

# International Journal of Population Data Science

Journal Website: [www.ijpds.org](http://www.ijpds.org)



Swansea University  
Prifysgol Abertawe

## A Pan-Canadian Data Resource for Monitoring Child Developmental Health: The Canadian Neighbourhoods and Early Child Development (CanNECD) Database

Janus, M<sup>1</sup>, Enns, J<sup>2</sup>, Forer, B<sup>3</sup>, Raos, R<sup>1</sup>, Gaskin, A<sup>1</sup>, Webb, S<sup>1</sup>, Duku, E<sup>1</sup>, Brownell, M<sup>2</sup>, Muhajarine, N<sup>4</sup>, and Guhn, M<sup>3</sup>

### Submission History

Submitted:	22/11/2017
Accepted:	07/05/2018
Published:	21/09/2018

<sup>1</sup>Offord Centre for Child Studies, McMaster University, Hamilton, Canada

<sup>2</sup>Manitoba Centre for Health Policy, Department of Community Health Sciences, University of Manitoba, Winnipeg, Canada

<sup>3</sup>Human Early Learning Partnership, School of Population and Public Health, University of British Columbia, Vancouver, Canada

<sup>4</sup>Department of Community Health and Epidemiology and Saskatchewan Population Health and Evaluation Research Unit, University of Saskatchewan, Saskatoon, Canada

### Abstract

The Canadian Neighbourhoods and Early Child Development (CanNECD) database is a unique resource for research on child developmental health and well-being within the socioeconomic and cultural context of Canadian neighbourhoods. This paper describes the CanNECD database and highlights its potential for advancing research at the intersection of child development, social determinants of health, and neighbourhood effects.

The CanNECD database contains cross-sectional population-level child developmental health data from all across Canada collected through regional implementation of the Early Development Instrument (EDI), geo-coded information on residential neighbourhoods covering all of Canada, and socioeconomic and demographic variables from the Canada Census and Income Taxfiler database. Individuals are not identified in the database, as no identifying information, such as names and addresses, is attached to the EDI record. At data collection, each individual child is given a unique number which is a combination of site, school, and position on a class list. Each neighbourhood receives a unique identifier which then is linkable across datasets. The nearly 800,000 EDI records spanning 2003-2014 and representing all Canadian provinces and territories (with the exception of Nunavut) are compiled in a secure electronic collection system at the Offord Centre for Child Studies, McMaster University in Hamilton, Canada.

Early studies using the EDI demonstrated its utility as a tool for assessing child developmental health at a population level, and its potential for both community-level and large-scale monitoring of child populations. Research using the CanNECD database is now examining to what extent social determinants and the steepness of the social gradients of developmental health differ between geographical jurisdictions and between different sub-populations. We are also working to identify outlier neighbourhoods in which EDI scores are substantially higher or lower than predicted by a neighbourhood's demographic and socioeconomic characteristics, and exploring other potentially important determinants of children's developmental health. Finally, we are examining the extent to which change-over-time in aggregate EDI scores varies geographically, and how well it coincides with changes in socioeconomic factors. Thus, the CanNECD database offers the opportunity for research that will inform national policies and strategies on child developmental health.

## Introduction

The early years of a child's life are critical for long-term health and well-being. A large body of social and medical sciences research describes the factors that are vital for different aspects of children's developmental health: the presence of a loving, supportive caregiver is essential for attachment formation [1]; play and creative learning opportunities for early social and cognitive development [2]; food security and a balanced diet for healthy early physical development [3]; and universally accessible and affordable child and family care, health, and education services are significantly associated with positive developmental health outcomes in multiple domains [4]. In addition, the physical environment (i.e., the neighbourhood)

in which young children live and grow provides important resources and exposures that influence child development [5;6]. However, monitoring children's well-being and identifying areas of risk requires current and systematic data that paint a detailed picture of child developmental health. Canada lacks such comprehensive up-to-date information on the state of child development contextualized by social and cultural characteristics and resources of the neighbourhoods where they live. This continues to be an important barrier for the successful implementation of effective early child development and education programs and policies [7;8].

We have begun to address this gap by establishing the first population-level Pan-Canadian data system on children's developmental health, the Canadian Neighbourhoods and Early

\*Corresponding Author:

Email Address: [janusm@mcmaster.ca](mailto:janusm@mcmaster.ca) (M Janus)

Child Development (CanNECD) database [9]. The CanNECD database holds de-identified, linkable data from several different sources: (i) Developmental health data in five core domains are collected using the Early Development Instrument (EDI), a questionnaire completed by kindergarten teachers [10]. The five developmental domains measured by the EDI are physical health and wellbeing; social competence; emotional maturity; language and cognitive development; and communication skills and general knowledge. The questionnaire is completed for each child individually, and the results are then reported at aggregate levels (e.g., by neighbourhood, school division, or province). EDI scores are aggregated to the levels of analysis and used to assess the proportion of children who could be considered 'developmentally vulnerable', and therefore can provide an estimate of the proportion of the child population at risk for future academic or societal challenges and lower levels of well-being [10]. The CanNECD database also contains (ii) geo-coded information on the boundaries of 2,058 residential neighbourhoods, representing the entirety of Canada, as well as (iii) socioeconomic and demographic data from the Canadian Census and Income Taxfiler database at levels corresponding to these neighbourhood boundaries [9]. With the ability to link developmental health, geographic, socioeconomic and demographic information across these datasets, CanNECD provides a platform for studying child developmental health and well-being within the socioeconomic and cultural context of Canadian neighbourhoods. Thus, this data resource offers a unique opportunity for conducting research that will inform national policies and strategies on child developmental health.

## The CanNECD Database

### Area and Population Coverage

In Canada, kindergarten represents the first year of the public education system accessible to all children. Kindergarten attendance is not strictly mandatory in most provinces, but close to 90% of eligible children participate [11]. Most children enroll in kindergarten in the academic year (September to June) or during the calendar year (January to December) in which they will turn five years old. Ontario and Quebec offer both junior and senior kindergarten, with admission to junior kindergarten beginning at age four. The CanNECD database contains EDI data for senior-kindergarten-age (5-year-old) children across Canada.

