The Early Development Instrument (EDI) in Manitoba: Linking School Readiness in Kindergarten to Grade 7 and 8 School Outcomes

by

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Abstract

In Canada, the Early Development Instrument (EDI), a measure of school readiness, has contributed significantly to our understanding of how children are faring in the early years. The EDI measures school readiness on 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. The EDI has been associated with elementary school outcomes however, there is a dearth of research examining the lingering effects of school readiness on school outcomes beyond elementary school, specifically in early adolescence. The objective of the study is to examine associations between school readiness in Kindergarten and three long-term school outcomes: Grade 7 mathematics, Grade 8 reading and writing, and Grade 7 student engagement.

With linkable de-identified population administrative, registry, survey, and other databases housed at the Manitoba Centre for Health Policy, logistic regression analyses were used to examine the associations between the EDI in Kindergarten and Grade 7 and 8 school outcomes for a total of 16,252 youth, after adjusting for individual, family, and neighbourhood-level variables.

Children identified as ‘not ready’ on one or more EDI domains in Kindergarten had increased odds of doing poorly on all Grade 7 and 8 school outcomes. The associations between school readiness and all school outcomes did not differ by area-level socioeconomic status. An increasing number of ‘not ready’ EDI domains corresponded with increased odds of doing poorly in all school outcomes. Each EDI domain was significantly associated with Grade 7 and 8 school outcomes.

This study underscores the importance of development in the early years and school readiness for long-term academic trajectories. The findings suggest that multidisciplinary and collaborative efforts should be aimed at ensuring children arrive in Kindergarten ready to benefit from school-based learning and to ensure that all children can thrive in the school environment and thus attain their many goals that would allow them to become responsible, productive and happy citizens.

Disclaimer

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Chapter 1: Introduction and Literature Review

Early childhood is a critical developmental period with enduring life-long effects on health and well-being, social status, and educational attainment (Case, Fertig, & Paxson, 2005; Clyde Hertzman, Power, Matthews, & Manor, 2001). In Canada, the development and widespread implementation of the Early Development Instrument (EDI), a holistic assessment of school readiness (Janus & Offord, 2000), contributed significantly to our understanding of how Canadian children are faring in the early years. School readiness, as measured by the EDI, is conceptualized as the ability to meet the demands of school and entry into Grade 1 (Janus & Offord, 2007; Janus & Offord, 2000). In Manitoba, the proportion of Kindergarten children not ready to meet school demands, as measured by the EDI, has been about 28% since 2005/2006 (Healthy Child Manitoba, 2013). This is a bit higher than the Normative II Canada-wide cohort where approximately 25.4% of children were identified as 'not ready' on one or more EDI domains (Early Development Instrument, 2016).

Population-level EDI results, along with other population-level databases in Manitoba, are utilized to monitor, evaluate, and inform funding, policies, and programs. These aggregate results are also communicated to communities, schools, and school divisions to help identify areas of strength and areas that require additional attention to inform and mobilize local planning and action (Healthy Child Manitoba, 2015). In Manitoba, EDI outcomes have been used to evaluate initiatives such as the Family's First Home Visiting Program (Chartier et al., 2017).

The EDI is reflective of early developmental outcomes prior to school entry (e.g., Santos, Brownell, Ekuma, Mayer, & Soodeen, 2012) and predictive of later outcomes (Brinkman et al., 2013; Brownell et al., 2012; D'Angiulli, Warburton, Dahinten, Hertzman, & Santos, 2009; Forget-Dubois et al., 2007; Guhn, Gadermann, Almas, Schonert-Reichl, & Hertzman, 2016;

Janus, Harren, & Duku, 2004; Lloyd & Hertzman, 2009; Lloyd, Irwin, & Hertzman, 2009). While the evidence examining the relationship between the EDI and long-term outcomes is growing (Brinkman et al., 2013; Brownell et al., 2012; D'Angiulli et al., 2009; Forget-Dubois et al., 2007; Guhn, Gadermann, et al., 2016; Magdalena Janus et al., 2004; Lloyd & Hertzman, 2009; Lloyd et al., 2009), there is a dearth of research examining the lingering effects of school readiness on school outcomes beyond elementary school, specifically in early adolescence. Early adolescence, defined as the period from age 12 to 15 years old (Cloutier & Drapeau, 2008), is a critical transition period characterized by important changes in brain development (for reviews, see Blakemore, 2012; Crone & Dahl, 2012), a clustering of risk behaviours (Jackson, Sweeting, & Haw, 2012; van Nieuwenhuijzen et al., 2009), and social changes (for reviews, see Collins & Laursen, 2012; Collins & Steinberg, 2006), to name a few. Adolescents may experience challenges such as substantial negative changes to perceived school environment, student psychological functioning, interpersonal competence, and problem behaviours (Barber & Olsen, 2004).

Using the first province-wide data collection of the EDI in public schools in Manitoba (2005/06 and 2006/07), the objective of the present study is to examine associations between school readiness in Kindergarten, as measured by the EDI, and three long-term school outcomes in early adolescence: Grade 7 mathematics, Grade 8 reading and writing, and Grade 7 student engagement. A better understanding of the relationship between school readiness and school outcomes in early adolescence could help inform educators, parents, and policy makers on how to prepare children for long term academic success.

Early Development Instrument

The EDI was developed to provide an acceptable, reliable, and cost-effective measure of school readiness in Kindergarten (Janus & Offord, 2007). Rather than assessing students on typical achievement-oriented outcomes (e.g., literacy and numeracy), the EDI provides a holistic measure, assessing students on five developmental 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). The instrument is not used to diagnose children, but rather serves as a community-level tool to inform policies, community interventions, and prevention efforts (Janus & Offord, 2007).

The EDI has been studied retrospectively to examine factors that predict children's school readiness in Kindergarten (Curtin, Browne, Staines, & Perry, 2016; Santos et al., 2012). In Manitoba, Santos and colleagues (2012) found that low socioeconomic status, low birth weight, children born to teenage mothers, and children from families on Income Assistance or Child Family Services were associated with greater risk of not being ready on the EDI in Kindergarten. The EDI serves as a reflection of children's early childhood development by providing a snapshot of their well-being upon transition into school. It is also crucial information for policy makers regarding where the children came from and where they are going (L. Boyd, Personal Communications, January 21, 2016).

When EDI data are linked prospectively to education data, academic trajectories can be developed to gain a greater understanding of the associations between school readiness and later school outcomes. The enduring effects of school readiness on academic outcomes in elementary school have frequently been documented in the EDI literature (Brownell et al., 2012; D'Angiulli et al., 2009; Davies, Janus, Duku, & Gaskin, 2016; Forget-Dubois et al., 2007; Guhn et al., 2016;

Magdalena Janus et al., 2004; Lloyd & Hertzman, 2009; Lloyd et al., 2009). Although there is variability in children's academic trajectories (Lloyd & Hertzman, 2009; Lloyd et al., 2009), there is considerable and accumulating evidence demonstrating a strong association between the EDI and later school outcomes (Brownell et al., 2012; D'Angiulli et al., 2009; Forget-Dubois et al., 2007; Magdalena Janus et al., 2004).

Mathematics, Reading, and Writing

The majority of the prospective EDI research has been focused on mathematics, reading, and writing as later school outcomes. It is important to examine mathematics, reading, and writing because they influence socioeconomic trajectories and, in turn, affect health outcomes (Hertzman & Power, 2005). In fact, researchers (Ritchie & Bates, 2013) found that early mathematics and reading performance were positively associated with socioeconomic status by 42 years of age. Monitoring these academic skills are critical within a Canadian context given that a substantial proportion of Canadians (16 and over) lacked the desired level of literacy and numeracy competencies to deal with growing demands of the knowledge and information economy (48% for literacy and 55% for numeracy; Statistics Canada, 2005).

Individuals' academic pathways are strongly influenced by their experiences early in life. Previous EDI research has found that children identified as 'not ready' on one or more EDI domains were more likely to perform poorly on literacy and numeracy assessments in Grade 3 (Brownell et al., 2012) in Canada and Years 3, 5, and 7 in Australia (Brinkman et al., 2013) when compared with children identified as 'ready' on all domains. Furthermore, previous EDI research has also found a cumulative effect of being 'not ready' on a number of EDI domains. More specifically, children experience incrementally poorer outcomes with each 'not ready' EDI

domain in Grades 3, 4, and 7 (Brinkman et al., 2013; Brownell et al., 2012; D'Angiulli et al., 2009).

It is also important to examine the associations between specific EDI domains and later outcomes. Development is complex and there remains debate in the literature on the competencies necessary to experience later success in school (Davies et al., 2016). Determining the specific EDI domains that have long lasting effects on school outcomes may identify areas of vulnerability which can inform policy and program development; for example, if the language and cognitive development EDI domain is identified as predicting Grade 8 reading and writing competencies, identifying activities or initiatives that enhance children's language and cognitive development prior to school entry may be associated with long-term literacy outcomes.

Much of the academic literature examining associations between domain-specific school readiness, as measured by the EDI, and later school outcomes have found the language and cognitive development domain to have the strongest association with literacy and numeracy in Grades 1, 3, and 4 (Brownell et al., 2012; D'Angiulli et al., 2009; Davies et al., 2016; Forget-Dubois et al., 2007; Guhn et al., 2016). While the language and cognitive domain has repeatedly been found to be the strongest predictor of later outcomes, there is a growing body of knowledge suggesting that all domains may play a role. Previous research (D'Angiulli et al., 2009) has also shown that the social competence and emotional maturity domains are significant predictors of Grade 4 literacy and numeracy. Another study (Davies et al., 2016) found that, while adjusting for language and cognitive development, the physical health and well-being, social competence, and emotional maturity domains were also significantly associated with later Grade 3 literacy and numeracy. The language and cognitive development, physical health and well-being, and communication skills and general knowledge domains were significantly associated with Grade

1 literacy and numeracy in another study (Forget-Dubois et al., 2007). While the social competence and emotional maturity domains were not significant in the initial model, they were significant predictors when included in the model separately. Finally, additional research (Brownell et al., 2012) found a significant positive association between each of the EDI domains and Grade 3 literacy and numeracy. While mathematics, reading, and writing are all important school outcomes to consider, there is little EDI research that examines other key outcomes in children's academic and developmental trajectories, such as student engagement.

Student Engagement

Very little consensus has been reached in terms of conceptualizations and methods of measuring student engagement. Programme for International Student Assessment (PISA) measures student engagement by assessing connectedness with teachers and sense of belonging in school (Weiss & García, 2015). Others have conceptualized student engagement as having three dimensions: behavioural, emotional, and cognitive engagement (Archambault, Janosz, Fallu, & Pagani, 2009). In Manitoba, teachers assess student engagement in Grade 7 using the following working definition developed by Manitoba Education (Manitoba Education, 2007c), and based on previous work (Jimerson, Campos, & Greif, 2003; Norris, Pignal, & Lipps, 2003): "Engagement with learning is a multifaceted concept that reflects student actions related to engagement, their feelings about school, and their understandings about their own learning" (p.14). Similar to previous conceptualizations (e.g., Archambault et al., 2009), Manitoba Education's (2007b) definition touches on behavioural, emotional, and cognitive engagement.

Despite the differing conceptualizations of student engagement, there is, nonetheless, a general agreement regarding its importance. In early adolescence, keeping students engaged at school remains an important challenge faced by many teachers (Brewster & Fager, 2000).

Greater levels of student engagement, measured using various methods, have been associated with greater academic performance (Weiss & García, 2015), reduced risk of delinquency and substance use (Li et al., 2011), reduced dropouts (Archambault et al., 2009), and bi-directionally related to greater life satisfaction (Lewis, Huebner, Malone, & Valois, 2011). Of particular relevance for the present study, Grade 7 student engagement in Manitoba has been linked to credit completion in Grade 9, which, in turn, was linked to high school completion within four to five years (Brownell et al., 2012).

There is little consensus in the academic literature on the early predictors of student engagement to identify children at risk of disengagement. Previous research (Pagani, Fitzpatrick, & Parent, 2012) found attention levels in Kindergarten to be positively associated with student engagement throughout elementary school. Another study (Pagani, Fitzpatrick, Belle, & Janosz, 2011) found early math skills to be associated with greater later student engagement, while fine motor and locomotion skills were associated with poorer student engagement. The authors suggested that, perhaps, the nature of academic learning may lead more active children to lose interest and disengage.

The domain-specific measures of school readiness on the EDI are similar to many of the early predictors identified in the academic literature. Attention levels, as previously identified (Pagani et al., 2012), may be similarly captured in the emotional maturity and/or the social competence domain of the EDI; for example, in the social competence domain, children are assessed on their approaches to learning (e.g., would you say that this child listens attentively), amongst other competencies (Early Development Instrument, 2015). In addition, the social competence domain may assess children on further competencies relevant to student engagement, such as eagerness to explore new experiences and knowledge of acceptable public

behaviour (Early Development Instrument, 2015). Math skills and fine motor and locomotion skills may correspond to language and cognitive development and the physical health and well-being EDI domains, respectively (Pagani et al., 2011). Examining the association between the EDI and school engagement may increase our understanding of the factors that influence school engagement.

Factors that Influence Early Development Instrument and School Outcomes

Child factors. Studies have shown that children who are older at the time of the EDI assessment or who are female tend to have better EDI scores than those who are younger or male (Brownell et al., 2012; Janus & Offord, 2007). Gender or sex differences in educational outcomes have also been shown; such that girls are more engaged (Marks, 2000) perform better on reading and language arts assessments (Brochu, Deussing, Houme, & Chuy, 2013; Brownell et al., 2012; Brownell et al., 2006; Bussière, Rogers, Knighton, & Cartwright, 2004; Levine, Pollack, & Comfort, 2001), and are less likely to repeat grades in comparison to boys (Levine et al., 2001). Gender or sex differences have also been found for mathematics assessments, however the findings vary. Some studies suggest that boys perform better on mathematics assessments (e.g., Brochu et al., 2013; Brownell et al., 2012; Bussière et al., 2004), while others suggest that girls perform better (e.g., Brownell et al., 2006).

Family factors. In addition to individual-level factors, life course research commonly examines family factors that may impact developmental trajectories. Family factors such as family size, mother's marital status, and residential mobility have been associated with school outcomes relevant to the present study.

Family size. Family size has been associated with both EDI outcomes (Santos et al., 2012) and later school outcomes (Fransoo et al., 2008; Leslie L. Roos et al., 2013). Santos et al.

(2012) found that children from families with four or more children have increased odds of being not ready on one or more EDI domain. The authors also found that children from families with a greater number of children have poorer outcomes in the social competence and emotional maturity EDI domains. More specifically, Fransoo et al. (2008) found that children in smaller families had better Grade 3 school outcomes. Roos et al. (2013) found a statistically significant association between family size and Grade 9 and 12 school outcomes. However, the authors concluded that this variable was of little importance in explaining these outcomes from a population perspective given its small effect size.

Parental marital status. Parental marital status has been associated with both EDI outcomes (Chittleborough, Searle, Smithers, Brinkman, & Lynch, 2016; Santos et al., 2012) and later school outcomes (Adam & Chase-Lansdale, 2002; Jutte et al., 2010). Santos et al. (2012) found that children with a married mother had decreased odds of being not ready on one or more EDI domain than children with unmarried mothers. Children from single parent families had poorer outcomes on the communication skills and general knowledge EDI domain than children raised by more than one parent (Santos et al., 2012). Similarly, Chittleborough et al. (2016) determined that children of mothers who were single around the time of the birth of the child had higher odds of being 'not ready' on two or more EDI domains in Kindergarten that children of mothers who were married or in a *de facto* relationship. Jutte et al. (2010) observed a 50% decreased odds of not passing Grade 12 on time for children of married parents. Adam and Chase-Lansdale (2002) found a marginal relationship between an increasing number of parental separations and poorer adolescent academic outcomes. Of interest, the authors determined that parental separations that took place in early childhood were significantly associated with

adolescent academic outcomes but this association was not present when parental separations occurred in school-age or adolescent periods.

Residential mobility. Residential mobility, which refers to moving households resulting in postal code changes, is a form of family disruption associated with negative adolescent school outcomes (Adam & Chase-Lansdale, 2002; Roos et al., 2013). Residential mobility, however, has not been found to be associated with EDI outcomes (Santos et al., 2012) nor Grade 3 school outcomes (Fransoo et al., 2008).

Neighbourhood factors. Numerous neighbourhood-level factors have been associated with EDI and later school outcomes. Lapointe, Ford, and Zumbo (2007) found that the proportion of unemployed males within a neighbourhood negatively predicted the language and cognitive development and communication skills and general knowledge EDI domains. Furthermore, the authors found a positive association between the proportion of residents with a university-level education and the physical health and well-being and communication skills and general knowledge EDI domains.

Previous studies found that low socioeconomic status was associated with both poorer EDI outcomes (Brownell et al., 2012; Santos et al., 2012) and later school outcomes (e.g., Brownell et al., 2012; Magdalena Janus et al., 2004; Lloyd, Li, & Hertzman, 2010). Of particular interest for the present study, area-level variables such as neighbourhood-level socioeconomic status have been found to be strongly associated with Grade 3 reading, writing, and mathematics (Janus et al., 2004; Lloyd et al., 2010). Lloyd et al. (2010) found that neighbourhood-concentrated socioeconomic conditions in Kindergarten were strongly and negatively associated with reading competencies in Grade 7. The authors' neighbourhood-concentrated socioeconomic variable was computed using a number of census variables

including low income rate (families or unattached individuals aged 15 years and older), percentage of lone parent families, percentage with less than Grade 9 education, male unemployment rate (15 years and older), proportion of residents aged 15 and over not graduated from high school, median income, and percentage of families receiving social assistance (families with children under 18).

Brownell et al. (2012) explored children's developmental trajectories from Kindergarten to Grade 3 reading and numeracy assessments and found socioeconomic status to be an important factor in the developmental pathways. In this study, the authors followed Lloyd and Hertzman's (Lloyd & Hertzman, 2009) pathway categorizations and examined four pathways based on the child's EDI and their performance in later assessments. The first pathway was the *positive trajectory* where children were identified as ready on the EDI in Kindergarten and maintained positive Grade 3 outcomes (i.e., meeting or approaching expectations). The second pathway was the *negative deflection* trajectory where children were identified as 'ready' on the EDI in Kindergarten but did not meet or approached expectations in Grade 3. The third pathway was the *positive deflection* trajectory where children were not ready on the EDI in Kindergarten but met or approached expectations on their Grade 3 assessments. Finally, the fourth pathway was the *negative trajectory* where children were not ready in Kindergarten and maintained negative outcomes (i.e., not meeting or approaching expectations) in Grade 3.

Brownell et al. (M. Brownell et al., 2012) found that the percent of children identified as 'ready' on the EDI in Kindergarten that maintained the *positive trajectory* increased as socioeconomic status increased for Grade 3 reading and numeracy. The percentage of Kindergarten children identified as 'not ready' on the EDI that maintained a *negative trajectory* in Grade 3 reading and numeracy decreased as socioeconomic status increased. The percentage

of deflections in trajectories, both positive and negative deflections, were highest in low socioeconomic status and decreased as income socioeconomic status increase for both reading and numeracy.

Gaps in Early Development Instrument Research

The literature reviewed showed that a number of studies have examined the relationship between the EDI and later school outcomes however, few studies have examined the EDI and school outcomes beyond the early school years. While there is limited research examining the EDI's association with school outcomes beyond elementary school, one study was conducted examining this relationship among Australian children (Brinkman et al., 2013). The adapted version of the EDI, the Australian Early Development Index (AEDI) (also referred to as the Australian Early Development Census (AEDC)) was associated with Grade 7 literacy and numeracy. In comparison to their 'ready' peers, children identified as 'not ready' in one or more EDI domains were more likely to score in the lower 20% of the distribution on the Grade 7 standardized assessments. These findings, however, may not be generalizable to the Canadian context due to demographic and institutional differences. A further limitation of Brinkman et al.'s (2013) study was the nature of their sample. Their sample was limited to a specified area of the capital city of Western Australia, representing only 38% of the school entry population within the city.

In prospective EDI research, mathematics, reading, and writing have been the predominant measure of academic outcomes. However, very little research examines more psychological outcomes of child well-being. One of the few studies examining the link between the EDI and outcomes other than mathematics, reading, and writing was conducted by Guhn et al. (2016). In this study, the researchers examined the relationship between specific EDI

domains and children's self-reported social relations with peers and emotional well-being in Grade 4. The authors found that the EDI's social competence domain predicted students' connectedness to peers. Furthermore, the EDI's emotional maturity domain predicted emotional well-being in Grade 4. No known EDI study has examined the link between school readiness and school engagement. The present study builds on Brinkman et al.'s (2013) and Guhn et al.'s (2016) studies to address the identified gaps within the literature.

Theoretical Framework

This study was guided by two theoretical frameworks that provide insight into how early childhood development and experiences contribute to shaping future outcomes: the life course approach and the frustration-esteem model.

