and producing new standard scores for the drawing task, the scores were added to the two other items of the manual dexterity

(MD1 and MD2) to provide the total score of the manual dexterity, which was then added to the aiming and catching and balance items to obtain the total MABC-2 score.

The PCA was repeated after restandardization of the drawing task, and although the overall changes were minute, the drawing item (MD3) loaded with the other manual dexterity items (MD). Table (7.10) shows the differences between the PCA for AB1 and AB2 before and after restandardization.

Table 7.10: Comparison of PCA before and after restandardization of drawing item

	AB1		AB2	
	Before	After	Before	After
KMO	0.764	0.762	0.577	0.586
MSA for MD3	0.841	0.834	0.437	0.530
Communalities	0.388	0.356	0.355	0.315
Total variance	68.26%	67.95%	52.7%	53.03%
Rotation components	MD3 loaded with hopping and lacing board	MD3 loaded with all other items of MD	MD3 loaded with jumping and catching beanbag	MD3 loaded with all other items of MD

7.3.2 The Performance of Kuwaiti Children in the MABC-2 Total Score

After the restandardization of the drawing task and calculation of the MABC-2 standard manual dexterity and total scores, ANOVA and MANOVA analyses were used to examine the main effects of gender, age, and school type in the motor ability of Kuwaiti children aged 5 to 9 years in the total score and its three components, manual dexterity, aiming and catching, and balance.

7.3.2.1 ANOVA Test for the MABC-2 Total Score

Prior to conducting the ANOVA analyses, four assumptions were tested. The scale of measurements and independence assumptions were theoretical, and met. The normality was assessed. Although the Shapiro-Wilk was significant, the skewness, kurtosis, histogram, Q-Q plot, and Box plot indicated no violation of the sample distribution.

Gender, age, and school type (2×5×2) ANOVA was conducted for the total score. The homogeneity of variance shows that Levene's Test of Equality of Error Variances was significant at $\alpha = 0.05$, $F(19,277) = 1.94$, $p = 0.012$. The assumption of homogeneity of variance was violated. However, the group sizes for all variables were more than 20-30 and approximately equal (except for age group five) indicating that the ANOVA is fairly robust against violations of homogeneity. To confirm the ANOVA finding, the non-parametric Kruskal-Wallis Test was used. The asymptomatic probabilities of χ^2 at k-1 degrees of freedom are: for age ($H(4, 297) = 25.29$, $p = 0.000$), for gender ($H(1, 297) = 2.077$, $p = 0.150$), and for school type ($H(1, 297) = 2.778$, $p = 0.096$) which confirm the ANOVA results.

Table 7.11 shows the descriptive data including means and standard deviations of the total MABC-2 score for each age group.

Table 7.11: Mean and SD of MABC-2 total score for each age group

Age	Number	Mean (SD)
5 years	22	80.54 (8.78)
6 years	70	75.34 (10.41)
7 years	76	67.54 (14.78)
8 years	69	70.56 (12.19)
9 years	60	75.78 (11.54)

The ANOVA results show no interaction effects between variables. There were no effects of gender or school type for the MABC-2 total score (Table 7.12), but there was a significant difference between age groups in the total score.

Table 7.12: ANOVA results for gender, age, and school type in MABC-2 total score

	df	Mean Square	F	Sig.	Partial Eta Squared	Observed Power
Gender (G)	1	77.213	0.515	0.473	0.002	0.110
Age (A)	4	800.916	5.346	0.000	0.072	0.972
School type (S)	1	351.944	2.349	0.126	0.008	0.333
G * A	4	117.549	0.785	0.536	0.011	0.251
G * S	1	0.062	0.000	0.984	0.000	0.050
A * S	4	97.742	0.652	0.626	0.009	0.212
G * A * S	4	10.130	0.068	0.992	0.001	0.064

The Post Hoc Tests using Tukey HSD showed significant differences between five and seven years (mean difference 13.01, $p < 0.001$) and between five and eight years (mean difference 9.98, $p = 0.008$). There were significant differences between the six- and seven-year-old children (mean difference 2.02, $p = 0.001$and between nine- and seven-year-olds (mean difference 8.24, $p = 0.001$). Partial eta-squared (η^2) indicated that the age accounted for 7.2% of the overall variability of the motor performance in the total score; Cohen's f = 0.28, an effect considered moderate.

7.3.2.2 MANOVA Test for the MABC-2 Components

Prior to conducting the analyses, six assumptions were tested. The cell sizes were more than 20, therefore the independence and cell size assumptions were met. The histogram, Box plot, Q-Q plot, skewness, and kurtosis indicate normal distribution of the sample. The Shapiro-Wilk was significant for the three variables (manual dexterity, aiming and catching, and balance), $p < 0.05$ indicates violation of the normality. However, because the cell sizes were more than 20 for all groups, the MANOVA is robust against violation of normality (Allen and Bennett, 2008). For testing the multivariate normality, the Mahalanobis distance was checked. The critical χ^2 value for df = 3 at $\alpha = 0.001$ is 16.26 and our maximum Mahalanobis distance was 13.14; there is no concern about multivariate outliers.

The assumption of linearity was met as the relationships between the variables were linear. The multicollinearity was also met as all the significant correlations did not reach 0.85 (r between 0.194 and 0.317).

Box's Test of Equality of Covariance Matrices was not significant; Box's M = 147.14, F (102, 5415.2) = 1.227, p = 0.062 indicating that the assumption of homogeneity of variance-covariance matrices was not violated. Levene's Test of Equality of Error Variances was met for balance but was violated for the manual dexterity and aiming and catching. Therefore, a non-parametric procedure was carried out with the Kruskal-Wallis Test for the manual dexterity and for aiming and catching. The asymptomatic probabilities of χ^2 at k-1 degrees of freedom for the manual dexterity are: for gender (H (1, 297) = 10.06, p = 0.002), for age (H (4, 297) = 26.92, p < 0.001), and for school type (H (1, 297) = 0.57, p = 0.45) which confirm the MANOVA results. The asymptomatic probabilities of χ^2 at k-1 degrees of freedom for the aiming and catching are: for gender (H (1, 297) = 30.62, p = 0.002), for age (H (4, 297) = 7.73, p < 0.001), and for school type (H (1, 297) = 1.98, p = 0.45) which confirm the MANOVA results.

Table 7.13 shows the descriptive analysis of the sample for the significant variables (gender and age) in the three MABC-2 components, manual dexterity, aiming and catching, and balance.

Table 7.13: Mean and SD of the three MABC-2 components for Kuwaiti children

		Manual dexterity Mean (SD)	Aiming and Catching Mean (SD)	Balance Mean (SD)
Gender	Male (n = 147)	24.97 (5.24)	21. 86 (4.65)	24.79 (7.74)
	Female (n = 150)	27.15 (5.62)	18.79 (4.13)	27.84 (6.99)
Age	5years (n = 22)	29.45 (2.68)	21.59 (4.37)	29.50 (6.68)
	6 years (n = 70)	26.66 (4.55)	20.33 (3.57)	28.36 (6.69)
	7 years (n = 76)	24.21 (6.26)	20.01 (4.57)	23.32 (8.22)
	8 years (n = 69)	24.91 (4.93)	19.65 (6.18)	26.00 (7.00)
	9 years (n = 60)	27.83 (5.94)	20.95 (3.82)	27.00 (7.20)

The gender, age, and school type (2×5×2) MANOVA test was conducted for the three components, manual dexterity, aiming and catching, and balance. The results show no interaction effects between variables and no effect of school type. However, there were significant effects of gender and age (Table 7.14). Partial eta-squared (η^2) indicated that the gender accounted for 17.7% and age accounted for 3.7% of the overall motor performance variability in the three components of the MABC-2. Cohen's f for gender was 0.46, considered a large effect and for age 0.2, a small effect.

Table 7.14: MANOVA results for the three MABC-2 components

	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Observed Power
Gender (G)	19.778	3.000	275.000	0.000	0.177	1.000
Age (A)	2.660	12.000	727.873	0.002	0.037	0.964
School type (S)	2.356	3.000	275.000	0.072	0.025	0.587
G*A	1.620	12.000	727.873	0.081	0.023	0.786
G*S	1.310	3.000	275.000	0.271	0.014	0.348
A*S	0.658	12.000	727.873	0.792	0.009	0.341
G*A*S	0.941	12.000	727.873	0.505	0.013	0.495

Univariate analyses showed significant gender differences in the three components (Table 7.15), girls being significantly better than boys in manual dexterity and balance whereas boys were better than girls at aiming and catching. There were significant effects of age in the manual dexterity and balance only.

Table 7.15: Univariate analysis of gender, age, and school type in MABC-2 components

	F		
	Manual dexterity	Aim and catch	Balance
Gender (G)	4.684*	28.533***	8.019**
Age (A)	3.511**	0.999	5.293***

*p < 0.05, **p < 0.01, ***p < 0.001

The Post Hoc Tests for the manual dexterity show that children at five years were significantly better than at seven (mean difference 5.24, $p = 0.001$) or eight (mean difference 4.54, $p = 0.005$). The six-year-olds were significantly better than the seven-year-olds (mean difference 2.45, $p = 0.046$) and the nine-year-olds were significantly better than the seven- and eight-year-olds (mean differences 3.62, $p = 0.001$ and 2.92, $p = 0.017$).

The Post Hoc Tests for balance show that the five-year-old children were significantly better than the seven-year-old children (mean difference 6.18, $p = 0.005$). Six-year-olds were significantly better than seven-year-olds (mean difference 5.04, $p < 0.001$). The nine-year-old children were significantly better than the seven-year-olds (mean difference 3.68, $p = 0.03$).

To sum up, the ANOVA and MANOVA tests for the total score and its three components for the Kuwaiti children indicate that there were effects of age on the MABC-2 total score but no effects of gender. There were effects of gender and age on the three components based on standardization score. However, the school type showed no effects on the motor performance of Kuwaiti children measured by MABC-2 and its components.

7.3.3 Comparison between Kuwaiti Children and UK Children (MABC-2 norm) in MABC-2 and its Components

Country, age, and gender (2×5×2) ANOVA and MANOVA tests were carried out for Kuwait and UK samples for the MABC-2 total score and its three components (manual dexterity, aiming and catching, and balance).

7.3.3.1 ANOVA for the MABC-2 Total Score

Prior to conducting the analyses, four assumptions were tested. The scale of measurements and independence assumptions were theoretical and met. The normality was assessed. Although the Shapiro-Wilk was significant, the skewness, kurtosis, histogram, Q-Q plot, and Box plot indicated no violation of the sample distribution.

Country, age, and gender (2×5×2) ANOVA design was conducted for the MABC-2 total standard score. Levene's Test of Equality of Error Variances was significant at α = 0.05, F (19,673) = 1.81, p = 0.019 suggesting the assumption of homogeneity of variance is violated. However, the group sizes for all variables are more than 30 and approximately equal, and the ANOVA is fairly robust against violations of homogeneity under these circumstances. To confirm the ANOVA finding, the non-parametric Kruskal-Wallis Test was completed. The asymptomatic probabilities of χ^2 at k-1 degrees of freedom are: for country (H (1, 693) = 63.51, p < 0.001), for age (H (4, 693) = 12.89, p = 0.012), and for gender (H (1, 693) = 6.32, p = 0.012), which confirm the ANOVA results.

The results of 2×5×2 ANOVA for the MABC-2 total score (Table 7.16) show that there were significant differences between children from Kuwait (mean 72.71, SD =12.76) and UK (mean 80.54, SD = 13.14), and between different age groups. There was also a significant difference between genders; for male, mean = 75.89 (SD = 14.29) and for female, mean = 78.40 (SD = 12.68). Partial eta-squared (η^2) indicated that the country accounted for 5.5%, with age 2%, and gender 0.6% of the overall variability of the motor performance in the total score of the MABC-2; Cohen's f being for country, 0.24; for age, 0.14; and for gender, 0.08; effects considered moderate for country, and small for age and gender.

Table 7.16: One-way ANOVA for country, gender, and age for MABC-2 total score

Source	df	Mean Square	F	Sig.	Partial Eta Squared	Observed Power
Country	1	6360.805	39.408	0.000	0.055	1.000
Age	4	550.633	3.411	0.009	0.020	0.854
Gender	1	699.665	4.335	0.038	0.006	0.547
Country * Age	4	913.311	5.658	0.000	0.033	0.980
Country * Gender	1	18.528	0.115	0.735	0.000	0.063
Age * Gender	4	303.530	1.880	0.112	0.011	0.571
Country * Age * Gender	4	104.327	0.646	0.630	0.004	0.212

There was a significant interaction between country and age, so a simple effect analysis was done. Table 7.17 shows descriptive data explained by the mean and standard deviation of the MABC-2 total score for interaction between country and age.

Table 7.17: Mean and SD for total MABC-2 score for country × age

		Kuwait (n = 297)	UK (n = 396)	Total (n = 693)
age	5 years	80.55 (8.78)	81.18 (13.71)	81.10 (12.86)
	6 years	75.34 (10.41)	79.04 (14.33)	77.24 (12.67)
	7 years	67.54 (14.78)	81.57 (11.71)	74.86 (14.97)
	8 years	70.57 (12.20)	81.20 (12.87)	76.34 (13.60)
	9 years	75.78 (11.54)	79.28 (13.10)	77.63 (12.46)
Mean of total sample		72.71 (12.76)	80.54 (13.13)	77.19 (13.53)

7.3.3.1.1 Simple Effect Analysis for Total Score

Simple effect analyses for the MABC-2 total score using age by country and country by age interaction effects analysed the interaction from both sides.

- *Age by country effect*

The country significantly influenced the seven-year-old children, with $F(1,683) = 47.95$, $p = 0.000$ and the eight-year-old children, with $F(1,683) = 26.01$, $p = 0.000$.

However, the country did not influence the five-, six-, and nine-year-old children, with F (1, 683) = 0.043, p = 0.835, F (1, 683) = 3.022, p = 0.083, and F (1, 683) = 2.38, p = 0.123 respectively. The linearly independent pairwise comparisons among the estimated marginal means show that the seven and eight year old UK children performed significantly better than the Kuwaiti children. Figure 7.6 shows the effect of the age on country.

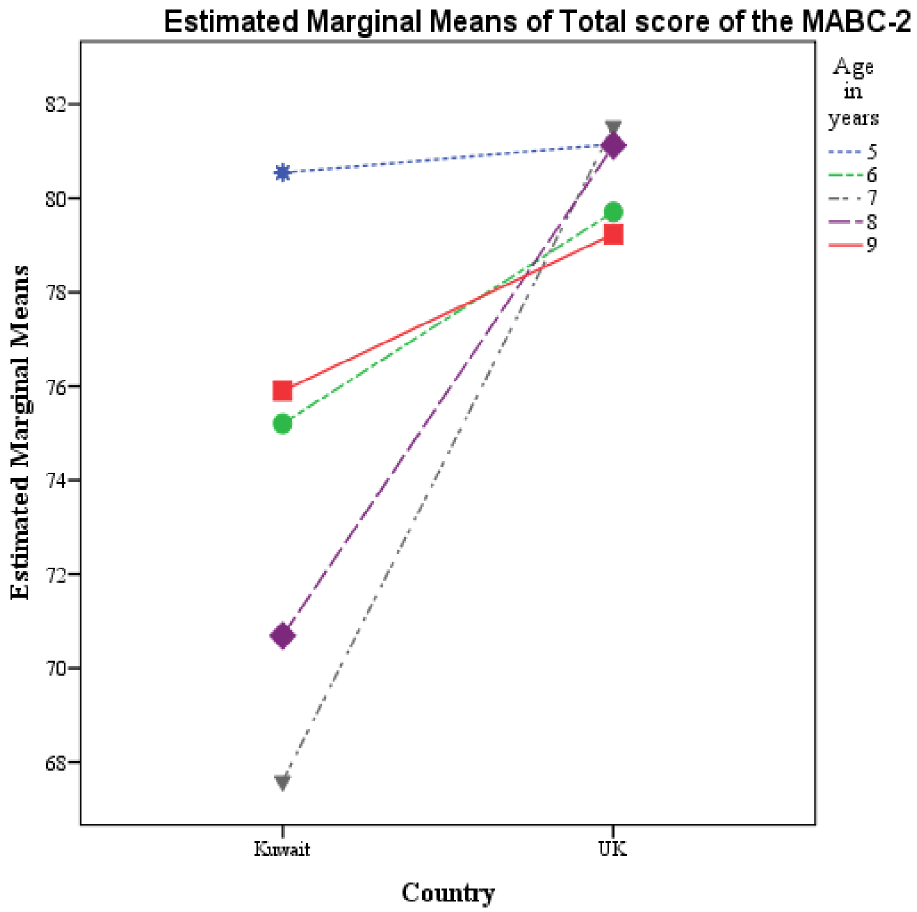

Figure 7.6: Mean plots for effect of age on country

- *Country by age effect*

The country-by-age interaction effect was analysed using a simple main effect analysis. The age significantly influenced the Kuwaiti children, F (4,683) = 7.298, p = 0.000, but not the MABC-2 children, F (4, 683) = 0.663, p = 0.618. The linearly independent pairwise comparisons among the estimated marginal means for Kuwaiti children show that five-year-olds were significantly better than seven- (p = 0.000) and eight-year-olds (p = 0.001); the mean differences were 13 and 9.9 respectively. The six-year-olds were significantly better than the seven- and eight-year-olds (p = 0.000 and p = 0.028 respectively); the mean differences were 7.80 and 4.78 respectively. The nine-year-old were significantly better than the seven- (p = 0.000) and eight-year-olds (p = 0.021); the mean differences were 8.24 and 5.22 respectively. Figure 7.7 shows the effect of country on age.

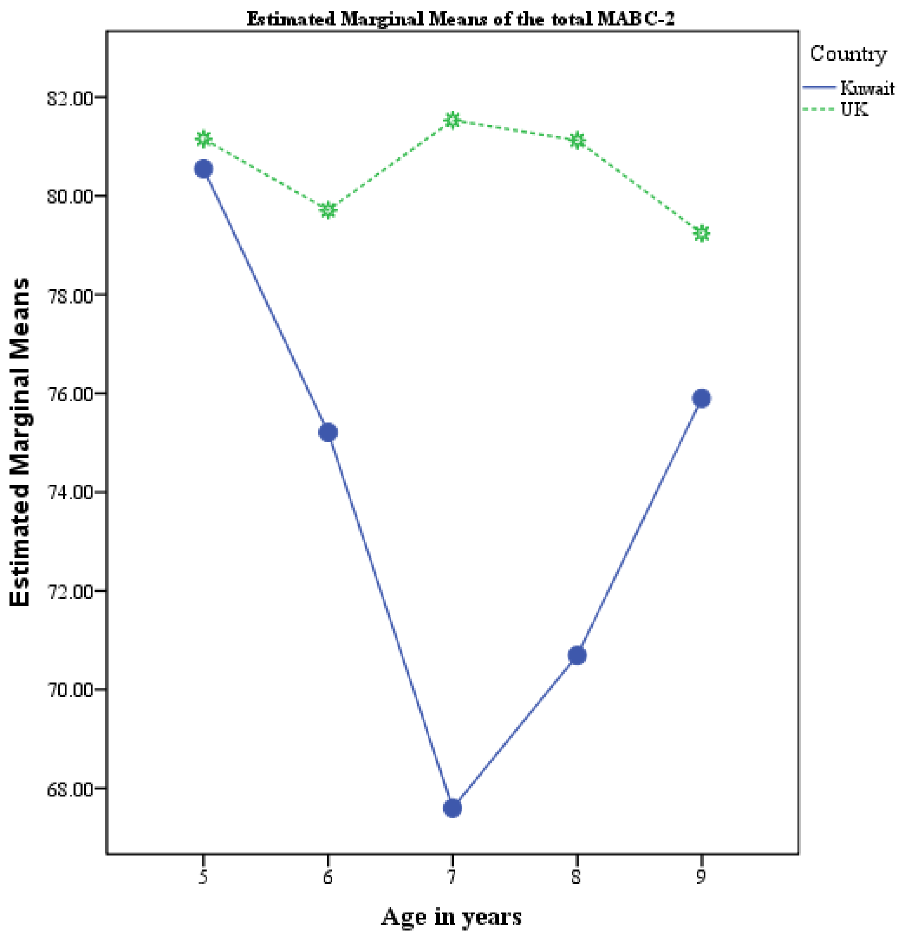

Figure 7.7: Mean plots for the effect of country on age

7.3.3.2 MANOVA for the MABC-2 Components

Prior to conducting the analyses, six assumptions were tested to ensure that the analyses can be run. The independence and cell sizes assumptions were met; the cell sizes were more than 20. The histogram, Box plot, Q-Q plot, skewness, and kurtosis indicate normal distribution of the sample. The Shapiro-Wilk was significant for the three variables (manual dexterity, aiming and catching, and balance). However, because the cell sizes were more than 20 for all groups which were approximately equal, the MANOVA was robust against violation of normality. For testing the multivariate normality, the Mahalanobis distance was checked. The critical χ^2 value for df = 3 at $\alpha = 0.001$ was 16.26 and our maximum Mahalanobis distance was 14.30; there were no multivariate outliers.

The assumption of linearity was met as the relationships between the variables were linear. The multicollinearity was also met as all the significant correlations did not reach 0.85 (r ranged between 0.22 and 0.43).

Box's Test of Equality of Covariance Matrices was significant; Box's M = 176.17, $F(1142, 81468.82) = 148$, $p = 0.001$ indicating that the assumption of homogeneity of variance-covariance matrices was violated. MANOVA is robust against the violation of homogeneity of variance-covariance matrices in condition of large group sizes.

Levene's Test of Equality of Error Variances was not significant for balance but was violated for the components of manual dexterity and aiming and catching. Therefore, the non-parametric Kruskal-Wallis Test was used for the manual dexterity and for aiming and catching.

The asymptomatic probabilities of χ^2 at k-1 degrees of freedom for the manual dexterity are: for country ($H(1, 694) = 70.98$, $p < 0.001$), for age ($H(4, 694) = 13.69$, $p = 0.008$), and for gender ($H(1, 694) = 21.17$, $p < 0.001$) which confirm the MANOVA results.

The asymptomatic probabilities of χ^2 at k-1 degrees of freedom for the aiming and catching are: for country (H (1, 694) = 0.043, p = 0.835), for age (H (4, 694) = 1.17, p = 0.884), and for gender (H (1, 694) = 48.12, p < 0.001) which confirm the MANOVA results.

Table 7.18 shows the descriptive data explained by the mean and standard deviation (SD) for the MABC-2 components of the country-age interaction

Table 7.18: Mean and SD of MABC-2 components for country-age interaction

	Kuwait						UK					
	5year (n=22)	6year (n=70)	7year (n=76)	8year (n=69)	9year (n=60)	Total (n=297)	5year (n=90)	6year (n=74)	7year (n=83)	8year (n=82)	9year (n=67)	Total (n=396)
Manual dexterity	29.45 (2.69)	26.66 (4.55)	24.21 (6.26)	24.91 (4.93)	27.83 (5.94)	26.07 (5.54)	30.07 (6.20)	29.35 (6.52)	30.46 (5.06)	30.34 (6.34)	29.51 (5.93)	29.98 (6.01)
Aiming & Catching	21.59 (4.37)	20.33 (3.57)	20.01 (4.57)	19.65 (6.18)	20.95 (3.82)	20.31 (4.65)	20.30 (4.92)	20.00 (4.58)	20.45 (4.55)	20.37 (4.80)	19.72 (5.01)	20.19 (4.75)
Balance	29.50 (6.68)	28.36 (6.70)	23.32 (8.22)	26.00 (7.00)	27.00 (7.20)	26.33 (7.51)	30.81 (6.94)	29.70 (6.70)	30.66 (6.55)	30.50 (5.98)	30.06 (6.78)	30.37 (6.57)

MANOVA findings show a significant interaction between country and age. There were significant effects of country, age, and gender on children's motor performance in the MABC-2 components; $p < 0.05$ (Table 7.19). Partial eta-squared (η^2) indicated that the country accounted for 11.5%, age for 1.1%, and gender for 17.7% of the overall variability of the motor performance in the total score; Cohen's f for country was 0.36, for age 0.11, and for gender 0.46, effects considered moderate for country, small for age, and large for gender.

Table 7.19: MANOVA results of MABC-2 components for country, age, and gender

	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Observed Power
Country	29.174	3.000	671.000	0.000	0.115	1.000
Age	1.870	12.000	1775.591	0.034	0.011	0.858
Gender	48.028	3.000	671.000	0.000	0.177	1.000
C*A	2.642	12.000	1775.591	0.002	0.015	0.965
C*G	1.174	3.000	671.000	0.319	0.005	0.317
A*G	1.735	12.000	1775.591	0.054	0.010	0.825
C*A*G	1.033	12.000	1775.591	0.415	0.006	0.547

Univariate analysis shows the differences between variables in the components (Table 7.20). The UK children performed significantly better in manual dexterity and balance than Kuwaiti children.

Table 7.20: Univariate analysis of country, age, and gender in MABC-2 measures

	F			
	Country (C)	Age (A)	Gender (G)	C*A
Manual dexterity	52.205***	2.939*	20.491***	5.345***
Aiming and Catching	0.526	0.455	52.214***	1.124
Balance	38.865***	3.404**	24.405***	4.175**

*p<0.05, **p<0.01, ***p<0.001

Girls were significantly better in manual dexterity (mean 29.38, SD = 5.77) and balance (mean 30.00, SD = 6.64) than boys (mean and SD 27.16, 6.29 and 27.19, 7.63

respectively). Boys were better at aiming and catching (mean 21.54, SD = 4.86) than girls (mean 19.02, SD = 4.21).

There were interaction effects between country and age in manual dexterity and balance, so simple effect analyses were done for the manual dexterity and balance using age-by-country and country-by-age interaction effects to examine the interaction from both sides.

7.3.3.2.1 Simple Effect Analysis for Manual Dexterity

- *Age by Country Interaction*

Country significantly influenced the six-year-old children, with F (1,683) = 7.94, p = 0.005, the seven-year-old children, with F (1,683) = 47.09, p= 0.000, and the eight-year-old children, with F (1,683) = 33.58, p = 0.000. However, it did not influence the five- and nine-year-old children, with F (1, 683) = 0.20, p = 0.654 and F (1, 683) = 2.698, p = 0.101 respectively. The linearly independent pairwise comparisons among the estimated marginal means show that the six-, seven-, and eight-year-old children were significantly different in both countries with the UK children were better; the mean differences in the manual dexterity being 2.694, 6.247, and 5.428 respectively.

Figure 7.8 shows the effect of the age on country for manual dexterity.

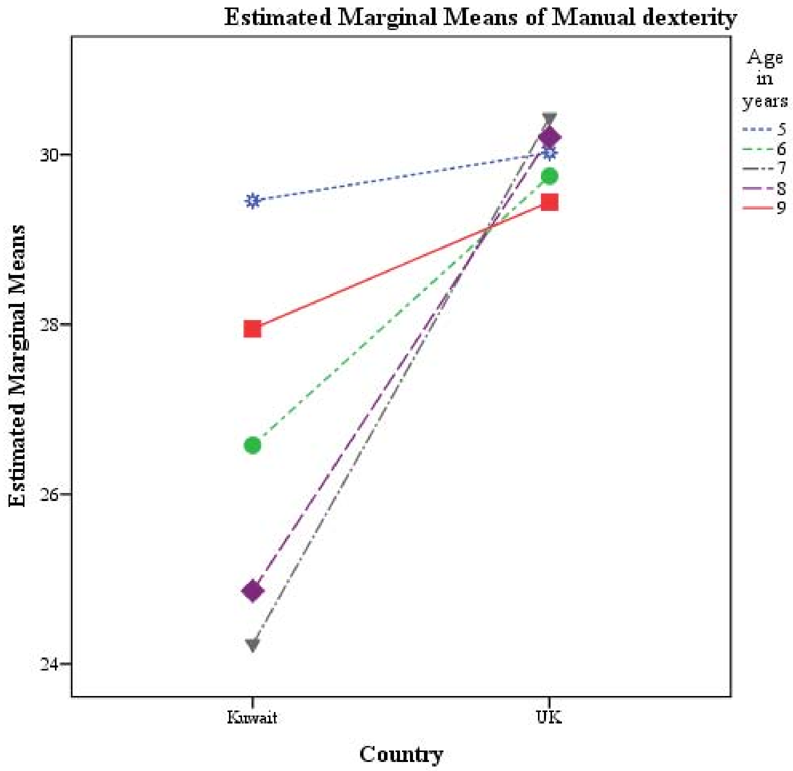

Figure 7.8: Mean plots for the effect of age on country for the manual dexterity

- *Country by Age Effect*

The country by age interaction effect was analysed using a simple effect analysis. The age significantly influenced the Kuwaiti children, F (4,683) = 6.218, p = 0.000. However, the age did not influence the UK children, F (4, 683) = 0.567, p = 0.687. The linearly independent pairwise comparisons among the estimated marginal means for Kuwaiti children show that the five years were significantly better than six- (p = 0.046), seven- (p = 0.000), and eight-year-olds (p = 0.001); the mean differences were 2.797, 5.244, and 4.542 respectively. The six-year-olds were significantly better than the seven (p = 0.01); the mean difference was 2.447. The nine-year-olds were significantly better than the seven- (p = 0.000) and eight-year-olds (p = 0.004); the mean differences were 3.623 and 2.92 respectively. Figure 7.9 shows the effect of country on age.

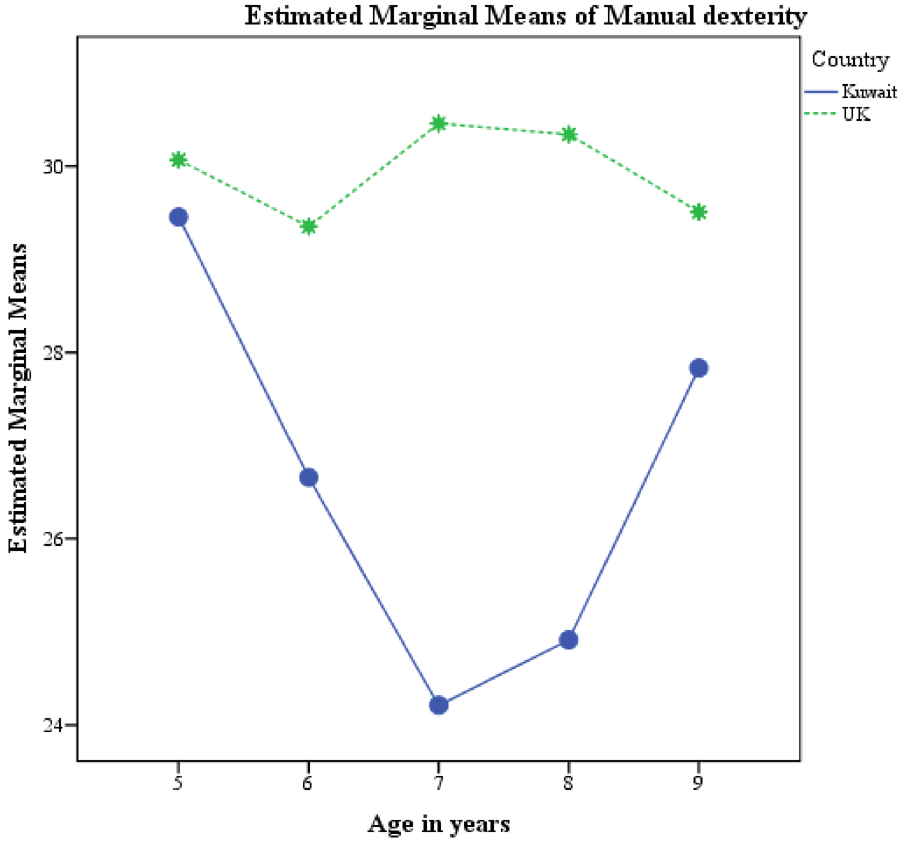

Figure 7.9: Mean plots for effect of country on age for manual dexterity

7.3.3.2.2 Simple Effect Analysis for Balance

- *Age by Country Interaction*

The age by country interaction effect for the balance was analysed using a simple effect analysis. The country significantly influenced the seven-year-old children, with F (1,684) = 44.986, p = 0.000, the eight-year-olds, with F (1,684) = 15.854, p = 0.000, and the nine-year-olds, with F (1,684) = 6.225, p = 0.013. However, the country did not influence the five- and six-year-olds, with F (1, 684) = 0.549, p = 0.459 and F (1,

684) = 1.341, p = 0.247 respectively. The linearly independent pairwise comparisons among the estimated marginal means show that the seven-, eight-, and nine-year-old children were significantly different, with the UK children performing better, the mean differences in balance being 7.347, 4.488, and 3.060 respectively. Figure 7.10 shows the effect of the age on country for balance.

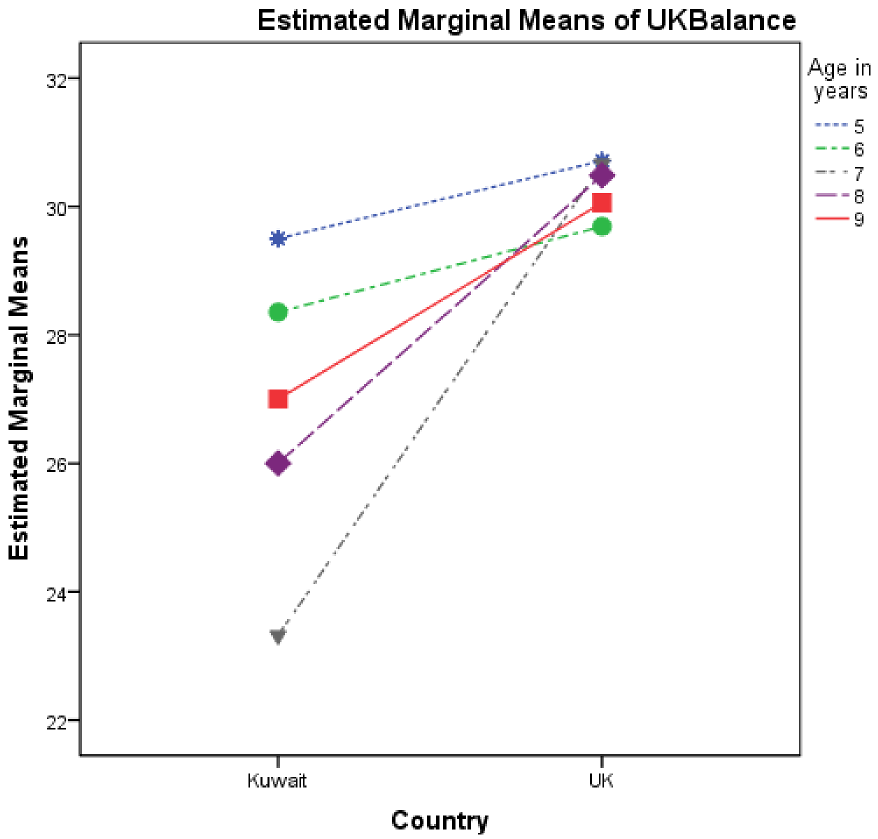

Figure 7.10: Mean plots for effect of age on country for balance

- *Country by Age Effect*

The country by age interaction effect was analysed in the same way. The age significantly influenced the Kuwaiti children, F (4,684) = 6.479, p = 0.000, but not the UK children, F (4, 684) = 0.314, p = 0.869. The linearly independent pairwise comparisons among the estimated marginal means for Kuwaiti children show that the five-year-olds were significantly better than seven- (p = 0.000) and eight-year-olds (p = 0.039), the mean differences in balance being 6.184 and 3.500 respectively. The six-year-olds were significantly better than the seven- (p = 0.000) and eight-year-olds (p = 0.044). Here the mean differences in balance were 5.041 and 2.357 respectively. The seven-year-old children were significantly worse than the eight-year-olds (p = 0.020); the mean difference in balance was 2.684. The nine-year-olds were significantly better than the seven-year-olds (p = 0.002) with the mean difference being 3.684. Figure 7.11 shows the effect of country on age on balance.

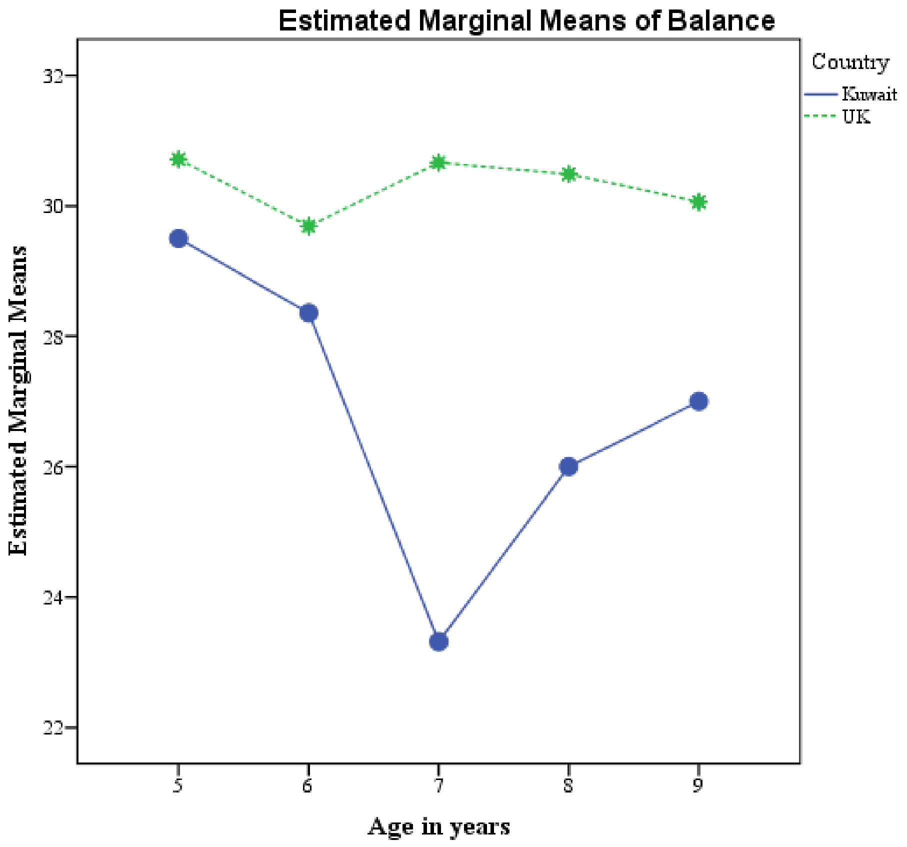

Figure 7.11: Mean plots for effect of country on age for balance

To sum up, the comparison analysis between Kuwaiti and UK children using ANOVA and MANOVA tests for the total score and its three components indicate that there were effects of country, age, and gender. The effects of country and age were for manual dexterity and balance, whereas the effects of the gender were evident in all three components.

7.3.4 The Percentage of Kuwaiti Children in the MABC-2 Categories after Restandardization

The performance of Kuwaiti children between 5 and 9 years was calculated after restandardization of the drawing task, and the percentages of children at the 5^{th} and 15^{th} percentile were also calculated. Figure 7.12 shows that out of 297 children, 33 (18 boys and 15 girls) performed at the 5^{th} percentile and 68 (33 boys and 35 girls) performed at the 15^{th} percentile. There was no significant difference between boys and girls, Pearson Chi-Square χ^2 (2, N = 297) = 0.383, p = 0.826.

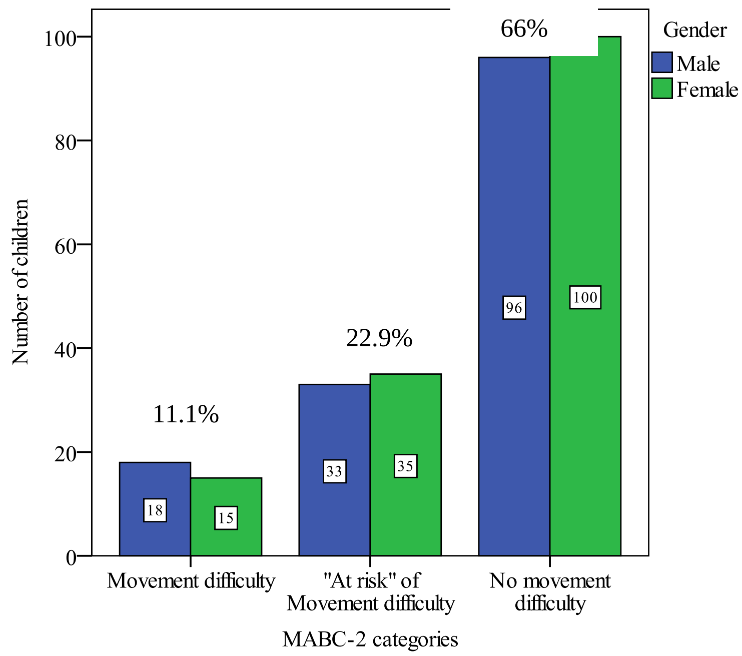

Figure 7.12: Percentages of Kuwaiti children in each MABC-2 category

These results indicate a decrease in the number of children at each percentile after the restandardization of the drawing task (Figure 7.12). At the 5th percentile, the percentage was 17.8% before the restandardization, 11.1% after the restandardization. At the 15th percentile, the percentage was 26.3% before and 22.9% after.