Implementation of the EDI began in the late 1990s in a small number of communities, and over time, the EDI data collection has expanded into regular province-wide data collections: specifically, the EDI has been implemented at least once in all ten Canadian provinces and two of the three territories, with the exception of Nunavut (Table 1). In most provinces and territories, the instrument is implemented either every year (e.g., Northwest Territories), or in waves of two to three years, so that different subsets (school districts or geographical regions) of the population of children attending kindergarten are sampled until each neighbourhood in the jurisdiction is fully represented at the population level (e.g., British Columbia, Ontario). In Manitoba, Quebec and Alberta, the EDI is implemented in semi-regular intervals for the

entire province. The CanNECD database currently holds aggregated EDI information collected from nearly 800,000 children through population-level regional implementation over a span of 11 years (2003/04-2013/14). However, it excludes EDI data that were collected for restricted, sample-based research purposes. As the EDI data include almost 100% of children attending publicly funded kindergarten in the year of implementation, our estimates indicate that this includes approximately 82-96% of all children in any given cohort [11].

## Data Sources and Data Measures

### Child Developmental Health: Early Development Instrument Data

The EDI is a 103-item questionnaire on which teachers rate children's characteristics, behaviours, competencies, and abilities to meet age-appropriate developmental expectations in five general domains: 1) physical health and well-being; 2) social competence; 3) emotional maturity; 4) language and cognitive development; and 5) communication skills and general knowledge [10]. Within these domains, items are further divided into subdomains. For example, the physical health and well-being domain includes the subdomains 'gross and fine motor skills', 'physical independence', and 'physical readiness for the school day'. Social competence questions pertain to, for example, children's approaches to learning and readiness to explore new things. Language and cognitive development is measured through questions about, for example, children's basic literacy levels and memory. The full list of EDI questions, nested within the five domains and the 16 subdomains, is available online at <https://edi.offordcentre.com/researchers/domains-and-subdomains/>. A detailed list of the EDI variables in the CanNECD database is provided in Supplemental Table 1.

### Defining Neighbourhood Boundaries: Canadian Neighbourhoods Data

A systematic neighbourhood boundary algorithm was used to create 2,058 contiguous and discrete residential neighbourhood units spanning all provinces and territories where EDI data are available. The unit boundaries are designed to optimally portray geographic and socioeconomic variability across neighbourhoods in accordance with pre-defined inclusion and exclusion criteria and appropriate definitions ranging from high-density urban to low-density rural areas [9]. A detailed description of the neighbourhood definition process is available elsewhere [9], but in brief, each neighbourhood had to have a minimum of 50 and a maximum of 400-600 EDI records; the neighbourhood boundaries nest within Statistics Canada Census Divisions and align with local or administrative boundaries where possible. Throughout the neighbourhood definition process, we consulted with government and community representatives to ensure that the neighbourhood boundaries matched those being used for local governance and community planning. We also conferred with academic groups conducting early childhood development research in each province to ascertain that the new neighbourhood boundaries met scientific criteria for locally meaningful neighbourhood effects research.

Table 1: Distribution of EDI Records in the CanNECD Database by Canadian Province/Territory and Year

	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	Total
<b>BC</b> <sup>1,3,4</sup>	-	6,830	21,847	9,734	3,164	35,020	25,033	21,911	12,485	30,034	-	166,058
<b>AB</b> <sup>1,2</sup>	-	-	-	-	-	9,641	21,976	20,881	14,492	20,734	-	87,724
<b>SK</b> <sup>1,2,3</sup>	-	-	-	-	-	5	6,181	5,501	-	-	-	11,687
<b>MB</b> <sup>1,2,3</sup>	-	-	12,214	12,092	-	12,139	-	12,885	13,538	-	-	62,868
<b>ON</b> <sup>1,2,3</sup>	20,185	46,743	58,085	20,494	40,742	59,127	33,384	38,728	57,089	-	-	374,577
<b>QC</b> <sup>1,2,4</sup>	-	-	-	-	-	-	-	-	65,498	-	-	65,498
<b>NL</b> <sup>1,2</sup>	-	-	-	-	-	-	-	-	-	4,942	5,182	10,124
<b>NB</b> <sup>1,2</sup>	-	-	-	-	-	7,252	-	-	-	-	-	7,252
<b>PEI</b> <sup>1</sup>	-	-	-	-	1,147	-	-	-	-	-	-	1,147
<b>NS</b> <sup>1,2</sup>	-	-	-	-	-	-	-	-	8,592	-	-	8,592
<b>YT</b>	-	-	-	-	-	-	362	344	368	401	-	1,475
<b>NWT</b> <sup>1,2</sup>	-	-	-	-	-	-	-	672	659	654	-	1,985
<b>Total</b>	20,185	53,573	92,146	42,320	45,053	123,184	86,936	100,922	172,721	56,765	5,182	798,987

EDI data collected for the purposes of specific research projects on samples of children are not included in the CanNECD database. Each school is included only once per wave. Regional data collections include <sup>1</sup>publically funded schools; <sup>2</sup>Francophone schools (Anglophone for Quebec); <sup>3</sup>some on-reserve schools; <sup>4</sup>privately funded (tuition paid) schools. BC: British Columbia; AB: Alberta; SK: Saskatchewan; MB: Manitoba; ON: Ontario; QC: Quebec; NL: Newfoundland and Labrador; NB: New Brunswick; PEI: Prince Edward Island; NS: Nova Scotia; YT: Yukon Territory; NWT: Northwest Territories. No data are available from Nunavut.

