SPECIAL HEALTH NEEDS OF CANADIAN KINDERGARTEN CHILDREN

SPECIAL HEALTH NEEDS AMONG CANADIAN KINDERGARTEN CHILDREN: A PRE-POST COVID-19 ONSET ANALYSIS USING THE EARLY DEVELOPMENT INSTRUMENT

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TITLE: Special Health Need among Canadian Kindergarten Children: A Pre-Post COVID-19 Onset Analysis Using the Early Development Instrument

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Lay Abstract

Children with special health needs (SHN) experience more challenges when starting school compared to their typically developing peers, putting them at risk of poor social and academic outcomes later in life. The onset of the COVID-19 pandemic disrupted schools, childcare and healthcare services making it harder for families to access support if needed. This thesis explores how the proportion of Canadian kindergarteners identified with SHN may have changed from before to after the onset of the pandemic. It also examines mental health concerns among SHN children before and after pandemic onset. To do this, we used teacher-reported data from the Early Development instrument (EDI), a tool that assesses developmental health in children. We found that the proportion of kindergarten children with SHN increased following the onset of the pandemic, including a rise in mental health concerns. More children with SHN lived in lower-income neighbourhoods than higher-income neighbourhoods, and this pattern became stronger after the pandemic.

Abstract

Background: The COVID-19 pandemic led to disruptions in healthcare, childcare, and early education programs, which may have affected children with special health needs (SHN) more severely than their typically developing peers. While medical diagnoses take time, kindergarten teachers' observations can initiate early support for children at school. However, it remains unclear whether the proportion of children identified with SHN, based on teacher-reports, increased after the onset of COVID-19 pandemic. This thesis aimed to determine the proportion of Canadian kindergarten children identified with SHN before and after the onset of COVID-19 pandemic using the Early Development Instrument (EDI), and to examine the changes in mental health concerns among SHN children during this period.

Methods: Kindergarten teachers used the EDI to report SHN and mental health concerns for their students. EDI records were linked with sociodemographic data from the 2016 Canadian Census and 2015 Taxfiler data across 1,639 neighbourhoods to determine associations between SHN prevalence and neighbourhood-level socioeconomic status (SES).

Results: Among 485,543 kindergarteners, the study found that: (1) proportion of children with SHN increased after the onset of the pandemic (2) prevalence of SHN was inversely associated with neighbourhood-level SES, with a stronger association after the onset of pandemic, (3) the strength of this association varied across jurisdictions, and (4) while mental health concerns among SHN children increased, the adjusted odds of having mental health concerns were lower following the onset of the pandemic.

Conclusion: The findings indicate an overall rise in SHN prevalence, including a rise in mental health concerns among SHN children, following the onset of COVID-19 pandemic. A greater proportion of children with SHN resided in lower-SES neighbourhoods, with this association becoming more pronounced after the onset of the pandemic, suggesting widening inequities. The study points to the urgency for additional classroom support and early identification strategies for children who are showing signs of difficulty in kindergarten.

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List of abbreviations and symbols

ADHD = Attention-deficit/ hyperactivity disorder

ASD = Autism spectrum disorder

BC = British Columbia

CanNECD = Canadian Neighbourhoods and Early Child Development

Cohen's f^2 = Effect size

COVID-19 = Coronavirus disease of 2019

CIHI = Canadian Institute for Health Information

CIHR = Canadian Institute of Health Research

E/FSL = English/ French as a second language

EDI = Early Development Instrument

HiREB = Hamilton Integrated Research Ethics Board

IEP = Individual Education Plans

MB = Manitoba

NfA = Needs further assessment

NL = Newfoundland and Labrador

NS = Nova Scotia

NT = Northwest Territories

ON = Ontario

PE = Prince Edward Island

QC = Quebec

R^2 = Coefficient of Determination

REB = Research Ethics Boards

SC = Special concerns

SD = Standard deviation

SES = Socioeconomic status

SHN = Special health needs

SN = Special needs

WHO = World Health Organization

β = Standardized beta coefficient

Declaration of academic achievement

I, Anjelica Shrestha, declare that this thesis is my own original work. I contributed to the development of the study design, conducted literature search, statistical analyses, and authored this thesis document, including the manuscript.

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"The first five years have so much to do with how the next eighty will turn out."

– Bill Gates

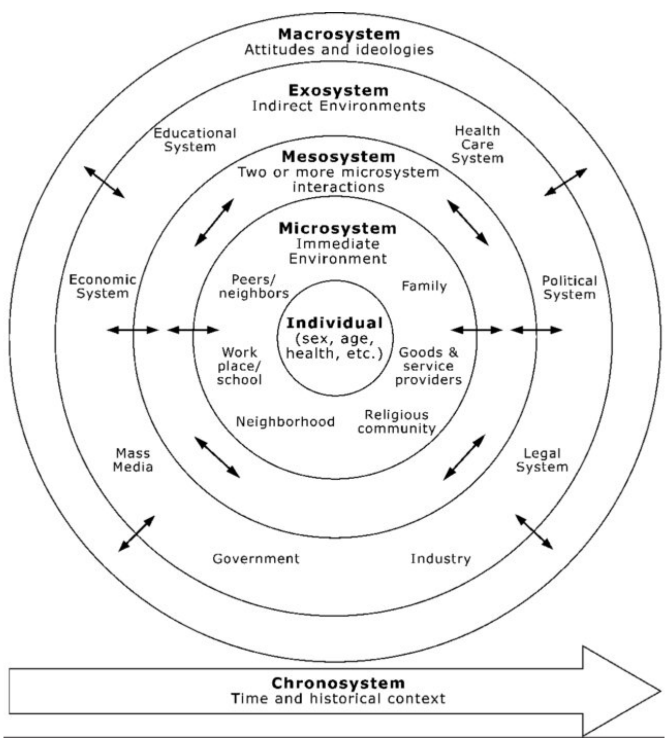
1.0 Introduction

1.1 Early child development

Early childhood is a foundational period that offers a unique opportunity to influence children's health and development (Irwin et al., 2007). Within the first six years of age, the brain reaches approximately 90% of adult volume (Bondi et al., 2024). The "sensitive periods" for brain development occur particularly at this time, where the neural pathways established by early experiences and environment set the foundation for the future to have lasting and important consequences (Irwin et al., 2007; Ramey & Ramey, 2004). While neural plasticity and learning allow the brain to continue developing throughout a child's life, early childhood represents a particularly sensitive and efficient period for intervention (Irwin et al., 2007). For instance, early-life nutrition is not only critical for immediate growth but also has long-term health implications, as proposed by the Developmental Origins of Health and Disease hypothesis (Lacagnina, 2019). This framework suggests that early exposures can shape physiological systems and influence the risk of chronic disease later in life. Alongside nutrition, individual factors, such as genetics and parental behaviours, interact with broader societal influences, such as socioeconomic status, neighbourhood quality, and access to education, to shape children's health and developmental trajectories (World Health Organization, 2024)

According to Hertzman (2012), early exposures and experiences can "get under the skin" to influence the child's trajectories in various areas of life, including social, economic and physical well-being. This means that differences in early life experience in different social environments can shape a child's biological and development processes. These differences have the capacity to influence the child's health, learning, well-being or behaviour over their life course. In 1979, Bronfenbrenner's Ecological Systems Theory proposed that a child's development is influenced by complex reciprocal interactions within their early environment, from their home and educational setting to the broader society, all embedded within the era of the child's growth (Crawford, 2020; Lopez et al., 2021). As shown in Figure 1, these interactions are described through five systems in the child's environment, nested in overlapping circles: microsystem, mesosystem, exosystem, macrosystem and chronosystem.

Figure 1: Bronfenbrenner's Ecological Systems Theory (Brown & Strommen, 2018)



The first level is known as the microsystem, and it includes the child's most immediate relationships and environment, such as family, classmates, teachers, and neighbours. Second, the mesosystem consists of the interactions between different microsystems in the child's life, such as parents interacting with their child's teacher. Parents who are more involved in their child's academic life, such as attending parent-teacher conferences, can foster a supportive environment for learning and set the child up for academic success (El Nokali et al., 2010). Third, the exosystem refers to the settings, such as, but not limited to governmental policies, parent's work environment, and mass media that do not directly include the child, but exerts influence on their development (Crawford, 2020). This reflects the reality of educational decisions by policymakers impacting the child's learning experience (e.g., special education programs) and thus, their academic and social development (Luo & Chan, 2022).

Fourth, the macrosystem encompasses the cultural elements such as norms, beliefs, and values that weave through the inner systems to affect the child's development (Crawford, 2020). For instance, the beliefs about gender roles and family structures affect the way the child views the world, reinforcing the child's attitudes and behaviour as they interact with others and their surroundings (National Academies of Sciences et al., 2016). Lastly, the chronosystem represents time, reflecting its influence on lifetime trajectories, as well as the occurrence of significant global events, for example the recent COVID-19 pandemic. Children growing up during the COVID-19 pandemic experienced various disruptions in their education, healthcare visits, as well as shifts in family dynamics and altered social interactions, (Pozniak et al., 2024; Shikako et al., 2023; Stewart et al., 2021; Wener et al., 2023), all of which may have long-lasting consequences on their development.

Altogether, these overlapping systems interact in unique ways to support or shape the developing child. Understanding child development from an ecological perspective is essential for shaping effective public health policies and interventions (e.g. special education programs). Population-level tools that assess children's developmental health, such as the Early Development Instrument (EDI), can help identify trends in kindergarten children's health by examining both individual factors, such as health disorders, and broader societal influences, such as neighbourhood circumstances (Siddiqua et al., 2020; Zeraatkar et al., 2020). These trends, observed at community, provincial, and national levels, can guide identification of early intervention needs for young children. Particularly, research has demonstrated significant benefits of early interventions for children with intellectual and developmental disabilities (Ramey & Ramey, 2004; Tollan et al., 2023).

1.2 Social determinants of child health

The idea that living circumstances shape health is not new. Early in 400 century BC, Greek philosopher Plato described that "a healthy mind in a healthy body" could only be achieved through harmony with the physical and social environment (Svalastog et al., 2017). During the 1980s, the publication of the Black Report in the United Kingdom, once again rekindled interest in these issues, where the term "social determinants of health" emerged to characterize health being shaped by important living conditions (Raphael, 2010). Since then, the term has been extended to children's health, with early childhood development being recognized as a social determinant of health. Social determinants of health are societal and environmental factors such as education, support networks, neighbourhoods, and income, among others, that shape children's development health (Janus, Brownell, et al., 2018; Raphael, 2010). From a social perspective, these factors can be understood through Bronfenbrenner's Ecological Systems theory, which illustrates how interactions between a child and their environment impact their growth and development (See Section 1.1). According to the National Collaborating Centre for Healthy Public Policy (2012), developmental health concept encompasses a range of skills, abilities, and competences that determine early growth and development during the early childhood period.

Among the many social determinants, socioeconomic status (SES), which is often measured as the combination of income, education and employment, has one of the strongest associations with health outcomes, with lower SES relating to both higher morbidity and mortality (Braveman & Gottlieb, 2014; Janus, Brownell, et al., 2018). Children growing up in low-SES neighbourhoods face higher risk of adverse health developmental outcomes compared to those in higher-income areas. These disparities include high rates of low birth-weight, dental caries, poorer cognitive tests, difficulties with behaviour and socialization, frequent hospitalizations and disengagement from school (Guttmann, 2001; Irwin et al., 2007).

The National Longitudinal Study of Children and Youth followed a nationally representative sample of Canadian children's development and well-being from infancy to adulthood. The study revealed that by the time children entered first grade, preventable inequalities in child development had already emerged within the society (Statistics Canada, 2004). Substantive differences in developmental health are observed among typically developing children at school entry within Canadian provinces, with those with lower-SES background having poorer academic outcomes than their higher-SES peers (Guhn et al., 2010; Lapointe et al., 2007; Oliver et al., 2007; Zeraatkar et al., 2020). These systematic disparities in health across SES are conceptualized as the socioeconomic gradient, indicating that the differences in health outcomes are gradual and occur across the full spectrum of SES (Janus, Brownell, et al., 2018). The gradient in early development is known to be the most powerful explanation for differences seen in children's health and well-being within different communities (Irwin et al., 2007). Children living in poverty tend to experience worse outcomes when compared with those with higher SES, with each incremental increase in income associated with progressively better developmental outcomes (Janus, Brownell, et al., 2018). In Canada, the development of children with disabilities at school entry is the poorest in lower-SES neighborhoods (Siddiqua et al., 2020).

1.3 Children with special needs in Canada

Health conditions in early years are typically categorized as either health disorders, which are specific diagnoses made by healthcare professionals, or special needs, which encompass disabilities and challenges interfere with a child's ability to participate fully in the classroom and often require additional support services within educational settings. According to the World Health Organization (WHO), disability is an umbrella term which covers an impairment in body function, a limitation in activity, and/or restriction in participation in daily life. Similarly, the Government of Canada (2013) recognizes disability as a complex phenomenon, influenced by both individual and societal factors. Formal diagnosis by healthcare professionals plays an important role in identification of children with disabilities and granting access to specialized services for children with disabilities (Clark, 2023). However, by tying support primarily to diagnostic labels risks excluding children who face significant challenges but do not meet the criteria for a formal diagnosis, or may not have access to early intervention services (Thomas et al., 2025), such as during the COVID-19 pandemic. These children may struggle in school because their needs are not formally recognized. For example, children with specific learning disabilities are usually identified after entering school, where significant disparities are noted between their achievements in specific domains and their overall abilities (Institute of Medicine, 2001)

A national survey conducted by the Canadian Teachers Association found that while students with disabilities represented 16.3% of total students in a particular classroom, students with learning disabilities or those waiting to be identified were not included in that proportion (Towle, 2015). The lack of accurate representation of how many children need support and the kind of support they might require, leads to inaccurate allocation of resources and inequitable access to their learning needs. Thus, expanding identification criteria beyond formal diagnoses would ensure that all children who require support are identified in case they need intervention and accommodations.

As such, a more inclusive language, term "'special needs" is used within educational settings with focus on supporting programming and resources for children, rather than just relying on diagnostic labels (Clark, 2023). While there is no standardized definition of special needs in Canada, most definitions used across Canada are similar across jurisdictions in that they include children with conditions such as physical, communication, intellectual, emotional, social and/or behavioural development (Dworet & Bennett, 2002; Towle, 2015). In educational settings, teachers' observation and concerns for their students may lead to identification of special needs and initiate early support for children at school. In Canada, teachers use the Early Development Instrument (EDI) to assess the developmental health of kindergarten children in a holistic manner at a population-wide level (Janus & Offord, 2007). The data are collected for all children in kindergarten, including those who have special health needs, conceptualized as including formal diagnosis from health professionals, functional impairments, as well as teacher-reported concerns. For the purposes of our research, special health needs are defined as a category based on teacher answers to specific items on the EDI, which operationalizes atypical developmental health in children (See Section 2.5).

Children with special health needs often begin school with poorer academic, emotional and social skills compared to their peers developing typically. Early differences persist and continue to widen if there is no support provided, which is often associated with later school failure, unemployment, and poor health in adulthood (O'Connor et al., 2019; Zeraatkar et al., 2020). In Canada, the association of child development at school entry with neighbourhood-level SES shows the same pattern for typically developing and children with disabilities: child development is worse in lower SES neighbourhoods and better in higher SES neighbourhoods. The majority of these children attend regular schools (Towle, 2015), highlighting the need for inclusive policies to support their special needs in educational settings.

One of the strategies used across Canadian schools to assist children with learning needs, is special education programming developed as Individual Education Plans (IEP) (Towle, 2015). Depending on the region and province, it might be known as the Inclusion and Intervention Plan in Saskatchewan, Personalized Learning Program in New Brunswick or Individual Program Plan in Alberta. Regardless of the name, the purpose of this process is to allow the child with special needs to succeed in the classroom by implementing inclusive educational policies and providing appropriate special-education programs. The IEP process calls for the student to first be assessed or identified in order to determine their strengths and needs. Upon the completion of the IEP process, the school can apply to the Department of Education for additional funds that may be required to offer special educational services (Dworet & Bennett, 2002).

Despite the systems in place to deliver individualized education to children that meet their special health needs, various challenges still exist. These challenges encompass delivering special-education programs in Canada's ethnically diverse landscape, securing adequate funding, and ensuring access to qualified teachers and services, particularly in remote and rural communities (Dworet & Bennett, 2002). An additional issue that is largely outside the control of educators and has received less attention is contextual factors, such as the socioeconomic environment and the impact of the COVID-19 pandemic, which are the focus of my thesis.

1.4 COVID-19 and needs of vulnerable children

The COVID-19 pandemic has had a profound impact on vulnerable children, exacerbating pre-existing disparities in education, mental health and access to healthcare

(Mental Health Commission of Canada, 2021; Nicholas et al., 2022; United Nations, 2020). In March 2020, WHO declared COVID-19 a global pandemic, prompting lockdown measures that led to widespread school closures (Abufhele et al., 2024). Such a response caused the largest disruption in education history, affecting the learning of nearly 1.6 billion children in more than 190 countries (United Nations, 2020). Previous studies have found that children exposed to pandemics, natural disasters, and famines often experience lifelong negative consequences (Abufhele et al., 2024; Datar et al., 2013; Meng & Qian, 2009). Since children's developing brains are more sensitive to their early environments, the immediate negative impacts of closing early programs and supports are further intensified by diminished future learning, to cause more pronounced inequalities later in life (Hertzman, 2012; Hertzman & Bertrand, 2007; Nelson et al., 2007; Zeraatkar et al., 2020).

Children who start school with health disorders tend to have poorer developmental trajectories and require more health support than children who do not (Janus et al., 2024). While many families of children with special needs were already experiencing difficulties before the pandemic, COVID-19 further exacerbated these challenges (Pozniak et al., 2024). The disruption of healthcare visits, childcare, and early education programs significantly impacted early child development, particularly for children with special needs and disabilities, who experienced a higher rate of adverse events in comparison to the general population (Pozniak et al., 2024; Shikako et al., 2023; Stewart et al., 2021).

