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About the Manitoba Centre For Health Policy

The Manitoba Centre for Health Policy (MCHP) is located within the Department of Community Health Sciences, Faculty of Medicine, University of Manitoba. The mission of MCHP is to provide accurate and timely information to healthcare decision-makers, analysts and providers, so they can offer services which are effective and efficient in maintaining and improving the health of Manitobans. Our researchers rely upon the unique Population Health Research Data Repository (Repository) to describe and explain patterns of care and profiles of illness, and to explore other factors that influence health, including income, education, employment, and social status. This Repository is unique in terms of its comprehensiveness, degree of integration, and orientation around an anonymized population registry.

Members of MCHP consult extensively with government officials, healthcare administrators, and clinicians to develop a research agenda that is topical and relevant. This strength, along with its rigorous academic standards, enables MCHP to contribute to the health policy process. MCHP undertakes several major research projects, such as this one, every year under contract to Manitoba Health. In addition, our researchers secure external funding by competing for research grants. We are widely published and internationally recognized. Further, our researchers collaborate with a number of highly respected scientists from Canada, the United States, Europe, and Australia.

We thank the University of Manitoba, Faculty of Medicine, Health Research Ethics Board for their review of this project. MCHP complies with all legislative acts and regulations governing the protection and use of sensitive information. We implement strict policies and procedures to protect the privacy and security of anonymized data used to produce this report and we keep the provincial Health Information Privacy Committee informed of all work undertaken for Manitoba Health.

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Community Health Sciences

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Acronyms

ADG	Aggregated Diagnosis Groups
AIC	Akaike Information Criterion
CA	Community Area
CFI	Bentler's Comparative Fit Index
CFS	Child and Family Services
CFSIS	Child and Family Services Information System
ECD	Early Childhood Development
EDI	Early Development Instrument
HCMO	Healthy Child Manitoba Office
IA	Income Assistance
ICU	Intensive Care Unit
LBW	Low Birth Weight
MCHP	Manitoba Centre for Health Policy
MCI	Multiple Challenge Index
NR	Not Ready
OR	Odds Ratios
PHIN	Personal Health Identification Number
RHA	Regional Health Authority
SEM	Structural Equation Modeling
SES	Socioeconomic Status
VLBW	Very Low Birth Weight
VR	Very Ready

Executive Summary

Background

This is the first Manitoba Centre for Health Policy (MCHP) report to use data from the province-wide collection of the Early Development Instrument (EDI) in Manitoba. The EDI is a reliable and valid measure of children's outcomes in five areas of early development: physical health and well-being, social competence, emotional maturity, language and cognitive development (including literacy and numeracy), and communication skills and general knowledge. Funded and coordinated by the Healthy Child Manitoba Office (HCMO), EDI data are population-level data: all Kindergarten teachers complete the EDI for all Kindergarten children in all public school divisions in Manitoba.

Purpose

To build on previous MCHP research related to children as well as the ongoing HCMO use of the EDI in measuring progress and identifying priorities in early childhood development (ECD) to influence communities and public policy and evaluate the outcomes of ECD investments at a population level.

Research Questions

This report provides new evidence regarding three questions.

1. **Socioeconomic adversity and children's vulnerability at age five:** How does the prevalence of children's EDI outcomes at age five differ by the SES of their communities?
2. **Biological vulnerability at birth and children's vulnerability at age five:** How does health status at birth and through childhood relate to children's EDI outcomes at age five?
3. **Children's vulnerability at age five in three at-risk subgroups of children:** What is the prevalence of, and what predicts, EDI outcomes in the general Kindergarten population and in (a) children of mothers who were teenagers at their first childbirth ("teen moms"), (b) children in families on income assistance (IA), and (c) children in the care of child and family services (CFS)?

Methods

This report used data from the first two province-wide EDI collections in the 2005-06 and 2006-07 school years, each representing about 12,000 children, with usable data for about 11,000 children per year (about 22,000 children). Of this group, there was continuous data for over 18,000 children from birth to Kindergarten. To address the research questions, we linked EDI to information about (a) the SES and health status of children's communities (i.e., the premature mortality rate); (b) children's health status (e.g., birth weight) at birth and through childhood (before Kindergarten); and (c) being in one or more of the three at-risk subgroups (teen moms, IA, CFS).

Key Findings

1. **SES inequities appear very early in life.** Larger proportions of vulnerable children are found in lower levels of SES in both urban and rural communities.
2. **Early life (in utero and at birth) predicts EDI outcomes at age five.** Children's health status before and around the time they are born is important for their later development (at Kindergarten age). For example, larger proportions of low and very low birth weight babies go on to be vulnerable at age five, compared to babies born with normal (and high) birth weight. After accounting for the significant influences of socioeconomic adversity in the lives of children, their biological vulnerability at birth is clearly important for their later development, five years later.

3. **Three groups of children are especially vulnerable on EDI outcomes.** Children born to teen moms, in families on IA, or in CFS, as a group represent nearly a third of children in Winnipeg (32%). The odds of these children being vulnerable on EDI outcomes is up to four times higher than children who are not in any of these subgroups. Much larger proportions of children in one or more of these subgroups are vulnerable on the EDI (ranging from 33% to 54%), compared to children who are not in any of these subgroups (23%).

Based on very preliminary, exploratory analyses, we find that **some children may be "differentially susceptible" to their environments (not just more "vulnerable").** For example, children born with low Apgar scores (indicating a less healthy baby at birth) appear to respond more strongly to breastfeeding. They go on to have a significantly lower proportion of vulnerability on the EDI (25%) than low Apgar children who are not breastfed (40%), children with normal Apgar scores who are not breastfed (33%), and comparable rates to normal Apgar children who are breastfed (22%). Positive caregiving environments in early life, such as breastfeeding, may have the potential to "close the gap" in vulnerability for children at age five.

Key Implications

The findings in this report suggest that children's developmental vulnerability in Manitoba has several characteristics that, in turn, can inform policy:

- It begins very early in life, in the **prenatal** through **preschool** period, and is related to a common set of biological and socioeconomic risk and protective factors, including some that are modifiable and potentially amenable to prevention and intervention, which indicates the need to simultaneously address these factors as early as possible in the life course.
- It is **pervasive**, affecting large numbers (thousands) of young children across a wide range of the population every year, which indicates the need for population-level approaches that reach as many children as possible.
- It is **persistent**, showing effects over time within and across populations, which indicates the need for sustained action in serving and supporting children from preconception to Kindergarten.
- It is **pernicious**, affecting a wide range of outcomes, and disproportionately affecting children from socioeconomically disadvantaged communities. This indicates the need to coordinate and converge resources (often from different sectors) to support the early physical and mental health, learning, and social development of entire populations with additional attention to children in low-SES families and communities.

The findings indicate that early developmental vulnerability is overrepresented in three subgroups of children: those born to teen moms, living in families on IA, or in CFS. The provincial IA and CFS systems therefore provide considerable opportunity via existing infrastructure for reaching children who are disproportionately vulnerable in their EDI outcomes. The findings also support a "proportionate universalism" approach that serves all children, with resources allocated proportionately to different levels of need.

The major implication of this report is that **significant additional attention and investment in early childhood development (ECD) is needed**, particularly during the prenatal and perinatal period. The scientific literature provides evidence-based strategies that, when combined with Manitoba experience, offer potentially powerful policy options for preventing children's early developmental vulnerability and promoting their healthy development at a population level across our province, particularly for our most disadvantaged children living in conditions of risk. Based on the findings of this report as well as the scientific literature, 10 specific ECD strategies are outlined that deserve consideration in building the best policy mix for Manitoba's youngest children in every region and community of Manitoba.

Chapter 1: Introduction and Methods

Background: The Early Development Instrument (EDI)

This report was undertaken under contract by the Manitoba Centre for Health Policy (MCHP) as a "deliverable," funded by Manitoba Health, in support of the Manitoba government's Healthy Child Committee of Cabinet (HCCC), the Healthy Child Deputy Ministers' Committee the ten HCCC partner departments (Aboriginal and Northern Affairs; Culture, Heritage and Tourism; Education; Family Services and Labour; Health; Healthy Living, Seniors and Consumer Affairs; Housing and Community Development; Justice; Immigration and Multiculturalism; Children and Youth Opportunities), and the Healthy Child Manitoba Office (HCMO). This report focuses on the **Early Development Instrument (EDI)**[1]—a population-based, community-level measure of children's development in five domains (**physical health and well-being, social competence, emotional maturity, language and cognitive development**, and **communication skills and general knowledge**) in Kindergarten (approximately age five years) (Janus & Offord, 2007). In Manitoba, the EDI is collected province-wide on behalf of HCMO by all Kindergarten teachers regarding all of their students in all 37 public school divisions, providing a census of early childhood outcomes and school readiness.

This report builds on previous and current MCHP deliverables and research related to children (e.g., child health atlas, SES and educational outcomes, inequalities in child health, vulnerable children), as well as ongoing HCMO use of the EDI in measuring progress and identifying priorities in early childhood development (ECD); influencing school divisions, communities and public policy; and evaluating the outcomes of ECD investments at a population level. This report includes descriptive and correlational analyses (**structural equation modelling, logistic regression**, multilevel logistic regression) using the EDI, including prevalence of and socioeconomic gradients in EDI outcomes and predictors at birth of EDI outcomes at a population level and in three at-risk subgroups of children: children of mothers who were teenagers at their first childbirth, children in families on **income assistance**, and children in child and family services (see Objectives of Report section).

The EDI can be used both retrospectively, as a reflection of the first five years of life (early childhood outcomes), and prospectively, as a forecast of future outcomes in school and life (school readiness). Extensive meta-analytic evidence indicates that, at school entry in Kindergarten, school readiness predicts later achievement in school. The strongest specific predictors include math, reading, and attention skills (Duncan et al., 2007; Grimm, Steele, Mashburn, Burchinal, & Pianta, 2010; Hooper, Roberts, Sideris, Burchinal, & Zeisel, 2010; Pagani, Fitzpatrick, Archambault, & Janosz, 2010; Romano, Babchishin, Pagani, & Kohen, 2010); fine motor skills (Grissmer, Grimm, Aiyer, Murrah, & Steele, 2010; Pagani et al., 2010); social and emotional behaviours (Grimm et al., 2010; Pagani et al., 2010; Romano et al., 2010); and general knowledge (Grissmer et al., 2010). In recent longitudinal studies using the EDI to predict later achievement, the physical health and well-being domain and the language and cognitive development domain are especially strong predictors (Forget-Dubois et al., 2007; Lloyd, Li, & Hertzman, 2010) as is overall vulnerability in one or more domains of the EDI (Lloyd & Hertzman, 2009; Lloyd, Irwin, & Hertzman, 2009). Achieving school readiness is considered one of the most important developmental tasks facing preschool-aged children (Lemelin et al., 2007). Thus, identifying the early life determinants or predictors of school readiness is a top cross-sectoral priority for policymakers.