### Demographic and Socioeconomic Characteristics: Canadian Census and Taxfiler Data

The Canadian Census is conducted every five years by Statistics Canada. The CanNECD database contains results from two implementations of the Census (2006 and 2011), including population demographics, income, employment, immigration, language, education, mobility, and housing variables. Taxfiler data, which report on information from personal tax returns, are available annually. The CanNECD database contains Taxfiler data from 2005 and 2010, to match the income variables from the 2006 and 2011 censuses. The Taxfiler data comprise approximately 400 custom-defined variables per census year. These variables provide information on various aspects of income, poverty and wealth, as well as child and family policy-relevant characteristics such as expense deductions and tax benefits. These variables are reported for eight different family types, including single- and couple-parent families, and families with and without young children. For CanNECD, the Census and Taxfiler data were aggregated by Statistics Canada according to CanNECD's custom geo-coded neighbourhood boundaries, and were then linked to neighbourhood-level aggregate EDI data in the CanNECD database.

## Creating the CanNECD Database

### EDI Data Collection

The EDI is completed in a two-month window between February and April of the kindergarten year (which begins in September) in participating schools. In preparation for data collection, kindergarten teachers are offered an in-person training session and written materials (including guides, instructional videos, templates and manuals) to support EDI completion. The time teachers spend on training and data collection is paid for by

provincial governments and other sources, but participation is voluntary, and schools, teachers, and children are allowed to withdraw from the questionnaire administration. At no time are children's names collected; instead, a unique numeric indicator called the EDI ID is created by the Offord Centre for Child Studies (OCCS) for each student. In earlier years, the EDI was implemented using paper forms that were filled out by teachers and then sent to OCCS where questionnaires were scanned and data transferred into a secure electronic database. EDI data collection has since been phased into a web-based system called the e-EDI; teachers now log into a secure website to enter their responses, and these are automatically compiled in an electronic collection system.

### Data Quality Assessment and Anonymization of EDI Data

EDI records included in the CanNECD database first underwent rigorous data quality assessment, wherein they were examined for inconsistencies, missing values, and out-of-range values. Where possible, any inconsistencies were investigated at both OCCS and with the respective provincial and school board contacts. Once the data were scored and all variables computed, the full data file was subdivided to protect the children's anonymity. Each dataset contained either EDI core item scores or the children's demographic indicators, but not both. For example, variables such as school name and school board name were available in one data file, whereas gender and date of birth were saved to a separate file. The EDI ID was included in all datasets so the respective variables could be linked during analyses guided by specific research questions.

## Data Cleaning, Scoring and Compilation

EDI data were cleaned and scored before they were aggregated and added to the CanNECD database. Data from questionnaires with more than 25% of responses missing for more than one of the five EDI domains were not included in the calculation of population-level statistics or results; however, missing responses were included in analyses of data validity. Also excluded were questionnaires with missing data on whether or not a child had special needs. Only questionnaires completed for children in kindergarten (or senior kindergarten in Ontario and Quebec) that had been in a teacher's class for more than one month were included in analyses. The method used to score EDI responses and calculate results (e.g., percentage of developmentally vulnerable children within a neighbourhood) in each of the five domains has been previously described [10].

While the core EDI developmental questions (pertaining to the five domains) and standard demographic information (date of birth and date of completion, child gender, English/French learner status, first language, and Special Needs status) were consistent among all jurisdictions, additional customized variables have routinely been added for each province/territory. Sometimes these differed not only between jurisdictions but also between years within a jurisdiction. A process of cleaning and harmonization of the database ensures consistency in national coverage. Only the variables for which there were consistent data, including a valid postal code, were retained in the CanNECD database (Supplemental Table 1).

## Integration of Neighbourhood, Census and Taxfiler Data into the CanNECD Database

The procedures we conducted to establish comparable national neighbourhood boundaries are highlighted above and described in more detail elsewhere [9]. Briefly, to integrate the neighbourhood data into the CanNECD database, EDI scores and demographic variables in the harmonized database were matched with neighbourhood boundaries by analysts at Statistics Canada, who calculated a population-weighted aggregate for each variable for each of the 2,058 neighbourhoods. The resulting, custom-built data file was sent to OCCS, and the EDI data were then matched with customized Census information from 2006 and 2011 years, and Taxfiler information from 2005 and 2010 (years corresponding to the 2006 and 2011 Census). Thus, the resulting CanNECD database includes aggregated neighbourhood-level (i) EDI-based developmental health data, (ii) demographic data, and (iii) socioeconomic data.

## Privacy and Ethics

Ethics approval for collecting the EDI was granted by McMaster University. Prior to EDI data collection, parents of kindergarten students were informed of the purpose of the project via an information letter, providing them with detailed information on consenting to or opting out of EDI data collection. All EDI data in the CanNECD database were collected through "passive" consent (parents had to inform the school if they wanted to opt out; if no such information was received, data were collected for the child), with the exception of Alberta, where active consent was required.

## Challenges in Creating the CanNECD Database

We faced numerous logistic, conceptual, legal, and methodological challenges in planning and constructing the CanNECD database. The feature making this database possible was the Pan-Canadian commonality in the developmental health measure (the EDI) and in data collection routines across the country. Still, some demographic and educational variables in the CanNECD database needed to be retrofitted in order to harmonize provincial and territorial datasets. For example, the Northwest Territories did not use the "Aboriginal status" demographic item but instead had one for "ethnic status". Also, since the public education system in Canada is governed by individual jurisdictions, there were differences in variable names and/or definitions pertaining to the education system. For example, "Special Needs" status is contained in all jurisdictional databases, and the variable was included in the harmonization process, but jurisdictional differences in the definition of sub-categories subsumed under the 'Special Needs' variable impose some limitations on the comparability of this variable.