Life course approach. The life course approach, as outlined by Hutchison (2012), is a multifaceted developmental theory commonly adopted in longitudinal research in the health domain. The premise of this approach that is of particular interest to the present study is the notion that lifetime experiences influence individuals' future outcomes (Hutchison, 2012). Hertzman et al. (2001) describe three processes by which the early years' environment can impact later outcomes, namely latent, pathway, and cumulative effects. The latency model describes direct and independent effects of early life environment on later outcomes. The pathway model describes how the early years' environment impact life trajectories which, in turn, have long term effects. Finally, the cumulative model describes the cumulative impact of disadvantages over a period of time. Although it is acknowledged that one or several of the life course approach processes may account for the relationship between school readiness and early adolescence outcomes, the specific processes that may account for this relationship are beyond the scope of the study.

Frustration-esteem model. The frustration-esteem model may help further understand how early school readiness may be associated with later student engagement. The basis of the frustration-esteem model is that student disengagement originates from school failure (Audas & Willms, 2001); where children who experience failure in school at an early age leads to reduced self-esteem and, in turn, they reject the institution to blame for their failure. In the present study, school readiness may act as the child's first experience of failure or success in school, thus shaping their self-beliefs and sense of engagement to school. Measures of self-esteem are not assessed in the present study, thus the mechanism that may account for a relationship between school readiness and later student engagement cannot be tested.

Rationale

As previously mentioned, educational attainment and school outcomes affect developmental trajectories and well-being of individuals. It is, therefore, important to understand the relationship between measures of school readiness in Kindergarten and early adolescent school outcomes. Understanding this relationship contributes to our understanding of crucial developmental trajectories; for example, if vulnerabilities do in fact persist throughout long-term academic trajectories, it would suggest a greater need for multidisciplinary and collaborative efforts aimed at improving early childhood developmental outcomes. These findings could help inform targeted and universal policies and interventions targeting the children's development during the early years such that children arrive at school ready to benefit from school-based learning. Programs and policies could aim to provide additional parental support and education to be able to improve the child's environment and learning opportunities in the early years. Early childhood education and care programs may also provide enriched environments to foster positive development in the early years. These findings may also help

inform school-based interventions targeting children identified as 'not ready' on the EDI such that they experience positive deflections in their academic trajectories.

Objective

Using the first province-wide data collection of the EDI in public schools in Manitoba (2005/06 and 2006/07), the objective of the study is to examine associations between school readiness in Kindergarten, as measured by the EDI, and three long-term school outcomes: Grade 7 mathematics, Grade 8 reading and writing, and Grade 7 student engagement.

Research Questions and Hypotheses

The following provides a description of the four research questions and hypotheses investigated in this study.

Research Question 1. Is school readiness in Kindergarten associated with Grade 7 and 8 school outcomes, after adjusting for age, sex, family size, mother's marital status, residential mobility, and socioeconomic level?

Taking into consideration previous research that found an association between school readiness as measured by the EDI and later literacy and numeracy outcomes (e.g., Brinkman et al., 2013; Brownell et al., 2012; D'Angiulli et al., 2009), it is hypothesized that a similar association will also be found in the population-based Manitoba cohort for three school outcomes of interest. More specifically, it is hypothesized that Kindergarten being identified as 'not ready' on one more of the EDI domains will be associated with poorer Grade 7 mathematics competencies (Hypothesis 1a), Grade 8 reading and writing competencies (Hypothesis 1b), and Grade 7 student engagement (Hypothesis 1c) than children identified as 'ready' on all EDI domains, after adjusting for age, sex, family size, mother's marital status, residential mobility, and socioeconomic level.

Research Question 2. Is the association between school readiness and Grade 7 and 8 school outcomes altered by socioeconomic level, after adjusting for age, sex, family size, mother's marital status, and residential mobility?

Based on Brownell et al.'s (2012) study that found a greater percentage of deflections in trajectories in low socioeconomic status, it is hypothesized that, after adjusting for age, sex, family size, mother's marital status, and residential mobility the strength of the association between EDI and later school outcomes will be greater among children living in higher socioeconomic levels compared with those living in lower socioeconomic levels, as measured by the SEFI-2.

Research Question 3. Does the accumulation of being 'not ready' in a number of EDI domains increase the risk of poor Grade 7 and 8 school outcomes, after adjusting for age, sex, family size, mother's marital status, residential mobility, and socioeconomic level?

Considering previous research that found an association between the number of EDI domains where children were identified as 'not ready' and later literacy and numeracy school outcomes (e.g., Brinkman et al., 2013; Brownell et al., 2012; D'Angiulli et al., 2009), it is hypothesized that a similar association will also be found in the population-based Manitoba cohort for the three school outcomes of interest. Specifically, it is hypothesized that he risk of poorer Grade 7 mathematics (Hypothesis 3a), Grade 8 reading and writing (Hypothesis 3b), and Grade 7 student engagement (Hypothesis 3c) will increase with each 'not ready' EDI domain, after adjusting for age, sex, family size, mother's marital status, residential mobility, and socioeconomic level. For example, children who are 'not ready' on all five domains will have poorer later school outcomes compared with those who are 'not ready' on only one domain.

Research Question 4. What is the association between each EDI domain and Grade 7 and 8 school outcomes, after adjusting for age, sex, family size, mother's marital status, residential mobility, and socioeconomic level?

Considering previous research that found an association between each EDI domain and later numeracy and literacy (e.g., Brownell et al., 2012), it is hypothesized that each EDI domain will be associated with Grade 7 mathematics (Hypothesis 4a) and Grade 8 reading and writing (Hypothesis 4b), after adjusting for age, sex, family size, mother's marital status, residential mobility, and socioeconomic level. With regards to student engagement, considering previous findings (Pagani et al., 2011; Pagani et al., 2012) and the similarity in the concepts, it is hypothesized that the social competence, emotional maturity, and language and cognitive development domains will be associated with better Grade 7 student engagement, while physical health and well-being will be negatively associated (Hypothesis 4c), after adjusting for age, sex, family size, mother's marital status, residential mobility, and socioeconomic level.

Chapter 2: Methods

Research Design and Cohort Selection

This retrospective cohort study made use of administrative, registry, survey, and other datasets housed at the Manitoba Centre for Health Policy (MCHP) to examine all four research questions. These datasets (further described below) are population-based capturing virtually all children in the province. The population in the study consisted of two cohorts of Kindergarten children who were assessed with the EDI in 2006 and 2007 and who were still living in Manitoba during their expected Grade 7 (2012/13 and 2013/14, respectively) and Grade 8 (2013/14 and 2014/15, respectively) academic years (further described below). The EDI was collected among all Kindergarten children[a] in all 37 public school division in Manitoba and some independent and First Nations schools that participated voluntarily. The exclusion and database clean-up process is summarized in Figure 1. The study cohort was developed in two phases and is described below.

Phase one study exclusion criteria, similar to Santos et al. (2012), remove children with invalid, duplicate, or missing Personal Health Identification Numbers (PHINs), invalid EDI data, children who died, and children without continuous health coverage from birth to age five. Only children with continuous health coverage from birth to age five were included in the analyses in order to have complete information on cohort members' characteristics at birth as well as early life exposures before school entry; children who were born out of province or moved out of province before school entry were excluded from the analyses. Further details on the control variables are available in the "Variables" subsection. Children younger than five years or older than seven years of age at the date of EDI assessment were excluded to eliminate outliers and to

[a] Unless parents requested for their children to be withdrawn.

restrain the sample to the age group that the EDI was intended for. In the situation that children had EDI assessments in both years of the specified EDI cohorts, the EDI assessment that had corresponding Grade 7 assessments (e.g., the 2006 EDI assessment if children were assessed on Grade 7 student engagement in 2012) were kept to decrease the amount of missing data. Children's EDI assessments are linked to the Grade 7 and 8 assessments of their anticipated Grade 7 and 8 school years. If the Grade 7 and 8 assessments are not provided for the anticipated Grade 7 and 8 school years, these data are missing when, in reality, assessments are available in the previous or subsequent year. For children with multiple EDI assessments, the years of these assessments, nonetheless, correspond to the anticipated year of assessment based on one of the available EDI assessments. By keeping the EDI assessment with the corresponding Grade 7 and 8 assessments, it is possible to avoid these missing data. In the case that children had duplicate EDI assessments within the same year, the most complete data were kept or chosen at random.

As the data included more than one cohort year, it was possible that more than one child from a family would be present in the cohort. Siblings have similar genetics and environments which would violate one of the key assumptions of logistic regressions: the independence of observations. Siblings were identified using the mother's personal identification number available in the Manitoba Health Insurance Registry (Manitoba Centre for Health Policy, 2015). One sibling was selected at random and the other was excluded from analyses. Finally, children identified in the Population Health Registry as 'family head' or as the grandchild of the family head were also excluded from analyses. Those identified as 'family head' are likely children who have been removed from the family (e.g., children in child protective services) or orphaned (L. MacWilliam, personal communications, March 7, 2017). These decisions were made given

that the accuracy and integrity of the data for these children for certain variables (e.g., family size) may be compromised. In addition, these children may have significantly different experiences and may act as outliers in the data.

In phase two of study exclusion criteria, youth who were no longer living in Manitoba during their Grade 7 and 8 academic years were excluded from analyses. All children residing in Manitoba who should have undergone the Grade 7 and 8 assessments within the specified time frames were included in the analyses (i.e., including those with missing assessments). This approach is similar to Brownell et al.'s (2012) approach to reduce bias, since the youth with unavailable assessments who are still living in Manitoba may represent the poorest academic performances (e.g., unavailable data due to grade repetition). Furthermore, previous studies have linked unavailable academic assessments to lower socioeconomic status (e.g., Brownell et al., 2006; Roos et al., 2006). Further details on the classification of these students are available in the "Variables" subsection. Students categorized in the *out of range*/*scope* level of performance in all three dependent variables described below were not included in the analyses. For Grade 7 mathematics and Grade 8 reading and writing, these students represent a group performing below their grade-level because of learning disabilities or because they are learning a new language. With regards to Grade 7 student engagement, the *out of scope* categorization is an indication that measures are judged to be non-applicable due to students' severe conditions, such as mental health conditions and cognitive disabilities. Finally, students who were assessed in Grade 7 and 8 in years earlier than expected based on the year indicated by their EDI assessment were also excluded from analyses.

Datasets

This study used datasets from the Manitoba Population Research Data Repository housed at MCHP. The Manitoba Population Research Data Repository is a comprehensive collection of more than 80 linkable administrative, survey, registry, and clinical datasets, some dating back to 1970. The population-wide data, collected for purposes other than research, are linkable at an individual-level using scrambled PHINs and merged for individual research projects.

The four datasets utilized in this study are 1) the Population Health Registry, 2) Early Development Instrument from Healthy Child Manitoba Office (HCMO), 3) Manitoba Education's Grade 7 and 8 assessments, and 4) Census data. The EDI and the Manitoba Education assessments (further described below) are utilized for administrating programs and services for children in the province, and the Statistics Canada Census is collected to understand characteristics of the Canadian population for a variety of purposes. Further details on the information-rich environment at the MCHP and the Manitoba Population Research Data Repository's capabilities, validity, and reliability have been previously reported (Becker & Grilo, 2011; Jutte, Roos, & Brownell, 2011; Nickel et al., 2014; Roos & Nicol, 1999; Roos et al., 2008; Roos, Gupta, Soodeen, & Jebamani, 2005). The following provides a brief summary of each dataset as described on the Manitoba Centre for Health Policy's (n.d.) website.

Manitoba Health Insurance Registry (Population Health Registry). As described by Roos et al. (2008), the Population Health Registry from Manitoba Health includes all persons registered with the Manitoba Health Insurance Plan since 1970. The Health Registry allows for individual-level de-identified linkages between the databases using scrambled PHINs. It also provides individual and family-level information such as birth date, sex, postal code, and information on the family's composition (e.g., family size and mother's marital status). For the

purpose of the present study, the years of interest are from 1984 to 2015 to be able to capture a comprehensive history of children living in the same registry family (further discussed in the "Variables" subsection below).

Healthy Child Manitoba Office: Early Development Instrument. The EDI is a close-ended questionnaire completed by Kindergarten teachers. HCMO began collecting EDI data in some school divisions in 2002/03 and expanded data collection to all public school divisions in Manitoba in 2005/06. Currently, the EDI data are collected province-wide in all 37 public school divisions by HCMO every two years (Brownell et al., 2012). For the present study, this database provides the school readiness results for all Kindergarten children assessed in 2006 and 2007.

Manitoba Education: Grade 7 and 8 assessments. Via the Education Information System, Manitoba Education collects province-wide administrative data on a variety of school measures from Kindergarten to Grade 12. This dataset provides the results of teacher-administered middle years' assessments with regards to Grade 7 mathematics, Grade 8 reading and writing, and Grade 7 student engagement. The database years of interest for the present study are 2012/2013 and 2013/2014 for Grade 7 assessments and 2013/2014 and 2014/2015 for Grade 8 assessments.

Statistics Canada Census. Census data in 2006 from Statistics Canada provide area-level measures of socioeconomic status. The year was selected because all children were born at the time of the 2006 Census data collection and it is close to the time of the EDI assessment. Furthermore, Kunz, Page, & Solon (2003) found that there is little variation in children's neighbourhood characteristics and thus, point-in-times measures of neighbourhood factors have only modest measurement error biases. Socioeconomic measures are linked to students' six-digit

postal codes provided in the Population Health Registry to estimate individual-level measures of socioeconomic status (for further details see "Variables" subsection). Past research has demonstrated that neighbourhood-level measures of income are associated with measures of individual-level income, and therefore can provide appropriate measures when individual-level data are not available (Mustard, Derksen, Berthelot, & Wolfson, 1999).

Variables

Explanatory variables of interest. The following provides a description of the main independent variables used in the study: measures of school readiness derived from the EDI and socioeconomic status.

Early Development Instrument. The psychometrics of the EDI have been documented in numerous studies examining both the reliability (e.g., inter-rater reliability, internal reliability) and validity (e.g., concurrent validity, convergent validity) in multiple countries (e.g., Canada, Australia, the United Sates, Jamaica) and different groups of children (e.g., children with English-as-a-second-language status, with Aboriginal status) (e.g., Brinkman et al., 2007; Curtin, Browne, Staines, & Perry, 2016; Duku & Janus, 2004; Forget-Dubois et al., 2007; Janus, Brinkman, & Duku, 2011; Janus & Offord, 2007). The EDI is outlined in more detail elsewhere and is only briefly summarized here (for further details, see the EDI Manitoba Questionnaire in Appendix A; Early Development Instrument, 2015; Magdalena Janus & Offord, 2007; The Offord Centre for Child Studies, 2012)

The EDI is a 103-item teacher-completed close-ended questionnaire collected in Manitoba between February and March. Although the questionnaire is completed for each individual, the results are reported at an aggregate-level. Kindergarten teachers are provided with 20 minutes per student in their classroom to assess school readiness on five developmental

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). Each domain consists of a number of scored questions in yes/no format (scores for *yes* = 10, *no* = 0) and three-point scale format (scores for *very poor/poor* or *never or not true* = 0, *average* or *sometimes or somewhat true* = 5, *good/very good* or *often or very true* = 10). The questionnaire used in Manitoba in 2006/07 is included in Appendix A.

Physical health and well-being. The physical health and well-being domain consists of 13 items examining 1) physical readiness for the school day, 2) physical independence, 3) gross and fine motor skills, and 4) energy level (Janus & Offord, 2007). This domain includes questions such as: "How would you rate this child's ability to manipulate objects?" and "How would you rate this child's level of energy throughout the school day?" (Janus & Offord, 2007, pp. 50-51).

Social competence. The social competence domain consists of 26 items examining 1) competence and cooperation, 2) remembering and following rules, 3) approaches to learning and problem-solving, and 4) readiness to explore new things (Janus & Offord, 2007). This domain includes questions such as: "How would you rate this child's ability to get along with peers?" and "Would you say that this child accepts responsibility for actions?" (Janus & Offord, 2007, p. 50).

Emotional maturity. The emotional maturity domain consists of 28 items examining the following types of behaviours 1) pro-social and helping, 2) anxious and fearful, 3) aggressive, and 4) inattentiveness (Janus & Offord, 2007). This domain includes questions such as: "Would you say that this child can't sit still, is restless?" and "Would you say that this child will try to help someone who has been hurt?" (Janus & Offord, 2007, pp. 50-51).

Language and cognitive development. The language and cognitive development domain consists of 26 items examining 1) basic literacy, 2) interest literacy/ numeracy and memory, 3) advanced literacy, and 4) basic numeracy. This domain includes questions such as: "Would you say that this child is generally interested in books?" and "Would you say that this child is interested in games involving numbers?" (Janus & Offord, 2007, pp. 50-51).

Communication skills and general knowledge. The communication skills and general knowledge, unlike the other domains, does not consist of discrete subdomains. This domain examines children's communication skills with regards to communicating ideas, articulation, and knowledge. This domain includes questions such as: "How would you rate this child's ability to tell a story?" and "How would you rate this child's ability to communicate own needs in an understandable way?" (Janus & Offord, 2007, p. 50).

For the purpose of the study, the EDI variables of interest consisted of dichotomized categorical variables indicating vulnerability. Children who scored in the bottom 10th percentile, based on Canadian normative data, on one or more of the developmental domains (Hypotheses 1 and 2) and for each domain (Hypotheses 3 and 4) were categorized as 'not ready' (Janus & Offord, 2007), while the others were identified as 'ready'.

Neighbourhood-level socioeconomic status. Socioeconomic status was estimated using the Socioeconomic Factor Index – Version 2 score, hereinafter referred to as SEFI-2. This area-level measure takes into account the following variables from the Census: average household income (age 15+), percent of single parent households, unemployment rate (age 15+), and high school education rate for a specified dissemination area (Metge et al., 2009). The continuous SEFI-2 scores are interpreted as follows: "Scores less than zero indicate more favorable socioeconomic conditions, while scores greater than zero indicate lower socioeconomic

conditions" (Manitoba Centre for Health Policy, 2009, para. 3). SEFI-2 scores were linked to each child by linking the SEFI-2 score for a specified dissemination area to the child's six-digit postal code at age 5, as provided by the Population Health Registry. Where children had more than one residence at age five, the residence start and end dates were first examined to ensure that they included one of the EDI years (i.e., 2006 or 2007). If the residence start and end dates at age five did not include one of these EDI years, the observation was removed. If both residence periods included the EDI years, the latest residence (i.e., postal code) was kept. Previous research (e.g., Metge et al., 2009) has demonstrated that the composite SEFI-2 variable is a better estimation of socioeconomic status than the average household income variable provided in the Census for a specified area.

Adjustment variables. The following provides a description of the child-level and family-level covariates used in the study.

Child variables. Similar to past EDI studies (e.g., Forget-Dubois et al., 2007; Guhn et al., 2016), age and sex were included as covariates in the analyses based on previous studies that found that these variables were significantly associated with EDI score as well as later school outcomes. Furthermore, since age and sex are routinely included as covariates in other studies, including these variables within the models allows for greater comparability of findings (Guhn, Gadermann, et al., 2016).

Sex. To account for any sex differences in Grade 7 and 8 school outcomes, the dichotomous categorical sex variable representing the child's biological sex at birth was included as a covariate in the analyses. This variable was obtained from the Population Health Registry.

Age at testing. Given that EDI scores have been found to vary with age (e.g., Janus & Offord, 2007), the continuous age variable measured in months was calculated at the child's EDI

assessment date, using birth date data from the Population Health Registry. Furthermore, this variable was used to exclude children younger than 5 years or older than 7 years of age at the EDI assessment date from the analyses.

Family variables. Similar to previous EDI studies (e.g., Santos et al., 2012), family size, mother's marital status, and residential mobility were included as covariates in the analyses because previous research found that these variables were associated with EDI and later school outcomes. Since the present study examines how early life is associated with later adolescent outcomes, the family variables included in the models were captured at age five. The following provides descriptions of each family variable as described within the MCHP online Concept Dictionary and Glossary.

Family size. The family size variable was obtained from the Population Health Registry. Using the mother's scrambled PHIN, family size was calculated counting the number of children aged 0-19 with the same mother from 1984 to the child's fifth birthday (Manitoba Centre for Health Policy, 2007).

Mother's marital status. Using information from the Health Registry, a child's mother was identified using the mother's scrambled PHIN to examine the mother's marital status at the child's fifth birthday. The Population Health Registry may contain information on the mother's marital status if the child's mother has registered this information with Manitoba Health. This variable was categorized as 1) married or common law or 2) single or unknown.

Residential mobility. As described within the MCHP (2008) Concept Dictionary and Glossary, residential mobility refers to the within-province residential movement which results in changes in postal code. This information is captured twice a year (i.e., every six months) using six-digit postal code information from the Population Health Registry. For the purpose of the

present study, residential mobility was measured examining the total number of changes in postal code from birth to age five.

Dependent variables. Halfway through the academic year, teachers assess their respective middle years' students on Grade 7 mathematics, Grade 8 reading and writing, and Grade 7 student engagement. Similar to Brownell et al.'s (2012) approach, individuals still living in Manitoba who do not have available assessments at the time that they are expected to be in Grade 7 or 8 will be classified as 'not meeting expectations' for Grade 7 mathematics and Grade 8 reading and writing and 'inconsistent or emerging' for Grade 7 student engagement.