After restandardization of the "drawing" item, the scores of 20 children (10 boys and 10 girls) changed from the 5th to the 15th percentile, and the score of 30 children (18 boys and 12 girls) changed from the 15th to above the 15th percentile. This indicates changes in assessment of motor ability after restandardization of the drawing task. Figures 7.13 and 7.14 show the distribution of boys and girls according to age at the 5th and 15th percentiles.

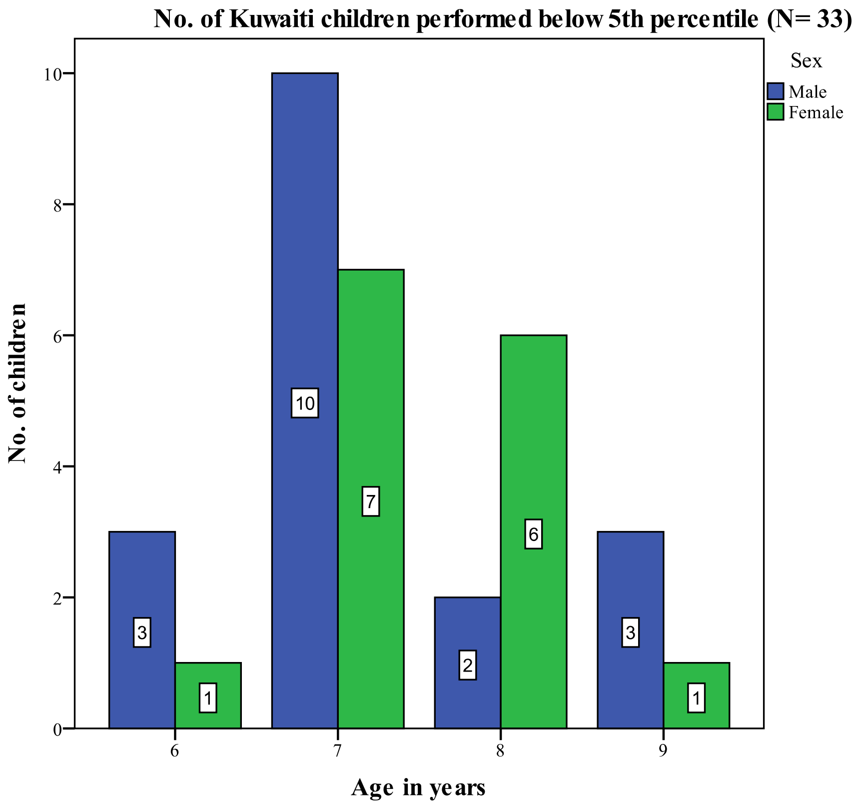

Figure 7.13: Number of boys and girls performing at the 5th percentile in each age group

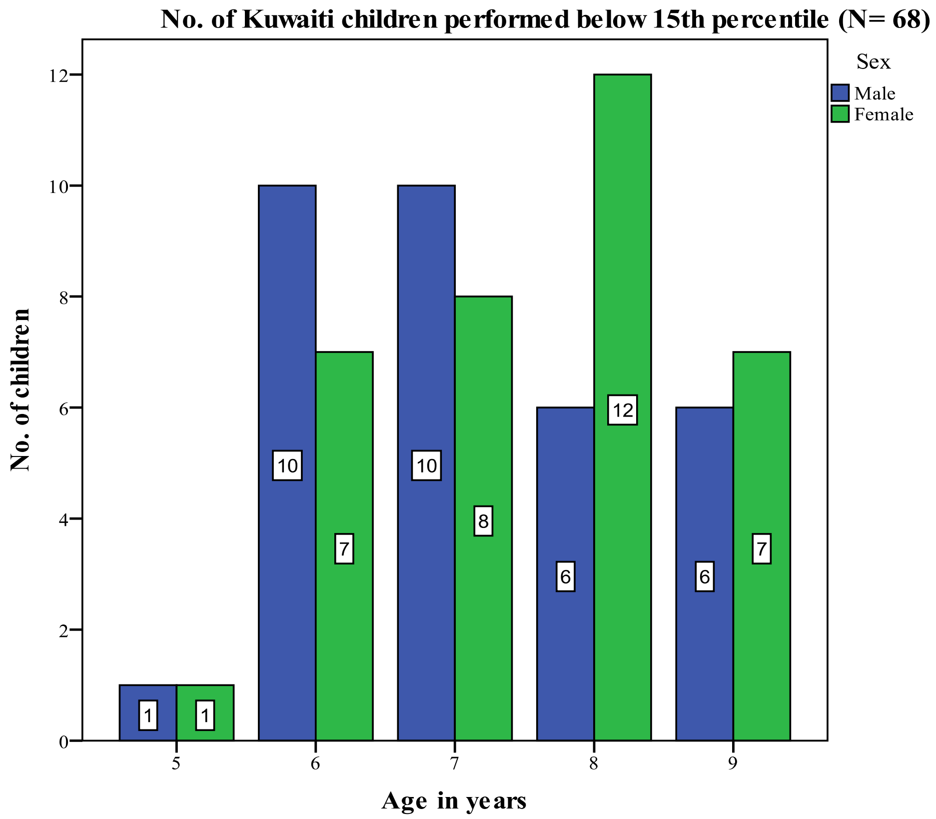

Figure 7.14: Number of boys and girls performing at the 15th percentile in each age group

7.3.5 Comparison between Kuwait and UK at 5th and 15th Percentiles

The study aimed also to determine the differences between Kuwaiti children and the MABC-2 norm children at the 5th (movement difficulty) and 15th (at risk of movement difficulty) percentiles. Figure 7.15 shows that the percentage of Kuwaiti children with movement difficulty and at risk of movement difficulty was higher than the UK, the difference being significant, χ^2 (2, N = 693) = 29.74, $p < 0.001$.

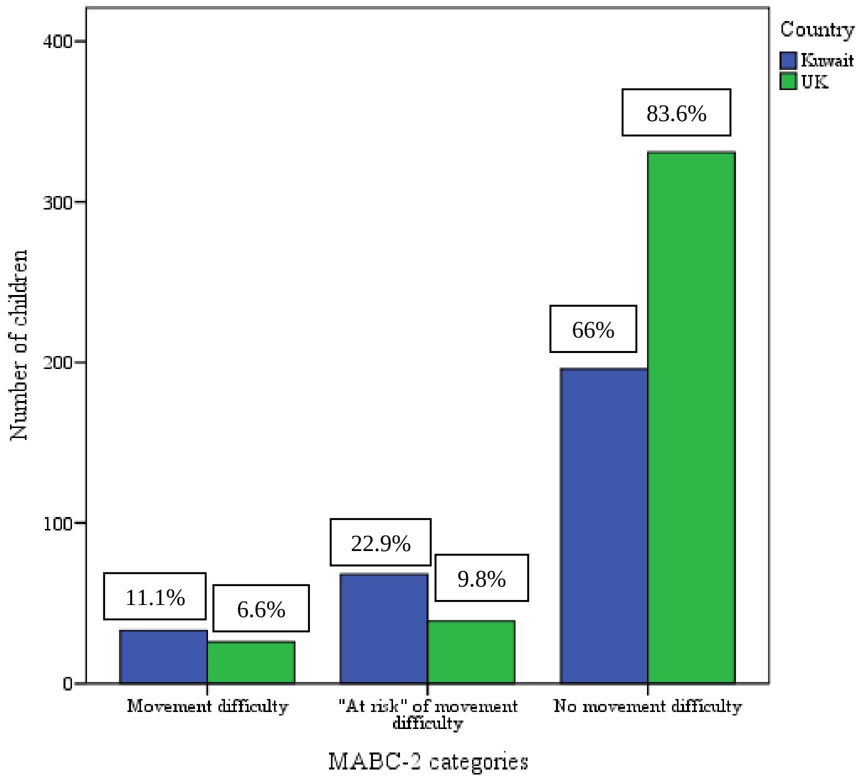

Figure 7.15: Percentages of children in each MABC-2 category for Kuwait and UK

To sum up, in spite of the decrease in the percentage of Kuwaiti children with movement difficulties at the 5th and 15th percentiles after restandardization of the “drawing” task, the percentage remained higher than the UK children, the MABC-2 norm.

7.3.6 Summary

The aim of this chapter was to identify motor impairments in primary school aged children in Kuwait using the MABC-2. We hypothesized that there were different numbers of Kuwaiti children at the 5th and 15th percentiles compared to the UK based MABC-2 norms. We were also interested in investigating the motor performance of Kuwaiti children based on the standard MABC-2 total score and its three components, comparing gender, school type, and country.

Our findings showed that the percentage of Kuwaiti children at the 5th and 15th percentile was much higher than the UK norms which resulted in our doing the PCA to investigate the validity of the MABC-2 in Kuwaiti culture. This showed that the "drawing" task was problematic in age band one (AB1), age band two (AB2), and public schools. This was then restandardized and the total score and its three components computed. The percentages at both 5th and 15th percentile after restandardization were reduced, but they were still higher than the UK.

The motor performance of Kuwaiti children on the standard total score after restandardization was similar between boys and girls and between public and private schools, but differences between age groups were significant within the Kuwaiti sample and compared to UK with the UK children being better.

The motor performances of Kuwaiti children in the three components were significantly different between boys and girls and between age groups. Boys were better at aiming and catching while girls were better in manual dexterity and balance. UK children were better than Kuwaiti children in manual dexterity and balance but there was no difference in aiming and catching.

7.4 Discussion

This chapter addresses the identification of motor impairments of Kuwaiti children aged between 5 and 9 years, with three main themes:

- The numbers of children performing at the 5^{th} and 15^{th} percentile of MABC-2.
- The difference in motor performance of Kuwaiti children aged 5 - 9 years in the MABC-2 total score and the three components based on gender, age, and school type
- The comparison of Kuwaiti children and UK children (the norm for MABC-2 total score and its three components).

The MABC-2 has been revised recently, but no investigations of its construct validity have been published apart from those in the test manual. However, a recent study in Germany has investigated the factorial validity of the MABC-2 (Wagner, et al.). The study provided the validity for AB2 but its sub-structure was problematic; the discriminant and convergent validity was not confirmed.

Principle component analysis (PCA) was used in our study to investigate the construct validity of the MABC-2 in the Kuwaiti culture, showing that the drawing item was problematic, as it did not correlate with the other items examining manual dexterity. Therefore, we restandardized for Kuwaiti children, repeated the PCA and found good loadings for this item with the other manual dexterity items.

The benefit of running the PCA was the determination of the suitability of the test for a non-western country like Kuwait, particularly as this was the first use of the MABC-2 in Kuwait.

7.4.1 The Percentage at the 5^{th} and 15^{th} Percentile

The initial findings show that 17.8% of Kuwaiti children in primary schools had movement difficulty ($\leq 5^{th}$ percentile) and 26.3% were at risk of movement difficulty

(> 5th and ≤ 15th percentile) , which we consider high. There was a significant gender difference, the ratio of boys to girls being 1.12:1. However, after restandardization of the drawing item, the figures declined to 11.1% and 22.9% respectively, with no significant difference between boys and girls. The proportions before and after the restandardization were significantly higher than the UK sample which were 6.6% for the “movement difficulty” and 9.8% for “at risk of movement difficulty”.

Many studies in different cultures have measured the motor impairment at the 5th and 15th percentile as a cut off for the MABC. Van Waelvelde et al. (2008) found that 3% and 15% of four-year-old Flemish children performed at the 5th and 15th percentile respectively, but the percentage was less at 5 years old (0.4% and 5% respectively). Another study found 1.1% and 7.7% of four-year-old Norwegian children had movement difficulties or were at risk of movement difficulties, respectively, as measured by the MABC (Sigmundsson & Rostoft, 2003). Recently, Lingam (2009) found 4.6% and 18.4% out of 6990 children (age 7.5±2.8) in UK performing at the 5th and 15th percentile on the MABC. Compared with all these studies, our findings are high.

However, there have been studies with results similar to ours. A study in Japan (Miyahara, et al., 1998) found 17.4% of the Japanese children (n = 104, age = 7-10 years) performed at the 5th percentile on the MABC. The authors attributed the high percentage, especially with older children, to developmental lag in their motor skills. However, their sample size was small and children were recruited from one school, so the results cannot be generalized.

Another study investigated the percentage of Greek children performing below the 12th percentile on the BOTMP-SF compared to Canadian children and reported 19% for Greek children (n = 329, average age = 11.3 years) compared to the Canadian 8% (Tsiotra, et al., 2006). The authors attributed the high percentage to the possibility of failure of BOTMP-SF to discriminate between children with and without motor difficulties. They discounted the increase as an indicator of poor motor skill development among Greek children, and attributed the differences to the respective life styles, Greek children were less active with a higher prevalence of clinical obesity (48%) and low cardiorespiratory fitness (90%) compared to the Canadian children (23% and 83%, respectively).

There are several possible explanations for the high percentage of Kuwaiti children with or at risk of movement difficulty based on MABC-2. First, Kuwaiti children may truly lag behind their counterparts in the UK, and there are several possible reasons. Based on the MABC, Japanese (Miyahara, et al., 1998) and Israeli (Engel-Yeger, et al., 2010) children were also found to be behind their US counterparts, perhaps for cultural or environmental reasons. Miyahara et al. (1998) attributed the differences to possible biological factors.

Biological factors may indeed play a role in the motor impairment of Kuwaiti children, such as low gestational age, low birth weight, birth order; prenatal factors including smoking, drug use, antenatal care of the mother, gestational diabetes, and hypertension; and perinatal factors including breast feeding, and special medical care following birth such as admission to ICU, and ventilation. All these factors can contribute to motor impairment.

The literature reports that low gestational age and low birth weight are related to motor impairments (Davis, Ford, Anderson, Doyle, & Victorian Infant Collaborative Study, 2007; de Kieviet, et al., 2009; Foulder-Hughes & Cooke, 2003; Goyen & Lui, 2002; Hemgren & Persson, 2009; Holsti, et al., 2002). In our sample, 10.7% were born preterm. This percentage is high as compared to US which is 3.2% (Rawlings, Rawlings, & Read, 1995).

In addition, the prevalence of low birth weight in Kuwait was found to be 7.8% in full term delivery (Alfadhli, Hajia, Mohammed, Alfadhli, & El-Shazly, 2010). Although this prevalence is lower than in Egypt (12.1%) and Tunisia (13.7%) (Blanc & Wardlaw, 2005b), it is considered high as compared to western countries (4% - 6%)

(Alfadhli, et al., 2010). Furthermore, 9.4% of children in our sample born with LBW. The high percentage of Kuwaiti children born preterm and with LBW may relate to the high percentage of motor impairment.

Further studies are also needed to investigate the possible contribution of the other biological factors on the motor impairments of Kuwaiti children and to explore the available protocols in the Ministry of Health in Kuwait to control the impacts of these factors.

Factors influencing motor impairment can also be environmental. It has been found that there is an impact of environment on the motor ability of disadvantaged children (Goyen & Lui, 2002; McPhillips & Jordan-Black, 2007a). Children born with low gestational age, low birth weight and low socioeconomic status as measured by environmental stimulus were found to have motor problems mainly fine motor deficits at ages of three or five years (Goyen & Lui, 2002). This factor also received attention in our study. The home environment including type of accommodation, family description, and district may be a risk factor for motor impairment of Kuwaiti children aged between five and nine years. As mentioned in Chapter Four “Rationale” that differences in home size and its correlation to the crowded index were found between urban and rural areas (Hamadeh, et al., 2008). Hence, living in crowded home may influence the motor abilities of children. Therefore, further study is required to investigate these factors and their impact on motor impairment of Kuwaiti children.

Second, neither the MABC nor the MABC-2 has been used before in Kuwait. The MABC has been found to be sensitive to some cultural differences, and modification of the norms was needed. Therefore, it might be argued that the MABC-2 is insensitive in some ways to Kuwaiti culture and so fails to distinguish between Kuwaiti children with different motor abilities. Hence, PCA was run for age bands one and two as a primary analysis and for the public and private schools as a secondary analysis.

Our PCA findings indicated that generally the MABC-2 is a valid assessment tool in the Kuwaiti culture for motor ability of children aged between five and nine years. However, two considerations must be given to the drawing task if the MABC-2 is used to measure the motor ability of younger Kuwaiti children, 5 to 6 years old.

From a cultural perspective, we suggest that this may be due to the different directions of Arabic writing (right to left) and the "drawing" task (left to right). Evidence for this was provided by the PCA for public and private schools, where the "drawing" item was problematic in public but not in private schools. In private schools, children write in English. Miyahara et al. (1998) found significant differences between Japanese, where the direction of writing is also opposite to that of the drawing task, and the MABC norm for that task. For Japan, Miyahara et al. (1998) attributed the problem to line continuity, because Japanese writing does not have this, but it is not an issue in Arabic where writing produces a continuous line without lifting the pencil from the paper.

As noted from the individual item comparisons in the previous chapter; Kuwaiti children performed the drawing item significantly worse than UK children and other children (Chow, et al., 2001; Livesey, et al., 2007; Miyahara, et al., 1998; Sigmundsson & Rostoft, 2003), so care must be taken in using standardized assessment tools in different cultures.

The other issue that needs to be considered is the use of the MABC-2 with younger children (5 to 6 years old). The internal consistency was low for the manual dexterity and the aiming and catching tasks. The low consistency for the younger ages may be related to the small number of participants of age five years which might influence the results. Another possibility is the small number of items in each component after deleting one item from each component. There is a need to investigate the internal consistency with a large sample as well as with ages younger and older than our sample, and to include more private schools. It is also worth investigating the MABC-2 in other Arab cultures.

To sum up, the PCA findings were considered and the drawing item restandardized to reflect the percentage of Kuwaiti children with movement difficulties (at 5th percentile) and at risk of movement difficulties (15th percentile). However, the proportions are still higher than in the UK. This suggests exploring the motor performance of Kuwaiti children in the MABC-2 total score (re-standard score) and in the three components (manual dexterity, aiming and catching, and balance) to provide us with a skill profile for each child from these components.

7.4.2 The Performance on the Standard Score of the MABC-2

This study aimed to investigate the motor performance of Kuwaiti children aged 5 to 9 years on the new total score and its components based on gender, age, and school type. Comparisons with the UK children, the MABC-2 norm, were also made.

7.4.2.1 The Motor Performance in the Total Score of the MABC-2

The motor performance of Kuwaiti children was compared between genders, age groups, and school type, then with that of UK children.

No difference was found between Kuwaiti boys and girls on the MABC-2 total score. This finding is consistent with other studies (Engel-Yeger, et al., 2010; Junaid & Fellowes, 2006; Van Waelvelde, et al., 2008) although Sigmundsson and Rostoft (2003) found in Norwegian four-year-olds that girls were significantly better than boys. This finding also confirms the conclusion of Henderson et al. (Henderson, et al., 2007) that the MABC-2 total score is free of gender bias. Rather, gender differences in the analyses of individual items in the previous chapter were specific to task and age, and were not in all items or at all age groups.

On the other hand, significant differences were found between age groups. The seven-year-old children performed significantly worse than other age groups, consistent with the results found in individual item analyses in the previous chapter where children at seven years had lower performance. The development of fundamental motor skills occurs in the period from two to seven years of age, and consequences of delay or poorer development of skills in this period may show in the first years of entering school (Chambers & Sugden, 2002). Further investigation through longitudinal studies is needed to see whether the children will catch up, or whether the problem is not related to age but to this particular cohort of seven-year-old children.

Type of school did not affect the motor performance in Kuwaiti children. Although there are differences between public and private school environments, they did not influence the overall motor performance of Kuwaiti children as measured by the MABC-2 total score

Comparison with UK children shows moderately poorer performance of Kuwaiti children in the MABC-2 total score. Our findings are similar to those of other cultures when comparisons were made with American children, used for the MABC norm (Engel-Yeger, et al., 2010; Miyahara, et al., 1998; Van Waelvelde, et al., 2008). Israeli children aged 9 to 10 were worse than the American children but no significant differences were found for those 5 to 8 year old. Similarly, performance by Flemish children was significantly lower than the American but the effect was small (Van Waelvelde, et al., 2008). In Japan, children also performed worse than in American norms (Miyahara, et al., 1998). This raises the possibility of cultural differences.

7.4.2.2 The Performance on the Three Components of the MABC-2

The components of MABC-2 for gender, age, and school type mirrored the findings of the total score; there was no effect of the school type on the motor performance of Kuwaiti children in manual dexterity, aiming and catching, or balance. Gender and age differences in Kuwaiti children were identified.

The gender differences were found in all components. Kuwaiti girls were better in manual dexterity and balance tasks whereas boys were better at aiming and catching, in parallel to Junaid and Fellowes (2006) and Sigmundsson and Rostoft (2003) who found girls better than boys on manual dexterity and balance. However, others found no effects of gender on the three components (H. Van Waelvelde, et al., 2008).

There are many factors playing a role in gender differences in motor ability, particularly biological and cultural. Some researchers found differences between boys and girls at younger ages (Livesey, et al., 2007; Piek, et al., 2002) and attributed this to biological factors, with differences in brain structure and function, postural control, and hormonal levels.

The development of brain structure and functioning were investigated and compared between age groups and gender as well as between typically developed children and children with developmental disorders. For the typically developed children, gender differences were found in the cortical and subcortical level; boys have greater volume (Pangelinan et al., 2011; Tiemeier et al., 2010). However, boys peak later in cerebellar volume and cerebral maturation (Tiemeier, et al., 2010). Although these results do not show a direct relation to motor function, Pangelinan et al. (2011) supports the interrelation of motor and cognitive skills with regard to brain structures. Nevertheless, this evidence does not explain the superiority of boys in aiming and catching component skills nor the components in which girls were better.

Another biological factor is the development of postural control. The skills of the MABC-2 items require postural control in order to execute movements. Postural control develops earlier in girls and becomes adult-like by 9 to 10 years old, boys a few years later (Nolan, Grigorenko, & Thorstensson, 2005). There are differences in the mechanisms of the postural control between catching and throwing tasks and the manual dexterity and balance tasks. Therefore, the demand of the postural control for each task also differs. For example, manual dexterity and balance tasks depend on accuracy in performing tasks while the aiming and catching tasks need speed. Boys aged 9 to 17 years were found to be better than girls in performance speed while boys and girls were similar in accuracy (Dorfberger, Adi-Japha, & Karni, 2009).

The prenatal testosterone hormone concentration plays an essential role in gender differences. It produces differing brain structure and function in the genders by influencing cell survival, anatomical connectivity, and neurochemical specification. Female children with high level of prenatal testosterone, or with mothers taking androgenic progestins during pregnancy, show male-typical motor behaviour. They excel like boys in throwing and aiming at targets but have impaired fine motor skills (Hines, 2010), further evidence of the role of biological factors on task-specific gender difference in the motor performance.

Gender differences might be expected in Arab countries where parents emphases sex-appropriate behaviour. However, can this be applied to motor development? In the past, Kuwaiti boys and girls played different kinds of games. Boys preferred outdoor activities around the beach, while girls preferred to be indoors or outdoors near the house playing with dolls, sewing, and rope jumping and hopping. (http://www.e.gov.kw/sites/kgoenglish/portal/Pages/Visitors/AboutKuwait/CultureAndHeritage_CustomsAndTraditions.aspx, retrieved August 24, 2010). Because practice enhances motor ability, gender differences are expected (Thomas, Nelson, & Church, 1991), and boys benefit from training more than girls (Dorfberger, et al., 2009). However, nowadays boys and girls have changed the type of games they choose. Both play computer games as well as going with parents to cafes and shopping centres that have outdoor and indoor playground games. So, based on the effect of practice, gender differences would not be expected now. Nevertheless, gender differences were significant in our study. Working out the role of cultural practice and gender-specific or stereotype play needs a screening survey to identify childhood activities in Kuwait and the influence of parents or culture on gender-appropriate behaviour among Kuwaiti children in different age groups as well as in different ethnicities.

Differences occurred among Kuwaiti children in the three components of the MABC-2 also by age group in manual dexterity and balance, but not between age groups in aiming and catching. The seven and eight year-old children were significantly poorer than other age groups. There were no significant differences between other age groups. This result underscores the importance of longitudinal studies to investigate the motor performance of seven-year-old Kuwaiti children.

Kuwaiti children were significantly worse than UK children in manual dexterity and balance, but there was no significant difference in the aiming and catching component. Van Waelvelde et al. (2008) found that children in Belgium also performed below the MABC norm in manual dexterity. Performance of three out of the four manual dexterity items and two out of five balance items are time dependent, and children with movement problems have problem with timing, being slower in executive functioning (Piek et al., 2004; Piek & Skinner, 1999).

The manual dexterity items use postural adjustment and trunk control to facilitate arm movements, as well as coordination between right and left limbs and dissociation between right and left hand when using one hand for stabilization and the other for manipulation. The balance tasks also need postural control, body adjustment, weight shifting, body awareness, vestibular adequacy, and proper proprioception. Despite being biological innate, the development of postural control is influenced by personal and environmental demands (Shumway-Cook & Woollacott, 2001), so Kuwaiti culture and environment may impact on the development of the postural control and on the ability of children to perform the tasks accurately.

Although the MABC-2 includes qualitative as well as quantitative analysis, our study concentrated on the quantitative aspects. Further study is needed of the qualitative aspects of motor performance and the relationships between the findings from both aspects in order to understand the mechanisms of the motor control in children with motor impairments.

7.5 Summary

This Chapter investigated the motor ability of Kuwaiti children between 5 and 9 years by assessing their motor performance using the standard score for the MABC-2 total and its three components. Standard scores have the benefit of providing a skill profile for particular components which cannot be obtained from the raw scores. Also from the standard score, motor impairment can be determined.

There are four important findings in this Chapter:

- Gender differences between Kuwaiti children were found on the three MABC-2 components but not the total score. Boys were better at aiming and catching, while girls were better at manual dexterity and balance.
- Differences in Kuwaiti children in manual dexterity and balance were apparent for seven year-olds, who performed more poorly.
- Performance of the Kuwaiti children was worse than the UK children in the MABC-2 total score, manual dexterity, and balance. Children from both countries were similar in aiming and throwing.
- The increased number of Kuwaiti children with motor impairments in spite of the reduction after the restandardization of the drawing item.

The findings of this Chapter, in line with those of Chapter Six “Motor Performance of Kuwaiti Children” added further understanding of the motor development of Kuwaiti children that will benefit both clinicians in Kuwait and future research.

Having identified the movement difficulties in Kuwaiti children aged between 5 and 9 using MABC-2, the impact of the movement difficulties on functional activities through parent reports and the prevalence of DCD from DSM-IV criteria can be determined.

8 Screening the Activities of Daily Living

8.1 Introduction

In terms of the DSM-IV, DCD cannot be diagnosed only from the score obtained from the standardized assessment tools that detect motor impairment (criterion A), but also requires determination of the impact of motor impairments on daily activities or academic achievements (criterion B). In this study, the DCDQ'07, completed by parents, was used to identify children whose motor problem impact on their ADL. The questionnaire has 15 questions indicating if the motor impairments impact negatively on the child's activities.

Like the MABC-2, the DCDQ'07 has not been administered in Kuwait, either in English or in Arabic.

It was hypothesized that

1. DCDQ'07 is a valid screening tool to determine the motor coordination in everyday functional activities of Kuwaiti children aged between 5 and 9 years.
2. DCDQ'07 has acceptable sensitivity and specificity compared to the MABC-2 in identifying motor problems of Kuwaiti children aged between 5and 9 years.
3. The prevalence of DCD in Kuwait is higher than that reported in the American Psychology Association ; 5-8% of children in primary school (American Psychiatric Association, 1994).

8.2 Method

8.2.1 Participants

A parent of each child who participated in the MABC-2 assessment was provided with the DCD questionnaire, and DCDQ'07 was included in the analysis if the parent answered all the questions. Three children were excluded from the DCDQ'07 data analysis for this reason. The number of completed questionnaires was 294, the mean age in months was 92.89 and SD = 14.28 (Table 8.1).

Table 8.1: The mean age and SD for Kuwaiti children whose parents completed the DCDQ

Age	Total number	Boys	Girls	Mean* (SD)
5 years	22	11	11	70.09 (0.86)
6 years	69	33	36	78.01 (3.66)
7 years	76	39	37	89.68 (3.65)
8 years	67	32	35	101.43 (3.69)
9 years	60	32	28	112.90 (2.95)
Total	294	147	147	

*Age calculated by months

8.2.2 Statistical Analysis

All data were entered into SPSS-18. According to the DCDQ'07 administration scoring, the total score of the DCDQ'07 was divided into Group One "Indication of, or Suspect for, DCD" and Group Two "probably not DCD".

Normality and Homogeneity of Variance using skewness, kurtosis, Shapiro-Wilk and Levene's Test for Equality of Error Variances were completed to ensure that the data were normally distributed and not violated. One-way ANOVA and Pearson Correlations investigated the effect of gender and age on the DCDQ'07 total score.

For testing hypothesis one, that is the validity of the DCDQ'07, reliability tests were done to assure internal consistency, Principle Component Analysis (PCA) measured the construct validity, and the Pearson Correlation tested the concurrent validity.

Hypothesis two is related to the sensitivity and specificity of the DCDQ'07. Cross-tabs were used. The MABC-2 total score was divided into Group One equal or below the 15th percentile indicating risk of motor impairments and Group Two above the 15th percentile indicating no motor impairments. The 15th percentile was used as a cut-off for the MABC-2 to be compatible with the DCDQ'07, which has this cut-off. Calculations of sensitivity, specificity, positive predictive value, and negative predictive value are presented in Table 8.2.

Table 8.2: The calculation equations for measuring sensitivity, specificity, and positive and negative predictive values

		MABC-2 groups Positive	Negative	
DCDQ'07 groups	Positive	True positive (TP)	False positive (FP)	Positive predictive value = TP / (TP + FP)
	Negative	False negative (FN)	True negative (TN)	Negative predictive value = TN / (FN + TN)
		Sensitivity = TP / (TP + FN)	Specificity = TN / (FP + TN)	Total agreement = [(TP+TN)/n]×100 n indicates number of participants

For testing hypothesis three, related to the prevalence of DCD in Kuwait, cross-tab measurement was done to determine the number of children who performed at or below the 15th percentile in both the MABC-2 and the DCDQ'07. Then descriptive analysis was applied to those children identified by both tests to categorize them into two groups based on the MABC-2 cut-offs (5th and 15th percentiles), "with DCD" and "at risk of DCD".

8.3 Results

The Normality Test of the total score for the total DCDQ'07 sample showed that the histogram is slightly skewed to the right (Figure 8.1). However, skewness and kurtosis values are within normal range (-1 to +1). The Shapiro-Wilk was significant ($p < 0.001$), but the sample size is large enough to consider that the violation of the Shapiro-Wilk is not problematic. Levene's Test of Equality of Error Variances was not significant ($p > 0.05$) indicating that the Homogeneity of Variance is not violated.

The Box plot show five outliers (2 males and 3 females) and although the outliers were not too far from the Box plot they were experimentally deleted and normality analyses were done. The deletion of the outliers did not improve the normality results, so we consider that the outlier and right skewing of the sample are not problems and that the sample is roughly normally distributed.

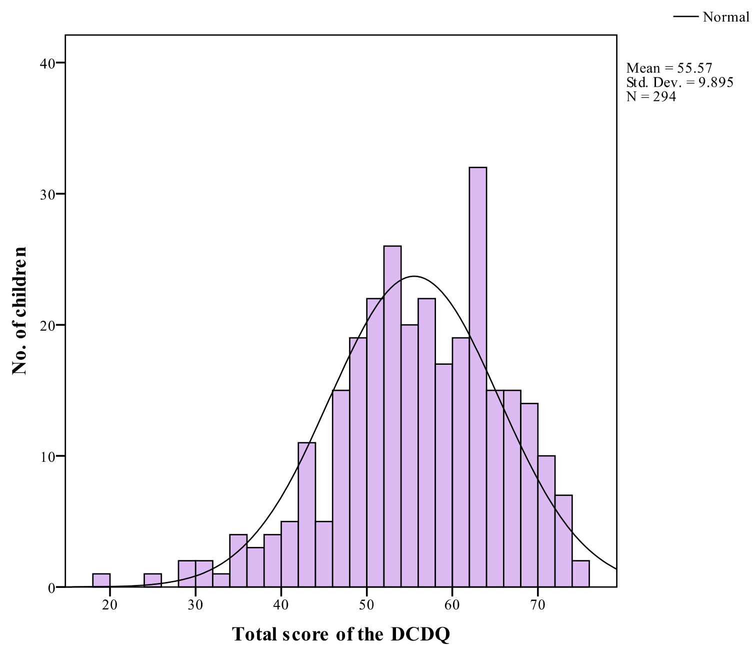

Figure 8.1: The distribution of the data sample based on the total score for the DCDQ total sample

The ANOVA found that the main effects of gender ($F_{(1,294)} = 0.011$, $p = 0.92$) and age ($F_{(4,294)} = 1.77$, $p = 0.135$) were not significant indicating that there were no significant differences in the total scores between boys and girls and between each age group. However, the Pearson correlation test showed that there were significant correlations between age groups and the total score of the DCDQ'07 ($r = 0.135$, $p = 0.021$) indicating the necessity for age-specific cut-off scores. There were no significant correlations between gender and the total score ($r = 0.025$, $p = 0.668$) or between gender and age groups ($r = - 0.21$, $p = 0.715$).

8.3.1 Validity of the DCDQ'07

8.3.1.1 Internal Consistency

Reliability analysis on the consistency of the questionnaire items was measured using Cronbach's alpha for the 15 questions and for the subscale items.

8.3.1.1.1 Reliability of the 15-item total

The results of Cronbach's alpha coefficient for the total 15 items was high ($\alpha = 0.87$) and Cronbach's alpha on deletion of an item was also high for each item (α ranged from 0.860 to 0.881). The corrected item-correlation ranged from 0.287 to 0.635 (Table 8.3).

Table 8.3: Item-total correlation of the 15-items and Cronbach's alpha if item deleted

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Q1: Throws ball	51.82	87.313	0.559	0.863
Q2: Catches ball	52.15	86.533	0.544	0.863
Q3: Hits ball/birdie	52.53	87.936	0.493	0.866
Q4: Jumps over	51.94	85.867	0.517	0.865
Q5: Runs	51.38	86.939	0.537	0.864
Q6: Plans activity	51.49	85.971	0.624	0.860
Q7: Writing fast	51.74	85.156	0.594	0.861
Q8: Writing legibly	51.59	84.727	0.635	0.859
Q9: Effort and pressure	51.95	85.332	0.500	0.866
Q10: Cuts	51.79	84.656	0.622	0.860
Q11: Likes sports	51.28	86.134	0.609	0.861
Q12: Learning new skills	51.91	85.865	0.538	0.864
Q13: Quick and competent	51.56	85.797	0.559	0.863
Q14: "Bull in shop"	52.62	87.505	0.287	0.881
Q15: Does not fatigue	52.19	85.317	0.425	0.871

Further analysis was done to measure the correlation between the 15 items. The results showed that all the questions are significantly correlated to each other ($p < 0.05$) except for Question 12 (learning new skills) and Question 14 (bull in shop); the correlation was not significant, $p = 0.092$.

The strength of the association was small to high between all questions (correlation coefficient ranging from 0.224 to 0.615) except for Question 14 which has very weak association with other questions, $r < 0.2$ (Appendix E).

8.3.1.1.2 Reliability of the subscales

The internal consistency was also measured for the three subscales of the DCDQ'07. Cronbach's alpha for the total subscales was acceptable ($\alpha = 0.799$). However, the internal consistency within each subscale item varies; control during movement was high ($\alpha = 0.812$), fine motor/ handwriting was acceptable ($\alpha = 0.777$), but general coordination was low ($\alpha = 0.658$). The alpha increased to 0.680 for the subscale "general coordination" if Question 14 "bull in a shop" were removed. The correlation coefficients between subscales were significant ($p < 0.01$). Large associations were found between "control during movement" and "fine motor/ handwriting" ($r = 0.585$) and "general coordination" ($r = 0.542$). The association between "fine motor/ handwriting" and "general coordination" was also large ($r = 0.620$).

8.3.1.2 Construct Validity

Principle component analysis (PCA) was used to examine the DCDQ'07 construct validity for Kuwaiti children. The aims of the PCA were to determine if the questionnaire items could be separated into component factors to clearly describe what they measure, and also if the measurement structure of the questionnaire and the validity of the questionnaire items were appropriate to be applied in a non-western country with different background, language, and culture. The 15 questions are divided into three components; the first with six questions, the second with four questions, and the third with five questions (Table 8.4).

Table 8.4: DCDQ'07 components demonstrating the loading of each question

<table>
<tr><th></th><th>Control during movement</th><th>Fine motor / handwriting</th><th>General coordination</th></tr>
<tr><td>1- Throws ball</td><td style="background:#5590d6"></td><td></td><td></td></tr>
<tr><td>2- Catches ball</td><td style="background:#5590d6"></td><td></td><td></td></tr>
<tr><td>3- Hits ball/birdie</td><td style="background:#5590d6"></td><td></td><td></td></tr>
<tr><td>4- Jumps over</td><td style="background:#5590d6"></td><td></td><td></td></tr>
<tr><td>5- Runs</td><td style="background:#5590d6"></td><td></td><td></td></tr>
<tr><td>6- Plans activity</td><td style="background:#5590d6"></td><td></td><td></td></tr>
<tr><td>7- Writing fast</td><td></td><td style="background:#5590d6"></td><td></td></tr>
<tr><td>8- Writing legibly</td><td></td><td style="background:#5590d6"></td><td></td></tr>
<tr><td>9- Effort and pressure</td><td></td><td style="background:#5590d6"></td><td></td></tr>
<tr><td>10- Cuts</td><td></td><td style="background:#5590d6"></td><td></td></tr>
<tr><td>11- Likes sports</td><td></td><td></td><td style="background:#5590d6"></td></tr>
<tr><td>12- Learning new skills</td><td></td><td></td><td style="background:#5590d6"></td></tr>
<tr><td>13- Quick and competent</td><td></td><td></td><td style="background:#5590d6"></td></tr>
<tr><td>14- "Bull in shop"</td><td></td><td></td><td style="background:#5590d6"></td></tr>
<tr><td>15- Does not fatigue</td><td></td><td></td><td style="background:#5590d6"></td></tr>
</table>

PCA was carried out for the sample gathered from 294 Kuwaiti children aged 5 to 9 years. The results show that the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (0.894) was well above the commonly recommended value of 0.6 and close to 1.0. Bartlett's Test of Sphericity was significant, χ^2 (105) =1618.468, P = 0.000, indicating that the sample was randomly drawn from the population. These two results mean there are relationships between the variables worth analysing.

The correlation matrix showed moderate to high correlations between variables and the diagonals of the anti-image correlation matrix for the variables were all above 0.5; the MSA values for all variables were all excellent, ranging from 0.775 to 0.933 (Appendix E). Based on the results obtained from the extraction communalities, all the variables were above 0.3, ranging from 0.408 to 0.657, indicating that all variables fit well with the component solution and no item was eliminated.

Three distinct components with eigenvalues ≥ 1 appeared to explain 56.31% of the total variance (Figure 8.2). All items were moderate to highly primary loaded in each component and were above 0.5 except Question 5 “runs” which had low cross-loadings into two components. Five items were cross-loaded; they had higher primary loading except for Question 5 “runs”.

