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Neighbourhood socioeconomic status indices and early childhood development

Simon Webb[a,*], Magdalena Janus[a], Eric Duku[a], Rob Raos[a], Marni Brownell[b], Barry Forer[c], Martin Guhn[c], Nazeem Muhajarine[d]

[a] Offord Centre for Child Studies, Department of Psychiatry and Behavioural Neurosciences, McMaster University, McMaster Innovation Park, 201A, 1280 Main Street West, Hamilton, ON, Canada L8S 4K1
[b] Manitoba Centre for Health Policy, University of Manitoba, MB, Canada, R3E 3P5
[c] The Human Early Learning Partnership, University of British Columbia, Suite 440, 2206 East Mall, Vancouver, BC, Canada V6T 1Z3
[d] Saskatchewan Population Health and Evaluation Research Unit, University of Saskatchewan, 104 Clinic Road, Saskatoon, SK, Canada S7N 5E5

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ABSTRACT

The developmental health of young children is highly influenced by the socioeconomic conditions in which they are raised. How to accurately measure these conditions is a point of debate in the current literature on child development, health, and social determinants. We have evaluated four existing indices of socioeconomic status (SES) to determine the most relevant for the analysis of early childhood development (ECD) in Canada. Following a literature review of published SES indices which used 2006 Canadian Census data, four indices were chosen based on their relevance to ECD and the number of citations in subsequent articles. These were: the Canadian Deprivation Index, the Socioeconomic Factor Index, the Canadian Marginalization Index and an index created by the Early Childhood Mapping Project in Alberta, Canada. The indices were replicated using SES data for 2038 customized geographic neighbourhoods encompassing 99.9% of the Canadian population, and the relationship of the indices to ECD was investigated by linking to aggregated data from the Early Development Instrument (EDI), a teacher-completed questionnaire used to assess kindergarten children's physical, social, emotional, and cognitive development, and communication skills. The derived SES indices were compared based on four criteria: the input variables used, the index structure, the interpretability of the index and the variance they explained (R^2) in the different EDI outcome measures. In terms of variance explained, material components of the SES indices (e.g., income, education) consistently showed the strongest association with children's language and cognitive development. The patterns of association for the non-material SES components and the other developmental domains of the EDI were more complex. We discuss the findings in regard to current developments in the field, and the need for refining empirical and theoretical approaches to examine associations between different facets of SES contextual factors and different aspects of ECD outcomes.

1. Introduction

Socioeconomic gradients in health outcomes have existed since the development of the first forms of agriculture, when the previously existing collective mentality of the hunter-gatherer communities was replaced by competitive independent workers (Frank & Mustard, 1994). Over time, the relationships between SES and health have evolved along with society. Socioeconomic gradients in health outcomes have both direct causes such as differences in access to nutrition, hygiene, work conditions, exposure to toxins, and exercise, as well as

indirect causes such as the impact of SES on stress levels and immune response (Frank & Mustard, 1994). Our understanding of health gradients at the individual level improved considerably after the Whitehall Study of British civil servants in 1967 (Marmot et al., 1991), which suggested that even after controlling for differences in behavioural factors, such as smoking and exercise, social class still had a substantial association with the health status of individuals. This was a seminal finding, because it suggested that aside from day-to-day access to resources, gradients in health outcomes may also be affected by other factors accumulating over the course of individuals' lives. In

particular, the Whitehall Study gave rise to an enhanced focus on stress as a critical causal mechanism that linked differences in social status to health outcomes. Furthermore, the study was seminal in spurring research in the area of social determinants of health. As a result, research over the past decades has accumulated evidence that shows that multiple social determinants, referring to the social conditions in which an individual lives, works and grows up, shape every person's day-to-day experiences.

"Socioeconomic status is commonly conceptualized as the social standing or class of an individual or group. It is often measured as a combination of education, income and occupation", (American Psychological Association; http://www.apa.org/topics/socioeconomic-status/). This is one of many similar definitions of socioeconomic status (SES) found within social science literature. As the term implies, the concept of SES includes a social aspect and an economic aspect. SES is conceptualized as a composite measure combining economic (finance and wealth), human (education and training) and social (family and community relationships) resources and safeguards (i.e., "capital") to which individuals or a community have access (Bradley & Corwyn, 2002). Townsend (1987) defined SES as the level of social and material deprivation of an individual in a society. He referred to deprivation as a state of disadvantage below socially acceptable levels compared to an individual's peers or surrounding community. While SES is often approximated by socioeconomic variables such as income or education, most authors acknowledge that single variables do not capture the complexity of the concept of SES (whether at an individual or group level) since it is inherently multi-dimensional (Krishnan, 2010; Martens, Frohlich, Carriere, Derksen, & Brownell, 2002; Matheson, Dunn, Smith, Moineddin, & Glazier, 2012; Messer et al., 2006; Pampalon & Raymond, 2000; Townsend, 1987). Rather, it is commonly proposed to use indices that combine multiple variables into overarching themes. Indices can differ in their variable composition and structure. While some indices were created based on the more traditional definition of SES involving social and material variables at various levels of analysis (Martens et al., 2002; Pampalon & Raymond, 2000; Townsend, 1987), others use expanded definitions that include cultural and demographic variables as well (Krishnan, 2010; Matheson et al., 2012). In health research, SES indices have commonly been used to examine socioeconomic gradients in population health outcomes, such as mortality, life expectancy, or disease prevalence rates (Krishnan, 2010; Martens et al., 2002). In addition to general health, SES at various levels of analysis has been shown to be associated with several indicators of child health. For instance, neighbourhood SES has been shown to relate to child injury rates (Brownell et al., 2010). Both neighbourhood- and family-level SES have been shown to correlate with childhood hospitalizations (Jutte et al., 2010). Further, family SES has been shown to correlate with mental health outcomes such as anxiety, ADHD, conduct disorders, and depression (Essex et al., 2006).