Grade 7 mathematics. Grade 7 mathematics is assessed on five competencies: 1) orders fractions, 2) orders decimal numbers, 3) understands that a given number may be represented in a variety of ways, 4) uses number patterns to solve mathematical problems, and 5) uses a variety of strategies to calculate and explain a mental mathematics problem (Manitoba Education, 2007b). For each competency, teachers categorize the students into one of four levels of performance (1 = *meeting expectations*, 2 = *approaching expectations*, 3 = *not meeting expectations*, and 4 = *out of range*). For the purpose of this study, the Grade 7 mathematics outcomes were dichotomized into two categories: "not meeting expectations in one or more competencies" and "approaching or meeting expectations in all competencies".

Grade 8 reading and writing. Grade 8 reading and writing is assessed on six competencies: 1) understands key ideas and messages in a variety of texts, 2) interprets a variety of texts, 3) responds critically to a variety of texts, 4) generates, selects and organizes ideas to support the reader's understanding, 5) chooses language (word choices and sentence patterns) to make an impact on the reader, and 6) uses conventions (spelling, grammar, and/or punctuation) and resources to edit and proofread to make meaning clear (Manitoba Education, 2007c). For

each competency, teachers categorize the students into one of four levels of performance (1 = *meeting expectations*, 2 = *approaching expectations*, 3 = *not meeting expectations*, and 4 = *out of range*). For the purpose of this study, the Grade 8 reading and writing outcomes were dichotomized into two categories: "not meeting expectations in one or more competencies" and "approaching or meeting expectations in all competencies". Note that students are evaluated on reading and writing in the language of their school division.

Grade 7 student engagement. Grade 7 student engagement is evaluated on five indicators: 1) demonstrating an interest in his/her learning, 2) engaging in self-assessment, 3) aware of learning goals as a unit of study and/or personal learning goals, 4) participating in lessons, and 5) accepting responsibility for assignments (Manitoba Education, 2007b). Note that additional student engagement indicators are assessed for French immersion and Français students, however for the purpose of the present study, these measures were not analyzed. For each indicator, the students are categorized into one of five levels of performance (1 = *established*, 2 = *developing*, 3 = *emerging*, 4 = *inconsistent*, and 5 = *out of scope*). In the present study, the Grade 7 student engagement outcomes were dichotomized into two categories: "inconsistent or emerging in one or more indicators" and "developing or established in all indicators".

Data Analysis

Statistical analyses were completed using SAS 9.4 (Sas Insitute Inc, 2013). All statistical analyses were considered significant at $p < .05$. The first step in the data analysis plan involved calculating descriptive statistics to describe the population and the variables of interest including measures of prevalence, distribution, mean, median, range, and standard deviation, when appropriate. Cross-tabulations were also computed to examine the differences between 'ready'

and 'not ready' groups on the EDI according to each covariate. Chi-square, t-test, and ANOVA analyses were employed to test for statistical differences. Preliminary analyses also involved testing the assumptions of logistic regressions, namely 1) the absence of multicollinearity, 2) the linearity of the logit, and 3) the lack of outliers.

Once the assumptions of logistic regressions were tested and deemed adequately met, statistical analyses were computed to test the hypotheses. Logistic regressions were used given that previous studies examining the association between the EDI and later school outcomes have used such analyses (e.g., Brinkman et al., 2013) and the school outcome variables (i.e., the dependent variables) could be easily summarized into two categories.

The models' goodness-of-fit was assessed using Brierscores as a measure of accuracy and c-statistics as a measure of discrimination. A suggested benchmark for a useful risk prediction model is a Brier score below 0.25, given that scores of 0 are indicative of complete accuracy while scores of 0.5 represent complete inaccuracy (Gerds, Cai, & Schumacher, 2008). A suggested c-statistic for a reasonable discriminant model is a 0.7 and a score of 0.8 is indicative of a strong model (Hosmer & Lemeshow, 2000).

Hypothesis 1. To test the first hypothesis, nine multiple logistic regression models were built (i.e., three models per outcome variable) to estimate the associations between being identified as 'not ready' on one or more EDI domains and Grade 7 mathematics, Grade 8 reading and writing, and Grade 7 student engagement. Covariates were entered into the models in three steps: base child individual variables (age and sex adjusted), family variables (adjusting for family size, mother's marital status, and residential mobility), and neighbourhood-level variable (adjusting for socioeconomic level using the SEFI-2). Let $P(Y= 1|\boldsymbol{x}) = \pi(\boldsymbol{x})$, $\mathbf{x}$ = vector of variables, x = single variable, then:

Step 1:

$$l(\pi(\boldsymbol{x})/1-\pi(\boldsymbol{x})) = \beta_0+\beta_1x_1+\beta_2x_2+\beta_3x_3$$

Where x_1 = 'not ready' on one or more EDI domains, x_2 = 66 to 71 months old, and x_3 = girls.

Step 2:

$$l(\pi(\boldsymbol{x})/1-\pi(\boldsymbol{x})) = \beta_0+\beta_1x_1+\beta_2x_2+\beta_3x_3+\beta_4x_4+\beta_5x_5+\beta_6x_6$$

Where x_4 = residential mobility from birth to age five, x_5 = 0-1 siblings, and x_6 = mother is single or unknown.

Step 3:

$$l(\pi(\boldsymbol{x})/1-\pi(\boldsymbol{x})) = \beta_0+\beta_1x_1+\beta_2x_2+\beta_3x_3+\beta_4x_4+\beta_5x_5+\beta_6x_6+\beta_7x_7$$

Where x_7 = neighbourhood level socioeconomic status as measured by the SEFI-2.

Hypothesis 2. To test the second hypothesis, three multiple logistic regressions were built (i.e., one model per outcome) to assess whether the association between school readiness and later school outcomes is moderated by socioeconomic status after adjusting for age, sex, family size, mother's marital status, and residential mobility (Hypothesis 2). Multiple logistic regression models were built for each school outcome, with the addition of an interaction term between the EDI and SEFI-2. Let $P(Y= 1|\boldsymbol{x}) = \pi(\boldsymbol{x})$, **x** = vector of variables, x = single variable, then:

$$l(\pi(\boldsymbol{x})/1-\pi(\boldsymbol{x})) = \beta_0+\beta_1x_1+\beta_2x_2+\beta_3x_3+\beta_4x_4+\beta_5x_5+\beta_6x_6+\beta_7x_7 + \beta_1x_1 * \beta_7x_7$$

Where x_1 = 'not ready' on one or more EDI domains, x_2 = 66 to 71 months old, x_3 = girls, x_4 = residential mobility from birth to age five, x_5 = 0-1 siblings, x_6 = mother is single or unknown, x_7 = neighbourhood level socioeconomic status as measured by the SEFI-2, and $\beta_1x_1 * \beta_7x_7$ = the interaction between being 'not ready' on one or more EDI domain (x_1) and neighbourhood level socioeconomic level (x_7).

Hypothesis 3. To test the third hypothesis, nine multiple logistic regression models were built (i.e., three models per outcome variable) to examine the association between the number of 'not ready' EDI domains and later school outcomes after adjusting for age, sex, family size, mother's marital status, residential mobility, and socioeconomic level (Hypothesis 3). Independent variables were entered into the models in three steps: child-level variables (age and sex adjusted), family-level variables (adjusting for family size, mother's marital status, and residential mobility), and neighbourhood-level variable (adjusting for socioeconomic conditions). Let $P(Y= 1|\boldsymbol{x}) = \pi(\boldsymbol{x})$, **x** = vector of variables, x = single variable, then:

Step 1:

$$l(\pi(\boldsymbol{x})/1-\pi(\boldsymbol{x})) = \beta_0+\beta_1x_1+\beta_2x_2+\beta_3x_3$$

Where x_1 = number of 'not ready' EDI domains (0 to 5), x_2 = 66 to 71 months old, and x_3 = girls.

Step 2:

$$l(\pi(\boldsymbol{x})/1-\pi(\boldsymbol{x})) = \beta_0+\beta_1x_1+\beta_2x_2+\beta_3x_3+\beta_4x_4+\beta_5x_5+\beta_6x_6$$

Where x_4 = residential mobility from birth to age five, x_5 = 0-1 siblings, and x_6 = mother is single or unknown.

Step 3:

$$l(\pi(\boldsymbol{x})/1-\pi(\boldsymbol{x})) = \beta_0+\beta_1x_1+\beta_2x_2+\beta_3x_3+\beta_4x_4+\beta_5x_5+\beta_6x_6+\beta_7x_7$$

Where x_7 = neighbourhood level socioeconomic status as measured by the SEFI-2.

Hypothesis 4. To test the fourth hypothesis, a total of 45 multiple logistic regression models were built (i.e., three models per predictor per dependent variable) to examine the odds of each school outcome noted above for each of the five EDI domains, while adjusting for age, sex, family size, mother's marital status, residential mobility, and socioeconomic level (Hypothesis 4). Let $P(Y= 1|\boldsymbol{x}) = \pi(\boldsymbol{x})$, **x** = vector of variables, x = single variable, then:

Step 1:

$$l(\pi(\boldsymbol{x})/1-\pi(\boldsymbol{x})) = \beta_0+\beta_1 x_1+\beta_2 x_2+\beta_3 x_3$$

Where x_1 = EDI domain, x_2 = 66 to 71 months old, and x_3 = girls.

Step 2:

$$l(\pi(\boldsymbol{x})/1-\pi(\boldsymbol{x})) = \beta_0+\beta_1 x_1+\beta_2 x_2+\beta_3 x_3+\beta_4 x_4+\beta_5 x_5+\beta_6 x_6$$

Where x_4 = residential mobility from birth to age five, x_5 = 0-1 siblings, and x_6 = mother is single or unknown.

Step 3:

$$l(\pi(\boldsymbol{x})/1-\pi(\boldsymbol{x})) = \beta_0+\beta_1 x_1+\beta_2 x_2+\beta_3 x_3+\beta_4 x_4+\beta_5 x_5+\beta_6 x_6+\beta_7 x_7$$

Where x_7 = neighbourhood level socioeconomic status as measured by the SEFI-2.

Ethical Considerations

Ethics approval was received from the University of Manitoba's Health Research Ethics Board (HREB) for administrative data use, the Government of Manitoba's Health Information Privacy Committee (HIPC), HCMO, and the Department of Education and Training. Upon approval, a data analyst at the MCHP extracted the de-identified data for all databases. The research was conducted in a highly restricted and secure student office at the MCHP; protecting confidentiality and anonymity in accordance with MCHP's, HIPC's, and HREB's policies. Following MCHP's policies on privacy and confidentiality, data are presented in aggregate forms and data groupings with five or fewer individuals were supressed. In addition, privacy is further protected, as all data linkages were completed using encrypted PHINs (completed at Manitoba Health).

Chapter 3: Results

There were originally 24,306 children in the sample of children who received EDI assessment in the years 2006 and 2007; 16,827 of which met phase one inclusion criteria. In phase two, 15,988 youth met exclusion criteria for Grade 7 mathematics; 15,771 youth for Grade 8 reading and writing; and 15,738 youth for Grade 7 student engagement. The final total sample was comprised of 16,252 youth (see Figure 1 for a step-by-step exclusion and database clean-up process).

Descriptive Statistics

Tables 1 through 6 provide descriptive statistics of the sample. Table 1 presents the descriptive statistics of the main EDI independent variables. The majority of the sample was identified as 'ready' on the EDI in one or more EDI domains (73.59%), on the physical health and well-being domain (89.29%), on the social competence domain (90.27%), on the emotional maturity domain (88.52%), on the language and cognitive domain (87.32%), and on the communication and general knowledge domain (91.00%). With regards to the count variable of the number 'not ready' EDI domains, the majority of the sample was identified as 'ready' on all EDI domains (i.e., 'not ready' on zero EDI domains).

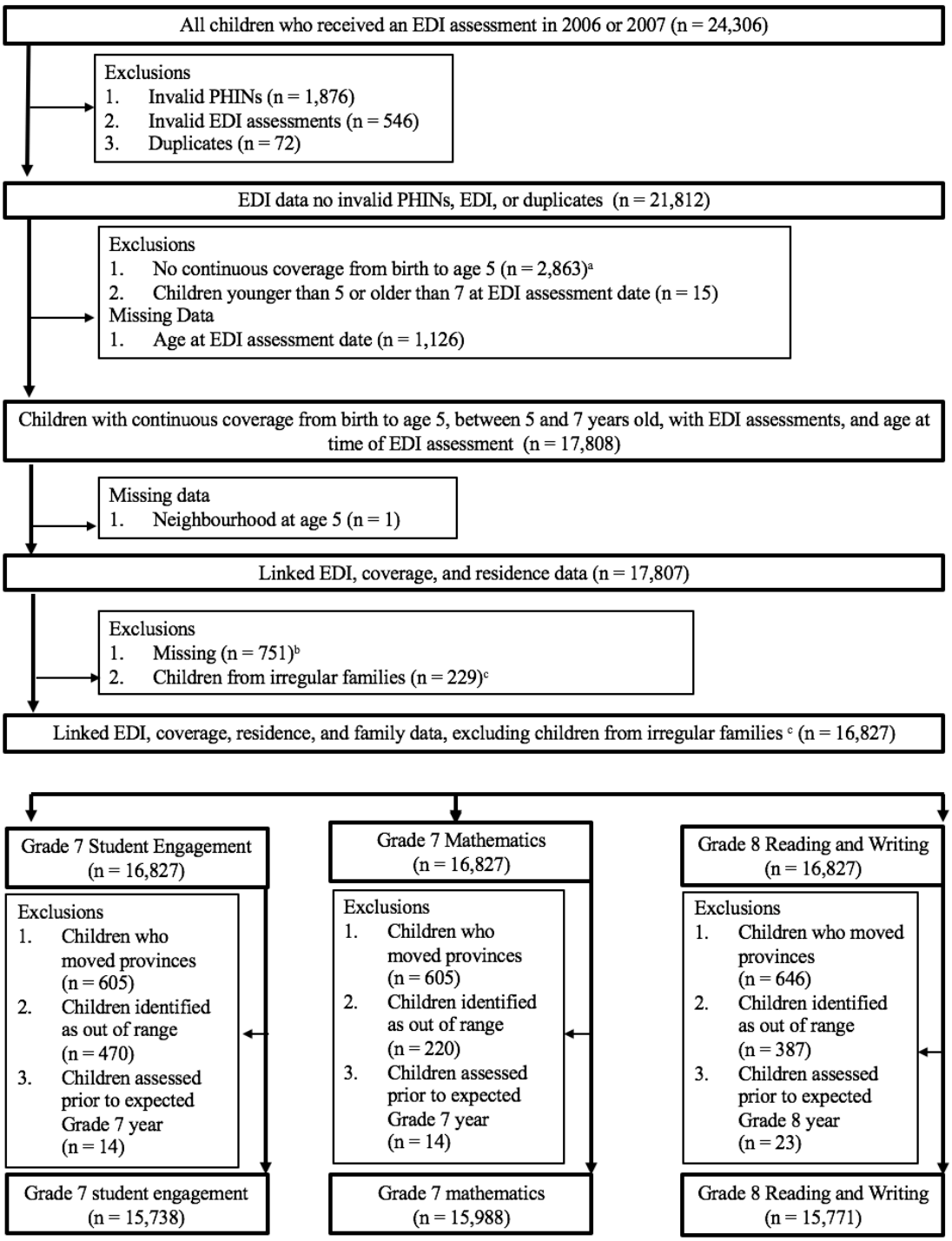


Figure 1 Dataset cleanup and exclusion process

EDI = Early Development Instrument. [a] Children who were born out of province or children who were born in the province but moved out of province. [b] The Population Health Registry family dataset was provided with siblings already excluded. Sibling exclusions may account for a portion of the missing data while missing family registry data may also account for this. [c] Children identified as 'Family Head' or whose grandparents are identified as 'Family Head'.

Table 1

Descriptive Statistics of the Sample on the Main Early Development Instrument Independent Variables

Variables	n (%)
One or more EDI domains	
'Ready'	11,820 (73.59)[a]
'Not Ready'	4,241 (26.41)
Physical health and well-being	
'Ready'	14,512 (89.29)
'Not Ready'	1,725 (10.61)
Social competence	
'Ready'	14,671 (90.27)
'Not Ready'	1,576 (9.70)
Emotional maturity	
'Ready'	14,386 (88.52)
'Not Ready'	1,730 (10.64)
Language and cognitive development	
'Ready'	14,191 (87.32)
'Not Ready'	1,937 (11.92)
Communication and general knowledge	
'Ready'	14,790 (91.00)
'Not Ready'	1,459 (8.98)
Number of 'Not ready' EDI domains	
0	11,820 (74.02)[a]
1	2,030 (12.71)
2	977 (6.12)
3	547 (3.43)
4	350 (2.19)
5	245 (1.53)

EDI = Early Development Instrument. [a] These percentages are different given that the number of children identified as 'not ready' differs between the two variables. The number of children identified as 'not ready' differs between the two given that, in some instances, certain EDI domains were missing, however the children were identified as 'not ready' on at least one domain. In the first variable (i.e., one or more EDI domains), these children were coded as 'not ready' given that sufficient information was available to make that conclusion. However, it is not possible to know the exact number of 'not ready' domains and, therefore, these children were coded as missing for the second variable (i.e., number of 'not ready' EDI domains).

Table 2 presents the sample characteristics as it pertains to the covariates included in the models. The sample was practically evenly divided between boys (50.84%) and girls (49.16%). The mean age of the children at the time of the EDI assessment was 68.47 months. Children in the sample were on average from families with 2.36 siblings (i.e., family size). The mothers of children in the sample were predominantly married or common-law (54.23%). From birth to age 5, children had an average of 1.74 residences. The SEFI-2 scores ranged from -3.70 to 4.65 and the mean score was 0.01, meaning that the children were from a wide range of socioeconomic levels.

Table 2

Descriptive Statistics of the Sample on the Covariates

Variables	n (%) or mean ± SE
Sex	
Boys	8,263 (50.84)
Girls	7,989 (49.16)
Age (months)	68.47 (0.03)
Age (categorical)	
60 to 65 months	3,872 (23.82)
66 to 71 months	8,642 (53.17)
72 to 77 months	3,659 (22.51)
78 months or older	79 (0.49)
Family size	2.36 (0.008)
Family size (categorical; # of siblings)	
0 - 1	2,778 (17.09)
2 - 3	11,572 (71.20)
4+	1,902 (11.70)
Mother's marital status	
Married or common-law	8,814 (54.23)
Single or unknown	7,438 (45.77)
Residential mobility	1.74 (0.008)
Socioeconomic Status - SEFI-2	0.01 (0.007)

SE = standard error

Tables 3 through 5 present the results of cross tabulations comparing the difference in covariates across 'ready' and 'not ready' groups for all measures of the EDI. Table 3 shows the difference in individual-level covariates (i.e., sex and age). A greater proportion of boys than

girls are identified as ‘not ready’ on all measures of the EDI (i.e., not ready on one or more EDI domains, each EDI domain, and each increasing number of ‘not ready’ EDI domains). Results of Chi-square analyses showed that children identified as ‘ready’ and ‘not ready’ differed significantly by sex on each measure of the EDI domain. Results of t-tests indicated that the mean age of children identified as ‘ready’ was significantly greater than the mean age of children identified as ‘not ready’ on one or more EDI domains and each EDI domain. Results of an ANOVA analysis indicated that the number of ‘not ready’ EDI domains groups also significantly differed by age ($F(5, 15{,}963) = 23.22$, $p < .0001$). When examining the four-level categorization of age, among the youngest age group (i.e. 60 to 65 months or 5 to 5.42 years) and the oldest age group (i.e., 78 months and older or 6.5 years and older), a larger proportion of children were identified as ‘not ready’ for school. The inverse is true for the 66 to 71 months old (i.e., 5.5 to 5.92 years) and 72 to 77 months (i.e., 6 to 6.42 years) old age groups. Results of Chi-square analyses note significant categorical age differences between ‘ready’ and ‘not ready’ groups on all measures of the EDI.