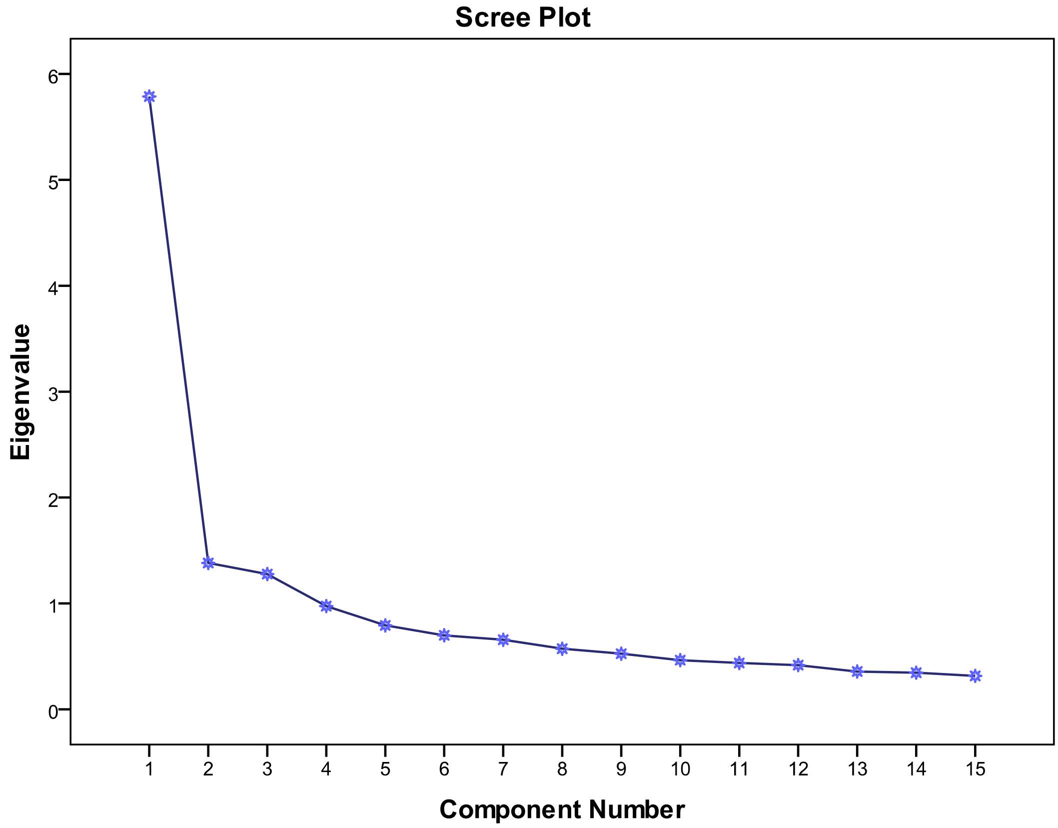

Figure 8.2: Scree plot showing the three components of the PCA for the Kuwaiti DCDQ sample

Although PCA retrieved three components similar to the DCDQ’07, not all items loaded in the expected components of DCDQ’07 (Table 8.5).

Table 8.5: Component loadings and communalities based on PCA with varimax rotation for the 15 questions of DCDQ'07

Items	Factor: Component – Fine motor/general coordination	Control during movement	Handwriting/gross motor coordination
Q13: Quick and competent	0.776		
Q11: Likes sports	0.714		
Q12: Learning new skills	0.698		
Q7: Writing fast	0.691		
Q8: Writing legibly	0.671		
Q10: Cuts	0.631		
Q6: Plans activity	0.569	0.409	
Q1: Throws ball		0.772	
Q2: Catches ball		0.751	
Q3: Hits ball/birdie		0.730	
Q4: Jumps over		0.695	
Q5: Runs	0.447	0.453	
Q14: "Bull in shop"			0.772
Q15: Does not fatigue			0.766
Q9: Effort and pressure			0.587
Eigenvalue	5.787	1.382	1.277
% Variance	38.58%	9.15%	8.5%
Total % Variance	56.31%		

Note: Component loadings < 0.4 were suppressed

The first component included eight items and accounted for 38.58% of the total variance. This component was labelled as "fine motor/general coordination". It is the combined items from two components of the DCDQ'07; Questions 7, 8, and 10 from the second component and Questions 11 to 13 from the third component. Question 6 from the first component had a primary strong cross loading in this component and secondary weak loading with another component. Question 5 also loaded in this component but it had strong primary loading in the second component.

The second component included six items and accounted for 9.21% of the total variance. It was labelled “control during movement” and resembled the component found in DCDQ’07 because it has six items similar to the DCDQ’07. Five items (Questions 1 to 5) had strong primary loading. Question 6 had low cross-loading in this component.

The third component included three items and accounted for 8.5% of the total variance. It was labelled “handwriting/gross motor coordination” as it has two items requiring coordination and one involving handwriting. Two items (Questions 14 and 15) loaded similarly to DCDQ’07 but Question 9 loaded in a component differing from that in DCDQ’07.

Internal consistency for each factor was checked using scale reliability. Cronbach’s alphas were moderate to high: 0.858 for “fine motor/general coordination”, 0.789 for “control during movement”, and 0.612 for “handwriting/gross motor coordination”. There were no substantial increases in alpha for the scales by eliminating an item. Therefore, the internal consistency of the components was moderate to high. It can be seen from Table 8.6 that “fine motor/general coordination” had a negative skewed distribution. All the skew and kurtosis values were within a tolerable range for a normal distribution and examination was consistent with this.

Table 8.6: The descriptive statistics for the four factors based on mean and standard deviation for each factor

	No. of items	Mean (SD)	Skewness	Kurtosis	Alpha
Fine motor/general coordination	7	27.61 (5.315)	-0.990	0.879	0.858
Control during movement	5	18.02 (3.727)	-0.405	-0.082	0.789
handwriting/gross motor coordination	3	9.94 (3.077)	-0.242	-0.546	0.612

8.3.1.3 Concurrent Validity

Prior to calculating the correlation, the assumptions of normality and linearity were investigated. The scatterplot confirmed the linear relationship between total scores of the DCDQ'07 and the total score of the MABC-2 and their subscales.

Pearson's correlation coefficient was used to measure the strength and direction of the relationship between DCDQ'07 and MABC-2, for the total scores and for the subscales of both tools (Table 8.7). The bivariate correlation between the total scores of the DCDQ'07 and the MABC-2 was positive but weak, $r(292) = 0.22$, $p < 0.001$. The correlation between subscales was positive but weak between some of the subscales. There was no correlation between the DCDQ'07 "fine motor" and the MABC-2 "aim and catch" or between the DCDQ'07 "general coordination" and the MABC-2 "manual dexterity" and "aim and catch".

Table 8.7: Pearson's correlation coefficient between DCDQ'07 and MBC-2

	DCDQ				MABC-2			
	Total	Control during movement	Fine motor/ handwriting	General coordination	Total	Manual dexterity	Aim and catch	Balance
DCDQ total	1							
Control during movement	0.853**	1						
Fine Motor/ handwriting	0.845**	0.585**	1					
General coordination	0.848**	0.542**	0.620**	1				
MABC-2 total	0.211**	0.262**	0.181**	0.088	1			
Manual dexterity	0.096	0.134*	0.132*	-0.018	0.693**	1		
Aim and catch	0.102	0.204**	0.010	0.025	0.585**	0.169**	1	
Balance	0.223**	0.218**	0.203**	0.146*	0.825**	0.335**	0.250**	1

** Correlation is significant at the 0.01 level
* Correlation is significant at the 0.05 level

8.3.2 Sensitivity and Specificity of DCDQ'07

The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were measured for the two DCDQ'07 categories based on the children's performance on the MABC-2. MABC-2 scores were regrouped into two categories instead of three, "movement difficulty" and "at risk of movement difficulty" categories merged to be compatible with the DCDQ'07 cut-offs at the 15^{th} percentile. Table 8.8 shows the number of children in each category.

Table 8.8: The cross-tab between MABC-2 categories and DCDQ'07 categories

	MABC-2 groups		
DCDQ'07 groups	Movement difficulty/at risk of movement difficulty	No movement difficulty	
Indication of, or Suspect for, DCD	42	41	PPV = 42/42+41 = 50.6%
Probably not DCD	57	154	NPV = 154/154+57 = 73%
	Sensitivity = 42/42+57 = 42.4%	Specificity = 154/154+41 = 79%	

The sensitivity refers to the percentage of children with motor impairment based on MABC-2 that are correctly identified by the DCDQ'07. The preferable percentage according to the American Psychological Association (APA) is 80% (Schoemaker, et al., 2006) but the sensitivity of DCDQ'07 obtained in this study was lower at 42.40%.

The specificity refers to the percentage of children without motor problems who are correctly identified by the DCDQ'07 as having no motor problems. The preferable value is 90% according to the APA (Schoemaker, et al., 2006) and the specificity of the DCDQ'07 obtained in this study was 79%.

The positive predictive value is the percentage of children correctly identified by the DCDQ'07 who are correctly categorized as having motor problems based on the MABC-2, the preferable value being 70%. This value is proportional to the prevalence of the condition. The PPV obtained in this study was 50.6%.

The negative predictive value is the percentage of children identified by the DCDQ'07 as probably not having motor problems who were identified as having no motor problems based on the MABC-2; the NPV obtained in this study was 73%.

The degree of agreement between the DCDQ'07 and the MABC-2 using the 15th percentile as a cut-off for both tools was poor (kappa = 0.223). The overall agreement between DCDQ'07 and the MABC-2 was 66.6% [((42+154)/294) ×100].

8.3.3 The Prevalence of DCD in Kuwait

Having obtained the results from both MABC-2 and DCDQ'07, the prevalence of DCD in Kuwait was calculated based on the DSM-IV criteria A, B, C, and D. Criteria C and D were met before conducting the study through the restrictive inclusion and exclusion criteria. For criterion A, the MABC-2 was introduced to measure the motor impairments of children, while for criterion B, the DCDQ'07 was distributed for parents to record the impact of the motor impairments on children's activities.

Based on the MABC-2 scores before re-standardization of the drawing task, the percentage of children with movement difficulty (≤ 5th percentile) was 17.8% and the percentage of children at risk of movement difficulty (>5th and ≤ 15th percentile) was 26.3%. After re-standardization of the drawing task, the percentages fell to 11.1% and 22.9% respectively.

The results show that the number of children performing below the 15th percentile in both tools was 42 accounting for 14.14% of the total sample. Based on the MABC-2 cut-offs (5th and 15th percentiles), 17 out of 42 children may have DCD, 5.7% of the total and ratio of boys to girls is 1.8:1. The number of children at risk of DCD was 25 out of 42 (8.4% of total) with an equal ratio of boys to girls. Figure 8.3 shows the prevalence of DCD and risk of DCD in Kuwaiti children aged between 5 and 9 years, with gender differences.

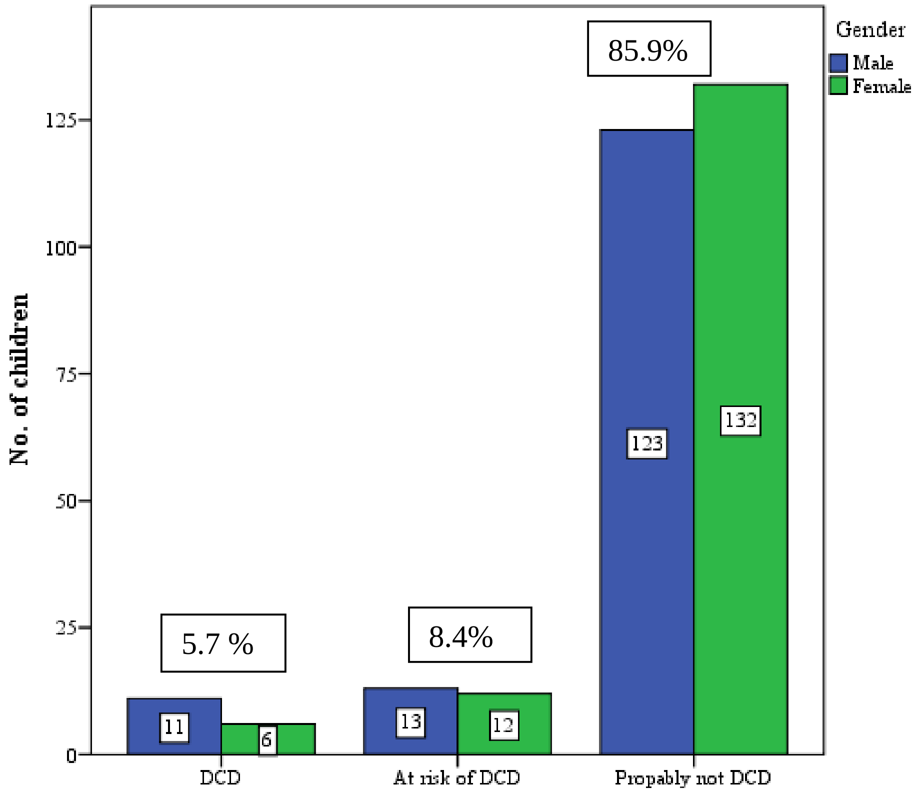

Figure 8.3: The prevalence of DCD for Kuwaiti children aged between 5 and 9 years

8.4 Discussion

Screening daily living activities is essential to satisfy criterion B of the DSM-IV in order to identify children with DCD, and the DCDQ'07 is a parent questionnaire that has been used in many countries and with different languages, so we hypothesized that it is a suitable screening tool for this purpose for Kuwaiti children aged between 5 and

9 years. The findings are outlined in three themes: gender and age effects, validity of the DCDQ’07, and prevalence of DCD in Kuwait.

8.4.1 Gender and Age Effects

Before investigating the validity of the DCDQ’07, the gender and age effects were tested. ANOVA showed no significant effects of gender or age on the total score: the performances of Kuwaiti boys and girls were similar in the total score and the sample can be analysed as a whole with no need to split the sample by gender or age.

However, the results of the Pearson correlation test between total score and age groups revealed the need for specific cut-offs based on age for Kuwaiti children. Our results support the findings of Wilson (2009), but a Chinese study showed significant gender differences in the total score; girls had higher scores than boys in the mean of the total score (Tseng, et al., 2010). Similarly in the Netherlands, gender and age were also found to affect the total DCDQ score and the authors suggested separate impairment scores for boys and girls based on age (Schoemaker, et al., 2006).

8.4.2 Validity of the DCDQ’07

The DCDQ’07 has not been used in Kuwait and has not previously been translated into Arabic, so its validity (internal consistency, construct, and concurrent) was tested. Two published studies have examined the validity of the 15-item DCDQ’07 (Cairney, et al., 2008; B. Wilson, et al., 2009), both introducing the questionnaire in its original language (English), and one translating it into Chinese (Tseng, et al., 2010). There is a difference in the method of the translation between our study and Tseng’s study. As mentioned in Chapter 5, “General Methodology”, the translation in our study was word-for-word without interfering with the meaning, while in Tseng’s study the translation method included cultural perspectives. Tseng et al. (2010) translated the DCDQ’07 to Chinese language based on the cross-cultural adaptation of instruments considering the adjustment of cultural words and idioms. Tseng also changed the name of the activities that were not familiar in Chinese culture and worked closely with the author Wilson to choose appropriate Chinese activities. They also changed the phrase “bull in a shop”. One of the limitations of our study is the translation method which may influence the answers to the questions. For example, the activity in Question 3 (“birdie with a bat”) is not popular in Kuwait, so parents needed think of other popular activities with similar actions to base the answer on. However, after this examination of the validity of the DCDQ’07 in Kuwaiti culture, future research is needed using the DCDQ’07 translated into Arabic with consideration of cross-cultural adaptation of instruments.

8.4.2.1 Internal Consistency

Our findings revealed high internal consistency ($\alpha = 0.87$) for the total DCDQ’07 score and acceptable consistency for the subscales. Our findings were similar to other studies conducted in Canada using the revised 15-item DCDQ’07 which found high consistency, $\alpha=0.89$ (Cairney, et al., 2008; B. Wilson, et al., 2009). Similar results were also found in the Chinese version (Tseng, et al., 2010), and Brazilian version (MSS, Magalhães, & Wilson, 2009). The high internal consistency was also found with the 17-item DCDQ (Civetta & Hillier, 2008; Schoemaker, et al., 2006; Tseng, et al., 2010). These findings confirmed that all DCDQ’07 items are measuring the same underlying construct.

With regard to the internal consistency of the subscales, our results show moderate to high correlations between the subscales, supporting Cairney’s study (2008). The lowest consistency ($\alpha = 0.658$) was for the general coordination subscale, which contains five items (Questions 11 to 15). The lower consistency within that subscale may be due to the inconsistency between its items which would be measured by the correlation test.

In the correlation test, significant moderate to large positive correlations were found between all questions except Question 12 (“learning new skill”) which did not correlate significantly with Question 14 ("bull in shop"). The strength of the correlation between Question 14 and Question 15 ("does not fatigue") with other items was very weak (r ~ 0.1), perhaps explaining the weakness of the internal consistency of the general coordination subscale.

Question 9 also has limited correlation with other items (r ~ 0.2). Many Kuwaiti parents commented on Questions 9, 14, and 15. For example, Question 9 refers to effort or tension which are two different issues. Moreover, the explanation of the question between brackets includes also two issues, excessive pressure and tightness of grasping pencil. Many parents asked for clarification of the meaning of the question: the question might be clear for an English speaker, but English is the second language for Kuwaiti parents and most used the translated version which may have influenced understanding of the question, perhaps influencing the way the questions were answered.

Parents suggested that Questions 9 and 15 included information that may need to be in two questions instead of one. For example, in Question 15, the question asks whether the child "does not fatigue easily or appear to slouch". Mothers commented that their children might fatigue easily if required to sit down for long period, but not necessarily appear to slouch or fall out of the chair. They commented that their children moved out of the chair if they were fatigued.

Many parents commented on Question 14 ("bull in china shop") because they found it unacceptable to describe their children as an animal. This is more a cultural issue. Furthermore, the translation might interfere with the meaning of the question. The comments of the parents in regards to "appear clumsy" and "might break fragile things in small room" indicated that they did not understand the general meaning of the question, rather they looked at the question word by word as it was translated. Moreover, the Arabic translation of the word "clumsy" did not give a meaning of clumsiness and might mislead them in answering the question. Similar comments particularly on this question was also approached by Brazilian parents, although the word “bull” was changed to “elephant” to be culturally acceptance (MSS, et al., 2009).

Generally, the high internal consistency of the total score confirmed the homogeneity of the DCDQ’07 in screening motor coordination of Kuwaiti children between 5 and 9 years old. In spite of the non-significant correlation between Questions 12 and 14, there were significant associations between the 15 items confirming that the questions measured the motor coordination of the children in their daily activities.

8.4.2.2 Construct Validity

Our findings show that the loadings of the items in the PCA were not similar to the original DCDQ confirming that the construct validity of the DCDQ’07 was not met. The fit of the component structure of the DCDQ’07 was poor. Our results are consistent with those of Cairney et al. (2008) who found a poor fit of the hypothesized factor structure.

Because there are no published studies investigating the 15-item DCDQ’07, we based our discussion for construct validity on the studies of the 17-item DCDQ in which PCA (Civetta & Hillier, 2008; Schoemaker, et al., 2006) or confirmatory factor analysis (Martin, Piek, Baynam, Levy, & Hay, 2010; Tseng, et al., 2010) were conducted. Not all studies found that the items were loaded into four factors similar to the original DCDQ-17items. Although Schoemaker et al. (2006) and Martin et al. (2010) found that the items loaded into four factors, one factor included items that had problems fitting with others and deletion was suggested. The loading of the items into these three factors were similar to the revised version of the DCDQ’07 15-item (B. Wilson, et al., 2006).

In our study, the items for “fine motor/handwriting” and “general coordination” merged. The items for “control during movement” loaded in one component similar to the DCDQ’07 and other studies (Civetta & Hillier, 2008; Martin, et al., 2010; Schoemaker, et al., 2006; Tseng, et al., 2010). Questions 9, 14, and 15 loaded together into one component. This can be explained from the findings of the reliability and correlations as these questions had weak correlations with other items. As explained previously, the content or the translation of these questions may influence the interpretation of the results.

Although these Questions 9, 14, and 15 were problematic, they could not be deleted from the PCA for several reasons. First, the values of these questions in the anti-image correlation were high (0.917, 0.779, and 0.832 respectively) and the values of the extraction were moderate to high (0.50, 0.61, and 0.64 respectively) indicating that statistically there is no reason for deleting them from the PCA. Second, eliminating these questions from the PCA did not improve the results; the other items loaded in two components just as they had before deleting these questions.

Although the results of other studies confirmed the underlying motor components and cultural commonality in the motor disorder, our findings revealed different motor components which might indicate cultural differences or different features of children with motor impairments. Therefore, a clinical consideration of each activity with which a child has a problem has been suggested, instead of relying on the motor components of impairments (Cairney, et al., 2008). However, the DCDQ’07 needs to be corrected to be compatible with Kuwaiti culture as done in China (Tseng, et al., 2010) to ensure that parents understand the content of the questions and are able to adequately interpret the questions and respond appropriately.

8.4.2.3 Concurrent Validity

Our study is the first to compare the new versions of two established assessments: the DCDQ’07 with the MABC-2. Although there was a positive significant correlation between the MABC-2 total score and the DCDQ’07, the correlation was weak ($r = 0.22$). Both instruments succeeded in measuring motor impairments, but the weakness of the association between items indicates that each tool measures different aspects of impairment.

Not all correlations between the subscales of the instruments were significant, indicating differences between each tool in measuring motor behaviour. MABC-2 measures specific tasks in three different components for manual dexterity, ball skills, and static and dynamic balance, while DCDQ'07 screens the ability of the child to coordinate and control his or her movements in different life activities as reported by parents. Similar results were found between the MABC and DCDQ-17 items for the population-based sample, but the correlation became high for the sample when equal numbers of children with and without motor problems were included (Schoemaker, et al., 2006). Another study included both children diagnosed with DCD on the basis of their DCDQ scores, and a control group, and found significant correlation between total scores and sub-scales but with a fair relationship (Civetta & Hillier, 2008). A low significant correlation was also found between the MAND and the DCDQ (Loh, et al., 2009) and between the Children's Self-perceptions of Adequacy in and Prediction toward Physical Activity (CSAPPA) (Cairney et al., 2007). The significant correlation between the tools may be explained in that both are compatible with measuring motor impairments, whereas the weak relationship may indicate differences between the tools in measuring different aspects of motor behaviour.

8.4.2.4 Agreement between Instruments

We also hypothesized that DCDQ'07 has high sensitivity and specificity in identifying children with motor impairments when using MABC-2 as a criterion measure for Kuwaiti children. Our findings show that the sensitivity, specificity, PPV, and NPV of the DCDQ'07 were lower than recommended values (Schoemaker, et al., 2006), indicating that DCDQ'07 might not be sensitive in identifying Kuwaiti children with motor impairments. Our findings were similar to many researchers who used the DCDQ or DCDQ'07 in different countries such as Australia (Civetta & Hillier, 2008; Loh, et al., 2009), Brazil (MSS, et al., 2009), the Netherlands (Schoemaker, et al., 2006), and Taiwan (Tseng, et al., 2010).

The sensitivity and specificity of the test are affected by the proportions of children with and without impairments. Sensitivity increases if the number of children with and without impairment is equal rather than relying on the population sample (Green et al., 2005). Schoemaker (2006) found that the sensitivity of DCDQ compared to MABC increased (81.9%) in a sample with equal numbers of participants with and without motor problems while in the sample with a minority of participants with motor problems the sensitivity was low (28.9%). It has been reported that the MABC is sensitive in detecting motor impairments (Crawford, et al., 2001), but the sensitivity of the DCDQ was low (38%) compared with BOTMP for children confirmed as having DCD (Crawford, et al., 2001).

Our findings showed that the specificity was better than the sensitivity, confirming studies in Australia (Loh, et al., 2009), Brazil (MSS, et al., 2009), Canada (Crawford, et al., 2001), and the Netherlands (Schoemaker, et al., 2006). However, many studies found that the specificity of the DCDQ or DCDQ'07 was lower than the sensitivity (Civetta & Hillier, 2008; Green, et al., 2005; Tseng, et al., 2010; Wilson, et al., 2009). In Civetta and Hillier's study (2008) the specificity became better than the sensitivity when the cut-off decreased to the 5^{th} percentile for the diagnostic test and to 63 for the DCDQ. On the other hand, MSS, Magalhaes, and Wilson (2009) found that the sensitivity of the DCDQ'07 increased from 0.66 to 0.73 after removal of two items that parents had difficulties answering them; questions "hits birdie" and "elephant (Bull) in china shop". This result may indicate that the translation, although it was cross-cultural translation, impacts on the answers of the questions.

The positive and negative predictive values were also low in our study consistent with other studies (Green, et al., 2005; Loh, et al., 2009; Schoemaker, et al., 2006).

Agreement between MABC-2 and DCDQ'07 in our study was poor, consistent with other studies comparing DCDQ (17 items) with MABC (Green, et al., 2005; Schoemaker, et al., 2006). Poor agreement between DCDQ and MAND was found also in a study conducted in Australia (Loh, et al., 2009). The DCDQ'07 was also compared to another questionnaire, CSAPPA, and the results confirmed poor agreement between the instruments (Cairney, et al., 2007). Similar results were also reported with DCDQ in poor agreement with BOTMP in identifying children with DCD but in good agreement for those who did not have DCD (Crawford, et al., 2001). Considering the characteristics of the test, it is crucial to evaluate the agreement between tests because different assessments measuring motor impairments may identify different motor problems. The most popular tests for measuring motor impairments (MABC and BOTMP) were also inconsistent in identifying children with motor impairments (Dewey & Wilson, 2001). Similarly, limited agreement has been found between the MABC and MAND, and there were significant differences in the way children with motor difficulties were identified (Brantner, et al., 2009). Whilst disagreement was found between different assessments tools as mentioned, the poor agreement between the MABC-2 and the DCDQ'07 in our study may raise a question for the appropriateness of the MABC-2 as gold standard for DCD as suggested by Venetsanou et al (2011).

Based on the results outlined above, it can be concluded that the DCDQ'07 is not sensitive in detecting children with motor impairments compared to standard assessment tools such as the MABC, MAND, BOTMP, and MABC-2. However, an important issue here is that the assessment tools are measuring the motor performance in order to detect the motor impairments, while the DCDQ'07 is a screening tool to detect the impact of the motor impairments on the child's activities. DCDQ'07 is not designed to diagnose children with DCD but it is a supportive instrument to screen children, differentiating those who are in need of further investigation. Because assessment tools are expensive and time consuming, screening tools can be used as alternatives for initial identification of children with motor coordination difficulties (Dewey et al., 2011).

Although the sensitivity and specificity did not reach recommended values, its ability to detect 42% of Kuwaiti children from a school-based population is worth considering especially as its agreement with MABC-2 exceeds 50% and no screening tool has been used before in Kuwait for parents or teachers to help in initially identifying children with motor coordination problems.

However, the Arabic translation needs to be revised and reworded with adjustment of cultural words and idioms for cross-cultural adaptation of these instruments.

8.4.3 The Prevalence of DCD in Kuwait

Our study is restricted by the DSM-IV criteria in identifying children with DCD. Considering the four criteria of DSM-IV, the prevalence of DCD in primary schools in Kuwait was 5.7 % with 8.4% at risk of DCD. We hypothesized that the prevalence of DCD in Kuwait is higher than reported by the DSM-IV (American Psychiatric Association, 1994). However, the results show that the prevalence of DCD in Kuwait is within the range reported in other countries. The prevalence has been reported as lower as 0.4% in Belgium (Van Waelvelde, et al., 2008) to 1.4% in Singapore (Wright & Sugden, 1996), in Sweden 4.9% (Kadesjo & Gillberg, 1999),6% in Australia (Pearsall-Jones, et al., 2008), 8% in Canada and 19% in Greece (Tsiotra, et al., 2006). These studies did not reported differences in prevalence at different ages. Miyahara et al. (1998) measured the prevalence of DCD in Japan for different age groups; 1.8% for age band two (7-8 years), 15.6% for age band three (9-10 years), and 45% for age band four (11 years).

The differences in the prevalence occur because not all these studies were restricted to the DSM-IV criteria and most based their identification of children with DCD on the impairment scores in standardized assessment tools, meaning that only criterion A was considered. None of these studies considered criterion B to confirm that the impairments impact on the activities in daily life, as discussed in Chapter 2 “Children with DCD”. Although Wright and Sugden (1996) used a two-step procedure to identify children with DCD in Singapore including the MABC test and checklist, the prevalence was measured at cut off at 5th percentile in both checklist and test. Wright and Sugden (1996) also found the prevalence at the15th percentile cut off for both tests to be 4%.

However, a population-based study for a large UK birth cohort using strict criteria to define children with DCD (Lingam, et al., 2009) found a prevalence of 1.7%, much lower than any other reported study. Although the method used in this study was considered a good example to follow especially since it met all the DSM-IV criteria, there are some issues which should be pointed out. The study cannot be generalized as the sample was drawn from one age group (7 to 8 years old) although the sample size was large. Although the authors investigated the motor impairments based on the MABC test, they used only three items representing each component of the MABC test based on the factor analysis provided by the MABC-2 authors: placing pegs, throwing bean bag, and walking heel-to-toe. This method might provide misleading results for children with task-specific problems. Some children may perform poorly in one task or two but not necessarily in the total score (Junaid & Fellowes, 2006). The screening tool used was not standardized nor did the authors examine its validity. Although the study is a good example of the use of DSM-IV criteria for identifying children with DCD, the results cannot be generalized.

8.5 Summary

This chapter investigated the activities of Kuwaiti children measured by the DCDQ’07, which we hypothesized as a valid screening tool with acceptable sensitivity and specificity to determine motor coordination difficulties in Kuwaiti children. The findings show that although the construct validity of the DCDQ’07 was poor for the component structure, it has moderate to high internal consistency and significant correlations between most of the items. However, it has low sensitivity and specificity. The reasons for its weak validity may be related to the differences in the activities between the Kuwaiti culture and the Canadian culture where the standardization sample was recruited, and to the Arabic translation of the questionnaire.

DSM-IV requires the application of four criteria in order to identify children with DCD and results in a dramatic decline in the percentage of Kuwaiti children with movement difficulties diagnosed with DCD. This shows that the DSM-IV criteria are effective in Kuwait for identifying children with DCD, and based on these inclusion criteria the prevalence of DCD in Kuwait is within the reported range for DSM-IV, between 5.7% and 8.4%.

Given this clear picture of the proportion of Kuwaiti children with movement difficulties and with DCD, now the risk factors should be investigated. Although the literature provides many predictors for motor difficulties, they have not been studied in Kuwait.

CHAPTER NINE

9 Predictive Factors for Motor Impairments

9.1 Introduction

There are many predictive factors for motor impairment which influence motor ability, such as the gestational age and birth weight: being born very preterm or with very low birth weight (VLBW) is significantly related to motor impairments (de Kieviet, et al., 2009). A study of a cohort of extremely low birth weight (ELBW) children in Vancouver, Canada identified 51% as having DCD (Holsti, et al., 2002). Gender and age may also be factors, evidence showing that boys are more likely to have DCD than girls (Barnhart, et al., 2003; Kadesjo & Gillberg, 1999; Lingam, et al., 2009; Zoia, et al., 2006).

There are other risk factors for motor impairment such as birth order, school type, home type, family size, and district, some of which were investigated. It has been reported that birth order correlates with motor and cognitive impairments (Bassett, Gayton, Blanchard, & Ozmon, 1977), the motor performance of the first-born children being worse than that of children born later (Bassett, et al., 1977; Krombholz, 2006). Social disadvantage also negatively impacts on motor development (McPhillips & Jordan-Black, 2007b).

These factors that may influence a child’s motor ability have not been investigated in Kuwait, but there are many reasons to do so, and this chapter studies predictive factors for DCD in Kuwaiti primary school children. It also investigates the predictive factors for motor impairment that measured by the MABC-2.

The term DCD is applied to those children who meet the DSM-IV criteria: children who perform below the 15^{th} percentile in the MABC-2 and the DCDQ’07. As noted in

Chapter 2, “Children with DCD”, many researchers give children the DCD label based on motor impairments only without consideration of DSM-IV Criterion B (Geuze, et al., 2001). Investigating the predictive factors for DCD only may lead to missing important information about the broader factors influencing motor impairment in children, necessary in order to avoid or minimize these factors in the Kuwaiti environment. It may also lead to miss many children with motor impairment, but not necessarily having DCD, who need interventions. Therefore, the aim of this chapter is to determine the risk factors for having motor impairment. The second aim is to determine the risk factors for having DCD.

We hypothesize that there are relationships involving the factors

- gender
- age
- gestational age
- birth weight
- birth order
- house type
- family description
- school type
- geographical district.

to whether motor impairment appears or not in Kuwaiti children aged 5 to 9 years. We also hypothesize that the abovementioned factors relate to whether DCD appears or not in Kuwaiti children aged 5 to 9 years.

9.2 Material

Predictive factors were obtained from the demographic questionnaire containing five questions related to the birth history and socioeconomic status (Appendix D). The other predictive factors including gender, age, school type, and district were obtained from the MABC-2 form for each child.

9.2.1 Participants

The total number of the children was 297 (147 boys and 150 girls), those who were included in Study One. However, because there were separate analyses with two different outcomes and there were missing data, the numbers of children included in each analysis are slightly different.

9.2.1.1 Motor impairments

The motor impairments outcome was obtained from the MABC-2 total score for the 297 children. Of these, 36 parents omitted some of the answers in the demographic questionnaire, so the analysis was done for 261.

9.2.1.2 DCD/at risk of DCD

This information was obtained from the MABC-2 and DCDQ’07 material. Because three parents did not answer all the DCDQ’07 questions, required for the total score, they were eliminated from the data results, and of these 294 children 34 parents omitted some of the answers in the demographic questionnaire, so the analysis was done for 260.

9.2.2 Data analysis

All data were entered into SPSS-18. Because our interest was investigation of the appearance of the motor impairment and the appearance of DCD in certain situations (predictors) for Kuwaiti children aged between 5 and 9 years, the logistic regression analyses (LRA) is the appropriate analyses to determine our aims. Because we have different outcomes with different numbers of categories, we used two different LRA:

- The motor impairment outcome has three categories based on the MABC-2: movement difficulties (≤5th percentile), at risk of movement difficulty (> 5th and ≤ 15th percentile), and no movement difficulty (> 15th percentile). Multinominal logistic regression analysis (MLRA) was used.
- The DCD outcome has two categories based on results obtained from the MABC-2 and the DCDQ'07: DCD and non-DCD. Thus, binary logistic regression analysis (BLRA) was used.

The categorizations of the predictive factors were detailed in Chapter 5, "Methodology of Study One". Some modifications were because of the large differences in cell sizes between categories which made it difficult to run the analyses. For example, the gestational age is divided into four groups: very pre-term, pre-term, full term, and post-term. For this analysis, the classification of gestational age was reduced to two, full term and not full term; any GA below 37 weeks is considered preterm. For birth weight, any birth weight below 2500 gram is considered low birth weight. Figure 9.1 shows the description of the sample and the categorization of all predictive factors.

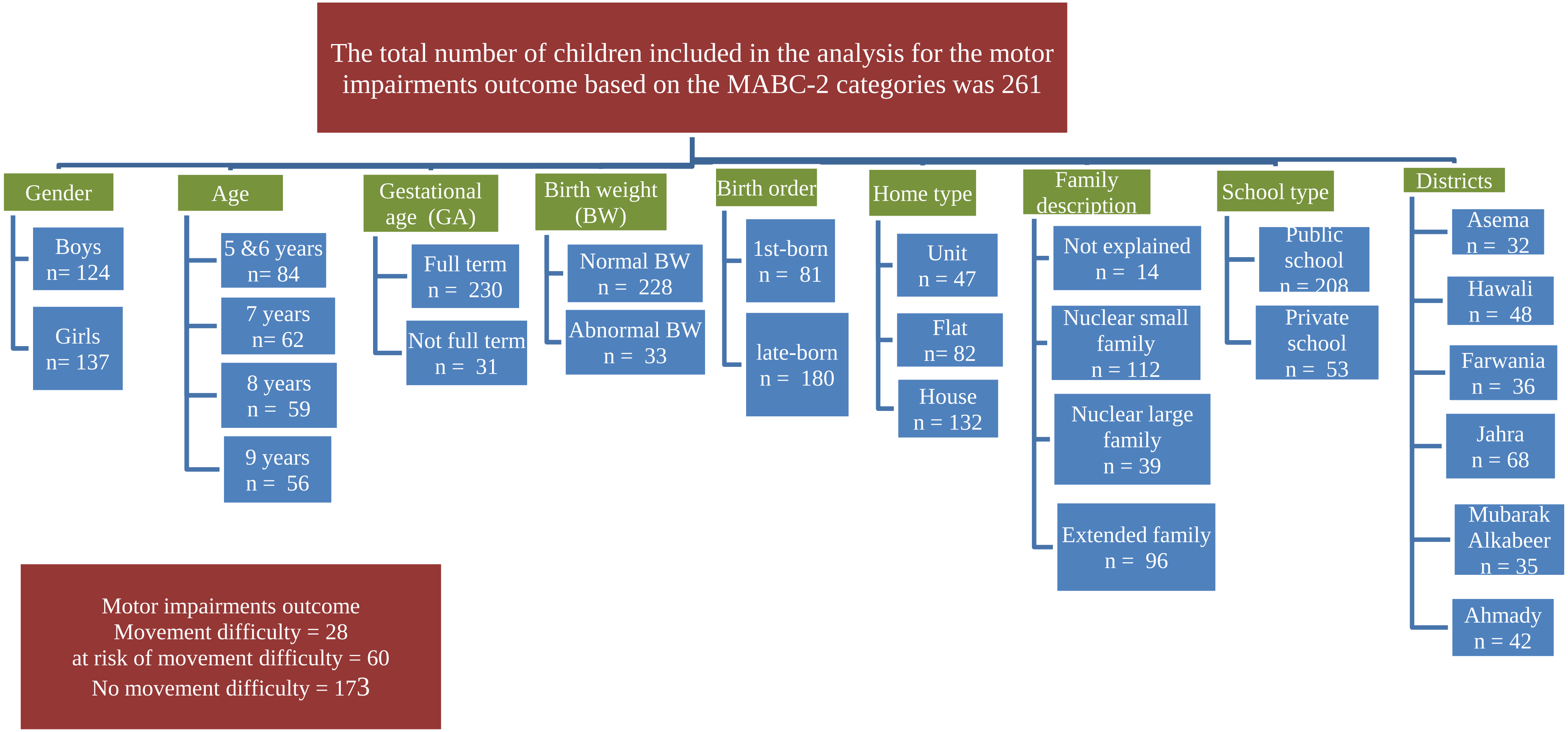

Figure 9.1: Description of the sample for the motor impairments outcomes

BLRA used backward Log Likelihood Rotation (backward LR). The categorizations of the predictive factors in this analysis were similar to MLRA except for the gestational age and birth weight. The BLRA fitted well with three groups for gestational age (preterm, term, overdue), preterm is ≤ 37 weeks and post-term is ≥ 42. For birth weight (low, normal, over), low birth weight is below 2500 gram and over birth weight is above 4000 gram. Table 9.1 shows the description of the sample for the BLRA.

Table 9.1: Description of the sample for DCD/at risk of DCD outcome based on DSM-IV criteria A and B

	Categories	Number of children
DCD outcomes	DCD/At risk of DCD	37
	Non DCD	223
Gender	Boys	124
	Girls	136
Age	Five & six years	83
	Seven years	62
	Eight years	59
	Nine years	56
Gestational age	Preterm	28
	Over due	3
	Full term	229
Birth weight	Low birth weight	26
	High birth weight	7
	Normal birth weight	227
Birth order	First-born	81
	Late-born	180
Home type	Unit	53
	Flat	89
	House	89
Family description	Small family	111
	Big family	39
	Extended family	96
	Not explained	14
School type	Public	207
	Private	53
Districts	Asema	32
	Hawali	48
	Farwania	36
	Jahra	68
	Mubarak ALkabeer	34
	Ahmadi	42

9.3 Results

9.3.1 The Predictor for Motor Impairments

MLRA assigned motor impairments of Kuwaiti children aged 5 to 9 years to the nine factors (gender, age, gestational age, birth weight, birth order, home type, family description, school type, and district).

Before conducting the MLRA, the assumption of multicollinearity and multivariate outliers were tested. This assumption is necessary to be tested because of the multilevel categories for the dependent and independent variables.

The critical χ^2 value for $df = 9$ at $\alpha = 0.001$ is 27.877 and our Maximum Mahalanobis Distance is 21.663, indicating no multivariate outliers (Appendix E). The results of the linear correlation between the nine factors showed multicollinearity between factors. There was significant multicollinearity between gestational age and birth weight, school type, and birth order. Home type had significant correlation with family description, birth order, and age. The school type had significant correlation with district, birth order, and gestational age. Birth order had significant correlation with gestational age, home type, school type, and birth weight. However, the strengths of the correlations between variables did not reach the critical level, 0.85 (Allen & Bennett, 2008). Deleting one of these correlated variables did not change the significant effect of others in the MLRA, so we decided to not delete them from the first step, and MLRA was carried out with nine factors; gender, age, gestational age, birth weight, birth order, family description, home type, school type, and district.

