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The development of human capability across the lifecourse: Perspectives from childhood

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Introduction

To date, research efforts in lifecourse epidemiology have offered impressive contributions to our understanding of health trajectories across lives, generations and populations^{1,2}. This has been accomplished through the careful assembly of data from multiple methodologies (e.g., longitudinal, cross-sectional, time-series) and different sources of data (e.g., census and administrative datasets, area level information, postal surveys, direct assessment). These efforts show us that there is no “one perfect” study design for the lifecourse. Instead, the lifecourse, as represented in epidemiological research, is best understood as a construction of findings from suitably designed and powered studies that permit causal insights into the relationship between the timing and sequencing of exposures on one hand, and outcomes of interest on the other. While recent interest in lifecourse epidemiology has turned toward the developmental origins of health and disease³, the place of childhood, and child development in the spectrum of lifecourse epidemiology has, to date, been relatively circumscribed.

Childhood as a developmental epoch is a time of prodigious change that poses specific challenges and opportunities for lifecourse epidemiologists. From conception and onward through infancy, childhood, adolescence, early, mid- and late-life, disciplinary specialisation and convention have operated to colonise epochs of the lifecourse rather than foster exchange of knowledge across the lifecourse that would permit the fuller study of it. This is because childhood is easy to partition into stages that are characterised by distinct developmental accomplishments. This partitioning of the lifecourse by scholars and researchers, along with the mirroring of this in political portfolios, bureaucracies, institutions, and professions, impedes the progress of lifecourse science.

Notwithstanding the challenges posed in penetrating disciplinary boundaries and integrating across them, there are substantial opportunities and potential benefits in bringing more of the science of childhood into the practice of lifecourse epidemiology. In this paper we consider what the science of child development, particularly as it relates to *social development*, brings to the study of the lifecourse. Specifically, we: (1) detail a general conceptual framework of social skills as the candidate outcomes that underpins human capability across the lifecourse along with (2) the causal mechanisms that prompt, facilitate or constrain their development and (3) the resources that

potentially mediate or moderate these effects. We conclude with a discussion of data design to inform lifecourse outcomes and the emergent opportunities for this in Australian research.

Childhood, social skills, and the development of human capability across the lifecourse

A focus on lifecourse outcomes from infancy and childhood (see footnote) confronts researchers with a fundamental question: what constitutes an “outcome” when so much of life and development is still ahead? We believe that the broad overarching outcome of human development is the capability to participate economically, socially and civically. To be interested in capability formation across the lifecourse is to ask, how do individuals and populations achieve more equal outcomes in enabling people to choose the lives that they value? This capability can be measured across the lives of individuals, generations and populations.

Capability, and an interest in its expansion, has several theoretical, philosophical and political origins and an extensive literature and application^{4,5}. Its attraction here in the context of viewing the lifecourse from childhood onwards is through its ability to define some “end” to which human development broadly works and to serve as a theoretical anchor point of developmental coherence across the lifecourse. It enables this without restricting the scope of study into specific types of outcomes (i.e. diseases, health, education) while at the same time encouraging many outcomes to be considered as developmental “means”.

For example, the achievement of good health or the occurrence of specific diseases, are typically studied as “outcomes” in their own right. These outcomes may also be thought of as the means through which the capability to participate economically, socially and civically is achieved or diminished. Note that the consequence of this focus is that humans are seen as “ends” in their own right rather than as a means to particular ends. An awareness of this allows an opportunity to observe and measure overarching outcomes through the lifecourse. This framework, shown in Figure 1, brings a greater theoretical coherence, fidelity, and parsimony to assembling the plethora of lifecourse “outcomes” reported in the literature.

Our interest is in the period from periconception onward. For economy of presentation here we have limited the scope of this paper to the period encompassing birth, infancy and childhood and use the generic term “childhood” to denote this.

Looking from childhood onwards across the lifecourse, a human capability framework seeks to understand the ways in which health, wellbeing and capability develop in individuals, generations and populations in different historical, political, cultural, social and economic contexts. Its attraction here in the context of lifecourse epidemiology is through its ability to define the outcomes to which human development broadly works at the level of the individual (e.g. health status) and society (e.g. social cohesion). While health and wellbeing are “outcomes” in their own right, they are also components of the “means” or “resources” for human capability formation. Childhood, then, brings into the study of the lifecourse a fundamental opportunity to focus on *what* changes along with an opportunity to examine the prompts, facilitators, constraints and resources that influence these changes and the role of their timing and sequencing.