A second challenge was defining neighbourhoods that would be meaningfully comparable across the extreme variability in population density across different regions in Canada. As described above, we established an algorithm that, for statistical reliability and data privacy purposes, required that each 'neighbourhood' had to have at least 50 EDI scores for each available wave of data collection. As a result, some 'neighbourhoods' in very sparsely populated areas were enormously large, mostly covering uninhabited land. Also, coverage rates for the EDI varied locally and over time, which meant that some neighbourhoods needed to be construed as larger than if EDI data for all local kindergarten children had been collected at each data collection. Finally, the neighbourhood boundaries were defined with the purpose that our neighbourhoods were relevant to the community partners implementing the EDI. In the consultation process with these partners, it became clear that in some instances – mostly in smaller jurisdictions – our neighbourhood boundaries would differ from locally used administrative boundaries (e.g., school district and health units). That is, although our methods took locally used administrative boundaries into account, exact alignment was not always possible (e.g., when not consistent with the criteria for our neighbourhood boundary algorithm). Given that EDI data are widely used for local planning (and at different levels of aggregation), our consultation therefore led to an agreement with our local partners that the CanNECD neighbourhoods were designed for and would be used for representative comparative (Pan-Canadian) research purposes, but that multiple other aggregations of EDI data (e.g., school district and health units) would remain in use for local planning.

## Research using the CanNECD Database

### Peer-Reviewed Research

To date, over 100 peer-reviewed empirical, conceptual, and theoretical articles pertaining to the EDI have been published.

The articles span child development research in the areas of health, education, psychology, and sociology, and also reflect the comprehensive studies that have examined multiple aspects of the EDI's reliability and validity. This includes three invited special journal issues dedicated to EDI research in *Early Education & Development* in 2007 [12], *Social Indicators Research* in 2011 [13], and *Early Childhood Research Quarterly* in 2016 [14]. Early studies introduced the EDI as a tool for assessing child developmental health at a population level, and demonstrated the EDI's potential for both community-level and large-scale monitoring of child populations [15-20]. Later work used provincial data or samples of national data to examine the validity of the EDI as a common tool across jurisdictions for studying children's developmental trajectories and social and educational outcomes [21-27]. More recently, longitudinal data linkage studies have used the EDI to predict vulnerabilities in language and cognitive development [28-30], examine the association between child developmental health at kindergarten and later academic achievement [31-33], and analyze how physical and social settings (i.e., neighbourhoods) are associated with early child development [6, 34-37]. A regularly updated bibliography of published works including EDI analyses is available at: <https://edi.offordcentre.com/resources/bibliography-of-the-edi/>.

### Ongoing Research

The CanNECD program of research focuses on children's developmental health from a population perspective. Given that population-level developmental health data had not previously been available and could not be contextualized with socioeconomic data, the CanNECD research program has unique potential to inform early child development practice, programs and policies. Our analyses focus on examining variability in social gradients in early child development and health outcomes. Our first step was to develop a Pan-Canadian socioeconomic status (SES) index composed of the 10 Census and Taxfiler variables that maximize the amount of explained variation in EDI scores across all Canadian neighbourhoods (manuscript under development). The CanNECD SES Index will allow us to examine to what extent social determinants and the steepness of the social gradients of children's developmental health differ among geographical jurisdictions and among sub-populations of children, such as those categorized by gender or first language. A specific aim of the research program is to identify outlier neighbourhoods in which child developmental health is substantially higher or lower than predicted by the neighbourhoods' socioeconomic characteristics, and explore other potentially important determinants of children's health that may be associated with these particularly fragile or resilient neighbourhoods. Lastly, research using the CanNECD database will foster improved understanding of the extent to which change-over-time in aggregate EDI scores (e.g., aggregated by neighbourhood, school district, or province) varies geographically, and how well it coincides with change-over-time in socioeconomic factors.

### Future Directions

The CanNECD database is unprecedented in its Pan-Canadian neighbourhood-level linkages between demographic, socioeco-

nomie and child developmental health data. Specifically, it allows one to examine local variability in children's developmental health, across Canada and over time, while also allowing differentiated analyses of the socioeconomic determinants of children's developmental health. The database can representatively illustrate the extent of inequalities in Canadian children's developmental health and associated socio-economic inequities. Thus, it serves as a platform for future research that aims to establish population-level developmental health trajectory databases, and is also an important resource for researchers aiming to raise community awareness, inform policy, and mobilize resources both locally and nationally to support children's developmental health in order to ameliorate the observed inequalities.

## Accessing the CanNECD Database: A Resource for Early Child Development Researchers

The CanNECD database is held on a secure network at the Offord Centre for Child Studies at McMaster University in Hamilton, Ontario, Canada. Interested parties wishing to obtain research access to the database are invited to submit a short application, upon approval of which the full anonymized, neighbourhood-aggregated dataset can be downloaded from a secure server at the Offord Centre for Child Studies. The application asks for a brief outline of the researcher's background and description of their intended research project. This process is meant to ensure that the dataset is applicable for the project and to avoid duplication of efforts. To request the application form, please contact Dr. Magdalena Janus ([janusm@mcmaster.ca](mailto:janusm@mcmaster.ca)). Published studies using the CanNECD database will be added to the Bibliography of the EDI compiled at <https://edi.offordcentre.com/resources/bibliography-of-the-edi/>. As new projects supporting the database are funded, it will be updated with subsequent EDI cohorts and the most recent Census and Taxfiler data.

## Acknowledgements

The creation of the CanNECD database and consolidation of developmental health data for research purposes is supported by an operating grant from the Canadian Institutes of Health Research (FRN 125965). However, the collection of data over the years was funded by many other sources, usually provincial governments, and relied on the voluntary participation and professionalism of the many kindergarten teachers who completed the questionnaire.

## Conflict of Interest Statement

The authors declare that they have no competing interests.