9.3.1.1 Results of First MLRA

There were 64.6% cells with zero frequency indicating that the results of the goodness-of-fit tests could probably be used, but with caution because the number of the zero cells was large, 444.

The Likelihood Ratio Test was significant; -2 Log Likelihood = 369.73, $R_{(36)} = 53.76$, $p = 0.029$ indicating that the final model is outperforming the null. Pearson and Deviance was not significant $R_{(420)} = 453.06$, $p = 0.128$ and $R_{(420)} = 350.09$, $p = 0.994$ respectively, indicating that the data were consistent with the model assumptions.

The Likelihood Ratio Test for each predictor after controlling other factors was not significant except for age ($p = 0.001$) and birth weight ($p = 0.038$) indicating that initially these two factors are risk factors for motor impairments (Table 9.2).

Table 9.2: The Likelihood Ratio Test for each predictor

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Gender	370.31	0.578	2	0.749
Age	391.35	21.618	6	0.001
Gestational age	372.47	2.74	2	0.254
Birth Weight	376.25	6.519	2	0.038
Birth order	372.95	3.22	2	0.200
Home type	377.31	7.57	4	0.108
Family description	371.97	2.24	6	0.897
School type	371.67	1.94	2	0.380
Districts	380.88	11.15	10	0.346

The Wald statistic of the effects of each predictor show that the age 7 years and the birth weight were significant indicators of movement difficulties and the home type was a predictor factor for the risk of movement difficulty (Appendix E). Therefore, the MLRA was done again with these three factors.

9.3.1.2 Results of Second MLRA

The results of the second MLRA that included three factors (birth weight, age, and home type) showed that home type was not a significant predictive factor for motor impairments, so it was deleted and the MLRA was done for birth weight and age (Table 9.3).

The results show that the goodness-of-fit tests can be used without caution as the level of the dependent variables by subpopulation was 4.2% cells with zero frequencies (n = 1).

The Likelihood Ratio Test was significant; -2 Log Likelihood = 53.70, R (8) = 23.37, p = 0.003 indicating that the final model is outperforming the null. Pearson and Deviance were not significant R (6) = 7.30, p = 0.294 and R (6) = 8.37, p = 0.212 respectively, indicating that the data were consistent with the model assumption.

The Likelihood Ratio Test for each predictor after controlling other factors was not significant except for age (p = 0.011) and birth weight (p = 0.022), indicating that initially these are both risk factors for the motor impairment.

For each child, being aged 7 years increases the odds of having movement difficulty by 4.671 equal to 15.41% with 95% confidence interval of 1.403 and 15.550, p = 0.012.

For each child, being born with abnormal birth weight whether low birth weight (< 2.5 kg) or overweight (> 4 kg) increases the odds of having movement difficulty by 4.084 equal to 14.07% with 95% confidence interval of 1.485 and 11.227, p = 0.006.

Table 9.3: The Wald statistics of the effects of each factor

Parameter Estimates									
Motor impairments based on the total score of the MABC-2[a]								95% Confidence Interval for Exp(B)	
		B	Std. Error	Wald	df	Sig.	Exp(B)	Lower Bound	Upper Bound
Movement difficulty	Age[b] = 5&6 years	-0.489	0.742	0.435	1	0.510	0.613	0.143	2.627
	Age = 7 years	1.541	0.614	6.309	1	0.012	4.671	1.403	15.550
	Age = 8 years	0.702	0.677	1.077	1	0.299	2.019	0.536	7.603
	Birth weight[c] = abnormal birth weight	1.407	0.516	7.436	1	0.299	2.019	0.536	7.603

a. The reference category is: No movement difficulty.

b. The reference for age is 9 years.

c. The reference for birth weight is normal birth weight

9.3.2 The predictors of DCD/at risk of DCD

BLRA with a backward stepwise method was used to investigate the likelihood of DCD/at risk of DCD in Kuwaiti children aged 5 to 9 years being explained by the nine factors (gender, age, gestational age, birth weight, birth order, home type, family description, school type, and district).

The BLRA results show that before the influence of the predictors 85.8% of the overall cases were correctly identified. However, after including all the nine predictors the percentage remained constant. In step one all predictors were included, and through the backward stepwise method one predictor was eliminated at each step. In successive steps predictors were eliminated in the following order: birth order, family description, school type, gestational age, home type, district, gender. In the final step where there were two predictors in the analysis (age and birth weight); there were 85.8% of overall cases predicted. Although the overall percentage declined slightly, the model appears good but further evaluations of model fit and significant are needed.

Table 9.4 shows the statistical tests of model fit indicating the contribution of each predictor to the model if included. It can be seen that there were two predictors of DCD/at risk of DCD, gestational age and birth weight.

Table 9.4: Variables not in the equation

	Variables	Score	df	Sig.
Step 0	Gender (female) (reference)	1.421	1	0.233
	Age (5&6-year-old)	3.357	1	0.067
	Age (7-year-old)	0.118	1	0.732
	Age (8-year-old)	2.333	1	0.127
	Age 9-year-old (reference)	4.782	3	0.189
	Gestational age(reference)	6.368	2	0.041
	Gestational age(preterm)	5.287	1	0.021
	Gestational age(overdue)	0.907	1	0.341
	Birth Weight(reference)	15.612	2	0.000
	Birth Weight(low birth weight)	13.896	1	0.000
	Birth Weight(over birth weight)	1.212	1	0.271
	Birth order (1^{st} child - Reference)	0.041	1	0.840
	Home Type house (reference)	2.896	2	0.235
	Home Type (unit)	2.895	1	0.089
	Home Type (flat)	0.319	1	0.572
	Family description extended family (reference)	0.083	3	0.994
	Family description (not explained)	0.000	1	0.995
	Family description (nuclear small family)	0.005	1	0.942
	Family description (nuclear large family)	0.050	1	0.823
	School type (private) (reference)	0.462	1	0.497
	District Asema (reference)	9.037	5	0.108
	District (Hawali)	0.144	1	0.704
	District (Farwania)	0.333	1	0.564
	District (Jahra)	0.459	1	0.498
	District (Mubarak Alkabeer)	7.386	1	0.007
	District (Ahmady)	0.244	1	0.622
	Overall Statistics	38.873	23	0.020

The model chi-square shows the effects of the predictors in the model. In each step the predictors were significant, creating an essentially different model, $p < 0.05$. Table 9.5 shows the model chi-square in first and last steps.

Table 9.5: Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	34.403	20	0.024
	Block	34.403	20	0.024
	Model	34.403	20	0.024
Step 8	Step	-1.930	1	0.165
	Block	19.279	5	0.002
	Model	19.279	4	0.001

The model summary (Table 9.6) shows that the Cox and Snell R square and Nagelkerke R square decreased from steps one to eight. In step one 12.4% to 22.2% of the variation in the DCD/at risk of DCD was explained by the logistic model while 7.1% to 12.8% was explained at step eight indicating mildly strong relationship between the predictors and the prediction.

Table 9.6: Model summary of BLRA for DCD/at risk of DCD

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	178.345	0.124	0.222
2	178.375	0.124	0.222
3	179.423	0.120	0.215
4	179.937	0.119	0.212
5	181.643	0.113	0.202
6	183.988	0.105	0.187
7	191.539	0.078	0.140
8	1930.469	0.071	0.128

The goodness-of-fit of the models were not significant in all steps; $p > 0.05$ indicating that the model has good fit (Table 9.7).

Table 9.7: Hosmer and Lemeshow Test of goodness-of-fit of the BLRA of DCD/at risk of DCD

Step	Chi-square	df	Sig.
1	3.029	8	0.933
2	6.025	8	0.664
3	8.278	8	0.407
4	7.231	8	0.512
5	6.869	8	0.551
6	5.816	8	0.668
7	9.686	7	0.207
8	4.352	4	0.361

From the backward elimination, the Wald statistic and associated probabilities, only the birth weight was significant; $p < 0.05$ and 0.01 indicating that the birth weight is a risk factor of having DCD/at risk of DCD (Appendix E). However, the significance was for the low birth weight $p < 0.001$ but not for over-weight birth, $p = 0.177$. In step one, a child being born with low birth weight (LBW) (< 2.5 kg) increases the odds of DCD/at risk of DCD by 5.529 equal to 17.1% with 95% confidence interval of 1.869 and 16.361. In step eight, a child being born with LBW increases the odds of having DCD/being at risk of DCD by 6.336 equal to 18.46% with 95% confidence interval of 2.462 and 16.304, $p < 0.001$.

9.4 Discussion

Many factors contribute to motor impairments and DCD. Some are related to birth history like gestational age, birth weight, birth order as well as gender and age. Others are related to socioeconomic status like type of the house, family description, school type, and type of district. Our findings show that age (7 years old) was a predictor for movement difficulty. Birth weight was a predictor factor for movement difficulty and for DCD/at risk of DCD

It is clearly documented that the birth history factors like gestational age and birth weight are risk factors for many developmental problems including DCD (Davis, et al., 2007) due to the complications that the infant faces as a result of undeveloped organs. Our findings showed that the birth weight was a risk factor for both movement difficulties and DCD. In particular, the low birth weight (< 2.5 kg) was a predictive factor for DCD. However, for movement difficulties the birth weight was divided into two categories, normal and abnormal birth weight. It was difficult to separate abnormal birth weights into low (< 2.5 kg) and high (> 4 kg) due to difficulty in running the MLRA with three categories for the birth weight because of the small number in each category to fit with the MLRA model, one of the limitations of this study.

Many studies have found that birth weight contributes positively to motor impairments (Davis, et al., 2007; de Kieviet, et al., 2009; Goyen & Lui, 2002; Holsti, et al., 2002). Children born with extremely low birth weight (≤ 800 g) are more likely to have DCD (Holsti, et al., 2002). In our sample, the percentage of LBW among 297 children was 9.4%. A study conducted in Kuwait investigated the prevalence of LBW and its risk factors in the period of year 2006 in Al-Adan hospital (Alfadhli, et al., 2010). Alfadhli et al. (2010) included babies born of Kuwaiti and non-Kuwaiti women, who were free of any congenital anomalies, normal singleton delivery, and their gestational age should be between 36 to 42 weeks. Out of 939 legible babies, 7.8% born with LBW. The risk factors for LBW were mother age lower than 25 years during pregnancy, maternal underweight measured by maternal pregnancy body mass index (BMI), maternal anemia, and history of previous abortion. Authors stated that anemia in Kuwait is not due under-nutrition, rather it is related to eating habits and imbalance of food elements. The rate of LBW in Kuwait based on these two results is consider high as compared to what reported in US 3.2% (Rawlings, et al., 1995).

The LBW may result from medical complications during pregnancy due to medical risks before or during gestation, maternal lifestyles, and socio-economic factors (Valero de Bernabé et al., 2004). These complications impact on the child’s health status in the uterus. Infants born with extremely LBW have been found to have chronic lung disease that needed re-hospitalization due to premature lung (Chien, Tsao, Chou, Tang, & Tsou, 2002). Pearsall-Jones, Piek, Rigoli, Martin, and Levy (2009) found a correlation between anoxia and DCD. The similarity in birth complication between DCD and CP put them in same continuum (Pearsall-Jones, et al., 2008; Pearsall-Jones, et al., 2010; Pearsall-Jones, et al., 2009).

The gestational age is also a risk factor to motor impairments and is closely related to birth weight. It has been found that children who were born prematurely with low birth weight had motor delay and/or motor problems like DCD (Davis, et al., 2007; de Kieviet, et al., 2009; Foulder-Hughes & Cooke, 2003; Goyen & Lui, 2002; Hemgren & Persson, 2009; Holsti, et al., 2002). Hemgren and Persson (2009) also found that preterm children had lower motor performance than full term children when their motor ability and motor coordination were assessed at the age of three years, and were identified as having motor impairments (Hemgren & Persson, 2009).

Gestational age and birth weight are closely linked. In our study, although the gestational age was not a risk factor for either motor impairments or DCD, it was a confounder for the birth weight. The gestational age associated by 19.24% in the relationship between birth weight and DCD.

The percentage of preterm in our study is 10.8% of the total sample. Alshimmiri et al. (2003) investigated the rate of preterm in Kuwait for singleton births in largest two obstetric centers. The total number of babies born from September 1998 to December 2000 included in the study was 25768 babies. The rate of preterm was 9.8% among Arab ethnicity, 5.5% for Mediterranean Arabs, 5.2% for Egyptians, and 11% for Indian-Asians. The rate of preterm in Kuwait based on these two results is also considered high as compared to 6.2% in European countries (Beck et al., 2010).

The MLRA results also showed that age was a predictive factor of movement difficulty for Kuwaiti children. The age of seven years was a significant predictor. It is difficult to assess why that age group specifically and not another should be a predictor, although there are several possible explanations. It is the transition stage between early childhood and middle childhood where biological and psychological changes occur which might impact on the child’s motor ability. In Kuwaiti primary schools, children at this age are in grades two and three where the school activity demands are higher than grade one, so seven year old Kuwaiti children may have difficulties coping with such demands that negatively impact on their motor abilities. However, explaining this finding requires a cohort longitudinal study to investigate the motor ability of children at age seven and up to see whether they catch up later.

Another explanation is that the age factor may not be a predictor. Kuwaiti children aged 7 years were found having poor motor performance which may indicate that the MABC-2 is not appropriate for that age group in particular. Therefore, a cross-sectional cohort study is required to investigate the motor ability of Kuwait children aged seven years to determine whether it is a general problem at this age or just in our sample.

In summary, the predictive factors of the birth history added further evidence for the impact of the birth weight on the movement difficulties and DCD. Although our findings showed that a particular age was also a risk factor for movement difficulties, this may be related to our sample and this age group needs further investigation.

9.5 Summary

Motor impairments can be predicted by many factors related to birth history and socioeconomic status. Our study included nine predictive factors covering birth history (gender, age, gestational age, birth weight, and birth order) and socioeconomic status (family description, home type, school type, and district). Birth weight was a risk factor for both movement difficulties and DCD, and movement difficulty was also predicted by age, in particular at seven years.

Birth weight has been investigated widely and found to be a risk factor for motor impairments and DCD, and our study supports these findings. However, there are no published reports of the relationships linking these factors with motor impairments and DCD in relation to Kuwaiti culture. This information would help in the provision of intervention to address that problem, for example an educational approach by Kuwaiti parents, community, and government, establishing prevention and promotion protocols to reduce the incidence of motor impairments and DCD.

10 Study Two – Interviewing Professionals

10.1 Introduction

Detecting motor coordination difficulties needs the attention and the perception of people surrounding the child, like family members and professionals from educational and health sectors. Although the perceptions parents have of the motor ability of their children are essential as parents are usually the first to notice and recognize the difficulties of children, the perceptions of professionals are also important. Usually, parents seek help from professionals to overcome their children's difficulties. Generally, children with motor coordination difficulties are under-diagnosed (Miller, et al., 2001; Missiuna, Gaines, et al., 2008; Missiuna, Moll, et al., 2006) and we assume that children with such difficulties in Kuwait are also misdiagnosed or under-diagnosed.

Some professions like physicians have little knowledge of DCD (Missiuna, Pollock, et al., 2008). One survey showed that 91% of physicians who participated in an educational outreach program were unaware of the diagnosis DCD (Gaines, et al., 2008). It has been found that some physicians think that children with motor difficulties will grow out of it (Cousins & Smyth, 2003; Dewey & Wilson, 2001). Although primary physicians may be aware of a child's difficulties, they might not know how to respond to parent concerns (Gaines, et al., 2008). In a study evaluating the knowledge of professionals, it has been found that 37% of teachers and 36% of doctors had limited knowledge about the term DCD, being more familiar with the term "clumsy" (Peters, et al., 2001).

Similarly, not all teachers are able to detect motor difficulties, especially if the children have attention problems (Schoemaker, et al., 2008). Some evidence shows that class teachers differ in their perception of gross motor difficulties compared with physical education teachers who have more ability to detect those problems (Piek & Edwards, 1997). It has been found that teachers have high workloads (Schoemaker, et al., 2008), making it more difficult to notice each child in the class.

There is a need to further explore the knowledge professionals have of DCD, and to determine whether children with DCD are being recognized in the school setting and being diagnosed in health settings. Therefore the primary aim of this study was to explore through interview, the DCD knowledge of educational and health professionals. The secondary aim of the study was to explore the facilities available in both health and educational sectors for children with motor coordination difficulties.

10.2 Method

Professionals were interviewed in an exploratory study. A qualitative structured interview was conducted for professionals from the health sector including medical doctors from different specialties such as paediatrician, paediatric neurologist, and paediatric physical medicine physician, paediatric physiotherapists, occupational therapists, and speech language pathologists from public hospitals and public and private clinics in Kuwait. Professionals from the educational sector were teachers, psychologists, and social workers from public and private schools in Kuwait.

10.2.1 Participants

Because the study was exploratory, we planned to interview 22 professionals, 11 from health and 11 from educational sectors. Twenty eight professionals, sixteen from public and private health sectors and twelve from public and private educational sectors were randomly selected (Figure 1). Two from the private health clinics declined to participate because they were too busy. Two health professionals and one teacher from a public school declined as they did not want to be audiotaped. In addition, one professional from the public health sector withdrew consent after commencing the interview. Therefore, the number of participants involved in the data analysis was 22 (11 from health sector and 11 from educational sector).

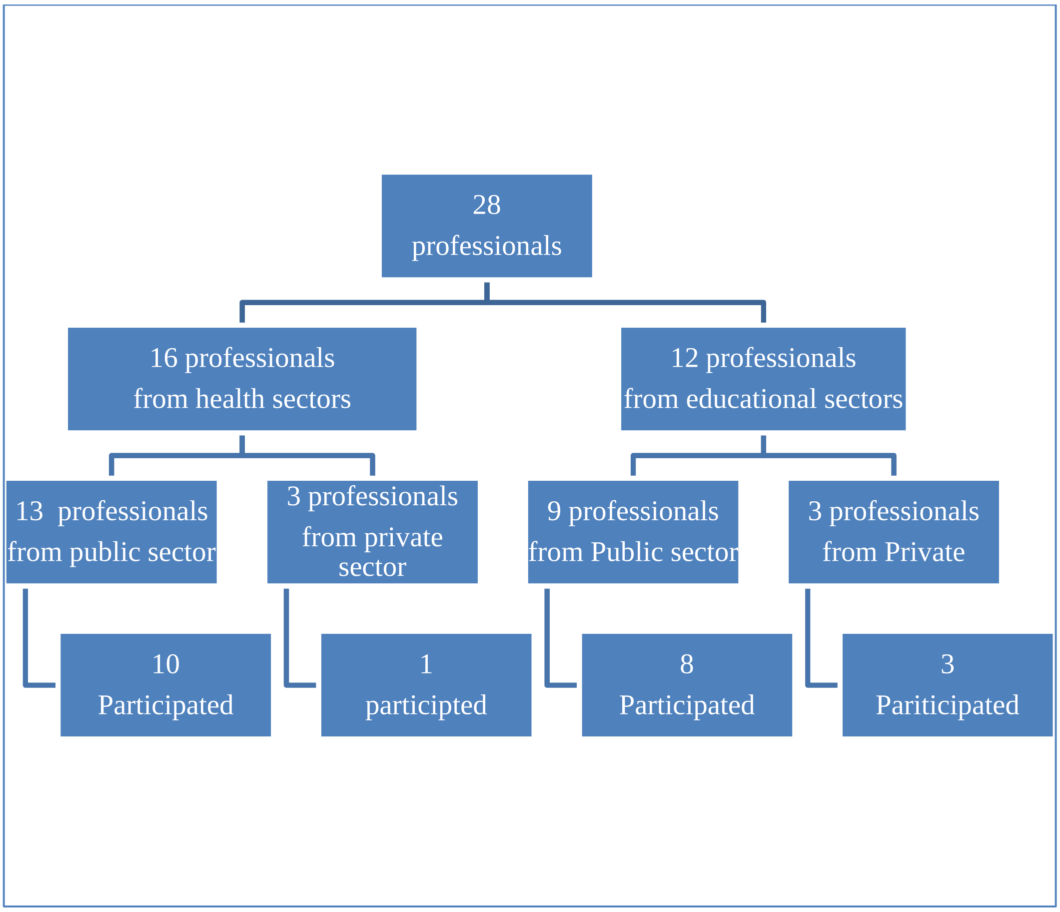

Figure 10.1: Distribution of participants between health and education sectors

Figure 10.2 shows the distribution of the participants according to their profession. The medical doctor were paediatricians, physical medicine physicians, and developmental medicine physicians. The allied health professionals were physiotherapists (PT), occupational therapists (OT), and speech language pathologists (SLP). The number of professionals in each specialty has not been included for confidentiality, as some specialist categories included only one interviewee.

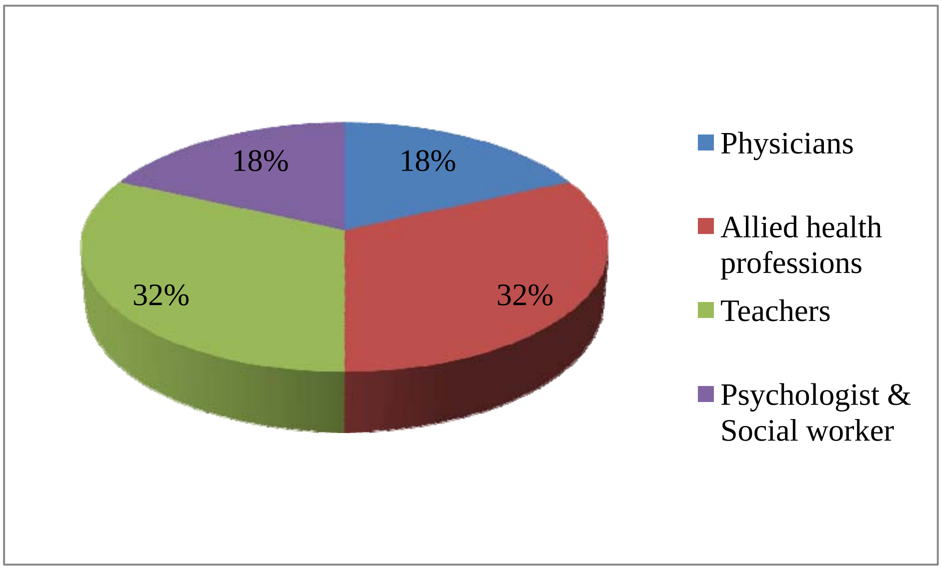

Figure 10.2: Distribution of participants based on their specialties

10.2.2 Materials

The interview used a structured questionnaire that gathered information from two kinds of questions, relating to demography and DCD. The demographic questions included gender, age, specialty, experience, and working area (Appendix F).

The questions relating to DCD were aimed at finding three different kinds of information: main issues, follow-up issues, and probe questions. The questions were structured to flow easily from one to another to help the interviewee feel comfortable, starting with general DCD issues and moving to more specific points related to the individual professional experiences.

The interviewer asked the 16 questions in the same words and in the same order for all interviewees. The main questions were similar for both groups but the probe questions were reworded to be compatible with each of the professions (health and education) and with the different settings, medical and school.

Both main and follow-up questions were related to the primary aim of the study, to examine the professionals' knowledge of DCD. The main questions required yes/no answers. Some examples are: "Do you know the terminologies clumsy, dyspraxia, DCD, and sensory integration disorder"; "Do you know the features and symptoms of DCD, consequences, and prognosis".

The follow-up questions were open-ended, to gather information about what the interviewee knows about DCD terminology, features, symptoms, consequences, and prognosis.

There were also other questions relating to the experience of the professionals, open-ended to acquire extra information on the facilities in both sectors. The construction of the questions differed between the health and educational interviews. For example the question for the health sector "Have you ever treated a child with DCD in your clinic" in the education sector was "Have you ever had a child being clumsy or uncoordinated in your class". Another example for the health sector was "Which kind of assessment instruments do you use, and what kind of treatment do you offer", becoming in the educational sector "How did you manage him/her".

10.2.3 Procedure

Ethics approval was obtained from the Curtin University Ethics Committee. The research proposal and ethics form with the letter from Curtin University were handed to the Ministry of Health in Kuwait for approval to interview professionals from public hospitals. The letter was forwarded to the Assistant Undersecretary for Public Health who referred the letter to the research committee. The research proposal was discussed in the committee and was approved, and a letter for medical districts was provided as well as being faxed to managers of all districts.

There is only one public hospital in each district so all were included in the recruitment process. From each hospital the names of the professionals were randomly selected. The research proposal was discussed with the head of the chosen departments who then provided a list of the professionals. The clinic in the private health sector was randomly selected from the list of all paediatric clinics.

The research proposal and ethics form were also handed to the Ministry of Education for approval to interview professionals from public and private schools. The educational professionals were randomly selected from the list of the schools involved in study one. Eleven schools were randomly selected from the 24 schools.

Professionals were provided with an information sheet (Appendix F) that informed them of the intent of the study but not information that would bias their answers during the interview. They gave written consent to participate in the interview (Appendix F).

Each interview was conducted individually in the workplace of the professional, in English with the professionals from the health sector and from private schools in the educational sector, and in Arabic with the public educational sector professionals. The interview was audio-taped for later analysis. The investigator facilitated the interview so that the professional felt comfortable and engaged in the discussion. The interviewer asked the questions as written, maintaining their sequence.

10.2.4 Statistical Analysis

All data were entered into SPSS-18. The data were analyzed using descriptive analysis for the demographic questions and for closed questions; text analysis for the open-ended questions using coding procedure by assigning labels to text passages and measuring agreements; then descriptive analysis for each question.

10.3 Results

The descriptive analysis results are presented in three themes, the first being general information about the definition, features, consequences, and prognosis of DCD; the second being specific facilities available for children with DCD in the health sector; and the third being the specific facilities available for children with DCD in the education sector.

10.3.1 General information about DCD

This section contains answers gathered from questions numbered from one to ten for both health and educational professionals. The odd numbers were closed questions with yes/no answers (Figure 10.3) and each even question was an explanation for the preceding odd questions if the answer was yes.

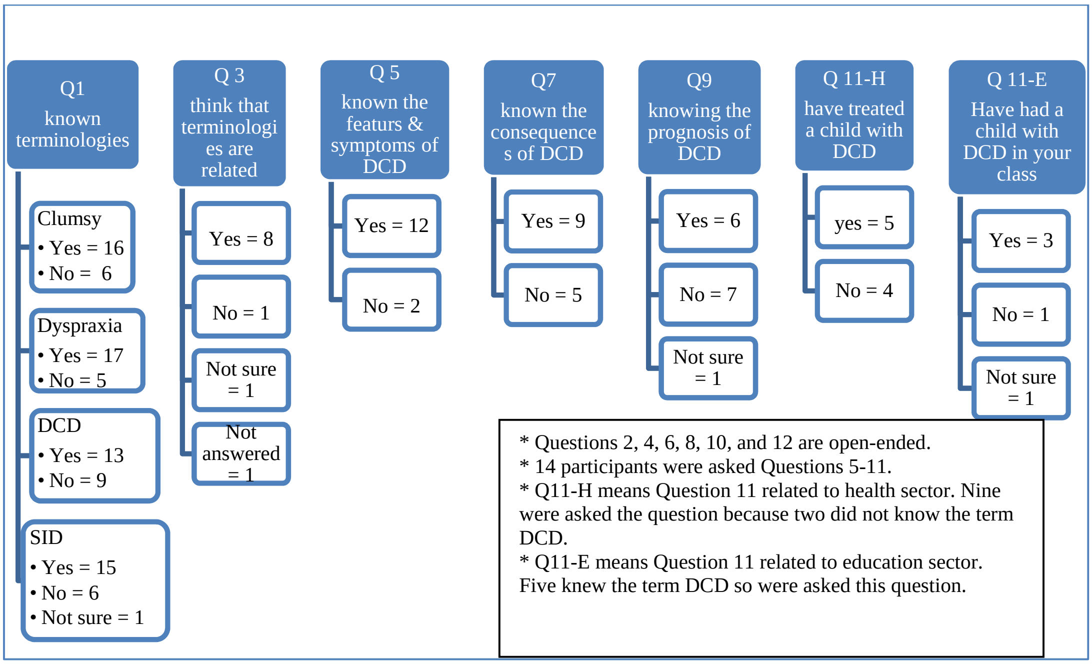

Figure 10.3: Number of participants based on their answers for the yes/no questions

<u>Question one: Do you know the terminologies: clumsy, dyspraxia, developmental coordination disorder, and sensory integration disorder?</u>

The aim of introducing this question was to determine whether the term DCD is known and used, otherwise which term has been used most frequently.

The answer for this question was “yes” or “no”. It can be seen from Figure 10.4 that 16 participants knew the term “clumsy”, 17 knew the term dyspraxia, 13 knew the term DCD, and 15 knew the term "sensory integration disorder". One participant was not sure about the term “sensory integration disorder”. It can be seen that DCD was the least known term.

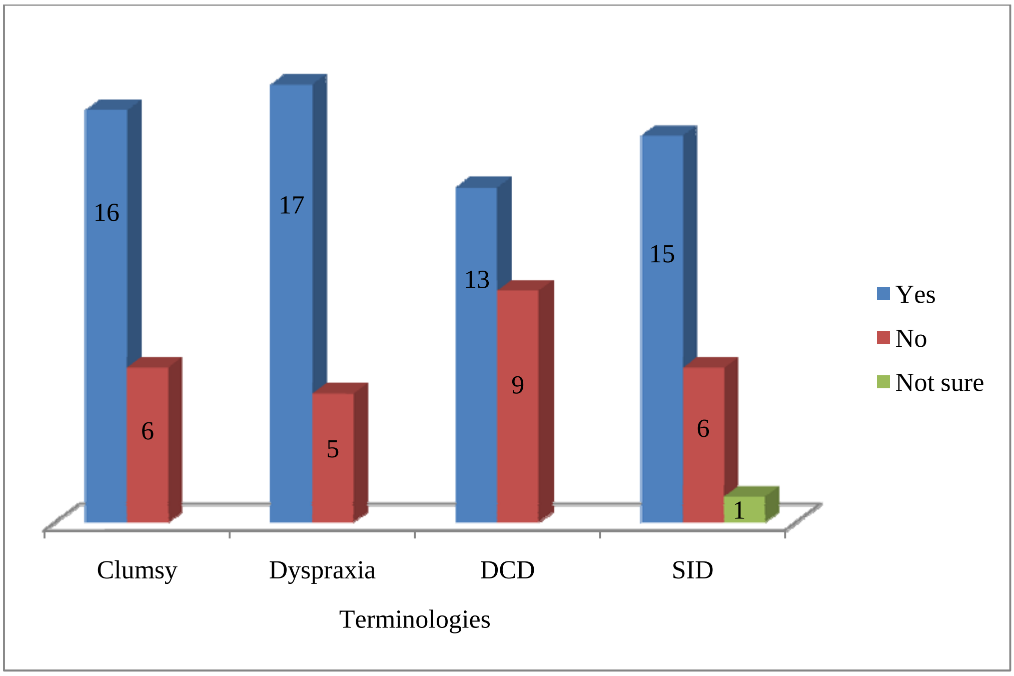

Figure 10.4: Number of participants answering Question one

Question two: Could you please define what you know of these terminologies?

Those participants who answered "yes" for Question one, were asked to define the terms. The acceptable definitions for the four terms are:

1- Clumsy: “Lacking physical coordination, skill, or grace; awkward” (http://www.thefreedictionary.com/clumsiness, retrieved on November 26, 2010).
2- Dyspraxia: “an impairment or immaturity of the organization of movement and, in many individuals, there may be associated problems with language, perception and thought”

(http://www.dyspraxiafoundation.org.uk/services/gu_introduction.php, retrieved on November 26, 2010.

3- Developmental coordination disorder (DCD): “Marked impairment in the performance of motor skills that significantly has negative impact on activities of daily living and/or academic achievement” (http://www.dyspraxiafoundation.org.uk/services/gu_introduction.php, retrieved on November 26, 2010).

4- Sensory integration dysfunction (SID): “the brain is not processing or organizing the flow of sensory impulses in a manner that gives the individual good, precise information about himself or his world” (Ayres & Robbins, 1979, p. 51).

The answers to this question were categorized into three levels, “completely correct” if the participant included almost all key information provided in the acceptable definition (not expecting to find an exact definition word by word), “completely incorrect” if the participant did not include any of that information, and “partially correct” if the participant included some of the information provided in the acceptable definition.

Because of the small number of participants in the study, to avoid participants being identified, they were categorized only according to their sector, health or educational.

Figure 10.5 shows the answers of the 16 participants who know the term “clumsy”: only four participants (two from each of the health and educational sectors) could define the term “clumsy” correctly. Two-thirds of the participants who were partially correct in their definition were from the health sector.

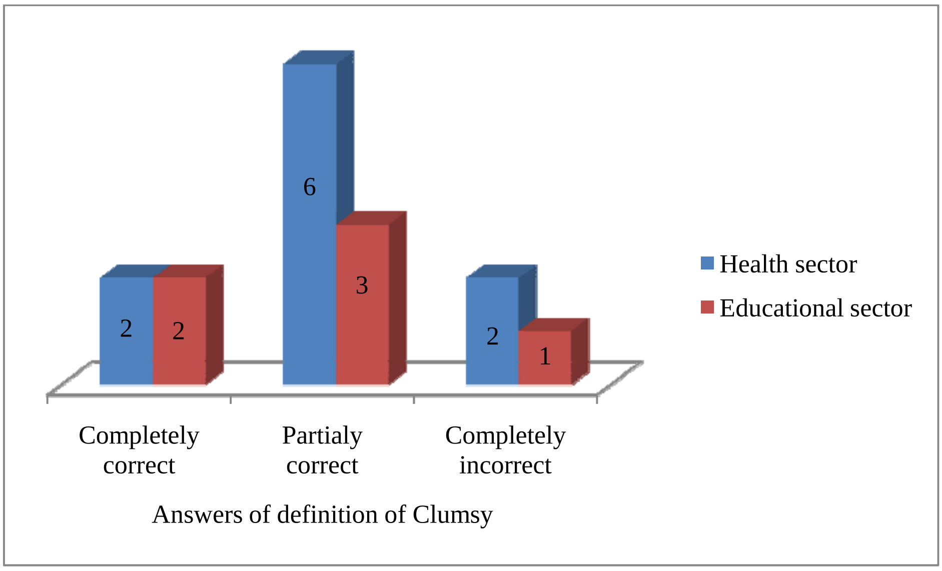

Figure 10.5: The answers of the participants for definition of "clumsy"

Figure 10.6 shows the answers of 17 participants who knew the term “dyspraxia”: only four participants from the health sector could define the term correctly.

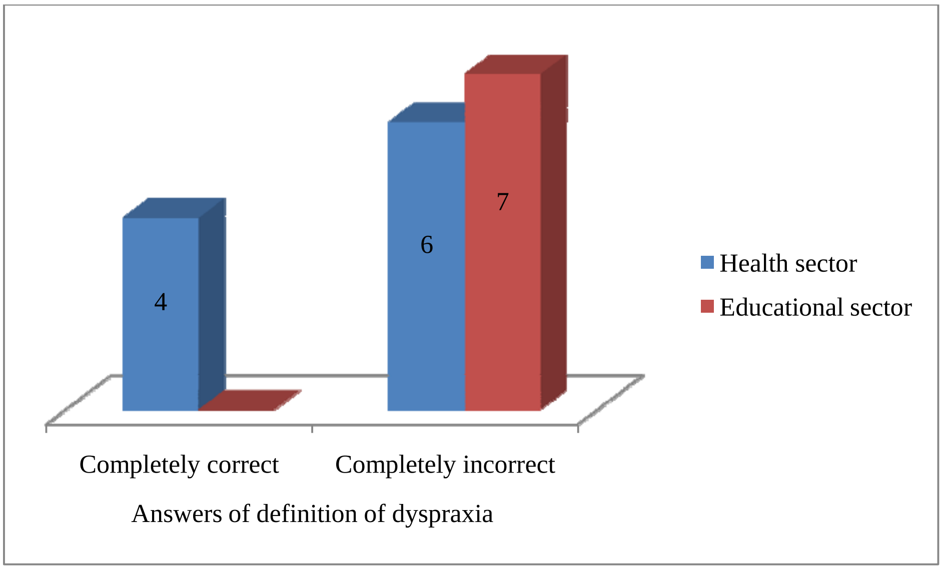

Figure 10.6: The answers of participants for the definition of "dyspraxia"

Figure 10.7 shows the answers of the 13 participants who knew the term DCD: none could correctly define it, and five (three from health and two from education) provided a partially correct answer. The missing information was related to the impact of motor impairments on the daily living activities.

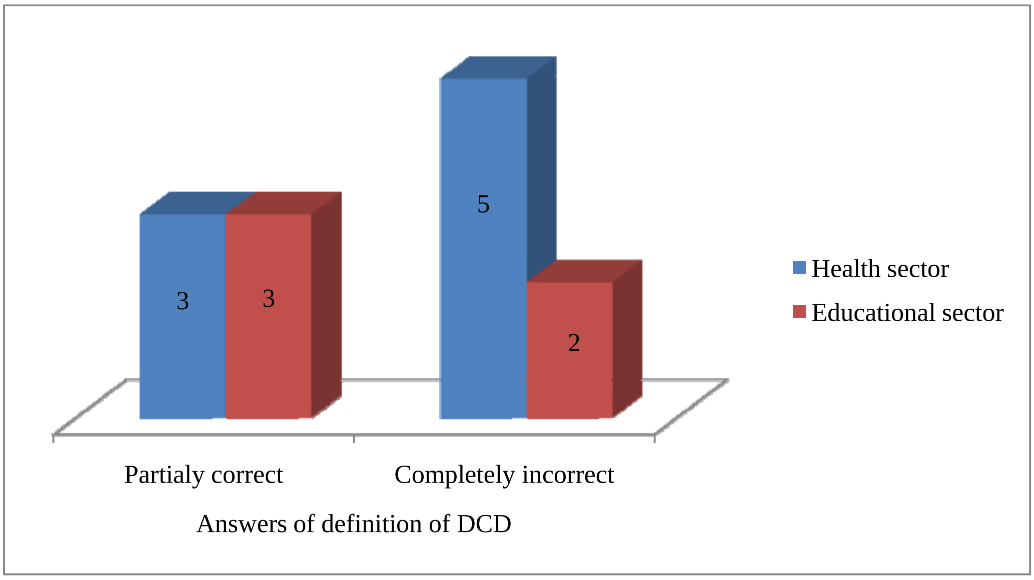

Figure 10.7: The answers of participants for the definition of "DCD"

Figure 10.8 shows the answers of the 15 participants who knew the term “SID” and one who was not sure. Four from the health sector could define the term correctly and five participants (four from health and one from educational sector) could define the term partially correctly.

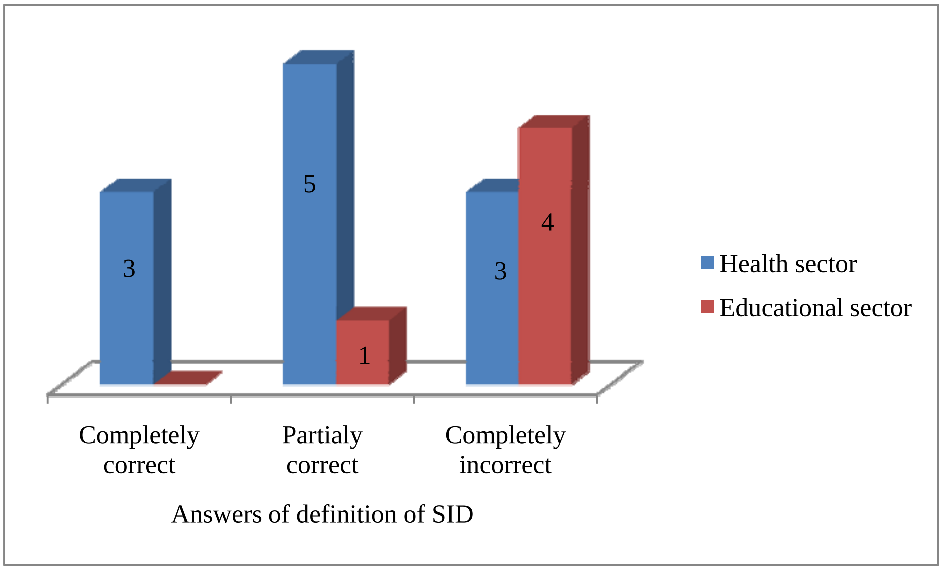

Figure 10.8: The answers of participants for the definition of "SID"

<u>Questions three and four: Do you think these terminologies are related to each other? Explain how?</u>

This question was part of the health profession interview only. Eight of ten health professionals said “yes”, one said “no”, and one was not sure.