Table 3

Descriptive Statistics of Individual-Level Covariates by EDI Domains

	Individual-Level Covariates									
	Sex			Age (months)		Age (categorical; months)				
Main Independent Variables	Boys *n* (%)	Girls *n* (%)	χ^2(df)	Mean (SE)	t(df)	60 to 65 *n* (%)	66 to 71 *n*(%)	72 to 77 *n* (%)	78+ *n* (%)	χ^2(df)
One or More EDI Domains										
‘Ready’	5,428 (45.92)	6,392 (54.08)	441.54 (1, 16,061) ***	68.64 (0.03)	9.89 (6,937.5) ***	2,552 (21.59)	6,403 (54.17)	2,833 (23.97)	32 (0.27)	179.91 (3, 16,061) ***
‘Not Ready’	2,745 (64.73)	1,496 (35.27)		67.99 (0.06)		1,267 (29.88)	2,136 (50.37)	792 (18.67)	46 (1.08)	
Physical health and well-being										
‘Ready’	7,144 (49.23)	7,368 (50.77)	141.02 (1, 16,237) ***	68.51 (0.03)	4.19 (2,063) ***	3,359 (23.15)	7,785 (53.65)	3,314 (22.84)	54 (0.37)	72.92 (3, 16,237) ***
‘Not Ready’	1,110 (64.35)	615 (35.65)		68.10 (0.09)		506 (29.33)	851 (49.33)	343 (19.88)	25 (1.45)	
Social Competence										
‘Ready’	7,169 (48.87)	7,502 (51.13)	236.06 (1, 16,247) ***	68.49 (0.03)	2.74 (1,856.9) **	3,418 (23.30)	7,855 (53.54)	3,344 (22.79)	54 (0.37)	69.57 (3, 16,247) ***
‘Not Ready’	1,091 (69.23)	485 (30.77)		68.21 (0.10)		452 (28.68)	784 (49.75)	315 (19.99)	25 (1.59)	
Emotional Maturity										
‘Ready’	6,902 (47.98)	7,484 (52.02)	448.32 (1, 16,116) ***	68.50 (0.03)	2.95 (2,095.1)* *	3,354 (23.31)	7,688 (53.44)	3,290 (22.87)	54 (0.38)	54.91 (3, 16,116) ***
‘Not Ready’	1,296 (74.91)	434 (25.09)		68.22 (0.09)		473 (27.34)	893 (51.62)	339 (19.60)	25 (1.45)	
Language and Cognitive Development										
‘Ready’	6,958 (49.03)	7,233 (50.97)	158.46 (1, 16,128) ***	68.58 (0.03)	10.03 (2,391) ***	3,185 (22.44)	7,625 (53.73)	3,328 (23.45)	53 (0.37)	174.59 (3, 16,128) ***
‘Not Ready’	1,245 (64.27)	692 (35.73)		67.66 (0.09)		658 (33.97)	944 (48.74)	310 (16.00)	25 (1.29)	
Communication and General Knowledge										
‘Ready’	7,322 (49.51)	7,468 (50.49)	117.22 (1, 16,249) ***	68.51 (0.03)	4.07 (1,675.6)* **	3,422 (23.14)	7,927 (53.60)	3,393 (22.94)	48 (0.32)	140.66 (3, 16,249) ***
‘Not Ready’	939 (64.36)	520 (35.64)		68.06 (0.11)		450 (30.84)	713 (48.87)	265 (18.16)	31 (2.12)	
Number of ‘Not Ready’ EDI Domains										
0	5,428 (45.92)	6,392 (54.08)	481.45 (5, 15,969) ***	68.64 (0.03)	23.22 (5, 15,963)[a] ***	2,552 (21.59)	6,403 (54.17)	2,833 (23.97)	32 (0.27)	257.81 (15, 15,969) ***
1	1,236 (60.89)	794 (39.11)		68.00 (0.08)		580 (28.57)	1,056 (52.02)	383 (18.87)	11 (0.54)	
2	642 (65.71)	335 (34.29)		67.80 (0.12)		313 (32.04)	479 (49.03)	179 (18.32)	6 (0.61)	
3	384 (70.20)	163 (29.80)		68.16 (0.17)		164 (29.98)	269 (49.18)	99 (18.10)	15 (2.74)	
4	252 (72.00)	98 (28.00)		67.85 (0.21)		117 (33.43)	165 (47.14)	61 (17.43)	7 (2.00)	
5	182 (74.29)	63 (25.71)		68.56 (0.27)		63 (25.71)	125 (51.02)	50 (20.41)	7 (2.86)	

Note. * = p <.05, **p < .01, *** p < .0001. χ^2 = Chi-square, t = t-value of Satterthwaite t-test due to unequal variance. [a] Represents the F-Value statistic of ANOVA analyses comparing multiple means.

Table 4 presents the results of cross tabulations comparing differences in the family-level covariates (i.e., family size, mother's marital status, and residential mobility) across 'ready' and 'not ready' groups across all measures of the EDI. Children identified as 'not ready' on the measures of the EDI generally came from families with a greater average number of children than children identified as 'ready'. Results of t-tests and ANOVA analyses showed that these differences were statistically significant except the social competence and emotional maturity EDI domains. When examining the three-level categorical family size variable, among the smallest family size (i.e., 0 to 1 siblings), generally, a larger proportion of children were identified as 'not ready' than 'ready' except for the language and cognitive development and communication skills and general knowledge domains and children identified as 'not ready' on five EDI domains. Similarly, among the largest family size (i.e., four or more siblings), a larger proportion of children were identified as 'not ready' than 'ready' on all measures of the EDI. Inversely, among families with two to three siblings, a higher proportion of children were identified as 'ready' than 'not ready' on all measures of the EDI. Chi-square analyses indicated that the 'ready' and 'not ready' groups on all measures of the EDI differed significantly by the categorical family size variable.

Also presented in Table 4, among children of married mothers or mothers in a common-law relationship, a larger proportion were identified as 'ready' than 'not ready' on all measures of the EDI. Inversely, among children of single mothers or mothers with an unknown relationship status, a larger proportion were identified as 'not ready' than 'ready' on all measures of the EDI. Results of Chi-square analyses indicated that children identified as 'ready' and 'not ready' on all measures of the EDI significantly differed by mother's marital status. Children identified as 'not ready' on all measures of the EDI, on average, had a greater number of residences than children identified as 'ready'. Results of t-test and ANOVA analyses showed that these differences were statistically significant for all measures of the EDI.

Table 4

Descriptive Statistics of Family-Level Covariates by EDI Domains

	Family-Level Covariates										
	Family size (# of siblings)		Family Size (categorical; # of siblings)				Mother's Marital Status			Residential mobility	
Main Independent Variables	Mean (SE)	t (df)	0 to 1	2 to 3	4+	χ^2(df)	Married or common-law	Single or unknown	χ^2(df)	Mean (SE)	t(df)
One or More EDI Domains											
'Ready'	2.31 (0.01)	9.41 (6203.5) ***	1,956 (16.55)	8,687 (73.49)	1,177 (9.96)	160.19 (2, 16,061) ***	6,872 (58.14)	4,948 (41.86)	284.22 (1, 16,061) ***	1.66 (0.01)	14.41 (6162.3) ***
'Not Ready'	2.51 (0.02)		783 (18.46)	2,750 (64.84)	708 (16.69)		1,828 (43.10)	2,413 (56.90)		1.95 (0.02)	
Physical health and well-being											
'Ready'	2.33 (0.01)	7.68 (1992.3) ***	2,468 (17.01)	10,471 (72.15)	1,573 (10.84)	107.41 (2, 16,237) ***	8,168 (56.28)	6,344 (43.72)	232.73 (1, 16,237) ***	1.70 (0.01)	10.46 (1979.3) ***
'Not Ready'	2.58 (0.03)		307 (17.80)	1,089 (63.13)	329 (19.07)		637 (36.93)	1,088 (63.07)		2.03 (0.03)	
Social Competence											
'Ready'	2.35 (0.01)	1.85 (1,830.5)	2,438 (16.62)	10,572 (72.06)	1,661 (11.32)	54.70 (2, 16,247) ***	8,196 (55.87)	6,475 (44.13)	161.42 (1, 16,247) ***	1.71 (0.01)	7.59 (1,807.6) ***
'Not Ready'	2.41 (0.03)		340 (21.57)	996 (63.20)	240 (15.23)		616 (39.09)	960 (60.91)		1.95 (0.03)	
Emotional Maturity											
'Ready'	2.36 (0.01)	0.13 (2,079.5)	2,378 (16.53)	10,354 (71.97)	1,654 (11.50)	35.86 (2, 16,116) ***	7,999 (55.60)	6,387 (44.40)	96.04 (1, 16,116) ***	1.71 (0.01)	7.94 (2,027.4) ***
'Not Ready'	2.36 (0.03)		374 (21.62)	1,131 (65.38)	225 (13.01)		747 (43.18)	983 (56.82)		1.95 (0.03)	
Language and Cognitive Development											
'Ready'	2.32 (0.01)	10.41 (2,259.5) ***	2,428 (17.11)	10,274 (72.40)	1,489 (10.49)	174.65 (2, 16,128) ***	6,986 (58.16)	5,025 (41.84)	286.41 (1, 16,128) ***	1.69 (0.01)	11.79 (2,243.6) ***
'Not Ready'	2.65 (0.03)		323 (16.68)	1,213 (62.62)	401 (20.70)		1,828 (43.10)	2,413 (56.90)		2.05 (0.03)	
Communication and General Knowledge											
'Ready'	2.32 (0.01)	10.69 (1,624.5) ***	2,567 (17.36)	10,644 (65.51)	1,579 (10.68)	167.34 (2, 16,249) ***	8,152 (55.12) 662 (45.37)	6,638 (44.88) 797 (54.63)	50.81 (1, 16,249) ***	1.71 (0.01)	7.92 (1,657.4) ***
'Not Ready'	2.72 (0.04)		211 (14.46)	926 (63.47)	322 (22.07)					1.97 (0.03)	
Number of 'Not Ready' EDI Domains											
0	2.31 (0.01)	24.10 (5, 15,963)[a] ***	1,956 (16.55)	8,687 (73.49)	1,177 (9.96)	177.31 (10, 15,969) ***	6,872 (58.14)	4,948 (41.86)	316.69 (5, 15,969) ***	1.66 (0.01)	57.08 (5, 15,963)[a] ***
1	2.47 (0.03)		366 (18.03)	1,363 (67.14)	301 (14.83)		970 (47.48)	1,060 (52.22)		1.89 (0.02)	
2	2.46 (0.04)		187 (19.14)	630 (64.48)	160 (16.38)		406 (41.56)	571 (58.44)		1.99 (0.04)	
3	2.58 (0.06)		104 (19.01)	332 (60.69)	111 (20.29)		207 (37.84)	340 (62.16)		2.03 (0.05)	
4	2.55 (0.71)		70 (20.00)	218 (62.29)	62 (17.71)		122 (34.86)	228 (65.14)		2.00 (0.06)	
5	2.70 (0.09)		39 (15.92)	152 (62.04)	54 (22.04)		87 (35.51)	158 (64.49)		2.13 (0.09)	

Note. * $p < .05$, ** $p < .01$, *** $p < .0001$. χ^2 = Chi-square, t = t-value of Satterthwaite t-test due to unequal variance. [a] Represent the F-Value statistics of ANOVA analyses comparing multiple means.

Table 5 presents the results of cross tabulations examining the difference in the neighbourhood-level variable (i.e., socioeconomic status as measured by the SEFI-2) across all EDI domains. The mean SEFI-2 score was higher (i.e., indicating lower socioeconomic conditions) among children identified as 'not ready' than 'ready' on all measures of the EDI. Results of t-test and ANOVA analyses indicated that these differences were statistically significant.

Table 5

Descriptive Statistics of the Neighbourhood-Level Covariate by EDI Domains

	Socioeconomic Status – SEFI-2	
Main Independent Variables	Mean (SE)	t (df)
One or More EDI Domains		
'Ready'	-0.08 (0.01)	19.62 (6612.3) ***
'Not Ready'	0.27 (0.02)	
Physical health and well-being		
'Ready'	-0.03 (0.01)	15.26 (2041.4) ***
'Not Ready'	0.38 (0.03)	
Social Competence		
'Ready'	-0.02 (0.01)	11.86 (1,847.1) ***
'Not Ready'	0.31 (0.03)	
Emotional Maturity		
'Ready'	-0.01 (0.01)	7.28 (2,087.3) ***
'Not Ready'	0.18 (0.02)	
Language and Cognitive Development		
'Ready'	-0.05 (0.01)	19.98 (2,332.4) ***
'Not Ready'	0.46 (0.02)	
Communication and General Knowledge		
'Ready'	-0.02 (0.01)	13.11 (1,705.1) ***
'Not Ready'	0.35 (0.03)	
Number of 'Not Ready' EDI Domains		
0	-0.08 (0.01)	97.44 (5, 15,930)[a] ***
1	0.18 (0.02)	
2	0.30 (0.03)	
3	0.39 (0.04)	
4	0.35 (0.06)	
5	0.58 (0.07)	

Note. *p <.05, **p < .01, ***p <.0001. t = t-value. [a] Represent the F-Value statistics of ANOVA analyses comparing multiple means.

Table 6 presents the descriptive statistics of the dependent variables. The majority were identified as approaching or meeting expectations in all competencies in Grade 7 mathematics (71.82%) and Grade 8 reading and writing (78.79%). For Grade 7 student engagement, the majority were identified as developing or established in all indicators (66.79%).

Table 6

Descriptive Statistics of the Sample on the Dependent Variables

Variables	
Grade 7 mathematics	
Approaching or meeting expectations in all competencies	11,303 (71.82)
Not meeting expectations in one or more competencies	4,435 (28.18)
Grade 8 reading and writing	
Approaching or meeting expectations in all competencies	12,426 (78.79)
Not meeting expectations in one or more competencies	3,345 (21.21)
Grade 7 student engagement	
Developing or established in all indicators	10,678 (66.79)
Inconsistent or emerging in one or more indicators	5,310 (33.21)

Note. Data are presented as *n* (%).

Assumption Testing

While logistic regressions have fewer assumptions compared to other types of statistical analyses (Tabachnick & Fidell, 2014), three assumptions remain: 1) the linearity of the logit, 2) the absence of multicollinearity, and 3) the lack of outliers.

Linearity of the Logit. The linearity of the logit assumption in logistic regressions assumes that the continuous independent variables are linearly related to the logit of the dependent variables (Tabachnick & Fidell, 2014). The violation of the linearity of the logit assumption may increase the possibility of making a Type II error (Hilbe, 2009). To test this assumption, the Box-Tidwell approach was employed. The Box-Tidwell approach involves

testing the interaction term between each independent variable and its natural logarithm in a logistic regression. Separate models were computed for each main independent variable (i.e., 1) not ready on one or more EDI domains, 2) physical health and well-being domain, 3) language and cognitive development domain, 4) communication skills and general knowledge domain, 5) emotional maturity domain, 6) social competence domain, and 7) the number of not ready domains) and for each dependent variable (i.e., 1) Grade 7 mathematics, 2) Grade 8 reading and writing, and 3) Grade 7 student engagement) and for each dependent variable (i.e., 1) Grade 7 mathematics, 2) Grade 8 reading and writing, and 3) Grade 7 student engagement) for a total of 21 models. Similar to the approach outlined by Tabachnick and Fidell (2014), the independent variables (i.e., the main independent variables and covariates) were included in the models concurrently. Therefore, the main independent variable, all categorical and continuous covariates, and the interaction terms of each continuous independent variables (i.e., age, family size, residential mobility, and the SEFI-2) with each of their natural logarithms were added concurrently to each model. The assumption of the linearity of the logit is considered violated when one or more interaction terms are statistically significant.

Three of the continuous independent variables violated the assumption of linearity of the logit in a minimum of one model. The age variable violated the assumption in all 21 models, the family size variable in 12 models, and the socioeconomic status variable (i.e. SEFI-2) violated the assumption in seven models (i.e., all Grade 7 mathematics models). While the violation of the linearity of the logit assumption warrants data transformations, it has been argued that such transformation make the interpretation of the results less intuitive and less meaningful (Tabachnick & Fidell, 2014). Therefore, a decision was made not to perform log, square, or square root data transformations on two of the continuous independent variables: age and family

size. Rather, age and family size were recoded into categorical variables to maintain the intuitiveness and meaning in the interpretations. Given that these variables are covariates in all models, it is believed that this will not greatly impact the interpretation of the findings. Age was categorized into four levels: 1) *60 to 65 months* , 2) *66 to 71 months*, 3) *72 to 77 months*, and 4) *78 months and older*. This categorization was based on 6-month intervals as well as taking into consideration adequate numbers for each category. Family size was categorized into three levels: 1) *0 to 1 sibling*, 2) *2 to 3 siblings*, and 4) *4 or more siblings*. The family size variable becomes more intuitive given that it is not possible to have a portion of a sibling (e.g., 1.5 siblings). Given that the interpretation of the SEFI-2 in its original form is not intuitive, a decision was made to perform data transformations to the variable. Log, square, and square root transformations of the SEFI-2 variable were computed.

The assumption of linearity was tested once again to examine whether the recoding of age and family size into categorical variables and the transformations of the SEFI-2 variable addressed the linearity assumption for the socioeconomic status variable and affected the residential mobility variable. With square root transformations of the SEFI-2 variable, none of the models violated the assumption of linearity, thus the violations were addressed. Residential mobility only marginally ($p = 0.045$ and $p = 0.054$) violated the assumption of linearity in two of the 21 models following the recoding of age, family size, and socioeconomic status. Therefore, it was decided not to make any changes to this variable.

Multicollinearity. To test the assumption of multicollinearity, variance inflation factors (VIF) were examined using linear regression models. Given that the interest is only in the interrelatedness of the independent variables it does not matter that the dependent variable is dichotomous rather than continuous. A VIF greater than 10 is indicative of high

multicollinearity. Similar to the approach employed above, models were built for each independent variable by each dependent variable for a total of 21 models. The highest VIF was 1.16 for the marital status variable in each model. Thus, the assumption of multicollinearity was met.

Outliers. To assess for outliers, standardized residuals were inspected. Potential outliers are identified as having a standardized residual value greater than ± 3.3 (Tabachnick & Fidell, 2014). However, outliers are expected in large samples such as the one used in the current study. Similar to the approach employed above, models were built for each independent variable by each dependent variable for a total of 21 models. The percentage of outliers present in the solutions ranged from 0.02% to 1.23% of the sample. It was concluded that, given the large sample size, this proportion of outliers is tolerable and therefore this assumption is adequately met.

Logistic Regression Models

Hypothesis 1. As stated in the introduction, the first research question that was investigated was: Is school readiness in Kindergarten associated with Grade 7 and 8 school outcomes, after adjusting for age, sex, family size, mother's marital status, residential mobility, and socioeconomic level? Tables 7 through 9 present the results of multiple logistic regression analyses that examined the relationship between being 'not ready' on one or more EDI domains and Grade 7 and 8 school outcomes.

Hypothesis 1a. Table 7 presents the results of the multiple logistic regression analysis that examined the relationship between being 'not ready' on one or more EDI domains and Grade 7 mathematics. After adjusting for age and sex (i.e., Model 1), the odds of not meeting expectations in one or more Grade 7 mathematics competencies was 3.60 (95% Confidence

Interval (CI): 3.33-3.89) times greater in children identified as 'not ready' on one or more EDI domains in Kindergarten compared with those who are ready on all domains. When further adjusting for family variables (i.e., family size, mother's marital status, and residential mobility; Model 2), the association remained significant (Odds ratio (OR) = 3.17, 95% CI = 2.92-3.43). When also adjusting for socioeconomic status (i.e., SEFI-2 scores), children identified as 'not ready' on one or more EDI domains in Kindergarten maintained significantly greater odds of not meeting expectations on one or more Grade 7 mathematics competencies than children identified as ready on all EDI domains (OR = 2.97, 95% CI = 2.73-3.22).

Among individual-level factors, age at time of the EDI assessment was significantly associated with Grade 7 mathematics. Specifically, the youngest (i.e., 60 to 65 months) and oldest (i.e., 78+) age categories had significantly greater odds of not meeting expectations in one or more competencies in Grade 7 mathematics in all three models (ORs ranging from 1.11 to 1.12 and 3.83 to 4.13, respectively). Among family-level factors, having four or more siblings, mother's marital status at age five, and residential mobility from birth to age five were significantly associated with Grade 7 mathematics. Children with four or more siblings had increased odds of not meeting expectations on one or more Grade 7 mathematics competencies (Model 2: OR = 1.95, 95% CI = 1.70-2.23); Model 3: OR = 1.64, 95% CI = 1.43-1.88). Children whose mother's marital status was identified as single or unknown had significantly greater odds of not meeting expectations in one or more competencies in Grade 7 mathematics (Model 2: OR = 1.54, 95% CI = 1.43-1.67; Model 3: OR = 1.32, 95% CI = 1.22-1.43). An increase in one residence was associated with 1.21 (95% CI = 1.17-1.26) increased odds of not meeting expectations in one or more Grade 7 mathematics competencies in Model 2 and 1.16 greater odds (95% CI = 1.12-1.21) in Model 3. In Model 3, socioeconomic status was significantly

associated with Grade 7 mathematics such that a one unit increase in the square root SEFI-2 scores (i.e., indicative of lower socioeconomic conditions) was associated with 5.91 times greater odds (95% CI = 4.97-7.01) of not meeting expectations in one or more mathematics competencies.