Specifically, the pandemic significantly impacted the mental health and well-being of both young children and their families (Mental Health Commission of Canada, 2021). According to WHO, mental health is defined as a state of mental well-being that allows individuals to cope with the stresses of life, realize their abilities, learn well and work well, and contribute to their community (World Health Organization, 2022). Parental mental health, particularly among mothers, was severely impacted during the COVID-19 pandemic with maternal depression rates rising from 9% to 43% for mothers of children aged five to eight years (Cameron et al., 2020). Given the strong association between parental mental health and children's well-being, parenting stress during early childhood has also been shown to increase the likelihood of mental health disorders in preschoolers (Hattangadi et al., 2020). Despite the growing need for mental health and developmental support, Canada's child mental health services continue to struggle with long wait-times and weak accountability mechanisms for public funding even before the COVID-19 pandemic (Boyle et al., 2019). These challenges persist alongside rising emotional-behavioral issues, which have been the leading cause of referrals to children's mental health services for the past decades (Comeau et al., 2019).

Furthermore, remote healthcare was often inadequate for families with children experiencing acute illness or developmental and behavioural issues during the COVID-19 pandemic (Nicholas et al., 2022). For children with autism, virtual support was perceived by families to be as less effective than what was offered prior to the pandemic. Psychosocial supports that could have helped families cope with anxiety and isolation were either unavailable or modified. Essential community support services, such as early intervention and counselling were closed or significantly reduced, further hindering wellness and stability of children and their families. WHO report on Developmental

Disabilities and Delay in Canada, revealed that most families of children with disabilities experienced a lack of access to necessary services to support their child's physical and mental health during the COVID-19 pandemic (Shikako et al., 2023). As a result, children who were already vulnerable could have been at an even greater risk due to the unavailability of critical health services and programs compared to pre-pandemic years. This highlights the shortcoming of existing Canadian policies in addressing the unique needs of children with special health needs and disabilities. Given the availability of pre- and post-pandemic data on children's developmental health, our research addresses these gaps by examining the prevalence of special health needs and mental health concerns among kindergarten children across Canada.

1.5 Population measurement of child development

High quality, representative data from early childhood can help service providers, educators and policymakers identify factors influencing the developmental health of children with special needs and guide efforts to positively shape their developmental trajectory (Raikes et al., 2023). Research has demonstrated the association between early school achievements and later social and academic outcomes (Lloyd et al., 2009; Szumski & Karwowski, 2012; Turner et al., 2008). Additionally, social and academic trajectories are more challenging to alter by middle childhood, emphasizing early childhood as a critical time for identification and intervention (Irwin et al., 2007). In the United States, federal legislation requires the collection of data on the developmental status of children with special needs and disabilities to ensure access to appropriate services (e.g. special education) throughout early childhood (U.S Department of Education, 2017). The "Child

Find" mandate is a federal requirement in the United States that requires schools to identify, evaluate, and locate children who may need special education services (Kyrie, 2024). Canada does not have this mandate in place; however, population-level tools such as the EDI can still provide valuable information about developmental health of children (Janus & Offord, 2007).

The EDI is a teacher-completed questionnaire that measures children's developmental health at school entry in kindergarten in five 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 (Janus & Offord, 2007). Overall vulnerability on the EDI is defined as a score in the bottom 10th percentile in at least one of the five EDI domains, using nationally established norms (Janus et al., 2021). While the main purpose of the EDI is the assessment of child development, the questionnaire also includes demographic information on age, sex, first language, and children's special needs status (Janus et al., 2007). In Canada, twelve out of thirteen jurisdictions have implemented the EDI at least once since its finalization in 2004 (CIHI, 2021). These jurisdictions include: Ontario, Quebec, Newfoundland and Labrador, Prince Edward Island, New Brunswick, Nova Scotia, Manitoba, Saskatchewan, Alberta, British Columbia, Yukon, and Northwest Territories. Data are collected through kindergarten teacher reports on developmental health and demographics for each child in kindergarten; in some jurisdictions these happen at regular intervals, e.g., every three years in Ontario. Kindergarten represents the first year of the public education system accessible to all children in Canada, which is when the child turns five years of age (Janus, Enns, et al., 2018). While kindergarten attendance is not mandatory in most provinces, close to 90% of eligible children still enroll, highlighting its widespread participation across Canada (Council of Ministers of Education Canada, 2021).

Internationally, the EDI has been adapted and implemented in many countries, including Australia, Scotland, Sweden, Ireland, Chile, Brazil, Peru, Estonia, Jordan, United States (Janus et al., 2021; Janus & Offord, 2007). The validity and reliability of the EDI continues to be extensively tested on an ongoing basis (Janus et al., 2021). The EDI scores are also predictive of later outcomes including academic achievement in primary school (Brinkman et al., 2007; Davies et al., 2022; Silburn et al., 2007). While teachers complete the EDI for every child in their class, the results are not interpreted at the individual level (Janus et al., 2021). Rather, they are aggregated into various categories of interest (e.g., sex, age, special needs, immigrant status, neighbourhood-level SES) and results are compared between groups. The reports are provided to school authorities at the district level, to communities at the municipality level, and to provinces or territories at the jurisdictional level. Accomplishing a successful transition to school is one of the most important developmental tasks for preschool children. As a result, the identification of early predictors, such as emotional well-being and vulnerabilities, is considered a key priorities for policymakers and educators (Lemelin et al., 2007)

Furthermore, EDI provides a cost-effective method to gather population-level data on kindergarten children within educational settings, making it a valuable tool for examining early childhood development across various jurisdictions (Janus et al., 2021). While the EDI is often used to assess developmental vulnerabilities at the community level, its strength also lies in its ability to track patterns and disparities in developmental health at population level (Guhn et al., 2011; Janus et al., 2021). Given the availability of pre- and post-pandemic EDI data, my thesis aims to provide critical insights into how early identification of special health needs may have been impacted by the COVID-19 pandemic. The specific application of the EDI in this study will be discussed in greater detail in Chapter 2, which covers the methodology.

1.6 Thesis rationale and objectives

The disruptions caused by the COVID-19 pandemic, such as closures of educational, childcare and healthcare services may have long-term developmental consequences for children. Those who were already at risk, such as children with special health needs, may have faced even greater challenges due to the unavailability of critical health services, programs, and early identification compared to pre-pandemic years. However, limited evidence on the prevalence of special health needs amid the pandemic remains a barrier in addressing challenges young children face in Canada. Given the availability of pre- and post-pandemic data on early child development and special needs identification at a population-level by EDI, our research aims to address these gaps by examining special health needs and mental health concerns among kindergarten children across Canada. As such, our work offers an unprecedented opportunity to inform inclusive and supportive interventions beyond educational settings, such as improvements in early health screenings, access to specialized care, and community-based interventions, paving the way for healthier trajectories for children with special health needs in Canadian society.

The primary objective of our research is to examine the prevalence of the special health needs among Canadian kindergarten children (5-6 years old) before and after the COVID-19 pandemic onset using the EDI through the three specific research questions:

1. What is the prevalence of special health needs (special needs designation, special concerns, and needs for further assessment) in kindergarten children as measured by the Early Development Instrument (EDI) before (2017-2020) and after the onset of the COVID-19 pandemic (2021-2023), both overall and for subgroups of children categorised by sex, language fluency, rurality and neighbourhood-level socioeconomic status (SES)?
2. What is the prevalence of special health needs in kindergarten children in 2023 by province or territory in comparison with the most recent pre-pandemic data and in relation to neighbourhood-level SES?
3. Within the population of kindergarten children with special health needs, how has the prevalence of mental health concerns changed from before to after the onset of the COVID-19 pandemic?

1.7 References

Abufhele, A., Bravo, D., Lopez-Boo, F., & Soto-Ramirez, P. (2024). Developmental Losses in Young Children from Preprimary Program Closures during the COVID-19 Pandemic. Comparative Education Review, 68(3), 423–442. https://doi.org/10.1086/731588

Bondi, B. C., Tassone, V. K., Bucsea, O., Desrocher, M., & Pepler, D. J. (2024). A Systematic Review of Neurodevelopmental Assessments in Infancy and Early Childhood: Developing a Conceptual Framework, Repository of Measures, and Clinical Recommendations. Neuropsychology Review. https://doi.org/10.1007/s11065-024-09641-7

Boyle, M. H., Duncan, L., Georgiades, K., Comeau, J., Reid, G. J., O'Briain, W., Lampard, R., & Waddell, C. (2019). Tracking Children's Mental Health in the 21st Century: Lessons from the 2014 OCHS. Canadian Journal of Psychiatry. Revue Canadienne de Psychiatrie, 64(4), 232–236. https://doi.org/10.1177/0706743719830025

Braveman, P., & Gottlieb, L. (2014). The Social Determinants of Health: It's Time to Consider the Causes of the Causes. Public Health Reports, 129(Suppl 2), 19–31.

Brinkman, S. A., Silburn, S., Lawrence, D., Goldfeld, S., Sayers, M., & Oberklaid, F. (2007). Investigating the Validity of the Australian Early Development Index. Early Education and Development, 18(3), 427–451. https://doi.org/10.1080/10409280701610812

Brown, L., & Strommen, J. (2018). Training Younger Volunteers to Promote Technology Use Among Older Adults. Family and Consumer Sciences Research Journal, 46, 297–313. https://doi.org/10.1111/fcsr.12254

Cameron, E. E., Joyce, K. M., Delaquis, C. P., Reynolds, K., Protudjer, J. L. P., & Roos, L. E. (2020). Maternal psychological distress & mental health service use during the COVID-19 pandemic. Journal of Affective Disorders, 276, 765–774. https://doi.org/10.1016/j.jad.2020.07.081

CIHI. (2021). Children Vulnerable in Areas of Early Development. Canadian Institute for Health Information. https://www.cihi.ca/en/indicators/children-vulnerable-in-areas-of-early-development

Clark, H. (2023). Defining Disability: Reviewing the Construct of Special Education. Canadian Journal for New Scholars in Education/ Revue Canadienne Des Jeunes Chercheures et Chercheurs En Éducation, 14(2), Article 2.

Comeau, J., Georgiades, K., Duncan, L., Wang, L., & Boyle, M. H. (2019). Changes in the Prevalence of Child and Youth Mental Disorders and Perceived Need for Professional Help between 1983 and 2014: Evidence from the Ontario Child Health Study. The Canadian Journal of Psychiatry, 64(4), 256–264. https://doi.org/10.1177/0706743719830035

Council of Ministers of Education Canada. (2021). A pan-Canadian companion report to the OECD Starting Strong V: Transitions from Early Childhood Education and Care to Primary Education (p. 72). OECD. https://doi.org/10.1787/9789264276253-en

Crawford, M. (2020). Ecological Systems Theory: Exploring the Development of the Theoretical Framework as Conceived by Bronfenbrenner Article Details. Journal of Public Health Issues and Practices, 4, 170. https://doi.org/10.33790/jphip1100170

Datar, A., Liu, J., Linnemayr, S., & Stecher, C. (2013). The Impact of Natural Disasters on Child Health and Investments in Rural India. Social Science & Medicine (1982), 76(1), 83–91. https://doi.org/10.1016/j.socscimed.2012.10.008

Davies, S., Janus, M., Reid-Westoby, C., Duku, E., & Schlanger, P. (2022). Does the early development instrument predict academic achievement in Ontario French schools? Canadian Journal of Behavioural Science / Revue Canadienne Des Sciences Du Comportement, 54(4), 294–303. https://doi.org/10.1037/cbs0000285

Dworet, D., & Bennett, S. (2002). A View from the North: Special Education in Canada. TEACHING Exceptional Children, 34(5), 22–27. https://doi.org/10.1177/004005990203400504

El Nokali, N. E., Bachman, H. J., & Votruba-Drzal, E. (2010). Parent Involvement and Children's Academic and Social Development in Elementary School. Child Development, 81(3), 988–1005. https://doi.org/10.1111/j.1467-8624.2010.01447.x

Gonzalez, A., & MacMillan, H. L. (2021). Impact of the COVID-19 pandemic on Ontario Families with Children: Findings from the Third Wave. McMaster University. https://strongfamilies.ca/projects/ontario-parent-survey-2/

Government of Canada. (2013, April 11). Federal Disability Reference Guide [Policies]. Government of Canada. https://www.canada.ca/en/employment-social-development/programs/disability/arc/reference-guide.html

Guhn, M., Gadermann, A. M., Hertzman, C., & Zumbo, B. D. (2010). Children's Development in Kindergarten: A Multilevel, Population-Based Analysis of ESL and Gender Effects on Socioeconomic Gradients. Child Indicators Research, 2(3), 183–203. https://doi.org/10.1007/s12187-009-9053-7

Guhn, M., Hertzman, C., Janus, M., & Zumbo, B. D. (2011). Opening Remarks to the Special Issue on Validation Theory and Research for a Population-Level Measure of Children's Development, Wellbeing, and School Readiness. Social Indicators Research, 103. https://doi.org/10.1007/s11205-011-9840-7

Guttmann, A. (2001). Child poverty, health and health care use in Canada. Paediatrics & Child Health, 6(8), 509–513.

Hattangadi, N., Cost, K. T., Birken, C. S., Borkhoff, C. M., Maguire, J. L., Szatmari, P., & Charach, A. (2020). Parenting stress during infancy is a risk factor for mental health problems in 3-year-old children. BMC Public Health, 20(1), 1726. https://doi.org/10.1186/s12889-020-09861-5

Hertzman, C. (2012). Putting the concept of biological embedding in historical perspective. Proceedings of the National Academy of Sciences of the United States of America, 109(Suppl 2), 17160–17167. https://doi.org/10.1073/pnas.1202203109

Hertzman, C., & Bertrand, J. (2007). Children in poverty and the use of early development instrument mapping to improve their worlds. Paediatrics & Child Health, 12(8), 687–692.

Institute of Medicine. (2001). Neurological, Psychiatric, and Developmental Disorders. National Academies Press (US). https://www.ncbi.nlm.nih.gov/books/NBK223473/

Irwin, L., Siddiqi, A., & Hertzman, C. (2007). Early child development: A powerful equalizer. World Health Organization. https://www.who.int/publications/i/item/early-child-development-a-powerful-equalizer-final-report-for-the-world-health-organization-s-commission-on-the-social-determinants-of-health

Janus, M., Brinkman, S., Duku, E., Hertzman, C., Sayers, M., Schroeder, J., & Walsh, C. (2007). The Early Development Instrument: A Population-based Measure for Communities A Handbook on Development, Properties, and Use.

Janus, M., Brownell, M., Reid-Westoby, C., Bennett, T., Birken, C., Coplan, R., Duku, E., Ferro, M. A., Forer, B., Georgiades, S., Gorter, J. W., Guhn, M., Maguire, J. L., Manson, H., Pei, J., & Santos, R. (2018). Establishing a protocol for building a pan-Canadian population-based monitoring system for early childhood development for children with health disorders: Canadian Children's Health in Context Study (CCHICS). *British Medical Journal Open, 8*(5), e023688. https://doi.org/10.1136/bmjopen-2018-023688

Janus, M., Brownell, M., Reid-Westoby, C., Pottruff, M., Forer, B., Guhn, M., & Duku, E. (2024). Neighbourhood-level socioeconomic status and prevalence of teacher-reported health disorders among Canadian kindergarten children. Frontiers in Public Health, 11. https://doi.org/10.3389/fpubh.2023.1295195

Janus, M., Enns, J., Forer, B., Raos, R., Gaskin, A., Webb, S., Duku, E., Brownell, M., Muhajarine, N., & Guhn, M. (2018). A Pan-Canadian Data Resource for Monitoring Child Developmental Health: The Canadian Neighbourhoods and Early Child Development (CanNECD) Database. International Journal of Population Data Science, 3(3), 431. https://doi.org/10.23889/ijpds.v3i3.431

Janus, M., & Offord, D. R. (2007). Development and psychometric properties of the Early Development Instrument (EDI): A measure of children's school readiness. Canadian Journal of Behavioural Science / Revue Canadienne Des Sciences Du Comportement, 39(1), 1–22. https://doi.org/10.1037/cjbs2007001

Janus, M., Reid-Westoby, C., Raiter, N., Forer, B., & Guhn, M. (2021). Population-Level Data on Child Development at School Entry Reflecting Social Determinants of Health: A Narrative Review of Studies Using the Early Development Instrument. International Journal of Environmental Research and Public Health, 18(7), 3397. https://doi.org/10.3390/ijerph18073397

Kyrie, D. (2024). The Individuals with Disabilities Education Act (IDEA), Part B: Key Statutory and Regulatory Provisions (R41833). Congressional Research Service. https://crsreports.congress.gov/product/details?prodcode=R41833

Lacagnina, S. (2019). The developmental origins of health and disease(Dohad). American Journal of Lifestyle Medicine, 14(1), 47–50. https://doi.org/10.1177/1559827619879694

Lapointe, V. R., Ford, L., & Zumbo, B. D. (2007). Examining the Relationship Between Neighborhood Environment and School Readiness for Kindergarten Children. Early Education and Development, 18(3), 473–495. https://doi.org/10.1080/10409280701610846

Lemelin, J.-P., Boivin, M., Forget-Dubois, N., Dionne, G., Séguin, J. R., Brendgen, M., Vitaro, F., Tremblay, R. E., & Pérusse, D. (2007). The genetic-environmental etiology of cognitive school readiness and later academic achievement in early childhood. Child Development, 78(6), 1855–1869. https://doi.org/10.1111/j.1467-8624.2007.01103.x

Lloyd, J. E. V., Irwin, L. G., & Hertzman, C. (2009). Kindergarten school readiness and fourth-grade literacy and numeracy outcomes of children with special needs: A population-based study. Educational Psychology, 29(5), 583–602. https://doi.org/10.1080/01443410903165391

Lopez, M., Ruiz, M. O., Rovnaghi, C. R., Tam, G. K.-Y., Hiscox, J., Gotlib, I. H., Barr, D. A., Carrion, V. G., & Anand, K. J. S. (2021). The social ecology of childhood and early life adversity. Pediatric Research, 89(2), 353–367. https://doi.org/10.1038/s41390-020-01264-x

Luo, J., & Chan, C. K. Y. (2022). Influences of shadow education on the ecology of education – A review of the literature. Educational Research Review, 36, 100450. https://doi.org/10.1016/j.edurev.2022.100450

Meng, X., & Qian, N. (2009). The Long Term Consequences of Famine on Survivors: Evidence from a Unique Natural Experiment Using China's Great Famine. National Bureau of Economic Research.