Social skills as outcomes for human capability

In the progression from childhood onward through the lifecourse there is a general consensus of evidence that human capability is optimised when individuals 1) are able to regulate their emotions, 2) are able to engage in exploratory behaviour, 3) are able to communicate effectively, 4) are self-directed, 5) have intellectual flexibility, 6) possess some degree of introspection, and 7) possess self-efficacy in meeting life’s challenges. These “social” skills are used by individuals across the lifecourse to influence their social and physical environment for their own development and for the development of others – they are necessary skills for capability expansion. Indeed, these seven characteristics are so pervasive that they can be used to describe not only individual development, but the development of institutions, communities and nations as well. Each one of these social skills can be studied as a developmental process or outcome in its own right across the lifecourse⁶. Our interest here is in selecting candidate measures of these skills and measuring *changes* to these skills across the lifecourse at the individual, generational and population level. This is not as daunting as it might seem.

Prompts, facilitators, constraints and resources that influence the development of social skills

The evidence base in child development supports a relatively circumscribed framework of causal influences that prompt, facilitate and constrain the development and maintenance of these social skills across the lifecourse. The developmental *prompts* of these skills include biology (including genes), expectations, and opportunities. Prompts are particularly critical in the initiation of the acquisition and accumulation of skills. Developmental *facilitators* increase leverage from developmental prompts. These facilitators include 1) at least average intelligence, 2) an easygoing temperament, 3) emotional support in the face of challenge, and 4) good language development. Developmental *constraints* are those influences that impede or diminish the effects of the prompts or interact with the facilitators. These constraints include multiple accumulative stress, “chaos” that prevents developmental stability (ie war, social upheaval), social inequality, and social exclusion – both of the latter differentially effecting the distribution of expectations and opportunities.

Note that these prompts, facilitators and constraints may include influences from a variety of levels (from individual to global) and may arise from different settings (family, school, care environments, work, etc). Acquisition in stages impacts not only on the domain within that stage, but throughout the lifecourse. For example, schooling in childhood (a legislated developmental prompt in many countries across the world) is a prompt for health outcomes in later life. It is important to note that prompts are fundamental – biology, opportunity and expectation exist and play a key role at all lifecourse stages.

Resources for social development across the lifecourse

Families, and parents particularly, cite two main resources as instrumental for the development of children: time and money. In reality, however, families and parents bring a great deal more than just time and money to the task of raising children. In addition to time and money they bring human, psychological and social capital as part of the developmental “resource mix”^{7–11} potentially available for the development of children. It should also be noted that this resource mix is also potentially available in settings outside the home – in care settings, schools, work places, and communities, to name a few.

These resources are not “steady states” across the lifecourse. We propose a model of studying the acquisition, accumulation, transformation and loss of these developmental resources as they relate to the prompts, facilitators and/or constraints of capability development across the lifecourse. The focus here is on the nature of lifecourse exposures with an emphasis on their timing (onset and offset) and sequencing⁸. Acquisition then, refers to the initial attainment of a developmental resource. Accumulation refers to the accrual of these developmental resources over time, prompted by maturational mechanisms and facilitated or constrained by environmental opportunities and expectations. Transformation refers to the conversion of specific developmental resources from one form to another. Loss relates to either the loss of an achieved resource or the absence of a critical developmental resource.

This human capability development model shares characteristics with critical periods models and accumulative risk models of lifecourse processes¹² and applies these concepts to prevention (e.g. universal parenting programmes) and early detection and intervention for children with developmental vulnerabilities (e.g. newborn hearing screening). The inclusion of “loss” in the model acknowledges that human capability can be vulnerable and may diminish within and across generations¹³.