1 Terms in **bold** type face are defined in the Glossary at the end of this report.

Recent evidence indicates a substantial environmental contribution to school readiness, after accounting for the genetic contribution to school readiness (Lemelin et al., 2007). Identifying specific environmental determinants of school readiness that are amenable to policy intervention is essential for improving school readiness in the population. Evidence from cross-sectional studies indicates that low family income is associated with poor EDI outcomes at both individual and neighbourhood levels (Cushon, Vu, Janzen, & Muhajarine, 2011 Janus & Duku, 2007; Kershaw, Forer, Irwin, Hertzman, & Lapointe, 2007; Lapointe, Ford, & Zumbo, 2007; Lesaux, Vukovic, Hertzman, & Siegel, 2007; Puchala, Vu, & Muhajarine, 2010) as is poor health status (Janus & Duku, 2007). Longitudinal evidence indicates that the neighbourhood socioeconomic conditions of Kindergarten children predict their development four years (Lloyd & Hertzman, 2010) and seven years later (Lloyd et al., 2010), over and above their EDI outcomes in Kindergarten. However little longitudinal evidence is available regarding what predicts EDI outcomes themselves.

The EDI is the first population-level measure of school readiness (Guhn, Gadermann, & Zumbo, 2007; Guhn, Janus, & Hertzman, 2007) and demonstrates good psychometric properties (Brinkman et al., 2007; Forer & Zumbo, 2011; Hymel, LeMare, & Mckee, 2011; Janus & Offord, 2007; Keating, 2007) including measuring school readiness in the same way across different groups of children in Canada (e.g., gender, English as a Second Language, and Aboriginal status) (Guhn, Gadermann, et al., 2007; Muhajarine, Puchala, & Janus, 2011; see also Li, D'Angiulli, & Kendall, 2007, reply from Janus, Hertzman, Guhn, Brinkman, & Goldfeld, 2009; and response from Li et al., 2009) and across countries (Janus, Brinkman, & Duku, 2011). Validation of the EDI is ongoing (Guhn, Zumbo, Janus, & Hertzman, 2011a, 2011b; Sam, 2011). Improved knowledge on the prevalence, socioeconomic distribution, and early life predictors of early childhood outcomes and school readiness is also essential for mobilizing community action to improve children's health and development (Guhn & Goelman, 2011; Kershaw et al., 2007; Sayers et al., 2007). This report aims to increase our knowledge in these areas with respect to the EDI (see Objectives of Report section).

Early Development Instrument (EDI) Outcomes

The five domains of the EDI are presented in Table 1.1. Four of the five domains comprise a respective series of sub-domains.

In this report, we focus primarily on early developmental vulnerability at age five, as measured by the EDI. The standard approach for designating vulnerability on the EDI is scoring in the bottom 10th percentile of at least one domain of the EDI (Janus & Offord, 2007). This is also referred to as being *"Not Ready" (NR)* for school, and we will use these terms (NR and vulnerability) interchangeably in this report. Children can also be classified as being NR in a given EDI domain, again using the 10th percentile cut-off score. NR is a dichotomous variable (i.e., either present or absent).

On the strengths side of the EDI distribution of scores, children who score in the top 30th percentile of at least one domain are referred to as being *"Very Ready" (VR)* for school. Children can also be classified as being VR in a given EDI domain, also using the 30th percentile cut-off score. VR is also a dichotomous variable (i.e., either present or absent).[2]

2 Community and government interest in both strengths and challenges identified by the EDI led to an interest in the upper end of the EDI distribution, and public reports have included both NR and VR (Healthy Child Manitoba, 2005, 2010). However, the EDI was not originally designed to measure excellence or high levels of ability, so ceiling effects on the EDI are likely (Magdalena Janus, personal communication, November 18, 2009).

The EDI also has a **Multiple Challenge Index (MCI)** as an indicator of a child experiencing challenges in at least three EDI domains. The MCI is scored based on challenges in nine or more sub-domains (see Table 1.1). The MCI is also a dichotomous variable (i.e., either present or absent).

Table 1.1: Early Development Instrument (EDI) Domains and Sub-Domains

Physical Health and Well-Being (25 items)
Sub-domains: • Physical readiness for school day • Physical independence • Gross and fine motor skills
Social Competence (26 items)
Sub-domains: • Overall social competence • Responsibility and respect • Approaches to learning • Readiness to explore new things
Emotional Maturity (30 items)
Sub-domains: • Prosocial and helping behaviour • Anxious and fearful behaviour • Aggressive behaviour • Hyperactivity and inattention
Language and Cognitive Development (28 items)
Sub-domains: • Basic literacy • Interest in literacy/numeracy and uses memory • Advanced literacy • Basic numeracy
Communication Skills and General Knowledge (8 items)
Sub-domains: • No sub-domain: covers skills to communicate effectively, symbolic use of language, and age-appropriate knowledge about the world

Objectives of Report

Building on previous research at MCHP, this report focuses primarily on three questions:

1. Socioeconomic adversity and children's vulnerability at age five: How does the prevalence of children's EDI outcomes at age five differ by the **socioeconomic status (SES)** of their communities?
2. Biological vulnerability at birth and children's vulnerability at age five: How does health status at birth and through childhood relate to children's EDI outcomes at age five?
3. Children's vulnerability at age five in three at-risk groups of children: What is the prevalence of, and what predicts, EDI outcomes in the general Kindergarten population and in the following three "at-risk" groups of children: children of mothers who were teenagers at their first childbirth ("teen moms"), children in families on income assistance (IA), and children involved with **Child and Family Services (CFS)**?

The first question builds on the Manitoba Child Health Atlas Update (Brownell et al., 2008) and other MCHP reports describing SES gradients in population outcomes, e.g., the Manitoba RHA Health Atlas (Fransoo et al., 2009). The second question replicates and extends the first population-based study to link health status at birth and through childhood to children's later outcomes in school (Fransoo et al., 2008). The third question replicates and extends work by Dr. Marni Brownell and Dr. Noralou Roos on the school-age and early adulthood outcomes of children in the three aforementioned at-risk subgroups (Brownell et al., 2010). The population-based use of the EDI will fill a gap in knowledge regarding a key period in the life course and the developmental transition of starting school in Kindergarten.

Design and Methods

We used information from selected **administrative data** files (from HCMO, Manitoba Health, Manitoba Education, Manitoba Family Services and Consumer Affairs; see Data Sources Used in Study section for a full description). We report descriptive statistics at provincial, **regional health authority (RHA)**, and sub-regional levels, as well as at the level of sociodemographic variables such as age, gender, and area-level SES. We also report the results of statistical models used to predict EDI outcomes (described in detail in the Modeling section).

Data Sources Used in Study

Following review and approval by the Health Information Privacy Committee of the Government of Manitoba and the Health Research Ethics Board of the University of Manitoba, existing data files available in the **Population Health Research Data Repository (Repository)** at MCHP were used in this study. The Repository is a comprehensive set of databases that contains records for all Manitobans' contacts with physicians, hospitals, home care, and personal care homes and for pharmaceutical prescriptions dispensed in retail pharmacies. The Repository records have been de-identified: prior to data transfer, Manitoba Health processes the records to encrypt all personal identifiers and remove all names and addresses. The specific files we analyzed and the key research insights that each file contributed to the project are as follows:

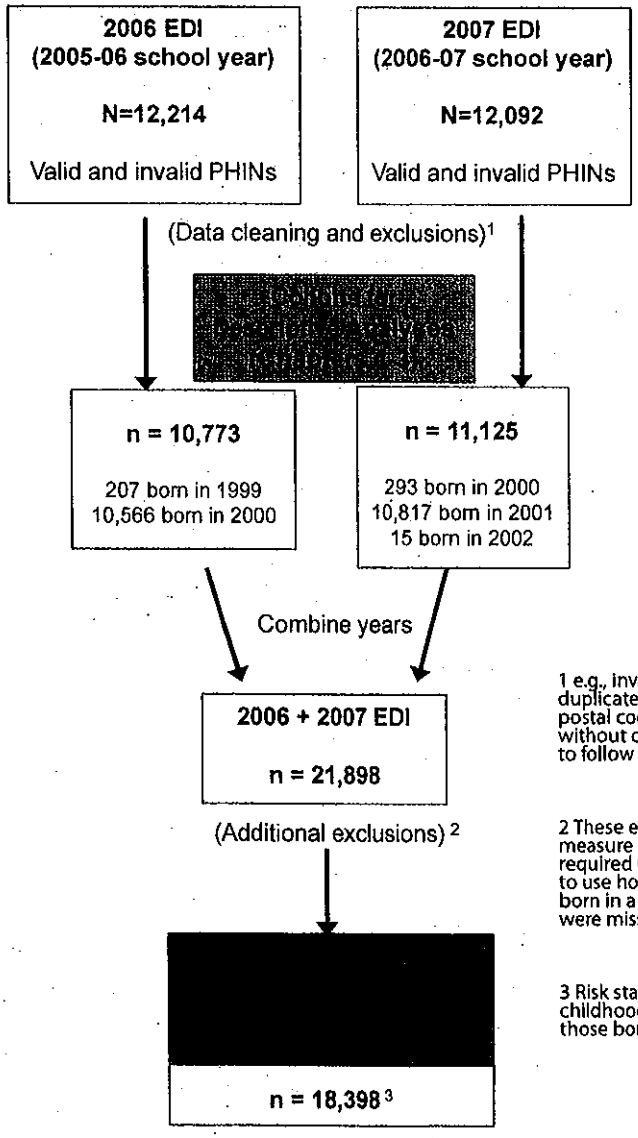
- Data from HCMO, specifically the EDI data, provided the major dependent variables in analyses regarding early childhood outcomes and school readiness.
- Data from the public use 2006 Census files were used to define area-level SES, using indicators such as mean household income of area residents, in order to calculate SES gradients in EDI outcomes, as well as to evaluate SES indicators as predictors of EDI outcomes.
- Data from Manitoba Health, specifically **hospital abstracts**, **physician claims**, pharmaceutical claims (from the **Drug Programs Information Network/DPIN**), **Vital Statistics**, and the population registry, were used to develop indicators of risk and health status at birth and through childhood as predictors of EDI outcomes, as well as to define the at-risk group of children born to mothers who were teenagers at their first childbirth.
- Data from Manitoba Education were used to define the intellectual disability variable for modeling EDI outcomes for at-risk children.
- Data from Manitoba Family Services and Consumer Affairs, specifically **Social Assistance Management Information Network** and the **Child and Family Services Information System (CFSIS)**, were used to define the two other at-risk groups: children in families ever on income assistance (IA) and children involved with CFS, respectively.

All data management, programming, and analyses were performed using SAS® statistical analysis software, Version 9.2.

Study Period and Cohorts

We used data from the first two province-wide EDI collections in Manitoba, completed in the 2005–06 (n=12,214 children) and 2006–07 (n=12,092 children) school years. These generally represent Manitoba children born in 2000 and 2001, respectively, as shown in Figure 1.1. In order to carry out our analyses, we made the following exclusions: children with invalid **Personal Health Identification Numbers (PHINs)**, multiple PHINs, duplicate or erroneous health registrations, and children without continuous healthcare coverage. Postal codes of the **Public Trustee** and CFS were also excluded from all regional descriptive and income-related analyses because we did not know the geographical locations of the residences for the children under their respective care. The 2005–06 EDI sample included 10,773 children and the 2006–07 EDI sample included 11,125 children, for a combined total sample of 21,898 children who lived in Manitoba (see Figure 1.1). We used this sample for descriptive analyses.

Figure 1.1: Development of Manitoba Cohorts for Descriptive and Modeling Analyses



1 e.g., invalid PHIN, missing PHIN, invalid EDI scores, duplicate and erroneous records, postal codes errors, postal codes of Public Trustee and CFS, and those without continuous health coverage since we needed to follow the child from birth to five years of age.