Mental Health Commission of Canada. (2021). COVID-19 and Early Childhood Mental Health: Fostering Systems Change and Resilience Policy Brief. Mental Health Commission of Canada. https://mentalhealthcommission.ca/resource/covid-19-and-early-childhood-mental-health-fostering-systems-change-and-resilience-policy-brief/

National Academies of Sciences, E., Education, D. of B. and S. S. and, Board on Children, Y., Children, C. on S. the P. of Y., Breiner, H., Ford, M., & Gadsden, V. L. (2016). Parenting Knowledge, Attitudes, and Practices. In Parenting Matters: Supporting Parents of Children Ages 0-8. National Academies Press (US). https://www.ncbi.nlm.nih.gov/books/NBK402020/

National Collaborating Centre for Healthy Public Policy. (2012, April 2). Developmental Health Knowledge as a Catalyst for Healthy Family Policies in Canada [Government of Quebec]. National Collaborating Centre for Healthy Public Policy. https://ccnpps-ncchpp.ca/developmental-health-knowledge-as-a-catalyst-for-healthy-family-policies-in-canada/

Nelson, C. A., Zeanah, C. H., Fox, N. A., Marshall, P. J., Smyke, A. T., & Guthrie, D. (2007). Cognitive Recovery in Socially Deprived Young Children: The Bucharest Early Intervention Project. Science, 318(5858), 1937–1940. https://doi.org/10.1126/science.1143921

Nicholas, D. B., Zulla, R. T., Conlon, O., Dimitropoulos, G., Urschel, S., Rapoport, A., Katz, S. L., Bruce, A., West, L. J., Belletrutti, M., Cullen, E., & Zwaigenbaum, L. (2022). Mental health impacts of the COVID-19 pandemic on children with underlying health and disability issues, and their families and health care providers. Paediatrics & Child Health, 27(Supplement_1), S33–S39. https://doi.org/10.1093/pch/pxab103

O'Connor, M., O'Connor, E., Quach, J., Vashishtha, R., & Goldfeld, S. (2019). Trends in the prevalence and distribution of teacher-identified special health-care needs across three successive population cohorts. Journal of Paediatrics and Child Health, 55(3), 312–319. https://doi.org/10.1111/jpc.14192

Oliver, L. N., Dunn, J. R., Kohen, D. E., & Hertzman, C. (2007). Do Neighbourhoods Influence the Readiness to Learn of Kindergarten Children in Vancouver? A Multilevel Analysis of Neighbourhood Effects. Environment and Planning A: Economy and Space, 39(4), 848–868. https://doi.org/10.1068/a37126

Pozniak, K., Swain, A., Currie, G., Doherty-Kirby, A., Grahovac, D., Lebsack, J., Campbell, W., Humphreys, C., Patterson, S., Raha, S., Whitley, J., & Kraus de Camargo, O. (2024). What supports and services post COVID-19 do children with disabilities and their parents need and want, now and into the future? Frontiers in Public Health, 12. https://doi.org/10.3389/fpubh.2024.1294340

Raikes, A., Rao, N., Yoshikawa, H., Cohrssen, C., Behrman, J., Cappa, C., Devercelli, A., Lopez Boo, F., McCoy, D., Richter, L., & the UKRI GCRF Harnessing the power of global data to support young children's learning and development research group. (2023). Global tracking of access and quality in early childhood care and education. International Journal of Child Care and Education Policy, 17(1), 14. https://doi.org/10.1186/s40723-023-00116-5

Ramey, C. T., & Ramey, S. L. (2004). Early learning and school readiness: Can early intervention make a difference? Merrill-Palmer Quarterly, 50(4), 471–492.

Raphael, D. (2010). The health of Canada's children. Part III: Public policy and the social determinants of children's health. Paediatrics & Child Health, 15(3), 143–149.

Shikako, K., Lencucha, R., Hunt, M., Jodoin-Pilon, S., Chandra, A., Katalifos, A., Gonzalez, M., Yamaguchi, S., Cardoso, R., Elsabbagh, M., Hudon, A., Martens, R., Cogburn, D., Seth, A., Currie, G., Roth, C., Finlay, B., & Zwicker, J. (2023). Children with Disabilities in Canada during the COVID-19 Pandemic: An Analysis of COVID-19 Policies through a Disability Rights Lens. Children, 10(6), 942. https://doi.org/10.3390/children10060942

Siddiqua, A., Duku, E., Georgiades, K., Mesterman, R., & Janus, M. (2020). Association between neighbourhood socioeconomic status and developmental vulnerability of kindergarten children with Autism Spectrum Disorder: A population level study. SSM - Population Health, 12, 100662. https://doi.org/10.1016/j.ssmph.2020.100662

Silburn, S. R., Brinkman, S., Lawrence, D., Sayers, M., Goldfeld, S., & Oberklaid, F. (2007). P1-151 Establishing the construct and predictive validity of the Australian Early Development Index (AEDI). Early Human Development, 83, S125. https://doi.org/10.1016/S0378-3782(07)70321-3

Statistics Canada. (2004). National Longitudinal Survey of Children: Overview of Survey Instruments - ARCHIVED. https://www150.statcan.gc.ca/n1/en/catalogue/89F0078X

Stewart, S. L., Vasudeva, A. S., Van Dyke, J. N., & Poss, J. W. (2021). Following the Epidemic Waves: Child and Youth Mental Health Assessments in Ontario Through Multiple Pandemic Waves. Frontiers in Psychiatry, 12. https://doi.org/10.3389/fpsyt.2021.730915

Svalastog, A. L., Donev, D., Jahren Kristoffersen, N., & Gajović, S. (2017). Concepts and definitions of health and health-related values in the knowledge landscapes of the digital society. Croatian Medical Journal, 58(6), 431–435. https://doi.org/10.3325/cmj.2017.58.431

Szumski, G., & Karwowski, M. (2012). School achievement of children with intellectual disability: The role of socioeconomic status, placement, and parents' engagement. Research in Developmental Disabilities, 33(5), 1615–1625. https://doi.org/10.1016/j.ridd.2012.03.030

Thomas, E. K., Rowland, K. L., Borowy, A., Wedderburn, Q., & Edmunds, S. R. (2025). Examining the influence of COVID-19 on Part C early intervention enrollment by state, year, and racial group. Children and Youth Services Review, 169, 108075. https://doi.org/10.1016/j.childyouth.2024.108075

Tollan, K., Jezrawi, R., Underwood, K., & Janus, M. (2023). A Review on Early Intervention Systems. Current Developmental Disorders Reports, 10(2), 147–153. https://doi.org/10.1007/s40474-023-00274-8

Towle, H. (2015, July 8). Disability and Inclusion in Canadian Education. Canadian Centre for Policy Alternatives. https://www.policyalternatives.ca/news-research/disability-and-inclusion-in-canadian-education/

Turner, S., Alborz, A., & Gayle, V. (2008). Predictors of academic attainments of young people with Down's syndrome. Journal of Intellectual Disability Research: JIDR, 52(Pt 5), 380–392. https://doi.org/10.1111/j.1365-2788.2007.01038.x

United Nations. (2020). Policy Brief: Education during COVID-19 and beyond. https://unsdg.un.org/resources/policy-brief-education-during-covid-19-and-beyond, https://unsdg.un.org/resources/policy-brief-education-during-covid-19-and-beyond

U.S Department of Education. (2017). Individuals with Disabilities Education Act. U.S Department of Education. https://sites.ed.gov/idea/about-idea/

Wener, E., Booth, L., Bensky, H., Desai, V., Negandhi, J., Cushing, S. L., Papsin, B. C., & Gordon, K. A. (2023). Exposure to Spoken Communication During the COVID-19 Pandemic Among Children With Cochlear Implants. JAMA Network Open, 6(10), e2339042. https://doi.org/10.1001/jamanetworkopen.2023.39042

World Health Organization. (2013). Disability: Report by the Secretariat (A66/12). Article A66/12. https://iris.who.int/handle/10665/105691

World Health Organization. (2022). Mental health. World Health Organization. https://www.who.int/news-room/fact-sheets/detail/mental-health-strengthening-our-response

World Health Organization. (2024). Determinants of health. World Health Organization. https://www.who.int/news-room/questions-and-answers/item/determinants-of-health

Zeraatkar, D., Duku, E., Bennett, T., Guhn, M., Forer, B., Brownell, M., & Janus, M. (2020). Socioeconomic gradient in the developmental health of Canadian children with disabilities at school entry: A cross-sectional study. *British Medical Journal Open*, *10*(4), e032396. https://doi.org/10.1136/bmjopen-2019-032396

2.0 Methods

2.1 Pan-Canadian database for early child development

The data for our study were a subset of the Canadian Neighbourhoods Early Child Development (CanNECD), a pan-Canadian population-based database on children's development health at school entry (Janus, Enns, et al., 2018). The database integrates data from all provincial and territorial implementations of the EDI, along with a large set of socioeconomic variables derived from the Canadian Census from 2006 and Taxfiler data from 2005 and every 5 years onwards. These data are aggregated at the level of custom-defined neighborhoods (Guhn et al., 2016). The data from all the Canadian provinces and territories, except for Nunavut, are compiled in a secure electronic collection system at the Offord Centre for Child Studies, McMaster University in Hamilton, Canada. Below, the description of the database is provided as is relevant to the thesis.

2.1.1 Early Development Instrument

The Early Development Instrument (EDI) is a 103-item, teacher-completed questionnaire that measures children's developmental health at school entry (Janus & Offord, 2007). In Canada, kindergarten represents the first year of the public education system accessible to all children, typically when the child turns five years of age (Janus, Brownell, et al., 2018). While kindergarten attendance is not mandatory in most provinces, nearly 90% of eligible children are enrolled, highlighting its widespread participation across Canada (Statistics Canada, 2020). EDI data are collected in the second half of the school year. This ensures that kindergarten teachers know their students well enough to complete the instrument, as well as that students are well adapted to the school environment. The EDI evaluates five major domains of child development: (1) physical health and well-being, (2) social competence, (3) emotional maturity, (4) language and cognitive development, and (5) communication skills and general knowledge. Children whose domain scores fall within the 10th percentile of the distribution established in a normative sample are considered vulnerable. In addition to the core EDI items, key demographic characteristics, such as age at the EDI completion, sex at birth, language fluency, postal code, and special needs designation, are also collected in the EDI.

Sex is referred to as sex at birth, “male” or “female”, recorded at school entry. We acknowledge that this designation may not reflect a child’s gender identity and recognize this as a limitation of our dataset and study. Language fluency is a measure of fluency in the school’s official language of instruction, either English or French, as Canada has two official languages. In our study, language fluency is represented by the variable English/French as a Second Language (E/FSL). Students who are identified as E/FSL are children who are not fluent in the school's official language of instruction and who typically require additional support in the classroom. The postal code collected on the EDI is used to match geospatial indices, including neighbourhood-level SES from the CanNECD SES Index (see Section 2.1.3) and the remoteness index from Statistics Canada (2020). The remoteness index measures geographical isolation based on factors such as distance to services and population density. It categorizes areas into five levels, from highest population density and greatest service access to lowest: easily accessible, accessible, less accessible, remote, and very remote. Data for full jurisdictional coverage are collected either during a single year or in a wave of 2-3 years. Since 2004, the EDI national repository has records for over 1.6 million children. (Equity from the Start, 2025). For my thesis, a subset of the database from 2017 to 2023 is used to capture the timeline for before and after the onset of the COVID-19 pandemic.

2.1.2 Development of geographic neighbourhood boundaries

To explore the association between early child development health at school entry and neighbourhood socioeconomic characteristics, custom comparable neighbourhood units were created for Canadian EDI data (Guhn et al., 2016). When defining neighborhood boundaries, priority was given to preserving meaningful neighborhoods based on existing social structures, administrative divisions and geographic features. The smallest geographic unit for which Statistics Canada (2021) reports on is called a dissemination block, which is an area bounded by features such as road networks, ramp areas, or other standard geographic divisions. All neighborhoods were constructed using the smallest viable geographic units that allowed for linking with Canadian Census and Taxfiler data (Guhn et al., 2016). Canadian Census and Taxfiler data are used to create neighbourhood socioeconomic status index (Refer to Section 2.1.3). Each neighborhood contained a minimum of 50 and a maximum of 400-600 EDI records. The minimum of fifty records were based on an EDI reliability study, whereas a maximum of 400-600 records were chosen to optimally reflect the sociodemographic heterogeneity within urban areas (Forer et al., 2020). This process resulted in the creation of a total of 2,058 neighborhoods across Canada.

2.1.3 Development of neighbourhood socioeconomic status index

A neighbourhood-level socioeconomic status index was used as a measure of socioeconomic status (SES). The original index was created with the 2006 Canadian Census and Taxfiler variables. For this study, Canadian Census and Taxfiler variables from 2015/2016 were aggregated at the custom neighbourhood-level and were linked to EDI data to create this index. The Canadian Census contains approximately 2,200 variables covering population demographics (Forer et al., 2020; Guhn et al., 2016). Taxfiler data contains approximately 400 variables related to income, poverty and wealth. Large number of variables were considered and reduced to ten key SES variables, presented in Table 1 which contribute to the final neighbourhood SES index (Janus et al., 2024). To ensure comparability, all ten SES variables were transformed into Z-scores to ensure that the variables were on the same scale and equally weighted when combined into an overall SES Index. Higher SES index indicates higher overall neighbourhood-level SES, while lower SES index reflects a lower overall neighbourhood-level SES. The CanNECD SES index dataset was merged with the EDI dataset utilising children's postal codes with a 97.5% match rate. For detailed protocol and analysis, refer to Forer et al (2020) and Guhn et al. (2016).

Table 2.1: Variables in the neighbourhood-level SES index (Forer et al. 2020)

Poverty	% of low-income, lone parent families with children under 6
Marital Status	% separated or divorced individual
High income	% of families with children under 6 earning more than twice the provincial median
Dues	% of families with children under 6 with union/association dues
Wealth	% of families with children under 6 with investment income
Residential Stability	% non-migrant movers in the past year
Social Capital	% of families with children under 6 with charitable donations
Education	% of individuals with no high school diploma
Language/Immigration	% individuals who do not speak either official language at home
Income inequality	Gini Coefficient quintile for lone female-led families with children under 6

2.2 Ethics

The use of EDI data for this project was approved by the McMaster University Research Ethics Board (REB), now Hamilton Integrated Research Ethics Board (HiREB). To maintain confidentiality, the records in the Pan-Canadian database are de-identified.

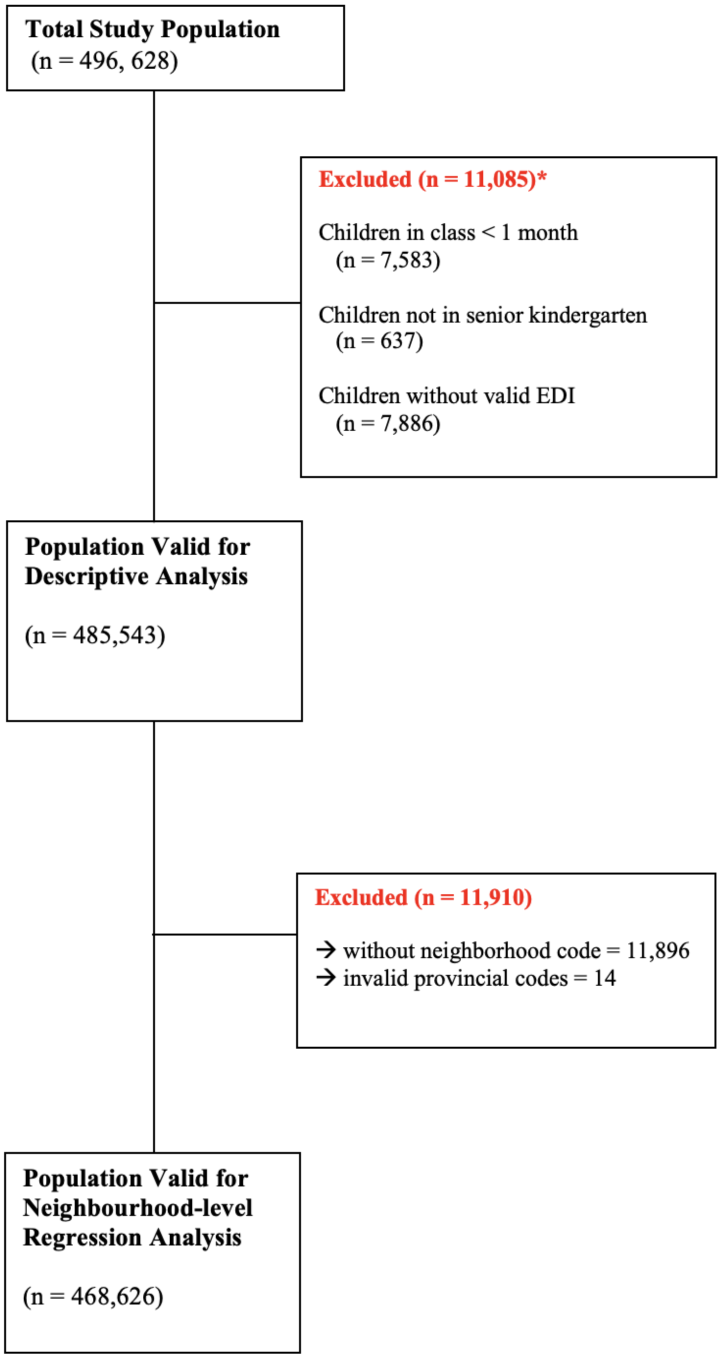
2.3 Study design and participants

This study was a multiple cross-sectional, population-level analysis study of kindergarten children in publicly funded schools across Canada between 2017 and 2023 years. The dataset included children from eight of Canada's thirteen jurisdictions: British Columbia, Manitoba, Ontario, Quebec, Nova Scotia, Prince Edward Island, Newfoundland and Labrador, and Northwest Territories. These were the only provinces and territories in Canada with both pre- and post-COVID-19 onset EDI data.

