Soreness during non-music activities is associated with playing-related musculoskeletal problems: an observational study of 731 child and adolescent instrumentalists

Sonia Ranelli a, Leon Straker b, Anne Smith c

Introduction

Activities of childhood and adolescence, such as vigorous physical activity, computer use and playing musical instruments, contribute to physical, cognitive and social development. Positive and adverse health outcomes are associated with activity participation and may be influenced by levels of exposure. Musculoskeletal soreness has been reported with high exposures to: physical activity participation; use of information and communication technology such as computers and electronic games; television viewing; writing or other intensive hand activities such as needlework or handicraft. Subsequently, position statements and evidence-based guidelines for children have been developed to ensure safe physical activity participation and wise computer use.

Learning a musical instrument is a common activity amongst children and adolescents. In 2005, 20% (520 500) of Australian children aged 5 to 14 years played a musical instrument outside of school hours. Learning music promotes positive cognitive, social, emotional and physical development in children and contributes to positive life-long learning experiences. However, playing a musical instrument is associated with rates of up to 67% of children having playing-related musculoskeletal problems, which is similar to the rates of adult musicians.

KEY WORDS
Instrument playing
Musculoskeletal problems
Children
Adolescents
Activity-related soreness

ABSTRACT

Question: Is exposure to non-music-related activities associated with playing-related musculoskeletal problems in young instrumentalists? Is non-music-activity-related soreness associated with playing-related musculoskeletal problems in this group of instrumentalists? Design: Observational study using a questionnaire and physical measures. Participants: 859 instrumentalists aged 7 to 17 years from the School of Instrumental Music program. Results: Of the 731 respondents who completed the questionnaire adequately, 412 (56%) experienced instrument-playing problems; 219 (30%) had symptoms severe enough to interfere with normal playing. Children commonly reported moderate exposure to non-music-related activities, such as watching television (61%), vigorous physical activity (57%), writing (51%) and computer use (45%). Greater exposure to any non-music activity was not associated with playing problems, with odds ratios ranging from 1.01 (95% CI 0.7 to 1.5) for watching television to 2.08 (95% CI 0.5 to 3.3) for intensive hand activities. Four hundred and seventy eight (65%) children reported soreness related to non-music activities, such as vigorous physical activity (52%), writing (40%), computer use (28%), intensive hand activities (22%), electronic game use (17%) and watching television (15%). Non-music-activity-related soreness was significantly associated with instrument playing problems, adjusting for gender and age, with odds ratios ranging from 1.01 (95% CI 0.7 to 1.5) for soreness whilst watching television to 4.3 (95% CI 2.6 to 7.1) for soreness during intensive hand activities. Conclusion: Non-music-activity-related soreness co-occurs significantly with playing problems in young instrumentalists. The finding of significant co-occurrence of music and non-music-related soreness in respondents in this study suggests that intervention targets for young instrumentalists could include risk factors previously identified in the general child and adolescent population, as well as music-specific risk factors. This is an important consideration for the assessment and management of the musculoskeletal health of young musicians.


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The musculoskeletal problems of musicians include tendinopathies, nerve compression syndromes and focal dystonia, and are thought to have multiple risk factors. These include: intrinsic factors (age, gender, psychosocial); extrinsic music-related factors (type of instrument, music exposure); extrinsic non-music-related factors (participation in activities of daily living, physical activity or computer use), with interactions between intrinsic and extrinsic factors (playing posture is influenced by physical attributes of instrument). There is limited research on playing-related musculoskeletal problems in children and adolescents, despite evidence that the development of musculoskeletal disorders commonly begins in adolescence. Emerging evidence suggests that age, gender, psychosocial factors, instrument type, and computer use – amongst 278 professional and music students – contribute to musculoskeletal problems in young instrumentalists. However, the relevance of participation in non-music activity is unclear.