2 These exclusions were necessary in order to measure health and family characteristics, which required us to link each child to their mother, and to use hospital data. Thus we excluded children not born in a Manitoba hospital and those whose mothers were missing their PHIN.

3 Risk status and health status at birth and through childhood were examined for a subset of this cohort, those born in 2000 and 2001.

From this combined sample of 21,898 children, we used a smaller sample (n=18,398) for our modeling analyses. Because we required birth data, we excluded children not born in a Manitoba hospital (n=3,485) and those whose mothers were missing their PHIN (n=15). To look at risk and health status at birth and through childhood as predictors of EDI outcomes, we examined data for the 2000 and 2001 birth cohorts (combined) to determine family circumstances, generally at birth or as of the child's fourth birthday[3], unless otherwise indicated (e.g., mother's age at first childbirth).

Modeling

To predict children's EDI outcomes at age five, we used several statistical modeling techniques depending on the characteristics of the EDI data: structural equation modeling (SEM), logistic regression, and multilevel logistic regression. We used SEM to model children's average EDI scores for each of the five EDI domains (see Table 1.1). We used both logistic and multilevel logistic regression to model the following outcomes: Very Ready in one or more domains (VR1+), Not Ready in one or more domains (NR1+), Multiple Challenge Index (MCI), Very Ready in each domain (VR), and Not Ready in each domain (NR). The EDI data for the SEMs are continuous (e.g., scores ranging from 0 to 10), whereas the EDI data for the logistic and multilevel logistic regressions are dichotomous (i.e., present or absent, wherein we used "dummy variables" of 1 or 0 to denote the presence or absence of the outcome, respectively).

In principle, a given child could score in the bottom 10th percentile in one EDI domain, but also score in the top 30th percentile in another EDI domain, thereby being simultaneously classified as both NR and VR. For clarity in the interpretation of our SEMS, logistic regressions, and multilevel logistic regressions, we excluded children who fell in this overlapping category (5.9% of total sample).

Structural Equation Modeling (SEM)

SEM is a statistical technique used to test a theory. SEM specifies a model that represents predictions of that theory among constructs measured with indicators (Kline, 2011). In Chapter 3, based on a theory relating the constructs of "health at birth" and "major illness" and "minor illness" through early childhood to EDI outcomes, we specify a model of predictor variables measured at birth and through early early childhood.[4] We adapted the predictor variables used by Fransoo et al. (2008) for our SEMs. We set the measurement endpoint of our predictor variables at each child's fourth birthday to ensure that they all temporally preceded children's EDI outcomes in Kindergarten at age five. Children are generally admitted into Kindergarten if they will be turning age five in that year, so children's ages vary around age five at the time of EDI completion (see Footnote 3). Descriptions of our predictor variables are presented in Table 1.2.

3 We used the child's fourth birthday rather than age of testing or age five to ensure that all the predictors clearly preceded the outcome variable (EDI) in time (without having different measurement cut-off times for each predictor variable); some children turned age five before the EDI while others did afterwards.

4 In SEM, it is important to assess how well our conceptual models match up with the observed data, which is referred to as "goodness of fit." The following indices were used in judging the goodness of fit of our SEMs (Hatcher, 1994): Bentler's Comparative Fit Index (CFI); Bentler and Bonnet's Normed Fit Index (NFI); Bentler and Bonnet's Non-Normed Fit Index (NNFI), and Bollen's Normed Index (Rho1). For each of these indices, all our models had values above 0.9, indicating a good fit (Hatcher, 1994).

Table 1.2: Variables Used in Study

Male	Sex of child (female=0; male=1)
Child's Age	The child's exact age in years, as of the EDI date
Health Status At Birth - A latent construct created from four variables:	
a) **Premature**	A dichotomous measure of whether the child was born 'preterm' (before 37 complete weeks of gestation)
b) **Low Birth Weight**	A dichotomous measure of whether the child weighed 0-2,499 grams versus 2,500 or more at birth
c) **ICU 3+ Days at Birth**	A dichotomous measure of whether the child spent three or more days in an intermediate or intensive care nursery
d) **Long Birth Stay**	A dichotomous measure of whether the length of the birth hospitalization was above the 90th percentile
Breastfed	A dichotomous measure of whether breastfeeding (exclusive or partial) was initiated during birth hospitalization
Minor Illness - A latent construct created using data from two variables:	
a) **90% Minor ADGs**[1]	A dichotomous measure of whether the child accumulated, from birth to their 4th birthday, more than the 90th percentile value (24) of Minor ADG-years
b) **Physician Visits**	A continuous measure of the number of times the child had an 'ambulatory visit'[2] with a physician (GP or specialist)
Major Illness - A latent construct created using data from three variables:	
a) **2+ Major ADGs**	A dichotomous measure of whether the child had two or more Major ADG-years from birth to their 4th birthday
b) **6+ Days in Hospital**	A dichotomous measure of whether the child spent six or more days admitted to hospital from birth discharge to their 4th birthday
c) **ICU**	A dichotomous measure of whether the child was ever admitted to an intensive care unit from birth discharge to their 4th birthday
Area Income	The average household income for the area in which the child's family lived as of the child's fourth birthday
Family Ever On IA	A dichotomous measure of whether the child's family received Income Assistance (IA) from the child's birth to their 4th birthday
CFS	A dichotomous measure of whether the child was ever involved in Child and Family Services (CFS) up to their 4th birthday; used only in the logistic models
Mother's Age	The age of the child's mother at the birth of her first child
Mom Married	A dichotomous measure of whether the mother was registered as married or not (legal or common-law) as of the child's 4th birthday
Maternal Depression	A dichotomous measure of whether the mother had at least one diagnosis for depression[3] from the child's birth to their 4th birthday
4+ Children	A dichotomous measure of whether the child's mother had four or more children as of the child's 4th birthday
3+ Moves	A dichotomous measure of whether child's family moved three or more times from the child's birth to their 4th birthday

[1] Aggregated Diagnostic Groups – "a grouping of diagnosis codes that are similar in terms of severity and likelihood of persistence of the health condition over time." Please see Glossary for more information and Table A1.1 in the Appendix for the codes used in this study.
[2] Almost all contacts with a physician excluding most visits for prenatal care and visits that take place during a patient's hospital stay.
[3] See Glossary for details.

Logistic Regression

The modeling of our dichotomous outcomes for this deliverable presented a challenge in terms of which predictors to include in the logistic and multilevel logistic regression models. Based on Fransoo et al. (2008), our SEMs comprised 19 predictor variables to which we added being in CFS as our 20th predictor variable. The inclusion of predictors in models is often based on prior evidence suggesting that the variables are associated with the outcomes. Apart from SES–related predictor variables, very few of our predictor variables have been directly associated with EDI scores as the outcome variable in previous work. Thus, we considered all 20 predictors for potential inclusion in our logistic and multilevel logistic regression models. However, before using all of the 20 variables, we tested for **multicollinearity** using tolerance and variance inflation. Some authors suggest a value of tolerance below 0.4 to indicate high multicollinearity (Allison, 1999). Accordingly, all our models passed multicollinearity testing with very high values for tolerance and variance inflation.

The next step in our modeling process was the selection of optimal logistic models. Considering our 20 predictor variables, there were potentially 2^{20} (about 1,048,576) possible models for each outcome. We, therefore, used **stepwise logistic regression** to reduce the number of candidate models to 20 (Shtatland et al., 2001) and used best subset selection to determine the optimal logistic models, based on the values of the **Akaike Information Criterion (AIC**, a way of selecting a model from a set of models). For each outcome, we designated the model with the lowest AIC value as the optimal model.

Multilevel Logistic Regression

With the exception of area–level income, all of the other predictor variables were defined at an individual level. Because of the presence of both individual and area–level data, we then computed multilevel logistic regression models for our dichotomous outcomes with two levels. Level 1 is the individual level and level 2 represents the area–level, specifically the districts for the non–Winnipeg sample and the 25 neighbourhood clusters for Winnipeg.

In our multilevel logistic regression models, we considered only random intercept models, using the 20 predictors used in the optimal logistic regression models described above (see Tables A1.2 to A1.14 of Appendix 2 for summaries of these predictors). We discuss the results for our dichotomous outcomes based on these optimal multilevel logistic regression models.

We used SAS® PROC LOGISTIC AND PROC GLIMMIX for our dichotomous outcomes in the logistic and multilevel logistic regression analyses and used SAS® PROC CALIS for our continuous outcomes in the SEMs.

Chapter 2: Socioeconomic Adversity and Children's Vulnerability at Age Five

Does SES Relate to EDI Outcomes?

In this chapter, we provide descriptive information about children's vulnerability at age five, being "Not Ready" in at least one Early Development Instrument (EDI) domain. This information is provided as a function of socioeconomic status (SES), measured by area-level income from the 2006 Census. The Census information on average household income was applied to Manitoba residents, according to postal code or dissemination area. The Manitoba population was then divided into quintiles, separately for urban areas (U1–U5) and rural areas (R1–R5) in the province.

How well is individual-level SES represented by area-level income? Table 2.1 (from Martens et al., 2010) provides additional descriptive information from the 2006 Census regarding each **income quintile.** Average area-level income is strongly representative of other variables pertinent to SES. Higher levels of average area-level income are associated with

(a) lower percentages of unemployment
(b) higher percentages of high school completion
(c) lower percentages of homes in disrepair

Further, income is also related to Aboriginal status; higher percentages of people self-identifying as Aboriginal (particularly North American Indian, i.e., First Nations) live in areas with lower income levels. Lastly, of note is a "not found" group for whom income data are not available (and so it is not included in the income quintiles). The "not found" group has higher percentages of unemployment and homes in disrepair, a low percentage of high school completion, and a high percentage of First Nations people. It can also be noted that while percentages of Metis and recent immigrant peoples are relatively evenly distributed across rural income quintiles, they are overrepresented in lower SES levels in urban areas.