## Abbreviations

CanNECD	Canadian Neighbourhoods and Early Child Development
EDI	Early Development Instrument
OCCS	Offord Centre for Child Studies
SES	Socioeconomic status

## References

- Whitcomb DA. Attachment, occupation, and identity: Considerations in infancy? *Journal of Occupational Science*. 2012;19(3):271-82. <https://doi.org/10.1080/14427591.2011.634762>
- Bronfenbrenner U. *Making human beings human: Biological perspectives on human development*. Thousand Oaks, CA: Sage Publications; 2005.
- Pérez-Escamilla R. Food insecurity in children: Impact on physical, psychoemotional, and social development. In: Roos AC, Caballero B, Cousins RJ, Tucker KL, Ziegler TR, editors. *Modern nutrition in health and disease*. 11th ed. Wolters Kluwer Health Adis; 2012. p. 1006-15.
- Zigler E, Styfco SJ. America's Head Start Program: An effort for social justice. In: Turiel E, Smetana JG, Wainryb C, editors. *Social Development, Social Inequalities, and Social Justice*. Taylor & Francis; 2012. p. 53-80. <https://doi.org/10.4324/9780203810132>
- Christian H, Zubrick SR, Foster S, Giles-Corti B, Bull F, Wood L, et al. The influence of the neighborhood physical environment on early child health and development: A review and call for research. *Health & Place*. 2015;33:25-36. <https://doi.org/10.1016/j.healthplace.2015.01.005>
- Minh A, Muhajarine N, Janus M, Brownell M, Guhn M. A review of neighborhood effects and early child development: How, where, and for whom, do neighborhoods matter? *Health & Place*. 2017;46:155-74. <https://doi.org/10.1016/j.healthplace.2017.04.012>
- Andrew AB, Ben-Arieh A. Measuring and monitoring children's well-being across the world. *Social Work*. 1999;44(2):105-15. <https://doi.org/10.1093/sw/44.2.105>
- Ben-Arieh A. The child indicators movement: Past present, and future. *Child Indicators Research*. 2008;1(1):3-16. <https://doi.org/10.1007/s12187-007-9003-1>
- Guhn M, Janus M, Enns J, Brownell M, Forer B, Duku E, et al. Examining the social determinants of children's developmental health: Protocol for building a pan-Canadian population-based monitoring system for early childhood development. *BMJ Open*. 2016;6:e012020. <https://doi.org/10.1136/bmjopen-2016-012020>
- Janus M, Offord D. Development and psychometric properties of the Early Development Instrument (EDI): A measure of children's school readiness. *Canadian Journal of Behavioral Science*. 2007;39(1):1-22. <https://doi.org/10.1037/cjbs2007001>
- Raos R, Janus M. Examining spatial variations in the prevalence of behaviour problems among 5-year-old children in Canada. *Soc Sci Med*. 2011;72(3):383-8. <https://doi.org/10.1016/j.socscimed.2010.09.025>
- Guhn M, Janus M, Hertzman C. The Early Development Instrument [Special Issue]. *Early Education & Development*. 2007;18(3). <https://doi.org/10.1080/10409280701610622>
- Guhn M, Zumbo BD, Janus M, Hertzman H. Validation Theory and Research for a Population-Level Measure of Children's Development, Wellbeing, and School Readiness [Special Issue]. *Social Indicators Research*. 2011;103(2).
- Harrison LJ, Janus M. International Research Utilizing the Early Development Instrument (EDI) as a Measure of Early Child Development. *Early Childhood Research Quarterly*. 2016;35:1-134.
- Janus M, Duku E. The school entry gap: Socioeconomic, family, and health factors associated with children's school readiness to learn. *Early Education & Development*. 2007;18(3):375-403. <https://doi.org/10.1080/10409280701610796a>
- Forget-Dubois N, Lemelin JP, Boivin M, Dionne G, Séguin JR, Vitaro F, et al. Predicting early school achievement with the EDI: A longitudinal population-based study. *Early Education & Development*. 2007;18(3):405-26. <https://doi.org/10.1080/10409280701610796>
- Lapointe VR, Ford L, Zumbo BD. Examining the relationship between neighbourhood environment and school readiness for kindergarten children. *Early Education & Development*. 2007;18(3):473-95. <https://doi.org/10.1080/10409280701610846>
- Lesaux NK, Vukovic RK, Hertzman C, Siegel LS. Context matters: The interrelatedness of early literacy skills, developmental health, and community demographics. *Early Education & Development*. 2007;18(3):497-518. <https://doi.org/10.1080/10409280701610861>
- Keating DP. Formative evaluation of the Early Development Instrument: Progress and prospects. *Early Education & Development*. 2007;18(3):561-70. <https://doi.org/10.1080/10409280701610937>
- Guhn M, Janus M, Hertzman C. The Early Development Instrument: Translating school readiness assessment into community actions and policy planning. *Early Education & Development*. 2007;18:369-74. <https://doi.org/10.1080/10409280701610622>