For our study, we classified the years 2017-2020 as the pre-COVID-19 period, and 2021-2023 as the post-COVID-19 onset period. Although the COVID-19 pandemic was officially declared in March 2020 (Cucinotta & Vanelli, 2020), majority of data collection for the 2017-2020 period occurred prior to this declaration. An internal data investigation conducted by our research team found no discernible differences between data collected before and after March 11, 2020. Moreover, data collection for 2020 primarily took place between February 2020 and May 2020, when teacher reported concerns were still based on pre-pandemic classroom interactions, meaning the pandemic had not yet influenced children's developmental health. Thus, 2020 was classified as part of the pre-COVID-19 cohort.

Our total study population consisted of 496,628 kindergarten children with EDI data. We included children in the study if they met the following inclusion criteria: (1) enrolled in senior kindergarten; (2) in their current classroom for at least one month at the time of EDI completion; (3) no more than 25% of items were missing on their EDI questionnaire. For research questions one and two, two additional inclusion criteria were applied for regression analysis: (1) the EDI data for a child was successfully matched to a neighbourhood code and associated SES index; and (2) the jurisdiction had at least 40 neighbourhoods to ensure adequate statistical power. Since Northwest Territories, and Prince Edward Island had less than 40 neighbourhoods, they were excluded, leaving six jurisdictions available for regression analysis. For research question three, the additional criterion was required for inclusion: the child must have special health needs, which was determined based on the analysis in research question one. Refer to Figure. 1 for a flowchart of participants included in the analysis.

Figure 2: Flowchart of participants



**Exclusions are based on multiple criteria applied together.*
Some children meet more than one exclusion condition.

2.4 Exposure variables

Our exposure variable in this study was the COVID-19 pandemic. The 2017-2020 cohort consisted of children who were not exposed to the pandemic prior to the time of EDI data collection and is therefore referred to as the pre-COVID-19 cohort. In contrast, the 2021-2023 cohort included children who were exposed to the COVID-19 pandemic and is referred to as the post-COVID-19 cohort. We also examined the prevalence of special health needs (SHN) for both pre- and post-COVID-19 cohorts, stratified by key demographic factors, including their sex, language fluency, and remoteness index.

2.5 Outcomes

For research question one, our outcome of interest was the prevalence of SHN among kindergarten children. The prevalence of SHN was further examined across its three categories on the EDI: special needs, special concerns, and needing further assessment. Additionally, another key outcome of interest was the association between SHN and neighbourhood-level SES. For research question two, our outcome of interest was the prevalence of overall SHN among kindergarten children for eight individual Canadian jurisdictions and its association to neighbourhood-level SES. For research question three, our outcome of interest was the vulnerability in the emotional maturity domain among children with SHN. A detailed description of all outcomes of interest is provided in the following subsections.

2.5.1 Special health needs

We identified special health needs (SHN) of children through three distinct categories in the EDI: 1) special needs, 2) special concerns, and 3) needing further assessment. A child was considered having "special needs" (SN) if their teacher indicated that they had already been identified as having either a medical, physical, or mental health diagnosis by a healthcare professional. A child was identified as having "special concerns" (SC) if their teacher indicated they had a problem that influenced their ability to function in a regular classroom. These concerns include physical disability, visual impairment, hearing impairment, speech impairment, learning disability, emotional problem, and behavioural problem. The "needs further assessment" (NfA) category includes children for whom teachers indicated they considered a further assessment was needed and included children who have not been identified as having special needs or special concerns. The latter two classifications of SHN reflect a child's health in the context of a school environment and thus are observed designations, not diagnostic ones. All the conditions within these classifications are likely to interfere in some way with a child's ability to learn or take advantage of educational activities at school. As such, while the concerns may not be diagnosed, the behaviours witnessed by the teachers can serve as a precursor for diagnosis later in the child's life. Children identified as NfA in kindergarten are more likely to have special educational needs status in grade 3 than children without NfA (Mir et al., 2020).

2.5.2 Mental health concerns and vulnerability in the emotional maturity domain

We assessed mental health concerns using the domain of emotional maturity on the EDI. The mental health concerns in this study are based on teacher observations, not on formal diagnoses. They have nevertheless comparable reliability with clinically validated tools (Janus et al. in prep). The emotional maturity domain evaluates a child's ability to understand and manage their feelings and thoughts at an age-appropriate level. It includes four subdomains: (1) prosocial and helping behaviour, (2) anxious and fearful behaviour, (3) aggressive behaviour, and (4) hyperactivity and inattention. Children whose scores fall below 10th percentile, are considered vulnerable in the emotional maturity domain. For our study, mental health concerns were defined as vulnerability in the emotional maturity domain. Studies have shown that children with elevated levels of anxiety, aggression and attention problems are at greater risk of poorer academic performance compared to their peers (Janus et al., 2023; Tamayo Martinez et al., 2021; Vuoksimaa et al., 2021). As such, a child's actions, behaviours, and emotions in kindergarten are predictive of academic outcomes years, influencing their emotional and mental well-being in the present and later in their life.

2.6 Data analysis

My thesis conducted individual-level and neighbourhood-level data analyses. Individual-level data analyses were conducted for research questions one, two and three. Neighbourhood-level analyses were conducted for research question one and two. These included developing regression models to examine the association between neighbourhood-level SES and SHN prevalence. All statistical analyses were conducted using SPSS version 29.0.2.0 and RStudio (R version 4.4.0).

2.7 Individual-level analysis

For the first and second research questions, we conducted the descriptive analysis on individual EDI records. In research question one, we examined the national prevalence of SHN and its three categories (SN, SC, and NfA) for pre- and post-COVID-19 cohorts. Additionally, we explored how the prevalence varied by demographic factors, including sex, language fluency, and remoteness index. In research question two, we examined the prevalence of SHN at the jurisdictional levels for seven provinces and one territory, respectively: British Columbia, Manitoba, Ontario, Quebec, Nova Scotia, Prince Edward Island, Newfoundland & Labrador, and Northwest Territories. For the third research question, we conducted individual-level analysis using both descriptive analysis and binary logistic regression. Descriptive analysis examined the prevalence of vulnerability in the emotional maturity domain among SHN children for pre- and post-COVID-19 cohorts. Binary logistic regression was used to determine the odds of vulnerability in the emotional maturity domain among children with SHN pre- and post-COVID-19 onset.

For all analyses, we report both the statistical significance and the effect size to compare findings between the two cohorts. Statistical significance refers to the probability that the observed difference between two groups is unlikely due to chance. If the p-value is larger than the chosen alpha level (e.g., 0.05), any observed difference is assumed to be explained by sampling variability. However, in large-scale population studies, such as our study, statistical tests will almost always yield significant differences unless there is no effect or, specifically, when the effect size is exactly zero (Sullivan & Feinn, 2012). Thus, very small differences, even if statistically significant, may be meaningless in the real-world context. To address this, we also report the effect size, which measures the magnitude of differences between groups (See Table 2.2). For individual-level analyses, we used Cramer's V effect size, a standardized measure for assessing the strength of association between two categorical variables as the effect size. For our study, the categorical variables refer to pre and post COVID-19 cohorts.

Table 2.2: Interpretation of Cramer's V Effect Size (IBM, 2005)

Effect Size (ES)	**Interpretation**
ES ≤ 0.2	Weak association.
$0.2 < \text{ES} \leq 0.6$	Moderate association.
ES > 0.6	Strong association.

2.8 Neighbourhood-level analysis

We examined the association between neighbourhood-level prevalence of SHN, and the neighbourhood-level SES, using individual children's EDI data aggregated to neighbourhoods. We assessed these associations using a series of linear regression models. Specifically, we conducted several regression analyses to address research questions one and two. For research question one, we developed four separate regression models, with each model using one of the following dependent variables: (1) percentage of children with SHN in a neighbourhood, (2) percentage of children with SN in a neighbourhood, (3) percentage of children with SC in a neighbourhood, and (4) percentage of children with reported to NfA in a neighbourhood. In all four models, the independent or explanatory variable was CanNECD neighbourhood-level SES index. For research question two, we separately conducted regression analyses for each jurisdiction with more than 40 neighbourhoods. This criterion excluded Northwest Territories and Prince Edward Island, leaving six jurisdictions for analysis: Ontario, Manitoba, British Columbia, Newfoundland and Labrador, Nova Scotia, and Quebec. Again, the independent variable in this case was CanNECD neighbourhood-level SES Index for each specific jurisdiction. The linear regression model produced key measures of interest: statistical significance, standardized beta-coefficient, R^2 coefficient of determination, and effect size. A detailed description of these measures is provided in the following subsection below.

2.8.1 Statistical significance

Statistical significance assesses whether the results of our linear regression analysis occurred due to random change. Typically, the significance threshold, or alpha, is set at 0.05. If the p-value (the probability of observed data obtained from statistical testing) is less than 0.05, this indicates a statistically significant result, meaning there is less than 5% probability that the observed results occurred by chance. However, conducting multiple statistical tests, as in our regression analysis, increases the likelihood of false positives. False positives occur when results are reported as statistically significant when they are not. To minimize the risk of false positives, we applied Bonferroni correction, adjusting the alpha level to 0.0025 (See Table 2.3). This means that for a result to be considered statistically significant, the p-value must be less than 0.0025.

Table 2.3: Bonferroni Correction Calculation

To determine the adjusted alpha value, we used the following calculation

- Initial significance level (alpha): α = 0.05
- Number of Statistical tests:
  - 4 categories of SHN (SHN, SN, SC, NfA)
  - 6 jurisdictions (ON, MB, BC, NL, NS and QC)
  - Pre & post analysis (2 time points)
  - Total tests = $2 \times (4 + 6) = 20$
- Adjusted Alpha Calculation:
  - $\alpha = \frac{0.05}{20} = 0.0025$

2.8.2 Standardized beta-coefficient

In linear regression analysis, a beta coefficient (β) also known as the regression coefficient measures the average change in the dependent variable for a one-unit increase in the independent variable. β represents the slope of the regression line, indicating the strength and direction of the association between the independent and dependent variables. A positive β indicates positive association meaning that as the independent variable increases, the dependent variable also increases. A negative β indicates an inverse association, meaning that as the independent variable increases, the dependent variable decreases.

In our study, β is standardized in standard deviation units, allowing for direct comparison across different regression models, such as those with different jurisdictions. Specifically, for our analysis, β represents the change in percentage of children with SHN (dependent variable) for every 1 standard-deviation increase in neighbourhood-level SES (independent variable).

2.8.3 Coefficient of determination

The coefficient of determination, also known as R^2 is the proportion of variance in the outcome observed by the model. An R^2 of 0 indicates no association between independent and dependent variables, whereas R^2 of 1 indicates a strong association, where the independent variable explains all variability in the dependent variable (Sullivan & Feinn, 2012). The interpretation of a “good” R^2 value varies by field. In the social sciences and psychology, where human behaviors are more variable than controlled conditions in scientific experiments, R^2 values of 0.10 to 0.30 are often considered acceptable (Gupta et al., 2024). In population-based studies on children, R^2 typically ranges from 0.1 to 0.4 (Janus et al., 2024; Webb et al., 2016). Instead of focusing on the total R^2 in the model, which is influenced by having multiple covariates such as sex, age, language fluency and remoteness index in the model, our research specifically examines the unique contribution of neighbourhood-level SES. This is captured by adjusted R^2 value, or more specifically, the R^2 change that isolates the effect of the association of neighbourhood-level SES with the percentage of children with SHN in each neighbourhood (Cohen, 1977; Selya et al., 2012).

To determine this R^2 change, we conducted a two-block hierarchical linear regression. In the first block, the dependent variable was the percentage of children with SHN, and the independent variable included age, sex, remoteness index and language fluency. This step captured the variance explained by demographic factors alone and is referred to as R^2 covariates. In the second block, we added neighbourhood-level SES index as predictor, along with the original independent variables. This provided the total R^2, representing the variance explained by both demographic factors and neighbourhood-level SES index. We calculated R^2 using the Equation 1 below. This calculation isolates the unique contribution of neighbourhood-level SES index to the observed percentage of children with SHN within a neighbourhood.

Equation 1: Calculating R^2 Change

$$R^2_{(change)} = R^2_{(total)} - R^2_{(covariates)}$$

2.8.4 Effect size for regression model

Understanding the practical significance of the findings are important, especially when analyzing population-level data on children. Effect size provides a measure of how meaningful the observed differences are in the real-world context. For linear regression, Cohen's f^2 is the standard method for calculating effect-size (Selya et al., 2012).

Equation 2: Calculating Cohen's f^2

$$f^2 = \frac{R^2\ change}{1 - R^2\ total}$$

The traditional approach to interpreting effect sizes follows Cohen's guidelines, where 0.2 is small, 0.5 is medium, and 0.8 is large. While Cohen's benchmarks continue to be widely used in social sciences, they were originally developed based on small, tightly controlled lab experiments in social psychology in the 1960s (Kraft, 2020). These thresholds may not be appropriate for population health studies where research is conducted in real-world settings influenced by environmental, temporal, and social factors. Given these limitations, Matthew Kraft (2020) proposed alternative effect size benchmarks based on studies of pre- kindergarten to grade 12 educational interventions, a context more relevant to this research. According to Kraft's guidelines, f^2 <0.05 is small effect, 0.05-0.20 is medium effect, >0.20 is large effect. These revised thresholds provide a more appropriate framework for evaluating effect sizes in this study. Therefore, we used Kraft's metric to interpret the effect sizes in the analysis.

2.9 References

Cohen, J. (1977). CHAPTER 9—F Tests of Variance Proportions in Multiple Regression/Correlation Analysis. In J. Cohen (Ed.), *Statistical Power Analysis for the Behavioral Sciences* (pp. 407–453). Academic Press. https://doi.org/10.1016/B978-0-12-179060-8.50014-1

Cucinotta, D., & Vanelli, M. (2020). Who declares covid-19 a pandemic. Acta Bio Medica : Atenei Parmensis, 91(1), 157–160. https://doi.org/10.23750/abm.v91i1.9397

Equity from the Start. (2025). *Results: A National Perspective*. Offord Centre for Child Studies. https://efts.offordcentre.com/results/

Forer, B., Minh, A., Enns, J., Webb, S., Duku, E., Brownell, M., Muhajarine, N., Janus, M., & Guhn, M. (2020). A Canadian Neighbourhood Index for Socioeconomic Status Associated with Early Child Development. *Child Indicators Research*, *13*. https://doi.org/10.1007/s12187-019-09666-y

Guhn, M., Janus, M., Enns, J., Brownell, M., Forer, B., Duku, E., Muhajarine, N., & Raos, R. (2016). Examining the social determinants of children's developmental health: Protocol for building a pan-Canadian population-based monitoring system for early childhood development. *British Medical Journal Open*, *6*(4), e012020. https://doi.org/10.1136/bmjopen-2016-012020

Gupta, A., Stead, T. S., & Ganti, L. (2024). Determining a Meaningful R-squared Value in Clinical Medicine. *Academic Medicine & Surgery*. https://doi.org/10.62186/001c.125154

IBM. (2005). IBM Cognos Analytics 11.1.x. IBM Corporation. https://www.ibm.com/docs/en/cognos-analytics/11.1.0?topic=terms-cramrs-v

Janus, M., Brownell, M., Reid-Westoby, C., Bennett, T., Birken, C., Coplan, R., Duku, E., Ferro, M. A., Forer, B., Georgiades, S., Gorter, J. W., Guhn, M., Maguire, J. L., Manson, H., Pei, J., & Santos, R. (2018). Establishing a protocol for building a pan-Canadian population-based monitoring system for early childhood development for children with health disorders: Canadian Children's Health in Context Study (CCHICS). *British Medical Journal Open*, *8*(5), e023688. https://doi.org/10.1136/bmjopen-2018-023688

Janus, M., Brownell, M., Reid-Westoby, C., Pottruff, M., Forer, B., Guhn, M., & Duku, E. (2024). Neighbourhood-level socioeconomic status and prevalence of teacher-reported health disorders among Canadian kindergarten children. *Frontiers in Public Health*, *11*. https://doi.org/10.3389/fpubh.2023.1295195

Janus, M., Enns, J., Forer, B., Raos, R., Gaskin, A., Webb, S., Duku, E., Brownell, M., Muhajarine, N., & Guhn, M. (2018). A Pan-Canadian Data Resource for Monitoring Child Developmental Health: The Canadian Neighbourhoods and Early Child Development (CanNECD) Database. *International Journal of Population Data Science*, *3*(3), 431. https://doi.org/10.23889/ijpds.v3i3.431

Janus, M., & Offord, D. R. (2007). Development and psychometric properties of the Early Development Instrument (EDI): A measure of children's school readiness.