Table 2.1: Neighbourhood Income Quintile Group Description Chart 2006 Census

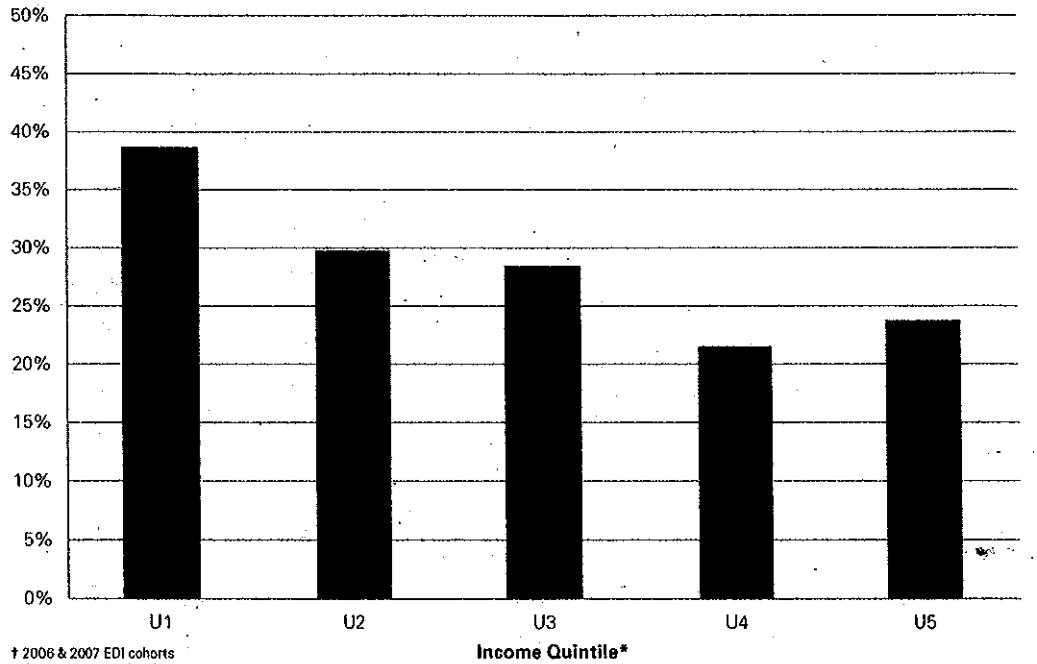
Not Found	10,251	100.0		0.00	3.7	44.5	47.6	0.0	13.4	56.8	26.3
R1	91,367	19.8	$34,331	0.01	5.4	48.2	52.5	0.6	12.9	43.9	24.8
R2	91,509	19.9	$45,021	0.13	6.9	10.6	16.9	1.6	5.3	58.5	11.3
R3	91,680	19.9	$50,851	0.03	7.3	6.9	13.5	2.1	4.4	61.2	10.4
R4	91,296	19.8	$59,572	0.12	8.0	6.4	13.7	1.9	3.9	64.2	10.3
R5	95,152	20.6	$81,336	0.16	7.2	6.4	13.0	1.2	3.9	72.3	7.1
U1	142,655	20.1	$34,371	0.12	8.1	11.6	19.0	7.3	8.5	68.2	10.6
U2	141,721	20.0	$48,458	0.11	7.7	6.6	13.9	3.2	5.1	73.1	11.2
U3	141,732	20.0	$61,085	0.07	5.4	4.0	9.1	2.7	4.5	77.8	8.3
U4	141,564	20.0	$77,308	0.10	5.0	2.7	7.4	2.0	3.9	81.0	5.2
U5	141,703	20.0	$114,331	0.03	2.9	1.6	4.5	1.9	3.5	84.6	4.3

‡ Column does not sum to 100% due to rounding of numbers
Note: Information is included for all First Nations communities in Manitoba

Adapted from Martens et al. (2010)

As shown in Figures 2.1 and 2.2, both urban and rural children's vulnerability at age five exhibits an SES gradient, with disproportionately higher prevalence of Not Ready in one or more EDI domains at lower SES levels. The SES gradient appears steeper in urban Manitoba, indicating greater inequities in

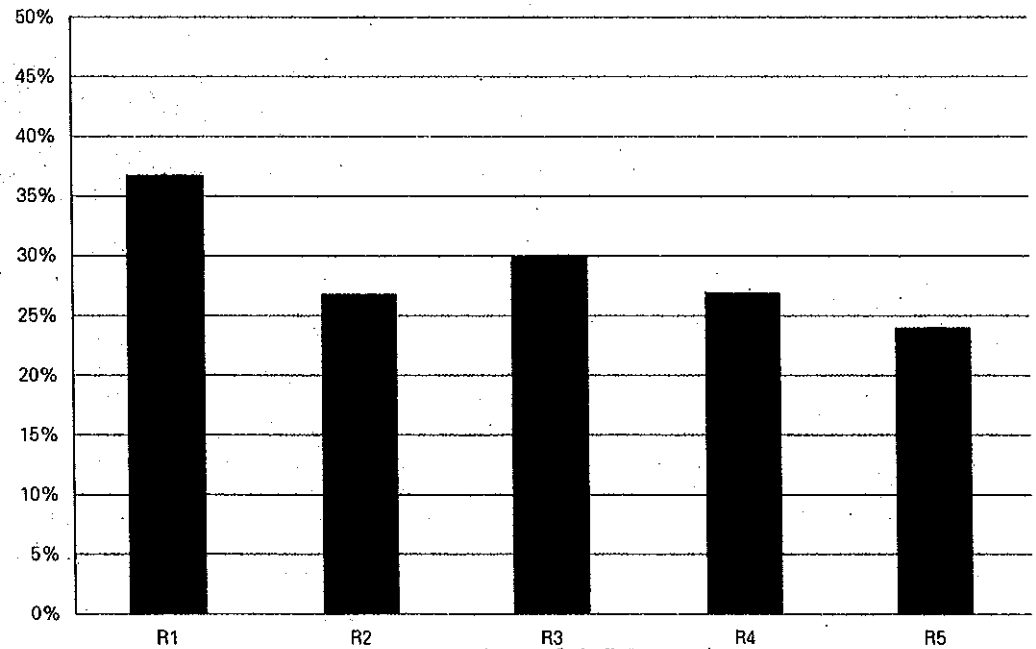
Figure 2.1: Percent Not Ready (≥ 1 EDI Domains) at Age 5 by Urban Income Quintile, Manitoba†



† 2006 & 2007 EDI cohorts
*Linear trend test significant (p <0.05)

Source: Manitoba Centre for Health Policy, 2011

Figure 2.2: Percent Not Ready (≥ 1 EDI Domains) at Age 5 by Rural Income Quintile, Manitoba†



† 2006 & 2007 EDI cohorts
*Linear trend test significant (p < 0.05)

Source: Manitoba Centre for Health Policy, 2011

5 This may be due to better measurement of SES in urban areas.

Across income quintiles, the prevalence of children's vulnerability at age five is considerable, ranging from 21% to nearly 40% of children in a given income quintile and representing thousands of Manitoba children at the crucial developmental transition from the early years into school at Kindergarten. As shown in Table 2.2, overall across Manitoba, 26% of the Kindergarten children in our cohort (5,726 of 21,898) were vulnerable. Proportionately more children in the lowest income quintile are vulnerable; but numerically more children in the middle and upper class (the three middle and upper income quintiles) are vulnerable because the majority of children in the population are not socioeconomically poor, as shown in Table 2.2. In other words, 29% of all vulnerable children (1,652 of 5,726) are in the lowest income quintile; these are the children traditionally targeted by policies (e.g., anti-poverty programs). By comparison, 51% of all vulnerable children (2,905 of 5,726) are from the middle and upper income quintiles.

Table 2.2: Number of Children Not Ready (≥ 1 EDI Domains) at Age 5 by Urban and Rural Income Quintiles, Manitoba†

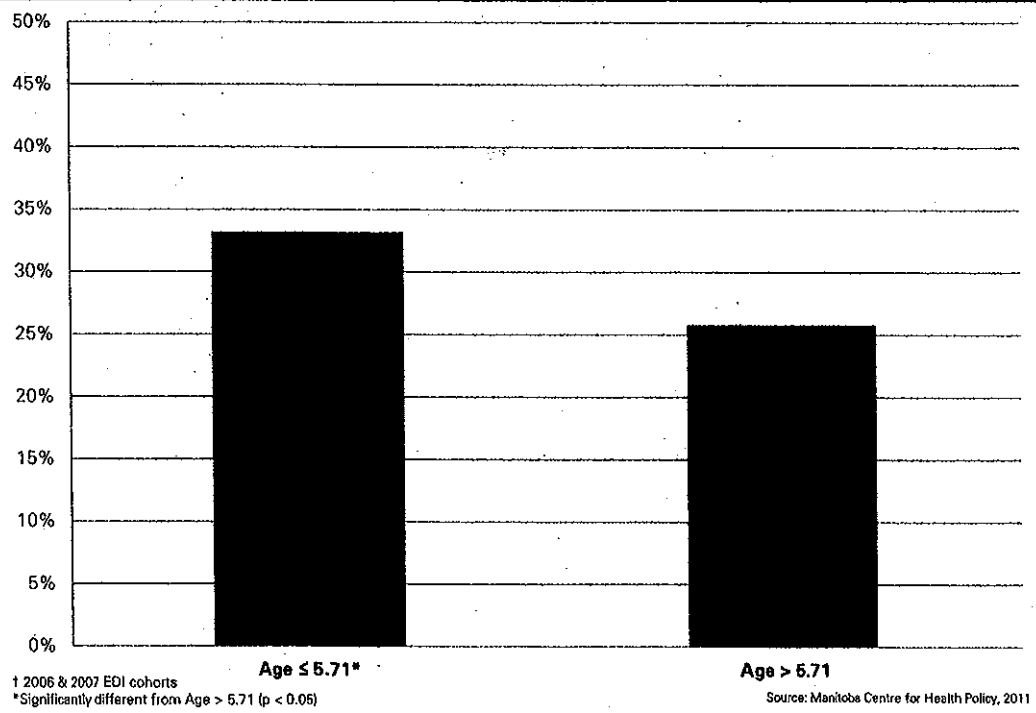
U1	1,131	**R1**	521	1,652
U3	693	**R3**	459	1,162
U5	422	**R5**	377	799
				5,726

† 2006 & 2007 EDI cohorts

Source: Manitoba Centre for Health Policy, 2011

Figures 2.3 and 2.4 show the percentage of vulnerable children grouped by age and gender. Vulnerability is more prevalent in younger children, compared to older children, and is considerably more prevalent in boys compared to girls.

Figure 2.3: Percent Not Ready (≥ 1 EDI Domains) by Age, Manitoba†

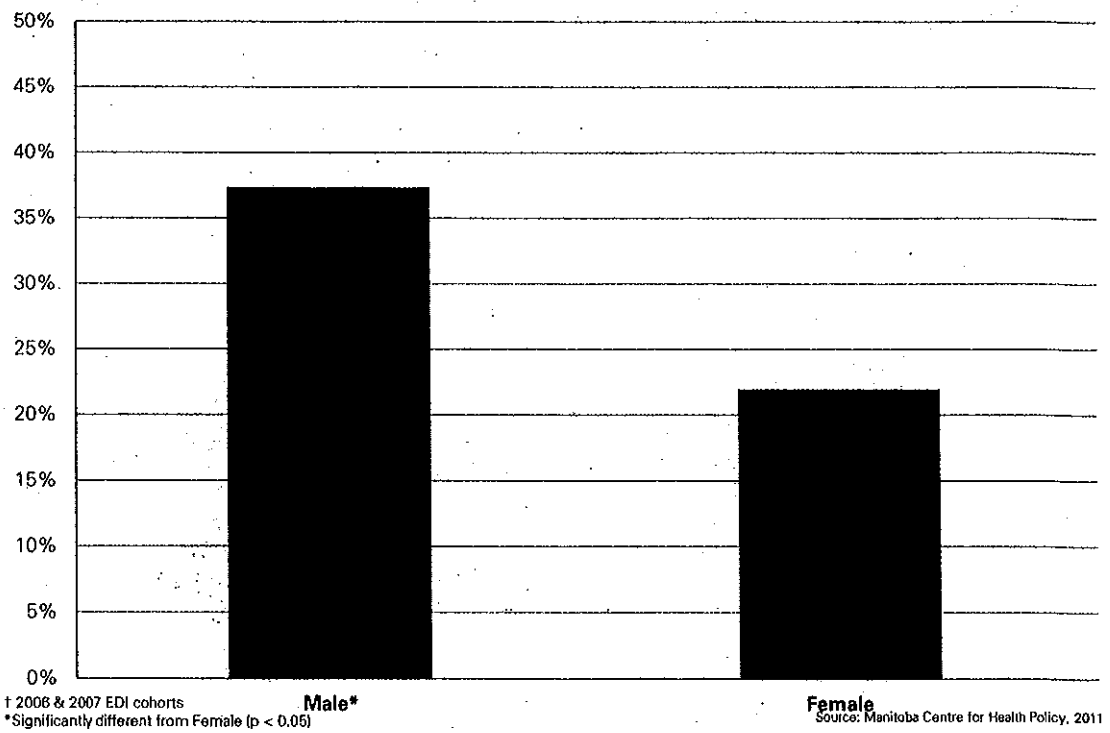


† 2006 & 2007 EDI cohorts

*Significantly different from Age > 5.71 (p < 0.05)