A human development approach, along with the general concept of acquisition, accumulation, transformation and loss of developmental resources, sets a broader context in which the processes of *change* in risk exposure for a range of health or disease outcomes across the lifecourse can be understood (see Figure 1). Broadly speaking, the epidemiology of associating risk exposures with health outcomes can be extended to examine how these risk exposures are acquired and accumulated both within individuals and populations. For instance, the lifecourse approach in the field of chronic disease epidemiology represents an important aspect of developing a population preventative

health approach rather than just informing individual treatment as a means of responding to chronic disease. This has been well described for coronary heart disease (CHD)¹². In the second half of the 20th century, substantial progress was made in identifying a range of risk factors that have proven to be reliable markers of CHD and adverse CHD outcomes. These are summarised in the Framingham Risk Equation approach. These equations predict the risk of CHD for an adult of a given age and sex, based on biological markers such as blood pressure, cholesterol, and presence of left ventricular hypertrophy, whether the person has diabetes or whether they smoke. This type of approach is useful for identifying treatment options for individuals. But at the population level, the prevention of CHD also requires understanding how to prevent or remediate the development of the risk factors for CHD. The risk factors in the Framingham equations do not appear suddenly at older ages under the conscious and direct control of individuals, but likely result from the acquisition and accumulation of risk exposures over the lifecourse. For instance, the vast majority of adult smokers become addicted to cigarettes during their teenage years, and persistent adult smoking is almost always the result of difficulty breaking the addiction rather than the independent, conscious, informed choice to smoke in adulthood. Using the model of acquisition, accumulation, transformation and loss we may delineate critical periods for intervention and the type of intervention that may be most useful. The acquisition of smoking risk behaviour almost always occurs during the teenage years and there are known facilitators and constraints for this risk behaviour including educational development, market forces, social and emotional support, and emotional and behavioural difficulties. A framework of prompts, facilitators and constraints operates both at the individual and population level, governing the manifest risk for tobacco use and the timing and accumulation of risk exposure. Interventions that prevent the development of CHD may be classified as those that prevent the acquisition of the risk exposure, and those that remediate the accumulation of the risk exposure.

Similarly, a range of biological, nutritional, lifestyle and other factors underpin the development of high risk profiles for blood lipids, blood pressure and blood glucose. These processes are likely to develop over many years. A developmental lifecourse approach could consider the developmental phases during which risk exposure occurs and the life stages in which risk exposure could be altered. The risk factor approach emphasises the acquisition and accumulation of risk, but a human capability framework also offers the obverse perspective of acquiring and accumulating the capacities that allow people and populations to acquire and develop protective behaviours. The role that education, skills development, social capacities and emotional wellbeing play in developing lifecourse trajectories that not only avoid the development of risk but actively promote the development of protective profiles is a key aspect of the developmental health agenda.

Data design to inform lifecourse outcomes

At the outset we noted that there is no one single research design that measures all aspects of the lifecourse as relevant to describing the development of human capability in individuals

and populations. Different study designs illuminate different aspects of the lifecourse and permit varying levels of causal inference.

Data collection designs that can be useful include population registers and administrative collections, such as births, deaths, and hospital records covering the whole population of a jurisdiction; longitudinal surveys following specific cohorts over time; cross-sectional surveys, collecting information on a population representative sample at a specific point in time; and time series based on regular cross-sectional surveys, censuses or administrative data. A variant on the longitudinal cohort study is the rotating panel survey where over time new members are recruited to the panel to replace those who retire from the panel. Additionally a range of data not specifically collected at the level of individuals or families is relevant to informing the lifecourse paradigm, and can have a strong influence on the development of specific capabilities in each stage of the lifecourse. These include macro-economic measures, measures of community resources, information on material circumstances, environmental data, and an understanding of social, cultural and political influences as they manifest in individual lives.

Each of these different data sources has benefits as well as limitations in terms of what they can contribute to understanding lifecourse dynamics. Registers can cover the entire population of a jurisdiction and may provide many years of follow-up. When different administrative data collections are linked together there is the potential to cover the entire lifecourse. It can also be possible when linking together these types of registers to identify genealogies and family units¹⁴.

However, while registers are extremely valuable tools, they also have limitations. They usually contain only a restricted range of variables many of which are related to use of services. Many registers were initially established for the purposes of monitoring the use of specific services, and as such data quality can be a significant limitation as the register data are often not collected with research purposes in mind. Cross-sectional surveys and censuses have a longer history with many countries having programs that go back forty years or more but offer limited insights into the lifecourse as they represent a snap shot at a single point in time. When cross-sectional surveys are repeated at regular intervals, the time series data from the ongoing surveys provide an opportunity to observe changes in population dynamics over time. As these surveys generally employ independent samples at each time point, and thus do not go back to the same individuals at each time point, larger sample sizes are required to observe differences over time than in the case of longitudinal follow-up designs. Longitudinal studies have come to be viewed as the most useful design in lifecourse epidemiology as they have the capability to prospectively follow individuals and families over long periods of time, often from birth or conception. However, they do not pick up underlying changes in the population structure over time. Challenges in designing longitudinal studies include trying to predict what questions will be of interest in the future so that appropriate measures can be collected in early waves. As there can be a long lead time in collecting the information, by the time it is possible to relate mid- and late-life outcomes to earlier lifecourse stages, the

socio-political-cultural circumstances of the cohort when they were going through early stages of the lifecourse may be very different from the circumstances of current generations which can impact on the ability to translate the results of longitudinal studies into practical outcomes.