The eight participants were asked to explain how these terms are related. Their answers were:

- “Comorbidity”.
- “The relationship between the terminologies was in the etiology”.
- “Deficit in the central nervous system and sensory system”.
- “All terms under the category of sensory integration disorder”.

- “It is commonly in paediatric and neurological cases”.
- “Each term leads to the other”.

If the professional had no idea about DCD, Questions 5-10 were ignored. However if health professionals thought that the terms were similar, Questions 5-10 were asked.

As a result, 14 participants (nine from health and five from education, 13 who knew the term DCD and one who thought that all four terms are related to each other) were asked Questions 5-10.

Question five and six: Do you know the features and symptoms of children with DCD? Give three examples.

The literature states that the features and symptoms of children with DCD are:

- At an early age they may show delay in sitting, crawling and walking, while later they may have difficulties in running, playing ball, assembling puzzles, and understanding maps and directions (WHO, 1992).
- They may have problems with using their hands for manipulation and posture control (Miller, et al., 2001).
- They may present with gait disturbances, and have difficulty in running, hopping and climbing stairs. Their performance in these activities may be slow, awkward, or untidy (Barnhart, et al., 2003).
- They may easily bump into obstacles and drop things (WHO, 1992).
- They may have speech difficulties (Cheng, et al., 2009; Hill, 1998; Scabar, et al., 2006).

Twelve participants (nine from health and three from education) answered "yes" for Question five indicating that they knew the features and symptoms of DCD (Figure 10.9). Five health participants gave three correct examples and seven gave two correct examples. Seven education participants gave two correct examples.

The examples given by professionals were:

- Difficulty in fine motor activities like threading.
- Inability to use eye-hand coordination.
- Delay in the development of praxis; the motor planning.
- Difficulty tying shoe laces.
- Difficulty holding a spoon.
- Difficulty in walking and running.
- Problems with speech.
- Planning motor function difficulties like climbing obstacles and fasten their buttons.
- Difficulty coordinating hand functions like writing and drawing.

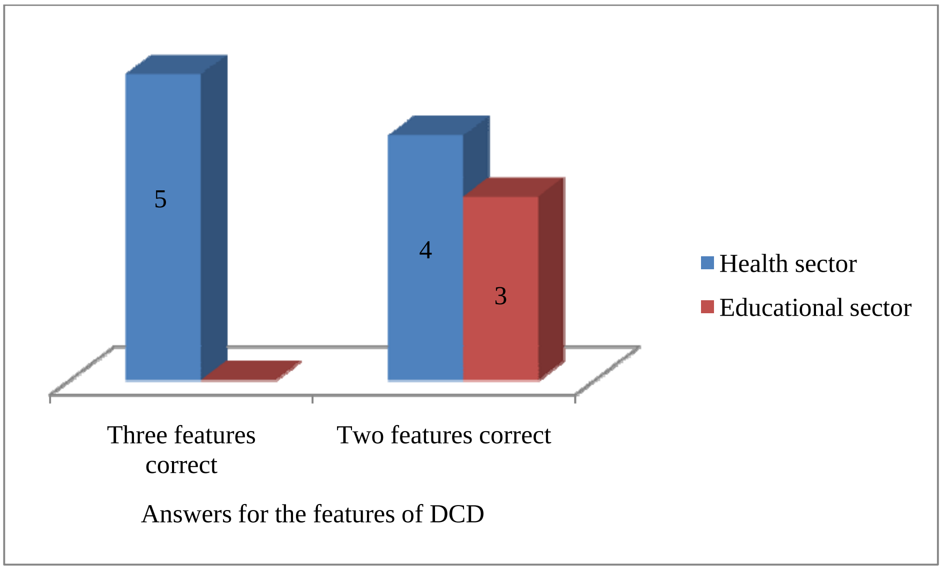

Figure 10.9: The answers of participants for the features and symptoms of DCD

<u>Question seven and eight: Do you know the consequences of DCD? What are the consequences?</u>

The consequences of DCD can be summarized as: anxiety, depression, feelings of inferiority, lack of personal satisfaction, behavioural and emotional problems, low self-esteem, avoidance of participation in physical (sport) activities, introverted, victimization, obesity, learning difficulties and low school achievement, and in the long-term leading to mental health problems.

Nine participants (eight from health and one from education) were familiar with the consequences of the DCD. Two participants from the health sector gave correct answers; only one participant from the health sector and one from the education sector gave partially correct examples (Figure 10.10).

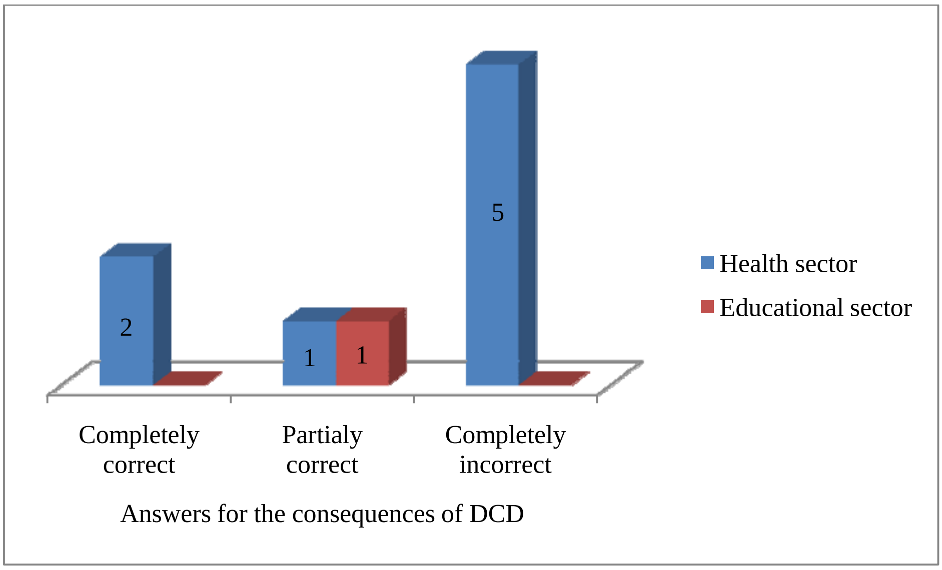

Figure 10.10: The answers of participant for the consequences of DCD

Questions nine and ten: Do you know the prognosis for those children with DCD? What is the prognosis for children with DCD?

Six participants (five from health and one from education) knew the prognosis of DCD (Figure 10.11). For this question, we were interested in exploring the professionals' knowledge of the prognosis of DCD so there is no correct or incorrect answer and the answers were:

- "The prognosis is unpredictable".

- “Low academic achievement and school failure”.
- “Cannot catch up with other children”.
- “Depends on the child; if has sensory therapy will have better improvement”.
- “It is not a degenerative disorder”.

- “Depends on the severity, progression, and changes”.
- “Depends on the PT and OT input that help child to overcome his/her difficulties”.

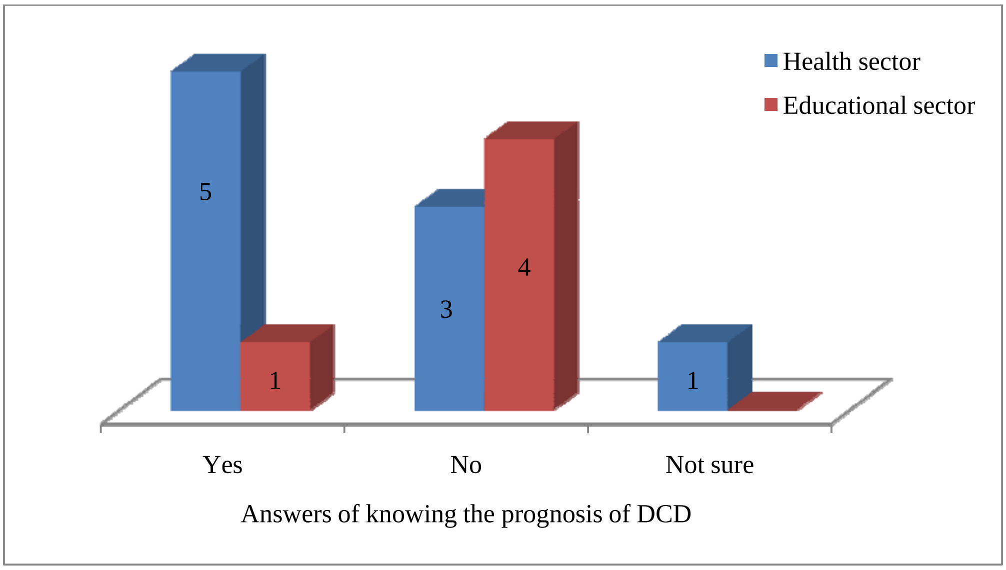

Figure 10.11: The answers of participants for the prognosis of DCD

10.3.2 Facilities in the health sector

In this section, the health sector interviewees were asked to answer six questions related to services available in each clinic to explore the facilities available for children with DCD. Based on the answers provided to Question one relating to the term DCD, nine participants who answered “yes” were asked these questions.

Question 11: Have you ever treated a child with DCD in your clinic?

Out of the nine participants, five participants (two physicians, PT, OT, and SLP) had treated children with DCD and three therapists said that they treated children with DCD but children were not diagnosed as having DCD.

Those participants who had treated children with DCD continued the interview and were asked Questions 12-16.

Question 12: Which kind of assessment instruments do you use?

The participants varied in their answers. It can be seen from graph (Figure 10.12) that the participants mentioned nine different kinds of methods to assess children with DCD. Each participant gave more than one method. Medical doctors mentioned using clinical observation, unofficial assessment, informal examination, and neurological assessment. Some of them referred children to physiotherapy and occupational therapy for further assessments. One medical doctor mentioned that she used the MABC during her training in Scotland but not in Kuwait. The physiotherapists mentioned using official neurological examination and clinical observation.

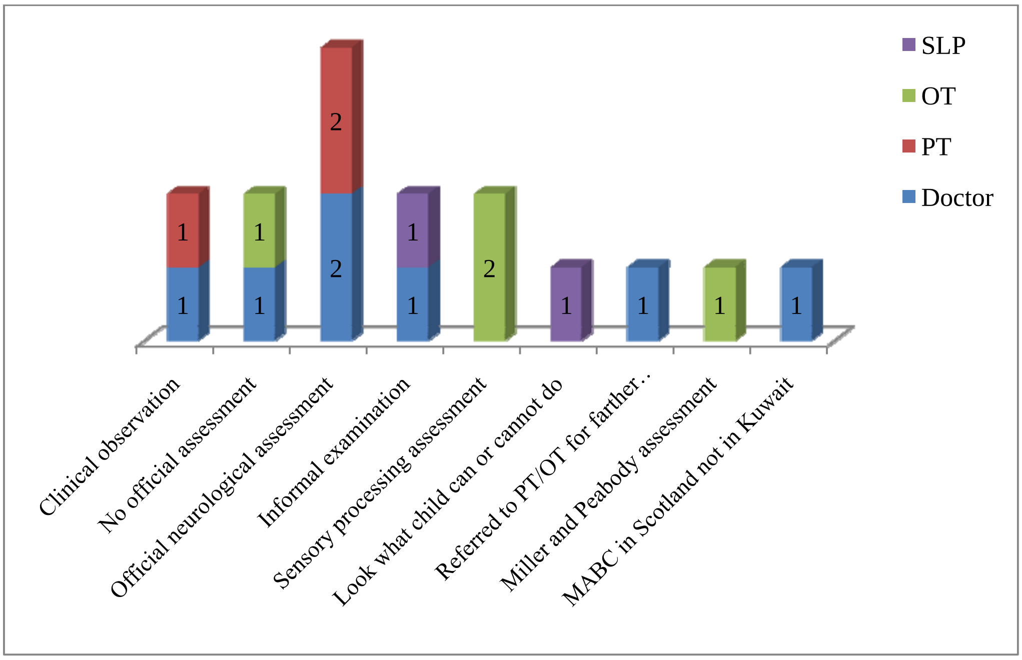

Figure 10.12: The assessment types used in clinical sessions by health professionals

The occupational therapists mentioned using unofficial assessments, sensory processing assessment, and "Miller and Peabody assessments". The speech language pathologists used informal examination to observe what the child could or could not do.

Question 13: Which kind of treatment do you offer?

The treatment methods vary based on the services provided (Figure 10.13). Physicians, for example, had no specific treatment for children with DCD but they referred them to specialists for further examination, or to physiotherapy and/or occupational therapy. The physiotherapists treated children with sensory integration approach, neurodevelopmental treatment (NDT), and motor learning. The occupational therapists used the sensory integration approach, coordination activities, and functional goals for activities of daily life. The speech language pathologist concentrated on treatments associated with the mouth and related organs, including desensitization for the hypersensitivity in the mouth, feeding training, and speech training.

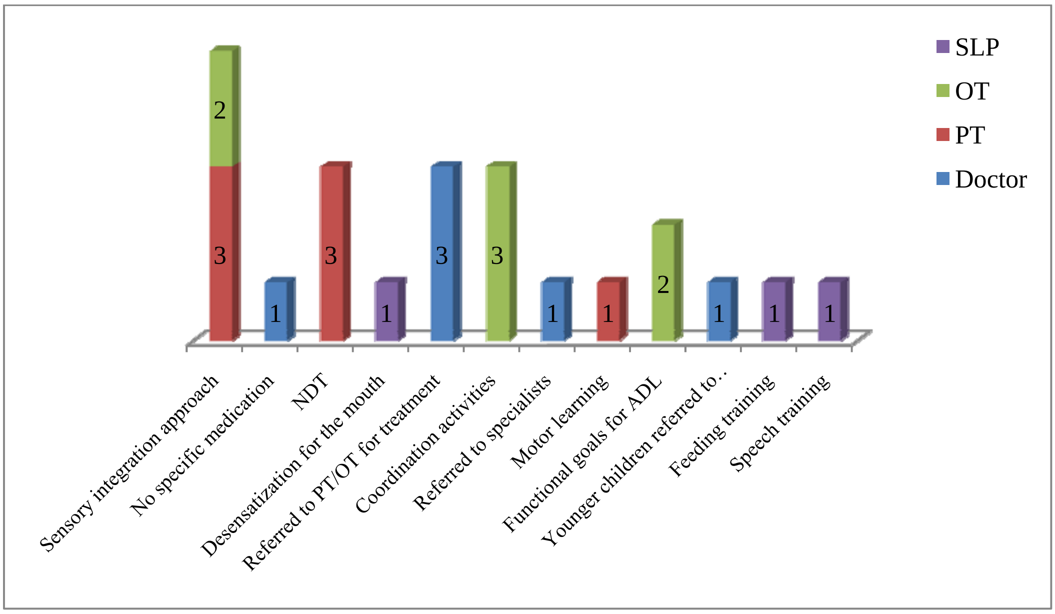

Figure 10.13: DCD interventions provided by health professionals

<u>Question 14: Which kinds of facilities are available in the Ministry of Health for those children with DCD?</u>

One doctor was not sure if there were any facilities available for children with DCD and another doctor said that the facilities were available in a specialized hospital.

The physiotherapists mentioned that there were no specific facilities available for children with DCD. One physiotherapist said that it depends on them and on their interest in trying to modify the environment at work. One physiotherapist said that there was a paediatric gym with sensory integration equipment.

Similarly, the occupational therapists said that there were no specific facilities for children with DCD and that they tried to modify the environment at work. One occupational therapist said that there is a rehabilitation hospital with specialized physiotherapists and occupational therapists.

A therapist said that the rehabilitation hospital with specialized physiotherapists and occupational therapists provided the facilities. The therapist also mentioned that the

Ministry of Health provided courses in sensory integration therapy enabling the staff to provide appropriate intervention.

<u>Questions 15 and 16: Are you satisfied with the services offered in your place? Explain?</u>

Three participants were satisfied, four were not, and one was not sure.

The satisfied professionals related their satisfaction to:

- Good specialists and good facilities: "patient examined well and referred to specialist and offered good facilities. Regular follow-ups and good improvement".
- One medical doctor mentioned that there were "good facilities in one centre only, however they did not have an afternoon program and does not accept all referrals".
- One therapist mentioned that "the place where I work is the best in the gulf, actually not only in the Gulf but also in the world" because the hospital supported continuing education like lectures and seminar, and updating. Patients were getting good improvements.

The non-satisfied professional referred dissatisfaction to:

- "The number of children with this problem is increasing, although this is not officially announced; the main issue is that they are not diagnosed as DCD".
- "There is no privacy for the patients, which they need, and people really work hard there".
- "There is no Sensory Integration gym (isolated, lighting, visual, auditory, special equipment, texture, and wall)".
- "Overloaded because of shortage of staff; these children should have regular, continual treatment".
- "Many protocols are not available".
- "Specialization is needed".

- “The rehabilitation team of doctors, OTs, and PTs are not working together, especially in outpatient clinics, but in wards there is communication between professionals from different specialties”.
- “Need space, shortage of tools”.
- “No communication between hospitals; one doctor said: "When I referred the child to the rehabilitation centre I do not get much feedback from them; I do not know what facilities they offer; I cannot rely on parents’ comments; parents have their own expectations which are not correct. I am not satisfied with the communication, but other staff I cannot comment on it”.

10.3.3 Facilities available in the Education sector

Similarly, the education professionals were asked questions specifically related to their specialties.

<u>Question 11 and 12: Have you ever had a child with DCD in your class? How did you manage him/her?</u>

The five participants who were familiar with the term DCD were asked this question. Three of them had children with DCD in their classes. One teacher was not sure whether the child in her class had DCD or not.

Two teachers mentioned that the management they used with children with DCD was instructing them to be careful while moving in the class. One psychologist said that she tested his IQ and dyslexic symptoms and referred him to specialized centre for further assessment and treatment.

Question 13: Which kinds of facilities at school are available to help you with those children with DCD?

Most of the participants who answered this question said that there were no specific facilities for those children. The teachers said that they referred children to the school psychologist. The school psychologist said that she involved children with DCD in teams to merge children with difficulties with normal children to improve their self-esteem. She also said that she contacted teachers to take care of children with difficulties.

One teacher commented "I do not think there is specific thing, but I am not special needs teacher to know the needs to decide whether there is some, but as far as I know there is nothing specific in the school".

Question 14: Have you ever had a child being clumsy or uncoordinated in your class?

This question was reworded and asked of all education participants to gather more information from participants who might have children with DCD without knowing the term "DCD". It is necessary to know the answers of the education professionals in order to formulate a policy for managing children with DCD.

Figure 10.14 shows that almost all education professionals had clumsy or uncoordinated children in their classes. One psychologist said: "There are a lot of children but I did not have them because I cannot examine all children, and we do not have specific examination to decide whether children have DCD or not".

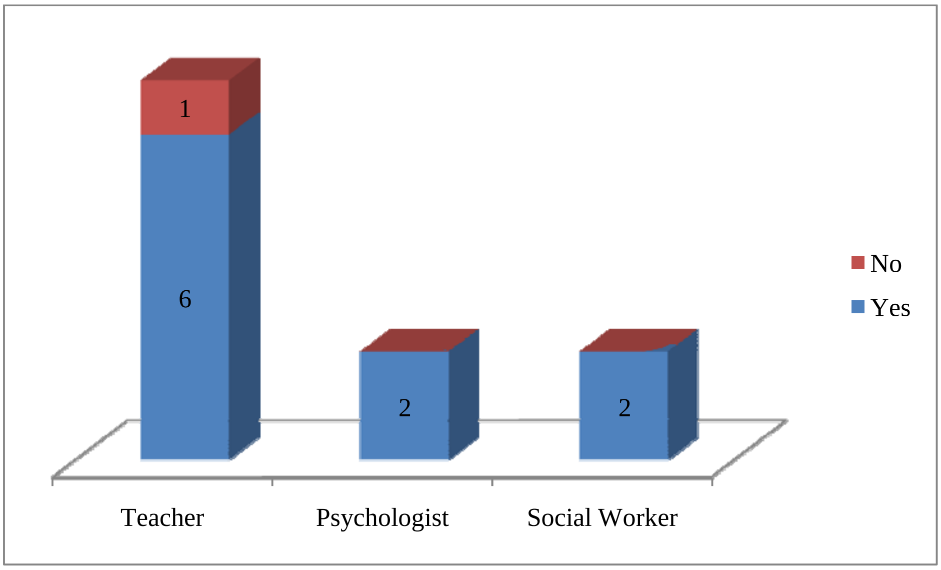

Figure 10.14: Number of education participants who had clumsy children in their classes

Question 15: Could you please describe the feature of the clumsy child?

The ten participants who had clumsy or uncoordinated children in their class were asked to describe the child. Their descriptions were:

- “Problems in academic achievement and communication with peers”.
- “Difficulties in reading and writing from whiteboard”.
- “Distracted”.
- “Unable to grip the pen to write”
- “Unable to catch up with other children in dictation”.
- “Understanding not at the same level of other children; giving different answers to questions”
- “Physiological development below normal”
- “Difficulties in academic skills; very slow in writing (dictation)”.
- “Nervous, hyperactive in class, and naughty”.
- “Has problems in her legs, does not have stability”.
- “Meaningless movement, suddenly stand, go out of class”.

- “Uncoordinated in his limbs, fall over place, quite clumsy could not control his limbs”.
- “Learning problems, looks clumsy in playground”.

Question 16: Why do you think s/he is being clumsy or uncoordinated?

The education professionals thought that the reasons for clumsiness or uncoordination were:

- “Medical disorder or problem rather than psychological or mental”.
- “Disability”
- “Heredity”
- “Home not involved in teaching the child”.
- “No control of his limbs”.
- “Because of his behavior and attitude, family does not care”.
- “An inherent part of him; a developmental, mental or social problem rather than physical”.

Question 17 and 18: Do you think that the child being clumsy or uncoordinated needs medical intervention such as physiotherapy or occupational therapy? Clarify your answer.

Six out of ten education professionals thought that clumsy or uncoordinated children need medical intervention (Figure 10.15). They clarified their answers as follows:

- “It is a medical problem, child needs to be examined and describe suitable cure for him/her”.
- “Child needs to catch up with his/her peers”.
- “For the child’s psychological issues”.
- “Because she has problems in her physiological development and needs to be followed up”.

- “Because he needs to push up in his academic long life and also for psychological issues in front of his colleague to not be embarrassed”.
- “Because some have weakness in their hands' muscles so need exercises to improve his condition. But she never referred children to PT/OT because she did not know that there is such facility in health sector”.
- “I know they need medical intervention because of the features of those children from my knowledge about DCD”.

Three out of ten thought that those children do not need medical intervention (Figure 10.15). One social worker was not sure whether the child needs medical intervention or not. Those professionals clarified their answers as:

- “Intervention should start from the school to rebuild up the environment”.
- “Being clumsy does not necessarily mean that therapy is necessary”.
- “I prefer to wait and watch the child for a while before judging if he needs therapy”.
- “There is no medical reason to seek medical intervention”.
- “The child needs to be checked to determine his/her problems”.

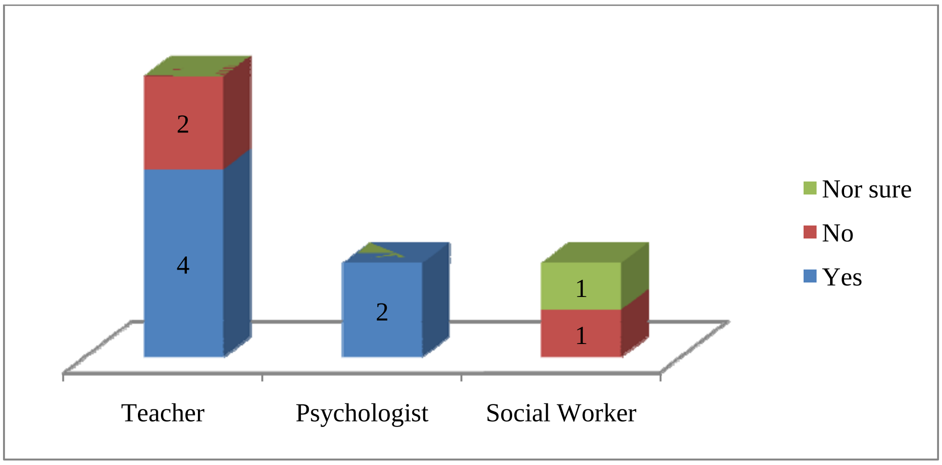

Figure 10.15: Number of professionals who think that a clumsy or uncoordinated child needs medical intervention

10.4 Discussion

This study was an exploratory qualitative study aimed at exploring the professionals' knowledge about DCD and the facilities available for children with DCD in the education and health sectors. Therefore, the sample of this study was small, with 22 participants, half from each sector. The study had three themes (general information about DCD, facilities in the health sector, and the facilities in the education sector) and the discussion is presented on the basis of these themes.

10.4.1 General information about DCD

This study examined knowledge of the term "DCD" by professionals from the health and education sectors in Kuwait. Three other common terms ("clumsy", "dyspraxia", and "SID") were also examined to determine which was more common in Kuwait. These terms were chosen as they are common synonyms and found extensively in literature describing children with motor difficulties.

Our findings show that more than half of the participants knew the four terms. However, not all participants who answered "yes" to knowing the terms could correctly define them. From the results, it can be noticed that participants from the health sector were able to define the four terms whether correct or partially correct except for the term "DCD"; no one could give a correct definition. It is not surprising to find health professionals more familiar with the terms than education professionals because medical professionals usually study the terminology and would see these conditions in their work. The terms "dyspraxia" and "SID" were the best known in the health sector.

Most of the participants from the education sectors were unfamiliar with the terminology. Although some of the education participants answered yes for knowing the terms, most of the answers were completely unrelated to the meaning of the terms. They referred the meaning to the psychological problems, behavior, emotions and feeling, and cognitions. The explanation might refer to the fact that education professionals are unfamiliar with the terms because they do not study them in their courses. They are not a special needs teacher to hear about these terms. Education professionals in Kuwait are familiar with learning difficulties, dyslexia, autism, and ADHD. These disorders have been recognized in schools in Kuwait and there are three private non-profit centres for those children. However, because of the comorbidity of DCD with other disorders such as dyslexia, learning difficulties, autism, and ADHD, children with DCD might be missed or under-diagnosed.

In particular, no one could define correctly the term “DCD”, but there were five participants (three from health and two from education) who could partially define it. The missing information was related to the impact of the motor difficulties on the activities of daily living whether at home or at school. Most of the participants who provided incorrect answers gave etiology, symptoms, and description of the condition.

Not surprisingly, in the literature, researchers identified children with DCD based on the motor impairments and rarely considered the impact of the impairments on daily activities (Geuze, et al., 2001). Even professionals who kept themselves up-to-date by reading the literature might not have any idea that the DCD definition should include the impact of the impairments on the activities of daily life. Moreover, the acceptable definition on which we based the analyses was drawn from the DSM-IV, but do not know whether or not the professionals are familiar with this.

It is important to look for the answers in detail from the perspective of professionals, especially in the health sector because most of the “yes” answers were from the health sector. The health system in Kuwait requires the patient to be seen by a physician before referral to a specialist, such as physiotherapist, occupational therapist, or speech language therapist.

Some physicians were not able to answer “yes” or could not define the terms; this might be related to his/her background and level of qualification, or not being up-to-date. Although the number of participants was too small to generalize the findings, from the available data we can conclude that therapists appear to be more familiar with DCD than medical doctors indicating that therapists had more exposure to these children. Since physicians are the first contact practitioner when children present with movement problems, it is important that they are well informed about DCD and can make differentiate diagnosis.

Our findings are similar to those of others who found that 91.1% of physicians were unaware of the diagnosis of DCD prior to participating in an educational outreach and collaborative care program (Gaines, et al., 2008). The program was developed by a team including developmental paediatrician, speech-language pathologist, and psychologist, and was provided by occupational therapists. The aim of the program was to enhance physician knowledge of DCD (Gaines, et al., 2008).

A study conducted in the UK determined the view of the health and education professionals towards three terms, “clumsy”, “dyspraxia”, and “DCD” by giving a written definition for each term (Peters, et al., 2001). The professionals were paediatric specialists including medical doctors, physiotherapists, occupational therapists, speech language therapists, and teachers from primary, secondary, and special mainstream schools. The results showed that the term “dyspraxia” and “DCD” were less familiar than “clumsy”. All participants provided some information about clumsy, 93% were familiar with “dyspraxia”, and 68% were familiar with “DCD”. All therapists were familiar with “dyspraxia” and the occupational therapists were more familiar with “DCD” than others. In regard to “DCD”, 37% of teachers, 36% of medical doctors, and 31% of physiotherapists lacked knowledge of the term.

In response to a question on whether the terms are related, eight participants thought that the four terms are related but no one thought that the terms were synonyms. The explanation for this might be lack of knowledge or that each specialty has a different perspective on these terms. Professionals might be aware of the terms but not necessarily have enough knowledge of their meaning. So because our interest was the identification of children with DCD and how the professionals identify those children with DCD, further questions were asked of those who know the term “DCD” and who thought that the four terms are related. These questions, relating to features and symptoms, consequences, and prognosis of DCD are important to obtain further information about professional knowledge of children with DCD, what they look like, what problems that they may face, and what their futures might be. These questions can provide a final impression of whether the professional really can identify children with DCD and is aware of the problems that they face.

Our findings show that some professionals were sufficiently familiar with DCD to be able to identify children with DCD based on its features and symptoms, but the majority were from the health sector. Children with DCD should be recognised in school settings because of the difficulties they face due to the high demands of school work. Only two teachers out of 11 professionals from the education sector knew and were able to give two examples of the features and symptoms, indicating that education professionals might be unable to recognise children with DCD as they thought that the problems are related to cognitive and social problems. Professionals from education sector should know those features in order to know how to deal with them.

In regard to the consequences of DCD, only two professionals out of the 14 could give correct examples and the answers of two were partially correct, indicating that professionals were unaware of the problems that face the children with DCD. They might not have seen a child with DCD or realized the consequences of DCD.

The final question was on the prognosis of DCD. Only six participants, five of them from the health sector, knew the prognosis. Although their answers were varied and partially correct, no one answer indicated that professionals are aware of the prognosis. Their answers lacked detail, suggesting that professionals did not deal with that diagnosis in particular. As in the previous two questions, the findings of this question could explain the under-diagnosis of children with DCD. Usually, professionals learn from their experiences: if they have treated or had children with DCD in their class, they would know the prognosis.

These findings raise two questions. Should professionals know the consequences and prognosis in order to highlight the need for recognition of children with DCD? Should they have treated children with DCD in their setting to know the consequences and prognosis in order to realize the need of identifying children with DCD? Both questions are important as one relates to theory, the other relates to clinical practice, but one leads to each other. Consequently, an outreach education program for professionals is essential.

These findings emphasise the need for us as researchers to explore facilities provided in the health and educational settings for those children with DCD.

10.4.2 Facilities Provided by Health Sector

The information in this section was gathered from nine professionals from the health sector who knew the term "DCD". The first question related to whether they had treated children with DCD. This question is important because it adds further information about how health professionals deal with children with DCD and what kinds of facilities are available in the health sector for them. Eight professionals, medical doctors, physiotherapists, occupational therapists, and speech-language pathologists, had treated children with DCD and therefore continued the interview.

There are reasons for continuing the interview with only participants who treated children with DCD. First, the answers of the professional who have not treated children with DCD may be more theoretical and unrealistic. Second, we are interested to know the actual experiences in the health sector of professionals.

Identification of children with DCD requires an assessment tool to measure the motor impairment and its impact on activities of daily living. Therefore, the first question in this part was "which kind of assessment instruments do you use?" The answer to this question reflects the fact that the assessment methods used in clinical sessions is based on the perspective of different health sector specialties.

The findings show that all professionals from all specialties did not use a standardized assessment tool developed for identification of children with motor difficulties. However, one occupational therapist mentioned use of the Miller and Peabody assessment. One medical doctor also mentioned use of the MABC, but not in Kuwait. Almost all professionals depended on informal examinations. Although this type of examination might be beneficial to some extent, their purpose was determining the problems that the child encountered rather than for diagnosis. It might be argued that the job description of a therapist in Kuwait does not require them to diagnose. Most medical doctors send children to therapists, whether physiotherapists or occupational therapists, for further examination to confirm the diagnosis. Therefore, it is essential for the therapists to have a standardized assessment tool to help in identifying children with DCD.

Although one medical doctor mentioned the use of the MABC in Scotland, it was not explained why it was not being used in Kuwait. No professional mentioned having standard protocols for DCD including assessment, treatment, and follow up. There are many explanations for not having an official or protocol approach to DCD. First, the number of children referred to health sector might be small. Second, health professionals might be unaware of the term “DCD”; many professionals in developed countries also being unaware of the term (Gaines, et al., 2008; Peters, et al., 2001).

Despite the absence of an official method of assessing children with DCD, professionals in the health sector provided treatment for children with DCD. Doctors mentioned that there was no specific medication for children with DCD and they referred them to therapy. This answer explained the understanding of the medical doctor of the benefit of intervention for those children with DCD to help them to grow out of their difficulties or at least cope with them.

Therapists offered different types of interventions. Each specialty has its own methods reflecting the nature of their work. Physiotherapists used general terms in describing the type of the treatment, like motor learning, NDT, and the sensory integration approach. On the other hand, the speech-language pathologist concentrated on speech and feeding training, while the occupational therapists dealt with functional activities of daily life. The answers of therapists indicate that they are aware of the problems and therefore addressed intervention accordingly. Children appear to benefit from a multidisciplinary approach addressing the children's individual needs.

Turning to the question relating to the facilities available in their places, all agreed that there were no specific facilities available in hospitals. Medical doctors thought that the facilities were available in a specialized hospital, possibly explained by the fact that the medical doctor might consider the facilities as intervention facilities and because of that they referred children to a specialized hospital. This is a rehabilitation centre that includes different specialties like physiotherapy, occupational therapy, and speech-language pathologists.

However, some therapists because of the nature of their work consider the facilities as the environment of their workplace. They noted that there were no specific facilities available and therapists themselves were trying to modify the environment for the benefit of the children. Other therapists considered the facilities as the human resources like physiotherapists, occupational therapists, and speech language pathologists who are specialized and available in hospitals.

With regard to the satisfaction of participants, the responses of the satisfied participants were general, with no specific reason for their satisfaction. However, the dissatisfied participants were more specific. Each participant listed at least two reasons, and some of the reasons were similar. One of the important issues raised by the professionals was the team communication whether inside a hospital or between different hospitals. Children with DCD are heterogeneous with many difficulties, whether in fine motor, gross motor, or both, needing interpretation by different specialties. Team communication is essential between physician and therapists and between therapists themselves. Any miscommunication might lead to mismanagement. For example, if the physician refers the child to a therapist for further assessment that a physician cannot do and the therapist does not inform the physician of the findings, this incomplete management cycle might affect the diagnosis and consequently the treatment. The miscommunication might also result in missing the follow up of children, the progress, and hence the prognosis. It can be noticed in the first theme of this study that some participants knew, and were able to define and describe the features and symptoms of DCD without knowing its consequences and/or prognosis.

Therefore, the issues raised here are important for providing adequate facilities for those children with DCD. All those reasons were technical issues related to the facilities in general. However, one of the physiotherapists raised an important issue relating to the diagnosis, saying that children with DCD were not diagnosed as having DCD, supporting the view that children with DCD in Kuwait are misdiagnosed.

To sum up, the facilities provided in the health sector for children with DCD are available to provide adequate intervention for those children, but the system is not supportive for professionals to provide a service for them. Children with DCD need help from several professions, and avoiding miscommunication between professionals will play an essential role in addressing the problem of children with DCD and using the available facilities.

10.4.3 Facilities Provided by the Education Sector

Not only are health services essential for children with DCD, but also educational services. Education professionals were also asked several questions to determine the facilities offered in the education sector for children with DCD.

Because we are investigating the facilities available in education, professionals who have dealt with children with DCD were asked the questions. Three professionals had children with DCD and continued the interview. Although their opinions are mentioned here, their answers cannot be generlaised because of the small number of participants. The findings show that there was no specific management procedure or facilities for teachers to deal with children with DCD in the classroom or for psychologists in the school. A teacher raised an issue of importance for schools, saying that "I am not a special needs teacher to know the needs of children in order to decide whether the facilities are available or not". This might explain why educational professionals are unaware of DCD. The comment sheds light on the necessity for special needs teachers or teacher assistants in the public schools to help provide services for children with DCD. There is a need also for educational outreach courses or workshops for teachers to enhance their knowledge about DCD and the school management of children with DCD.

The number of educational professionals who knew DCD and continued the interview was small which makes the findings difficult to generalised. Also, educational professionals might have children with DCD in their class but not necessarily know the term "DCD", consistent with literature showing that teachers are unaware of DCD (Peters, et al., 2001).

The first part of the interview used medical terminology that was translated into Arabic for participants from public schools. The translation of the terminology from English to Arabic might affect the understanding of the questions which resulted in small number of educational participants to continue the interview. Because it was essential to ensure that we did not miss any information, all participants from the education sector were asked a further question to determine if they have children with DCD. The findings showed that almost all educational professionals had a "clumsy" child in their class. The findings gathered from the description of children who are clumsy indicate that educational professionals were unaware of the features and symptoms and causes of "clumsy" The findings of these questions confirm that educational professionals were unaware of DCD and its consequences. This is further evidence of the need for educational programs to assist them to identify children with DCD.

10.5 Summary

Interviews were carried out for a small group of professionals from health and education sectors to explore their knowledge of DCD, so the results cannot be generalized. However, from the available findings, it can be concluded that many professionals from both sectors were unaware of the exact definition of DCD. Although professionals from the health sector were better than the educational professionals in describing children with DCD, they were unaware of the consequences and prognosis. Facilities were not provided for children with DCD in either health or education sectors. Therefore, children with DCD need to be identified, referred, and treated by educated professionals from both health and education sectors.

A collaborative project is recommended between the Ministry of Health and the Ministry of Education to enhance professionals' knowledge of DCD in order to overcome the misdiagnosing and under-diagnosing of children with DCD. Further, there is a need to establish a protocol for identifying in preschools and kindergartens children at risk of motor difficulties that might lead to DCD.

11 General discussion and conclusion

11.1 Introduction

Developmental coordination disorder (DCD) is a heterogeneous disorder, so there are wide variations in its severity and in the difficulties it causes. Several studies have been conducted worldwide to investigate the motor performance of children in different cultures (Chow, et al., 2001; Engel-Yeger, et al., 2010; Livesey, et al., 2007; Rˆsblad & Gard, 1998; Van Waelvelde, et al., 2008) and the prevalence of DCD in different countries (Kadesjo & Gillberg, 1999; Lingam, et al., 2009; Pearsall-Jones, et al., 2008; Tsiotra, et al., 2006; Van Waelvelde, et al., 2008; Wright & Sugden, 1996). However, the prevalence of DCD in Kuwait is not known and children with DCD may be under diagnosed. Hence, the main objective of this study was to identify children with DCD in primary schools in Kuwait in order to investigate its prevalence and the motor performance of Kuwaiti children.

Identifying DCD requires assessing the motor ability of children in order to detect motor impairments and determine if the motor impairments impact on the activities at home and/or at school. These two requirements are necessary to fulfill the DSM-IV criteria for identification of children with DCD. The sample was recruited strictly based on the four criteria of the DSM-IV; criterion A was fulfilled by measuring the motor impairments, criterion B was fulfilled by screening activities, and criteria C and D were fulfilled through inclusion and exclusion criteria during the recruitment procedure.

Two studies were conducted. Study one was the measurement of motor impairments using the MABC-2 and screening the impact of motor impairment on the activities of daily life using the DCDQ’07. Study Two explored professional knowledge about

DCD and its consequences and prognosis, as well as exploring the facilities available in the Ministry of Education and the Ministry of Health for those children with DCD.

11.2 Prevalence of DCD

The prevalence of DCD in Kuwait was evaluated on the basis of the DSM-IV criteria showing that 5.7% have DCD and 8.4% are at risk of DCD. Although this prevalence is similar to that reported in the DSM-IV, it is higher than found in other studies (Lingam, et al., 2009; Van Waelvelde, et al., 2008; Wright & Sugden, 1996). A recent study of the prevalence of DCD in UK through a cohort using a strict recruitment method that complies with the DSM-IV criteria (Lingam, et al., 2009) found 1.7% of 7.5 year old children have DCD and 4.9% are at risk of DCD.