Source: Manitoba Centre for Health Policy, 2011

Figure 2.4: Percent Not Ready (≥ 1 EDI Domains) at Age 5 by Gender, Manitoba†

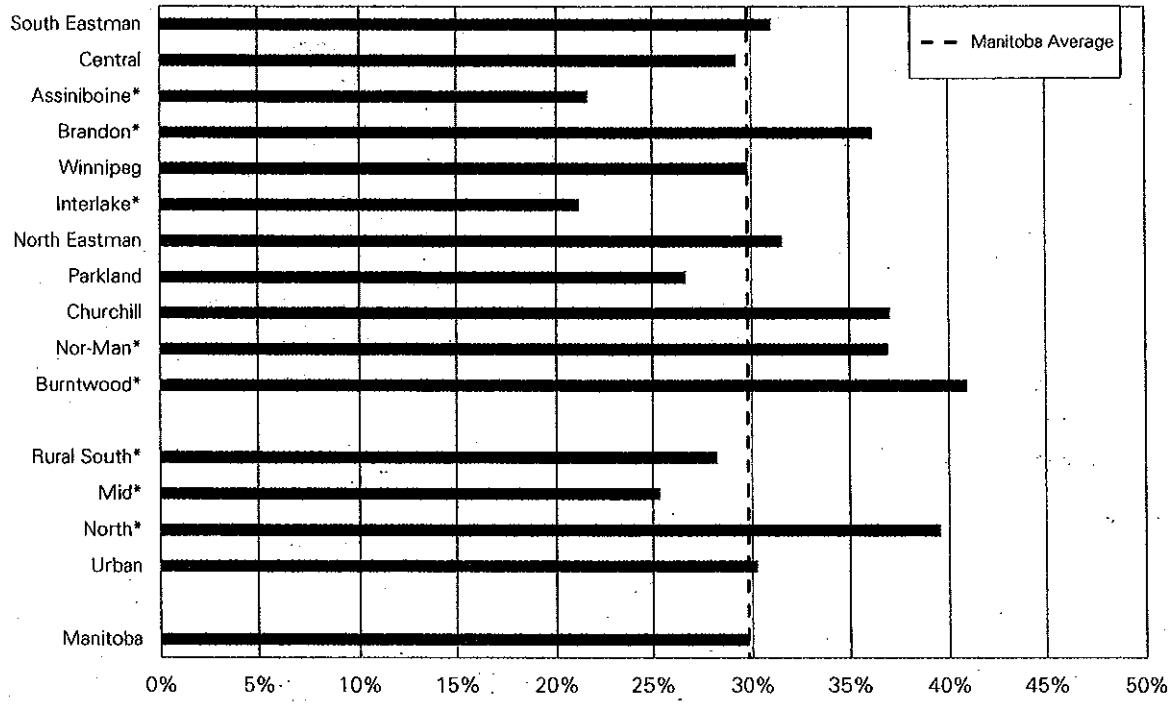


† 2006 & 2007 EDI cohorts
*Significantly different from Female ($p < 0.05$)
Source: Manitoba Centre for Health Policy, 2011

Figures 2.5 and 2.6 show the prevalence of children's vulnerability by Regional Health Authority (RHA) and by **Winnipeg Community Area (CA)**, each ordered by increasing premature mortality rate (PMR; the rate of deaths of residents aged 0 to 74 years per 1,000 residents aged 0 to 74 years) as an index of the overall health of the population in the RHA or CA, which generally follows an order based on area-level SES.

Across the 10 RHAs outside of Winnipeg, the prevalence of EDI vulnerability more than doubles from the lowest-prevalence to the highest-prevalence RHA. Across RHAs, EDI vulnerability does not appear to be as strongly related to PMR as other population health measures.

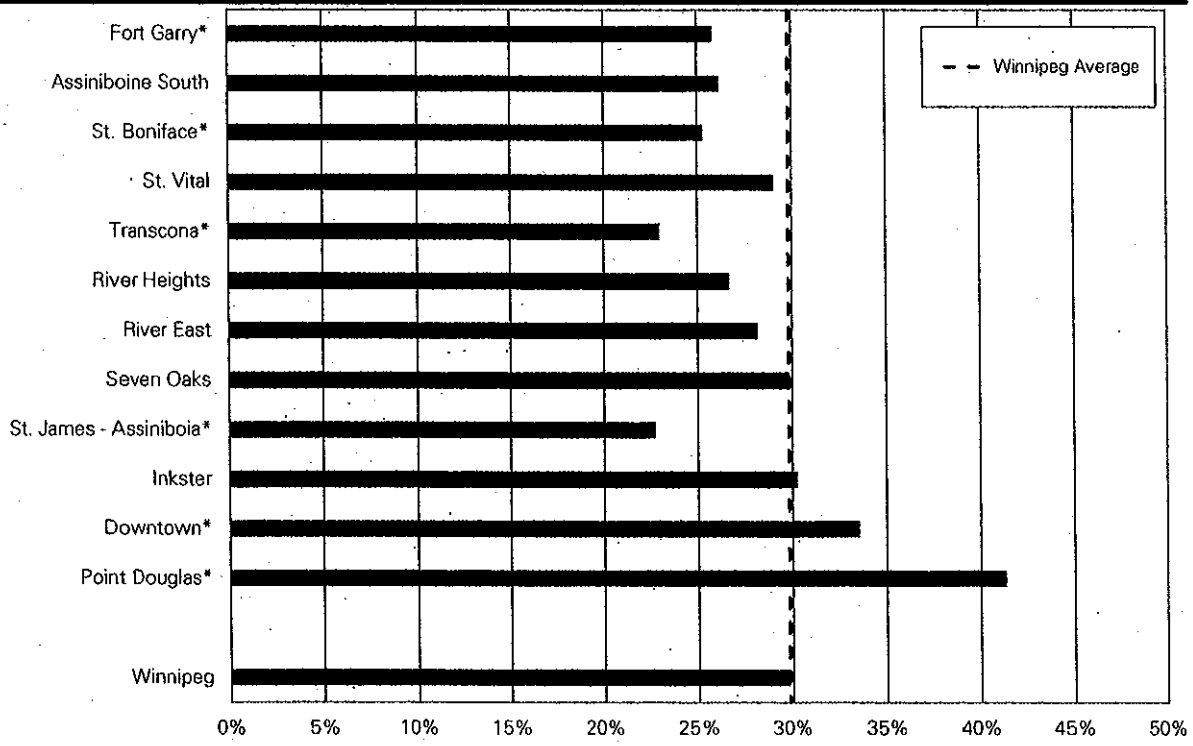
Figure 2.5: Percent Not Ready (≥ 1 EDI Domains) at Age 5 by RHA of Residence†



† 2006 & 2007 EDI cohorts
*Significantly different from the Manitoba average ($p < 0.05$)

Source: Manitoba Centre for Health Policy, 2011

Figure 2.6: Percent Not Ready (≥ 1 EDI Domains) at Age 5 by Winnipeg Community Area of Residence†



† 2006 & 2007 EDI cohorts
*Significantly different from the Winnipeg average ($p < 0.05$)

Source: Manitoba Centre for Health Policy, 2011

Across the Winnipeg CAs, the prevalence of EDI vulnerability nearly doubles from the lowest-prevalence to the highest-prevalence area. Compared to the RHA level, in Winnipeg, there appears to be a relationship between children's EDI vulnerability and the overall health of the community area (PMR).

In summary, children's vulnerability at age five is strongly graded by socioeconomic status (SES), as indexed by area-level (e.g., neighbourhood) income. Greater socioeconomic adversity is associated with greater vulnerability. There is no obvious threshold (e.g., poverty line) at which point children's vulnerability becomes especially prominent. The differential in vulnerability nearly doubles from the highest SES group to the lowest SES group. However, children's vulnerability is less strongly associated with the overall health (PMR) of a given region or community area, especially outside of Winnipeg.

Note: Corresponding figures showing the prevalence of children who were "Very Ready" (VR) on the EDI and who scored positive on the Multiple Challenge Index (MCI) are provided in Figures A2.1 to A2.14 in Appendix 2. SES gradients are also apparent for these EDI outcomes.

Chapter 3: Biological Vulnerability at Birth and Children's Vulnerability at Age Five

Does Early Life Health Predict EDI Outcomes?

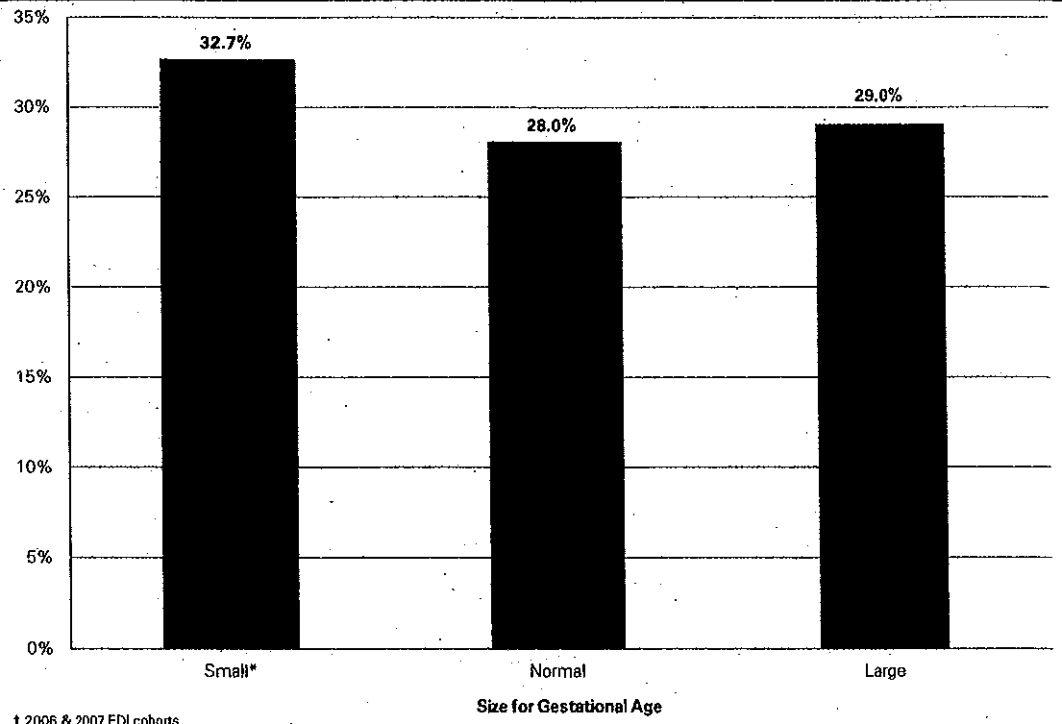
In this chapter, we look at how biological vulnerability at birth relates to children's vulnerability at age five and the mediating role of major and minor illnesses throughout early childhood. We first present findings relating measures of children's health at birth (**gestational age**, birth weight, preterm birth, long intensive care unit (ICU) stay, long hospital stay) to their EDI outcomes at age five.