By integrating information from different types of data collections it is possible to combine the strengths of different approaches while minimising some of their individual weaknesses. Maximising these opportunities represents an emergent area globally, as well as in Australia specifically, for potential advancement in the application of lifecourse methodologies. Analytic advances in this area have the potential to deliver added richness to our understanding of the prompts, facilitators and constraints in the reciprocal modification of individual human capability profiles (i.e. transformation between generations) and their effects on the expansion or narrowing of choice within and across developmental domains.

As the number of registers is increasing rapidly with advances in technological infrastructure and the tools to interrogate them, it is likely that more specifically research driven registers will become more common. For instance, linking administrative and register-based data with cross-sectional surveys or censuses can greatly enhance the usefulness of these data sources¹⁵. Cross-sectional surveys are good ways to collect information on psychosocial prompts, facilitators and constraints of development which are rarely collected well in registers. For modest additional cost, registers can provide a more unbiased measure of a range of sensitive end-points such as hospitalisation for sensitive or potentially stigmatising medical conditions or procedures^{14,16} or in supplying direct measures of educational participation and ability¹⁷.

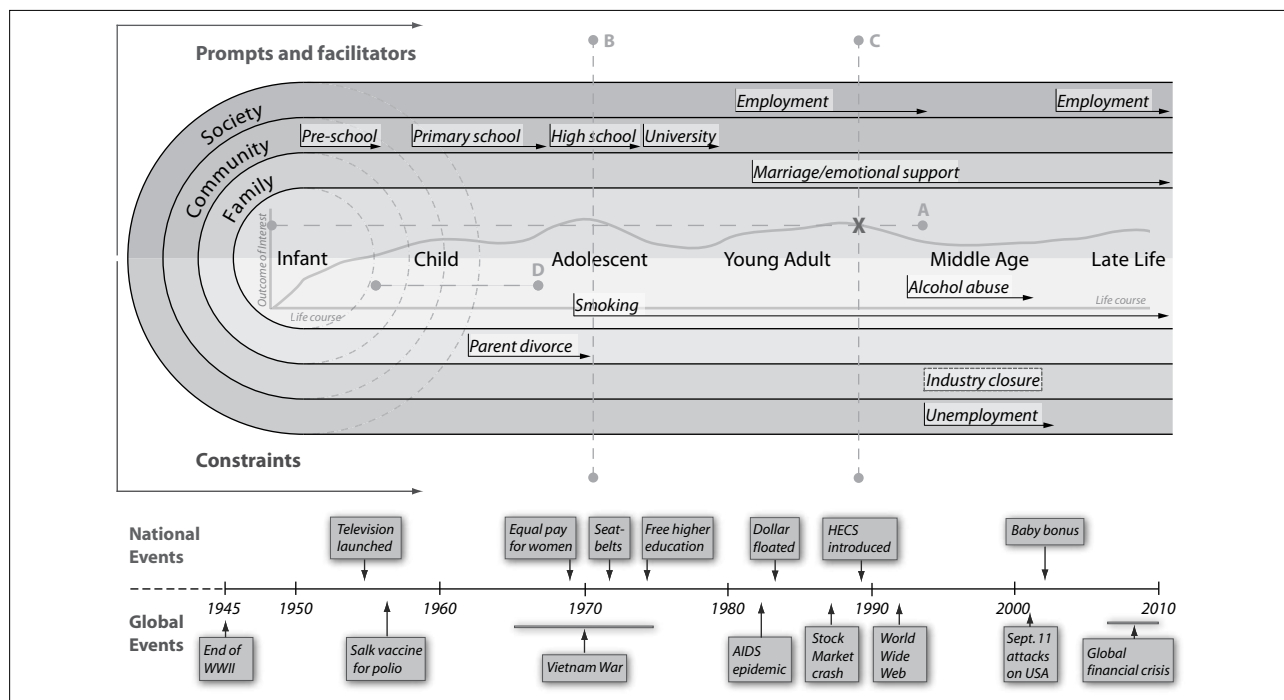
Data linkage to administrative data sources can also add value to longitudinal studies, especially where a genealogical linkage is possible. Combining data from longitudinal and cross-sectional

studies gives an opportunity to address the issue of cohort effects due to changes in populations, communities and societies over time, bringing greater policy relevance to results observed in longitudinal studies. Information from all of these data sources needs to be interpreted in the light of contextual information, not necessarily collected at the individual level, that describe the environment and circumstances in which children grow and develop into adults.