Table 7

Logistic Regression Models 'Not Ready' on One or More EDI Domains Predicting 'Not Meeting Expectations in One or More Competencies' in Grade 7 Mathematics, Adjusting for Individual, Family, and Neighbourhood Variables

	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)
Base Model			
'Not ready' on one or more EDI domains (vs. 'Ready' on all domains)	3.60 (3.33-3.89)***	3.17 (2.92-3.43)***	2.97 (2.73-3.22)***
Girls (vs. Boys)	1.03 (0.96-1.11)	1.00 (0.92-1.07)	0.98 (0.91-1.06)
Age			
60 to 65 months	1.11 (1.02-1.22)*	1.11 (1.01-1.21)*	1.12 (1.03-1.23)*
66 to 71 months	1.00	1.00	1.00
72 to 77 months	1.08 (0.99-1.19)	1.06 (0.96-1.16)	1.04 (0.95-1.14)
78+ months	4.13 (2.37-7.19)***	3.83 (2.19-6.72)***	3.97 (2.23-7.06)***
Family Variables			
Family size			
0 to 1 sibling		1.00	1.00
2 to 3 sibling		1.01 (0.91-1.11)	1.02 (0.92-1.13)
4+ siblings		1.95 (1.70-2.23)***	1.64 (1.43-1.88)***
Mother single or unknown (vs. married or common law)		1.54 (1.43-1.67)***	1.32 (1.22-1.43)***
Residential mobility		1.21 (1.17-1.26)***	1.16 (1.12-1.21)***
Neighbourhood Variable			
SEFI-2 score			5.91 (4.97-7.01)***
Brier Score	0.188	0.182	0.176
C-statistic	0.638	0.686	0.714
Total N	15,549	15,549	15,517

Note. * $p<.05$, ** $p<.01$, *** $p<.0001$. EDI = Early Development Instrument

Table 8

Logistic Regression Models 'Not Ready' on One or More EDI Domains Predicting 'Not Meeting Expectations in One or More Competencies' in Grade 8 Reading and Writing, Adjusting for Individual, Family, and Neighbourhood Variables

	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)
Base Model			
'Not ready' on one or more EDI domains (vs. 'Ready' on all domains)	4.32 (3.97-4.69)***	3.75 (3.45-4.09)***	3.51 (3.22-3.84)***
Girls (vs. boys)	0.60 (0.55-0.65)***	0.56 (0.52-0.61)***	0.54 (0.50-0.59)***
Age			
60 to 65 months	1.04 (0.94-1.14)	1.02 (0.92-1.13)	1.03 (0.93-1.14)
66 to 71 months	1.00	1.00	1.00
72 to 77 months	1.01 (0.91-1.12)	0.98 (0.89-1.09)	0.96 (0.86-1.07)
78+ months	3.28 (1.87-5.76)***	2.93 (1.65-5.20)**	3.03 (1.68-5.46)**
Family Variables			
Family size			
0 to 1 sibling		1.00	1.00
2 to 3 siblings		1.07 (0.96-1.20)	1.08 (0.96-1.21)
4+ siblings		2.13 (1.84-2.47)***	1.73 (1.49-2.01)***
Mother single or unknown (vs. married or common law)		1.73 (1.59-1.89)***	1.44 (1.31-1.58)***
Residential mobility		1.20 (1.16-1.25)***	1.15 (1.11-1.20)***
Neighbourhood Variable			
SEFI-2 score			7.04 (5.82-8.52)***
Brier score	0.150	0.145	0.140
C-statistic	0.701	0.737	0.762
Total N	15,582	15,582	15,550

* $p<.05$, ** $p<.01$, *** $p<.000$

Hypothesis 1b. Table 8 presents the results of the logistic regression analyses examining the relationship between being 'not ready' on one or more EDI domains in Kindergarten and not meeting expectations on one or more competencies in Grade 8 reading and writing. After adjusting for age and sex (i.e., Model 1), children identified as 'not ready' on one or more EDI domains had 4.32 times greater odds (95% CI = 3.97-4.69) of not meeting expectations in one or more Grade 8 reading and writing competencies compared with children who are identified as 'ready' on all EDI domains. When further adjusting for family variables (i.e., Model 2), the association remained significant (OR = 3.75, 95% CI = 3.45-4.09). Similarly, when also adjusting for socioeconomic status (i.e., Model 3), children identified as 'not ready' on one or more EDI domains had 3.51 times (95% CI = 3.22-3.84) greater odds of not meeting expectations on one or more Grade 8 reading and writing competencies when compared with their peers identified as ready on all domains.

When examining individual-level factors, Table 8 shows that girls had significantly lower odds of not meeting expectations on one or more Grade 8 reading and writing competencies compared with boys (ORs ranging from 0.54 to 0.60) in all three models. Children aged 78 months or older at the time of EDI assessment had significantly greater odds of not meeting expectations in one or more Grade 8 reading and writing competencies compared with children aged 66 to 71 months in all three models (ORs ranging from 2.93 to 3.28). Among family-level variables, family size, mother's marital status and residential mobility were significantly associated with Grade 8 reading and writing. Specifically, children with four or more siblings had increased odds of not meeting expectations in one or more Grade 8 reading and writing competencies in Model 2 (OR = 2.13, 95% CI = 1.84-2.47) and Model 3 (OR = 1.73, 95% CI = 1.49-2.01). Children of mothers identified as single or unknown had greater odds of not meeting

expectations in one or more Grade 8 reading and writing competencies when compared with children of married or common-law mothers in both models (Model 2: or = 1.73, 95 % CI = 1.59-1.89; Model 3: OR = 1.44, 95% CI = 1.31-1.58). An increase in one residence was associated with 1.20 greater odds (95% CI = 1.16-1.25) of not meeting expectations in one or more Grade 8 reading and writing competencies in Model 1 and 1.15 greater odds (95% CI = 1.11-1.20) in Model 2. An increase in square root SEFI-2 scores (i.e., lower socioeconomic conditions) was associated with 7.04 greater odds (95% CI = 5.82-8.52) of not meeting expectations in one or more Grade 8 reading and writing competencies.

Hypothesis 1c. Table 9 presents the results for the logistic regression analyses examining the relationship between being 'not ready' on one or more EDI domains and Grade 7 student engagement. After adjusting for age and sex (i.e., Model 1), children identified as 'not ready' on one or more EDI domains had 3.40 times greater odds (95% CI = 3.15-3.67) of being inconsistent or emerging on one or more indicators of Grade 7 student engagement compared with children identified as 'ready' on all EDI domains. The association remained significant when further adjusting for family-level factors (OR = 2.98, 95% CI = 2.76-3.22). When also adjusting for socioeconomic status, children identified as 'not ready' on one or more EDI domains had 2.82 times greater odds (95% CI = 2.60-3.05) of being inconsistent or emerging in one or more Grade 7 student engagement indicators compared with children identified as 'ready' on all EDI domains in Kindergarten.

Table 9

Logistic Regression Models 'Not Ready' on One or More EDI Domains Predicting 'Inconsistent or Emerging in One or More Indicators' in Grade 7 Student Engagement, Adjusting for Individual, Family, and Neighbourhood Variables

	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)
Base Model			
'Not ready' on one or more EDI domains (vs. 'Ready' on all domains)	3.40 (3.15-3.67)***	2.98 (2.76-3.22)***	2.82 (2.60-3.05)***
Girls (vs. boys)	0.61 (0.57-0.65)***	0.58 (0.54-0.62)***	0.57 (0.53-0.61)***
Age			
60 to 65 months	1.05 (0.96-1.14)	1.03 (0.94-1.12)	1.04 (0.95-1.14)
66 to 71 months	1.00	1.00	1.00
72 to 77 months	1.05 (0.96-1.15)	1.02 (0.94-1.12)	1.02 (0.93-1.11)
78+ months	2.47 (1.45-4.18)**	2.30 (1.35-3.93)**	2.34 (1.36-4.04)**
Family Variables			
Family size			
0 to 1 sibling		1.00	1.00
2 to 3 siblings		0.97 (0.88-1.07)	0.98 (0.89-1.08)
4+ siblings		1.69 (1.49-1.93)***	1.46 (1.28-1.67)***
Mother single or unknown (vs. married or common law)		1.73 (1.61-1.86)***	1.54 (1.42-1.66)***
Residential mobility		1.20 (1.15-1.24)***	1.15 (1.11-1.19)***
Neighbourhood Variable			
SEFI-2 score			4.24 (3.60-4.99)***
Brier score	0.202	0.195	0.191
C-statistic	0.669	0.704	0.721
Total N	15,797	15,797	15,765

* $p<.05$, ** $p<.01$, *** $p<.0001$

Among individual level factors, girls had significantly lower odds of being identified as inconsistent or emerging on one or more Grade 7 student engagement indicators when compared with boys (ORs ranging from 0.57 to 0.61). The oldest age group at the time of the EDI assessment date (i.e., 78 months and older) had significantly greater odds of being identified as inconsistent or emerging on one or more Grade 7 student engagement indicators compared with children aged 66 to 71 months at the time of the EDI in all three models (ORs ranging from 2.30 to 2.47). All family variables were significantly associated with Grade 7 student engagement. Children with four or more siblings had increased odds of being identified as inconsistent or emerging on one or more Grade 7 student engagement indicators in Model 2 (OR = 1.69, 95% CI = 1.49-1.86) and Model 3 (OR = 1.46, 95% CI = 1.28-1.67). Children of mothers who were single or had not reported their marital status (i.e., unknown) when the child was five years old had significantly greater odds of being inconsistent or emerging on one or more Grade 7 student engagement indicators (Model 2: OR = 1.73, 95% CI = 1.61-1.86; Model 3: OR = 1.54, 95% CI = 1.42-1.66). An increase in one residence was associated with 1.20 greater odds (95% CI = 1.16-1.24) of being inconsistent or emerging in one or more Grade 7 student engagement indicators in Model 2 and 1.15 times the odds (95% CI = 1.11-1.19) in Model 3. An increase in square root SEFI-2 scores (i.e., lower socioeconomic conditions) was associated with 4.24 times greater odds (95% CI = 3.60-4.99) of being inconsistent or emerging in one or more indicators of Grade 7 engagement.

To illustrate the findings of Hypothesis 1 in a meaningful way, the following describes scenarios of hypothetical children and their predicted probabilities of not meeting expectations in Grade 7 mathematics and Grade 8 reading and writing and being inconsistent or emerging in Grade 7 student engagement.

Predicted probabilities were calculated to estimate the likelihood that a boy who is identified as 'not ready' on one or more EDI domains, 66 to 71 months old, with 0 to 1 siblings, from a family with a single mother or a mother with an unknown relationship, with an average number of residences by age 5 (i.e., 1.44 residences), from the Point Douglas community area would not meet expectations on Grade 7 and 8 school outcomes. The SEFI-2 score for Point Douglas is approximately two (Metge et al., 2009). This boy would have a 64.58% chance of not meeting expectations on one or more Grade 7 mathematics competencies, a 65.24% chance of not meeting expectations on one or more Grade 8 reading and writing competencies, and a 74.59% chance of being inconsistent or emerging on one or more indicators of Grade 7 student engagement.

Predicted probabilities were calculated to estimate the likelihood that a boy who is identified as 'ready' on one or more EDI domains, 66 to 71 months old, with 0 to 1 siblings, from a family with a married mother, with an average number of residences by age 5 (i.e., 1.44 residences), from the Assiniboine South community area would not meet expectations on Grade 7 and 8 school outcomes. The SEFI-2 score for Assiniboine South is approximately -0.9 (Metge et al., 2009). This boy would have a 12.07% chance of not meeting expectations on one or more Grade 7 mathematics competencies, an 8.83% chance of not meeting expectations on one or more Grade 8 reading and writing competencies, and 20.07% chance of being inconsistent or emerging on one or more indicators of Grade 7 student engagement.

Predicted probabilities were calculated to estimate the likelihood that a girl who is identified as 'not ready' on one or more EDI domains, 66 to 71 months old, with 0 to 1 siblings, from a family with a single mother or a mother with an unknown relationship, with an average number of residences by age 5 (i.e., 1.44 residences), from the Point Douglas community area

would not meet expectations on Grade 7 and 8 school outcomes. This girl would have a 64.18% chance of not meeting expectations on one or more Grade 7 mathematics competencies, a 50.53% of not meeting expectations on one or more Grade 8 reading and writing competencies, and a 62.43% chance of being inconsistent or emerging on one or more Grade 7 student engagement indicators.

Predicted probabilities were calculated to estimate the likelihood that a girl who is identified as 'ready' on one or more EDI domains, 66 to 71 months old, with 0 to 1 siblings, from a family with a married mother, with an average number of residences by age 5 (i.e., 1.44 residences), from the Assiniboine South community area would not meet expectations on Grade 7 and 8 school outcomes. This girl would have a 11.89% chance of not meeting expectations on one or more Grade 7 mathematics competencies, a 5.01% chance of not meeting expectations on one or more Grade 8 reading and writing competencies, and a 12.45% of being inconsistent or emerging on one or more indicators of Grade 7 student engagement.

Hypothesis 2. As stated in the introduction, the second research question investigated in this study was: Is the association between school readiness and Grade 7 and 8 school outcomes altered by socioeconomic level, after adjusting for age, sex, family size, mother's marital status, and residential mobility? To assess this, multiple logistic models were built with all covariates with the addition of the interaction term between the EDI variable (i.e., 'not ready' on one or more EDI domains) and the socioeconomic status variable (i.e., SEFI-2 scores) for each dependent variable. For Grade 7 mathematics, the interaction term was not significant ($p = 0.50$) indicating that the association between school readiness and Grade 7 mathematics does not differ by socioeconomic level. For Grade 8 reading and writing, the interaction was not significant ($p = 0.27$) indicating the association between school readiness and Grade 8 reading and writing

does not differ by socioeconomic level. For Grade 7 student engagement, the interaction term was not significant ($p = 0.85$) indicating that the association between school readiness and Grade 7 student engagement does not differ by socioeconomic level.

Hypothesis 3. As indicated in the introduction, the third research question investigated in the current study was: Does the accumulation of being 'not ready' in a number of EDI domains increase the risk of poor Grade 7 and 8 school outcomes, after adjusting for age, sex, family size, mother's marital status, residential mobility, and socioeconomic level? Table 10 through 12 present the results or the logistic regression analyses examining the relationship between the number of 'not ready' EDI domains and Grade 7 and 8 school outcomes.

Hypothesis 3a. Table 10 presents the results of the logistic regression analyses examining the association between the number of 'not ready' EDI domains in Kindergarten and Grade 7 mathematics. Odds ratios increased with the number of 'not ready' EDI domains. In Model 1, after adjusting for age and sex, when compared with children ready on all EDI domains, children 'not ready' on one EDI domain had 2.58 times greater odds (95% CI = 2.33-2.86) of not meeting expectations on one or more Grade 7 mathematics competencies; on two domains, 3.74 times the odds (95% CI = 3.25-4.29); on three domains, 6.21 times the odds (95% CI = 5.12-7.53); on four domains, 6.50 times the odds (95% CI = 5.05-8.38); and on five domains, 13.03 times the odds (95% CI = 9.09-18.68). The associations remained significant and trends remained similar after adjusting for family-level variables (Model 2 ORs ranging from 2.34 to 10.67) and when adjusting for socioeconomic status (Model 3 ORs ranging from 2.23 to 9.18).

Table 10

Logistic Regression Models of Number of 'Not Ready' EDI Domains Predicting 'Not Meeting Expectations in One or More Competencies' in Grade 7 Mathematics, Adjusting for Individual, Family, and Neighbourhood Variables

	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)
Base Model			
'Not ready' EDI domains			
0 domains	1.00	1.00	1.00
1 domain	2.58 (2.33-2.86)***	2.34 (2.11-2.59)***	2.23 (2.00-2.47)***
2 domains	3.74 (3.25-4.29)***	3.25 (2.82-3.75)***	3.03 (2.62-3.50)***
3 domains	6.21 (5.12-7.53)***	5.25 (4.31-6.39)***	4.86 (3.98-5.94)***
4 domains	6.50 (5.05-8.38)***	5.54 (4.28-7.17)***	5.20 (4.00-6.76)***
5 domains	13.03 (9.09-18.68)***	10.67 (7.41-15.38)***	9.18 (6.33-13.30)***
Girls (vs. boys)	1.06 (0.98-1.14)	1.02 (0.95-1.10)	1.01 (0.93-1.09)
Age			
60 to 65 months	1.10 (1.01-1.21)*	1.10 (1.001-1.20)*	1.12 (1.02-1.22)*
66 to 71 months	1.00	1.00	1.00
72 to 77 months	1.09 (0.997-1.20)	1.07 (0.97-1.17)	1.05 (0.95-1.16)
78+ months	3.74 (2.12-6.60)***	3.49 (1.97-6.20)***	3.64 (2.02-6.56)***
Family Variables			
Family size			
0 to 1 sibling		1.00	1.00
2 to 3 siblings		1.01 (0.91-1.11)	1.02 (0.92-1.13)
4+ siblings		1.89 (1.65-2.17)***	1.60 (1.39-1.84)***
Mother single or unknown (vs. married or common law)		1.51 (1.40-1.64)***	1.30 (1.19-1.41)***
Residential mobility		1.21 (1.17-1.26)***	1.16 (1.12-1.21)***
Neighbourhood Variable			
SEFI-2 score			5.84 (4.91-6.95)***
Brier score	0.185	0.179	0.174
C-statistic	0.643	0.688	0.717
Total N	15,462	15,462	15,430

* $p<.05$, ** $p<.01$, *** $p<.0001$

Table 11

Logistic Regression Models Number of 'Not Ready' EDI Domains Predicting 'Not Meeting Expectations in One or More Competencies' in Grade 8 Reading and Writing, After Adjusting for Individual, Family, and Neighbourhood Variables

	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)
Base Model			
'Not ready' EDI domains			
0 domains	1.00	1.00	1.00
1 domain	3.06 (2.75-3.41)***	2.77 (2.48-3.09)***	2.62 (2.34-2.94)***
2 domains	4.05 (3.51-4.67)***	3.45 (2.98-4.00)***	3.20 (2.75-3.71)***
3 domains	7.19 (5.95-8.68)***	5.98 (4.93-7.25)***	5.56 (4.56-6.76)***
4 domains	9.02 (7.06-11.54)***	7.51 (5.84-9.65)***	7.07 (5.47-9.15)***
5 domains	16.64 (11.85-23.37)***	13.62 (9.64-19.25)***	12.07 (8.46-17.22)***
Girls (vs. boys)	0.61 (0.56-0.66)***	0.57 (0.53-0.63)***	0.55 (0.51-0.61)***
Age			
60 to 65 months	1.02 (0.93-1.13)	1.02 (0.91-1.12)	1.02 (0.92-1.13)
66 to 71 months	1.00	1.00	1.00
72 to 77 months	1.02 (0.91-1.13)	0.99 (0.89-1.10)	0.97 (0.87-1.08)
78+ months	2.90 (1.61-5.19)**	2.61 (1.44-4.71)**	2.69 (1.46-4.95)**
Family Variables			
Family size			
0 to 1 sibling		1.00	1.00
2 to 3 siblings		1.08 (0.96-1.21)	1.09 (0.97-1.22)
4+ siblings		2.08 (1.79-2.42)***	1.70 (1.46-1.98)***
Mother single or unknown (vs. married or common law)		1.70 (1.56-1.86)***	1.42 (1.30-1.56)***
Residential mobility		1.20 (1.15-1.25)***	1.15 (1.11-1.20)***
Neighbourhood Variable			
SEFI-2 score			7.00 (5.77-8.49)***
Brier score	0.146	0.141	0.137
C-statistic	0.707	0.741	0.765
Total N	15,495	15,495	14,463

* $p<.05$, ** $p<.01$, *** $p<.0001$

Hypothesis 3b. Table 11 presents the results of the logistic regression analyses examining the relationship between the number of 'not ready' EDI domains and Grade 8 reading and writing. Odds ratios increased with the number of 'not ready' EDI domains. After adjusting for age and sex, when compared with children ready on all EDI domains, children identified as 'not ready' on one EDI domain had 3.06 times greater odds (95% CI = 2.75-3.41) of not meeting expectations in one or more Grade 8 reading and writing competencies; on two EDI domains, 4.05 times the odds (95% CI = 3.51-4.67); on three EDI domains, 7.19 times greater odds (95% CI = 5.95-8.68); on four EDI domains, 9.02 times the odds (95% CI = 7.06-11.54); and on five EDI domains 16.64 times the odds (95% CI = 11.85-23.37). The associations remained significant and demonstrated similar trends after adjusting for family variables and socioeconomic status (ORs ranging from 2.77 to 13.62 and 2.62 to 12.07, respectively).

Hypothesis 3c. Table 12 presents the results of the logistic regression analyses examining the relationship between number of 'not ready' EDI domains and Grade 7 student engagement. Odds ratios increased with the number of 'not ready' EDI domains in all three models. After adjusting for age and sex, when compared with children identified as 'ready' on all EDI domains, children identified as 'not ready' on one EDI domain had 2.45 times (95% CI = 2.22-2.70) the odds of being inconsistent or emerging on one or more Grade 7 student engagement indicators; on two domains, 3.92 times the odds (95% CI = 3.41-4.50); on three domains, 5.18 times the odds (95% CI = 4.28-6.26); on four domains, 5.83 times the odds (95% CI = 4.55-7.47); and on five domains, 10.32 times the odds (95% CI = 7.26-14.65). The associations remained significant and similar trends were found after adjusting for family-level factors in Model 2 (ORs ranging from 2.22 to 8.35) and after further adjusting for socioeconomic status in Model 3 (ORs ranging from 2.12 to 7.31).