These descriptive analyses are followed by more sophisticated structural equation models (SEMs). SEMs help test a conceptual model that interconnects measured variables into theoretical (latent or unmeasured) constructs. In our analyses, these constructs include (a) children's *health at birth*—as indexed by measured variables relating to biological vulnerability (preterm birth, **low birth weight**, long ICU stay, long hospital stay); (b) children's *major illness* in early childhood to age four—as indexed by measured variables (major Aggregated Diagnosis Groups (ADGs), long ICU stay, long hospital stay); and (c) children's *minor illness* in early childhood to age four—as indexed by measured variables (minor ADGs, physician visits). We statistically relate these constructs to average scores on each of the five EDI domains, controlling for social, economic, and demographic variables (area-level income, family residential mobility, family income assistance, single parent family, large family, mother's age at first childbirth, **maternal depression**, and breastfeeding initiation).

Our interest was in attempting to replicate the first population-based study relating health at birth to school performance at age nine (Fransoo et al., 2008). That is, to see if this relationship also held true at age five, as measured by the EDI. Thus, we used the same variables in our SEMs (for details about each variable, see Table 1.2) and focused on our sample from Winnipeg. While the intent of SEM is to test a conceptual model, it is important to emphasize that the analyses are correlational in nature, and cannot be assumed to be causal, albeit ordered in a sequence over time. Statistical analyses provided estimates of "goodness of fit" between the conceptual model and the observed data. As noted earlier (see Footnote 4, Chapter 1), all of our SEMs met conventional standards of goodness of fit.

Descriptive Analyses. As shown in Figures 3.1 and 3.2, both suboptimal size for gestational age and suboptimal birth weight are related to EDI vulnerability five years later, with higher percentages of EDI vulnerability for children who are **small for gestational age (SGA**; compared to normal for gestational age and **large for gestational age**) and low birth weight (LBW) or **very low birth weight (VLBW)** (compared to normal and high birth weight). Tables A3.1 and A3.2 in Appendix 3 provide counts. Figures A3.1 and A3.2 in Appendix 3 provide results for MCI.

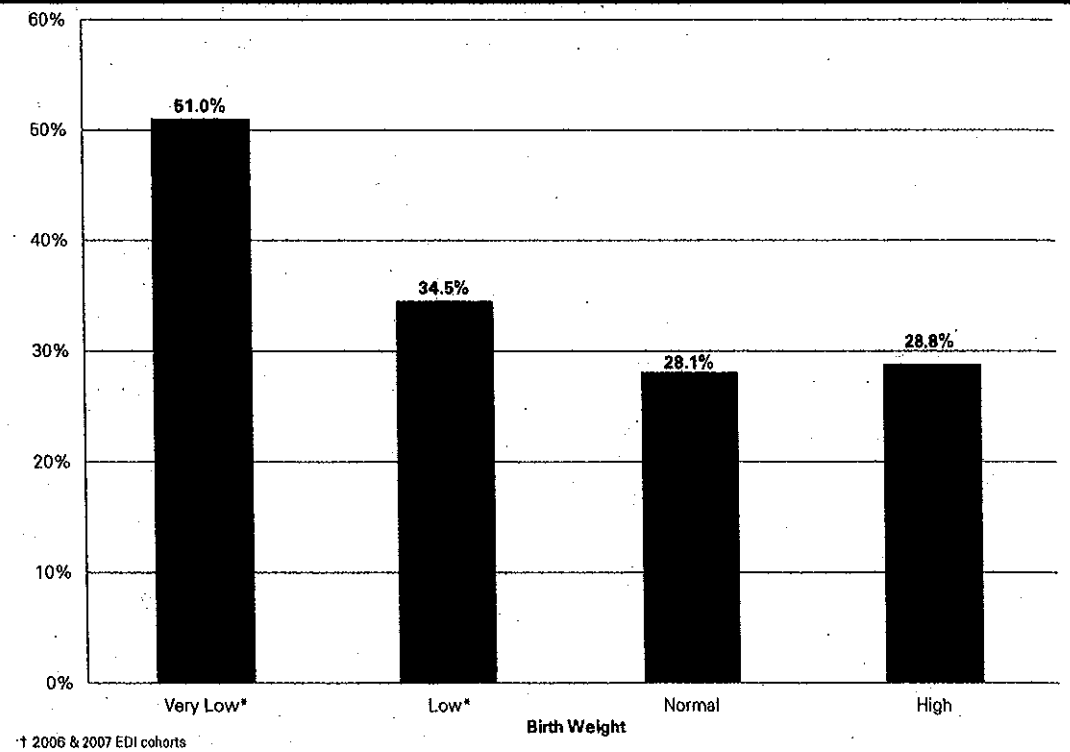
Figure 3.1: Percent Not Ready (≥ 1 EDI Domains) at Age 5 by Size for Gestational Age at Birth, Manitoba†



† 2006 & 2007 EDI cohorts
*Significantly different from Normal Gestational Age ($p < 0.05$)

Source: Manitoba Centre for Health Policy, 2011

Figure 3.2: Percent Not Ready (≥ 1 EDI Domains) at Age 5 by Birth Weight, Manitoba†

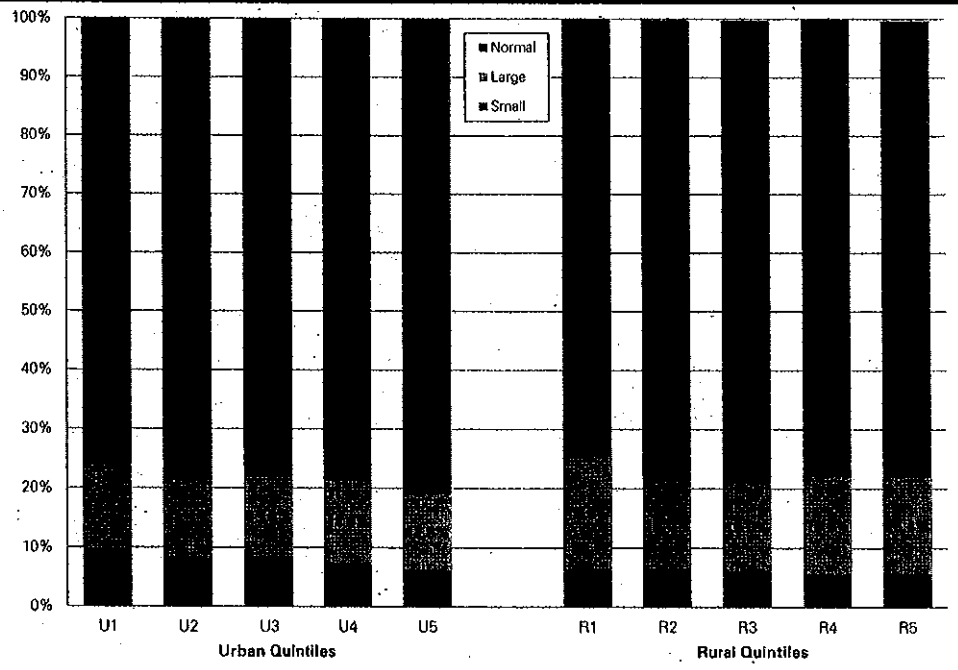


† 2006 & 2007 EDI cohorts
*Significantly different from Normal Birth Weight ($p < 0.05$)

Source: Manitoba Centre for Health Policy, 2011

It is worth noting that there are SES gradients in the three subgroups that are differentially vulnerable on the EDI five years later: SGA, LBW, and VLBW in urban areas, as shown in Figures 3.3 and 3.4. Tables A3.3 and A3.4 in Appendix 3 provide corresponding counts. Other measures of biological vulnerability at birth that also exhibit SES gradients are long ICU stay, preterm birth, and long hospital stay, as shown in Figure 3.5.

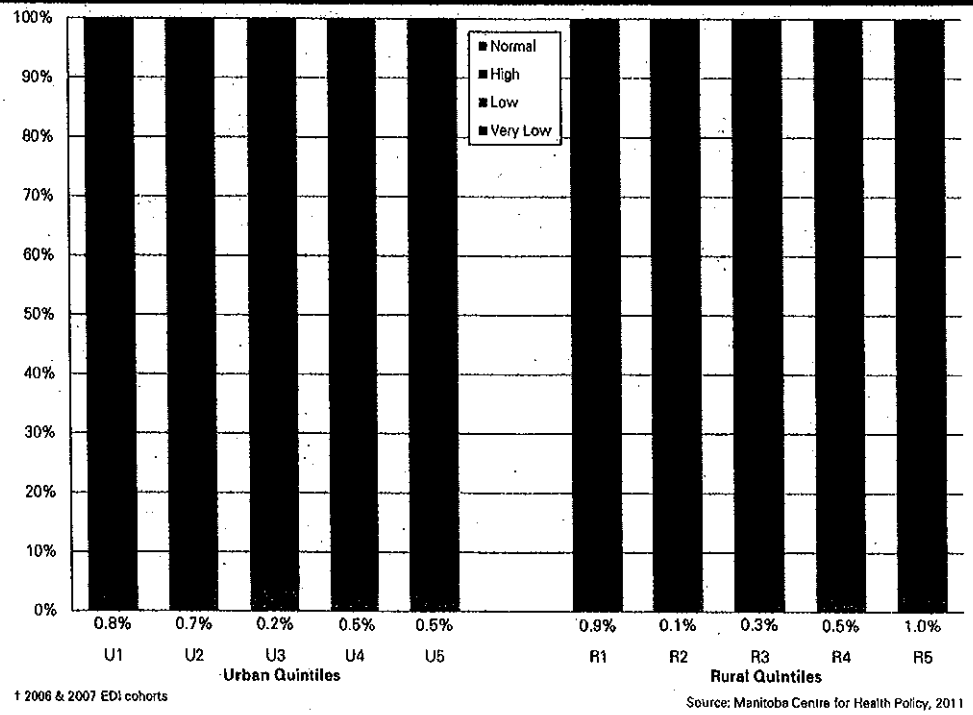
Figure 3.3: Size for Gestational Age by Urban and Rural Income Quintiles, Manitoba†