Although many studies have found a DCD prevalence within the DSM-IV range such as Sweden 4.9% (Kadesjo & Gillberg, 1999), Australia 6% (Pearsall-Jones, et al., 2008), and Canada 8% (Tsiotra, et al., 2006), these were based on criterion A only. If they had considered criterion B, the prevalence may have dropped. Therefore, the prevalence of DCD in Kuwait is considered high compared to those studies despite stricter criteria being used for the Kuwaiti sample.

There are many probable factors that could explain the high prevalence of DCD among Kuwaiti children. Biological factors like gestational age and birth weight may play a role in the high prevalence. In our study, LBW was found to be a risk factor of DCD and it was closely correlated gestational age (GA). The associations of GA and LBW to DCD were discussed thoroughly in Chapter 9 “predictive factors for motor impairment”. Kuwait has a higher rate of preterm birth (10.7%) compared to 6.2% in European countries (Beck, et al., 2010) and has higher rates of LBW (9.4%) compared to that reported in US of 3.2% (Rawlings, et al., 1995). The high proportion of preterm and low birth weight in our sample may explain the high prevalence of DCD.

Kuwait culture and environment may also play a role in the high prevalence of DCD and motor impairment. In a review of environmental factors affecting motor development of preschool children, Venetsanou and Kambas (2010) found that over caring of children affects the child's functional motor ability. They also found socioeconomic and social cultural context such as the child's rearing impact on the child's motor competence. Tsiotra et al. (2006) investigated the prevalence of DCD among Greek children and found a high prevalence 19%. The high rate of DCD in Greece correlated with the high body fat and low cardiorespiratory function associated with an inactive lifestyle (Tsiotra, et al., 2006). However, there is no published study investigating the relationship between cultural and environmental factors and DCD in Kuwait. Such studies are required to determine the causes of high prevalence of DCD in Kuwait.

Using standard assessment tools that are valid for different cultures is important to calculate a true prevalence. Not all standardized assessments are suitable for use in different cultures with distinct differences, whether non-western or western (Lansdown, et al., 1996). Lansdown et al. (1996) suggested that each country should devise its own normative data. In our study of motor impairment in Kuwait using the MABC-2, the percentage of children with movement difficulties was 17.8% and 26.3% at risk of movement difficulties. However, testing of the construct validity of the MABC-2 using the principle component analysis (PCA) showed the drawing task to be problematic so it was re-standardized resulting in the percentages falling to 11.1% and 22.9% respectively.

On balance, identifying children with DCD and determining prevalence should be based on the DSM-IV criteria. Standardized assessment tools, that are able to detect motor impairments and valid for different cultures, are recommended.

11.3 Psychometric properties of assessment tools

Neither the MABC-2 (2007) nor the DCDQ'07 (2007) tools used in this study to evaluate criteria A and B of the DSM-IV have been used in Kuwait previously. The construct validity of the MABC-2 revealed that the drawing item of the MABC-2 was problematic and re-standardization was carried out for that item. After re-standardization of the drawing item, the factor analysis was run again and showed that the drawing item fitted well with other items in the manual dexterity sub-test indicating a good fit of the component structure of the MABC-2 in both age band one (AB1) and age band two (AB2). Our findings confirm the construct validity of the MABC-2 for Kuwaiti children between five and nine years old.

Recently, and providing the only available evidence, a study measuring the factorial validity of the MABC-2 in the German population, reported that the fit measures confirmed the factorial validity of the MABC-2 but that the sub-structure was problematic. The discriminant and convergent validity were questionable. The authors concluded that the MABC-2 is suitable for therapeutic practice but not as a diagnostic tool for DCD (described by the term “specific developmental disorders of motor function”, F82 in the ICD-10 (Wagner, et al., 2011).

The original MABC has been used in many countries including Australia, Belgium, Germany, Hong Kong, Israel, Japan, Norway, and Sweden. Differences were found between the MABC norms for children from different countries specific to task, gender, and age indicating the influence of culture, society, and/or environment on specific task performance. For example, the Chinese culture encourages children as young as two years to use chopsticks. Chow et al. (2001) suggested that this activity may impact positively on the children’s performance on the MABC manual dexterity tasks.

In a similar way, practicing specific activities may impact on motor performance resulting in differences between children. It has been found that children who are practicing specific sport activities such as skiing, skating, or unicycle riding performed one-leg balance better than the norm sample (Miyahara, et al., 1998; Rˆsblad & Gard, 1998). Similarly, Chow et al. (2001) argued that practicing jumping in and out of buses everyday while using the public transportation may improve one-leg balance as in the case of the Chinese children in Hong Kong. However, the findings should be interpreted with caution as these activities are bilateral skills while Rˆsblad and Gard (1998) showed children performed better on one-leg using the non-preferred leg but not for both legs, or other balance tasks. Also, in the study of Miyahara the differences were specific to gender and age.

Although the motor performance of Kuwaiti children was lower than that of UK children in most items, children from both cultures were similar in catching and throwing. People of both countries like ball games, especially football (soccer). Children in Kuwait start playing football as young as two to three years. Practicing football involves not only kicking but also throwing and catching. This may explain the similarity between both countries in catching and throwing skills. Differences in these activities were found between American children who performed better than the Chinese children (Chow, et al., 2001). Authors attributed the differences to the influence of experience, as American children practice ball skills earlier than the Chinese.

Although, there were differences between Kuwaiti children and the UK children in manual dexterity and balance tasks, it is not clear which kind of activities in the Kuwaiti culture would influence the motor performance of Kuwaiti children. Therefore, further studies are needed to investigate the cultural environment in Kuwait and how children spend their time, the kinds of activities they practice, the kinds of life-styles they live, and how these issues correlate with motor performance.

The construct validity of the DCDQ’07 showed that the fit of the component structure of the DCDQ’07 was poor. However, the poor construct validity might be affected by the translation. It has been found that some of the Arabic translation of some questions like question 14 “Bull in shop” was not acceptable to parents. Arabic translation of question 15 “Does not fatigue” was confusing because it gives two different meanings; parents suggested splitting this into two questions.

Furthermore, the types of activities in the questionnaire are not those that children in Kuwait are used to which makes it hard for parents to judge. For example, Kuwaiti children are not familiar with the activity in question three “hit an approaching ball with bat or racquet”, so parents commented on this question. This may explain the poor construct validity of the DCDQ’07. Therefore, it should be retranslated with cross-cultural adaptation of the instrument taking into account the adjustment of cultural words and idioms as well as cultural activities.

Similar comments were reported in a Brazilian study (MSS, et al., 2009). The DCDQ’07 was translated into Portuguese using cross-cultural adaptation translation methods but parents also commented on two questions “hit with bat” and “bull in china shop” (MSS, et al., 2009). The activity “hit with bat” is not common in Brazilian culture. The question “bull in china shop” was not clear for parents, although the word “bull” was changed to “elephant” to be culturally acceptable.

The cut-off of the total score of the DCDQ’07 was categorized through a standardization process. However, our findings show significant age-related effects in the total score of the DCDQ’07 indicating the necessity for devising separate cut-off scores by age for Kuwaiti children. Similarly, Schoemaker et al. (2006) found a significant effect of gender on the total score for younger age children (4-8 years). This could be explained by differences between Kuwaiti culture, the Netherlands culture and the DCDQ’07 sample culture.

These findings raise concerns about the validity of the standardized assessment tools for the Kuwaiti culture. Researchers and clinicians should be careful when using any standardized assessment tools. The factorial analysis should be done first to ensure the construct validity and to make certain that the tool is suitable for different cultures.

A consultation held by the WHO on Family Health and Mental Health in the1980s reviewed several assessments of child development and found that not all the assessments were suitable for use in different cultures or in similar cultures with different societies. It was suggested that when using child development assessment or screening tools each country should have its own normative data (Lansdown, et al., 1996). Lansdown et al. (1996) conducted an extensive study on normalization of developmental assessment tools in China, India, and Thailand. Differences in motor development, specifically fine motor skills, were found between children from different countries as compared to the norms. Differences were also found within China and within India between urban and rural areas indicating cultural and societal variations which may impact on child motor development.

11.4 Gender differences

The authors of the MABC-2 stated in the manual that there were no gender differences in the motor performance of the norm sample (Henderson, et al., 2007) which was confirmed by our findings. However, the motor performance of Kuwaiti children between five and nine years was measured by the raw scores and the standard scores of the MABC-2 items. Although the findings showed that Kuwaiti boys were similar to girls in the total score of the MABC-2, there were significant differences between genders in the individual items and the components of the MABC-2.

Boys excelled in aiming and catching while girls excelled in manual dexterity and balance. The differences in the individual items were specific to age and task. For example, at age 5-6 years, boys were better at catching and throwing items while girls were better at walking heel raised. They were similar in other items. Between seven and nine years, boys were also better at catching and throwing items while girls were better at placing pegs.

The task specific differences between genders may be due to biological, cultural, or environmental factors. It is argued that gender differences are not seen before puberty and the differences between boys and girls post-puberty are due to biological changes (Thomas & French, 1985). The biological changes are associated with hormonal changes. Boys build muscle bulk and have accelerated motor performance while girls have smaller body size and are weaker than boys (Thomas & French, 1985). However, boys differ from girls in their motor ability as young as six months (Piek, et al., 2002). Gender-stereotyped play was found in children as young as three months and sex-preference play was found before self-awareness of gender identity. A study was conducted to measure sex-linked toy preferences in infants at age of three and eight months (Alexander, Wilcox, & Woods, 2009). The authors used trucks and dolls considered as preferable toys for boys and girls respectively at age of two years. The doll attracted the attention of girls while the truck attracted the attention of boys indicating that gender play preference may be biologically innate. The prenatal testosterone exposure may play a role in gender differences in motor ability because it acts on brain structure and function in gestational stages as early as eight week of gestation and continue across the life span (Hines, 2010).

Gender differences in motor ability may be a result of practicing certain activities which are sex-oriented and improve specific aspects of motor ability in children. Differences in specific motor skills have been noted between younger children; girls performed better in pencil grasp and writing, whereas boys were better at throwing and catching (Junaid & Fellowes, 2006). Motor experience and learning play a role in the differences between boys and girls. A study investigating gender differences in motor performance and motor learning in children and adolescents (Dorfberger, et al., 2009) found that female children were more advanced in fine motor skills like handwriting than males which may be because girls enhance their experience of handwriting. However, when children underwent training practice sessions, boys performed the task better than the girls before the training sessions. The study also investigated gender differences in motor memory consolidation and found that although boys and girls benefited from practicing and motor learning, boys benefited more than girls in the performance of the trained movement sequences and in the post-training motor consolidation and retention phase. The authors suggested that boys benefited from motor learning more than girls (Dorfberger, et al., 2009).

The fundamental learning of motor skills may differ between boys and girls. Garcia (1994), in a study conducted for six consecutive months and observing how a small sample of 29 preschool children interact in the context of learning fundamental motor skills, found that the type of interactions between children, peers relationship, and their personality impact on their way of learning motor skills. For example, the social interaction of girls showed cooperation with others and concern about their actions and as a consequence negatively affected their learning of fundamental motor skills especially in competitive or individualized situations. On the other hand, boys showed competitive and individualized interactions which impact favourably on the learning of motor skills; boys liked to demonstrate their abilities. Moreover, girls spent less time in practicing skills because the social interaction was more important for them than skill practice. This may explain the delay in manipulative skills like ball skills. Boys were aggressive in their interaction with girls when practicing ball skills throwing balls to girls too far, too high, or too fast for girls to catch, so impacting negatively on their self-confidence and discouraging future participation.

11.5 Professional knowledge about DCD

Although the diagnosis of DCD requires clear inclusion and exclusion criteria, it also requires professionals to be knowledgeable about DCD and its classification. The findings of study two, the professional interview, showed that although the findings cannot be generalized because of the small sample size, educational professionals appeared unaware of DCD. This is in line with other findings (Peters, et al., 2001). Health professionals were aware of the condition but not all of them were familiar with the term “DCD”. This might explain the limited number of DCD-diagnosed children being referred to therapy whether physiotherapy, occupational therapy, or speech-language therapy.

It is necessary for both the Ministry of Health and the Ministry of Education in Kuwait to be aware of the problem. The prevalence of DCD in Kuwait was estimated to be 5.7%, so in each primary school class (20-25 children) there may be one to two children with DCD and two to three children at risk of DCD. This means each primary teacher has to deal with three to five children in these categories. In the public education system in Kuwait, teachers, depending on their specialties, have between two to five classes a day. Multiplying the number of children per class by the number of classes a day, we see that each teacher may have to deal with between 6-10 and 15-25 children each day. This calculation highlights the issue that we have to consider that there are high numbers of children with DCD and teachers have a lack of knowledge but are confronted every day with children exhibiting many different motor coordination difficulties. Help should be provided not only for children but also for teachers to overcome their lack of knowledge and empower them with adequate procedures to assist those children.

According to the professionals' view, there were few facilities available for children with DCD within primary schools in Kuwait. Although the facilities in the health sector seem to be available, there is little inter-professional interaction. Furthermore, children with DCD were under-diagnosed and there is no standard protocol in the Ministry of Health for referral for those children. Professionals from health and educational sectors use their efforts to help those children, but they have no clear plan, no clear protocol, and no clear knowledge to guide their efforts.

11.6 Recommendations

It is apparent from the literature review that many studies use only one assessment tool to assess motor impairment in order to measure the prevalence of DCD. Although the term "DCD" should be applied only if a child meets the four criteria of the DSM-IV, the consideration of motor impairments is indeed important for children who have these problems. From a clinical perspective, it is not always possible to use two sources to identify children with DCD, so professionals usually use what is available which could be an assessment test or screening test. Therefore, restricting identification of children with motor coordination problems on the basis of the DSM-

IV will result in missing children with motor problems requiring intervention, although they are not necessarily diagnosed with DCD.

Furthermore, differences in the sensitivity and specificity between assessment tools and screening tools were reported in many studies indicating that the screening tools are less sensitive than assessment tools. Screening tools like the MABC-checklist and the DCDQ have poor sensitivity in detecting motor problems (Junaid, Harris, Fulmer, & Carswell, 2000; Schoemaker, et al., 2006; Schoemaker, Smits-Engelsman, & Jongmans, 2003), so relying on them for initial detection of motor impairments which are then assessed by assessment tools will lead to missing many children with motor difficulties that need intervention. For example, Wright and Sugden (1996) found that three children categorized as having no movement difficulties according to the MABC checklist but with borderline scores were confirmed by the MABC test as having movement difficulties.

We have shown that in each class in primary schools in Kuwait there may be three to five children with or at risk of DCD who need early intervention to help them overcome their difficulties. However, the interviews with professionals indicate that because of the dearth of facilities in the education and health sectors, these children might not be treated. A study found that children with DCD often were referred to therapy, not because of their motor difficulties, but because of other symptoms like learning problems and attention deficits (Dewey, et al., 2002). There are many consequences of DCD that limit activities of children, restrict their participation in their community, and lead to isolation that may cause secondary problems like obesity (Cairney, et al., 2005), low self-esteem (Miyahara & Piek, 2006), and depression (Piek, et al., 2008).

Because of the heterogeneity of the disorder, the nature and severity of the difficulties vary, so intervention is recommended for all children with or at risk of DCD. It is believed that each child is unique with unique needs requiring a specifically designed intervention. There are many kinds of interventions provided for children with DCD such as perceptual-motor training, sensory integration therapy, kinaesthetic training, task-specific training, cognitive affective training, sensory-motor training, Bobath and Bobath technique, Cognitive Orientation to daily Occupational Performance (CO-OP), and neuromotor task training (NTT) (Niemeijer, Schoemaker, & Smits-Engelsman, 2006). From the point of view of a clinician, physiotherapy, occupational therapy, and speech-language therapy benefit children with or at risk of DCD by reducing the effects of their difficulties and teaching them to accommodate their difficulties and to learn new skills that help them manage life's activities (Kaufman & Schilling, 2007; Niemeijer, et al., 2006; Niemeijer, Smits-Engelsman, & Schoemaker, 2007; Watemberg, Waiserberg, Zuk, & Lerman-Sagie, 2007).

Given the clear picture of DCD in Kuwait from the findings of the studies and their clinical implications, an educational outreach program for professionals from health and educational sectors is recommended. This would be a health promotion program to be implemented in primary public schools in the State of Kuwait with the mission of identifying children with DCD, assessing their difficulties, and designing suitable interventions to solve their difficulties at school and at home. The program aims to provide professionals in primary schools – teachers, psychologists, social workers, physicians, and physiotherapists - with knowledge of developmental disorders in general and DCD in particular adequate to allow them to identify children with such difficulties. The vision of the program is not just to teach professionals and improve their knowledge, but more importantly to assist those children with DCD who have difficulties that make life hard for them.

11.7 Future Research

From the findings, there is a high prevalence of DCD in Kuwaiti children aged between seven and eight years, having movement difficulties and a greater delay in their motor performance than any other age group. Therefore, we recommend a study to investigate the motor performance for those children at ages seven and eight to explore the factors that impact on the children's motor abilities. Also, a longitudinal study is needed to find out whether those children will catch up or not.

Because of the shortage of evidence regarding the motor performance of Kuwaiti children and the prevalence of DCD in Kuwait, we recommend a longitudinal study to evaluate the motor ability of Kuwaiti children and the impact of the socioeconomic status including income and education level of parents, environment at home and at school, and cultural perspective.

Lansdown et al (1996) suggested that each country should devise its own normative data, and a recommendation for future studies would be to determine normative data for the motor ability of Kuwaiti children.

Having examined the reliability and validity of the Arabic version of the DCDQ'07 in Kuwaiti culture and explored the problems of the literal translation that was used, it warrants a cross-cultural translation of the DCDQ'07 that is suitable for the Kuwaiti culture. A study examining the new Arabic translation is worth doing.

Other developmental disorders co-occur with DCD, so it is necessary to investigate children with DCD whether they have other disorders like ADHD, dyslexia, and learning difficulties. In addition, children with abovementioned developmental disorders may have DCD or motor problems, so examinations for motor ability are warranted and therefore possible benefits from the available interventions.

11.8 Strengths of the study

One of the strengths of the study was the large sample size with equal numbers of male and female children and involving all districts in Kuwait making generalization of the findings acceptable. The sample was representative of all Kuwait districts urban and rural, the children were Kuwaiti citizens from different ethnicities, and the study sample was large enough to confirm the external validity of the MABC-2 for Kuwaiti children.

Our study complied strictly with the DSM-IV criteria for recruiting a school based sample of children, helping to identify children with DCD. Literature shows that previous studies have not complied with the DSM-IV or ICD-10 criteria for recruiting children to determine the prevalence of DCD as explained in Chapter 2 “Identification of Developmental Coordination Disorder”. This might explain the reported variations in DCD prevalence of different countries. Researchers considered criterion A in identifying children with DCD measuring the movement difficulties only without adequately assessing criterion B (Geuze, et al., 2001).

The MABC-2 was used in Kuwait for the first time, so the findings of this study are considered unique. It was administered in Arabic and used with Arab children for the first time. Also, the DCDQ’07 was translated into Arabic and used with Arab children for the first time.

Finally, the data analyses were rigorous with both raw and standard scores being used. Individual items and MABC-2 components were analyzed to investigate differences in individual items to measure individual skill ability and to investigate differences in components measuring motor profiles for Kuwaiti children.

11.9 Limitations of the study

The school holidays and public holidays were barriers to recruiting and examining five year old children before they turned six. In the education system in Kuwait, children commence school at the age of five years and six months and study usually starts in September. The number of children aged five years was small which limited the recruitment, so the sample size for children aged 5 years old was smaller than for other ages.

Another limitation was recruitment of private schools. The number of private schools that follow the UK, USA, and Canadian curriculum was also limited. Principals of most schools declined to participate because they did not want any conflict with parents. Principals of other schools did not accept our offer of participation because they were involved in other research.

The translation of the DCDQ’07 was one of the limitations. The method of translation was thoroughly explained in Chapter 5 “General methodology”. The translation could have been culturally developed and based on the cross-cultural adaptation of instruments considering the adjustment of cultural words and idioms. However, this was deemed not appropriate in this study as some parents filled in the English version of the questionnaire and both needed to be comparable in their meaning.

Although recruitment of children in our study was strict with the DSM-IV criteria, assessment of criteria C and D was limited due to the available information. Children with medical disorders were excluded based on their medical record at school; we assumed that children with neurological disorders like cerebral palsy or spina bifida and with mental disorders are usually enrolled in special needs schools and rarely are allowed to enroll in public mainstream schools. In addition, not all mental disorders and developmental disorders such as PDD, especially mild conditions, are recorded in the medical records.

It is possible that parents of children with motor problems are more likely to accept to participate in the study. This is an important issue to consider during recruitment of children. However, it was not possible to determine whether parents who decline to participate had children with less motor problems than those who accepted and may impacted on the prevalence estimates.

11.10 Conclusion

Children with DCD are heterogeneous in their difficulties, affecting their identification and therefore their prevalence. The measured prevalence of DCD is based on inclusion and exclusion criteria of the DSM-IV and ignoring one or more of these criteria would bias the results. Our previous discussions highlight the variations of the prevalence of DCD between different studies in different cultures. Most of the studies comply with criterion A which assesses the motor difficulties but not DCD. Adding criterion B did reduce the number of children identified by criterion A, as exemplified by the studies of Lingam (2009) and Wright and Sugden (1996).

Our study complied with the four criteria of the DSM-IV in identifying children with DCD. Although the prevalence reduced when applying criterion B after identifying children with motor difficulties, the prevalence of DCD is still considered high compared to other studies.

Because of the dearth of research in Kuwait, conducting many studies could be beneficial for researchers, clinicians, children with DCD, and decision makers. Our study gives fundamental information about the motor abilities of Kuwaiti children that can be used for future planning of physiotherapy services in Kuwait.

Coping with the difficulties of DCD is a serious challenge. Children with DCD cannot face these difficulties alone, and need strong support before and after being identified. Having looked at several aspects of motor performance of Kuwaiti children, the prevalence of DCD in Kuwait, professionals knowledge about DCD, and the facilities available for children with DCD, we propose education programs to familiarize people with this group of children, so they will know how to help them.

Al-Mutawa, S. (1994). *History of architecture in old Kuwait city, and the influence of its elements on the architect*. Kuwait: S. Al-Mutawa.

Al-Thakeb, F. T. (1985). The Arab Family and Modernity: Evidence From Kuwait. *Current Anthropology, 26*(5), 575.

Alexander, G., Wilcox, T., & Woods, R. (2009). Sex Differences in Infants' Visual Interest in Toys. *Archives of Sexual Behavior, 38*(3), 427.

Alfadhli, A., Hajia, A., Mohammed, F., Alfadhli, H., & El-Shazly, M. (2010). Incidence and potential risk factors of low birth weight among full term deliveries. *Alexandria Bulletin, 46*(2), 157-164.

Allen, P. J., & Bennett, K. (2008). *SPSS for the health & behavioural sciences* (1st ed.). South Melbourne, Vic.: Thomson.

Alshimmiri, M. M., Hammoud, M. S., Al-Saleh, E. A., & Alsaeid, K. M. S. (2003). Ethnic variations in birthweight percentiles in Kuwait. *Paediatric and Perinatal Epidemiology, 17*(4), 355-362.

American Educational Research Association. (1985). *Standards for educational and psychological testing*. Washington, DC: American Psychological Association.

American Psychiatric Association. (1994). *Diagnostic criteria from DSM-IV*. Washington: American Psychiatric Association.

Ayres, A. J., & Robbins, J. (1979). *Sensory integration and the child*. Los Angeles, Calif.: Western Psychological Services.

Barnett, A., & Henderson, S. (2005). Assessment of handwriting in children with developmental coordination disorder. In D. Sugden & M. Chambers (Eds.), *Children with developmental coordination disorder* (pp. 168-188). London: Whurr.

Barnett, A., Kooistra, L., & Henderson, S. (1998). "Clumsiness" as Syndrome and Symptom. *Human Movement Science, 17*(4-5), 435-447.

Barnhart, R. C., Davenport, M. J., Epps, S., B., & Nordquist, V., M. . (2003). Developmental coordination disorder. *Physical Therapy, 83*(8), 722-731.

Bassett, J. E., Gayton, W. F., Blanchard, E. B., & Ozmon, K. I. (1977). Birth order and perceptual motor performance. *Perceptual and Motor Skills, 45*, 1076-1078.

Beck, S., Wojdyla, D., Say, L., Betran, A., Merialdi, M., Requejo, J., et al. (2010). The worldwide incidence of preterm birth: a systematic review of maternal mortality and morbidity. *Bulletin of the World Health Organization (BLT), 88,* 31-38.

Blanc, A. K., & Wardlaw, T. (2005a). Monitoring low birth weight. *Bulletin of the World Health Organization (BLT), 83*(3), 161-240.

Blanc, A. K., & Wardlaw, T. (2005b). Monitoring low birth weight: an evaluation of international estimates and an updated estimation procedure. *Bulletin of the World Health Organization (BLT), 83*(3), 178-185.

Bradley, R. H., Corwyn, R. F., McAdoo, H. P., & Coll, C. G. (2001). The home environments of children in the United States part I: Variations by age, ethnicity, and poverty status. *Child Development, 72*(6), 1844.

Brantner, S., Piek, J. P., & Smith, L. M. (2009). Evaluation of the validity of the MAND in assessing motor impairment in young children. *Rehabilitation Psychology, 54*(4), pp.

Brown, T., & Lalor, A. (2009). The Movement Assessment Battery for Children—Second Edition (MABC-2): A Review and Critique. *Physical & Occupational Therapy in Pediatrics, 29*(1), 86-103.

Bruininks, R. (1978). *Bruininks-Oseretsky Test ofMotor Proficiency:Examiner's Manual.* Circle Pines, MN: American Guidance Service.

Bruininks, R., & Bruininks, B. (2005). *Bruininks-Oseretsky Test of Motor Proficiency - Second Edition*. Minneapolis MN: NCS Pearson.

Cairney, J., Hay, J., Faught, B., & Hawes, R. (2005). Developmental coordination disorder and overweight and obesity in children aged 9-14 y. *International Journal of Obesity, 29*(4), 369-372.

Cairney, J., Hay, J., Veldhuizen, S., Missiuna, C., & Faught, B. (2009). Comparing probable case identification of developmental coordination disorder using the short form of the Bruininks-Oseretsky Test of Motor Proficiency and the Movement ABC. *Child: Care, Health and Development, 35*(3), 402-408.

Cairney, J., Missiuna, C., Veldhuizen, S., & Wilson, B. (2008). Evaluation of the psychometric properties of the developmental coordination disorder questionnaire for parents (DCD-Q): Results from a community based study of school-aged children. *Human Movement Science, In Press, Corrected Proof.*

Cairney, J., Veldhuizen, S., Kurdyak, P., Missiuna, C., Faught, B., & Hay, J. (2007). Evaluating the CSAPPA subscales as potential screening instruments for developmental coordination disorder. *Archives of disease in childhood, 92*(11), 987-991.

Cantell, M. H., Crawford, S. G., & Doyle-Baker, P. K. (2008). Physical fitness and health indices in children, adolescents and adults with high or low motor competence. *Human Movement Science, 27*(2), 344-362.

Cantell, M. H., Smyth, M. M., & Ahonen, T. P. (2003). Two distinct pathways for developmental coordination disorder: Persistence and resolution. *Human Movement Science, 22*(4-5), 413-431.

Chambers, M. E., & Sugden, D. A. (2002). The Identification and Assessment of Young Children with Movement Difficulties Identification *International Journal of Early Years Education, 10*(3), 157 - 176.

Cheng, H.-C., Chen, H.-Y., Tsai, C.-L., Chen, Y.-J., & Cherng, R.-J. (2009). Comorbidity of motor and language impairments in preschool children of Taiwan. *Research in Developmental Disabilities, 30*(5), 1054-1061.

Cherng, R.-J., Hsu, Y.-W., Chen, Y.-J., & Chen, J.-Y. (2007). Standing balance of children with developmental coordination disorder under altered sensory conditions. *Human Movement Science, 26*(6), 913-926.

Chien, Y.-H., Tsao, P.-N., Chou, H.-C., Tang, J.-R., & Tsou, K.-I. (2002). Rehospitalization of extremely-low-birth-weight infants in first 2 years of life. *Early Human Development, 66*(1), 33-40.

Chow, S., & Henderson, S. (2003). Interrater and test-retest reliability of the Movement Assessment Battery for Chinese preschool children. *American Journal of Occupational Therapy, 57*(5), 574-577.

Chow, S., Henderson, S., & Barnett, A. (2001). The movement assessment battery for children: a comparison of 4-year-old to 6-year-old children from Hong Kong and the United States. *American Journal of Occupational Therapy, 55*(1), 55-61.

Cintas, H. L. (1995). Cross-Cultural Similarities and Differences in Development and the Impact of Parental Expectations on Motor Behavior. *Pediatric Physical Therapy Fall, 7*(3), 103-111.

Civetta, L. R., & Hillier, S. L. (2008). The developmental coordination disorder questionnaire and movement assessment battery for children as a diagnostic method in Australian children. *Pediatric physical therapy, 20*(1), 39-46.

Cousins, M., & Smyth, M. M. (2003). Developmental coordination impairments in adulthood. *Human Movement Science, 22*(4-5), 433-459.

Crawford, S., & Dewey, D. (2008). Co-occurring disorders: A possible key to visual perceptual deficits in children with developmental coordination disorder? *Human Movement Science, 27*(1), 154-169.

Crawford, S., Wilson, B., & Dewey, d. (2001). Identifying developmental coordination disorder: Consistency between tests. In C. Missiuna (Ed.), *Children with developmental coordination disorder : strategies for success* (pp. 29-50). New York: Haworth Press.

Croce, R., Horvat, M., & McCarthy, E. (2001). Reliability and Concurrent Validity of the Movement Assessment Battery for Children. *Perceptual and Motor Skills, 93*, 275-280.

Davis, N. M., Ford, G. W., Anderson, P. J., Doyle, L. W., & Victorian Infant Collaborative Study, G. (2007). Developmental coordination disorder at 8 years of age in a regional cohort of extremely-low-birthweight or very preterm infants. *Developmental Medicine & Child Neurology, 49*(5), 325-330.

Dawson, B., & Trapp, R. G. (2004). *Basic & clinical biostatistics* (4th ed.). New York: Lange Medical Books/McGraw-Hill.

de Kieviet, J. F., Piek, J. P., Aarnoudse-Moens, C. S., & Oosterlaan, J. (2009). Motor Development in Very Preterm and Very Low-Birth-Weight Children From Birth to Adolescence. *JAMA: The Journal of the American Medical Association, 302*(20), 2235-2242.

De Kleine, M. J. K., Nijhuis-Van Der Sanden, M. W. M. W. G., & Ouden, A. L. D. (2006). Is paediatric assessment of motor development of very preterm and low-birthweight children appropriate? *Acta pædiatrica, 95*(10), 1202-1208.

Deitz, C. J. (1989). Chapter 6: Reliability. *Physical & Occupational Therapy in Pediatrics, 9*(1), 125-147.

Dewey, D., Creighton, D., Heath, J., Wilson, B., Anseeuw-Deeks, D., Crawford, S., et al. (2011). Assessment of Developmental Coordination Disorder in Children Born With Extremely Low Birth Weights. *Developmental Neuropsychology, 36*(1), 42 - 56.

Dewey, D., Kaplan, B., Crawford, S., & Wilson, B. (2002). Developmental coordination disorder: Associated problems in attention, learning, and psychosocial adjustment. *Human Movement Science, 21*(5-6), 905-918.

Dewey, D., & Wilson, B. (2001). Developmental Coordination Disorder. *Physical & Occupational Therapy in Pediatrics, 20*(2-3), 5-27.

Dorfberger, S., Adi-Japha, E., & Karni, A. (2009). Sex differences in motor performance and motor learning in children and adolescents: An increasing male advantage in motor learning and consolidation phase gains. *Behavioural Brain Research, 198*(1), 165-171.

Dunn, W. W. (1989). Chapter 7: Validity. *Physical & Occupational Therapy in Pediatrics, 9*(1), 149-168.

Dyck, M., Piek, J., Hay, D., & Hallmayer, J. (2007). The Relationship Between Symptoms and Abilities in Autism. *Journal of Developmental and Physical Disabilities, 19*(3), 251-261.

El-Haddad, Y. (2003). Major Trends Affecting Families In The Gulf Countries. Retrieved Februaury 14, 2011

Engel-Yeger, B., Rosenblum, S., & Josman, N. (2010). Movement Assessment Battery for Children (M-ABC): Establishing construct validity for Israeli children. *Research in Developmental Disabilities, 31*(1), 87-96.

Ennis, C. D., & Lazarus, J.-A. C. (1990). Cognitive style and gender differences in children's motor task performance. *Early Child Development and Care, 64*(1), 33 - 46.

Feise, R. (2002). Do multiple outcome measures require p-value adjustment? *BMC Medical Research Methodology, 2*(1), 8.

First, M. B., & Tasman, A. (2004). *DSM-IV-TR mental disorders : diagnosis, etiology, and treatment*. Chichester, West Sussex: Hoboken, NJ : J. Wiley.

Foulder-Hughes, L., & Cooke, R. (2003). Do Mainstream Schoolchildren who were Born Preterm have Motor Problems? *The British Journal of Occupational Therapy, 66*(1), 9-16.

Frances, A., First, M. B., Pincus, H. A., American Psychiatric Association., & American Psychiatric Association. Task Force on DSM-IV. (1994). *Diagnostic and statistical manual of mental disorders : DSM-IV* (4th ed.). Washington, DC: American Psychiatric Association.

Gaines, R., Missiuna, C., Egan, M., & McLean, J. (2008). Educational outreach and collaborative care enhances physician's perceived knowledge about Developmental Coordination Disorder. *BMC Health Services Research 8*, 21.

Garcia, C. (1994). Gender differences in young children's interactions when lea. *Research Quarterly for Exercise and Sport, 65*(3), 213.

Geuze, R. H. (2003). Static balance and developmental coordination disorder. *Human Movement Science, 22*(4-5), 527-548.

Geuze, R. H. (2005a). Motor impairment in DCD and activities of daily living. In D. Sugden & M. Chambers (Eds.), *Children with developmental coordination disorder* (pp. 19-46). London: Whurr.

Geuze, R. H. (2005b). Postural control in children with developmental coordination disorder. [Review] [38 refs]. *Neural Plasticity, 12*(2-3), 183-196.

Geuze, R. H., Jongmans, M., Schoemaker, M., & Smits-Engelsman, B. (2001). Clinical and research diagnostic criteria for developmental coordination disorder: a review and discussion. *Human Movement Science, 20*(1-2), 7-47.

Giagazoglou, P., Kyparos, A., Fotiadou, E., & Angelopoulou, N. (2007). The effect of residence area and mother’s education on motor development of preschool-aged children in Greece. *Early Child Development and Care, 177*(5), 479 - 492.

Gibbs, J., Appleton, J., & Appleton, R. (2007). Dyspraxia or developmental coordination disorder? Unravelling the enigma. *Arch Dis Child, 92*(6), 534-539.

Gillberg, C. (2003). Deficits in attention, motor control, and perception: A brief review. *Archives of Disease in Childhood j, 88*(10), 904-910.

Goyen, T.-A., & Lui, K. (2002). Longitudinal motor development of "apparently normal" high-risk infants at 18 months, 3 and 5 years. *Early Human Development, 70*(1-2), 103-115.

Green, D., & Baird, G. (2005). DCD and overlapping conditions. In D. Sugden & M. Chambers (Eds.), *Children with developmental coordination disorder* (pp. 93-118). London: Whurr.

Green, D., Baird, G., Barnett, A., Henderson, L., Huber, J., & Henderson, S. (2002). The severity and nature of motor impairment in Asperger's syndrome: a comparison with Specific Developmental Disorder of Motor Function. *Journal of Child Psychology and Psychiatry, 43*(5), 655-668.

Green, D., Baird, G., & Sugden, D. (2006). A pilot study of psychopathology in Developmental Coordination Disorder. *Child: Care, Health and Development, 32*(6), 741-750.

Green, D., Bishop, T., Wilson, B., Crawford, S., Hooper, R., Kaplan, B., et al. (2005). Is Questionnaire-Based Screening Part of the Solution to Waiting Lists for Children with Developmental Coordination Disorder? *British Journal of Occupational Therapy, 68*(1), 2-10.

Green, D., Charman, T., Pickles, A., Chandler, S., Loucas, T. O. M., Simonoff, E., et al. (2009). Impairment in movement skills of children with autistic spectrum disorders. *Developmental Medicine & Child Neurology, 51*(4), 311-316.

Grove, C. R., & Lazarus, J.-A. C. (2007). Impaired re-weighting of sensory feedback for maintenance of postural control in children with developmental coordination disorder. *Human Movement Science, 26*(3), 457-476.

Gubbay, S. S. (1975). *The clumsy child : a study of developmental aproxic and agnosic ataxia*. London: Saunders.

Hadders-Algra, M. (2001). Early Brain Damage and the Development of Motor Behavior in Children: Clues for Therapeutic Intervention? *NEURAL PLASTICITY, 8*(1-2), 31-49.

Haga, M., Pedersen, A. V., & Sigmundsson, H. (2008). Interrelationship among selected measures of motor skills. *Child: Care, Health and Development, 34*(2), 245-248.

Hamadeh, R., Al-Roomi, K., & Masuadi, E. (2008). Determinants of family size in a Gulf Arab state: a comparison between two areas. *The Journal of the Royal Society for the Promotion of Health, 128*(5), 226.

Hamilton, A. (1981). *Nature and nurture : Aboriginal child-rearing in north-central Arnhem Land* Canberra: Australian Institute of Aboriginal Studies

Hemgren, E., & Persson, K. (2009). Deficits in motor co-ordination and attention at 3 years of age predict motor deviations in 6.5-year-old children who needed neonatal intensive care. *Child Care, Health and Development, 35*(1), 120.

Henderson, S., & Barnett, A. (1998). The classification of specific motor coordination disorders in children: some problems to be solved. *Human Movement Science, 17*(4-5), 449-469.

Henderson, S., & Henderson, L. (2003). Toward an understanding of developmental coordination disorder: Terminological and diagnostic issues. *Neural Plasticity, 10*(1-2), 1-13.

Henderson, S., May, D., & Umney, M. (1989). An exploratory study of goal-setting behaviour, self-concept and locus of control in children with movement difficulties. *European Journal of Special Needs Education, 4*(1), 1 - 15.

Henderson, S., & Sugden, D. (1992). *Movement assessment battery for children manual*. New York: The Psychological Corporation/Harcourt.

Henderson, S., Sugden, D., & Barnett, A. (2007). *Movement assessment Battery for Children-2: Examiner's manual*. London: Harcourt assessment.

Hill, E. L. (1998). A dyspraxic deficit in specific language impairment and developmental coordination disorder? Evidence from hand and arm movements. *Developmental medicine and child neurology, 40*(6), 388.

Hill, E. L. (2001). Non-specific nature of specific language impairment: a review of the literature with regard to concomitant motor impairments. *International Journal of Language & Communication Disorders, 36*(2), 149-171.

Hill, E. L., Bishop, D. V. M., & Nimmo-Smith, I. (1998). Representational gestures in Developmental Coordination Disorder and specific language impairment: Error-types and the reliability of ratings. *Human Movement Science, 17*(4-5), 655-678.

Hilton, C., Wente, L., LaVesser, P., Ito, M., Reed, C., & Herzberg, G. (2007). Relationship between motor skill impairment and severity in children with Asperger syndrome. *Research in Autism Spectrum Disorders, 1*(4), 339-349.

Hines, M. (2010). Sex-related variation in human behavior and the brain. *Trends in Cognitive Sciences, 14*(10), 448-456.

Holm, I., & Vllestad, N. (2008). Significant effect of gender on hamstring-to-quadriceps strength ratio and static balance in prepubescent children from 7 to 12 years of age. *The American journal of sports medicine, 36*(10), 2007-2013.

Holsti, L., Grunau, R. V., & Whitfield, M. F. (2002). Developmental coordination disorder in extremely low birth weight children at nine years. *Journal of Developmental and Behavioral Pediatrics, 23*(1), pp.

Hopkins, B., & Westra, T. (1990). Motor development, maternal expectations, and the role of handling. *Infant Behavior and Development, 13*(1), 117-122.