Whilst a few instrumental studies have reported on non-music activity exposure in young instrumentalists or soreness from these activities, but none have investigated the relationship between either exposure to non-music-related activities or soreness related to these activities,24–26 but with interactions between intrinsic and extrinsic factors (participation in activities of daily living, physical activity or computer use), with interactions between intrinsic and extrinsic factors (playing posture is influenced by physical attributes of instrument). There is limited research on playing-related musculoskeletal problems in children and adolescents, despite evidence that the development of musculoskeletal disorders commonly begins in adolescence. Emerging evidence suggests that age, gender, psychosocial factors, instrument type, and computer use – amongst 278 professional and music students. Shoup26 found similar rates of playing problems in students who did and did not exercise. Dawson24 reviewed the medical notes of 148 music students seen in a medical clinic over a five-year period and reported that 30% of the hand and upper extremity problems were due to sports-related trauma. In a cross-sectional study of 517 adolescent non-music and music students, Fry and Rowley27 found that 71% of music students reported pain related to music playing and % reported pain from other activities such as pushing, lifting or carrying weights; 26% of non-music students reported hand pain due to writing. However, the music students were not questioned with regards to writing-related hand pain and therefore the relationship between writing-related hand pain and playing problems was not investigated.

Playing-related musculoskeletal problems and their risk factors need to be better understood in young instrumentalists. Therefore, the research questions for this study were:

1. What is the level of child instrumentalists’ participation in non-music activities within the last month and do these differ by gender or age?
2. What is the experience of non-music-activity-related soreness of child instrumentalists within the last month and does this differ by gender or age?
3. Is there an association between non-music-activity exposure within the last month and playing problems, after accounting for any age and gender differences?
4. Is there an association between reports of non-music-activity-related soreness within the last month and playing problems, after accounting for any age and gender differences?

**Method**

**Design**

A cross-sectional questionnaire and anthropometric measures survey were conducted between August and December 2003. The questionnaire used in this study was The Young People’s Activity Questionnaire, which was modified by the addition of music-specific questions and also contained general questions regarding the music student’s age, gender and year at school. The questionnaire is presented in Appendix 1 (see eAppendix). Questions regarding non-music activities covered watching television, use of computers and electronic games, vigorous physical activities, and intensive hand activities such as art and hand writing. The questions evaluated frequency of participation (nil, monthly, weekly, 2 to 3 times a week, daily), duration of each episode (<30 minutes, 30 to 60 minutes, 1 to 2 hours, 2 to 5 hours, >5 hours) and the soreness related to each non-music activity (nil, monthly, weekly, 2 to 3 times a week, daily) within the last month. The questionnaire focused on the experience of playing-related musculoskeletal problems within the past month, which were categorised as symptoms or disorders, as detailed under Outcome measures below. For both music-related and non-music-related activities, children indicated the location of their symptoms on a body diagram. Findings on the prevalence, frequency and impact of playing problems, the influence of age, gender and music exposure on playing problems, and the location of playing problems and associated risk factors are published elsewhere.

The questionnaire was completed in a scheduled music class with the supervision of the instrumental teacher and took approximately 20 minutes to complete. Height was measured using a wall tape and a digital scale measured weight. One author (SR) performed anthropometric measures and was present during questionnaire completion to answer queries.

**Participants**

The School of Instrumental Music program in Perth, Western Australia, had 1274 students enrolled at the time of data collection. Due to examinations, career events or industrial action by educators, 350 students were unavailable. Of the remaining 924 students, 65 declined to participate, so a total of 859 students were given the questionnaire to complete. Because some questions pertaining to the experience of playing problems were unanswered, 128 questionnaires were deemed incomplete. Therefore, 731 students (460 females) aged 7 to 17 years completed the questionnaire and survey appropriately. The school selection process ensured a representative range of instrument types, socioeconomic areas and age groups, as presented in Figure 1. Further details of the cohort are reported elsewhere. All instrumental classes at the selected schools were sampled, with no exclusion criteria.