† 2006 & 2007 EDI cohorts

Source: Manitoba Centre for Health Policy, 2011

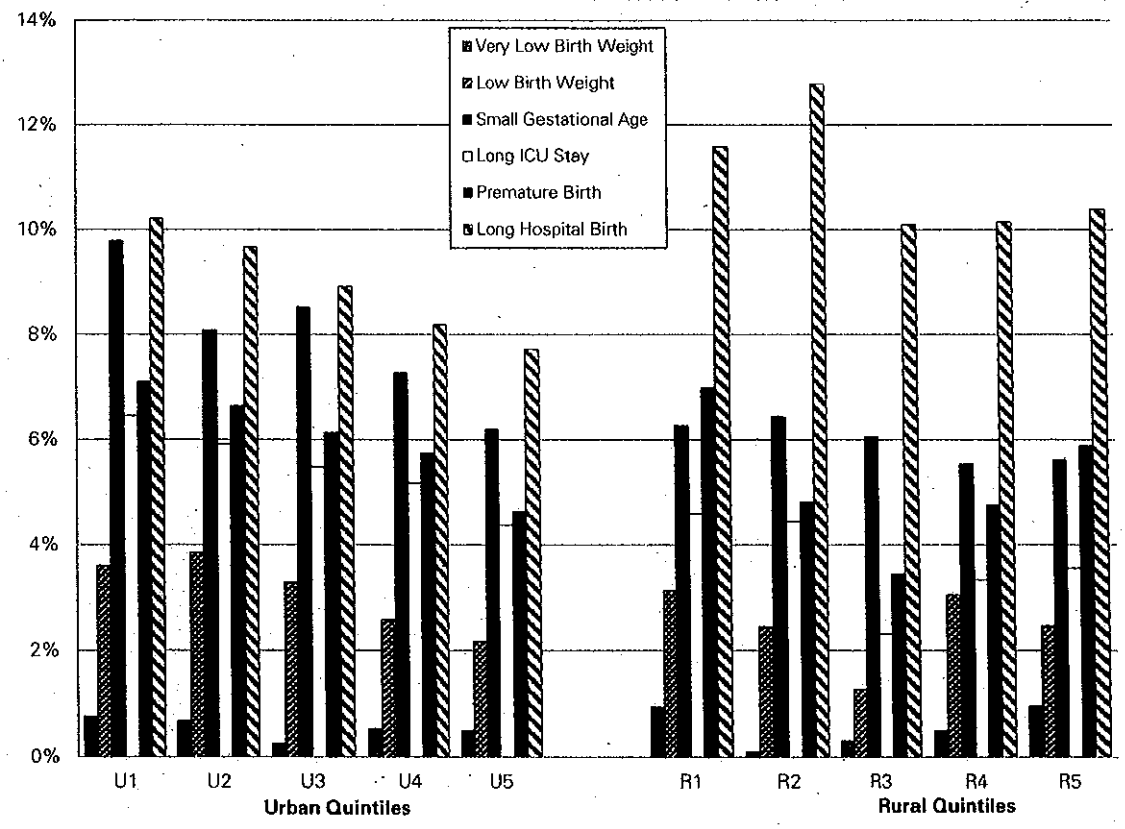
Figure 3.4: Birth Weight by Urban and Rural Income Quintiles, Manitoba†



† 2006 & 2007 EDI cohorts

Source: Manitoba Centre for Health Policy, 2011

Figure 3.5: Birth Measures by Urban and Rural Income Quintiles, Manitoba†



† 2006 & 2007 EDI cohorts

Source: Manitoba Centre for Health Policy, 2011

We now turn to a more complex look at how biological vulnerability at birth and socioeconomic adversity combine to influence EDI vulnerability at age five, using Structural Equation Models (SEM). Figures 3.6 to 3.10 present these results for Winnipeg, beginning with language and cognitive development, which is the EDI domain most closely associated with the school performance (language and mathematics) outcome measure used by Fransoo et al. (2008). Our findings shown in Figure 3.6 parallel those of Fransoo et al. (Appendix Figure A3.3). Health at birth predicts children's language and cognitive development at age five.

Major illness is the major mediating pathway from biological vulnerability at birth to vulnerability at age five. That is, increasingly poor health status at birth is associated with greater major illness and greater minor illness in early childhood which, in turn, is related to decreasing scores on the EDI (i.e., increasing vulnerability). This relationship is stronger for major illness than minor illness.[6]

Socioeconomic adversity—as measured by family income assistance—is as strongly related to poorer EDI outcomes at age five as is the pathway from biological vulnerability at birth through major illness in early childhood, similar to the results of Fransoo et al. (2008).

6 In SEMs, the sign of the coefficients, positive or negative (–), indicates the directionality of effect, i.e., if the variable is associated with better or poorer outcomes.

Comparing across Figures 3.6 to 3.10, for Winnipeg children, the influence of biological vulnerability at birth is strongest for physical health and well-being, followed by language and cognitive development, communication skills and general knowledge, social competence, and lastly, emotional maturity. Socioeconomic adversity is consistently related to all EDI domains, as are child sex and age. This corresponds with our descriptive findings in the previous chapter.

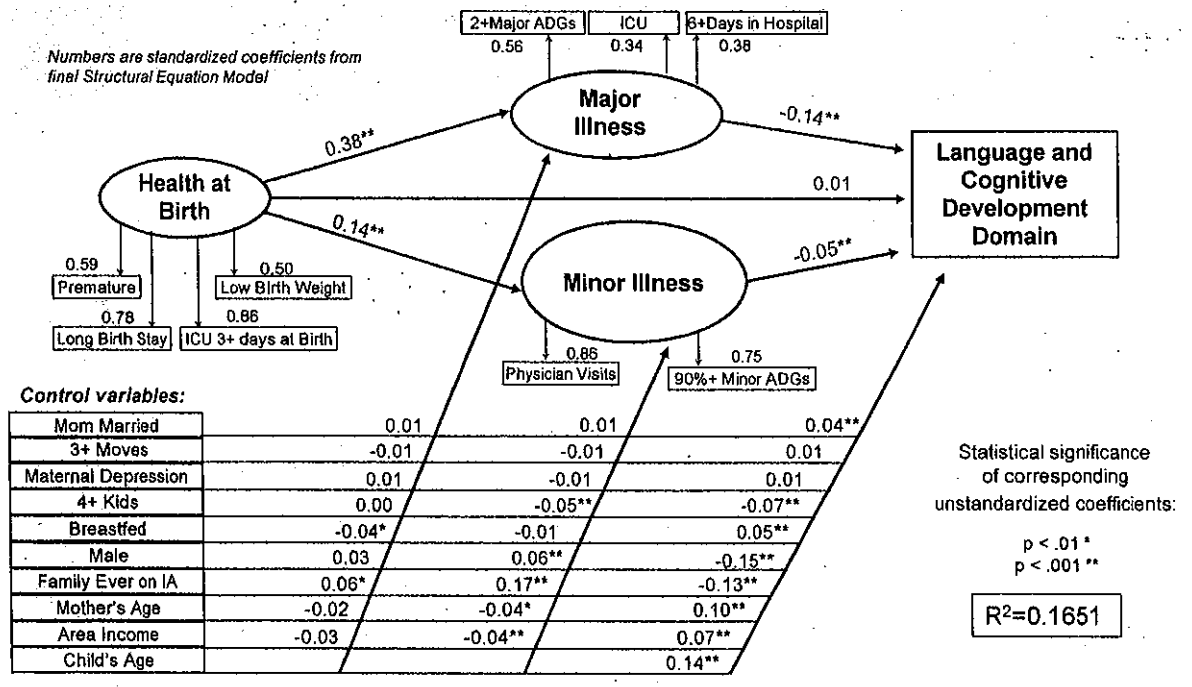
Breastfeeding initiation was significantly associated with language and cognitive development and communication skills and general knowledge, but not the physical, social, or emotional domains for Winnipeg children.

Contrary to expectations, (particularly for social and emotional outcomes), maternal depression and family residential mobility were not associated with Winnipeg children's vulnerability at age five in any of the five EDI domains, after accounting for the effects of biological vulnerability at birth and socioeconomic adversity indexed by the other measures. This was similar to the findings of Fransoo et al. (2008).

In summary, the five EDI outcomes all shared a common pathway originating from biological vulnerability at birth, in the context of socioeconomic adversity.

SEM results for Manitoba and non-Winnipeg are presented in Figures A3.4 to A3.13 in Appendix 3. Results for Manitoba are nearly identical to the pattern and magnitude of effects found in Winnipeg.

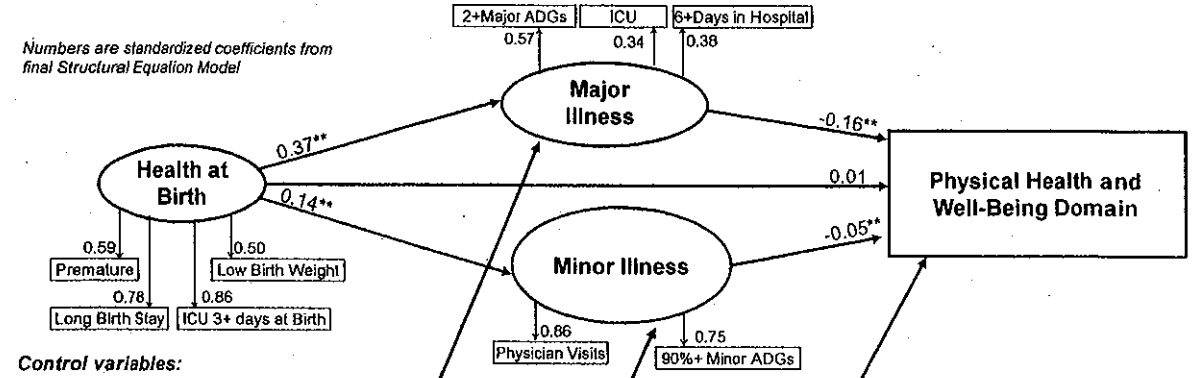
Figure 3.6: Relationships Between Health at Birth and EDI Language and Cognitive Development at Age 5, Winnipeg†



† 2006 & 2007 EDI cohorts

Source: Manitoba Centre for Health Policy, 2011

Figure 3.7: Relationships Between Health at Birth and EDI Physical Health and Well-Being at Age 5, Winnipeg†



Control variables:

Mom Married	0.01	0.01	0.05**
3+ Moves	-0.01	-0.01	-0.01
Maternal Depression	0.01	-0.01	0.00
4+ kids	0.00	-0.05**	-0.07**
Breastfed	-0.04*	-0.02	0.02
Male	0.03	0.06**	-0.13**
Family Ever on IA	0.05*	0.17**	-0.14**
Mother's Age	-0.02	-0.04*	0.05**
Area Income	-0.03	-0.04**	0.03
Child's Age			0.11**

Statistical significance of corresponding unstandardized coefficients:

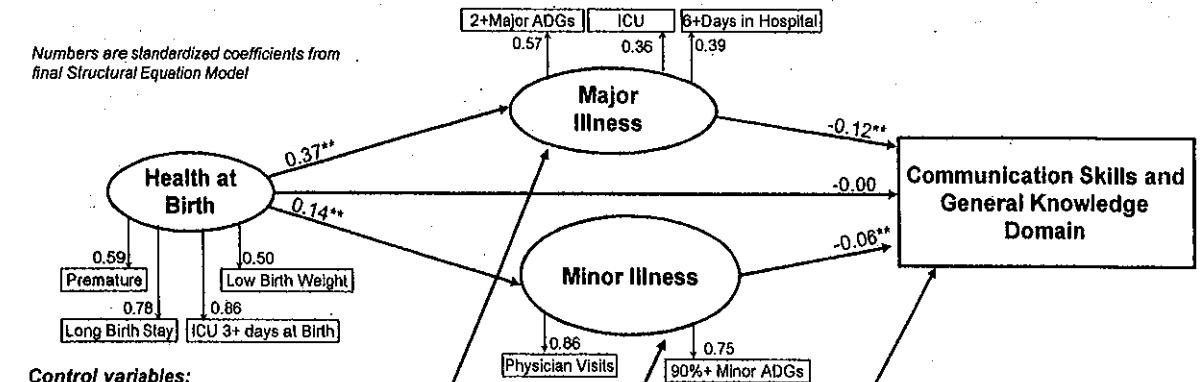
p < .01 *
p < .001 **

R^2=0.1308

† 2006 & 2007 EDI cohorts

Source: Manitoba Centre for Health Policy, 2011

Figure 3.8: Relationships Between Health at Birth and EDI Communication Skills and General Knowledge at Age 5, Winnipeg†