21. Janus M, Brick SA, Duku ER. Validity and psychometric properties of the Early Development Instrument in Canada, Australia, United States and Jamaica. *Social Indicators Research*. 2011;103:283-97. <http://dx.doi.org/10.1007/s11205-011-9846-1>
22. Guhn M, Gadermann A, Zumbo BD. Does the EDI measure school readiness in the same way across different groups of children? *Early Education & Development*. 2007;18(3):453-72. <https://doi.org/10.1080/10409280701610838>
23. Forer B, Zumbo BD. Validation of multilevel constructs: Validation methods and empirical findings for the EDI. *Social Indicators Research*. 2011; <https://doi.org/10.1007/s11205-011-9844-3>
24. Hymel S, LeMare L, McKee W. The Early Development Instrument: An examination of convergent and discriminant validity. *Social Indicators Research*. 2011;103(267). <https://doi.org/10.1007/s11205-011-9845-2>
25. Guhn M, Zumbo BD, Janus M, Hertzman C. Validation theory and research for a population-level measure of children's development, wellbeing, and school readiness. *Social Indicators Research*. 2011;103(2):183-91. <https://doi.org/10.1007/s11205-011-9841-6>
26. Muhajarine N, Puchala C, Janus M. Does the EDI equivalently measure facets of school readiness for aboriginal and non-aboriginal children? *Social Indicators Research*. 2007;103(2):299-314. <https://doi.org/10.1007/s11205-011-9847-0>
27. Guhn M, Goelman H. Bioecological theory, early child development and the validation of the population-level Early Development Instrument. *Social Indicators Research*. 2011;103(2):193. <https://doi.org/10.1007/s11205-011-9842-5>
28. Brownell M, Ekuma O, Nickel NC, Chartier M, Koseva I, Santos RG. A population-based analysis of factors that predict early language and cognitive development. *Early Childhood Research Quarterly*. 2016;35(2):6-18. <https://doi.org/10.1016/j.ecresq.2015.10.004>
29. Davies S, Janus M, Duku E, Gaskin A. Using the Early Development Instrument to examine cognitive and non-cognitive school readiness and elementary school achievement. *Early Childhood Research Quarterly*. 2016;35(2):63-75. <https://doi.org/10.1016/j.ecresq.2015.10.002>
30. Guhn M, Milbrath C, Hertzman C. Associations between child home language, gender, bilingualism and school readiness: A population-based study. *Early Childhood Research Quarterly*. 2016;35(2):95-110. <https://doi.org/10.1016/j.ecresq.2015.11.003>
31. Guhn M, Gadermann AM, Almas A, Schonert-Reichl KA, Hertzman C. Associations of teacher-rated social, emotional, and cognitive development in kindergarten to self-reported wellbeing, peer relations, and academic test scores in middle childhood. *Early Childhood Research Quarterly*. 2016;35(2):76-84. <https://doi.org/10.1016/j.ecresq.2015.12.027>
32. Ip P, Rao N, Bacon-Shone J, Li SL, Ho FK, Chow C, et al. Socioeconomic gradients in school readiness of Chinese preschool children: The mediating role of family processes and kindergarten quality. *Early Childhood Research Quarterly*. 2016;35(2):111-23. <https://doi.org/10.1016/j.ecresq.2015.10.005>
33. Guthridge S, Li L, Silburn S, Li SQ, McKenzie J, Lynch J. Early influences on developmental outcomes among children, at age 5, in Australia's Northern Territory. *Early Childhood Research Quarterly*. 2016;35(2):124-34. <https://doi.org/10.1016/j.ecresq.2015.12.008>
34. Martens PJ, Chateau DG, Burland EM, Finlayson GS, Smith MJ, Taylor CR, et al. The effect of neighborhood socioeconomic status on education and health outcomes for children living in social housing. *Am J Public Health*. 2014 Nov;104(11):2103-13. [10.2105/AJPH.2014.302133](https://doi.org/10.2105/AJPH.2014.302133)
35. Oliver LN, Dunn JR, Kohen DE, Hertzman C. Do neighbourhoods influence the readiness to learn of kindergarten children in Vancouver? A multilevel analysis of neighbourhood effects. *Environment and Planning*. 2007;A(39):848-68. <https://doi.org/10.1068/a37126>
36. Kershaw P, Forer B, Irwin LG, Lapointe V. Toward a social care program of research: A population-level study of neighborhood effects on child development. *Early Education & Development*. 2007;18(3):535-60. <https://doi.org/10.1080/10409280701610929>
37. Cushon J, Vu LTH, Janzen BL, Muhajarine N. Neighborhood poverty impacts children's physical health and well-being over time: Evidence from the Early Development Instrument. *Early Education & Development*. 2011;22:183-205. <https://doi.org/10.1080/10409280902915861>



Supplemental Table 1. Early Development Instrument Variables in the CanNECD Database

<b>Variable Name</b>	<b>Label</b>
<b>ncode</b>	Unique Neighbourhood Code
<b>prov</b>	Province
<b>Imp</b>	Implementation
<b>count</b>	Number of EDIs Aggregated
<b>sn</b>	Percentage of Children with Special Needs
<b>female</b>	Percentage of Female Children
<b>male</b>	Percentage of Male Children
<b>ms_sex</b>	Percentage Missing Sex
<b>efsl</b>	Percentage of Children with English or French as a Second Language
<b>no_efsl</b>	Percentage of Children without English or French as a Second Language
<b>ms_efsl</b>	Percentage of Children Missing E/FSL Status
<b>abst</b>	Percentage with an Aboriginal Status
<b>no_abst</b>	Percentage without Aboriginal Status
<b>dk_abst</b>	Percentage don't know Aboriginal Status
<b>ms_abst</b>	Percentage Missing Aboriginal Status
<b>age</b>	Average Age in Years
<b>ms_phwb</b>	Percentage Missing in Physical Health and Well-Being
<b>ms_sc</b>	Percentage Missing in Social Competence
<b>ms_em</b>	Percentage Missing in Emotional Maturity
<b>ms_lcd</b>	Percentage Missing in Language and Cognitive Development
<b>ms_csgk</b>	Percentage Missing in Communication Skills and General Knowledge
<b>mn_phwb</b>	Average Domain Score in Physical Health and Well-Being
<b>mn_sc</b>	Average Domain Score in Social Competence
<b>mn_em</b>	Average Domain Score in Emotional Maturity
<b>mn_lcd</b>	Average Domain Score in Language and Cognitive Development
<b>mn_csgk</b>	Average Domain Score in Communication Skills and General Knowledge
<b>vul_phwb</b>	Percentage Vulnerable in Physical Health and Well-Being
<b>vul_sc</b>	Percentage Vulnerable in Social Competence
<b>vul_em</b>	Percentage Vulnerable in Emotional Maturity
<b>vul_lcd</b>	Percentage Vulnerable in Language and Cognitive Development
<b>vul_csgk</b>	Percentage Vulnerable in Communication Skills and General Knowledge
<b>vul_one</b>	Percentage Vulnerable in One or More Domains
<b>prsd_mn</b>	PHWB Subdomain - Physical Readiness for the School Day - Mean
<b>pi_mn</b>	PHWB Subdomain - Physical Independence - Mean
<b>gfms_mn</b>	PHWB Subdomain - Gross and Fine Motor Skills - Mean
<b>osc_mn</b>	SC Subdomain - Overall Social Competence - Mean
<b>rar_mn</b>	SC Subdomain - Responsibility and Respect - Mean
<b>atl_mn</b>	SC Subdomain - Approaches to Learning - Mean
<b>rte_mn</b>	SC Subdomain - Readiness to Explore New Things - Mean
<b>phb_mn</b>	EM Subdomain - Prosocial and Helping Behaviour - Mean
<b>afb_mn</b>	EM Subdomain - Anxious and Fearful Behaviour - Mean
<b>ab_mn</b>	EM Subdomain - Aggressive Behaviour - Mean
<b>hib_mn</b>	EM Subdomain - Hyperactive and Inattentive Behaviour - Mean
<b>bl_mn</b>	LCD Subdomain - Basic Literacy - Mean
<b>ilnm_mn</b>	LCD Subdomain - Interest in Literacy/Numeracy and Memory - Mean
<b>al_mn</b>	LCD Subdomain - Advance Literacy - Mean
<b>bn_mn</b>	LCD Subdomain - Basic Numeracy - Mean
<b>csgk_mn</b>	CSGK Subdomain - Mean
<b>prsd_fn</b>	PHWB Subdomain - Physical Readiness for the School Day - Percentage Meeting Few or None of Developmental Expectations
<b>prsd_aa</b>	PHWB Subdomain - Physical Readiness for the School Day - Percentage Meeting Almost or All of Developmental Expectations
<b>prsd_ms</b>	PHWB Subdomain - Physical Readiness for the School Day - Percentage Missing
<b>pi_fn</b>	PHWB Subdomain - Physical Independence - Percentage Meeting Few or None of Developmental Expectations
<b>pi_aa</b>	PHWB Subdomain - Physical Independence - Percentage Meeting Almost or All of Developmental Expectations
<b>pi_ms</b>	PHWB Subdomain - Physical Independence - Percentage Missing