Canadian Journal of Behavioural Science / Revue Canadienne Des Sciences Du Comportement, *39*(1), 1–22. https://doi.org/10.1037/cjbs2007001

Janus, M., Ryan, J., Pottruff, M., Reid-Westoby, C., Brownell, M., Bennett, T., Birken, C. S., Duku, E., Ferro, M. A., Forer, B., Georgiades, S., Gorter, J. W., Guhn, M., Maguire, J., Manson, H., Pei, J., Santos, R., & Coplan, R. J. (2023). Population-Based Teacher-Rated Assessment of Anxiety Among Canadian Kindergarten Children. *Child Psychiatry and Human Development*, *54*(5), 1309–1320. https://doi.org/10.1007/s10578-022-01332-9

Kraft, M. A. (2020). Interpreting Effect Sizes of Education Interventions. *Educational Researcher*, *49*(4), 241–253. https://doi.org/10.3102/0013189X20912798

Mir, H., Reid-Westoby, C., Gaskin, A., Duku, E., & Janus, M. (2020). Do Predictors of Children's Special Educational Needs in Grade 3 Differ by Special Needs Status in Kindergarten in Ontario, Canada? *International Journal of Population Data Science*, *5*(5), Article 5. https://doi.org/10.23889/ijpds.v5i5.1469

Selya, A. S., Rose, J. S., Dierker, L. C., Hedeker, D., & Mermelstein, R. J. (2012). A Practical Guide to Calculating Cohen's f2, a Measure of Local Effect Size, from PROC MIXED. *Frontiers in Psychology*, *3*. https://doi.org/10.3389/fpsyg.2012.00111

Statistics Canada. (2021, November 17). *Dictionary, Census of Population, 2021 – Dissemination block (DB)*. Statistics Canada. https://www12.statcan.gc.ca/census-recensement/2021/ref/dict/az/Definition-eng.cfm?ID=geo014

Statistics Canada. (2020). *The Daily—Vast majority of students attended public schools prior to the pandemic*. The Government of Canada. https://www150.statcan.gc.ca/n1/daily-quotidien/201015/dq201015a-eng.htm

Sullivan, G. M., & Feinn, R. (2012). Using Effect Size—Or Why the P-Value Is Not Enough. *Journal of Graduate Medical Education*, *4*(3), 279–282. https://doi.org/10.4300/JGME-D-12-00156.1

Tamayo Martinez, N., Tiemeier, H., Luijk, M. P. C. M., Law, J., van der Ende, J., Verhulst, F., & Jansen, P. W. (2021). Aggressive behavior, emotional, and attention problems across childhood and academic attainment at the end of primary school. *Social Psychiatry and Psychiatric Epidemiology*, *56*(5), 837–846. https://doi.org/10.1007/s00127-021-02039-3

Vuoksimaa, E., Rose, R. J., Pulkkinen, L., Palviainen, T., Rimfeld, K., Lundström, S., Bartels, M., van Beijsterveldt, C., Hendriks, A., de Zeeuw, E. L., Plomin, R., Lichtenstein, P., Boomsma, D. I., & Kaprio, J. (2021). Higher aggression is related to poorer academic performance in compulsory education. *Journal of Child Psychology and Psychiatry*, *62*(3), 327–338. https://doi.org/10.1111/jcpp.13273

Webb, S., Janus, M., Duku, E., Raos, R., Brownell, M., Forer, B., Guhn, M., & Muhajarine, N. (2016). Neighbourhood socioeconomic status indices and early childhood development. *SSM - Population Health*, *3*, 48–56. https://doi.org/10.1016/j.ssmph.2016.11.006

3.0 Results

3.1 Study population characteristics

Out of 496,628 kindergarten children who participated in the provincial/territorial EDI data collections across Canada between 2017 and 2023, a total of 485,543 children met the inclusion criteria and were included in the analyses. The pre-COVID-19 cohort consisted of 266,461 children, while the post-COVID-19 onset cohort consisted of 219,082 children. The distribution of kindergarten children across the jurisdictions that collected EDI data at both time periods is presented in Table 3.1. Five school boards in Ontario did not participate in the post-COVID-19 onset data collection, resulting in a smaller cohort post-COVID-19 onset than pre-COVID-19. To ascertain the comparability of data, we conducted a sensitivity analysis for Ontario by excluding the school boards who did not participate post-COVID-19 onset from the pre-dataset (2018 specifically) to maintain regional consistency between the two cohorts. The results indicated minimal differences in the overall findings. Thus, the analyses proceeded with children attending school in the five Ontario school boards included in the pre-COVID-19 cohort. Additional details on the sensitivity analysis are provided in Appendix I.

Table 3.1: Population of kindergarten children in each jurisdiction in the pre- and post-COVID-19 cohorts

	N (% of each cohort)	
Jurisdiction	**Pre-COVID-19 Cohort**	**Post-COVID-19 Cohort**
Ontario	131,839 (49.5%)	91,306 (41.7%)
Manitoba	13,735 (5.2%)	12,768 (5.8%)
British Columbia	21,794 (8.2%)	19,217 (8.8%)
Newfoundland	4,319 (1.6%)	3,920 (1.8%)
Nova Scotia	8,518 (3.2%)	8,502 (3.9%)
Prince Edward Island	1,452 (0.5%)	1,422 (0.7%)
Quebec	83,176 (31.2%)	80,453 (36.7%)
Northwest Territories	1,628 (0.6%)	1,494 (0.7%)
Total	266,461 (100%)	219,082 (100%)

The demographic characteristics of the two cohorts are largely similar (See Table 3.2). The proportions of males and females were approximately equal in each cohort (51% vs. 49%) and between cohorts. The proportion of children identified as having E/FSL was slightly higher in the post-COVID-19 onset cohort compared to the pre-COVID-19 cohort. The distribution of children across remoteness categories was also similar, with many children in both cohorts residing in easily accessible areas. These similarities help ensure that comparisons between the two cohorts are not confounded by major demographic differences. Furthermore, children in the pre-COVID-19 cohort resided in 1,639 neighbourhoods, while the children in post-COVID-19 cohort resided in 1,618 neighbourhoods (See Table 3.3). For neighbourhood-level analysis, Northwest Territories and Prince Edward Island were excluded because they had fewer than 40 neighbourhoods which was the minimum number required for linear regression.

Table 3.2: Demographic characteristics of the pre- and post-COVID-19 cohorts of kindergarten children

	N (% of each cohort)	
Sex	**Pre-COVID-19 Cohort**	**Post-COVID-19 Cohort**
Male	136,795 (51.3%)	112,141 (51.2%)
Female	129,665 (48.7%)	106,930 (48.8%)
Missing	1 (0.0%)	11 (0.0%)
E/FSL Status		
No	222,769 (83.8%)	168,103 (81.6%)
Yes	42,928 (16.2%)	37,795 (17.2%)
Missing	764 (0.3%)	13,184 (6.0%)
Remoteness Index		
Easily Accessible Area	197,596 (74.2%)	152,584 (69.6%)
Accessible Area	39,805 (14.9%)	35,930 (16.4%)
Less Accessible Area	15,949 (6.0%)	13,485 (6.2%)
Remote Area	8886 (3.3%)	9,292 (4.2%)
Very Remote Area	1,323 (0.5%)	1,195 (0.5%)
Missing	2,902 (1.1%)	6,596 (3.0%)

Table 3.3: Number of neighbourhoods in each jurisdiction at each time point

	N (% of total cohort neighbourhoods)	
Jurisdiction	**Pre-COVID-19 Cohort**	**Post-COVID-19 Cohort**
Ontario	789 (48.1%)	791 (48.9%)
Manitoba	71 (4.3%)	75 (4.6%)
British Columbia	275 (16.8%)	248 (15.3%)
Newfoundland	42 (2.6%)	41 (2.5%)
Nova Scotia	56 (3.4%)	58 (3.6%)
Prince Edward Island	6 (0.4%)	6 (0.4%)
Quebec	397 (24.2%)	396 (24.5%)
Northwest Territories	3 (0.2%)	3 (0.2%)

3.2 National prevalence of special health needs among kindergarten children

During the post-COVID-19 onset period, 25.2% of children were identified as having SHN compared to 22.2% in the pre-COVID-19 period. This represents a 13.5% relative increase from the pre-pandemic years. Each of the SHN subcategories: SN, SC and NfA showed increases, with differences in the magnitude of change (see Table 3.4). The prevalence of SN increased from 4.4% in 2017-2020 to 5.5% in 2021-2023, reflecting a 25% relative increase. The prevalence of SC rose from 17.2% to 18.2%, reflecting a 5.8% relative increase. The prevalence of NfA increased from 14.5% to 17.3%, representing a 19% relative increase.

Table 3.4: The proportion of children in SHN, SN, SC, and NA categories in the pre- & post-COVID-19 cohorts

	Pre-COVID-19	Post-COVID-19	Cramer's V	*p*
SHN	59,035 (22.2%)	55,124 (25.2%)	.035	<.001*
SN	11,604 (4.4%)	12,031 (5.5%)	.028	<.001*
SC	45,684 (17.2%)	42,436 (18.2%)	.028	<.001*
NfA	37,842 (14.5%)	36,732 (17.3%)	.038	<.001*

**statistically significant (Bonferroni Correction p<.0025)*

3.2.1 Prevalence of SHN, pre-& post-COVID-19 by children's sex

The prevalence of SHN and its categories (SN, SC, NfA) increased from pre- to post-COVID-19 onset for both sexes, though rates varied. Males consistently had higher overall prevalence across all domains. See Table 3.5 for detailed prevalence rates.

Table 3.5: The proportion of children with SHN, SN, SC, and NfA in the pre- & post-COVID-19 cohorts categorized by sex

	Sex	Pre-COVID-19	Post-COVID-19	Cramer's V	*p*
SHN	Male	38,709 (28.3%)	35,786 (31.9%)	.039	<.001*
	Female	20,326 (15.7%)	19,334 (18.1%)	.028	<.001*
SN	Male	8,129 (6.0%)	8,490 (7.6%)	.028	<.001*
	Female	3,475 (2.7%)	3,540 (3.3%)	.038	<.001*
SC	Male	30,245 (22.2%)	27,803 (24.8%)	.026	<.001*
	Female	15,439 (12.0%)	14,630 (13.7%)	.031	<.001*
NfA	Male	25,346 (19.0%)	27,803 (24.8%)	.033	<.001*
	Female	15,439 (12.0%)	14,630 (13.7%)	.042	<.001*

**statistically significant (Bonferroni Correction p<.0025)*

3.2.2 Prevalence of SHN, pre- & post-COVID-19 by children's language fluency

The prevalence of SHN and its categories (SN, SC, NfA) increased from pre- to post-COVID-19 onset among children with and without E/FSL. Overall, both groups experienced similar relative increases. While these changes were statistically significant, the effect sizes were small. See Tables 3.6 for detailed prevalence rates.

Table 3.6: The proportion of children with SHN, SN, SC, and NfA in the pre- & post-COVID-19 cohorts among children with and without E/FSL

	E/FSL	Pre-COVID-19	Post-COVID-19	Cramer's V	*p*
SHN	Yes	9,550 (22.4%)	9,463 (25.0%)	.033	<.001*
	No	48,328 (21.8%)	42,421 (25.2%)	.036	<.001*
SN	Yes	1,839 (4.3%)	2,032 (5.4%)	.026	<.001*
	No	9,736 (4.4%)	9,175 (5.5%)	.026	<.001*
SC	Yes	7,239 (17.0%)	7,168 (19.0%)	.027	<.001*
	No	38,629 (17.4%)	32,991 (19.6%)	.029	<.001*
NfA	Yes	6,308 (15.0%)	6,424 (17.5%)	.034	<.001*
	No	31,438 (14.4%)	28,204 (17.2%)	.039	<.001*

**statistically significant (Bonferroni Correction p<.0025)*

3.2.3 Prevalence of SHN, pre- & post-COVID-19 by neighbourhood remoteness

The prevalence of SHN increased across all quintiles of remoteness from pre- to post-COVID-19 onset, with the largest increase observed in accessible and easily accessible areas. Less accessible and remote areas also showed moderate increases. Although very remote areas consistently had the highest SHN prevalence across both time periods, the change over time was not statistically significant. Similar patterns were observed for SN and SC. However, the most substantial increase in frequency of children reported as NfA occurred in very remote areas, where prevalence rose sharply, followed by increases in less accessible, accessible, and easily accessible areas. During pre-COVID-19, NfA prevalence was highest in accessible and less accessible areas. Post-COVID-19 onset, NfA prevalence aligned more closely with overall SHN, with very remote areas reporting the highest prevalence. See Tables 3.7 for prevalence rates.

Table 3.7: The proportion of children with SHN, SN, SC, and NfA in the pre- & post-COVID-19 cohorts by Remoteness Index categories

	Remoteness Index	Pre-COVID-19	Post-COVID-19	Cramer's V	*p*
SHN	Easily Accessible Area	42,964 (21.7%)	37,393 (24.5%)	.033	<.001*
	Accessible Area	8,811 (22.1%)	9,503 (26.4%)	.028	<.001*
	Less Accessible Area	4,065 (22.1%)	3,823 (28.4%)	.032	<.001*
	Remote Area	2,260 (25.4%)	2,549 (27.4%)	.023	<.001*
	Very Remote Area	343 (25.9%)	360 (30.1%)	.047	<.001*
SN	Easily Accessible Area	8,091 (4.1%)	8,260 (5.4%)	.028	<.001*
	Accessible Area	1,852 (4.7%)	2,034 (5.7%)	.038	<.001*
	Less Accessible Area	945 (5.9%)	814 (6.1%)	.003	.653
	Remote Area	483 (5.4%)	534 (5.8%)	.007	.332
	Very Remote Area	93 (7.0%)	87 (7.3%)	.047	.771
SC	Easily Accessible Area	33,512 (17.0%)	28,647 (18.8%)	.023	<.001*
	Accessible Area	6,588 (16.7%)	7,430 (20.7%)	.051	<.001*
	Less Accessible Area	3,103 (19.7%)	2,968 (22.0%)	.029	<.001*
	Remote Area	1,760 (20.0%)	1,999 (21.6%)	.020	.009
	Very Remote Area	282 (21.4%)	274 (23.0%)	.019	.333
NfA	Easily Accessible Area	27,771 (14.4%)	25,148 (17.0%)	.036	<.001*
	Accessible Area	5,611 (14.4%)	6,142 (17.5%)	.043	<.001*
	Less Accessible Area	2,535 (16.2%)	2,543 (19.3%)	.041	<.001*
	Remote Area	1,400 (16.2%)	1,630 (18.1%)	.025	<.001*
	Very Remote Area	190 (15.0%)	239 (21.2%)	.080	<.001*

**statistically significant (Bonferroni Correction p<.0025)*

3.2.4 Prevalence of SHN in the pre- & post-COVID-19 cohorts by neighbourhood-level socioeconomic status

We conducted linear regression models to examine the association between neighbourhood-level SES and the proportion of children identified with SHN at neighbourhood-level (See Table 3.8). The prevalence of SHN and its categories (SN, SC, NfA) varied by neighbourhood, with a higher percentage of children with SHNs observed in lower SES neighbourhoods. The unique contribution of neighbourhood-level SES to the percentage of children with SHN has increased across all categories of SHN post-COVID onset, though the magnitude varied. For SHN, the unique contribution of neighbourhood-level SES rose from 5.1% pre-COVID-19 to 6.6% post-COVID-19 onset. A one standard deviation decrease in neighbourhood-level SES was associated with a 0.235 increase in the percentage of SHN children pre-COVID-19 ($R^2 = 0.056$, $p<0.001$), and a 0.260 increase post-COVID-19 ($R^2 = 0.073$, $p<0.001$). The association between neighbourhood-level SES and the percentage of SHN children was stronger post-COVID-19 onset.

For SN, the unique contribution of neighbourhood-level SES increased from 1.8% pre-COVID-19 to 4.5% post-COVID-19. For one standard deviation decrease in neighborhood- level SES, there was a 0.139 increase in the percentage of SN children pre-COVID-19, and a 0.215 increase post-COVID-19 onset. This indicates a stronger association between neighborhood-level SES and percentage of SN children following the onset of COVID-19. For SC, the unique contribution of neighbourhood-level SES showed a moderate increase from 5.9% pre-COVID-19 to 6.0% post-COVID-19 onset. A one standard deviation decrease in neighborhood-level SES was associated with 0.253 increase in the percentage of SC children pre-COVID-19, rising slightly to 0.260 post-COVID-19 onset. Thus, similar strength of association is found between neighbourhood-level SES and percentage of SC children for both time periods. For NfA, the unique contribution of neighbourhood-level SES rose from 2.8% pre- COVID-19 to 3.9% post-COVID-19 onset. For one standard deviation decrease in neighborhood-level SES, there was a 0.176 increase in the percentage of children with SHN pre-COVID-19, and a 0.200 increase post-COVID-19 onset. This indicates a stronger association between neighborhood SES and percentage of NfA children following the onset of COVID-19.

Table 3.8: The association between neighbourhood-level prevalence of SHN categories in kindergarten children during the pre- & post-COVID-19 cohorts and neighbourhood-level SES in Canada

	Time-period	SHN	SN	SC	NfA
R^2 Change	Pre-COVID-19	.051 (p<.001*)	.018 (p<.001*)	.059 (p<.001*)	.028 (p<.001*)
	Post-COVID-19	.066 (p<.001*)	.045 (p<.001*)	.060 (p<.001*)	.039 (p<.001*)
Standardized Beta-Coefficient	Pre-COVID-19	-.235	-.139	-.253	-.200
	Post-COVID-19	-.260	-.215	-.251	-.200
Cohen's f^2 (Effect Size)	Pre-COVID-19	.056 medium	.019 small	.069 medium	.030 small
	Post-COVID-19	.073 medium	.051 medium	.066 medium	.040 small

**statistically significant (Bonferroni Correction p<.0025)*

3.3 Jurisdictional prevalence of special health needs among kindergarten children

We then examined the prevalence of SHN across the Canadian jurisdictions, in both the pre- and post-COVID-19 cohorts. There was an increase in SHN prevalence across all jurisdictions following the onset of COVID-19, except in Quebec and Northwest Territories. This change in prevalence was statistically significant (p<.0025) for all jurisdictions except for Prince Edward Island, Quebec, and Northwest Territories. The largest increases were observed in Newfoundland and Labrador and Manitoba, while Quebec had the smallest increase. After the onset of COVID-19, Prince Edward Island reported the highest overall SHN prevalence. For detailed provincial values of SHN prevalence, see Table 3.9.

Table 3.9: Jurisdictional prevalence of SHN for pre-COVID (2017-2020) and post-COVID (2021-2023) cohorts

	Pre-COVID-19	Post-COVID-19	Relative Increase	Cramer's V	*p*
ON	27,902	23,608	22.2%	.035	<.001*
	(21.2%)	(25.9%)			
MB	2,650	3,197	30.0%	.069	<.001*
	(19.3%)	(25.0%)			
BC	4,352	4,169	8.5%	.021	<.001*
	(20.0%)	(21.7%)			
NL	960	1,097	26.1%	.066	<.001*
	(22.1%)	(28.0%)			
NS	1,901	2,290	20.6%	.054	<.001*
	(22.3%)	(26.9%)			
PE	386	408	7.8%	.024	.206
	(26.6%)	(28.7%)			
QC	20,431	19,924	0.8%	.002	.345
	(24.6%)	(24.8%)			
NT	453	431	1.8%	.011	.526
	(27.8%)	(28.3%)			

**statistically significant (Bonferroni Correction p<.0025)*
*** Acronyms for province: Ontario (ON), Manitoba (MB), British Columbia (BC), Newfoundland & Labrador (NL), Nova Scotia (NS), Prince Edward Island (PE), Quebec (QC), Northwest Territories (NT)*

3.3.1 Jurisdictional proportion of children identified with SHN in the pre- & post-COVID-19 cohorts by neighbourhood-level socioeconomic status

Separate regressions for the six jurisdictions (Ontario, Manitoba, British Columbia, Newfoundland, Nova Scotia, and Quebec) with more than 40 neighbourhoods revealed that there were greater percentages of children with SHNs in lower-SES neighbourhoods in each of them. The association between neighbourhood-level SES and SHN was strongest in Newfoundland & Labrador and weakest in Quebec, both before and after the onset of COVID-19. The unique variance explained by the model (R^2 change) increased post-COVID-19 onset for all provinces except for Newfoundland & Labrador and Nova Scotia. There was no significant association between the prevalence of SHN and neighbourhood-level SES in British Columbia during pre-COVID-19 onset and no significant association between the prevalence of SHN and neighbourhood-level SES in both British Columbia and Nova Scotia in post-COVID-19 onset. For further details on association, see Table 3.10. Model summaries are provided in Appendix II.