Table 12

Logistic Regression Models Number of 'Not Ready' EDI Domains Predicting 'Inconsistent or Emerging in One or More Indicators' in Grade 7 Student Engagement, Adjusting for Individual, Family, and Neighbourhood Variables

	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)
Base Model			
'Not ready' EDI domains			
0 domains	1.00	1.00	1.00
1 domain	2.45 (2.22-2.70)***	2.22 (2.00-2.45)***	2.12 (1.92-2.35)***
2 domains	3.92 (3.41-4.50)***	3.42 (2.97-3.94)***	3.22 (2.79-3.72)***
3 domains	5.18 (4.28-6.26)***	4.33 (3.56-5.26)***	4.02 (3.30-4.90)***
4 domains	5.83 (4.55-7.47)***	4.82 (3.75-6.20)***	4.56 (3.53-5.89)***
5 domains	10.32 (7.26-14.65)***	8.35 (5.85-11.93)***	7.31 (5.10-10.47)***
Girls (vs. boys)	0.62 (0.58-0.67)***	0.59 (0.55-0.63)***	0.58 (0.54-0.62)***
Age			
60 to 65 months	1.03 (0.95-1.13)	1.02 (0.94-1.12)	1.03 (0.95-1.13)
66 to 71 months	1.00	1.00	1.00
72 to 77 months	1.05 (0.96-1.15)	1.02 (0.94-1.12)	1.01 (0.93-1.11)
78+ months	2.22 (1.29-3.82)**	2.10 (1.21-3.64)**	2.15 (1.23-3.75)**
Family Variables			
Family size			
0 to 1 sibling		1.00	1.00
2 to 3 siblings		0.97 (0.88-1.07)	0.98 (0.89-1.08)
4+ siblings		1.67 (1.47-1.91)***	1.45 (1.27-1.66)***
Mother single or unknown (vs. married or common law)		1.70 (1.58-1.84)***	1.53 (1.42-1.66)***
Residential mobility		1.19 (1.15-1.24)***	1.15 (1.11-1.19)***
Neighbourhood Variable			
SEFI-2 score			4.20 (3.56-4.95)***
Brier score	0.200	0.193	0.189
C-statistic	0.674	0.706	0.723
Total N	15,707	15,707	15,675

Note. EDI = Early Development Instrument, * $p<.05$, ** $p<.01$, *** $p<.0001$

Hypothesis 4. As indicated in the introduction, the final research question investigated in the study was: What is the association between each EDI domain and Grade 7 and 8 school outcomes, after adjusting for age, sex, family size, mother's marital status, residential mobility, and socioeconomic level? Tables 13 through 15 present the results of the logistic regressions examining the relationship between each EDI domain and Grade 7 and 8 school outcomes.

Hypothesis 4a. Table 13 presents the results of the logistic regression analyses examining the relationship between each EDI domain and Grade 7 mathematics. First, after adjusting for age and sex, children identified as 'not ready' on the physical health and well-being EDI domain had 3.23 times the odds (95% CI = 2.90-3.60) of not meeting expectations on one or more competencies in Grade 7 mathematics compared with children identified as 'ready' on the EDI domain. The association remained significant after adjusting for family-level factors in Model 2 (OR = 2.72, 95% CI = 2.43-3.05) and after further adjusting for socioeconomic status in Model 3 (OR = 2.51, 95% CI = 2.24-2.81). Second, after adjusting for age and sex, children identified as 'not ready' on the social competence EDI domain had 3.56 times the odds (95% CI = 3.17-3.99) of not meeting expectations on one or more Grade 7 mathematics competencies compared with children identified as 'ready' on the EDI domain. The association remained significant after adjusting for family-level variables in Model 2 (OR = 3.13, 95% CI = 2.86-3.61) and when further adjusting for socioeconomic status in Model 3 (OR = 3.04, 95% CI = 2.70-3.43).

Table 13

Logistic Regression Models 'Not Ready' on Each EDI Domain Predicting 'Not Meeting Expectations in One or More Competencies' in Grade 7 Mathematics, Adjusting for Individual, Family, and Neighbourhood Variables

'Not ready' EDI Domain	AOR-1 OR (95% CI)	AOR-2 OR (95% CI)	AOR-3 OR (95% CI)
Physical health and well-being	3.23 (2.90-3.60)***	2.72 (2.43-3.05)***	2.51 (2.24-2.81)***
Brier score	0.195	0.188	0.182
C-statistic	0.583	0.650	0.689
Total N	15,723	15,723	15,691
Social competence	3.56 (3.17-3.99)***	3.13 (2.86-3.61)***	3.04 (2.70-3.43)***
Brier score	0.194	0.187	0.181
C-statistic	0.581	0.656	0.693
Total N	15,734	15,734	15,702
Emotional maturity	2.74 (2.46-3.06)***	2.53 (2.26-2.82)***	2.50 (2.23-2.80)***
Brier score	0.196	0.188	0.182
C-statistic	0.574	0.649	0.691
Total N	15,605	15,605	15,573
Language and cognitive development	5.27 (4.73-5.87)***	4.51 (4.04-5.04)***	4.09 (3.66-4.58)***
Brier score	0.188	0.182	0.177
C-statistic	0.608	0.672	0.705
Total N	15,617	15,617	15,585
Communication skills and general knowledge	3.72 (3.30-4.19)***	3.31 (2.93-3.74)***	3.11 (2.74-3.52)***
Brier score	0.195	0.187	0.181
C-statistic	0.579	0.653	0.691
Total N	15,735	15,735	15,703

Note. EDI = Early Development Instrument, CI = confidence interval, *p<.05, **p<.01, ***p<.0001

Third, after adjusting for age and sex, children identified as 'not ready' on the emotional maturity EDI domain had 2.74 times greater odds (95% CI = 2.46-3.06) of not meeting expectations in one or more Grade 7 mathematics competencies compared with children identified as ready on the domain. The association remained significant after adjusting for family-level factors in Model 2 (OR = 2.53, 95% CI = 2.26-2.82) and when further adjusting for socioeconomic status in Model 3 (OR = 2.50, 95% CI = 2.23-2.80). Fourth, after adjusting for age and sex, when compared with children identified as 'ready' on the language and cognitive development domain, children identified as 'not ready' had 5.27 times the odds (95% CI = 4.73-5.87) of not meeting expectations in one or more Grade 7 mathematics competencies. The association remained significant after adjusting for family-level factors in Model 2 (OR = 4.51, 95% CI = 4.04-5.04) and when further adjusting for socioeconomic status in Model 3 (OR = 4.09, 95% CI = 3.66-4.58). Fifth, after adjusting for age and sex, children identified as 'not ready' on the communication skills and general knowledge EDI domain had 3.72 times the odds (95% CI = 3.30-4.19) of not meeting expectation in one or more competencies in Grade 7 mathematics when compared with children identified as 'ready' on the domain. The association remained significant after adjusting for family-level factors in Model 2 (OR = 3.31, 95% CI = 2.93-3.74) and when further adjusting for socioeconomic status in Model 3 (OR = 3.11, 95% CI = 2.74-3.52).

Hypothesis 4b. Table 14 presents the results of the logistic regression analyses examining the relationship between each EDI domain and Grade 8 reading and writing. First, after adjusting for age and sex, children identified as 'not ready' on the physical health and well-being EDI domain had 3.70 times the odds (95% CI = 3.31-4.13) of not meeting expectations in one or more Grade 8 reading and writing competencies compared with children identified as

'ready' on the domain. The association remained significant after adjusting for family-level factors in Model 2 (OR = 3.07, 95% CI = 2.74-3.44) and when further adjusting for socioeconomic status in Model 3 (OR = 2.81, 95% CI = 2.50-3.16). Second, after adjusting for age and sex, children identified as 'not ready' on the social competence EDI domain had 3.91 times the odds (95% CI = 3.49-4.39) of not meeting expectations in one or more competencies in Grade 8 reading and writing compared with children identified as ready on the EDI domain. The association remained significant when further adjusting for family-level factors in Model 2 (OR = 3.49, 95% CI = 3.10-3.93) and after adjusting for socioeconomic status in Model 3 (OR = 3.33, 95% CI = 2.95-3.76).

Third, after adjusting for age and sex, children identified as 'not ready' on the emotional maturity EDI domain had 3.14 times greater odds (95% CI = 2.81-3.51) of not meeting expectations in one or more Grade 8 reading and writing competencies when compared with children identified as ready on the domain. The association remained significant after adjusting for family-level variables in Model 2 (OR = 2.89, 95% CI = 2.58-3.23) and when further adjusting for socioeconomic status in Model 3 (OR = 2.89, 95% CI = 2.57-3.24). Fourth, after adjusting for age and sex, children identified as 'not ready' on the language and cognitive development EDI domain had 5.75 times the odds (95% CI = 5.17-6.40) of not meeting expectations in one or more Grade 8 reading and writing competencies when compared with children identified as 'ready' on the EDI domain. The association remained significant after adjusting for family-level factors in Model 2 (OR = 4.82, 95% CI = 4.32-5.39) and when further adjusting for socioeconomic status in Model 3 (OR = 4.35, 95% CI = 3.88-4.86). Fifth, after adjusting for age and sex, children identified as 'not ready' on the communication skills and general knowledge EDI domain had 4.61 times greater odds (95% CI = 4.09-5.20) of not meeting

expectations in one or more competencies in Grade 8 reading and writing when compared with children identified as ‘ready’ on the domain. The association remained significant after adjusting for family-level factors in Model 2 (OR = 4.09, 95% CI = 3.62-4.63) and when further adjusting for socioeconomic status in Model 3 (OR = 3.88, 95% CI = 3.41-4.40).

Table 14

Logistic Regression Models 'Not Ready' on Each EDI Domain Predicting 'Not Meeting Expectations in One or More Competencies' in Grade 8 Reading and Writing, Adjusting for Individual, Family, and Neighbourhood Variables

'Not ready' EDI Domain	AOR-1 OR (95% CI)	AOR-2 OR (95% CI)	AOR-3 OR (95% CI)
Physical health and well-being	3.70 (3.31-4.13)***	3.07 (2.74-3.44)***	2.81 (2.50-3.16)***
Brier score	0.157	0.151	0.146
C-statistic	0.649	0.700	0.733
Total N	15,756	15,756	15,724
Social competence	3.91 (3.49-4.39)***	3.49 (3.10-3.93)***	3.33 (2.95-3.76)***
Brier score	0.157	0.150	0.145
C-statistic	0.644	0.703	0.737
Total N	15,766	15,766	15,734
Emotional maturity	3.14 (2.81-3.51)***	2.89 (2.58-3.23)***	2.89 (2.57-3.24)***
Brier score	0.158	0.151	0.145
C-statistic	0.637	0.696	0.733
Total N	15,638	15,638	15,606
Language and cognitive development	5.75 (5.17-6.40)***	4.82 (4.32-5.39)***	4.35 (3.88-4.86)***
Brier score	0.150	0.145	0.141
C-statistic	0.672	0.721	0.748
	15,651	15,651	15,619
Communication skills and general knowledge	4.61 (4.09-5.20)***	4.09 (3.62-4.63)***	3.88 (3.41-4.40)***
Brier score	0.156	0.149	0.144
C-statistic	0.648	0.705	0.738
Total N	15,768	15,768	15,736

Note. EDI = Early Development Instrument, CI = confidence interval, *p<.05, **p<.01, ***p<.0001

Hypothesis 4c. Table 15 shows the results of the logistic analyses examining the relationship between each EDI domain and Grade 7 student engagement. First, after adjusting for age and sex, children identified as 'not ready' on the physical health and well-being EDI domain had 3.09 times the odds (95% CI = 2.78-3.44) of being inconsistent or emerging in one or more Grade 7 student engagement indicators when compared with children identified as 'ready' on the domain. The association remained significant after adjusting for family-level variables in Model 2 (OR = 2.58, 95% CI = 2.31-2.88) and when further adjusting for socioeconomic status in Model 3 (OR = 2.41, 95%CI = 2.16-2.70). Second, after adjusting for age and sex, children identified as 'not ready' on the social competence EDI domain had 3.71 times greater odds (95% CI = 3.31-4.16) of being inconsistent or emerging on one or more Grade 7 student engagement indicators when compared with children identified as 'ready' on the EDI domain. The association remained significant after adjusting for family-level factors in Model 2 (OR = 3.30, 95% CI = 2.94-3.71) and when further adjusting for socioeconomic status in Model 3 (OR = 3.15, 95% CI = 2.80-3.55).

Third, after adjusting for age and sex, children identified as 'not ready' on the emotional maturity EDI domain had 2.98 times the odds (95% CI = 2.68-3.32) of being inconsistent or emerging on one or more indicators of Grade 7 student engagement when compared with children identified as 'ready' on the domain. The association remained significant after adjusting for family-level variables in Model 2 (OR = 2.74, 95% CI = 2.45-3.06) and when further adjusting for socioeconomic status in Model 3 (OR = 2.71, 95% CI = 2.42-3.03). Fourth, after adjusting for age and sex, children identified as 'not ready' on the language and cognitive EDI domain had 4.09 times the odds (95% CI = 3.69-4.54) of being inconsistent or emerging on one or more Grade 7 student engagement indicators when compared with children identified as

'ready' on the domain. The association remained significant after adjusting for family-level factors in Model 2 (OR = 3.44, 95% CI = 3.09-3.83) and when further adjusting for socioeconomic status (OR = 3.13, 95% CI = 2.81-3.49). Fifth, after adjusting for age and sex, children identified as 'not ready' on the communication skills and general knowledge EDI domain had 3.24 times the odds (95% CI = 2.88-3.65) of being inconsistent or emerging in one or more Grade 7 student engagement indicators when compared with children identified as 'ready' on the EDI domain. The association remained significant after adjusting for family-level factors in Model 2 (OR = 2.88, 95% CI = 2.56-3.25) and when further adjusting for socioeconomic status in Model 3 (OR = 2.70, 95% CI = 2.39-3.05).

Table 15

Logistic Regression Models 'Not Ready' on Each EDI Domain Predicting 'Inconsistent or Emerging in One or More Indicators' in Grade 7 Student Engagement, Adjusting for Individual, Family, and Neighbourhood Variables

'Not ready' EDI Domain	AOR-1 OR (95% CI)	AOR-2 OR (95% CI)	AOR-3 OR (95% CI)
Physical health and well-being	3.09 (2.78-3.44)***	2.58 (2.31-2.88)***	2.41 (2.16-2.70)***
Brier score	0.210	0.202	0.197
C-statistic	0.626	0.677	0.700
Total N	15,973	15,973	15,941
Social competence	3.71 (3.31-4.16)***	3.30 (2.94-3.71)***	3.15 (2.80-3.55)***
Brier score	0.209	0.200	0.195
C-statistic	0.625	0.682	0.704
Total N	15,984	15,984	15,952
Emotional maturity	2.98 (2.68-3.32)***	2.74 (2.45-3.06)***	2.71 (2.42-3.03)***
Brier score	0.210	0.201	0.196
C-statistic	0.622	0.677	0.702
Total N	15,853	15,853	15,821
Language and cognitive development	4.09 (3.69-4.54)***	3.44 (3.09-3.83)***	3.13 (2.81-3.49)***
Brier score	0.205	0.198	0.194
C-statistic	0.640	0.688	0.706
Total N	15,864	15,864	15,832
Communication skills and general knowledge	3.24 (2.88-3.65)***	2.88 (2.56-3.25)***	2.70 (2.39-3.05)***
Brier score	0.211	0.201	0.197
C-statistic	0.619	0.676	0.698
Total N	15,985	15,985	15,953

Note. EDI = Early Development Instrument, CI = confidence interval, *p<.05, **p<.01, ***p<.0001

Chapter 4: Discussion and Conclusion

While there is a growing awareness of the importance of the early years, many children begin school experiencing many disadvantages. It is crucial to understand the relationship between being identified as 'not ready' when beginning school-based learning and the future success and well-being of youth. The present study is the first to utilize population-level data to examine the relationship between the EDI, a measure of school readiness in Kindergarten, and Grade 7 and 8 school outcomes in Canada.

Overall, the results from the current analyses largely support the research hypotheses that school readiness, as measured by the EDI, is associated with Grade 7 and 8 school outcomes. The main findings of the study are as follows: 1) children identified as 'not ready' on one or more EDI domains in Kindergarten have increased odds of doing poorly on Grade 7 and 8 school outcomes; 2) the associations between school readiness, as measured by the EDI, and these school outcomes do not differ by neighbourhood-level socioeconomic status; 3) an increasing number of 'not ready' EDI domains correspond with increased odds of doing poorly in Grade 7 and 8 school outcomes; and 4) each EDI domain is significantly associated with Grade 7 and 8 school outcomes (see Table 16). These findings are further summarized below and discussed in the context of existing literature and within the life course approach and frustration-esteem model. A discussion follows on the potential mechanisms that may account for the observations, the strengths of the study, its limitations, as well as implications and future directions.

Table 16

Summary of Main Findings

	Grade 7 mathematics	Grade 8 reading and writing	Grade 7 student engagement
Hypothesis 1	Children identified as 'not ready' on one or more EDI domains in Kindergarten have significantly greater odds of not meeting expectations on one or more Grade 7 mathematics competencies than children identified as 'ready' on all EDI domains, after adjusting for individual, family, and neighbourhood-level covariates.	Children identified as 'not ready' on one or more EDI domains in Kindergarten have significantly greater odds of not meeting expectations on one or more Grade 8 reading and writing competencies than children identified as 'ready' on all EDI domains, after adjusting for individual, family, and neighbourhood-level covariates.	Children identified as 'not ready' on one or more EDI domains in Kindergarten have significantly greater odds of being inconsistent or emerging on one or more indicators of Grade 8 reading and writing than children identified as 'ready' on all EDI domains, after adjusting for individual, family, and neighbourhood-level covariates.
Hypothesis 2	The association between school readiness and Grade 7 mathematics does not significantly differ by socioeconomic level, after adjusting for individual and family-level covariates.	The association between school readiness and Grade 8 reading and writing does not significantly differ by socioeconomic level, after adjusting for individual and family-level covariates.	The association between school readiness and Grade 7 student engagement does not significantly differ by socioeconomic level, after adjusting for individual and family-level covariates.
Hypothesis 3	The odds of not meeting expectations on one or more Grade 7 mathematics competencies increased with the number of 'not ready' EDI domains, after adjusting for individual, family, and neighbourhood-level covariates.	The odds of not meeting expectations on one or more Grade 8 reading and writing competencies increased with the number of 'not ready' EDI domains, after adjusting for individual, family, and neighbourhood-level covariates.	The odds of being inconsistent or emerging on one or more indicators of Grade 7 student engagement increased with the number of 'not ready' EDI domains, after adjusting for individual, family, and neighbourhood-level covariates.
Hypothesis 4	Each EDI domain was associated with Grade 7 mathematics, such that children identified as 'not ready' had greater odds of not meeting expectations on one or more competencies than children identified as ready, after adjusting for individual, family, and neighbourhood-level covariates.	Each EDI domain was associated with Grade 8 reading and writing, such that children identified as 'not ready' had greater odds of not meeting expectations on one or more competencies than children identified as ready, after adjusting for individual, family, and neighbourhood-level covariates.	Each EDI domain was associated with Grade 7 student engagement, such that children identified as 'not ready' had greater odds of being inconsistent or emerging on one or more indicators than children identified as ready, after adjusting for individual, family, and neighbourhood-level covariates.

Discussion of Main Study Findings

Hypothesis 1. As hypothesized, children identified as 'not ready' on one or more EDI domains in Kindergarten had significantly increased odds of having poorer Grade 7 mathematics, Grade 8 reading and writing, and Grade 7 student engagement outcomes when compared with children identified as 'ready' on all EDI domains, after adjusting for individual, family, and neighbourhood variables. The strength of the association was lowest for Grade 7 student engagement with an odds ratio of approximately 2.8 and strongest for Grade 8 reading and writing with an odds ratio of about 3.5.

These results are consistent with findings from previous studies. In Canada, being 'not ready' on one or more EDI domains was associated with poorer Grade 3 literacy and numeracy (Brownell et al., 2012). In Australia, compared with children identified as 'ready' on all domains, children identified as 'not ready' on one or more EDI domains had increased odds of ranking in the bottom 20% on reading and numeracy assessments in years 3, 5, and 7 (Brinkman et al., 2013). The present study builds on previous research and shows the extent to which school readiness is important and related to longer-term academic trajectories. Furthermore, the present study extends previous studies by examining for the first time the association between being 'not ready' on the EDI in Kindergarten and Grade 7 student engagement. The results of the analyses examining the relationship of the EDI with Grade 7 student engagement show similar trends to Grade 7 mathematics and Grade 8 reading and writing where children identified as 'not ready' on one or more EDI domains have poorer Grade 7 student engagement compared with children identified as 'ready' on all EDI domains. While the strength of the relationship is the weakest compared to the relationship between the EDI and Grade 7 mathematics and Grade 8 reading and writing, the association remains statistically significant and of considerable

magnitude. The findings suggest that children's readiness to benefit from school-based learning upon transition into school predicts their academic trajectories through early adolescence. This may continue to have important implications through the course of their lives and this further supports the importance of development in the early years.

Hypothesis 2. The hypothesis that, the strength of the association between the EDI and later school outcomes would be greater among children living in higher socioeconomic levels compared with those living in lower socioeconomic levels, after adjusting for individual, family, and neighbourhood-level factors, was not supported. In fact, no significant interactions were found between socioeconomic status, as measured by the SEFI-2, and the EDI on any of the Grade 7 and 8 school outcomes. These findings suggest that the magnitude of the relationship between the EDI and later school outcomes does not differ by socioeconomic status.

