



A population-based analysis of factors that predict early language and cognitive development



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ARTICLE INFO

Article history:

Received 30 July 2014

Received in revised form 16 October 2015

Accepted 25 October 2015

Available online 10 November 2015

Keywords:

Early childhood development

Structural equation modelling (SEM)

Early Development Instrument (EDI)

Administrative data

Life course perspective

Ecological model of development

School readiness

Language and cognitive development

ABSTRACT

Readiness for school learning is an important predictor of subsequent educational achievement, which in turn predicts health and social outcomes into adulthood. This longitudinal study used population-based administrative data from multiple sectors to follow a cohort of children ($n=8983$) from the prenatal period to kindergarten to examine early childhood development factors associated with academic school readiness as measured on the language and cognitive development domain of the Early Development Instrument (EDI). Structural equation modelling was used to study the complex inter-relationships among the EDI scores and the explanatory variables, which included maternal prenatal health behaviors, child health at birth, family risk factors, and neighborhood socioeconomic status. Our findings suggest that when multiple influences on early childhood development are considered together, family risk factors are the key driver of academic school readiness, and family risk, in turn, is strongly influenced by neighborhood socioeconomic status.

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1. Introduction

School performance and educational attainment are recognized as both predictors of adult outcomes and social determinants of health. Specifically, early school performance has been linked to subsequent education attainment, which, in turn, predicts many adult outcomes, not only in the economic realm but also in the social and health domains (Cunha & Heckman, 2007; Duncan et al., 2007). Some research suggests that these social determinants (i.e., school performance and educational attainment) may have a greater influence on health than many medical advances (Marmot et al., 2008). Thus, identifying the mechanisms that set individuals on a path toward achieving positive school performance and education outcomes has implications for economic and social well-being as well as overall health across the entire life course. In order

to elucidate the mechanisms that not only predict education outcomes, but also predict subsequent adult outcomes, early childhood development needs to be examined.

Early childhood development (ECD) considers a child's physical, social, emotional, language, and cognitive development. Understanding the pathways that connect optimal developmental health in each of these areas with family socioeconomic status, school performance, and education attainment may identify areas to intervene that will result in improved adult outcomes for initially less-advantaged children (Santos, 2014). Much of the ECD literature seeks to elucidate this complex network.

Research has explored those factors that predict positive ECD trajectories such as perinatal health indicators (e.g., access to prenatal care, health at birth, major early childhood illness), socioeconomic indicators (e.g., family environment, socioeconomic status (SES), and residential stability) (Fransoo et al., 2008; Jefferis, Power, & Hertzman, 2002; Jelleyman & Spencer, 2008; Shonkoff & Phillips, 2000) and neighborhood effects (e.g., median income, social cohesion, and income inequality) (Carpiano, Lloyd & Hertzman, 2009; Kohen, Brooks-Gunn, Leventhal & Hertzman, 2002; Kohen, Leventhal, Dahinton & McIntosh, 2008). Unfortunately, ECD studies are often either limited to a small analytic sample drawn from a select population and/or unable to follow children for an extended

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period during their early years; e.g., from prenatal to school-entry. This study builds on the existing ECD literature by addressing these two limitations by: (1) using a census of one Canadian province (i.e., a single cohort born in Manitoba and still living there through grade 3); and, (2) following children from the prenatal period through to kindergarten.

2. Theoretical frameworks

Both the life course perspective and the ecological model of development provide interdisciplinary frameworks for understanding how early experiences help to shape later outcomes. Within the life course framework, the antecedent experiences can occur *in utero*, in childhood and adolescence, and throughout adulthood (Ben-Shlomo & Kuh, 2002); however, the first several years of life appear to be critical in terms of influencing later outcomes (Boivin & Hertzman, 2012; Shonkoff, 2012), most likely because this is both a period of rapid development and of developmental malleability (Forrest & Riley, 2004). In keeping with the ecological model of development (Bronfenbrenner 1979, 1986), these early or exposures, can occur at multiple levels: biological and psychological influences at the person level; and social, economic, and cultural influences that can occur at the family, the community or neighborhood, and the societal levels.

Although developmental psychologists have understood for decades the profound effect that early experiences have on developmental trajectories (Fox & Rutter, 2010), epidemiologists have only relatively recently embraced the life course perspective (Boivin & Hertzman, 2012). Health researchers have hypothesized that early experiences can affect health across the life course in at least two ways: (1) through cumulative damage over the life course, or; (2) by the latent effects or “biological embedding” of insults occurring during sensitive periods of development (Hertzman, 1999; Shonkoff, Boyce, & McEwen, 2009).