Table 3.10: The association between neighbourhood-level prevalence of SHN categories in kindergarten children during the pre- & post-COVID-19 onset cohorts and neighbourhood-level SES in six Canadian jurisdictions

	Time point	ON	MB	BC	NL	NS	QC
R^2 Change	Pre-COVID-19	0.092 (p<0.001*)	0.149 (p<0.001*)	0.016 (p<0.025)	0.228 (p<0.001*)	0.157 (p<0.001*)	0.097 (p<0.001*)
	Post-COVID-19	0.095 (p<0.001*)	0.175 (p<0.001*)	0.035 (p<0.003)	0.197 (p<0.035)	0.106 (p<0.009)	0.099 (p<0.001*)
Standardized Beta-Coefficient	Pre-COVID-19	-0.310	-0.416	-0.136	-0.555	-0.427	-0.334
	Post-COVID-19	-0.310	-0.446	-0.192	-0.539	-0.347	-0.329
Cohen's f^2 (Effect size)	Pre-COVID-19	0.112 medium	0.215 high	0.017 small	0.390 high	0.230 high	0.119 small
	Post-COVID-19	0.107 medium	0.254 high	0.038 small	0.281 high	0.136 medium	0.102 small

**statistically significant (Bonferroni Correction p<.0025)*

3.4 Vulnerability in the emotional maturity domain of kindergarten children with special health needs

The last analysis conducted aimed to answer the third research question and determine the prevalence of mental health concerns among SHN children before and after the onset of COVID-19 pandemic. In our study, mental health concerns were defined as vulnerability in the emotional maturity domain. Out of 485,543 kindergarten children who met the inclusion criteria, a total of 114,159 children had SHN and were included in the analysis to assess vulnerability in the emotional maturity domain, comprising 59,035 children in the pre-COVID-19 onset cohort and 55,194 children in the post-COVID-19 onset cohort. Table 3.11 shows that demographic characteristics of children with SHN between the two cohorts were similar, although post-COVID-19 onset cohort has significantly more missing data.

Table 3.11: Demographic characteristics of the pre- and post-COVID-19 cohorts of kindergarten children

	***N* (% of each cohort)**	
Sex	**Pre-COVID-19 Cohort**	**Post-COVID-19 Cohort**
Male	38,709 (65.6%)	35,786 (64.9%)
Female	20,326 (34.4%)	19,334 (35.1%)
Missing	0 (0.0%)	4 (0.0%)
E/FSL Status		
No	49,328 (83.6%)	42,421 (77%)
Yes	9,550 (16.2%)	9,463 (17.2%)
Missing	157 (0.3%)	3,240 (5.9%)
Remoteness Index		
Easily Accessible Area	42,964 (72.8%)	37,393 (67.8%)
Accessible Area	8,811 (14.9%)	9,502 (17.2%)
Less Accessible Area	4,065 (6.9%)	3,823 (6.9%)
Remote Area	2,260 (3.8%)	2,549 (4.6%)
Very Remote Area	343 (0.6%)	360 (0.7%)
Missing	592 (1.0%)	1,497 (2.7%)

As shown in Table 3.12, the proportion of children with SHN identified with vulnerability in the emotional maturity domain increased from 43.4% pre-COVID to 45.5% post-COVID onset. After adjusting for covariates (language fluency, sex, neighbourhood-level SES, and remoteness index), the odds of vulnerability in the emotional domain among children with SHN was 14% lower in the post-COVID-19 cohort compared to pre-COVID cohort (odds ratio: 0.863, 95% CI: 0.838–0.888, p< 0.005). More details on binary logistic regression analysis are in Appendix IV.

Table 3.12: Vulnerability on emotional maturity for the population of SHN children

	Pre-COVID-19	Post-COVID-19	Cramer's V	*p*
Vulnerable	25,527 (43.4%)	24,974 (45.5%)	.035	<.001*
Not Vulnerable	33,305 (56.6%)	29,912 (54.5%)		

**statistically significant (Bonferroni Correction p<.0025)*

4.0 Discussion

4.1. Summary of the findings

Our population-level study demonstrated that: (1) the proportion of children identified by teachers as having SHN increased following the onset of the COVID-19 pandemic, albeit the increase was small in magnitude, (2) the prevalence of SHN is inversely associated with neighbourhood-level SES and this was more pronounced following the COVID-19 pandemic, (3) the strength of this association varied across jurisdictions, and (4) the prevalence of mental health concerns among children with SHN also increased during this period, however, the adjusted odds of having mental health concerns were lower following the onset of COVID-19 pandemic.

Our findings indicate a 13.5% relative increase in the proportion of children identified with SHN post-COVID-19 onset compared to pre-COVID onset. We confirmed the previously established association that a higher proportion of SHN children resided in lower SES neighbourhoods than higher SES neighbourhoods (Janus et al. 2024) and found that this association was stronger following the onset of the pandemic. While majority of children identified as having SHN were flagged for special concerns and the needing further assessment, only a small proportion were formally diagnosed with special needs - 4.5% pre-COVID-19 onset and 5.5% post-COVID-19 onset. However, this seemingly small increase reflects a substantial number of children (>10,000 children across Canada), and the 1 percentage point increase accounts for approximately 2,931 additional cases of special needs observed following the COVID-19-pandemic. As such, small increases in prevalence should raise public health concerns about diagnostic capacity, special education support resources, and equitable access to services.

We also observed an increase in risk of vulnerability in the emotional maturity domain among SHN children, highlighting the growing need for targeted mental health support. Our unadjusted logistic regression showed a slight increase in the odds of being vulnerable post-COVID-19 onset (OR = 1.09, 95% CI: 1.064–1.115, $p < 0.001$). However, after adjusting for covariates such as sex, language fluency, rurality, and neighbourhood-level SES, the odds of being vulnerable in emotional maturity were 14% lower post-COVID-19 onset compared to pre-pandemic levels. The reduction in odds ratio following the inclusion of control variables in the model may warrant further investigation, as it could be attributed to one or more of the covariates (See Appendix IV and V for full model details). Such findings raise the possibility that pre-existing structural inequities, such as neighbourhood and geographic factors, may have played more of a significant role in influencing the increased prevalence of mental health concerns than the pandemic itself. Together, our findings reveal the persistent and widening inequities in the identification of SHN across Canada in relation to the factors measured here following the onset of the COVID-19 pandemic. The following sections in this chapter will interpret these findings and their implications for policy and practice.

4.2 National prevalence of special health needs

In Canada, provincial figures estimate that between 10% to 20% of all students enrolled from kindergarten to grade 12 receive special education services (Whitley, 2020). Our research identified higher SHN prevalence than broader provincial estimates.

We observed an increase in SHN prevalence from 22.2% pre-COVID-19 to 25.2% post-COVID-19 onset amongst kindergarten children. Global literature has begun to document deteriorating developmental outcomes following the COVID-19 pandemic, often from the perspectives of parents and caregivers of children with disabilities (Arim et al., 2020; Neece et al., 2020; Yesil et al., 2022). A qualitative study from the United States found that parents of children with intellectual and developmental disabilities reported reduced access to services during the pandemic, and expressed their concerns with the hindrance in their children's developmental and academic progress (Neece et al., 2020). Similarly, a study conducted in Turkey found that parents reported developmental regression in their children, largely due to school closures and discontinuation of special education programs (Yesil et al., 2022). This concern is also echoed by Canadian parents of children with disabilities, 58% of whom expressed they were stressed about the school year and their child's academic success, compared to 36% of parents of children without disabilities (Arim et al., 2020). Other studies have shown worsening of behaviour problems' symptoms during the pandemic such as increased conduct challenges with children with attention deficit hyperactivity disorder (ADHD) and reduced prosocial behaviour amongst children with autism spectrum disorder (ASD) (Masters et al., 2020; Nonweiler et al., 2020).

At the national level, we found an increase in SHN prevalence pre- to post-COVID-19 onset among both male and female kindergarten children. Consistent with previous research, male children tend to have higher rates of ADHD, ASD, and other behavioural or speech-related challenges in early childhood compared to female children

(Danielson et al., 2024; Rutter et al., 2004; Thomson et al., 2017; Webb et al., 2020). According to the Public Health Agency of Canada (2022), males ages 1-17 were four times more likely than females to be diagnosed with ASD prior to the COVID-19 pandemic (Public Health Agency of Canada, 2022). While the SHN prevalence before and after the onset of the pandemic among female kindergarteners in our study was consistently lower than among males, their relative increase following COVID-19 was higher. This trend suggests potential growing inequities in how male and female children may be observed or diagnosed. Prior research has demonstrated that same behaviours may be perceived differently based on child's sex, with both educators and mental health professionals more likely to refer males for externalizing concerns even when both males and females present similar symptoms (Bruchmüller et al., 2012; Sciutto et al., 2004; Thomson et al., 2017).

We also found a comparable rise in prevalence of SHN amongst children with E/FSL (from 22.4% to 25.0%) and their non-E/FSL peers (21.8% to 25.2%) following the COVID-19 pandemic. While these findings suggest that E/FSL children are not disproportionately impacted, prior research has shown that immigrant children often receive special education services at rates misaligned with their actual needs (Conger et al., 2007; Conger & Grigorenko, 2009). Further research could benefit from integrating data on children's immigration status and their health.

SHN prevalence also varied by geographic location. Our research found that the prevalence of SHN was higher in socioeconomically disadvantaged and remotes areas than in other areas. Prior studies have found similar trends (Janus et al., 2024; Spadafora et al., 2022; Yazıcı & Acar, 2023). Specifically, a national survey conducted in 2015-2018 in the United States found that approximately 20% of children aged 3-17 years were diagnosed with developmental disabilities, with prevalence notably higher among children living in remote areas (Zablotsky & Black, 2020). Our study found that these inequities in SHN prevalence have been magnified following the onset of COVID-19 pandemic. Notably, Canadian educators in low-SES schools have reported more barriers to online learning during the pandemic, (Spadafora et al., 2022), which may have disproportionately affected children with SHN as they require more support than their peers but often have limited access to essential resources (Yazıcı & Acar, 2023). According to the United Nations (2020), the long-term effects of the pandemic will not be felt equally, as children who are already vulnerable, including those with disability and those living in poverty, are likely to experience most challenges in their development, health and overall-wellbeing.

4.3 Jurisdictional prevalence of special health needs

We examined the differences in SHN prevalence among kindergarten children before and after the onset of the COVID-19 pandemic among eight Canadian jurisdictions. We found that the relative increase in SHN prevalence post-COVID-19 onset ranged from 0.8% to 30.0% across jurisdictions, with the largest increase observed in Manitoba (19.3% to 25.0%) and smallest in Quebec (24.6% to 24.8%). These provincial and territorial differences may partly reflect the variations in both special education policies and pandemic-related measures across jurisdictions. Policies governing the education and support of children with SHN are determined at provincial and territorial level, and often differ even between regions or school boards within a province (Dworet & Bennett, 2002; Kohen et al., 2007; Towle, 2015). As such, there are inconsistencies in eligibility criteria for services, the types of support offered to children with similar needs, resource allocation and the availability of special education learning. The policies during the COVID-19 pandemic could have contributed to these variations. Each province and territory adopted its own approach to school closures and public health measures, which affected both the identification of children with SHN, and the continuity of special needs support services (MacPherson & Green, 2023). For example, the duration of school closures during the pandemic varied widely: Ontario reported the longest closure at 27 weeks, while British Columbia had the shortest at 10 weeks (MacPherson & Green, 2023). Since schools are a primary setting for identifying children with SHN and detecting learning concerns, prolonged closures likely reduced early identification opportunities. This may explain why Ontario saw a relatively higher SHN prevalence following the pandemic, as more children with unmet needs were only identified after in-person learning resumed. In contrast, shorter closure periods in British Columbia may have allowed for more consistent monitoring and earlier identification.

Moreover, no jurisdiction offered a standardized approach to remote education during school closures (MacPherson & Green, 2023). This lack of consistency across provinces and territories meant that children experienced vastly different educational and developmental experiences depending on where they lived. In British Columbia, the number of students from kindergarten to Grade 12 designated with learning exceptionalities in school boards rose significantly during the pandemic, with the largest increases observed in designations for ASD, learning disabilities and mental health conditions (Baumbusch & Lloyd, 2022). In contrast, our study found a smaller increase in the prevalence of SHN following the pandemic, likely because we focused solely on kindergarten children, who had fewer opportunities for identification during school closures compared to older children.

In Manitoba, parents reported struggling to access timely information about school-related changes during the pandemic and expressed concerns about schools remaining open despite province-wide “red-level” restrictions (Cullen, 2021). According to a provincial school survey in Manitoba, 28.8% fewer children were enrolled in kindergarten during the 2020/2021 school year (Cullen, 2021). In our study, Manitoba had the highest increase in SHN prevalence following the pandemic compared to other Canadian jurisdictions. One possible explanation may be that students were identified with SHN status due to in-person schooling remaining open for a longer time. However, this may also reflect a lack of communication or clarity around how to access services. Further research is needed to understand the trend between identification and service access.

In Ontario, kindergarten and primary school educators expressed confusion regarding how to provide accommodations for students with disabilities during remote learning (Rolland, 2020; Timmons et al., 2021). In Newfoundland and Labrador, families raised concerns that school boards were not doing enough to support students with disabilities (Mullaley, 2020). In Nova Scotia, academic performance declined during the pandemic, with the percentage of Grade 3 students meeting reading and writing standards fell from 76% in 2012-2013 to 68% in 2021-2022 (Bennett, 2023). Similarly, Côté et al. (2023) observed an 8.4 percentage point decline in reading assessment scores among Grade 4 students during this period in Quebec. The researchers also noted increasing inequity, with students in top performance brackets experiencing little to no learning loss, while those at bottom 20th percentile experiencing significant declines (Côté et al., 2023). These findings indicate deepening educational inequities following the pandemic, with students who are already vulnerable, falling even further behind their peers.

Furthermore, Prince Edward Island and Northwest Territories were reported to have the highest use of continued childcare usage during the pandemic; 17% and 30%, respectively (Statistics Canada, 2020). This maintained access of childcare services may have helped sustain support for children with SHN in these jurisdictions. Additionally, in Northwest Territories, focus group interviews revealed that communities with higher proportions of Indigenous populations, particularly in remote areas, faced greater educational disruptions. While disaggregated data for Indigenous children were not available, participants highlighted that COVID-19 exacerbated existing social and health inequities, such as widening of education gap, following the COVID-19 pandemic (Qadri, 2024).

4.4 Vulnerability in the emotional maturity domain of kindergarten children with special health needs

We found that vulnerability rates in the emotional maturity domain among the children identified as having SHN increased from 43.4% before COVID-19 to 45.5% following the onset of COVID-19. However, we observed a 14% decrease in odds for

SHN kindergarteners of having mental health concerns post-onset of COVID-19 pandemic, compared to before the COVID-19 pandemic. This contradiction suggests that the increased rates of vulnerability in the emotional maturity domain may not be directly attributable to the pandemic alone. Instead, it likely reflects existing differences in individual factors (such as age or type of disability), and broader systemic influences (such as neighbourhood-level SES and access to services).

Emerging literature shows that mental health outcomes during COVID-19 varied by age and type of disability among children with special educational needs (Bellomo et al., 2020; Colizzi et al., 2020; Tso et al., 2022, 2023). Recent CIHI report shows that factors, including age, sex and income, affect how children and youth receive care for mental health disorders (CIHI, 2025). For instance, a cross-sectional study in Hong Kong found that preschoolers with SHN showed improved emotional and behavioural functioning upon returning to school after closures, whereas school-aged children, adolescents and children with intellectual disabilities experienced a decline in quality of life (Tso et al., 2023). The authors attribute improvements seen in preschoolers' emotional and behavioural difficulties to higher neuroplasticity in younger brains, allowing them to adapt and respond better to in-person classes, and support (Tso et al., 2023). As such, there is potential for resilience among specific groups of children following pandemic disruptions.

In addition to mental health outcomes for children, parents of children with SHN in the United Kingdom also expressed high levels of stress and anxiety (Asbury et al., 2021). Many parents felt unequipped to meet their children's needs during school closures and feared their children were falling further behind. These heightened stress levels are not only concerning for caregiver well-being but also may have effects on children's mental health, highlighting the importance of providing coordinated support for both children and their families during and after periods of educational disruption. In contrast to adverse mental health concerns, a Canadian study identified positive impacts of the pandemic for some children with disabilities, such as break from school-related stress, improvement management of sensory needs, strengthened family bonds, and increased quality time (Lamptey et al., 2024). These findings suggest that family environments play a crucial role in child development during times of disruption. Children without such a supportive home environment may be more vulnerable to falling behind, both academically and emotionally.

4.5 Strengths and limitations

Our study had several strengths. First, it draws on population-level data on over 480,000 kindergarten children across eight of Canada's thirteen jurisdictions, making it one of the most comprehensive studies of SHN prevalence in young children following the COVID-19 pandemic. Another strength lies in our non-categorical approach to childhood disabilities, which reflects the perspective that diagnostic categories alone often do not fully account for actual needs and abilities of children (McDowell & O'Keeffe, 2012; Rosenbaum & Gorter, 2012). Thus, by relying on teacher-reported data and applying a broad, functional definition of SHN, the study captures a wide range of developmental, behavioural, and emotional needs, not just those with formal diagnoses. Such an inclusive approach recognizes the complexity and overlapping nature of many developmental and behavioral concerns (Janus et al., 2024). Our broad definitions also increased the sample size, enabling us to examine prevalence patterns in smaller and remote jurisdictions, which are often underrepresented in research.