Humphriss, R., Hall, A., May, M., & Macleod, J. (2011). Balance ability of 7 and 10 year old children in the population: Results from a large UK birth cohort study. *International Journal of Pediatric Otorhinolaryngology, 75*(1), 106-113.

Jarus, T., Lourie-Gelberg, Y., Engel-Yeger, B., & Bart, O. (2011). Participation patterns of school-aged children with and without DCD. *Research in Developmental Disabilities, In Press, Corrected Proof*.

Johnston, L., Burns, Y., Brauer, S., & Richardson, C. (2002). Differences in postural control and movement performance during goal directed reaching in children with developmental coordination disorder. *Human Movement Science, 21*(5-6), 583-601.

Johnston, O., Short, H., & Crawford, J. (1987). Poorly coordinated children: a survey of 95 cases. *Child: Care, Health and Development, 13*(6), 361-376.

Jongmans, M., Smits-Engelsman, B., & Schoemaker, M. (2003). Consequences of comorbidity of developmental coordination disorders and learning disabilities for severity and pattern of perceptual-motor dysfunction. *Journal of Learning Disabilities, 36*(6), 528.

Junaid, K., & Fellowes, S. (2006). Gender Differences in the Attainment of Motor Skills on the Movement Assessment Battery for Children. *Physical & Occupational Therapy in Pediatrics, 26*(1-2), 5-11.

Junaid, K., Harris, S. R., Fulmer, K. A., & Carswell, A. (2000). Teachers' use of the MABC checklist to identify children with motor coordination difficulties. *Pediatric Physical Therapy, 12*(4), 158-163.

Kadesjo, B., & Gillberg, C. (1999). Developmental coordination disorder in Swedish 7-year-old children. *Journal of the American Academy of Child and Adolescent Psychiatry, 38*(7), 820-828.

Kagerer, F. A., Contreras-Vidal, J. L., Bo, J., & Clark, J. E. (2006). Abrupt, but not gradual visuomotor distortion facilitates adaptation in children with developmental coordination disorder. *Human Movement Science, 25*(4-5), 622-633.

Kaplan, B., Crawford, S., Cantell, M., Kooistra, L., & Dewey, D. (2006). Comorbidity, co-occurrence, continuum: what's in a name? *Child: Care, Health and Development, 32*(6), 723-731.

Kaplan, B., Wilson, B., Dewey, D., & Crawford, S. (1998). DCD may not be a discrete disorder. *Human Movement Science, 17*(4-5), 471-490.

Kaufman, L. B., & Schilling, D. L. (2007). Implementation of a Strength Training Program for a 5-Year-Old Child With Poor Body Awareness and Developmental Coordination Disorder. *Physical Therapy, 87*(4), 455.

Kopp, S., Beckung, E., & Gillberg, C. (2010). Developmental coordination disorder and other motor control problems in girls with autism spectrum disorder and/or attention-deficit/hyperactivity disorder. *Research in Developmental Disabilities, 31*(2), 350-361.

Krombholz, H. (2006). Physical performance in relation to age, sex, birth order, social class, and sports activities of preschool children. *Perceptual and Motor Skills, 102*(2), 477-484.

Lansdown, R. G., Goldstein, H., Shah, P. M., Orley, J. H., & et al. (1996). Culturally appropriate measures for monitoring child development at family and community level: A WHO collaborative study. *World Health Organization. Bulletin of the World Health Organization, 74*(3), 283.

Largo, R. H., Caflisch, J. A., Hug, F., Muggli, K., Molnar, A. A., Molinari, L., et al. (2001). Neuromotor development from 5 to 18 years. Part 1: timed performance. *Developmental Medicine & Child Neurology, 43*(07), 436-443.

Lingam, R., Hunt, L., Golding, J., Jongmans, M., & Emond, A. (2009). Prevalence of developmental coordination disorder using the DSM-IV at 7 years of age: a UK population-based study. *Pediatrics, 123*(4), e693-e700.

Livesey, D., Coleman, R., & Piek, J. (2007). Performance on the Movement assessment Battery for children by Australian 3- to 5-year-old children. *Child care, health and development.*

Loh, P. R., Piek, J. P., & Barrett, N. C. (2009). The use of the developmental coordination disorder questionnaire in Australian children. *Adapted Physical Activity Quarterly, 26*(1), pp.

Magalhães, L., Missiuna, C., & Wong, S. (2006). Terminology used in research reports of developmental coordination disorder. *Developmental medicine and child neurology, 48*(11), 937-941.

Mandich, A. A., & Polatajko, H. J. H. J. (2003). Developmental coordination disorder: mechanisms, measurement and management. *Human Movement Science, 22*(4-5), 407-411.

Mandich, A. D., Polatajko, H. J., & Rodger, S. (2003). Rites of passage: Understanding participation of children with developmental coordination disorder. *Human Movement Science, 22*(4-5), 583-595.

Martin, N. C., Piek, J., Baynam, G., Levy, F., & Hay, D. (2010). An examination of the relationship between movement problems and four common developmental disorders. *Human Movement Science, 29*(5), 799-808.

Martin, N. C., Piek, J. P., & Hay, D. (2006). DCD and ADHD: A genetic study of their shared aetiology. *Human Movement Science, 25*(1), 110-124.

Maruff, P., Wilson, P., Trebilcock, M., & Currie, J. (1999). Abnormalities of imagined motor sequences in children with developmental coordination disorder. *Neuropsychologia, 37*(11), 1317-1324.

Mayson, T. A., Harris, S. R., & Bachman, C. L. (2007). Gross motor development of Asian and European children on four motor assessments: a literature review. *Pediatric Physical Therapy, 19*(2), 148-153.

McCarron, L. T. (1997). *MAND McCarron Assessment of Neuromuscular Development: Fine and gross motor abilities (rev. ed.).* Dallas, TX: Common Market Press.

McPhillips, M., & Jordan-Black, J.-A. (2007a). The effect of social disadvantage on motor development in young children: a comparative study. *Journal of Child Psychology and Psychiatry, 48*(12), 1214-1222.

McPhillips, M., & Jordan-Black, J.-A. (2007b). Primary reflex persistence in children with reading difficulties (dyslexia): A cross-sectional study. *Neuropsychologia, 45*(4), 748-754.

Mei, J. (1994). The Northern Chinese custom of rearing babyies in sandbags: Implications for motor and intellectual development. In J. H. A. Van Rossum & J. I. Laszco (Eds.), *Motor Development: Aspects of Normal and Delay Development* (pp. 41-48). Amsterdam: VU University Press.

Miller, L., Missiuna, C., Macnab, J., Malloy-Miller, T., & Polatajko, H. (2001). Clinical description of children with developmental coordination disorder. *The Canadian Journal of Occupational Therapy, 68*(1), 5-15.

Ministry of Education. (2007). *Education Indicators in the State of Kuwait*. Kuwait: Ministry of Education.

Missiuna, C., Cairney, J., Pollock, N., Russell, D., Macdonald, K., Cousins, M., et al. (2011). A staged approach for identifying children with developmental coordination disorder from the population. *Research in Developmental Disabilities, In Press, Corrected Proof.*

Missiuna, C., Gaines, R., McLean, J., DeLaat, D., Egan, M., & Soucie, H. (2008). Description of children identified by physicians as having developmental coordination disorder. *Developmental Medicine & Child Neurology, 50*(11), 839-844.

Missiuna, C., Moll, S., King, G., Stewart, D., & Macdonald, K. (2008). Life experiences of young adults who have coordination difficulties. *The Canadian Journal of Occupational Therapy, 75*(3), 157-167.

Missiuna, C., Moll, S., Law, M., King, S., & King, G. (2006). Mysteries and mazes: Parents' experiences of children with developmental coordination disorder. *The Canadian Journal of Occupational Therapy, 73*(1), 7-17.

Missiuna, C., Pollock, N., Egan, M., DeLaat, D., Gaines, R., & Soucie, H. (2008). Enabling occupation through facilitating the diagnosis of developmental coordination disorder. *Canadian journal of occupational therapy, 75*(1), 26-34.

Missiuna, C., Rivard, L., & Bartlett, D. (2003). Early Identification and Risk Management of Children with Developmental Coordination Disorder. *Pediatric Physical Therapy Spring, 15*(1), 32-38.

Missiuna, C., Rivard, L., & Bartlett, D. (2006). Exploring Assessment Tools and the Target of Intervention for Children with Developmental Coordination Disorder. *Physical & Occupational Therapy in Pediatrics, 26*(1), 71-89.

Miyahara, M., & Möbs, I. (1995). Developmental dyspraxia and developmental coordination disorder *Neuropsychology Review 5*(4), 245-268.

Miyahara, M., & Piek, J. (2006). Self-Esteem of Children and Adolescents with Physical Disabilities: Quantitative Evidence from Meta-Analysis. *Journal of Developmental and Physical Disabilities, 18*(3), 219-234.

Miyahara, M., & Register, C. (2000). Perceptions of three terms to describe physical awkwardness in children. *Research in Developmental Disabilities, 21*(5), 367-376.

Miyahara, M., Tsujii, M., Hanai, T., Jongmans, M., Barnett, A., Henderson, S., et al. (1998). The Movement Assessment Battery for Children: A preliminary investigation of its usefulness in Japan. *Human Movement Science, 17*(4-5), 679-697.

Miyahara, M., Tsujii, M., Hori, M., Nakanishi, K., Kageyama, H., & Sugiyama, T. (1997). Brief Report: Motor Incoordination in Children with Asperger Syndrome and Learning Disabilities. *Journal of Autism and Developmental Disorders, 27*(5), 595-603.

MSS, P., Magalhães, L., & Wilson, B. (2009). Cross-cultural adaptation of the Developmental Coordination Disorder Questionnaire for brazilian children. *Brazilian Physical Therapy, 13*(3), 236-243.

Niemeijer, A., Schoemaker, M., & Smits-Engelsman, B. (2006). Are teaching principles associated with improved motor performance in children with developmental coordination disorder? A pilot study. *Physical Therapy, 86*(9), 1221-1230.

Niemeijer, A., Smits-Engelsman, B., & Schoemaker, M. (2007). Neuromotor task training for children with developmental coordination disorder: a controlled trial. *Developmental Medicine and Child Neurology, 49*(6), 406.

Nolan, L., Grigorenko, A., & Thorstensson, A. (2005). Balance control: sex and age differences in 9- to 16-year-olds. *Developmental Medicine and Child Neurology, 47*(7), 449.

O'Brien, J. C., Williams, H. G., Bundy, A., Lyons, J., & Mittal, A. (2008). Mechanisms that underlie coordination in children with developmental coordination disorder. *Journal of Motor Behavior, 40*(1), 43-61.

O'Hare, A., & Shabana, K. (2002). The association of abnormal cerebellar function in children with developmental coordination disorder and reading difficulties. *Dyslexia, 8*(4), 234-248.

Pangelinan, M. M., Zhang, G., VanMeter, J. W., Clark, J. E., Hatfield, B. D., & Haufler, A. J. (2011). Beyond age and gender: Relationships between cortical and subcortical brain volume and cognitive-motor abilities in school-age children. *NeuroImage*, *54*(4), 3093-3100.

Pauc, R. (2005). Comorbidity of dyslexia, dyspraxia, attention deficit disorder (ADD), attention deficit hyperactive disorder (ADHD), obsessive compulsive disorder (OCD) and Tourette's syndrome in children: A prospective epidemiological study. *Clinical Chiropractic, 8*(4), 189-198.

Pearsall-Jones, J., Piek, J., Martin, N., Rigoli, D., Levy, F., & Hay, D. (2008). A monozygotic twin design to investigate etiological factors for DCD and ADHD. *Journal of Pediatric Neurology, 6*(3), 209.

Pearsall-Jones, J., Piek, J. P., & Levy, F. (2010). Developmental Coordination Disorder and cerebral palsy: Categories or a continuum? *Human Movement Science*, *29*(5), 787-798.

Pearsall-Jones, J., Piek, J. P., Rigoli, D., Martin, N. C., & Levy, F. (2009). An investigation into etiological pathways of DCD and ADHD using a monozygotic twin design. *Twin Research and Human Genetics, 12*(4), pp.

Perneger, T. V. (1998). What's wrong with Bonferroni adjustments. *BMJ, 316*(7139), 1236-1238.

Peters, J., Barnett, A., & Henderson, S. (2001). Clumsiness, dyspraxia and Developmental Co-ordination Disorder: How do health and educational professionals in the UK define the terms? *Child: Care, Health and Development, 27*(5), 399-412.

Piek, J. P., Bradbury, G. S., Elsley, S. C., & Tate, L. (2008). Motor Coordination and Social–Emotional Behaviour in Preschool-aged Children. *International Journal of Disability, Development and Education, 55*(2), 143 - 151.

Piek, J. P., Dworcan, M., Barrett, N. C., & Coleman, R. (2000). Determinants of self-worth in children with and without developmental coordination disorder. *International Journal of Disability, Development and Education, 47*(3), 259-272.

Piek, J. P., & Dyck, M. J. (2004). Sensory-motor deficits in children with developmental coordination disorder, attention deficit hyperactivity disorder and autistic disorder. *Human Movement Science, 23*(3-4), 475-488.

Piek, J. P., Dyck, M. J., Francis, M., & Conwell, A. (2007). Working memory, processing speed, and set-shifting in children with developmental coordination disorder and attention-deficit-hyperactivity disorder. *Developmental Medicine & Child Neurology, 49*(9), 678-683.

Piek, J. P., Dyck, M. J., Nieman, A., Anderson, M., Hay, D., Smith, L. M., et al. (2004). The relationship between motor coordination, executive functioning and attention in school aged children. *Archives of Clinical Neuropsychology, 19*(8), 1063-1076.

Piek, J. P., & Edwards, K. (1997). The identification of children with developmental coordination disorder by class and physical education teachers. *British Journal of Educational Psychology, 67*(1), 55-67.

Piek, J. P., Gasson, N., Barrett, N., & Case, I. (2002). Limb and gender differences in the development of coordination in early infancy. *Human Movement Science, 21*(5-6), 621-639.

Piek, J. P., Pitcher, T. M., & Hay, D. A. (1999). Motor coordination and kinaesthesis in boys with attention deficit-hyperactivity disorder. *Developmental Medicine & Child Neurology, 41*(3), 159-165.

Piek, J. P., Rigoli, D., Pearsall-Jones, J. G., Martin, N. C., Hay, D. A., Bennett, K. S., et al. (2007). Depressive symptomatology in child and adolescent twins with attention-deficit hyperactivity disorder and/or developmental coordination disorder. *Twin Research and Human Genetics, 10*(4), 587-596.

Piek, J. P., & Skinner, R. A. (1999). Timing and force control during a sequential tapping task in children with and without motor coordination problems. *Journal of the International Neuropsychological Society, 5*(4), 320-329.

Pitcher, T. M., Piek, J. P., & Hay, D. A. (2003). Fine and gross motor ability in males with ADHD. *Developmental Medicine and Child Neurology, 45*(8), 525.

Polatajko, H. J., & Cantin, N. (2006). Developmental Coordination Disorder (Dyspraxia): An Overview of the State of the Art. *Seminars in Pediatric Neurology, 12*(4), 250-258.

Poulsen, A. A., & Ziviani, J. M. (2004). Can I play too? Physical activity engagement of children with developmental coordination disorders. *Canadian journal of occupational therapy, 71*(2), 100-107.

Poulsen, A. A., Ziviani, J. M., Cuskelly, M., & Smith, R. (2007). Boys With Developmental Coordination Disorder: Loneliness and Team Sports Participation. *The American Journal of Occupational Therapy, 61*(4), 451-462.

Querne, L., Berquin, P., Vernier-Hauvette, M.-P., Fall, S., Deltour, L., Meyer, M.-E., et al. (2008). Dysfunction of the attentional brain network in children with developmental coordination disorder: A fMRI study. *Brain Research, 1244*, 89-102.

Rˆsblad, B., & Gard, L. (1998). The assessment of children with Developmental Coordination Disorders in Sweden: A preliminary investigation of the suitability of the Movement ABC. *Human Movement Science, 17*(4-5), 711-719.

Rasmussen, P., & Gillberg, C. (2000). Natural outcome of ADHD with developmental coordination disorder at age 22 years: A controlled, longitudinal, community-based study. *Journal of the American Academy of Child and Adolescent Psychiatry, 39*(11), 1424.

Rawlings, J. S., Rawlings, V. B., & Read, J. A. (1995). Prevalence of Low Birth Weight and Preterm Delivery in Relation to the Interval between Pregnancies among White and Black Women. *New England Journal of Medicine, 332*(2), 69-74.

Rechetnikov, R., & Maitra, K. (2009). Motor Impairments in Children Associated With Impairments of Speech or Language: A Meta-Analytic Review of Research Literature. *The American Journal of Occupational Therapy, 63*(3), 255.

Reid, V., Stahl, D., & Striano, T. (2010). The presence or absence of older siblings and variation in infant goal-directed motor development. [Journal Articles]. *International Journal of Behavioral Development, 34*(4), 325-329.

Roberts, G., Anderson, P., Davis, N., De Luca, C., Cheong, J., & Doyle, L. (2011). Developmental coordination disorder in geographic cohorts of 8-year-old children born extremely preterm or extremely low birthweight in the 1990s. *Developmental Medicine and Child Neurology, 53*(1), 55.

Rodger, S., Ziviani, J., Watter, P., Ozanne, A., Woodyatt, G., & Springfield, E. (2003). Motor and functional skills of children with developmental coordination disorder: A pilot investigation of measurement issues. *Human Movement Science, 22*(4-5), 461-478.

Rosenblum, S. (2006). The development and standardization of the Children Activity Scales (ChAS-P/T) for the early identification of children with Developmental Coordination Disorders. *Child: Care, Health and Development, 32*(6), 619-632.

Sanhueza, D. A. (2006). Psychomotor development, environmental stimulation, and socioeconomic level of preschoolers in Temuco, Chile. *Pediatric physical therapy*, *18*(2), 141-147.

Scabar, A., Devescovi, R., Blason, L., Bravar, L., & Carrozzi, M. (2006). Comorbidity of DCD and SLI: significance of epileptiform activity during sleep. *Child: Care, Health and Development, 32*(6), 733-739.

Schoemaker, M., Flapper, B., Reinders-Messelink, H., & Kloet, A. d. (2008). Validity of the motor observation questionnaire for teachers as a screening instrument for children at risk for developmental coordination disorder. *Human Movement Science, In Press, Corrected Proof*.

Schoemaker, M., Flapper, B., Verheij, N., Wilson, B., Reinders-Messelink, H., & de Kloet, A. (2006). Evaluation of the Developmental Coordination Disorder Questionnaire as a screening instrument. *Developmental medicine and child neurology, 48*(8), 668-673.

Schoemaker, M., & Kalverboer, A. (1994). Social and affective problems of children who are clumsy: How early do they begin? *Adapted Physical Activity quarterly, 11*(2), 130-140.

Schoemaker, M., Smits-Engelsman, B., & Jongmans, M. (2003). Psychometric properties of the Movement Assessment Battery for Children-Checklist as a screening instrument for children with a developmental co-ordination disorder. *British Journal of Educational Psychology, 73*, 425.

Shumway-Cook, A., & Woollacott, M. H. (2001). *Motor control : theory and practical applications* (2nd ed.). Philadelphia, Pa.: Lippincott Williams & Wilkins.

Sigmundsson, H., Hansen, P., & Talcott, J. (2003). Do 'clumsy' children have visual deficits. *Behavioural Brain Research*, *139*(1-2), 123-129.

Sigmundsson, H., Pedersen, A., Whiting, H., & Ingvaldsen, R. (1998). We can cure your child's clumsiness! A review of intervention methods. [Comparative Study Review]. *Scandinavian Journal of Rehabilitation Medicine, 30*(2), 101-106.

Sigmundsson, H., & Rostoft, M. S. (2003). Motor Development: Exploring the motor competence of 4-year-old Norwegian children. *Scandinavian Journal of Educational Research, 47*(4), 451 - 459.

Sigurdsson, E., van Os, J., & Fombonne, E. (2002). Are impaired childhood motor skills a risk factor for adolescent anxiety? Results from the 1958 U.K. Birth Cohort and the National Child Development Study. *The American Journal of Psychiatry, 159*(6), 1044-1046.

Skinner, R. A., & Piek, J. P. (2001). Psychosocial implications of poor motor coordination in children and adolescents. *Human Movement Science, 20*(1-2), 73-94.

Smits-Engelsman, B., Fiers, M., Henderson, S., & Henderson, L. (2008). Interrater reliability of the Movement Assessment Battery for Children. *Physical Therapy, 88*(2), 286-294.

Smits-Engelsman, B., Henderson, S., & Michels, C. (1998). The assessment of children with Developmental Coordination Disorders in the Netherlands: The relationship between the Movement Assessment Battery for Children and the Kˆrperkoordinations Test f¸r Kinder. *Human Movement Science*, *17*(4-5), 699-709.

Smyth, R. T., & Glencross, D. J. (1986). Information processing deficits in clumsy children. *Australian Journal of Psychology, 38*(1), 13 - 22.

Sugden, D., & Chambers, M. (2007). Stability and change in children with developmental coordination disorder. [Journal Peer Reviewed Journal]. *Child: Care, Health and Development, 33*(5), 520-528.

Sugden, D., Kirby, A., & Dunford, C. (2008). Issues surrounding children with developmental coordination disorder. *International Journal of Disability, Development and Education, 55*(2), 173-187.

Sundermier, L., Woollacott, M., Roncesvalles, N., & Jensen, J. (2001). The development of balance control in children: comparisons of EMG and kinetic variables and chronological and developmental groupings. *Experimental Brain Research 136*(3), 340-350.

Super, C. M. (1976). Environmental Effects on Motor Development: the Case of 'African Infant Precocity'. *Developmental Medicine & Child Neurology, 18*(5), 561-567.

Thomas, J. R., & French, K. E. (1985). Gender Differences Across Age in Motor Performance: A Meta-Analysis. *Psychological Bulletin, 98*(2), 260-282.

Thomas, J. R., Nelson, J. K., & Church, G. (1991). A Developmental Analysis of Gender Differences in Health Related Physical Fitness. *Pediatric Exercise Science, 3*(1), 28-42.

Tieman, B. L., Palisano, R. J., & Sutlive, A. C. (2005). Assessment of motor development and function in preschool children. *Mental Retardation and Developmental Disabilities Research Reviews, 11*(3), 189-196.

Tiemeier, H., Lenroot, R. K., Greenstein, D. K., Tran, L., Pierson, R., & Giedd, J. N. (2010). Cerebellum development during childhood and adolescence: A longitudinal morphometric MRI study. *NeuroImage, 49*(1), 63-70.

To, T., Cadarette, S. M., & Liu, Y. (2001). Biological, social, and environmental correlates of preschool development. *Child: Care, Health and Development, 27*(2), 187-200.

Tsai, C.-L., Pan, C. Y., Cherng, R. J., & Wu, S. K. (2009). Dual-task study of cognitive and postural interference: a preliminary investigation of the automatization deficit hypothesis of developmental co-ordination disorder. *Child: Care, Health & Development, 35*(4), 551-560.

Tsai, C.-L., Wu, S. K., & Huang, C.-H. (2008). Static balance in children with developmental coordination disorder. *Human Movement Science, 27*(1), 142-153.

Tseng, M.-H., Fu, C.-P., Wilson, B., & Hu, F.-C. (2010). Psychometric properties of a Chinese version of the Developmental Coordination Disorder Questionnaire in community-based children. *Research in Developmental Disabilities, 31*(1), 33-45.

Tseng, M.-H., Howe, T.-H., Chuang, I. C., & Hsieh, C.-L. (2007). Cooccurrence of problems in activity level, attention, psychosocial adjustment, reading and writing in children with developmental coordination disorder. *International Journal of Rehabilitation Research, 30*(4), 327-332.

Tsiotra, G. D., Flouris, A. D., Koutedakis, Y., Faught, B. E., Nevill, A. M., Lane, A. M., et al. (2006). A Comparison of Developmental Coordination Disorder Prevalence Rates in Canadian and Greek Children. *Journal of Adolescent Health, 39*(1), 125-127.

Valero de Bernabé, J., Soriano, T., Albaladejo, R., Juarranz, M., Calle, M. E., Martínez, D., et al. (2004). Risk factors for low birth weight: a review. *European Journal of Obstetrics & Gynecology and Reproductive Biology, 116*(1), 3-15.

van Beurden, E., Zask, A., Barnett, L. M., & Dietrich, U. C. (2002). Fundamental movement skills -- How do primary school children perform? The [`]Move it Groove it' program in rural Australia. *Journal of Science and Medicine in Sport, 5*(3), 244-252.

van Dellen, T., & Geuze, R. H. (1988). Motor response processing in clumsy CHILDREN. *Journal of Child Psychology and Psychiatry, 29*(4), 489-500.

Van Waelvelde, H., De Weerdt, W., De Cock, P., & Smits-Engelsman, B. (2004). Aspects of the validity of the Movement Assessment Battery for Children. *Human Movement Science, 23*(1), 49-60.

Van Waelvelde, H., Peersman, W., Lenoir, M., Engelsman, B., & Henderson, S. (2008). The Movement Assessment Battery for Children: similarities and differences between 4- and 5-year-old children from Flanders and the United States. *Pediatric Physical Therapy, 20*(1), 30-38.

Van Waelvelde, H., Peersman, W., Lenoir, M., & Smits Engelsman, B. (2007). The reliability of the Movement Assessment Battery for Children for preschool children with mild to moderate motor impairment. *Clinical Rehabilitation, 21*(5), 465-470.

Venetsanou, F., & Kambas, A. (2010). Environmental Factors Affecting Preschoolers' Motor Development. *Early Childhood Education Journal, 37*(4), 319-327.

Venetsanou, F., Kambas, A., Ellinoudis, T., Fatouros, I., & Giannakidou, D. (2011). Can the Movement Assessment Battery for Children-Test be the "gold standard" for the motor assessment of children with Developmental Coordination Disorder? *Research in Developmental Disabilities, In Press, Corrected Proof.*

Viholainen, H. H., Ahonen, T. T., Lyytinen, P. P., Cantell, M. M., Tolvanen, A. A., & Lyytinen, H. H. (2006). Early motor development and later language and reading skills in children at risk of familial dyslexia. *Developmental medicine and child neurology, 48*(5), 367-373.

Visscher, C., Houwen, S., Scherder, E. J. A., Moolenaar, B., & Hartman, E. (2007). Motor Profile of Children With Developmental Speech and Language Disorders. *Pediatrics, 120* (1), e158-e163

Visser, J. (2003). Developmental coordination disorder: a review of research on subtypes and comorbidities. *Human Movement Science, 22*(4-5), 479-493.

Visser, J., Geuze, R. H., & Kalverboer, A. F. (1998). The relationship between physical growth, the level of activity and the development of motor skills in adolescence: Differences between children with DCD and controls. *Human Movement Science, 17*(4-5), 573-608.

Volman, M., van Schendel, B. M., & Jongmans, M. J. (2006). Handwriting Difficulties in Primary School Children: A Search for Underlying Mechanisms. *American Journal of Occupational Therapy, 60*(4), 451-460.

Wagner, M., Kastner, J., Petermann, F., & Bös, K. (2011). Factorial validity of the Movement Assessment Battery for Children-2 (age band 2). *Research in Developmental Disabilities, 32*(2), 674-680.

Wang, T.-n., Tseng, M.-h., Wilson, B., & Hu, F.-C. (2009). Functional performance of children with developmental coordination disorder at home and at school. *Developmental Medicine and Child Neurology, 51*(10), 817.

Wann, J. P., Mon-Williams, M., & Rushton, K. (1998). Postural control and co-ordination disorders: The swinging room revisited. *Human Movement Science, 17*(4-5), 491-513.

Watemberg, N. M., Waiserberg, N. P., Zuk, L. P., & Lerman-Sagie, T. M. (2007). Developmental coordination disorder in children with attention-deficit-hyperactivity disorder and physical therapy intervention. *Developmental Medicine and Child Neurology, 49*(12), 920.

Watson, N. V., & Kimura, D. (1991). Nontrivial sex differences in throwing and intercepting: Relation to psychometrically-defined spatial functions. *Personality and Individual Differences, 12*(5), 375-385.

WHO. (1992). *The ICD-10 classification of mental and behavioural disorders : clinical descriptions and diagnostic guidelines. World Health Organization*. Geneva World Health Organization.

WHO Multicentre Growth Reference Study, G., & de Onis, M. (2006a). Assessment of sex differences and heterogeneity in motor milestone attainment among populations in the WHO Multicentre Growth Reference Study. *Acta Pædiatrica, 95*, 66-75.

WHO Multicentre Growth Reference Study, G., & de Onis, M. (2006b). WHO Motor Development Study: Windows of achievement for six gross motor development milestones. *Acta Pædiatrica, 95*, 86-95.

Wilson, B., Crawford, S., Green, D., Roberts, G., Aylott, A., & Kaplan, B. (2009). Psychometric properties of the revised Developmental Coordination Disorder Questionnaire. *Physical & Occupational Therapy in Pediatrics, 29*(2), 184-204.

Wilson, B., Crawford, S., Roberts, G., & Kaplan, B. (2006). *Further validation and revision of the developmental coordination disorder questionnaire.* Calgry, Alberta: University of Calgary and Calgary Health Region.

Wilson, B., Kaplan, B., Crawford, S., Campbell, A., & Dewey, D. (2000). Reliability and validity of a parent questionnaire on childhood motor skills. *American Journal of Occupational Therapy, 54*(5), 484-493.

Wilson, P. (2005). Practitioner Review: Approaches to assessment and treatment of children with DCD: an evaluative review. *Journal of Child Psychology and Psychiatry, 46*(8), 806-823.

Wilson, P., Maruff, P., Butson, M., Williams, J., Lum, J., & Thomas, P. (2004). Internal representation of movement in children with developmental coordination disorder: A mental rotation task. *Developmental Medicine & Child Neurology, 46*(11), 754-759.

Wingate, M. S., Alexander, G. R., Buekens, P., & Vahratian, A. (2007). Comparison of Gestational Age Classifications: Date of Last Menstrual Period vs. Clinical Estimate. *Annals of Epidemiology, 17*(6), 425-430.

Wisdom, S. N., Dyck, M. J., Piek, J. P., Hay, D., & Hallmayer, J. (2007). Can autism, language and coordination disorders be differentiated based on ability profiles? *European Child & Adolescent Psychiatry, 16*(3), 178-186.

World Health Organization. Management of substance abuse: Process of translation and adaptation of instruments. from http://www.who.int/substance_abuse/research_tools/translation/en/

Wright, H. C., & Sugden, D. A. (1996). A two-step procedure for the identification of children with developmental co-ordination disorder in Singapore. *Developmental Medicine & Child Neurology, 38*(12), 1099-1105.

Zoia, S., Barnett, A., Wilson, P., & Hill, E. (2006). Developmental Coordination Disorder: current issues. *Child: Care, Health and Development, 32*(6), 613-618.

12 Appendix A: Pictures of the State of Kuwait

The Amir of Kuwait Sheikh Sabah Al-Ahmad Al-Sabah

Crown Prince Sheikh Nawaf Al-Ahmad Al-Sabah

The Prime Minister Sheikh Nasser Al-Sabah

The location of Kuwait in the World map

Kuwait flag consists of four colours

Al-Seef Palace; building of the Ministry of Foreigner Affairs

Kuwait Towers

The Parliament Building

Participation of women as a parliament Member

Shopping Mole Souk Sharq

13 Appendices B: The Ethics Forms and their Arabic Translations

13.1 Ethics Approval

memorandum

Curtin University of Technology

Office of Research and Development

Human Research Ethics Committee

TELEPHONE 9266 2784
FACSIMILE 9266 3793
EMAIL hrec@curtin.edu.au

To	Professor Jan Piek, Physiotherapy
From	A/Professor Stephan Millett, Chair, Human Research Ethics Committee
Subject	Protocol Approval **HR 107/2008**
Date	10 September 2008
Copy	Suad ALAnzi & Lynn Jenson Graduate Studies Officer, Faculty of Physiotherapy

Thank you for your application submitted to the Human Research Ethics Committee (HREC) for the project titled "*The indentification of developments coordination disorder in primary school-aged Kuwaiti children*". Your application has been reviewed by the HREC and is **approved**.

- You are authorised to commence your research as stated in your proposal.
- The approval number for your project is **HR 107/2008.** *Please quote this number in any future correspondence.*
- Approval of this project is for a period of twelve months **02-09-2008** to **02-09-2009**. To renew this approval a completed Form B (attached) must be submitted before the expiry date **02-09-2009**.
- If you are a Higher Degree by Research student, data collection must not begin before your Application for Candidacy is approved by your Divisional Graduate Studies Committee.
- The following standard statement **must be** included in the information sheet to participants:

  This study has been approved by the Curtin University Human Research Ethics Committee (Approval Number HR 107/2008). The Committee is comprised of members of the public, academics, lawyers, doctors and pastoral carers. Its main role is to protect participants. If needed, verification of approval can be obtained either by writing to the Curtin University Human Research Ethics Committee, c/- Office of Research and Development, Curtin University of Technology, GPO Box U1987, Perth, 6845 or by telephoning 9266 2784 or by emailing hrec@curtin.edu.au.

Applicants should note the following:

It is the policy of the HREC to conduct random audits on a percentage of approved projects. These audits may be conducted at any time after the project starts. In cases where the HREC considers that there may be a risk of adverse events, or where participants may be especially vulnerable, the HREC may request the chief investigator to provide an outcomes report, including information on follow-up of participants.

The attached **FORM B** should be completed and returned to the Secretary, HREC, C/- Office of Research & Development:
When the project has finished, or

- If at any time during the twelve months changes/amendments occur, or
- If a serious or unexpected adverse event occurs, or
- 14 days prior to the expiry date if renewal is required.
- An application for renewal may be made with a Form B three years running, after which a new application form (Form A), providing comprehensive details, must be submitted.

Regards,

pp

A/Professor Stephan Millett
Chair
Human Research Ethics Committee

13.2 The Information sheet for parents- English version

Subject Information Sheet

Curtin University of Technology
School of Physiotherapy

Title: Identification of developmental coordination disorder in primary school-aged Kuwaiti children.

Thank you for your interest to support this research

Physiotherapy Investigator: Suad ALAnzi tel: (965) 6671070

Email: suadef@hotmail.com

Supervisor: Prof. Jan Piek el: +61 8 9266 7990 (School of Psychology)

Email: j.piek@curtin.edu.au

Co-supervisor: Mrs Lynn Jensen tel: 61 8 9266 340 (School of Physiotherapy) Email: L.Jensen@curtin.edu.au

Background Information:

Developmental Coordination Disorder (DCD) is a condition that affects a child's ability to move efficiently and to look coordinated while moving. Some children who do not have well coordinated movement have difficulty getting dressed, playing with other children and reading or writing. The condition is well documented in the medical, allied health, psychological and educational literature with studies conducted in diverse ethnic and cultural populations, yet it is not well understood in Kuwait for several reasons. Firstly, the disorder is labeled with different terminology. Secondly, children with DCD are usually referred to physiotherapy clinics only if they have serious problems that interfere with their ability to move (physical problems), and it is considered as a medical condition in need of medical intervention. Thirdly, parents and teachers may be unaware of the children's difficulties and think it is just misbehaving or that children will grow out of it.

The aim of this study is to determine how many children in Kuwait have DCD and whether parents can identify their child's movement ability.

The results of this study are significant for Kuwaiti children, their parents and professionals in the health and educational sectors so that children with DCD can receive adequate services to improve their impairments, reduce their activity limitations and encourage their participation in the community.

Procedure:

You and your child are being asked to participate in the study. If you agree to participate you are required to provide formal written consent to allow your child to be examined by the investigator and that you will complete a parent questionnaire which asks questions about your child's ability.

I will contact your child's school to arrange a time to test your child's movement ability. Your child will be requested to wear sport clothes and sport shoes to be comfortable during the examination. Your child will be asked to do eight items of three different types of tests: 3 items for fine motor skills; 2 items for catching and throwing a beanbag/ball; 3 items for balance. Your child will be given a demonstration and explanation of each test item and given one practice of the item. Then your child will be asked to perform the item twice. A score will be given for each performance. The complete test will take 30-45 minutes.

The DCD-Q is designed for parents to report their child's performance in everyday function activities to assist in identification of DCD. Parents compare their children's performance with their peers' performance. The new version (2007) is designed for children aged 5 -15 years and has 15 questions divided into three categories: "Control during Movement" which measures the motor control while the child or the object is in motion; "Fine Motor and Handwriting" which measures the ability to control fine movement during writing and cutting objects; "General Coordination" which measures general ability to control the movement.

The Human Research Ethics Committee of Curtin University has given approval for this study with reference number (XXXX). You are free to withdraw at any time without prejudice. All information is confidential and you and your child will not be identifiable in the results or reports from this study. There will be no cost incurred by you for participating in the study. The information gained from the study will be the property of the School of Physiotherapy, Curtin University of Technology, Western Australia. It will be stored securely in the School of Physiotherapy for five years and only accessible to investigator and supervisors.

There are no risks associated with this study for you or your child. The test items are what children do on a regular basis.

Your participation in the study will allow physiotherapists to further understand DCD in Kuwaiti children and provide further services for children to minimize their difficulties. If you would like a report of your child's movement ability please contact the investigator.

Ms Suad ALAnzi will be happy to answer any queries that you might have about the questionnaire and the child examination to be used in the study.

Mobile: 6671070

Email: suadef@hotmail.com

13.3 The Arabic Translation of the Information sheet for parents

<u>الملحق الأول</u>

<u>ورقة معلومات للمشاركين في البحث</u>

عنوان البحث:

<u>تعريف اضطراب التنسيق التطوري لدى التلاميذ في المدارس الابتدائية الكويتية</u>

شكرا لكم على مساندتكم لنا في هذا البحث

اسم الباحث: سعاد العنزي تلفون 6671070 (965)

البريد الإلكتروني: suadef@hotmail.com

المشرف: برفيسور جان بيك : تلفون 7990 9266 8 61+ (School of Psychology)

البريد الالكتروني: j.piek@curtin.edu.au

المشرف المساعد:

لين جنسن: تلفون 3409 9266 8 61 + (School of Physiotherapy)

البريد الإلكتروني: L..Jensen@curtin.edu.au

<u>نبذة عن المادة العلمية لموضوع البحث</u>

اضطراب التنسيق التطوري هو حالة تأثر على قدرة الطفل على الحركة بكفاءة وبصورة متزنة ومنسقة أثناء الحركة والتنقل. يجد بعض الأطفال الذين يعانون من اضطراب في التنسيق الحركي صعوبة في ارتداء ملابسهم، اللعب مع الأطفال، وكذلك يجدون صعوبة في القراءة والكتابة. وهذه الحالات موثقة جيداً في البحث العلمي في التخصصات الطبية والطبية المساعدة وعلم النفس والأبحاث التعليمية حيث اجريت الأبحاث العلمية في بيئات مختلفة وعلى عدة مجتمعات عرقية مختلفة، إلا إنها ليست معرفة بصورة جيدة في الكويت وذلك لعدة أسباب منها أن هذه الحالات تعرف بأسماء مختلفة. كما أن الأطفال الذين يعانون من هذه الحالة لا يتم تحويلهم للعلاج الطبيعي إلا إذا كانوا يعانون من مشاكل شديدة كعدم القدرة على الحركة مطلقاً و التي تعتبر مشكلة طبية تحتاج لتدخل طبي علاجي. ومن أحد

الأسباب أيضا هو أن أولياء الأمور والمدرسين لا يعون للمشاكل التي يعاني منها الأطفال ويعتقدون أن الأطفال يسيئون التصرف أو أنهم سوف يتجاوزون هذه المشاكل مع تقادم العمر.

الهدف من هذا البحث هو تحديد عدد الأطفال في الكويت الذين يعانون من هذه الحالة المرضية، كما يهدف البحث على معرفة فيما إذا كان أولياء الأمور لديهم القدرة على تقييم قدرة أطفالهم الحركية.

نتائج هذا البحث مهمة وذات معنى بالنسبة للأطفال في الكويت ولذويهم وللمختصين في القطاع الصحي والقطاع التعليمي على حد سواء بحيث أن الأطفال الذين يعانون من هذه الحالة سوف يقدم لهم الخدمات الطبية المناسبة والتي تعالج مشاكلهم وتقلل من العوائق والعقبات وتساعدهم على المشاركة والانخراط في المجتمع.