**Outcome measures**

**Primary outcome:** Respondents could indicate playing-related musculoskeletal symptoms (ie, the experience of mild aches and pains, experienced during and following playing, that may or may not affect performance). These were elicited by the question: ‘In the last month, did you feel any soreness anywhere when you played a musical instrument?’

**Secondary outcome:** Respondents could also indicate playing-related musculoskeletal disorders (ie, the experience of pain, weakness, lack of control, numbness, tingling or other symptoms that interfered with the ability to play the instrument as usual). These were elicited by the question: ‘Did you feel any instrument-playing-related soreness, tingling or weakness that stopped you from playing your instrument as well as you usually play?’

The definitions that were used for disorders best determine rates of serious problems in adults. However, symptoms were chosen as the primary outcome because symptoms in children should be acknowledged early, so that the relevant risk factors can
be identified and the appropriate intervention programs can be implemented to prevent development of disorders.13

Data analysis

A descriptive analysis was performed to characterise the non-music activities of the sample. To ensure adequate numbers for analysis, some categories of variables were combined, as presented in Table 1. A new variable – non-music-activity exposure – combined the frequency of participation and usual duration of participation, to establish categories of pattern of participation (eg, daily for 1 to 2 hours), and an exposure matrix27 assigned levels of exposure (low, moderate-low, moderate, high) for the patterns of non-music-activity participation, as presented in Table 2.

Chi-square analysis was used to examine differences between males and females for categorical variables. ANOVA and bivariate Pearson correlation analysis examined the relationship between age and categorical variables. A series of logistic regression models were estimated with playing symptoms or playing disorders as the outcome variable. Firstly, univariable models estimated the unadjusted effect of non-music-activity exposure and activity-related soreness on the primary and secondary outcomes (ie, playing symptoms and playing disorders). Secondly, multivariable models estimated the independent association of all variables (non-music-activity exposure and activity-related soreness) with the primary and secondary outcomes accounting for age and gender. Thirdly, a final multivariable model included all variables significantly associated with the primary and secondary outcomes adjusted for age and gender, to examine the independent contribution of those factors to playing symptoms and playing disorders.

Results

Flow of participants through the study

From the 859 students who were given the survey, 731 (85%) questionnaires were fully completed, including 559/659 (85%) at secondary schools and 172/200 (86%) at primary schools, as presented in Figure 1. Of the 731 respondents, 489 (67%) reported a lifetime prevalence of playing symptoms, 412 (56%) reported symptoms within the past month, and 219 (30%) reported a playing disorder, that is, they were unable to play their instrument as usual due to the symptoms. The most-commonly reported locations for problems were the right (24%) and left (23%) hands, followed by the neck (16%) and the right shoulder (14%). Females (OR 1.6, 95% CI 1.1 to 2.4) and older children (OR 1.2, 95% CI 1.1 to 1.3) were more likely to report problems.

What is the level of child instrumentalist’s participation in non-music activities within the last month and do these differ by gender or age?

Descriptive statistics for the non-music-activity frequency, duration and soreness are listed in Table 1. Frequencies of respondents in the exposure variable, which was derived from the reported frequency and duration according to the matrix in Table 2, are presented in Table 3. Respondents commonly reported playing electronic games (52%) and participating in intensive hand activities (54%), with respondents commonly reporting low exposure to electronic games (52%) and participating in intensive hand activities (54%).
games (23%) and moderate exposure to intensive hand activities (22%), as presented in Table 3.

Significantly more males reported high-exposure levels for watching television ($\chi^2 = 10.5, p = 0.03$), computer use ($\chi^2 = 11.9, p = 0.018$) and electronic game use ($\chi^2 = 94.7, p < 0.001$) than females, but there was no evidence of gender differences for exposure to writing, intensive hand activities and vigorous physical activities. For watching television ($F = 2.4, p = 0.05$), computer use ($F = 10.7, p < 0.001$), electronic game use ($F = 3.2, p = 0.014$) and writing ($F = 13.3, p < 0.001$), there was a significant association with age – with younger respondents reporting higher exposure levels than older respondents – but there was no association between age and exposure to intensive hand activities and vigorous physical activity.