However, our study is not without limitations. To begin, our study only includes eight of Canada's thirteen jurisdictions, lacking full national coverage and therefore, limiting the generalizability of our findings to the entire country. Furthermore, the sole reliance on teacher-reported observations presents both strengths and limitations. Teachers have consistent exposure to their students and are well-positioned to observe developmental and behavioral challenges. However, their judgments may be influenced by individual biases, differences in training, or contextual factors such as classroom stress during the pandemic (Spadafora et al., 2024). Finally, our study includes only children attending publicly funded schools who make up approximately 90% of school-aged enrollment in Canada (Council of Ministers of Education Canada, 2021). Children in private schools or who are homeschooled were not captured in this analysis.

4.6 Implications and recommendations

Our findings carry important implications for both policy and practice. The increase in SHN among kindergarten children in Canada since the onset of COVID-19 pandemic, particularly among those in socioeconomically disadvantaged communities, highlights the need for more targeted and equitable support. While Canada operates under a universal healthcare system, the variability in SHN prevalence across provinces and territories suggests inequitable access to early identification, intervention and support services. Based on our findings and the broader literature, we offer the following recommendations for policy and practice.

4.6.1 Policy and equity considerations

Our research found that the prevalence of SHN was higher in socioeconomically disadvantaged and remote areas than in other areas during both time periods, highlighting the need for policies that support equity in service access. Given that provinces control their own health and education budgets, we emphasize the urgency in developing equity-focused investments in early years, such as: (1) strengthening income support programs (e.g. Canada Child Benefit) that can reduce financial strain on families, (2) investing in inclusive early childhood education programs that support the developmental needs of at-risk children, and (3) improving early identification and referral systems to ensure children with emerging needs are supported as early as possible, and (4) prioritizing public health and education spending in socioeconomically disadvantaged regions to reduce structural barriers these communities face in accessing care and support.

4.6.2 Inclusive education and system design

The disruptions caused by the onset of COVID-19 pandemic revealed gaps in the way educational institutions support children with SHN, especially when in-person learning is not possible. Many families felt left behind during school closures (Asbury et al., 2021; Cullen, 2021; Qadri, 2024), and advocates have since called for a shift toward "Universal Design for Learning" which is a framework for designing learning environments that are accessible to all students, regardless of their ability (Rolland, 2020). Specifically, the core principles in this framework include the following: (1) offering multiple ways to acquire information, (2) allowing students to demonstrate learning in diverse ways, and (3) creating a flexible environment that supports motivation and engagement. By adopting inclusive design principles, educational institutions can better support all children, especially children with SHN, through both everyday instruction and during emergency disruptions.

4.6.3 Support for families and educators

During the COVID-19 pandemic, many families of children with SHN felt overwhelmed and unsupported (Colizzi et al., 2020; Pozniak et al., 2024; Rolland, 2020; Spadafora et al., 2022). Educational systems that rely solely on school-based delivery of services left major gaps when school closed. Moving forward, it is essential to: (1) develop and fund programs to support families when learning at home, particularly in times of crises, (2) invest in roles such as family liaisons or cultural brokers to improve communication and engagement between schools and families, and (3) offer professional development and emotional support for educators to help them meet the needs of children with vulnerabilities while also managing their own stress.

4.6.4 Monitoring and research

By demonstrating an increase in SHN prevalence across all categories studied, including a rise in mental health concerns among SHN children following the COVID-19 pandemic, our study highlights the importance of population-level monitoring to identify trends, guide early intervention, and track the impact of policies during the pandemic. To strengthen this work, we recommend: (1) ongoing monitoring of SHN prevalence and service usage across jurisdictions, (2) research that explores the long-term impact of COVID-19 pandemic on children with SHN, and (3) integration of EDI data with administrative health records to better understand child’s medical conditions and challenges. While our study does not address long-term predictors, our findings reinforce the need for early identification of SHN and vulnerabilities during key developmental transitions, such as school entry. Early identification at this stage, rather than waiting until problems become clinically significant is an important step toward improving children’s developmental and mental health over time (Thomson et al., 2017).

4.7 References

Arim, R., Findlay, L., & Kohen, D. (2020, August 27). *The impact of the COVID-19 pandemic on Canadian families of children with disabilities*. Government of Canada. https://www150.statcan.gc.ca/n1/pub/45-28-0001/2020001/article/00066-eng.htm

Asbury, K., Fox, L., Deniz, E., Code, A., & Toseeb, U. (2021). How is COVID-19 Affecting the Mental Health of Children with Special Educational Needs and Disabilities and Their Families? *Journal of Autism and Developmental Disorders*, *51*(5), 1772–1780. https://doi.org/10.1007/s10803-020-04577-2

Baumbusch, J., & Lloyd, J. E. V. (2022, September 20). *Back to School: Prevalence of Students with Disabilities and Learning Exceptionalities in British Columbia, Canada, during the COVID-19 Pandemic (2019 – 2022)*. https://doi.org/10.14288/1.0421811

Bellomo, T. R., Prasad, S., Munzer, T., & Laventhal, N. (2020). The impact of the COVID-19 pandemic on children with autism spectrum disorders. *Journal of Pediatric Rehabilitation Medicine*, *13*(3), 349–354. https://doi.org/10.3233/PRM-200740

Bennett, P. W. (2023). *The erosion of learning and Nova Scotia's lacklustre response*. Policy Options. https://policyoptions.irpp.org/magazines/march-2023/learning-erosion-nova-scotia/

Bruchmüller, K., Margraf, J., & Schneider, S. (2012). Is ADHD diagnosed in accord with diagnostic criteria? Overdiagnosis and influence of client gender on diagnosis. *Journal of Consulting and Clinical Psychology*, *80*(1), 128–138. https://doi.org/10.1037/a0026582

CIHI. (2025). *Child and youth mental health*. Canadian Institute for Health Information. https://www.cihi.ca/en/child-and-youth-mental-health

Colizzi, M., Sironi, E., Antonini, F., Ciceri, M. L., Bovo, C., & Zoccante, L. (2020). Psychosocial and Behavioral Impact of COVID-19 in Autism Spectrum Disorder: An Online Parent Survey. *Brain Sciences*, *10*(6), 341. https://doi.org/10.3390/brainsci10060341

Conger, D., & Grigorenko, E. (2009). Special Educational Needs of Children in Immigrant Families. In *Immigration, Diversity, and Education* (1st ed.). Routledge.

Conger, D., Schwartz, A. E., & Stiefel, L. (2007). Immigrant and Native-Born Differences in School Stability and Special Education: Evidence from New York City1. *International Migration Review*, *41*(2), 403–432. https://doi.org/10.1111/j.1747-7379.2007.00073.x

Côté, S., Larose, S., & Haeck, C. (2023, April 26). *Effects of School Disruptions in the Years 2020 and 2021 on the Learning of Quebec Children*. EdCan Network. https://www.edcan.ca/articles/effects-of-school-disruptions-in-the-years-2020-and-2021-on-the-learning-of-quebec-children/

Council of Ministers of Education Canada. (2021). *A pan-Canadian companion report to the OECD Starting Strong V: Transitions from Early Childhood Education and Care to Primary Education* (p. 72). OECD.

https://doi.org/10.1787/9789264276253-en
Cullen, C. (2021). *One year later: Learning from COVID-19 to shape the future of Educatio* (Better Education Starts Todau). Province of Manitoba. https://manitoba.ca/asset_library/en/proactive/2020_2021/K-12-covid-lessons-learned.pdf
Danielson, M. L., Claussen ,Angelika H., Bitsko ,Rebecca H., Katz ,Samuel M., Newsome ,Kimberly, Blumberg ,Stephen J., Kogan ,Michael D., & and Ghandour, R. (2024). ADHD Prevalence Among U.S. Children and Adolescents in 2022: Diagnosis, Severity, Co-Occurring Disorders, and Treatment. *Journal of Clinical Child & Adolescent Psychology*, *53*(3), 343–360. https://doi.org/10.1080/15374416.2024.2335625
Dekker, M. C., Ferdinand, R. F., van Lang, N. D. J., Bongers, I. L., van der Ende, J., & Verhulst, F. C. (2007). Developmental trajectories of depressive symptoms from early childhood to late adolescence: Gender differences and adult outcome. *Journal of Child Psychology and Psychiatry, and Allied Disciplines*, *48*(7), 657–666. https://doi.org/10.1111/j.1469-7610.2007.01742.x
Dworet, D., & Bennett, S. (2002). A View from the North: Special Education in Canada. *TEACHING Exceptional Children*, *34*(5), 22–27. https://doi.org/10.1177/004005990203400504
Houtrow, A., Harris, D., Molinero, A., Levin-Decanini, T., & Robichaud, C. (2020). Children with disabilities in the United States and the COVID-19 pandemic. *Journal of Pediatric Rehabilitation Medicine*, *13*(3), 415–424. https://doi.org/10.3233/PRM-200769
Janus, M., Brownell, M., Reid-Westoby, C., Pottruff, M., Forer, B., Guhn, M., & Duku, E. (2024). Neighbourhood-level socioeconomic status and prevalence of teacher-reported health disorders among Canadian kindergarten children. *Frontiers in Public Health*, *11*. https://doi.org/10.3389/fpubh.2023.1295195
Kohen, D., Uppal, S., Khan, S., & Visentin, L. (2007). *Access and Barriers to Educational Services for Canadian Children with Disabilities* (Canadian Council on Learning). Statistics Canada.
Lamptey, D.-L., McIsaac, J.-L. D., MacQuarrie, M., Cummings, R., Rossiter, M. D., Janus, M., & Turner, J. (2024). Relationship between Childhood Disability or Developmental Delay and COVID-19 Pandemic Impacts on Families across the Canadian Maritime Provinces. *Journal of Child and Family Studies*, *33*(2), 458–472. https://doi.org/10.1007/s10826-023-02779-7
MacPherson, P., & Green, K. P. (2023). The Forgotten Demographic Assessing the Possible Benefits and Serious Cost of COVID-19 School Closures on Canadian Children. In *COVID-19 Lessons We Should Have Learned COLLECTED ESSAYS* (p. 21). Fraser Institute.
Masters, G., Taylor-Guy, P., Fraillon, J., & Chase, A.-M. (2020). Ministerial Briefing Paper on Evidence of the Likely Impact on Educational Outcomes of Vulnerable Children Learning at Home during COVID-19. *Australian Government Department of Education*. https://research.acer.edu.au/learning_processes/24
McDowell, M., & O'Keeffe, M. (2012). Public services for children with special needs:

Discrimination by diagnosis? *Journal of Paediatrics and Child Health*, *48*(1), 2–5. https://doi.org/10.1111/j.1440-1754.2011.02394.x

Mullaley, R. (2020). Newfoundland and Labrador children with disabilities not getting help they need during pandemic, parents say. *The Telegram*. https://www.saltwire.com/newfoundland-labrador/newfoundland-and-labrador-children-with-disabilities-not-getting-help-they-need-during-pandemic-parents-say-442032

Neece, C., McIntyre, L. L., & Fenning, R. (2020). Examining the impact of COVID-19 in ethnically diverse families with young children with intellectual and developmental disabilities. *Journal of Intellectual Disability Research: JIDR*, *64*(10), 739–749. https://doi.org/10.1111/jir.12769

Nonweiler, J., Rattray, F., Baulcomb, J., Happé, F., & Absoud, M. (2020). Prevalence and Associated Factors of Emotional and Behavioural Difficulties during COVID-19 Pandemic in Children with Neurodevelopmental Disorders. *Children (Basel, Switzerland)*, *7*(9), 128. https://doi.org/10.3390/children7090128

Pozniak, K., Swain, A., Currie, G., Doherty-Kirby, A., Grahovac, D., Lebsack, J., Campbell, W., Humphreys, C., Patterson, S., Raha, S., Whitley, J., & Kraus de Camargo, O. (2024). What supports and services post COVID-19 do children with disabilities and their parents need and want, now and into the future? *Frontiers in Public Health*, *12*. https://doi.org/10.3389/fpubh.2024.1294340

Public Health Agency of Canada. (2022, February 3). *Autism spectrum disorder: Highlights from the 2019 Canadian health survey on children and youth*. Government of Canada. https://www.canada.ca/en/public-health/services/publications/diseases-conditions/autism-spectrum-disorder-canadian-health-survey-children-youth-2019.html

Public Health Ontario. (2022). *COVID-19: Use of Absenteeism Data to Inform Public Health Measures in K-12 Schools* [Environmental Scan]. https://www.publichealthontario.ca/-/media/Documents/nCoV/sch/2022/02/es-absenteeism-data-ph-measures-K-12-schools.pdf?sc_lang=en#page=7.67

Qadri, A. H. (2024). Exploring the Impacts of COVID-19 on Indigenous Peoples in the Northwest Territories. Education and Research Archives. https://doi.org/10.7939/r3-7a8g-pt72

Rolland, K. (2020). *COVID-19, "Learn at Home" & Students with Disabilities in Ontario* (International Human Rights Internship Program Working Paper Series). McGill Centre for Human Rights and Legal Pluralism. https://www.mcgill.ca/humanrights/files/humanrights/rolland_ihrip_v9_2021.pdf

Rosenbaum, P., & Gorter, J. W. (2012). The 'F-words' in childhood disability: I swear this is how we should think! *Child: Care, Health and Development*, *38*(4), 457–463. https://doi.org/10.1111/j.1365-2214.2011.01338.x

Rutter, M., Caspi, A., Fergusson, D., Horwood, L. J., Goodman, R., Maughan, B., Moffitt, T. E., Meltzer, H., & Carroll, J. (2004). Sex Differences in Developmental Reading Disability New Findings From 4 Epidemiological Studies. Journal of American Medical Association, *291*(16), 2007–2012. https://doi.org/10.1001/jama.291.16.2007

Sciutto, J., Nolfi, J., & Bluhm, C. (2004). Effects of Child Gender and Symptom Type on Referrals for ADHD by Elementary School Teachers. Journal of Emotional and Behavioral Disorders, *12*(4), 247–253.

Spadafora, N., Jezrawi, R., De Jesus, S., Cameron, D., & Janus, M. (2024). Understanding educator perceptions in assessment of kindergarten children's development. Early Childhood Education Journal. https://doi.org/10.1007/s10643-024-01807-5

Spadafora, N., Wang, J., Reid-Westoby, C., & Janus, M. (2022). Association between neighbourhood composition, kindergarten educator-reported distance learning barriers, and return to school concerns during the first wave of the COVID-19 pandemic in Ontario, Canada. *International Journal of Population Data Science*, *7*(4), Article 4. https://doi.org/10.23889/ijpds.v7i4.1761

Statistics Canada. (2020, July 29). *Child care use during and after the COVID-19 pandemic*. Government of Canada. https://www150.statcan.gc.ca/n1/pub/45-28-0001/2020001/article/00062-eng.htm

Thomson, K. C., Guhn, M., Richardson, C. G., Ark, T. K., & Shoveller, J. (2017). Profiles of children's social–emotional health at school entry and associated income, gender and language inequalities: A cross-sectional population-based study in British Columbia, Canada. *British Medical Journal Open*, *7*(7), e015353. https://doi.org/10.1136/bmjopen-2016-015353

Timmons, K., Cooper, A., Bozek, E., & Braund, H. (2021). The Impacts of COVID-19 on Early Childhood Education: Capturing the Unique Challenges Associated with Remote Teaching and Learning in K-2. *Early Childhood Education Journal*, *49*(5), 887–901. https://doi.org/10.1007/s10643-021-01207-z

Towle, H. (2015, July 8). Disability and Inclusion in Canadian Education. Canadian Centre for Policy Alternatives. https://www.policyalternatives.ca/news-research/disability-and-inclusion-in-canadian-education/

Tso, W. W. Y., Leung, L. K., Chow, M. S. C., Wang, Y., Li, C., Hui, K. Y., Ma, L., Wong, M. W., Lui, M. P. K., Wong, W. H. S., Lee, S. L., Lee, T. M. C., & Ip, P. (2023). Mental Health of Children With Special Educational Needs and the Return to In-Person Learning After the COVID-19 Pandemic. *JAMA Network Open*, *6*(12), e2346106. https://doi.org/10.1001/jamanetworkopen.2023.46106

Tso, W. W. Y., Wong, R. S., Tung, K. T. S., Rao, N., Fu, K. W., Yam, J. C. S., Chua, G. T., Chen, E. Y. H., Lee, T. M. C., Chan, S. K. W., Wong, W. H. S., Xiong, X., Chui, C. S., Li, X., Wong, K., Leung, C., Tsang, S. K. M., Chan, G. C. F., Tam, P. K. H., … lp, P. (2022). Vulnerability and resilience in children during the COVID-19 pandemic. *European Child & Adolescent Psychiatry*, *31*(1), 161–176. https://doi.org/10.1007/s00787-020-01680-8

United Nations. (2020). *Policy Brief: The Impact of COVID-19 on children*. United Nations Sustainable Development Group. https://unsdg.un.org/resources/policy-brief-impact-covid-19-children, https://unsdg.un.org/resources/policy-brief-impact-covid-19-children

Webb, S., Duku, E., Brownell, M., Enns, J., Forer, B., Guhn, M., Minh, A., Muhajarine, N., & Janus, M. (2020). Sex differences in the socioeconomic gradient of children's early development. *SSM - Population Health*, *10*, 100512. https://doi.org/10.1016/j.ssmph.2019.100512

Whalen, D. J., Luby, J. L., Tilman, R., Mike, A., Barch, D., & Belden, A. C. (2016). Latent class profiles of depressive symptoms from early to middle childhood: Predictors, outcomes, and gender effects. *Journal of Child Psychology and Psychiatry, and Allied Disciplines*, *57*(7), 794–804. https://doi.org/10.1111/jcpp.12518

Whitley, J. (2020, June 1). *Coronavirus: Distance learning poses challenges for some families of children with disabilities*. The Conversation. http://theconversation.com/coronavirus-distance-learning-poses-challenges-for-some-families-of-children-with-disabilities-136696

Yazıcı, G., & Acar, İ. H. (2023). Experiences of children with learning disabilities living in low-income households during the Covid-19 pandemic. *European Journal of Special Needs Education*, *38*(6), 916–927. https://doi.org/10.1080/08856257.2023.2172893

Yesil, A. M., Sencan, B., Omercioglu, E., & Ozmert, E. N. (2022). The Impact of the COVID-19 Pandemic on Children With Special Needs: A Descriptive Study. *Clinical Pediatrics*, *61*(2), 141–149. https://doi.org/10.1177/00099228211050223

Zablotsky, B., & Black, L. I. (2020). Prevalence of Children Aged 3-17 Years With Developmental Disabilities, by Urbanicity: United States, 2015-2018. *National Health Statistics Reports*, *139*, 1–7.