Individuals' experiences and socioeconomic circumstances can become biologically embedded over their lifetimes, especially during the developmentally sensitive period of early child development (ECD, Hertzman & Boyce, 2010), and thus influence a large range of health outcomes throughout the lifespan. The first five years of a child's life in particular are critically important for further development as they lay the foundations for development of complex skills in middle childhood and adolescence. Foremost, physiologically-based competencies, such as vision or hearing, need to be established in an optimal way in the first two years of life. Further, skills such as reasoning, understanding of symbols and relative quantities, self-regulation, develop through preschool years, with executive functioning – the decision-making skills – not fully maturing until adolescence. In the first years, the domains of development – physical, social, emotional, and cognitive (language, problem-solving, communication) are very closely inter-twined and correlated, and they are all reflecting the level of the child's developmental health. These domains all contribute to later markers of success such as academic achievement (Brinkman et al., 2013; Davies,

Janus, Duku, & Gaskin, 2016; Guhn, Gadermann, Almas, Schonert-Reichl & Hertzman, 2016), and socio-emotional well-being in later grades (Guhn, Gadermann, et al. 2016; Romano, Babchishin, Pagani, & Kohen, 2010). The Early Development Instrument (EDI, Janus & Offord 2007) is the only currently available indicator of ECD that allows researchers to examine variability across all of Canada in regard to children's early physical, social, emotional, language and cognitive, and communication skills development. In this paper, the five domains measured on the EDI will be referred to as measures of developmental health: optimal early child development is equivalent to optimal developmental health. Simply put, a child cannot achieve a high level of proficiency in the domains addressed here without being physically and mentally healthy.

There has been considerable attention in the recent population health literature given to the relationships between SES and ECD, since ECD is a strong determinant of health outcomes later in life (Case, Fertig, & Paxson, 2005; Heckman, 2011; Johnson & Schoeni, 2011). For example, Currie (2009) showed that children's SES has a causal effect on labour market outcomes later in life, perpetuated through gaps in childhood health. Further, in the late 1990s, a number of prominent researchers proposed that socioeconomic gradients for children might not exactly follow those for adults (Keating & Hertzman, 1999). In a comprehensive review of neuroscience research, aiming to determine the effects of traditionally defined (material and social) SES at the individual level on the developing brain, Hackman & Farah (2009) found that children's SES backgrounds tended to have a significant impact on various parts of the brain while developing in early childhood and in particular on the parts that control language and executive function. There is also some contradictory evidence in the literature regarding the SES measurement level most relevant to developmental health outcomes. For instance, in Chicago, Gibson, Sullivan, Jones, & Piquero (2009) found that neighbourhood SES was significantly correlated with children's self control, but this became non-significant when family-level SES was taken into account. In contrast, in a study of children in the Netherlands, Kalff et al. (2001) found that a significant effect of neighbourhood SES on child behaviour problems existed irrespective of individual-level SES.

What is lacking in the literature is a nuanced understanding of which operationalizations of SES are most relevant to ECD outcomes. In the current literature, associations are mostly examined using SES indices created for general populations, rather than for children specifically. The purpose of this paper is to evaluate different measures of neighbourhood SES based on their variable composition, structure, interpretability and level of association with ECD outcomes. In particular, we investigate which attributes of previously published and widely used Canadian SES indices are most important in the analysis of ECD, as measured by the EDI. It is our goal that ECD researchers use the findings of this study to inform their choice of neighbourhood SES indices. Particularly, our work will provide them with the necessary criteria to select an SES measure that will fit the requirements of their respective analyses.

2. Methods

2.1. Selection of Canadian census-based SES indices

The first step in our study was to identify Canadian census-based neighbourhood SES indices that had previously been used in research studies to examine socioeconomic gradients in health. Important pragmatic criteria for our search were that SES indices had to be derived using Canadian census data and that the source needed to provide methodological detail that would allow us to replicate the SES indices for our own empirical analyses. The complementary conceptual criterion was for the selected indices to have been based on theoretical underpinnings of the association between SES components included in the index and child health outcomes. Specifically, this final criterion