What is the experience of non-music-activity-related soreness of child instrumentalists within the last month and do these differ by gender or age?

Many respondents reported soreness with vigorous physical activities (52%), writing (40%), and computer use (28%), whilst fewer respondents reported soreness with intensive hand activities (22%), electronic game use (17%) and watching television (15%), as presented in Table 1. More females reported soreness than males with writing ($\chi^2 = 26.2, p < 0.001$), computer use ($\chi^2 = 5.6, p = 0.018$), watching television ($\chi^2 = 6.9, p = 0.009$) and intensive hand activities ($\chi^2 = 3.9, p < 0.001$). Reports of soreness increased with increasing age for writing ($F = 17.4, p < 0.001$), computer use ($F = 10.4, p = 0.001$) and vigorous physical activities ($F = 25.3, p < 0.001$).

Is there an association between non-music-activity exposure within the last month and playing problems, after accounting for any age and gender differences?

As the majority of respondents participated in non-music-related activities at moderate levels of exposure, as presented in Table 3, this exposure category was used as the referent category in univariable logistic regression analysis. There was no significant association between any non-music-activity exposure and playing problems (OR 0.50 to 2.08), as presented in Table 3.

Is there an association between reports of non-music-activity-related soreness within the last month and playing problems, after accounting for any age and gender differences?

The report of soreness from all the non-music activities was significantly associated with increased odds for both playing symptoms and playing disorders (OR 2.34 to 4.27), as presented in Table 4. Given the consistent relationships, a count variable – ‘number of reported activity-soreness experiences’ – was created to assess if there was an additive association of non-music-activity-related soreness. Only activities with majority participation (watching television, writing, computer use and vigorous physical activities) were used to create this count variable. The number of respondents who complained of soreness with 0, 1, 2, 3 or 4 activities was calculated, and is presented in Table 5. In the univariate analysis, the number of reported soreness experiences was significantly associated with both playing symptoms and playing disorders, with an increased count of soreness experience associated with increasing prevalence of playing symptoms and playing disorders, as presented in Figure 2. In a multivariable logistic regression model, the number of reported soreness experiences remained significantly associated with increased odds for both playing symptoms and playing disorders, as presented in Table 5.

Discussion

This study found a high prevalence of instrument playing problems, particularly in the hand, neck and shoulder, amongst young instrumentalists. A third of the respondents were unable to...
Table 4
Adjusted odds ratio (95% CI) for playing-related musculoskeletal symptoms and playing-related musculoskeletal disorders with non-music-activity-related soreness (n = 731).

<table>
<thead>
<tr>
<th>Non-music activity</th>
<th>Exposure category</th>
<th>Overall</th>
<th>n</th>
<th>%</th>
<th>OR</th>
<th>CI</th>
<th>Playing-related musculoskeletal symptoms</th>
<th>n</th>
<th>%</th>
<th>OR</th>
<th>CI</th>
<th>Playing-related musculoskeletal disorders</th>
<th>n</th>
<th>%</th>
<th>OR</th>
<th>CI</th>
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</tr>
<tr>
<td></td>
<td>moderate-low</td>
<td>83</td>
<td>11</td>
<td>44</td>
<td>11</td>
<td>0.95</td>
<td>0.6 to 1.5</td>
<td>26</td>
<td>12</td>
<td>1.07</td>
<td>0.6 to 1.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>moderate</td>
<td>415</td>
<td>57</td>
<td>225</td>
<td>55</td>
<td>1.00</td>
<td></td>
<td>124</td>
<td>57</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>high</td>
<td>70</td>
<td>10</td>
<td>44</td>
<td>11</td>
<td>1.43</td>
<td>0.8 to 2.4</td>
<td>25</td>
<td>11</td>
<td>1.30</td>
<td>0.8 to 2.2</td>
<td></td>
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</tr>
</tbody>
</table>