These findings are unlike a previous study by Brownell et al. (2012) that found the four academic pathways (i.e., positive trajectory, negative trajectory, positive deflection, and negative deflection, as previously described) from Kindergarten to Grade 3 literacy and numeracy differed by SES. Specifically, the authors found the percentage of children in the positive trajectory increased as socioeconomic status increased. The percentage of children in the negative trajectory decreased as socioeconomic status increased. The percentage of deflections in trajectories, both positive and negative deflections, were highest in low socioeconomic status and decreased as socioeconomic status increased. While the authors noted socioeconomic differences in prevalence for each trajectory when stratifying by income quintile, the results were only descriptive in nature and the differences were not statistically tested. This may, in part, explain why there is a discrepancy between the findings in the present study and the study by Brownell et al. (2012). Furthermore, the measure of socioeconomic status differed between the

two studies. Brownell et al. (2012) measured socioeconomic status using average household income data derived from the Census to calculate income quintiles for urban and rural regions, while the current study utilized the composite SEFI-2 measure. Previous research comparing the composite measure of socioeconomic conditions to the single average household income indicator from the Census found the SEFI-2 to be more strongly related to indicators of health status and a more desirable measure (Metge et al., 2009). Finally, the findings from the current study may also differ from this previous study given that a longer period of time has elapsed between the EDI and later school outcomes.

Hypothesis 3. As hypothesized, after adjusting for individual, family, and neighbourhood-level variables, the risk of poorer Grade 7 and 8 school outcomes increased with each 'not ready' EDI domain. These findings are consistent with the results of previous studies. Brownell et al. (2012) and D'Angiulli et al. (2009) found that the percentage of children not meeting expectations in literacy in Grade 3 and 4, respectively, increased with the number of accumulated 'not ready' EDI domains. Similar findings were observed in Australia in Year 7 literacy and numeracy (Brinkman et al., 2013). In addition, Brinkman et al. (2013) tested the association between the number of 'not ready' EDI domains in literacy and numeracy in years 3, 5, and 7 utilizing logistic regressions, similar to the present study. Corresponding to the results of the present study, the authors found each number of 'not ready' EDI domains to be statistically different from children identified as 'ready' on all EDI domains. While the authors saw a general trend where an increasing number of 'not ready' EDI domains was associated with an increase in odds of doing poorly in literacy and numeracy in years 3, 5, and 7, the results were not as discernible as those in the present study. In certain models, they noted a decrease or stability in odds ratios between the 4 and 5 'not ready' EDI domains. This, however, may be

explained by their small sample size, particularly in the highest number of 'not ready' EDI domains. In contrast, the present study observed a clear trend of increasing odds ratios with the increasing numbers of 'not ready' EDI domains in all models.

While these results correspond well with previous research, no research has previously examined the relationship between number of 'not ready' EDI domains and early adolescent student engagement. The results for Grade 7 student engagement corresponded to the trends noted in Grade 7 mathematics and Grade 8 reading and writing, where an increasing number of 'not ready' EDI domains was associated with increased odds of having poor Grade 7 student engagement outcomes. Taken together, these findings suggest that children with increased degrees of disadvantage upon school entry are particularly at risk of maintaining negative school trajectories in early adolescence.

Hypothesis 4. As hypothesized, after adjusting for individual, family, and neighbourhood-level factors, each EDI domain was associated with Grade 7 mathematics and Grade 8 reading and writing. While the literature examining the relationship between specific EDI domains and later school outcomes is mixed, the findings in the present study are, in large part, supported by the findings of previous studies. The discrepancy in the results of previous studies may, largely, be explained by the varying methods used to test these associations. These studies differ in terms of the statistical tests used to examine the associations (e.g., Spearman's Rho correlations, structural equation modelling, logistic regressions) and whether or not the EDI domains were entered simultaneously or separately in the models. Nonetheless, some trends were observed across studies; for instance, the language and cognitive development EDI domain was consistently found to be predictive of later literacy and numeracy and, in many studies, identified as the most strongly associated with these outcomes (Brinkman et al., 2013; Brownell

et al., 2012; D'Angiulli et al., 2009; Davies et al., 2016; Forget-Dubois et al., 2007; Guhn et al., 2016). These studies support the results of the present study where the language and cognitive development domain was identified as the strongest predictor of Grade 7 mathematics and Grade 8 reading and writing, compared to the other EDI domains.

The association between the communication skills and general knowledge domain and Grade 7 mathematics and Grade 8 reading and writing is supported by the literature (Brinkman et al., 2013; Brownell et al., 2012; D'Angiulli et al., 2009; Davies et al., 2016; Forget-Dubois et al., 2007). The present study identified the communication skills and general knowledge domain to be the second strongest predictor of Grade 7 mathematics and Grade 8 reading and writing, compared to the other EDI domains. While the order of EDI domains with the strongest associations to later literacy and numeracy differs across studies, Brinkman et al. (2013) and Davies et al. (2016) also identified communication skills and general knowledge as the domain with the second strongest association with later literacy and numeracy outcomes.

Davies et al. (2016) previously referred to the language and cognitive development as well as the communication skills and general knowledge domains as indicators of cognitive school readiness. These EDI domains are also the most conceptually similar to later literacy and numeracy outcomes; for example, the language and cognitive development EDI domain includes the following question: "Would you say that this child is interested in games involving numbers?" (Janus & Offord, 2007, p. 51), which corresponds well to assessments of mathematics. Further, questions such as "Would you say this child is generally interested in books" and "How would you rate this child's ability to tell a story" (Janus & Offord, 2007, p.50) from the language and cognitive development and communication skills and general knowledge EDI domains, respectively, correspond well to assessments of later reading and writing. This

may, in part, explain why these two domains are identified as the strongest predictors of Grade 7 mathematics and Grade 8 reading and writing.

In the present study, the social competence EDI domain was identified as the third strongest predictor of Grade 7 mathematics and Grade 8 reading and writing, relative to the other EDI domains. Although at times small (Brinkman et al., 2013), previous research observed an association between the social competence domain with later numeracy and literacy (Brownell et al., 2012; D'Angiulli et al., 2009; Davies et al., 2016). Guhn et al. (2016) only found an association between the social competence domain and Grade 4 numeracy. Forget-Dubois et al. (2007) only observed an association between the social competence domain and Grade 1 school achievement when social competence and the emotional maturity domains were inserted in models separately. This corresponds with the findings of the present study given that the relationship between each EDI domain and later Grade 7 and 8 school outcomes were examined individually.

The physical health and well-being and emotional maturity EDI domains were both significantly associated with Grade 7 mathematics and Grade 8 reading and writing. Although some studies found small associations between these domains and later literacy and numeracy (Brinkman et al., 2013), both EDI domains were found to be significantly associated to these later school outcomes in other studies (Brownell et al., 2012; D'Angiulli et al., 2009; Davies et al., 2016). Forget-Dubois et al. (2007) observed a significant association between the physical health and well-being domain and Grade 1 school achievement but only found this association with the emotional maturity domain when it was included in the models separate from the social competence domain. In the current study, physical health and well-being and emotional maturity were the fourth and fifth strongest predictors of Grade 7 mathematics, respectively. On the other

hand, emotional maturity was the fourth and physical health and well-being was the fifth strongest predictor of Grade 8 reading and writing. The odds ratios for the two were, however, quite similar in both the Grade 7 mathematics and Grade 8 reading and writing models.

The hypothesis that after adjusting for individual, family, and neighbourhood characteristics, the social competence, emotional maturity, and language and cognitive development domains would be positively associated and physical health and well-being would be negatively associated with Grade 7 student engagement was partially supported. As hypothesized, the social competence, language and cognitive development, and emotional maturity domains were associated with better Grade 7 student engagement. In fact, the three were the strongest predictors of student engagement in that respective order. While the relationship between specific EDI domains and student engagement had not been studied until now, these associations are supported by previous studies investigating early predictors of student engagement. Pagani et al. (2012) observed a relationship between attention and greater student engagement in elementary school. On the EDI, the emotional maturity domain includes questions relating to inattention and related behaviours such as "Would you say that this child can't sit still, is restless?" (Janus & Offord, 2007, p.51). Thus, it is not surprising that a positive association between this domain and Grade 7 student engagement was noted in the present study. A positive relationship between early math skills and later student engagement has also been observed in the literature (Pagani et al., 2011). The language and cognitive development domain of the EDI includes questions relating to ability and interest in numeracy, thus providing support for the relationship between this domain and Grade 7 student engagement noted in the current study. Research on the early predictors of student engagement, however, remains very limited therefore, it is difficult to find studies supporting these findings.

While supporting literature is lacking, it is important to note the conceptual similarities between these EDI domains and the indicators of student engagement assessed in Grade 7. The social competence EDI domain assesses children on their curiosity and eagerness, ability to follow rules, and whether they accept responsibility for their actions (Janus & Offord, 2007). These are conceptually similar and may correspond to necessary skills and attributes to demonstrate an interest in learning, to participate in lessons, and to accept responsibilities for assignments, as measured on the assessment of Grade 7 student engagement. In addition to measuring children's ability in numeracy, the language and cognitive development EDI domain also assesses children's curiosity, inquisitiveness, and interest in various aspects of literacy and numeracy. Literacy and numeracy are subjects that are taught throughout the school years, therefore, interest in these subjects at an early age may correspond well to a general interest in learning, as assessed as part of the measure of Grade 7 student engagement.

Although it was not hypothesized, the communication skills and general knowledge domain was also associated with Grade 7 student engagement such that children identified as 'not ready' on these domains had poorer student engagement outcomes. This domain was the fourth strongest predictor of Grade 7 student engagement. While there is virtually no literature on the relationship between communication skills and later student engagement, the relationship between the communication skills and general knowledge EDI domain and Grade 7 student engagement may be intuitively understood. This EDI domain assesses children's ability to effectively communicate thoughts to adults and their peers as well as understanding others (Janus & Offord, 2007). These key communication skills developed early on may be necessary to actively participate in the classroom, demonstrate one's awareness of learning goals, and convey interest in learning, as measured by the Grade 7 student engagement assessment.

Contrary to the hypothesis, the physical health and well-being domain was positively associated with Grade 7 student engagement (i.e., children identified as 'not ready' had poorer student engagement outcomes). The physical health and well-being domain measures a wide range of constructs including how their physical needs are cared for at home, measures of gross motor skills, measures of fine motor skills, etc. (see Appendix A for the items included in this domain). There are mixed findings in the literature regarding the relationship between early motor skills and student engagement. Some research identified a negative association (e.g., Pagani et al., 2011) while other research observed a positive association between fine motor skills in Kindergarten and Grade 2 student engagement behaviours (Pagani, Fitzpatrick, Archambault, & Janosz, 2010), providing support for the findings in the present research. The physical health and well-being EDI domain assesses more than just fine and gross motor skills, it also assesses children on their physical preparedness and energy for the school day and their physical independence; for example, the EDI questionnaire asks whether the child has arrived to school hungry since the beginning of the school year. Previous research has identified food insecurity to be negatively associated with student engagement (Ashiabi, 2005). While these findings from previous studies do not address all concepts covered in the physical health and well-being EDI domain, they do provide some support for the positive association noted between this domain and Grade 7 student engagement.

Similar to previous research (e.g., Guhn et al., 2016), it would appear that the strongest relationships between the EDI domains and Grade 7 and 8 school outcomes are within-domain (i.e., where the predictor and the outcome are conceptually similar); for instance, the *cognitive* EDI domains (i.e., language and cognitive development and communication skills and general knowledge domains) were the strongest predictors of Grade 7 mathematics and Grade 8 reading

and writing. For student engagement, the three EDI domains identified as corresponding most suitably with previously identified predictors of student engagement (i.e., the social competence, language and cognitive development, and emotional maturity domains), were the strongest predictors of Grade 7 student engagement. Taken together, the findings of the analyses testing Hypothesis 4 suggest that later school success is associated with well-rounded and holistic development where all facets are important for long-term academic trajectories.

Predictors of Grade 7 and 8 School Outcomes.

While exploring the relationship between the covariates and later Grade 7 and 8 outcomes was not a primary aim of the present study, it is, nonetheless, worth noting associations. Examining these relationships may help identify groups of children that may be at risk of experiencing negative school trajectories. This may help inform strategies and initiatives to improve early adolescent school outcomes.

Individual-Level Predictors. When testing Hypotheses 1 and 3, sex was not significantly associated with Grade 7 mathematics. However, when examining the relationship between specific EDI domains and Grade 7 mathematics, girls had decreased odds of not meeting expectations in the majority of the models. These findings suggest that, in general, boys and girls do not differ significantly on long-term numeracy outcomes. However, when differences are noted, it would appear that girls have better mathematics outcomes than boys. Literature on the relationship between sex and school outcomes is mixed. Some studies suggest that boys have better numeracy outcomes (Brochu et al., 2013; Brownell et al., 2012; Bussière et al., 2004). Others observed such advantages in girls (Brownell et al., 2006) which support the findings of the present study where girls fared better when examining the domain-specific relationships between the EDI and grade 7 mathematics. In all Grade 8 reading and writing and Grade 7

student engagement models, girls had decreased odds of doing poorly compared with boys. These findings are supported by previous studies that found girl to have greater literacy outcomes and were more engaged (Brochu et al., 2013; Brownell et al., 2012; Brownell et al., 2006; Bussière et al., 2004; Levine et al., 2001; Marks, 2000).

In all analyses examining the relationship between EDI and Grade 7 mathematics, children aged 60 to 65 months at the time of EDI assessment experienced increased odds of not meeting or approaching expectations. This suggests that children who begin Kindergarten at a younger age struggle in mathematics in early adolescence. While being 60 to 65 months predicted poorer Grade 8 reading and writing in a few EDI domain-specific models, it was not significantly and consistently associated with later Grade 8 reading and writing and Grade 7 student engagement outcomes in the majority of the models. In all models, children aged 78 months or more at the time of EDI assessment had greater odds of doing poorly in Grade 7 and 8 outcomes. This age group was among the strongest predictors of later outcomes in the majority of the models.

There are mixed findings in the literature regarding the persistent effects of age (i.e., at school entry and relative to students' classmates) throughout academic trajectories. Some studies find that older students have better academic outcomes in Grades 4 and 8 and in their eventual education attainment compared with younger students (e.g., Kawaguchi, 2011). Others suggest that students age relative to their classmates is positively associated with Grade 7, 8, and 9 numeracy but not literacy (e.g., Cobley, McKenna, Baker, & Wattie, 2009). Another study found that relatively older students had modestly greater academic achievements in the early years but that the associations were no longer present in Grade 3 (Stipek & Byler, 2001). Thoren, Heinig, and Brunner (2016) noted changes in the relationship between students relative

age to their classmates and later literacy and numeracy throughout their academic trajectories. The older students in this study had greater literacy and numeracy outcomes in Grade 2 however, the differences decreased in Grade 3. In Grade 8, relative age was no longer associated with literacy outcomes, while an inverse relationship was noted with numeracy where relatively younger students had greater numeracy outcomes.

Similar to many of these studies, children who belonged in the youngest age group upon school entry had poorer Grade 7 and 8 school outcomes relative to their older peers. Similar to the results from the study by Thoren et al. (2016), it would appear that this long-term association was most apparent for numeracy outcomes. Contrary to previous research, children belonging to the oldest age group at time of EDI assessment had consistently poorer Grade 7 and 8 school outcomes. This may, in part, be explained by the fact that 21.52% of these children had two EDI assessments in consecutive years (i.e., both 2006 and 2007) indicating that these individuals were most likely held back in Kindergarten. This may represent a group of children who are struggling in school and therefore may explain why these children have increased odds of doing poorly in later school outcomes.

Family-Level Predictors. Children with four or more siblings had consistently and significantly increased odds of doing poorly in all Grade 7 and 8 outcomes. These results are similar to the findings by Brownell et al. (2012) where four or more children in a family was negatively associated with Grade 3 numeracy outcomes. Further, previous studies have identified a negative association between family size and academic achievement (Fransoo et al., 2008; Roos et al., 2013). Children of single mothers had significantly greater odds of doing poorly in all Grade 7 and 8 outcomes. These findings are similar to previous studies that identified children of unmarried parents to be more likely to have poorer school outcomes (i.e.,

not passing Grade 12 on time; Jutte et al., 2010) A greater number or residences was also associated with increased odds of doing poorly in Grade 7 and 8 outcomes. While some studies have found no association between residential mobility and later school outcomes (e.g., Fransoo et al., 2008), others identified a negative association with adolescent school outcomes (Adam & Chase-Lansdale, 2002; Roos et al., 2013) thus, providing support for the present findings.

Potential Mechanisms

Potential mechanisms that may account for the relationship between school readiness and later school outcomes may be rooted in the theoretical frameworks that guide the present study: the life course approach and the frustration-esteem model. Studies on developmental trajectories and the life course approach may lend some insight into the mechanisms at work in the relationship between school readiness in Kindergarten and Grade 7 and 8 school outcomes observed in the present study. The life course approach highlights the importance of the early years as a critical developmental period characterized by rapid development (Forrest & Riley, 2004). Biology, environment or experiences, and their interactions at key development stages in early life play an important role in shaping the brain (e.g., Friederici, 2006; Grossman et al., 2002). The life course approach proposes that early experiences can affect future outcomes throughout the life course in three ways, namely, via latent, pathway, and cumulative effects (Hertzman et al., 2001).

The first process, the latency model, suggests that exposures and experiences during critical periods of development can have enduring effects that are not substantially altered by later circumstances or experiences (Ben-Shlomo & Kuh, 2002; Clyde Hertzman et al., 2001). As such, in the present study, the development of children during critical periods in their first five years of life, as captured by the EDI, would have direct effect on Grade 7 and 8 outcomes. The

second process is a pathway model where experiences and risks at critical stages throughout the life course may lead to later either adverse or beneficial exposures or experiencing, creating a chain of events and setting long-term trajectories (Ben-Shlomo & Kuh, 2002; Clyde Hertzman et al., 2001). Applying this model to the current findings, it could be hypothesized that exposures and experiences early in life lead to children arriving at school not ready to benefit from school-based learning, in turn, not acquiring the necessary literacy and numeracy skills and interest throughout their academic trajectories. The final process outlined in the life course approach is the cumulative model. This pathway suggests that the number and duration of disadvantages experienced may accumulate over time therefore increasing the risk of negative outcomes. Any or all of these processes may account for the relationships between school readiness and Grade 7 and 8 outcomes observed in the present study. Although the life course approach is widely adopted in epidemiology and health research and has accumulated considerable converging evidence from multiple disciplines, it is also important to acknowledge other potential mechanisms that might be at play here.

The frustration-esteem model may provide insight into the potential pathways related to student disengagement. As described by Audas and Willms (2001), this model posits that student disengagement is established in school failure. This model suggests that children may experience poor school outcomes at an early age leading to low self-esteem and, in turn, they abandon the institution responsible for their failure. One particular component of this model is of interest for the present study: school failure as the initial point in the process of disengagement. Linking this model to the findings in the present study, it is possible that children who were identified as ‘not ready’ in Kindergarten experienced greater difficulties and,

in the process suggested in this model, were at greater risk to distance themselves from the school context.

While these models provide insight as to the potential mechanisms that may explain why a relationship between school readiness in Kindergarten and Grade 7 and 8 school outcomes was observed in the present study, testing these pathways is beyond the scope of the present study. Future research should examine the mechanisms or interplay of mechanisms that account for the relationship between school readiness upon transition into school and early adolescent outcomes.

Strengths

Given the increasing awareness in the importance of the early years and the growing interest in the use of the EDI as a monitoring tool for program and policy evaluation across Canada (Guhn, Janus, et al., 2016) and internationally, the current study was undertaken to further the knowledge of the long-term trajectories of children identified as not ready to benefit from school-based learning upon transition into school. The current study is among the first Canadian studies to longitudinally examine the association between the EDI and school outcomes beyond elementary school. It is also among the first to examine the domain-specific relationship between the EDI and long-term outcomes beyond elementary school, building on previous research. It is not only important to understand the relationship between the overall school readiness of a child and later school outcomes, but also the multifaceted and comprehensive areas of development that are important and associated with mathematics, reading and writing, and student engagement. This may inform specific areas that need to be targeted to improve later school outcomes. Extending analyses to longer term outcomes contributes to the understanding of crucial developmental trajectories.

In addition, this study is among the first to study the link between the EDI and a more psychological component of successful learning namely, student engagement. This aligns well with HCMO's goal for Manitoba children to be socially engaged and responsible (L. Boyd, Personal Communications, March 24, 2016), which may help in engaging policy makers and stakeholders in investing in programs and policies to ensure the long-term success and well-being of Manitoba's youth.

There are many strengths of using administrative data. Strengths include the ability to link various measures between databases, less expensive and more feasible longitudinal research, reduced loss to follow up, and greater generalizability to the population (Jutte et al., 2011; Nickel et al., 2014; Roos et al., 2015). In fact, with the use of administrative databases housed at the MCHP, a large sample size was examined from two academic cohorts. This is an important strength of the population-based study which, although did not include all children, allowed for greater representation of the Manitoba youth population.