An illustration of a lifecourse data design is provided in Figure 1. This figure charts the lifecourse in the period from 1945 to the present. A selection of global and national events of potential developmental impact are positioned in the lower chart space. In the centre of the figure is a heuristic representation of the variation in a hypothetical "outcome of interest." Such outcomes have the potential of taking many forms including: specific health conditions, general health status, mental health, and any of the social skills we have cited above. The variation in the outcome of interest can be thought of as the variation in the lifecourse of an individual life or as a time series of the population estimate over the relevant period. The figure positions this variation as subject to multilevel effects through clustering at the family, community or within other societal settings. We have positioned the occurrence of parental divorce, the onset of smoking and alcohol abuse, the sudden closure of an industry and unemployment as examples of exposures of interest.

Data views are represented by dotted lines in the Figure and an example point estimate of an outcome of interest is represented by the "X". Two longitudinal lines are represented through the lifecourse (Line A and Line D) and two cross-sectional lines are represented at intersection points in the lifecourse at adolescence and in young adulthood (Line B and Line C). Figure 1 represents what may be seen in data depending on the nature of the data design or what may be seen through the construction of findings from multiple studies and sources over this period. No one design is optimal in what it provides in detailing the sequencing

Figure 1: Hypothetical lifecourse data design.



and timing of exposures, nor, particularly, in capturing information about multilevel effects or larger national and global exposures.

Several data methodologies and techniques are of particular value in achieving a greater representation of the lifecourse and enabling a greater ability to interrogate causal pathways and their counterfactuals. Longitudinal studies (Lines A and D) are powerful tools to determine antecedent exposures and consequent outcomes – timing and sequencing of exposures are also captured. Subjects in these studies are conceptually nested, though, in a larger population at any point in time. Cross-sectional random samples taken through this population at a specific time (Line B) or periodically repeated in time series (Lines B and C) provide point estimates that may be highly informative of (for example) drop-out or non-participation bias in the longitudinal view. The time series views may be the only data view by which specific macro-policy effects can be seen, particularly where these affect portions of the sample in the longitudinal views that are out of the scope of the policy owing to age. Value adding to these data views may come from nested studies. There are particular strengths that arise through data linkage of good quality population registers and administrative information to data collected in cross-sectional or longitudinal studies¹⁸. There are a number of examples where this has been done in Australia with the support (i.e. informed consent) and high levels of assent of survey participants in studies¹⁹ that meet ethical standards and adhere to privacy requirements. Findings from the application of these techniques have been shown to be of high scientific and practical value as well as true “value adding” to the study design through reduction of respondent burden to participants as well as validation of data collected through self-report or direct observation.

Conclusion

In this roundtable presentation we have reflected on a view of the epidemiology of the lifecourse as seen prospectively from childhood and through the lens of child development. Childhood allows us to ask, how do we think about health “outcomes” in the wider context of what life, and humans in it, enables? Childhood allows us to ask, where does human capability in individuals and populations come from? This capability is developed and maintained through social skills that enable people to participate socially, economically and civically – as individuals, families, and societies. These social skills are elaborated through mechanisms that prompt, facilitate or constrain their development. These mechanisms are potentially mediated by developmental resources within and across contexts. In this view, health status is a means to an end, rather than an end in its own right. Lifecourse study, in our view, requires a prodigious data capacity and a developmentally coherent theory in which cause, effect and change can be understood. The interplay of individual development within populations

requires a view of both of these elements. There is a growing capacity within Australia to undertake greater collaborative effort between research and policy settings in the design and creation of specific studies as well as enabling data environments that assemble administration and services data to inform urgent questions of public health, education and welfare. These practical steps, supported by community consultation, ethical regulation, and confidentiality and privacy accountability, can allow us to bring forth substantial contributions in our understanding of the lifecourse.

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