Table 5
Adjusted odds ratios (95% CI) in final multivariable model of relationship between playing-related musculoskeletal symptoms and playing-related musculoskeletal disorders and correlates.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Playing-related musculoskeletal symptoms</th>
<th>Playing-related musculoskeletal disorders</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR</td>
<td>CI</td>
</tr>
<tr>
<td>Age (yr)</td>
<td>1.14</td>
<td>1.05 to 1.25</td>
</tr>
<tr>
<td>Gender (female)</td>
<td>1.30</td>
<td>0.91 to 1.82</td>
</tr>
<tr>
<td>Number of soreness experiences</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>1 (n = 253)</td>
<td>2.22</td>
<td>1.50 to 3.29</td>
</tr>
<tr>
<td>2 (n = 145)</td>
<td>4.58</td>
<td>2.87 to 7.31</td>
</tr>
<tr>
<td>3 (n = 95)</td>
<td>6.59</td>
<td>3.72 to 11.69</td>
</tr>
<tr>
<td>4 (n = 38)</td>
<td>9.10</td>
<td>3.60 to 23.02</td>
</tr>
</tbody>
</table>
locations are common in children and adolescents, with occurrence of musculoskeletal pains at different anatomical sites. The reported experience of ‘other’ musculoskeletal pains being a predictor of subsequent occurrence of back pain. The co-occurrence of pain. The individual’s general pain vulnerability influenced by mechanisms of pain perception and processing may, for example, via central sensitisation, be responsible for the experience of pain independent to the initial nociceptive stimulus. The shared psychosocial risk factors, such as depressive mood, stress and the experience of pain by other family members, have been linked to low back pain, neck and upper limb pain in children and adolescents. The shared physical risk factors of concurrent activities, such as prolonged static postures adopted by children and adolescents while watching television and during computer use, have been associated with spinal pain.

In the current study, there was insufficient evidence to support the supposition that exposure to physical risk factors inherent in non-music activities contributes to playing problems. The current study provides evidence that the number of reported soreness experiences is associated with an increased risk of playing problems, and suggests that altered pain processing and psychological risk factors may be important. However, this study did not identify the time of onset of non-music or music-related soreness, so the temporal relationship between the two cannot be determined. Due to the cross-sectional design of the study, it is unknown whether children with activity-related soreness go on to develop playing problems or whether children with playing problems subsequently report activity-related soreness. However, 35% of respondents with playing problems did not report non-music-activity-related soreness. Furthermore, whether the locations of symptoms and problems were common or different across music and non-music related soreness was not determined, which may also be informative regarding potential mechanisms for the associations observed.

The present study included a large representative sample of young instrumentalists and controlled for age and gender. Future longitudinal studies are required to clarify the non-music-activity-related soreness and to elucidate any underlying causal relationship with instrument-playing problems. More than half of the music students surveyed experienced symptoms relating to playing their musical instruments, with 30% having symptoms severe enough to interfere with normal playing. Almost two thirds of the music students reported soreness, which was related to non-music activities. Soreness with non-music activities was associated with increased odds for playing problems, which suggests common mechanisms. It is important that the reported experience of soreness in children and adolescents is not trivialised, and that the appropriate intervention strategies are implemented to address the known risk factors in order to prevent the development of more chronic disabling disorders in young instrumentalists.

What this study adds: Non-music-activity-related soreness is associated with the experience of playing problems in children and adolescent instrumentalists. Greater exposure to any particular non-music activity is not associated with greater risk of instrument playing problems.

What is already known on this topic: In children and adolescents learning instrumental music, there is little research on the influence of non-music activity exposure and non-music-activity-related soreness with playing problems.

eAddenda: Appendix 1 is can be found online at doi:10.1016/j.jphys.2014.05.005

Ethics approval: The Curtin University Human Research Ethics Committee (HR234/2002) approved this study. Participants and their parent or guardian provided informed assent/consent before data collection began.

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Competing interests: Nil

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