Limitations

It is important to recognize limitations of the current study. First, the study's sample is limited in terms of its representativeness of the Manitoba youth population. The study sample did not include children younger than five years of age or older than seven years of age in Kindergarten, children without continuous health coverage from birth to age five, children identified as 'family head', and children whose grandparents are identified as 'family head'. Further, EDI assessments were voluntary among independent and First Nations and therefore these populations may be underrepresented. While the results may not be representative of the entire Manitoba youth population, the sample used in the current study remains larger and more representative compared to previous EDI research (e.g., Brinkman et al., 2013).

Second, the EDI and Grade 7 and 8 assessments are teacher-completed and therefore may be subject to bias. Previous studies found that teacher evaluations may be influenced by factors other than the child's competencies such as teacher characteristics or bias and classroom characteristics (Mashburn, Hamre, Downer, & Pianta, 2006). Similarly, EDI research has observed appreciable variability across teachers in the degree their EDI assessments corresponded with comparison measures (Hymel, LeMare, & McKee, 2011). Nonetheless, previous EDI research has examined parent-teacher interrater reliability and found high agreement (Janus & Offord, 2007). In addition, the EDI has undergone multiple validity and reliability testing (e.g., Brinkman et al., 2007; Curtin et al., 2016; Duku & Janus, 2004; Forget-Dubois et al., 2007; Janus et al., 2011). Perhaps future research could assess the reliability and validity of the Grade 7 and 8 assessments in Manitoba. While teacher-completed assessments may be subject to teacher bias, they allow for a feasible and population health approach to examining children's school readiness as they transition into school and their later school outcomes.

Third, it is possible that children were misclassified on certain variables; for instance, children who were identified as living in Manitoba during their Grade 7 and 8 academic years without assessments may have been misclassified as not meeting expectations in Grade 7 mathematics and Grade 8 reading and writing and inconsistent or emerging in Grade 7 student engagement. Previous studies (e.g., Brownell et al., 2012) have utilized this approach to reduce bias, given that these youth may represent the poorest academic performances and belong to lower socioeconomic status groups (e.g., Brownell et al., 2006; Roos et al., 2006). Efforts were made to avoid misclassification such that only youth who were present for the entire school year, give or take three months, were included in the analyses and coded in this way. Another variable

that may have been subject to misclassification is the mother's marital status, given that it requires the child's mother to register this information with Manitoba Health. Some children may have been classified as having mothers who are single or unknown when, in reality, they simply have not registered. Therefore, it is important to interpret with caution. Results may be biased towards the null given that married mothers may be included in the unknown category and thus, larger differences could actually exist between married and single mothers.

Fourth, several variables identified in the literature as associated with the EDI and/or later school outcomes may not be accounted for in the models. Some variables are not present in the data repository at the MCHP. Other variables such as in utero and birth outcomes (e.g., birth weight), receiving income assistance, being involved in Child and Family Services, having a mother who was a teenager when she first gave birth, etc. (Brownell et al., 2012; Santos et al., 2012), available at the MCHP, were not included in the models and therefore the models may not take into account confounding factors. Nonetheless, all models had Brier scores below 0.25, as recommended for useful risk prediction models, indicating reasonable levels of accuracy. Both Brier scores and C-statistics improved with the addition of covariates in Models 2 and 3. Full models (i.e., Model 3) all had or approached C-statistics indicative of a reasonable discriminant model (0.70) and, at times, approached C-statistics indicative of strong discriminant models (0.80).

Finally, given the observational nature of the data, the findings are correlational in nature and causation must not be inferred. Nonetheless, observational data allow for examination of important associations that can help inform programs and policies.

Implications and Future Directions

The findings further support the importance of the early years and fostering optimal development to ensure that all children begin school ready to benefit from school-based learning throughout their long-term academic trajectories. It is important for policy makers, researchers, and stakeholders to develop, identify, and evaluate policies, early interventions, and prevention strategies to improve children's early years. The results of the current study provide confidence in the effectiveness of the EDI as an indicator of the Manitoba population's potential and multi-faceted future success in school, further supporting its use as an evaluation tool for programs and policies aimed at improving youth school outcomes.

Limited studies have identified programs or policies that effectively improve EDI outcomes in Kindergarten. Studies extending from the Toronto First Duty demonstration project have found mixed results of an integrated school-based early childhood services approach including public school Kindergarten, child care, family literacy, parenting support, and other services for children under the age of six on EDI outcomes. One study observed modest improvements in the emotional maturity and social competence EDI domains (Corter, Patel, Pelletier, & Bertrand, 2008), while the other found participation dose to be associated with improvement in the physical health and well-being, language and cognitive development, and communication and general knowledge domains (Patel, Corter, Pelletier, & Bertrand, 2016). However, both studies had their limitations including small sample sizes and potential teacher bias due to expectations regarding the school-based interventions. While other initiatives such as the Family's First Home Visiting Program in Manitoba (Chartier et al., 2017) and full-day Kindergarten in Ontario (Youmans, Kirby, & Freeman, 2017) have been evaluated, neither were associated with changes to EDI outcomes. This suggests that further attention, investment, and

research is needed to evaluate current policies and programs or develop new initiatives that improve EDI outcomes which, based on the results of the current study, may also be associated to improved school outcomes in early adolescence.

The findings also suggest that it is important to identify ways that schools and other key stakeholders can better support and meet all children where they are as they transition to school and throughout their academic trajectories to foster an environment that allows all children to benefit from school-based learning. While early prevention and interventions may improve children's EDI outcomes upon school entry, schools must adopt inclusive and adaptable approaches for children who arrive at school 'not ready' so that can benefit from the school environment.

While the findings of the current study suggest that academic trajectories are set early, previous research has found that a percentage of students experience deflections in their trajectories (Brownell et al., 2012). Specifically, 17.1% who started Kindergarten 'not ready' had positive deflections and met or approached expectations in Grade 3 reading and 15.7% experienced positive deflections in Grade 3 numeracy. The authors identified individual-level factors such as sex, age, and having one to three of the following risks: 1) receiving income assistance at any point up to the child's fourth birthday, 2) being involved with child protective services up to the child's fourth birthday, and 3) having a mother who was a teenager at the time of first childbirth; to be associated with experiencing a positive deflection in the child's academic trajectory. Further research is needed to identify other school and community factors as well as programs and policies that may contribute to experiencing positive deflections and avoiding negative deflections in children's academic trajectories.

The findings that socioeconomic status did not alter trajectories from Kindergarten to Grade 7 and 8 school outcomes suggest that programs and policies should not exclusively be aimed at children in lower socioeconomic conditions. Rather it suggests that it is important to support all children to ensure they arrive at school ready. Nonetheless, the findings that socioeconomic status is the strongest predictor of Grade 7 and 8 outcomes indicate that the role of socioeconomic status cannot be ignored in academic trajectories. These findings suggest the need for macro-level policies aimed at reducing socioeconomic disparities to improve youths' long-term academic trajectories.

The findings that an increasing number of 'not ready' EDI domains is associated with increasing risk of poor Grade 7 and 8 outcomes identify a group of children who are particularly vulnerable to long-term negative academic trajectories. To address this, policy makers and program developers may utilize this measure to target groups of children with multiple 'not ready' EDI domains or areas where these children are more prevalent to invest and provide additional support.

The findings that all EDI domains are associated with each Grade 7 and 8 school outcomes suggest that well-rounded development is important for early adolescent school outcomes. Thus, interventions, programs, and policies in the early years and in schools should not strictly aim to improve cognitive development or skills typically associated with school outcomes. Rather, initiatives to improve early adolescent outcomes should take on a holistic approach including facets that are often overlooked in academia, including social, emotional, and physical development and well-being.

The relationships between the covariates and Grade 7 and 8 school outcomes identify groups of children that are particularly at risk for poor early adolescent outcomes and may

require additional support in the early years. The sex-association suggests that boys may require additional support particularly with regards to reading and writing and student engagement. The findings that children aged 60 to 65 months at time of EDI assessment had increased odds of having poor Grade 7 mathematics outcomes suggest that children who enter school at a young age may require additional support in numeracy skills. The oldest group of children (i.e., aged 78 months and older) are at greater risk of experiencing poor Grade 7 and 8 outcomes and thus, may require greater assistance. Children from single mother or unknown households, families with four or more children, and who have greater residential mobility could also be targeted to receive greater support, either in the form of programs and policies, to ensure the long-term success of the children.

Knowledge Translation

The findings of the current study will be published in peer-reviewed journals and will be presented at academic conferences. Targeted presentations will also be given to Healthy Child Manitoba, the Department of Education, and school divisions.

Conclusion

The present study utilized administrative database population-based linkages to examine the relationship between school readiness in Kindergarten, as measured by the EDI and Grade 7 mathematics, Grade 8 reading and writing, and Grade 7 student engagement in Manitoba. The main findings of the study were: 1) children identified as ‘not ready’ on one or more EDI domains in Kindergarten have increased odds of doing poorly on Grade 7 and 8 school outcomes; 2) the associations between school readiness, as measured by the EDI, and Grade 7 and 8 school outcomes are not altered by neighbourhood-level socioeconomic status; 3) an increasing number of ‘not ready’ EDI domains correspond with increased odds of doing poorly

in Grade 7 and 8 school outcomes; and 4) each EDI domain is significantly associated with Grade 7 and 8 school outcomes. These findings suggest that developmental trajectories are set in early life and persist through early adolescence.

The current study is an important first step in elaborating on crucial developmental trajectories and building on current EDI knowledge. The findings suggest that there is a greater need for multidisciplinary and collaborative stakeholder efforts to improve youths' long-term school trajectories. Greater investment and effort are needed to identify factors, policies, and programs, that improve children's early childhood development such that they arrive to school ready to benefit from school-based learning. While early prevention and interventions may improve children's EDI outcomes upon school entry, schools must also adopt inclusive and adaptable approaches for children who arrive at school 'not ready'. This would ensure that all children would thrive in the school environment and thus attain their many goals that would allow them to become responsible, productive and happy citizens.

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Appendix A

EARLY DEVELOPMENT INSTRUMENT
A Population-Based Measure for Communities
2006/2007

EDI

Offord CENTRE FOR CHILD STUDIES

Please fill in the circles like this ● or ⊗ NOT ✗
Please use a blue or black ballpoint pen.

1.Class Assignment

○ JK ● SK (see Guide)

2. Child's Date of Birth:

	dd	/ mm /	yy
0	○○	○○	○○
1	○○	○○	○○
2	○○	○○	○○
3	○○	○○	○○
4	○○	○○	○○
5	○○	○○	○○
6	○○	○○	○○
7	○○	○○	○○
8	○○	○○	○○
9	○○	○○	○○

3. Sex: ○ F ○ M

4. Postal Code:

5. Class Type: ○ SK ○ SK/1 ○ Other

6. Date of Completion:

	dd	/ mm /	yy
0	○○	○○	●○
1	○○	○○	○○
2	○○	○○	○○
3	○○	○○	○○
4	○○	○○	○○
5	○○	○○	○○
6	○○	○○	○○
7	○○	○○	○●
8	○○	○○	○○
9	○○	○○	○○

7. Exceptional/Special Needs:

○ Yes ○ No

8. Child considered ESL:

○ Yes ○ No

9. French Immersion:

○ Yes ○ No

10. Other Immersion:

○ Yes ○ No

11. Aboriginal:

○ Yes ○ No ○ Don't Know
(North American Indian, Métis, or Inuit)

12. Child's First Language(s):

○ English only
○ French only
○ Other only ☐☐☐
○ English & French
○ English & Other ☐☐☐
○ French & Other ☐☐☐
○ ☐☐☐ & ☐☐☐
Other Other

(Refer to Guide for language codes in "other" categories. If you do not know the "other" language code, use "000".)

13. Communicates adequately in his/her first language:

○ Yes ○ No ○ Don't know

14. Student Status: ○ in class more than 1 month

(skip pages 2-8)
- ○ in class less than 1 month
- ○ moved out of class
- ○ moved out of school
- ○ other

15. Student is repeating this grade:

○ Yes ○ No

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Section A - Physical Well-being

1. About how many regular days (see Guide) has this child been absent since the beginning of school in the fall?

Number of days absent: ☐☐.☐☐

Since the start of school in the fall, has this child sometimes (more than once) arrived:

	yes	no	don't know
2. over- or underdressed for school-related activities	○	○	○
3. too tired/sick to do school work	○	○	○
4. late	○	○	○
5. hungry	○	○	○

Would you say that this child:

	yes	no	don't know
6. is independent in washroom habits most of the time	○	○	○
7. shows an established hand preference (right vs. left or vice versa)	○	○	○
8. is well coordinated (i.e., moves without running into or tripping over things)	○	○	○

How would you rate this child's:

	very good/ good	average	poor/ very poor	don't know
9. proficiency at holding a pen, crayons, or a brush	○	○	○	○
10. ability to manipulate objects	○	○	○	○
11. ability to climb stairs	○	○	○	○
12. level of energy throughout the school day	○	○	○	○
13. overall physical development	○	○	○	○

Section B - Language and Cognitive Skills

How would you rate this child's:	very good/ good	average	poor/ very poor	don't know
1. ability to use language effectively in English	○	○	○	○
2. ability to listen in English	○	○	○	○
3. ability to tell a story	○	○	○	○
4. ability to take part in imaginative play	○	○	○	○
5. ability to communicate own needs in a way understandable to adults and peers	○	○	○	○
6. ability to understand on first try what is being said to him/her	○	○	○	○
7. ability to articulate clearly, without sound substitutions	○	○	○	○

Would you say that this child:	yes	no	don't know
8. knows how to handle a book (e.g., turn a page)	○	○	○
9. is generally interested in books (pictures and print)	○	○	○
10. is interested in reading (inquisitive/curious about the meaning of printed material)	○	○	○
11. is able to identify at least 10 letters of the alphabet	○	○	○
12. is able to attach sounds to letters	○	○	○
13. is showing awareness of rhyming words	○	○	○
14. is able to participate in group reading activities	○	○	○
15. is able to read simple words	○	○	○
16. is able to read complex words	○	○	○
17. is able to read simple sentences	○	○	○
18. is experimenting with writing tools	○	○	○
19. is aware of writing directions in English (left to right, top to bottom)	○	○	○
20. is interested in writing voluntarily (and not only under the teacher's direction)	○	○	○
21. is able to write his/her own name in English	○	○	○
22. is able to write simple words	○	○	○

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Section B - Language and Cognitive Skills

Would you say that this child:	yes	no	don't know
23. is able to write simple sentences	○	○	○
24. is able to remember things easily	○	○	○
25. is interested in mathematics	○	○	○
26. is interested in games involving numbers	○	○	○
27. is able to sort and classify objects by a common characteristic (e.g., shape, colour, size)	○	○	○
28. is able to use one-to-one correspondence	○	○	○
29. is able to count to 20	○	○	○
30. is able to recognize numbers 1 - 10	○	○	○
31. is able to say which number is bigger of the two	○	○	○
32. is able to recognize geometric shapes (e.g., triangle, circle, square)	○	○	○
33. understands simple time concepts (e.g., today, summer, bedtime)	○	○	○
34. demonstrates special numeracy skills or talents	○	○	○
35. demonstrates special literacy skills or talents	○	○	○
36. demonstrates special skills or talents in arts	○	○	○
37. demonstrates special skills or talents in music	○	○	○
38. demonstrates special skills or talents in athletics/dance	○	○	○
39. demonstrates special skills or talents in problem solving in a creative way	○	○	○
40. demonstrates special skills or talents in other areas *If yes, please specify:* _____	○	○	○

Section C - Social and Emotional Development

How would you rate this child's:	very good/ good	average	poor/ very poor	don't know
1. overall social/emotional development	○	○	○	○
2. ability to get along with peers	○	○	○	○

Below is a list of statements that describe some of the feelings and behaviours of children. For each statement, please fill in the circle that best describes this child now or within the past six months.

Would you say that this child:	often or very true	sometimes or somewhat true	never or not true	don't know
3. plays and works cooperatively with other children at the level appropriate for his/her age	○	○	○	○
4. is able to play with various children	○	○	○	○
5. follows rules and instructions	○	○	○	○
6. respects the property of others	○	○	○	○
7. demonstrates self-control	○	○	○	○
8. shows self-confidence	○	○	○	○
9. demonstrates respect for adults	○	○	○	○
10. demonstrates respect for other children	○	○	○	○
11. accepts responsibility for actions	○	○	○	○
12. listens attentively	○	○	○	○
13. follows directions	○	○	○	○
14. completes work on time	○	○	○	○
15. works independently	○	○	○	○
16. takes care of school materials	○	○	○	○
17. works neatly and carefully	○	○	○	○
18. is curious about the world	○	○	○	○
19. is eager to play with a new toy	○	○	○	○
20. is eager to play a new game	○	○	○	○
21. is eager to play with/read a new book	○	○	○	○

Section C - Social and Emotional Development

Would you say that this child:	often or very true	sometimes or somewhat true	never or not true	don't know
22. is able to solve day-to-day problems by him/herself	○	○	○	○
23. is able to follow one-step instructions	○	○	○	○
24. is able to follow class routines without reminders	○	○	○	○
25. is able to adjust to changes in routines	○	○	○	○
26. answers questions showing knowledge about the world (e.g., leaves fall in the autumn, apple is a fruit, dogs bark)	○	○	○	○
27. shows tolerance to someone who made a mistake (e.g., when a child gives a wrong answer to a question posed by the teacher)	○	○	○	○
28. will try to help someone who has been hurt	○	○	○	○
29. volunteers to help clear up a mess someone else has made	○	○	○	○
30. if there is a quarrel or dispute will try to stop it	○	○	○	○
31. offers to help other children who have difficulty with a task	○	○	○	○
32. comforts a child who is crying or upset	○	○	○	○
33. spontaneously helps to pick up objects which another child has dropped (e.g., pencils, books)	○	○	○	○
34. will invite bystanders to join in a game	○	○	○	○
35. helps other children who are feeling sick	○	○	○	○
36. is upset when left by parent/guardian	○	○	○	○
37. gets into physical fights	○	○	○	○
38. bullies or is mean to others	○	○	○	○
39. kicks, bites, hits other children or adults	○	○	○	○
40. takes things that do not belong to him/her	○	○	○	○
41. laughs at other children's discomfort	○	○	○	○
42. can't sit still, is restless	○	○	○	○
43. is distractible, has trouble sticking to any activity	○	○	○	○
44. fidgets	○	○	○	○
45. is disobedient	○	○	○	○

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Section C - Social and Emotional Development

Would you say that this child:	often or very true	sometimes or somewhat true	never or not true	don't know
46. has temper tantrums	○	○	○	○
47. is impulsive, acts without thinking	○	○	○	○
48. has difficulty awaiting turn in games or groups	○	○	○	○
49. cannot settle to anything for more than a few moments	○	○	○	○
50. is inattentive	○	○	○	○
51. seems to be unhappy, sad, or depressed	○	○	○	○
52. appears fearful or anxious	○	○	○	○
53. appears worried	○	○	○	○
54. cries a lot	○	○	○	○
55. is nervous, high-strung, or tense	○	○	○	○
56. is incapable of making decisions	○	○	○	○
57. is shy	○	○	○	○
58. sucks a thumb/finger	○	○	○	○

Section D - Special Problems

1. Does the student have a problem that influences his/her ability to do school work in a regular classroom?

○ yes ○ no ○ don't know (If answered no/don't know go to question 3)

If YES above, please mark all that apply.
Please base your answers on medical diagnosis or parent/guardian information.

	yes
2a. physical disability	○
b. visual impairment	○
c. hearing impairment	○
d. speech impairment	○
e. learning disability	○
f. emotional problem	○
g. behavioural problem	○
h. home environment/problems at home	○
i. other *(if known, print below)*	○

3. Do you feel that this child needs further assessment? yes ○ no ○ don't know ○

If yes , please specify in print: _____

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Section E - Additional Questions

To the best of your knowledge, please mark all that apply to this child:

	yes	no	don't know
1. attended an early intervention program *Specify if known, please print:* _____	○	○	○
2. has been in non-parental care on a regular basis prior to kindergarten entry	○	○	○

If yes, please specify type of care arrangement (please refer to Guide for examples):

2a. Centre-based, licensed, non-profit	○	2e. Other home-based, unlicensed, relative	○
2b. Centre-based, licensed, for profit	○	2f. Child's home, non-relative	○
2c. Other home-based, licensed	○	2g. Child's home, relative	○
2d. Other home-based, unlicensed, non-relative	○	2h. Other/don't know	○

	full-time	part-time	don't know
2i. To the best of your knowledge, prior to the child's entry to kindergarten, was this arrangement	○	○	○

	yes	no	don't know
3. attended other language or religion classes *Specify if known, please print:* _____	○	○	○
4. attended an organized pre-school/nursery school (**only if *part-time*, and if it was *not* the main child-care arrangement**)	○	○	○
5. attended Junior Kindergarten **(leave question blank if child currently in JK)**	○	○	○
6. If you answered "yes" to Question 11, page 1 (aboriginal status) please elaborate (check all that apply)			
6a. First Nation	○	○	○
6b. Inuit	○	○	○
6c. Métis	○	○	○
6d. Other	○	○	○
7. attended Aboriginal Head Start program	○	○	○

If you have any comments about this child and her/his readiness for school, list them below, please print.

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