Supplemental Table 1. cont. Early Development Instrument Variables in the CanNECD Database

<b>Variable Name</b>	<b>Label</b>
<b>gfms_fn</b>	PHWB Subdomain - Gross and Fine Motor Skills - Percentage Meeting Few or None of Developmental Expectations
<b>gfms_sm</b>	PHWB Subdomain - Gross and Fine Motor Skills - Percentage Meeting Some of Developmental Expectations
<b>gfms_aa</b>	PHWB Subdomain - Gross and Fine Motor Skills - Percentage Meeting Almost or All of Developmental Expectations
<b>gfms_ms</b>	PHWB Subdomain - Gross and Fine Motor Skills - Percentage Missing
<b>osc_fn</b>	SC Subdomain - Overall Social Competence - Percentage Meeting Few or None of Developmental Expectations
<b>osc_sm</b>	SC Subdomain - Overall Social Competence - Percentage Meeting Some of Developmental Expectations
<b>osc_aa</b>	SC Subdomain - Overall Social Competence - Percentage Meeting Almost or All of Developmental Expectations
<b>ocs_ms</b>	SC Subdomain - Overall Social Competence - Percentage Missing
<b>rar_fn</b>	SC Subdomain - Responsibility and Respect - Percentage Meeting Few or None of Developmental Expectations
<b>rar_sm</b>	SC Subdomain - Responsibility and Respect - Percentage Meeting Some of Developmental Expectations
<b>rar_aa</b>	SC Subdomain - Responsibility and Respect - Percentage Meeting Almost or All of Developmental Expectations
<b>rar_ms</b>	SC Subdomain - Responsibility and Respect - Percentage Missing
<b>atl_fn</b>	SC Subdomain - Approaches to Learning - Percentage Meeting Few or None of Developmental Expectations
<b>atl_sm</b>	SC Subdomain - Approaches to Learning - Percentage Meeting Some of Developmental Expectations
<b>atl_aa</b>	SC Subdomain - Approaches to Learning - Percentage Meeting Almost or All of Developmental Expectations
<b>atl_ms</b>	SC Subdomain - Approaches to Learning - Percentage Missing
<b>rte_fn</b>	SC Subdomain - Readiness to Explore New Things - Percentage Meeting Few or None of Developmental Expectations
<b>rte_sm</b>	SC Subdomain - Readiness to Explore New Things - Percentage Meeting Some of Developmental Expectations
<b>rte_aa</b>	SC Subdomain - Readiness to Explore New Things - Percentage Meeting Almost or All of Developmental Expectations
<b>rte_ms</b>	SC Subdomain - Readiness to Explore New Things - Percentage Missing
<b>phb_fn</b>	EM Subdomain - Prosocial and Helping Behaviour - Percentage Meeting Few or None of Developmental Expectations
<b>phb_sm</b>	EM Subdomain - Prosocial and Helping Behaviour - Percentage Meeting Some of Developmental Expectations
<b>phb_aa</b>	EM Subdomain - Prosocial and Helping Behaviour - Percentage Meeting Almost or All of Developmental Expectations
<b>phb_ms</b>	EM Subdomain - Prosocial and Helping Behaviour - Percentage Missing
<b>afb_fn</b>	EM Subdomain - Anxious and Fearful Behaviour - Percentage Meeting Few or None of Developmental Expectations
<b>afb_sm</b>	EM Subdomain - Anxious and Fearful Behaviour - Percentage Meeting Some of Developmental Expectations
<b>afb_aa</b>	EM Subdomain - Anxious and Fearful Behaviour - Percentage Meeting Almost or All of Developmental Expectations
<b>afb_ms</b>	EM Subdomain - Anxious and Fearful Behaviour - Percentage Missing
<b>ab_fn</b>	EM Subdomain - Aggressive Behaviour - Percentage Meeting Few or None of Developmental Expectations
<b>ab_sm</b>	EM Subdomain - Aggressive Behaviour - Percentage Meeting Some of Developmental Expectations
<b>ab_aa</b>	EM Subdomain - Aggressive Behaviour - Percentage Meeting Almost or All of Developmental Expectations
<b>ab_ms</b>	EM Subdomain - Aggressive Behaviour - Percentage Missing
<b>hib_fn</b>	EM Subdomain - Hyperactive and Inattentive Behaviour - Percentage Meeting Few or None of Developmental Expectations

Supplemental Table 1. cont. Early Development Instrument Variables in the CanNECD Database