طريقة البحث:

أنت وطفلك مدعوون للمشاركة في هذا البحث. إذا كنت موافق/موافقة على المشاركة في هذا البحث فالمطلوب منك أن تزودنا بموافقة خطية تسمح لنا (الباحث) بفحص الطفل واختبار قدراته الحركية، كما يتطلب منك أن تكمل/تكملي الإجابة على أسئلة الإستبيان و الذي يحتوي على أسئلة خاصة بقدرات الطفل.

سوف أقوم بزيارة مدرسة الطفل لتنسيق موعد محدد لإختبار قدرات الطفل الحركية. ويتطلب من طفلك أن يلبس ملابس رياضية وحذاء رياضي حتى يتسنى له الحركة براحة وسهولة أثناء الإختبار. وسوف يطلب من طفلك القيام بعمل ٨ بنود من أصل ثلاثة أنواع من الاختبارات المتنوعة: ٣ بنود للمهارات الحركية الدقيقة، بندان لمهارات حذف و امساك الكرة، و٣ بنود لقياس الاتزان. سوف يُشرح للطفل طريقة عمل كل تمرين بالإضافة إلى تطبيق التمرين تجريبيا مرة واحدة ومن ثم تطبيق التمرين مرتين. وستقيم كلتا المحاولتين وترصد له أفضل محاولة. يستغرق الاختبار من ٣٠-٤٥ دقيقة.

أما بالنسبة للإستبيان فهو مصمم لأولياء الأمور لتقيد مهارات الطفل في الأنشطة اليومية للمساعدة على التعرف على اضطراب التنسيق التطوري. يقارن أولياء الأمور مهارات أطفالهم بمهارات أقرانهم. والطبعة المجدد لهذا الإستبيان (٢٠٠٧) صممت للأطفال من عمر ٥-١٥ سنة و تحتوي على ١٥ سؤال مقسمة إلى ثلاثة أقسام: قسم "تحكم الحركة" والتي تقيس تحكم الحركة أثناء تحرك الطفل أو الشيء. قسم "الحركة الدقيقة و الكتابة" والتي تقيس القدرة على التحكم في الحركات الدقيقة أثناء الكتابة و استخدام المقص في القطع. قسم "التنسيق العام" والتي تقيس القدرة العامة في التحكم في الحركة.

تمت الموافقة على هذا البحث من قبل مجلس أخلاقيات البحث في جامعة كيرتن مرجع رقم (×××). ولكم الحرية للانسحاب من البحث في وقت شئتم دون أدنى ضرر. جميع المعلومات المزودة لدينا ستعامل بسرية تامة كما أن اسمك واسم طفلك لا يدون في نتائج البحث أو في تقرير الدراسة. تعد جميع المعلومات ضمن ملكية جامعة كيرتن كلية العلوم الطبية قسم العلاج الطبيعي في غرب استراليا. وستحفظ بأمان في الكلية لمدة خمس سنوات لا يحق لأحد الحصول عليها عدا الباحث والمشرف على البحث.

لا توجد أي خطورة عليك مصاحبة لهذا البحث و لا على طفلك. جميع البنود هي في الأصل الحركات التي يقوم بها الطفل في حياته اليومية.

مشاركتم في البحث سوف يساعد إختصاصيي العلاج الطبيعي على معرفة الحالة بتعمق و من ثم تقديم خدمات أفضل للأطفال حتى يقلل من الصعوبات لديهم. و إذا وددتم بتقرير عن حالة طفلكم الرجاء الاتصال بالباحث.

ويسر الباحثة سعاد العنزي الإجابة على استفساراتكم سواء عن الاستبيان أو اختبار الطفل في هذا البحث.

تلفون: 6671070
Email: suadef@hotmail.com

13.4 The Consent form for Parent

Curtin University of Technology
School of Physiotherapy

Consent form for parents

Title: Identification of developmental coordination disorder in primary school-aged Kuwaiti children.

I have read the information regarding the study purpose and procedure. I understand I can withdraw at any time without prejudice and all information I provided in the questionnaire will be confidential. Therefore, I agree to participate in the study. I also agree to let my child participates in the study and being examined by the investigator as outlined to me.

Name of participant (please print): ______________________________

Name of the child:______________________________

Relationship:______________________________

Date:______________________________

Signature:______________________________

Investigator: Suad ALAnzi

Date:______________________________

Signature:______________________________

13.5 The Arabic Translation of the Consent form for Parent

شركة الكندي للترجمة المعتمدة والطباعة ذ.م.م.

AL-CANADY Translation & Typing Co. W.L.L.

الملحق الثاني:

موافقة خطية من أولياء أمور التلاميذ وأبناؤهم

عنوان البحث:

تعريف اضطراب التنسيق التطوري لدى التلاميذ في المدارس الابتدائية الكويتية

قد قرأت المعلومات المزودة مع هذا الكتاب والتي تتضمن أهداف البحث والطريقة المتبعة في البحث. أنا متيقن بأنه لدي الحق بالانسحاب من المشاركة في البحث في أي وقت كان دون ضرر، كما ان المعلومات التي قمت بتزويدها في الاستبيان سوف تعامل بسرية تامة. لذلك أوافق على المشاركة في هذا البحث وكذلك أوافق على مشاركة طفلي في البحث والسماح للباحث بفحص طفلي واختباره كما هو مبين لدي.

اسم المشارك (يطبع):-----------------------------------

اسم الطفل:-----------------------------------

صلة القرابة:-----------------------------------

التاريخ:-----------------------------------

التوقيع:-----------------------------------

الباحث: سعاد العنزي

التاريخ:-----------------------------------

التوقيع:-----------------------------------

هذه ترجمة صحيحة للنص المرفق باللغة الإنجليزية

Certified True and Correct Translation of The Attached Text in English

الكويت - حولي - شارع ابن خلدون الرئيسي - مجمع الغريب - مكتب رقم 6 - الدور الأرضي - تلفون: 2644355 - 2644350 (965+)
Kuwait - Hawalli - Ibn Khaldoon St. - Al-Gharib Commercial Complex - G.F. - Office 6 - Tel.: (+965) 2644350 - 2644355
E-mail: al-canady_translation@hotmail.com

13.6 The Consent form for Child

Curtin University of Technology
School of Physiotherapy

Child Consent form

I understand that I will play some movement and ball games with Ms Suad ALAnzi

I am happy to play the movement and ball games

I can stop playing the movement and ball games

I understand that I circle the smiling face if I agree to help in this project and circle the angry face if I do not want to help.

I agree to help with this project

I do not want to help

My name:

Signature:

Date:

Investigator name: Suad ALanzi

13.7 The Arabic Translation of the Consent form for Child

شركة الكندي
للترجمة المعتمدة والطباعة ذ.م.م.
AL-CANADY
Translation & Typing Co. W.L.L.

موافقة خطية للطفل

أنا أدرك بأني سوف ألعب بعض الحركات و ألعاب الكرة مع الأنسة سعاد العنزي

أنا موافق لمقتضى لعب الحركات و ألعاب الكرة

أنا أستطيع التوقف عن لعب و ألعاب الكرة

أنا أدرك أن أضع دائرة حول الوجه المبتسم إذا كنت موافق على المشاركة في هذا البحث و أضع دائرة حول الوجه الغاضب إذا لا أريد المشاركة.

أنا موافق على المشاركة في هذا البحث

أنا لا أريد المشاركة

إسمي: --

توقيع:--

التاريخ:--

الباحث: سعاد العنزي

التوقيع:-------------------------------

التاريخ:---

هذه ترجمة صحيحة للنص المرافق باللغة الانجليزية
Certified True and Correct Translation of The Attached Text in English
ZAK
8/9

الكويت – حولي – شارع ابن خلدون الرئيسي – مجمع الغريب – مكتب رقم 6 – الدور الأرضي – تلفون: 2644355 - 2644350 (965+)
Kuwait - Hawalli - Ibn Khaldoon St. - Al-Gharib Commercial Complex - G.F. - Office 6 - Tel.: (+965) 2644350 - 2644355
E-mail: al-canady_translation@hotmail.com

14 Appendices C: The Developmental Coordination Disorder Questionnaire ’07 and the Arabic Translation

14.1 The DCDQ'07 - English version

THE DEVELOPMENTAL COORDINATION DISORDER QUESTIONNAIRE 2007©
(DCDQ'07)

Wilson, BN, Kaplan, BJ, Crawford, SG, and Roberts, G
October 2007

Alberta Children's Hospital
Decision Support Research Team
2888 Shaganappi Trail NW
Calgary, Alberta, Canada T3B 6A8
www.calgaryhealthregion.ca/dsrt/dcdq.htm

DSRT   calgary health region   Alberta Children's HOSPITAL FOUNDATION   FACULTY OF MEDICINE | UNIVERSITY OF CALGARY

DSRT calgary health region Alberta Children's HOSPITAL FOUNDATION FACULTY OF MEDICINE | UNIVERSITY OF CALGARY

COORDINATION QUESTIONNAIRE (REVISED 2007)

	Year	Mon	Day
Name of Child: ____________ **Today's Date:**			
Person completing Questionnaire: ____________ **Birth Date:**			
Relationship to child: ____________ **Child's Age:**			

Most of the motor skills that this questionnaire asks about are things that your child does with his or her hands, or when moving.

A child's coordination may improve each year as they grow and develop. For this reason, it will be easier for you to answer the questions if you think about other children that you know who *are the same age as your child*.

Please compare the degree of coordination your child has with other children of the same age when answering the questions.

Circle the one number that best describes your child. If you change your answer and want to circle another number, please circle the correct response twice.

If you are unclear about the meaning of a question, or about how you would answer a question to best describe your child, please call____________ at ____________ for assistance.

Not at all like your child	**A bit like your child**	**Moderately like your child**	**Quite a bit like your child**	**Extremely like your child**
1	**2**	**3**	**4**	**5**

1. Your child *throws a ball* in a controlled and accurate fashion.

   1 2 3 4 5

2. Your child *catches* a small *ball* (e.g., tennis ball size) thrown from a distance of 6 to 8 feet (1.8 to 2.4 meters).

   1 2 3 4 5

3. Your child *hits* an approaching *ball* or *birdie* with a bat or racquet accurately.

   1 2 3 4 5

4. Your child *jumps* easily *over* obstacles found in garden or play environment.

   1 2 3 4 5

5. Your child *runs* as fast and in a *similar* way to other children of the same gender and age.

   1 2 3 4 5

6. If your child has a *plan* to do a motor *activity*, he/she can organize his/her body to follow the plan and effectively complete the task (e.g., building a cardboard or cushion "fort," moving on playground equipment, building a house or a structure with blocks, or using craft materials).

   1 2 3 4 5

(OVER)

Decision Support Research Team
Alberta Children's Hospital
2888 Shaganappi Trail NW, Calgary, AB, Canada T3B 6A8
www.calgaryhealthregion.ca/dsrt/dcdq.htm

	Not at all like your child 1	A bit like your child 2	Moderately like your child 3	Quite a bit like your child 4	Extremely like your child 5

7. Your child's printing or *writing* or drawing in class is *fast* enough to keep up with the rest of the children in the class.

1 2 3 4 5

8. Your child's printing or *writing* letters, numbers and words is *legible*, precise and accurate or, if your child is not yet printing, he or she *colors and draws* in a coordinated way and makes pictures that you can recognize.

1 2 3 4 5

9. Your child uses appropriate *effort* or tension when printing or writing or drawing (no excessive *pressure* or tightness of grasp on the pencil, writing is not too heavy or dark, or too light).

1 2 3 4 5

10. Your child *cuts* out pictures and *shapes* accurately and easily.

1 2 3 4 5

11. Your child is interested in and *likes* participating in *sports or active* games requiring good motor skills.

1 2 3 4 5

12. Your child learns *new motor tasks* (e.g., swimming, rollerblading) easily and does not require more practice or time than other children to achieve the same level of skill.

1 2 3 4 5

13. Your child is *quick and competent* in tidying up, putting on shoes, tying shoes, dressing, etc.

1 2 3 4 5

14. Your child would ***never*** be described as a *"bull in a china shop"* (that is, appears so clumsy that he or she might break fragile things in a small room).

1 2 3 4 5

15. Your child does ***not*** *fatigue easily* or appear to slouch and "fall out" of the chair if required to sit for long periods.

1 2 3 4 5

Thank you.

DSRT calgary health region Alberta Children's Hospital Foundation Faculty of Medicine | University of Calgary

Coordination Questionnaire (DCDQ'07): Score Sheet

Name: ______________________ **Date:** ______________

Birth Date: ______________________ **Age:** ______________

	Control During Movement	Fine Motor/ Handwriting	General Coordination
1. Throws ball			
2. Catches ball			
3. Hits ball/birdie			
4. Jumps over			
5. Runs			
6. Plans activity			
7. Writing fast			
8. Writing legibly			
9. Effort and pressure			
10. Cuts			
11. Likes sports			
12. Learning new skills			
13. Quick and competent			
14. "Bull in shop"			
15. Does not fatigue			

TOTAL ____ /30 Control during Movement + ____ /20 Fine Motor/ Handwriting + ____ /25 General Coordination = ____ /75 **TOTAL**

For Children Ages 5 years 0 months to 7 years 11 months
15-46 indication of DCD or suspect DCD
47-75 probably not DCD

For Children Ages 8 years 0 months to 9 years 11 months
15-55 indication of DCD or suspect DCD
56-75 probably not DCD

For Children Ages 10 years 0 months to 15 years
15-57 indication of DCD or suspect DCD
58-75 probably not DCD

Decision Support Research Team
2888 Shaganappi Trail NW, Calgary, AB, Canada T3B 6A8
www.calgaryhealthregion.ca/dsrt/dcdq.htm

14.2 The DCDQ'07 - Arabic translation

مؤسسة برايتون للدعاية والإعلان تليفاكس : ٢٦٣٣٣٤٣

استبيان عن اضطراب التنسيق التطوري (روجع في ٢٠٠٧)

اسم الطفل ______________

الشخص المنفذ للاستبيان ______________

صلة القرابة مع الطفل ______________

	يوم	شهر	سنة
تاريخ اليوم			
تاريخ الميلاد			
عمر الطفل			

معظم المهارات الحركية التي يستفسر عنها الاستبيان هي الأشياء التي يفعلها طفلك بواسطة يديه أو عند الحركة.
قد يتحسن التنسيق الحركي لدى الطفل كل عام مع النمو والتطور ، ولذلك السبب فقد يكون من السهل عليك أن تجيب على الأسئلة إذا فكرت في الأطفال الذين تعرفهم والذين هم في نفس عمر طفلك.
أرجو مقارنة درجة التنسيق الحركي لدى طفلك مقارنة بالأطفال الذين هم في نفس عمره عند الإجابة على الأسئلة
ضع دائرة حول الرقم الذي تجده أفضل يصف حالة طفلك ، إذا أردت تغيير إجابتك وعمل دائرة حول رقم آخر برجاء عمل دائرة مرتين حول الإجابة الصحيحة
إذا كنت غير متأكد من معنى السؤال أو عن كيفية الإجابة على السؤال بصورة أفضل لتصف طفلك ، برجاء الاتصال على ______________ عند ______________ للمساعدة

م	الأسئلة	لا يشبه طفلك أبدا ١	يشبه طفلك قليلا ٢	يشبه طفلك بدرجة متوسطة ٣	يشبه طفلك إلى حد كبير ٤	يشبه طفلك بشدة ٥
١	يقذف طفلك الكرة بتحكم وبشكل مضبوط					
٢	يلتقط طفلك الكرة الصغيرة (بحجم كرة التنس مثلاً) الملقاة من مسافة ٦ – ٨ قدم (١,٨ – ٢,٤ متر)					
٣	يضرب طفلك كرة متحركة أو يصدها بواسطة مضرب بشكل مضبوط.					
٤	يقفز طفلك بسهولة فوق الحواجز الموجودة في الحديقة أو أماكن اللعب.					

مؤسسة برايتون للدعاية والإعلان

حولي – شارع بن خلدون مقابل سوق الذهب – مجمع الملحم التجاري – الدور الارضي مكتب رقم { ٩ } ت : ٢٦٣٣٣٤٣

م	الأسئلة	لا يشبه طفلك أبدا ١	يشبه طفلك قليلا ٢	يشبه طفلك بدرجة متوسطة ٣	يشبه طفلك إلى حد كبير ٤	يشبه طفلك بشدة ٥
٥	يجري طفلك بنفس السرعة وبنفس الطريقة التي يجري بها الأطفال من هم في نفس سنه وجنسه					
٦	إذا عزم طفلك أن يعمل نشاط حركي فإنه ينظم وضع جسمه لتأدية النشاط الحركي الذي عزم على فعله وينجز هذه المهمة بنجاح (مثل بناء قلعة ، أو التنقل والتحرك على الأجهزة في الملعب ، أو بناء منزل أو مجسم باستخدام المكعبات ، أو استخدام المواد الفنية)					
٧	طباعة طفلك أو كتابته أو تلوينه سريعاً بصورة كافية تجعله يواصل مستوى بقية الأطفال في الفصل .					
٨	كتابة وطباعة طفلك للأحرف والأرقام والكلمات مقروءة ودقيقة ومضبوطة ، وإذا كان طفلك لا يستطيع الطباعة الآن فإنه يلون ويرسم بطريقة متوافقة ويعمل لوحة يمكنك أن تتعرف عليها					
٩	يستخدم طفلك مجهود أو شد مناسب عند الكتابة أو الطباعة أو الرسم (لا يوجد ضغط زائد أو تشنج في القبضة على القلم ، الكتابة ليست كثيفة جداً أو غامقة أو رقيقة جداً)					
١٠	يقص طفلك الصور والأشكال بطريقة مضبوطة وسهلة					
١١	طفلك مهتم ويحب المشاركة في الرياضة والألعاب النشاطية التي تحتاج مهارات حركية جيدة.					
١٢	يتعلم طفلك مهارات حركية جديدة (مثل العوم والتزحلق) بسهولة ولا يحتاج تدريب حركي كثير أو إلى وقت أكثر مما يحتاجه الأطفال الآخرين لإنجاز نفس المستوى من المهارة.					
١٣	طفلك سريع وقادر على ترتيب الأشياء وارتداء الأحذية وربط الأحذية وارتداء الملابس وخلافه .					

م	الأسئلة	لا يشبه طفلك أبدا ١	يشبه طفلك قليلا ٢	يشبه طفلك بدرجة متوسطة ٣	يشبه طفلك إلى حد كبير ٤	يشبه طفلك بشدة ٥
١٤	لا يمكن وصف طفلك وكأنه (ثور في محل صيني) (يعني أنه غير دقيق وقد يكسر الأشياء سهلة الكسر في غرفة صغيرة)					
١٥	لا يتعب طفلك بسهولة أو يبدو مترهلاً و " يسقط " من الكرسي إذا تطلب منه الأمر الجلوس لمدة طويلة..					

وشكراً

ب،ن ويلسون ٢٠٠٧

فريق قرار دعم البحث

مستشفى البرتا للأطفال

مؤسسة برايتون للدعاية والإعلان

14.3 The DCDQ'07 – Retranslation to English

BRITISH TRANSLATION CENTER مركز البريطاني للترجمة

Questionnaire of Developmental Coordination Disorder

(Reversed in 2007)

Child name: ---------------------------------------

Questionnaire executor: -------------------------

Relation with the child: -------------------------

	Day	Month	Year
Today Date			
Date of Birth			
Child Age			

Most motor skills which the questionnaire inquires about are those things which your child performs with his hands or at motion.

The coordination may improve each year because of growth and development, for this reason, it may be easy to answer these questions if you think in children you know who are in the same age of your child.

Please, compare the extent of coordination of your child and his mates at the same age when answering these questions.

Draw a circle around the number that you see it is describe your child. If you would like to change your answer and draw a circle around another number, please draw two circles around the right number.

If you uncertain from the meaning of the question or how to answer the question in a good way to describe your child, please contact on ------------------------- at ------------ for assistance.

الكويت - حولي - شارع ابن خلدون - مجمع الغريب - الدور الأرضي - مكتب رقم (١٥) تلفاكس : ٢٦٦٠٣٢٣
Kuwait - Hawally - Ibn Khaldoon Str. - Al-Ghareeb Comp. - Ground Floor - Office No. (15) - Telefax : 2660323

SL	Questions	Never similar to your child 1	Little similar to your child 2	Moderate similar to your child 3	Most similar to your child 4	Strong similar to your child 5
1	Your child throws ball controllably and accuratly					
2	Your child catches the thrown small ball (in the size of tennis ball) from 6-8 feet (1.8-2.4 m)					
3	Your child hits a movable ball or repels it by racket exactly					
4	Your child jumps easily over the exist hurdles in the garden or the playing yards.					
5	Your child runs in the same speed and method of children in the same age and sex.					
6	If your child plans to perform a motor activity, he organizes his body position to perform the plan and achieves this duty successfully (such as building a castle, move and travel with devices in the playground, or					

مركز البريطاني للترجمة BRITISH TRANSLATION CENTER

	build house, tridimensional thing by using cubes or technical materials).					
7	Your child's printing, writing, drawing is sufficiently fast that enables him from be in line with the level of other children in the class.					
8	The print and writing of your child for letters, figures, and words are readable, accurate, and precise. If your child can't print now, he can color and draw in a coorrdinated way and draw a picture that you can recognize it.					
9	Your child uses a proper effort or tension when writing, printing, or drawing (no extra tension or spasm in holding pen). Writing is not too heavy, dark, or very light)					
10	Your child cut pictures and forms accurately and easily.					
11	Your child is interested in and likes participating in sports and activity games which require good motor skills.					

12	Your child learns new motor activities (such as swimming and skiing) easily without need for more motor training or longer time than other children to perform the same level of skill					
13	Your child is fast and able to arrange things, wearing footwear, tying footwear, putting in clothes, and others.					
14	You can't describe your child as a pull in Chinaware shop (this means that he is uncoordinated and he may breaks easy-break things in a small room).					
15	Your child doesn't get tired easily, seems flaccid, or falls from the chair if he asked to stay on it for a longer period.					

Thanks

B. N. Wilson (2007)

Research Decision Support Team

Alberta Pediatrics Hospital

15 Appendix D: Demographic questionnaire

15.1 English version

QUESTIONNAIRE FOR CHILD HISTORY

Curtin University of Technology
School of Physiotherapy

Title: Identification of developmental coordination disorder in primary school-aged Kuwaiti children.

Investigator: Suad ALAnzi

Name of Child: --

The questions in this part are about your child's birth history, and his/her activities at home, his/her level of educational achievements. Please answer the following questions carefully and ask relatives who are closely familiar with your child if you cannot remember. Your answers are essential.

Choose the closest suitable answer.

1. What is the gestational age of your child? ------------------
2. What is your child birth of weight? --------------------
3. What is the order of the child in the family?
   First child --------- Second child -------- Other -------- Specify ---------
4. Are you living in:?
   Unit----------- Flat ------------- House ------------
5. Describe your household – who lives with you? --------------------------------

   ----

15.2 The Translation of the Demographic Questionnaire

AL-CANADY
Translation & Typing Co. W.L.L.

الكندي

شركة الكندي
للترجمة المعتمدة والطباعة ذ.م.م

الملحق السادس:

استبيان عن تاريخ الطفل

عنوان البحث:

تعريف اضطراب التنسيق التطوري لدى التلاميذ
في المدارس الابتدائية الكويتية

اسم الباحث: سعاد العنزي

اسم الطفل:-----------------------------------

الأسئلة في هذا الجزء خاصة في تاريخ ولادة الطفل. الرجاء الإجابة على الأسئلة التالية بدقة والاستفسار من أقرباءك المقربين من الطفل فيما إذا كنت لا تتذكر. إجابتك ضرورية.

اختر الإجابة المناسبة

١- ما هو عمر الطفل الجنيني؟ ---------------------------------
----

٢- ما هو وزن الطفل عند الولادة؟ ---------------------------------
----

٣- ما هو ترتيب الطفل في الأسرة؟

الطفل الأول		الطفل الثاني		غير ذلك		وضح	

٤- هل تسكن في :

شقة		دور في بيت		بيت	

٥- الرجاء وصف أفراد الأسرة ممن يسكن معك في البيت.-----------------
----

هذه ترجمة صحيحة للنص المرافق
A True and Correct Translation of attached Text in English
ZAK
6/9

الكويت - حولي - شارع ابن خلدون الرئيسي - مجمع الغريب - مكتب رقم 6 - الدور الأرضي - تلفون: 2644355 - 2644350 (965+)
Kuwait - Hawalli - Ibn Khaldoon St. - Al-Gharib Commercial Complex - G.F. - Office 6 - Tel.: (+965) 2644350 - 2644355
E-mail: al-canady_translation@hotmail.com

16 Appendix E: The Results of the Data Analyses

See the thump drive attached for all appendixes for the data analyses of Chapter six to Chapter ten.

17 Appendix F: Interview questionnaires.

17.1 Consent Form for Professionals

Consent form for participant

Curtin
University of Technology

School of physiotherapy

I have been informed of the study purpose and procedure. I understand I can withdraw at any time without prejudice and all information I provided will be confidential. Therefore, I agree to participate in the study.

Name of participant: Date:

Signature:

Investigator: Date:

Signature:

17.2 The Translation of the Consent Form for Professionals

AL-CANADY
Translation & Typing Co. W.L.L.

شركة الكندي
للترجمة المعتمدة والطباعة ذ.م.م

الملحق الرابع

موافقة خطية للمختصين

قد قرأت المعلومات المزودة مع هذا الكتاب والتي تتضمن أهداف البحث و الطريقة المتبعة في البحث. أنا متيقن بأنه لدي الحق بالانسحاب من المشاركة في البحث في أي وقت كان دون ضرر، كما ان المعلومات التي قمت بتزويدها في الاستبيان سوف تعامل بسرية تامة. لذلك أوافق على المشاركة في هذا البحث.

اسم المشارك:---------------------------

التاريخ:---------------------------

التوقيع:---------------------------

الباحث: سعاد العنزي

التاريخ:---------------------------

التوقيع:---------------------------

هذه ترجمة صحيحة للنص المرافق باللغة الانجليزية
Certified True and Correct Translation of The Attached Text in English
TAK
6/9

الكويت – حولي – شارع ابن خلدون الرئيسي – مجمع الغريب – مكتب رقم 6 – الدور الأرضي – تلفون: 2644355 - 2644350 (965+)
Kuwait - Hawalli - Ibn Khaldoon St. - Al-Gharib Commercial Complex - G.F. - Office 6 - Tel.: (+965) 2644350 - 2644355
E-mail: al-canady_translation@hotmail.com

17.3 Information Sheet for Interviewees

Subject Information Sheet -2

Curtin University of Technology

School of Physiotherapy

Title: Identification of developmental coordination disorder in primary school-aged Kuwaiti children.

Thank you for your interest to support this research

Physiotherapy Investigator: Suad ALAnzi tel: (965) 6671070

Email: suadef@hotmail.com

Supervisor: Prof. Jan Piek tel: +61 8 9266 7990 (School of Psychology) Email: j.piek@curtin.edu.au

Co-supervisor: Mrs Lynn Jensen tel: 61 8 9266 3409 (School of Physiotherapy) Email: L.Jensen@curtin.edu.au

Background Information:

Developmental Coordination Disorder (DCD) is a condition that affects a child's ability to perform organized movement that impacts on their activities of daily living and academic performance in the absence of other medical or psychiatric conditions (DSM-IV). The condition is well documented in the medical, allied health, psychological and educational literature with studies conducted in diverse ethnic and cultural populations, yet it is not well understood in Kuwait. The aim of this study is to identify developmental coordination disorder (DCD) in Kuwaiti children by determining the prevalence in primary school-aged children; measuring parents' ability to evaluate their child's motor performance and ascertaining the knowledge of medical, allied health and educational professionals about DCD and its consequences. The outcome measures will be the Movement Assessment Battery for Children version 2, Developmental Coordination Disorder Questionnaire and a qualitative interview. The study hypothesizes that the motor performance of Kuwaiti children will be similar to their counterparts from UK with the prevalence of DCD between 6-10%. The results of this study are significant for Kuwaiti children, their parents and professionals in the health and educational sectors so that children with DCD can receive adequate services to improve their impairments, reduce their activity limitations and encourage their participation in the community.

Procedure:

As a participant of the study you will be asked to answer few questions in a paper related to your working area and specialty. Then the interviewer will ask you some questions related to DCD. The interview will take 15 – 20 minutes and it will be recorded. If you feel that you have no idea about any question, feel free to say I do not know.

The Human Research Ethics Committee of Curtin University has given approval for this study with reference number ( ). You are free to withdraw at any time without prejudice. However, the investigator would appreciate prior notice of this intention. All information is confidential and you will not be identifiable in the results or reports from this study. There will be no cost incurred by you for participating in the study. The information gained from the study will be the property of Curtin University of Technology. It will be stored securely in the School of Physiotherapy for five years.

There is no risk associated with this study.

Your participation in the study will allow physiotherapists to further understand of developmental coordination disorder in Kuwaiti children and provide further services for children to minimize their difficulties.

Miss Suad ALAnzi will be happy to answer any queries that you might have about the study and DCD.

17.4 The Translation of the Information Sheet

الملحق الثالث

ورقة معلومات للمختصين المشاركين في البحث

عنوان البحث:

تعريف اضطراب التنسيق التطوري لدى التلاميذ في المدارس الابتدائية الكويتية

شكرا لكم على مساندتكم لنا في هذا البحث

اسم الباحث: سعاد العنزي تلفون 6671070 (965) Email: suadef@hotmail.com

المشرف: برفيسور جان بيك : تلفون 7990 9266 8 61+ (School of Psychology)
Email: j.piek@curtin.edu.au

المشرف المساعد: لين جنسن: تلفون 3409 9266 8 61 + (School of Physiotherapy)
Email: L.Jensen@curtin.edu.au

نبذة عن المادة العلمية لموضوع البحث

الأطفال الذين يعانون من مشاكل حركية هم مجاميع متنوعة الأشكال- منهم مشاكله شديدة كالشلل الدماغي ومتلازمة داون ومنهم من لديه مشاكل طفيفة إلا أنهم غير متمكنين فيما إذا قورنوا بأقرانهم. وعواقب المشاكل الحركية على الأطفال قد تؤدي إلى انعزالهم عن المجتمع مما يؤدي إلى مشاكل نفسية. الهدف من هذا البحث هو أن نتحقق من معرفة و اطلاع المختصيين في التخصصات الطبية و الطبية المساعدة و التعليمية عن الأطفال الكويتيين الذين يعانون من مشاكل حركية.

طريقة البحث:

أنت مدعو للمشاركة في هذا البحث. أنت كمشارك سوف تسأل عدة أسئلة متعلقة بعملك اليومي وتخصصك وأيضا بعض الأسئلة المتعلقة بمفهومك للمشاكل الحركية لدى الأطفال. المقابلة سوف تستغرق من ١٥-٢٠ دقيقة وسوف يقام بتسجيل المقابلة صوتياً لتحليلها. لا يتم تسجيل اسمك في التسجيل الصوتي للمقابلة لذى إجابتك ستكون مجهولة المصدر.

تمت الموافقة على هذا البحث من قبل مجلس أخلاقيات البحث في جامعة كيرتن مرجع رقم (××××). ولكم الحرية للانسحاب من البحث في وقت شئتم دون أدنى ضرر. جميع المعلومات المزودة لدينا ستعامل بسرية تامة كما أن اسمك لا يدون في نتائج البحث أو في تقرير الدراسة. كما أن مشاركتك بالبحث لا يجلب عليك المال.
تعد جميع المعلومات ضمن ملكية جامعة كيرتن كلية العلوم الطبية قسم العلاج الطبيعي في غرب استراليا. وستحفظ بأمان في الكلية لمدة خمس سنوات لا يحق لأحد الحصول عليها عدا الباحث و المشرف على البحث.
لا توجد أي خطورة عليك مصاحبة لهذا البحث كما أنه لا توجد إجابة صحيحة أو خاطئة للأسئلة. جميع البنود هي في الأصل الحركات التي يقوم بها الطفل في حياته اليومية.
مشاركتم في البحث سوف يساعد إختصاصيي العلاج الطبيعي على معرفة الحالة بتعمق و من ثم تقديم خدمات أفضل للأطفال حتى يقلل من الصعوبات لديهم. و إذا وددتم بتقرير عن حالة طفلكم الرجاء الاتصال بالباحث.
ويسر الباحثة سعاد العنزي الإجابة على استفساراتكم سواء عن الاستبيان أو اختبار الطفل في هذا البحث.

تلفون: 6671070

Email: suadef@hotmail.com

هذه ترجمة صحيحة للنص المرافق باللغة الانجليزية
Certified True and Correct Translation of The Attached Text in English
TAK
6/9

17.5 Interview questions for Health sector

QUESTIONNAIRE FOR PROFESSIONAL INTERVIEW

Curtin University of Technology

(Health sector)

School of Physiotherapy

Title: Identification of developmental coordination disorder in primary school-aged Kuwaiti children.

Suad ALAnzi, School of Physiotherapy

Code:

Age:	Gender:
Specialty:	years of experience:
Working area:	Number of child/clinic

Thank you for your participation in this interview and we appreciate you spend this time with us. I would like to feel free to answer what you in the limit of your knowledge. If you have no idea about the question, just say I do not know. This interview will be audio-recorder for ease of data analysis and no one can her except me for the purpose of the study.

1. Do you know the terminologies:

Clumsy	Yes	
Dyspraxia	Yes	
Developmental coordination disorder	Yes	
Sensory integration disorder	Yes	

2. Could you please define what you know of these terminology.
3. Do you think these terminologies are related to each other?

Yes ☐ No ☐

4. If yes how?

If professional has no idea about DCD, questions 3-11 will be ignored. However if s/he think that the terminologies are similar continue the rest of questions.

5. Do you know the features and symptoms for children with DCD?

Yes ☐ No ☐

6. Could you give me three examples for the features and symptoms?
7. Do you know the consequences of DCD?

Yes ☐ No ☐

8. What are the consequences?
9. Do you know the prognosis for those children with DCD?

Yes ☐ No ☐

10. What is the prognosis for children with DCD?
11. Have you ever treated a child with DCD in your clinic?

Yes ☐ No ☐

IF yes, go to question 10 and 11. Otherwise end the interview.

12. Which kind of assessment instruments do you use?
13. Which kind of treatment do you offer?
14. Which kinds of facilities are available in the ministry of health for those children with DCD?
15. Are you satisfied with the services offer in your place?

Thank you very much for your time and participation in this research.

17.6 Interview questions for educational sector

QUESTIONNAIRE FOR PROFESSIONAL INTERVIEW

Curtin University of Technology

(Educational sector)

School of Physiotherapy

Title: Identification of developmental coordination disorder in primary school-aged Kuwaiti children.

Suad ALAnzi, School of Physiotherapy

Code: GEA:

Age: Gender:

Specialty: years of experience:

Number of staff with you

<u>Questions for teachers only:</u>

Number of children/class Number of classes/day

Grades you teach

<u>Questions for Psychologists and social workers:</u>

Number of sessions/day/week Number of student with d

Thank you for your participation in this interview and we appreciate you spend this time with us. I would like to feel free to answer what you in the limit of your knowledge. If you have no idea about the question, just say I do not know. This interview will be audio-recorder for ease of data analysis and no one can her except me for the purpose of the study.

1. Do you know the terminologies:

Clumsy	Yes	☐
Dyspraxia	Yes	☐
Developmental coordination disorder	Yes	☐
Sensory integration disorder	Yes	☐

2. Could you please define what you know of these terminology.

If professional has no idea about DCD, questions 3-11 will be ignored.

3. Do you know the features and symptoms for children with DCD?

Yes ☐ No ☐

4. Could you give me three examples for the features and symptoms?
5. Do you know the consequences of DCD?

Yes ☐ No ☐

6. What are the consequences?
7. Do you know the prognosis for those children with DCD?

Yes ☐ No ☐

8. What is the prognosis for children with DCD?
9. Have you ever have a child with DCD in your class?

Yes ☐ No ☐

IF yes, go to question 10 and 11. Otherwise end the interview.

10. How did you manage with him/her?
11. Which kinds of facilities at school are available to help you with those children with DCD?

If professional answer questions 3-11, no need to continue with the rest of the questionnaire.

12. Have you ever have a child being clumsy or uncoordinated in your class?

Yes ☐ No ☐

13. Could you please describe the feature of this child for me
14. Why do you think s/he is being clumsy or uncoordinated?
15. Do you think that the child being clumsy or uncoordinated needs medical intervention such as physiotherapy or occupational therapy?

Yes ☐ No ☐

16. Clarify your answer whether it is yes or no.

Thank you very much for your time and participation in this research.

17.7 The Translation of the Educational Interview Questions

<u>الملحق السابع:</u>

استبيان لمقابلة المختصين (القطاع التعليمي)

<u>تعريف اضطراب التنسيق التطوري لدى التلاميذ</u>

<u>في المدارس الابتدائية الكويتية</u>

الباحث: سعاد العنزي، كلية العلاج الطبيعي

الرمز: المنطقة التعليمية:

العمر: الجنس:

التخصص: عدد سنين الخبرة:

عدد الموظفين الذين يعملون معك:

<u>أسئلة خاصة بالمعلمين فقط:</u>

عدد التلاميذ في الفصل: عدد الحصص باليوم:

الفصول التي تقوم بتدريسها:

<u>أسئلة خاصة بالاختصاصي النفسيين و الأخصائيين الاجتماعيين:</u>

عدد المقابلات باليوم والأسبوع:

عدد التلاميذ الذين يعانون من مشاكل:

شكرا جزيلا لمشاركتكم في هذه المقابلة ونقدر لكم وقتكم الثمين معنا. نريد منك أن تشعر بالحرية للإجابة على الأسئلة على قدر استطاعتك. لا توجد إجابة صحيحة أو خاطئة. إذا ليس لديك فكرة عن السؤال، فقط قل لا أعلم. هذه المقابلة سوف تسجل وذلك لتسهيل تحليل المعلومات وأكون الشخص الوحيد الذي يطلع على شريط التسجيل لتحقيق هدف الدراسة.

١- هل تعرف المصطلحات التالية:

أخرق	نعم	لا
خلل التناسق	نعم	لا
اضطراب التنسيق التطوري	نعم	لا
اضطراب التكامل الحسي	نعم	لا

٢- الرجاء توضيح ما تعرفه من المصطلحات:

إذا كان المختص ليس لديه فكرة عن اضطراب التنسيق التطوري، الأسئلة من ٣-١١ سوف تُجهل.

الكويت - حولي - شارع ابن خلدون الرئيسي - مجمع الغريب - مكتب رقم 6 - الدور الأرضي - تلفون: 2644355 - 2644350 (965+)
Kuwait - Hawalli - Ibn Khaldoon St. - Al-Gharib Commercial Complex - G.F. - Office 6 - Tel.: (+965) 2644350 - 2644355
E-mail: al-canady_translation@hotmail.com

٣- هل تعرف العلامات و الأعراض للأطفال الذين يعانون من اضطراب التنسيق التطوري.

نعم	لا

٤- ممكن إعطائي ثلاثة أمثلة للعلامات و الأعراض.

٥- هل تعرف العواقب لاضطراب التنسيق التطوري؟

نعم	لا

٦- ما هي العواقب؟

٧- هل تعرف تقدم الحالة للأطفال الذين يعانون من اضطراب التنسيق التطوري؟

نعم	لا

٨- ما هو تقدم الحالة

٩- هل كان لديك طفل يعاني من اضطراب التنسيق التطوري في الفصل؟

نعم	لا

إذا كانت الإجابة نعم أكمل السؤالين ١٠ و ١١، و إلا انهي المقابلة.

١٠- كيف تعاملت معه؟

١١- ما هي الخدمات المتوفرة في المدرسة لمساعدتك مع الأطفال الذين يعانون من اضطراب التنسيق التطوري؟

إذا أجاب المختص على الأسئلة ٣- ١١ لا يحتاج أن نكمل بقية الاستبيان.

١٢- هل كان لديك طفل في الفصل يبدو أخرق أو غير منسق؟

نعم	لا

١٣- الرجاء وصف مميزات هذا الطفل لي.

١٤- ما السبب في اعتقادك بأن هذا الطفل اخرق أو غير منسق؟

١٥- هل تعتقد بان الطفل الأخرق أو الغير المنسق يحتاج لتدخل طبي مثل العلاج الطبيعي أو العلاج بالعمل؟

نعم	لا

١٦- وضح إجابتك سواء كانت نعم أم لا.

شكرا جزيلا على وقتك و على مشاركتك في هذا البحث.

هذه ترجمة صحيحة للنص المرافق باللغة الانجليزية
Certified True and Correct Translation of The Attached Text in English
ZAK
6/9