5.0 Appendices

Appendix I. Sensitivity analysis for Ontario's missing data

In the post-COVID-19 onset cycle in Ontario data were not collected from five school boards. We conducted a sensitivity analysis to determine whether omitting these school boards from the analysis, i.e., keeping the same school districts in both cohorts, would produce significant differences compared to using all available data. The analysis showed that the prevalence of SHN pre-COVID-19 remained consistent regardless of whether these five school boards were excluded or included (See Table 5.1 and 5.2). Therefore, we decided to retain all available data for Ontario and proceed with the full dataset for the remaining analyses.

Table 5.1: Prevalence of SHN in Ontario using all available data

Timepoint	SHN	No SHN	Total
2017-2020	27,902 (21.2%)	103,937 (78.8%)	131,189
2021-2023	23,608 (25.9%)	67,698 (74.1%)	91,306

Cramer's V = 0.035, p <0.001

Table 5.2: Prevalence of SHN in Ontario after omitting 5 school boards in 2017–2020

Timepoint	SHN	No SHN	Total
2017-2020	20,532 (22.0%)	72,610 (78.0%)	93,142
2021-2023	23,608 (25.9%)	67,698 (74.1%)	91,306

Cramer's V = 0.045, p <0.001

Appendix II. Linear regression model summaries for national prevalence of special health needs, special needs, special concerns and needs assessment

Model summary for special health needs pre-COVID-19 cohort (2017-2020)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.206[a]	.042	.040	9.3125	.042	18.106	4	1640	<.001
2	.305[b]	.093	.090	9.0657	.051	91.484	1	1639	<.001

a. Predictors: (Constant), RIclassM_pgt, egender_pgt, age_mean_1, EFSL_pgt

b. Predictors: (Constant), RIclassM_pgt, egender_pgt, age_mean_1, EFSL_pgt, cannecd_zsesindex_time3_updated22_mean

Model summary for special health needs post-COVID-19 onset cohort (2021-2023)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.159[a]	.025	.022	12.3334	.025	7.851	4	1215	<.001
2	.302[b]	.091	.088	11.9122	.066	88.450	1	1214	<.001

a. Predictors: (Constant), RIclassM_pgt, egender_pgt, EFSL_pgt, age_mean_1

b. Predictors: (Constant), RIclassM_pgt, egender_pgt, EFSL_pgt, age_mean_1, cannecd_zsesindex_time3_updated22_mean

Model summary for special needs pre-COVID-19 cohort (2017-2020)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.203[a]	.041	.039	4.7691	.041	17.665	4	1640	<.001
2	.243[b]	.059	.056	4.7265	.018	30.684	1	1639	<.001

a. Predictors: (Constant), RIclassM_pgt, egender_pgt, age_mean_1, EFSL_pgt

b. Predictors: (Constant), RIclassM_pgt, egender_pgt, age_mean_1, EFSL_pgt, cannecd_zsesindex_time3_updated22_mean

Model summary for special needs post-COVID-19 onset cohort (2021-2023)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.281[a]	.079	.076	4.8252	.079	26.058	4	1215	<.001
2	.352[b]	.124	.120	4.7076	.045	62.453	1	1214	<.001

a. Predictors: (Constant), RIclassM_pgt, egender_pgt, EFSL_pgt, age_mean_1

b. Predictors: (Constant), RIclassM_pgt, egender_pgt, EFSL_pgt, age_mean_1, cannecd_zsesindex_time3_updated22_mean

Model summary for special concerns pre-COVID-19 cohort (2017-2020)

Model Summary

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.292[a]	.085	.083	8.3504	.085	38.104	4	1639	<.001
2	.379[b]	.144	.141	8.0798	.059	112.617	1	1638	<.001

a. Predictors: (Constant), RIclassM_pgt, egender_pgt, age_mean_1, EFSL_pgt

b. Predictors: (Constant), RIclassM_pgt, egender_pgt, age_mean_1, EFSL_pgt, cannecd_zsesindex_time3_updated22_mean

Model summary for special concerns post-COVID-19 onset cohort (2021-2023)

Model Summary

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.185[a]	.034	.031	11.2198	.034	10.780	4	1215	<.001
2	.306[b]	.094	.090	10.8728	.060	79.795	1	1214	<.001

a. Predictors: (Constant), RIclassM_pgt, egender_pgt, EFSL_pgt, age_mean_1

b. Predictors: (Constant), RIclassM_pgt, egender_pgt, EFSL_pgt, age_mean_1, cannecd_zsesindex_time3_updated22_mean

Model summary for needs assessment pre-COVID -19 cohort (2017-2020)

Model Summary

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.229[a]	.053	.050	7.4108	.053	22.765	4	1638	<.001
2	.285[b]	.081	.078	7.3007	.028	50.760	1	1637	<.001

a. Predictors: (Constant), RIclassM_pgt, age_mean_1, egender_pgt, EFSL_pgt

b. Predictors: (Constant), RIclassM_pgt, age_mean_1, egender_pgt, EFSL_pgt, cannecd_zsesindex_time3_updated22_mean

Model summary for needs assessment post-COVID-19 onset cohort (2021-2023)

Model Summary

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.077[a]	.006	.003	10.4372	.006	1.810	4	1214	.125
2	.213[b]	.045	.041	10.2330	.039	49.953	1	1213	<.001

a. Predictors: (Constant), RIclassM_pgt, egender_pgt, EFSL_pgt, age_mean_1

b. Predictors: (Constant), RIclassM_pgt, egender_pgt, EFSL_pgt, age_mean_1, cannecd_zsesindex_time3_updated22_mean

Appendix III. Linear regression model summaries for prevalence of special health needs across jurisdictions in Canada

Ontario pre-COVID-19 cohort (2017-2020)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.295[a]	.087	.082	6.7875	.087	18.733	4	785	<.001
2	.424[b]	.180	.174	6.4387	.092	88.352	1	784	<.001

a. Predictors: (Constant), RlclassM_pgt, EFSL_pgt, age_mean_1, egender_pgt

b. Predictors: (Constant), RlclassM_pgt, EFSL_pgt, age_mean_1, egender_pgt, cannecd_zsesindex_time3_updated22_mean

Ontario post-COVID-19 onset cohort (2021-2023)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.120[a]	.014	.009	8.9802	.014	2.863	4	781	.023
2	.331[b]	.110	.104	8.5416	.095	83.258	1	780	<.001

a. Predictors: (Constant), RlclassM_pgt, egender_pgt, age_mean_1, EFSL_pgt

b. Predictors: (Constant), RlclassM_pgt, egender_pgt, age_mean_1, EFSL_pgt, cannecd_zsesindex_time3_updated22_mean

Manitoba pre-COVID-19 cohort (2017-2020)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.398[a]	.159	.110	7.5599	.159	3.255	4	69	.017
2	.555[b]	.308	.257	6.9073	.149	14.652	1	68	<.001

a. Predictors: (Constant), RlclassM_pgt, egender_pgt, age_mean_1, EFSL_pgt

b. Predictors: (Constant), RlclassM_pgt, egender_pgt, age_mean_1, EFSL_pgt, cannecd_zsesindex_time3_updated22_mean

Manitoba post-COVID-19 onset cohort (2021-2023)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.369[a]	.136	.088	9.2055	.136	2.800	4	71	.032
2	.558[b]	.311	.262	8.2797	.175	17.767	1	70	<.001

a. Predictors: (Constant), RlclassM_pgt, egender_pgt, age_mean_1, EFSL_pgt

b. Predictors: (Constant), RlclassM_pgt, egender_pgt, age_mean_1, EFSL_pgt, cannecd_zsesindex_time3_updated22_mean

British Columbia pre-COVID-19 cohort (2017-2020)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.124[a]	.015	.001	14.7175	.015	1.073	4	273	.370
2	.183[b]	.033	.016	14.6090	.018	5.070	1	272	.025

a. Predictors: (Constant), RIclassM_pgt, egender_pgt, age_mean_1, EFSL_pgt

b. Predictors: (Constant), RIclassM_pgt, egender_pgt, age_mean_1, EFSL_pgt, cannecd_zsesindex_time3_updated22_mean

British Columbia post-COVID-19 onset cohort (2021-2023)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.200[a]	.040	.024	20.0758	.040	2.549	4	244	.040
2	.274[b]	.075	.056	19.7487	.035	9.150	1	243	.003

a. Predictors: (Constant), RIclassM_pgt, egender_pgt, age_mean_1, EFSL_pgt

b. Predictors: (Constant), RIclassM_pgt, egender_pgt, age_mean_1, EFSL_pgt, cannecd_zsesindex_time3_updated22_mean

Newfoundland and Labrador pre-COVID-19 cohort (2017-2020)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.431[a]	.186	.095	7.5590	.186	2.051	4	36	.108
2	.643[b]	.414	.330	6.5053	.228	13.607	1	35	<.001

a. Predictors: (Constant), RIclassM_pgt, egender_pgt, age_mean_1, EFSL_pgt

b. Predictors: (Constant), RIclassM_pgt, egender_pgt, age_mean_1, EFSL_pgt, cannecd_zsesindex_time3_updated22_mean

Newfoundland and Labrador post-COVID-19 onset cohort (2021-2023)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.320[a]	.102	.003	8.1350	.102	1.026	4	36	.407
2	.547[b]	.300	.200	7.2870	.197	9.867	1	35	.003

a. Predictors: (Constant), RIclassM_pgt, EFSL_pgt, age_mean_1, egender_pgt

b. Predictors: (Constant), RIclassM_pgt, EFSL_pgt, age_mean_1, egender_pgt, cannecd_zsesindex_time3_updated22_mean

Nova Scotia pre-COVID-19 cohort (2017-2020)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.403[a]	.162	.096	7.9543	.162	2.465	4	51	.057
2	.565[b]	.319	.251	7.2426	.157	11.515	1	50	.001

a. Predictors: (Constant), RIclassM_pgt, EFSL_pgt, age_mean_1, egender_pgt

b. Predictors: (Constant), RIclassM_pgt, EFSL_pgt, age_mean_1, egender_pgt, cannecd_zsesindex_time3_updated22_mean

Nova Scotia post-COVID-19 onset cohort (2021-2023)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.406[a]	.165	.101	7.3891	.165	2.564	4	52	.049
2	.520[b]	.271	.199	6.9721	.106	7.406	1	51	.009

a. Predictors: (Constant), RIclassM_pgt, egender_pgt, EFSL_pgt, age_mean_1

b. Predictors: (Constant), RIclassM_pgt, egender_pgt, EFSL_pgt, age_mean_1, cannecd_zsesindex_time3_updated22_mean

Quebec pre-COVID-19 cohort (2017-2020)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.296[a]	.087	.078	6.7876	.087	9.345	4	390	<.001
2	.430[b]	.185	.174	6.4237	.097	46.433	1	389	<.001

a. Predictors: (Constant), RIclassM_pgt, egender_pgt, EFSL_pgt, age_mean_1

b. Predictors: (Constant), RIclassM_pgt, egender_pgt, EFSL_pgt, age_mean_1, cannecd_zsesindex_time3_updated22_mean

Quebec post-COVID-19 onset cohort (2021-2023)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.346[a]	.120	.111	.06890	.120	13.279	4	391	<.001
2	.458[b]	.210	.200	.06536	.090	44.492	1	390	<.001

a. Predictors: (Constant), RIclassM_pgt, QC_age_mean, egender_pgt, EFSL_pgt

b. Predictors: (Constant), RIclassM_pgt, QC_age_mean, egender_pgt, EFSL_pgt, cannecd_zsesindex_time3_updated22_mean_1

Appendix IV. Adjusted logistic regression analysis for vulnerability in the emotional domain in SHN children pre- and post-onset of COVID-19

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Timepoints for pre and post covid(1)	-.148	.015	102.692	1	<.001	.863	.838	.888
	Child's gender(1)	-.822	.015	3085.875	1	<.001	.440	.427	.453
	age at completion	.000	.020	.000	1	.996	1.000	.961	1.040
	EFSL or not(1)	.059	.019	10.029	1	.002	1.061	1.023	1.100
	Z-score version of CanNECD SES Index for time 3 (2016)	-.096	.007	166.288	1	<.001	.908	.895	.922
	RlclassM			15.646	5	.008			
	RlclassM(1)	-.315	.133	5.593	1	.018	.730	.562	.948
	RlclassM(2)	-.246	.080	9.416	1	.002	.782	.668	.915
	RlclassM(3)	-.216	.081	7.095	1	.008	.805	.687	.944
	RlclassM(4)	-.186	.083	4.982	1	.026	.830	.705	.978
	RlclassM(5)	-.226	.085	7.032	1	.008	.798	.675	.943
	Constant	.369	.142	6.792	1	.009	1.446		

a. Variable(s) entered on step 1: Timepoints for pre and post covid, Child's gender, age at completion, EFSL or not, Z-score version of CanNECD SES Index for time 3 (2016), RlclassM.

Appendix V. Unadjusted logistic regression analysis for vulnerability in the emotional maturity domain in SHN children pre- and post-onset of COVID-19

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Timepoints for pre and post covid(1)	.086	.012	51.293	1	<.001	1.089	1.064	1.115
	Constant	-.266	.008	1022.265	1	<.001	.766		

a. Variable(s) entered on step 1: Timepoints for pre and post covid.

Appendix VI: Exploratory analysis of the interactive effect of the COVID-19 pandemic on the association between neighbourhood-level SES and SHN prevalence

We conducted an inferential test using R statistical software to examine whether the association between neighbourhood-level SES and SHN prevalence differed meaningfully before and after the COVID-19 pandemic. This was done by including an interaction term between SES and the pre/post-pandemic indicator in the regression model. Key covariates such as age, sex, language fluency, and rurality were included to adjust for potential confounding. The model's visual output suggests a steeper negative association between SES and SHN in the post-pandemic period (See Figure 3), indicating a potential widening of disparities. However, the p-value for the interaction term is 0.058. While this points to a possible trend, it does not meet the threshold for statistical significance under the adjusted alpha level of 0.0025 used to correct for multiple comparisons.

Figure 3: Interaction effect of COVID-19 pandemic on the association between neighbourhood-level SES and SHN prevalence

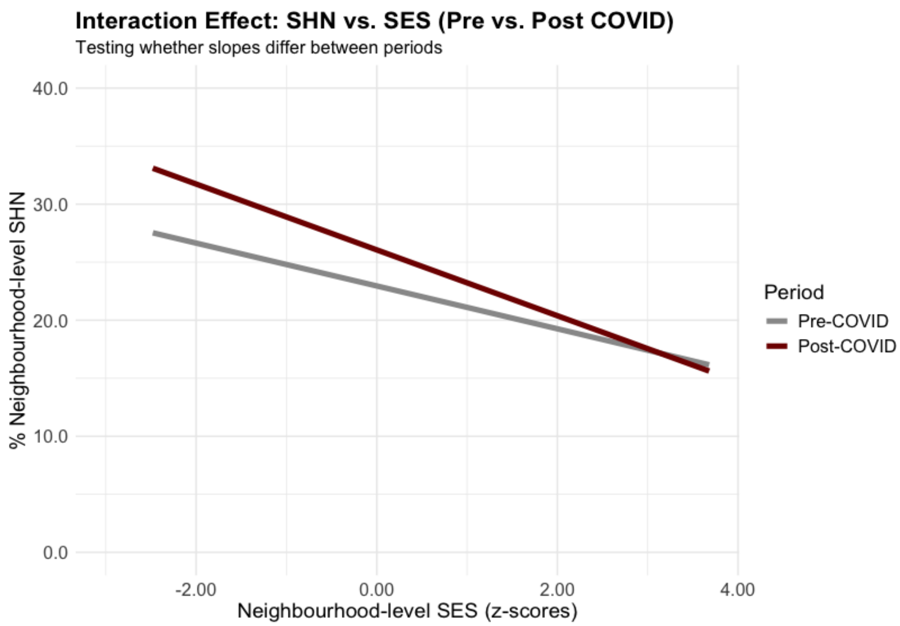


Figure 4: Model summary for inferential test

```
Call:
lm(formula = shn_overall_pgt ~ cannecd_zsesindex_time3_updated22_mean *
    prepostcovid + age_mean_1 + egender_pgt + EFSL_pgt + RlclassM_pgt,
    data = shn_sesindex)

Residuals:
    Min      1Q  Median      3Q     Max
-36.126  -4.827  -0.198   4.507  86.973

Coefficients:
                                                 Estimate Std. Error t value Pr(>|t|)
(Intercept)                                    -48.820488   8.494782  -5.747 1.00e-08 ***
cannecd_zsesindex_time3_updated22_mean          -2.251640   0.269794  -8.346  < 2e-16 ***
prepostcovid                                     2.163871   0.421127   5.138 2.96e-07 ***
age_mean_1                                      11.532548   1.462797   7.884 4.48e-15 ***
egender_pgt                                      0.121968   0.018685   6.528 7.88e-11 ***
EFSL_pgt                                        -0.057107   0.013251  -4.310 1.69e-05 ***
RlclassM_pgt                                     0.010843   0.008058   1.346   0.1785
cannecd_zsesindex_time3_updated22_mean:prepostcovid  -1.127904   0.408549  -2.761   0.0058 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 10.37 on 2857 degrees of freedom
  (416 observations deleted due to missingness)
Multiple R-squared:  0.1041,	Adjusted R-squared:  0.1019
F-statistic: 47.42 on 7 and 2857 DF,  p-value: < 2.2e-16
```