More recently, converging evidence from multiple disciplines, including genetics, epidemiology, biology, developmental psychology, and epigenetics has started to uncover the mechanisms by which this biological embedding occurs—in essence, how early experiences, which can be proximal or distal influences, “get under the skin” (Fox, Levitt, & Nelson, 2010; Hertzman & Boyce, 2010; Meaney, 2010; Shonkoff, 2012). This work has helped to explain socioeconomic gradients in developmental health trajectories that emerge across the life course. It also underscores the opportunities in childhood for interventions that not only improve cognitive, behavior, physical, and mental health outcomes during childhood but can also change developmental trajectories and ultimately adult outcomes (Boivin & Hertzman, 2012; Hertzman & Boyce, 2010; Shonkoff, 2012; Shonkoff et al., 2009). The ability to evaluate multiple exposure effects exerting their influence at various levels over the life course thus becomes an important strategy for explicating which factors are most important for determining current and future outcomes, and for designing policies and interventions that reduce the risks posed by particular early experiences (Santos, 2014). Population-based administrative databases that collect information continuously over time at individual, family, and community levels provide a valuable resource for conducting this type of ecological and life course research (Jutte, Roos, & Brownell, 2011).

3. Using administrative data to study ECD

The life course and ecological perspectives highlight that research aimed at understanding the multi-dimensional network comprising ECD requires data that possess both breadth and depth: individual-level measures across social and health domains, family

and area-level measures (such as income and neighborhood characteristics), participants from across the socioeconomic and health gradients, and multiple observations for individuals across time. Indeed, the ability to follow children, from a variety of backgrounds, measuring multiple levels of influence through several stages of the life course, across various domains is crucial to ECD research. Population-based, administrative data, linked across a variety of domains are capable of possessing both the breadth and depth required for ECD research. However, to date, few ECD studies have utilized such data.

Repositories of linkable administrative databases used for research purposes, such as those used in Canada and Australia (Brook, Rosman, & Holman, 2008; Jutte et al., 2011; Roos, Roos, Brownell, & Fuller, 2010), have features that make them well suited for conducting ECD research. The data in these repositories are generally population-based, meaning that they comprise nearly all residents within a given jurisdiction. In contrast, survey data, such as those data often used in ECD, are limited in that less-advantaged individuals (e.g., individuals of low socioeconomic status), when included, are often lost to follow-up (Jutte et al., 2011); as such, current understanding may be limited vis-à-vis the full extent to which disadvantage impacts a child’s development. Population-based administrative data provide a more comprehensive picture of development among less-advantaged children.

Another feature of repositories of linkable administrative datasets that make them well suited to ECD research is that they often contain databases across multiple domains including health, education, social services, and justice (Brownell et al., 2010; Malacova et al., 2008; Nickel et al., 2014; Roos et al., 2008, 2013), allowing researchers to consider a holistic set of individual, family, and community characteristics and their interactions with the physical, social, emotional, and cognitive development of children in the population. Survey data may be limited by reliance on self-report; administrative data on service utilization contains information on every contact with service systems for each child, eliminating recall and other biases affecting self-reported data. Furthermore, data systems that allow for children to be linked to their mothers (Brownell et al., 2011; Malacova et al., 2008), enable scientists to study how factors occurring during pre-conception and prenatal periods may impact ECD. Finally, survey data often do not easily facilitate ECD research from a life-course perspective; i.e., following a child from pre-conception onward. The linkages of person-level data across sectors and over time available through repositories of linked administrative datasets allow scientists to follow children from pre-conception through to school-entry, and beyond.

This research applied an ecological, life-course perspective to develop models for early childhood development and to study the pathways that connect socioeconomic factors, health, early development, and academic readiness for school. Specifically, this study (a) used individual-level, linked, population-based data held in the Population Health Research Data Repository housed at the Manitoba Centre for Health Policy, and (b) followed children from the prenatal period through to kindergarten. We used structural equation modelling (SEM) to both describe the complex network comprising ECD and conduct path analyses to differentiate between direct, indirect, and mediation effects within the system that comprises ECD. The specific objectives of this research were to:

- Understand how maternal health behaviors in the prenatal period relate to health status at birth.
- Examine the relationship between the child’s health status at birth and his/her language and cognitive development at kindergarten.

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