<b>Variable Name</b>	<b>Label</b>
<b>hib_sm</b>	EM Subdomain - Hyperactive and Inattentive Behaviour - Percentage Meeting Some of Developmental Expectations
<b>hib_aa</b>	EM Subdomain - Hyperactive and Inattentive Behaviour - Percentage Meeting Almost or All of Developmental Expectations
<b>hib_ms</b>	EM Subdomain - Hyperactive and Inattentive Behaviour - Percentage Missing
<b>bl_fn</b>	LCD Subdomain - Basic Literacy - Percentage Meeting Few or None of Developmental Expectations
<b>bl_sm</b>	LCD Subdomain - Basic Literacy - Percentage Meeting Some of Developmental Expectations
<b>bl_aa</b>	LCD Subdomain - Basic Literacy - Percentage Meeting Almost or All of Developmental Expectations
<b>bl_ms</b>	LCD Subdomain - Basic Literacy - Percentage Missing
<b>ilnm_fn</b>	LCD Subdomain - Interest in Literacy/Numeracy and Memory - Percentage Meeting Few or None of Developmental Expectations
<b>ilnm_sm</b>	LCD Subdomain - Interest in Literacy/Numeracy and Memory - Percentage Meeting Some of Developmental Expectations
<b>ilnm_aa</b>	LCD Subdomain - Interest in Literacy/Numeracy and Memory - Percentage Meeting Almost or All of Developmental Expectations
<b>ilnm_ms</b>	LCD Subdomain - Interest in Literacy/Numeracy and Memory - Percentage Missing
<b>al_fn</b>	LCD Subdomain - Advance Literacy - Percentage Meeting Few or None of Developmental Expectations
<b>al_sm</b>	LCD Subdomain - Advance Literacy - Percentage Meeting Some of Developmental Expectations
<b>al_aa</b>	LCD Subdomain - Advance Literacy - Percentage Meeting Almost or All of Developmental Expectations
<b>al_ms</b>	LCD Subdomain - Advance Literacy - Percentage Missing
<b>bn_fn</b>	LCD Subdomain - Basic Numeracy - Percentage Meeting Few or None of Developmental Expectations
<b>bn_sm</b>	LCD Subdomain - Basic Numeracy - Percentage Meeting Some of Developmental Expectations
<b>bn_aa</b>	LCD Subdomain - Basic Numeracy - Percentage Meeting Almost or All of Developmental Expectations
<b>bn_ms</b>	LCD Subdomain - Basic Numeracy - Percentage Missing
<b>csgk_fn</b>	CSGK Subdomain - Percentage Meeting Few or None of Developmental Expectations
<b>csgk_sm</b>	CSGK Subdomain - Percentage Meeting Some of Developmental Expectations
<b>csgk_aa</b>	CSGK Subdomain - Percentage Meeting Almost or All of Developmental Expectations
<b>csgk_ms</b>	CSGK Subdomain - Percentage Missing
<b>mci</b>	Percentage of Children with Multiple Challenges
<b>cllct_p</b>	Percentage of EDIs Collected via Paper
<b>cllct_e</b>	Percentage of EDIs Collected via an Electronic System
<b>cllct_pe</b>	Percentage of EDIs Collected via Either Paper or an Electronic System
<b>Zpcsepdiv06</b>	Zscore: Percent separated or divorced, 2006
<b>Zmed2a061</b>	Zscore: Percent at or exceeding twice the median BC income, families with children under 6, 2005
<b>Zliml061</b>	Zscore: Percent below Low Income Measure, lone parents with children under 6, 2005
<b>Zednone06</b>	Zscore: Percent of those 25 to 64 with no high school diploma, 2006
<b>Zduesa061</b>	Zscore: Percent deducting dues, families with children under 6, 2005
<b>Zlahnon06</b>	Zscore: Percent whose home language is a non-official language, 2006
<b>Zpcha061</b>	Zscore: Percent families declaring charitable donations, families with children under 6, 2005
<b>Znomig106</b>	Zscore: Percent of individuals, non-migrant movers in the past year, 2006
<b>Zpinva061</b>	Zscore: Percent families with investment income or capital gains, families with children under 6, 2005
<b>Zginqf061</b>	Zscore: GINI coefficient quintiles, lone female parents with children under 6, 2005
<b>Zpcsepdiv11</b>	Zscore: Percent separated or divorced, 2011

Supplemental Table 1. cont. Early Development Instrument Variables in the CanNECD Database

Variable Name	Label
<b>Zmed2a062</b>	Zscore: Percent at or exceeding twice the median BC income, families with children under 6, 2010
<b>Zliml062</b>	Zscore: Percent below Low Income Measure, lone parents with children under 6, 2010
<b>Zednone11</b>	Zscore: Percent of those 25 to 64 with no high school diploma, 2011
<b>Zduesa062</b>	Zscore: Percent deducting dues, families with children under 6, 2010
<b>Zlahnon11</b>	Zscore: Percent whose home language is a non-official language, 2011
<b>Zpcha062</b>	Zscore: Percent families declaring charitable donations, families with children under 6, 2010
<b>Znomig111</b>	Zscore: Percent of individuals, non-migrant movers in the past year, 2011
<b>Zpinva062</b>	Zscore: Percent families with investment income or capital gains, families with children under 6, 2010
<b>Zginqf062</b>	Zscore: GINI coefficient quintiles, lone female parents with children under 6, 2010
<b>cannecd_zsesindex_time1</b>	Z-score version of CanNECD SES Index for time 1 (2006)
<b>cannecd_zsesindex_time1</b>	t-score version of CanNECD SES Index for time 1 (2006)
<b>cannecd_zsesindex_time2</b>	Z-score version of CanNECD SES Index for time 2 (2011)
<b>cannecd_zsesindex_time2</b>	t-score version of CanNECD SES Index for time 2 (2011)
<b>cannecd_zsesindex_change_t2t1</b>	Change from Time1 to Time2 in CanNECD SES Index

Notes: PHWB - Physical Health and Well-Being; SC - Social Competence; EM - Emotional Maturity; LCD - Language and Cognitive Development; CSGK - Communication Skills and General Knowledge

