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## From Kindergarten readiness to fourth-grade assessment: Longitudinal analysis with linked population data

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### ABSTRACT

Early child development (ECD) – the development of physical, social–emotional, and language–cognitive capacities in the early years – is a foundation of health, well-being, learning, and behaviour across the life course. Consequently, the capacity to monitor ECD is an important facet of a modern society. This capacity is achieved by having in place an ongoing flow of high-quality information on the state of early child development, its determinants, and long-term developmental outcomes. Accordingly, there remains a considerable need for research that merges community-centred, longitudinal, and linked-data approaches to monitoring child development. The current paper addresses this need by introducing one method of summarising and quantifying the developmental trajectories of British Columbian children at the neighbourhood- or district-level: computing the *Community Index of Child Development (CICD)* for each geographic area. A simple index that describes change in children's developmental trajectories at the aggregate level, the *CICD* is computable because of our capacity to conduct individual-level linkage of two population data sets: the *Early Development Instrument (EDI)*, a holistic measure of children's readiness for school which is administered at Kindergarten, and the British Columbia Ministry of Education's *Foundation Skills Assessment (FSA)*, a Grade 4 measure of academic skills. In this paper, we demonstrate: (a) wide variation in the *CICDs* according to the children's district of residence in Kindergarten; (b) an association of the *CICDs* with an indicator of the socioeconomic character of the neighbourhoods; and (c) contrasting patterns of neighbourhood convergence and divergence in two different school districts – such that, in some areas, children from high vulnerability neighbourhoods tend to catch up between Kindergarten and Grade 4 whereas, in other areas, they tend to fall further behind.

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### Introduction

Early child development (ECD) – the development of physical, social–emotional, and language–cognitive capacities in the early years – is now recognized as a social determinant of health (World Health Organisation, 2007). ECD is influenced strongly by early life social circumstances

and has profound life-long effects on health, well-being, behaviour, and skill acquisition (Keating & Hertzman, 1999; Kershaw, Irwin, Trafford, & Hertzman, 2005). According to McCain, Mustard, and Shanker (2007), population-based research on ECD is necessary for understanding the capacity of our future population, and warrants the commitment of government, institutions, service providers, and individuals. The capacity to monitor ECD over time and by location is fundamental to this endeavour, and is achieved by having in place an ongoing flow of high-quality information on the state of early child development, its determinants, and long-term developmental outcomes. The most desirable

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approach, argues Hertzman (2008), would be to “create a coordinated ‘system of early child development statistics’ that is population-based, person-specific, and longitudinal in character. Moreover, it would need to be linkable at the level of the individual, and at the level of the group, to data on the social environments encountered by the developing child” (p. 3).

Regrettably, there remains a considerable need for research that merges community-centred, longitudinal, and linked-data approaches to monitoring early child development (Hertzman, 1999, 2008; Lloyd, 2008). A *community-centred* approach is one in which the social ecology of children’s early environments is viewed as being important for understanding ECD. A *longitudinal* approach is one in which information is collected at regular intervals so as to best capture the dynamic nature of ECD and long-term outcomes. Finally, a *linked-data* approach is one in which administrative records from multiple sources are merged, making population-based research on multiple domains of human experience feasible and cost-effective, minimising loss to follow-up, and reducing volunteer bias.

With an eye towards addressing this need for research that combines multiple approaches to monitoring ECD, the current paper introduces a method for reporting on the developmental trajectories of British Columbian children at the neighbourhood and school district level. In particular, this paper:

1. describes the process of linking, at the level of the individual child, two population-based databases: the *Early Development Instrument (EDI)*, a holistic measure of children’s physical, social, emotional, language, and communication skills development administered at Kindergarten, and the British Columbia Ministry of Education’s *Foundation Skills Assessment (FSA)*, a Grade 4 measure of numeracy, reading comprehension, and writing skills;
2. introduces the *Community Index of Child Development (CICD)*. A simple index of change we have created by individually linking Early Development Instrument and Foundation Skills Assessment records, the *CICD* may be used to describe the developmental trajectories of British Columbian children, at the neighbourhood (or district) level, from Kindergarten to Grade 4; and
3. uses data from our record linkage activities to illustrate the extent of variation in Kindergarten to Grade 4 developmental trajectories across actual (rather than synthetic or administratively defined) units of aggregation.

The *Community Index of Child Development* is a useful aggregate level descriptor of change for several reasons. For example, the *CICD*: (a) provides a means to summarise children’s longitudinal development, rather than simply making comparisons of cross-sectional data comprising different sets of children; (b) allows us to separate “vulnerable” children (those at developmental risk) from “non-vulnerable” children (those not at risk), thereby removing determinants of differential vulnerability; (c) serves as a useful outcome measure in future studies of the influence of community characteristics on children’s

development (e.g., socioeconomic, cultural/ethnic/immigration, social capital/civil society, community governance, and institutional performance); (d) provides a means to represent and quantify unexpected school success (better-than-expected school trajectories) or unexpected school failure (worse-than-expected school trajectories) at the aggregate level, as children move from Kindergarten to Grade 4; and arguably most important (e) provides a convenient and straightforward means to communicate to different audiences – such as policy-makers, parents, researchers, and educators – findings that merge community-centred, longitudinal, and linked-data approaches to monitoring child development. We are currently unaware of any other communication tool designed for this purpose.

Important to note at the outset is that, because both the Early Development Instrument (at Kindergarten) and the Foundation Skills Assessment (at Grade 4) are population-based, the longitudinal trajectories created by linking them together are not subject to volunteer bias nor to other sample selection effects. As time goes on, results of school testing in higher grades and school completion data will be available, allowing us to assess the prospects for health selection in educational success, using the EDI as a baseline health measure. Moreover, given the implications of ECD for long-term health, we will be able to assess how the socioeconomic characteristics of the neighbourhoods in which children reside matter for health trajectories across the life course.

Also important to note is that the physical, socioemotional, language/cognitive, and communication domains of school readiness measured by Kindergarten’s EDI, although moderately correlated, are distinct from one another. Only the physical scale can be construed as a direct measure of health, traditionally defined. However, many of the items on the other scales – physical aggression, helpfulness, understanding the language of the classroom, and being able to make oneself understood – relate directly to well-being. In recent years, social epidemiological approaches to the life course and health (Kuh & Ben-Shlomo, 1997) have begun to be complemented by a human development approach, which emphasises the role of early developmental trajectories as determinants of health over the life course (Schoon, Sacker, & Bartley, 2003). Early physical, socioemotional, and language/cognitive development has been shown to be associated with mid-life health and well-being through a mixture of latent, pathway, and cumulative effects (Hertzman & Power, 2005; Hertzman, Power, Matthews, & Manor, 2001). Thus, each scale of the EDI has been shown to be a predictor of health and well-being over the life course and early child development can be construed as a determinant of future health and well-being.

## Method

### Participants

We at the Human Early Learning Partnership (HELP) obtained from the British Columbia Ministry of Education the *Foundation Skills Assessment (FSA)* scores (described in a later section) for each individual British Columbian child for whom the *Early Development Instrument (EDI)* was

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