Control variables:

Mom Married	0.01	0.01	-0.01
3+ Moves	-0.01	-0.01	0.00
Maternal Depression	0.01	-0.01	0.01
4+ kids	0.00	-0.05**	-0.09**
Breastfed	-0.04*	-0.02	0.05**
Male	0.03	0.06**	-0.14**
Family Ever on IA	0.05*	0.17**	-0.10**
Mother's Age	-0.02	-0.04*	0.05**
Area Income	-0.03	-0.04**	0.06**
Child's Age			0.12**

Statistical significance of corresponding unstandardized coefficients:

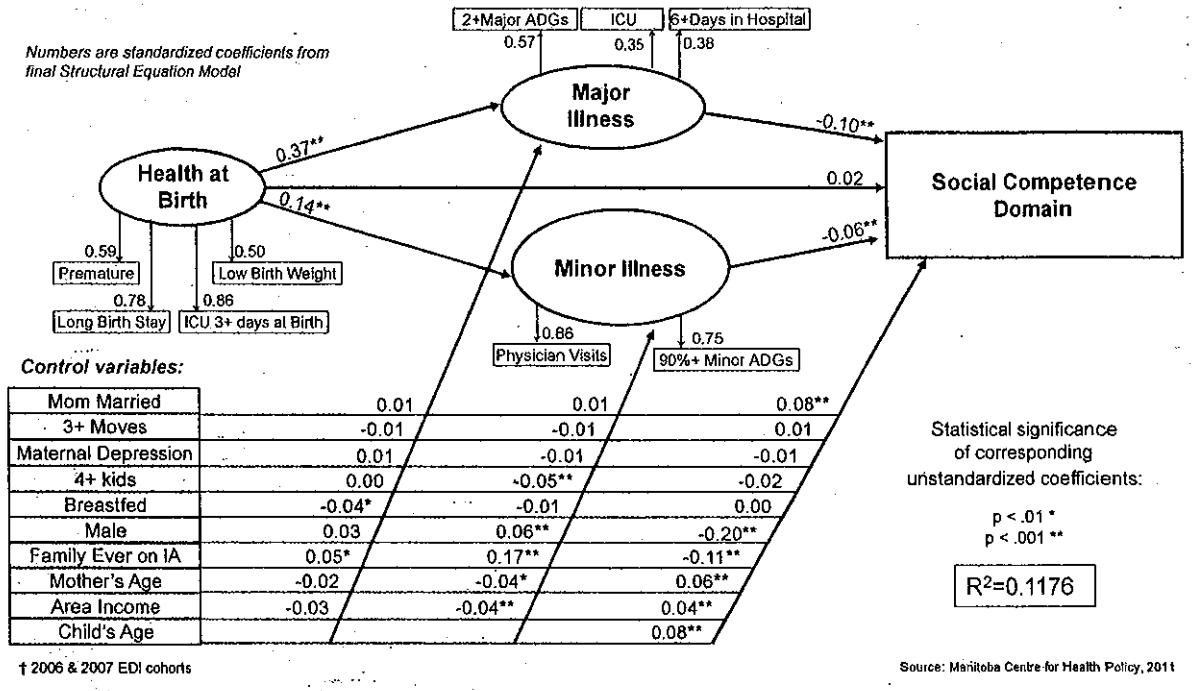
p < .01 *
p < .001 **

R^2=0.1120

† 2006 & 2007 EDI cohorts

Source: Manitoba Centre for Health Policy, 2011

Figure 3.9: Relationships Between Health at Birth and EDI Social Competence at Age 5, Winnipeg†

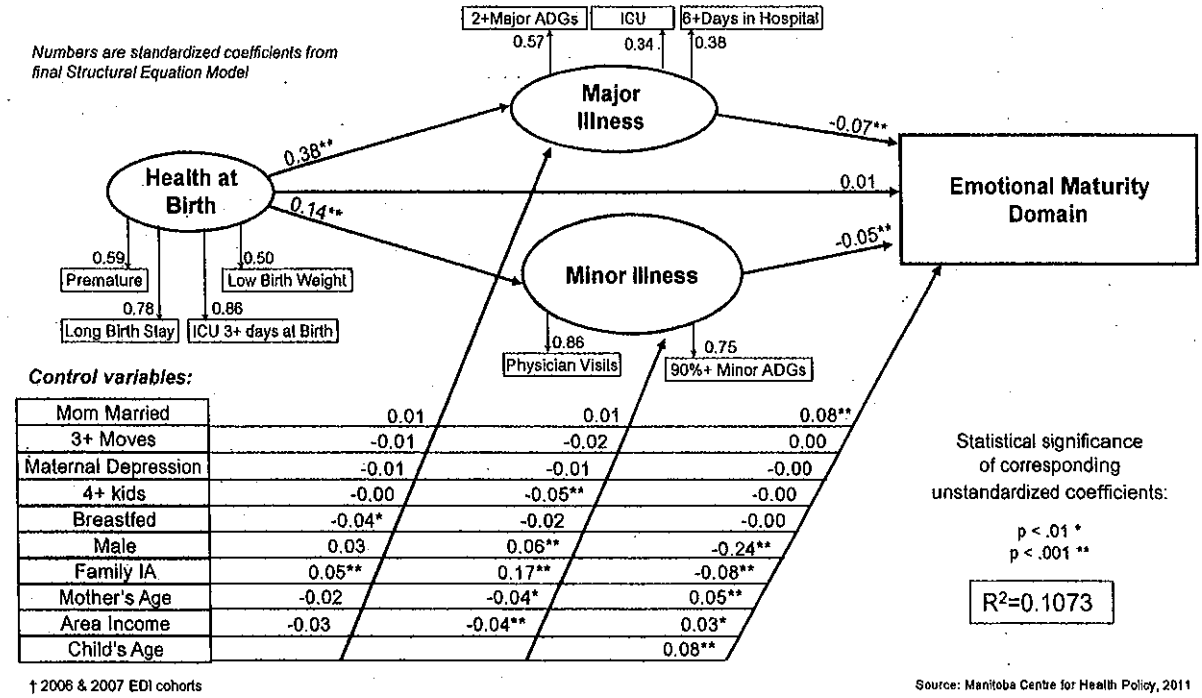


Mom Married	0.01	0.01	0.08**
3+ Moves	-0.01	-0.01	0.01
Maternal Depression	0.01	-0.01	-0.01
4+ kids	0.00	-0.05**	-0.02
Breastfed	-0.04*	-0.01	0.00
Male	0.03	0.06**	-0.20**
Family Ever on IA	0.05*	0.17**	-0.11**
Mother's Age	-0.02	-0.04*	0.06**
Area Income	-0.03	-0.04**	0.04**
Child's Age			0.08**

† 2006 & 2007 EDI cohorts

Source: Manitoba Centre for Health Policy, 2011

Figure 3.10: Relationships Between Health at Birth and EDI Emotional Maturity at Age 5, Winnipeg†



Mom Married	0.01	0.01	0.08**
3+ Moves	-0.01	-0.02	0.00
Maternal Depression	-0.01	-0.01	-0.00
4+ kids	-0.00	-0.05**	-0.00
Breastfed	-0.04*	-0.02	-0.00
Male	0.03	0.06**	-0.24**
Family IA	0.05**	0.17**	-0.08**
Mother's Age	-0.02	-0.04*	0.05**
Area Income	-0.03	-0.04**	0.03*
Child's Age			0.08**

† 2006 & 2007 EDI cohorts

Source: Manitoba Centre for Health Policy, 2011

However, some notable differences emerged in the SEMs for non-Winnipeg when compared to Winnipeg and Manitoba overall. First, for three EDI domains, the direct pathway from health at birth to EDI outcome was statistically significant: physical health and well-being, language and cognitive development, and communication skills and general knowledge. Second, the indirect pathway via minor illness was not statistically significant for physical health and well-being, language and cognitive development, social competence, or emotional maturity. Third, being in a single parent family was statistically significant for poorer communication skills and general knowledge. Fourth, maternal depression was a statistically significant predictor for poorer social competence and poorer communication skills and general knowledge. Fifth, having a large number of children in the home was statistically significant for poorer social competence and poorer emotional maturity. Finally, breastfeeding was not a statistically significant predictor for physical health and well-being or language and cognitive development.

To test our conceptual model for EDI outcomes that are present or absent (e.g., vulnerability or NR), we also conducted logistic regressions and multilevel logistic regressions,[7] using all of the variables from the SEM, as well as a variable denoting involvement with (CFS) (see Chapter 4). Overall, we found evidence consistent with our SEM results . In Table 3.1, we present the multilevel logistic regression results for Manitoba.

Table 3.1: Odds Ratios for EDI Not Ready (≥ 1 EDI Domains) at Age 5, Manitoba†

Predictors	Odds Ratios	Confidence Intervals
Male	**2.37**	2.20 - 2.57
Child's Age	**0.39**	0.35 - 0.45
Premature	0.83	0.68 - 1.01
Low Birth Weight	**1.34**	1.06 - 1.70
ICU 3+ Days At Birth	**1.31**	1.07 - 1.61
Breastfed	**0.86**	0.78 - 0.94
2+ Major ADGs	**1.51**	1.28 - 1.77
90%+ Minor ADGs	**1.28**	1.10 - 1.49
Physician Visits	1.00	1.00 - 1.00
6+ Days In Hospital	**1.52**	1.31 - 1.76
Area Income	**0.51**	0.41 - 0.63
Family Ever on IA	**1.69**	1.51 - 1.90
CFS	**1.51**	1.34 - 1.71
Teen Mom	**1.35**	1.23 - 1.49
Mom Married	**0.78**	0.71 - 0.85
4+ Kids	**1.62**	1.46 - 1.80

† 2006 & 2007 EDI cohorts
Bolded values are significant ($p < 0.05$)
Note: Results are from multilevel modelling
Note: **ADG**- Adjusted Diagnostic Group, **IA**- Income Assistance, **CFS**- Child and Family Services
Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

7 Multilevel models accounted for the hierarchical nature of our area-level income variable (i.e., families nested or clustered within geographic areas). Perhaps because our models also included some family-level income data (family IA), the results of the multilevel models are nearly identical in pattern and magnitude of statistical effects, compared to our other logistic models where the hierarchical levels were not taken into account.

The **odds ratios** (ORs) indicate that the odds of being vulnerable are statistically significantly higher with socioeconomic adversity; for example, the odds of EDI vulnerability are 1.7 times greater for children in families on IA than for those not on IA. In contrast, children in two-parent families are less likely to be vulnerable (OR = 0.78) than children in single parent families; and every unit increase in area-level income is associated with decreased odds of vulnerability (OR = 0.51), after controlling for other variables.

Similarly, the odds of being vulnerable at age five are statistically significantly higher with biological vulnerability: for example, the odds of being vulnerable are 1.5 times greater for children with major illness (as indicated by 2+ major ADGs) than children without major illness in early childhood (and 1.3 times greater for minor illness), for children who required extended hospital stays in early childhood, and for children who required extended ICU care at birth. Importantly for intervention (see Chapter 7), breastfeeding initiation was associated with lower odds of vulnerability (OR = 0.86). The odds of being vulnerable at age five are 2.4 times greater for boys than for girls and decrease with child age (OR = 0.39). This evidence indicates that our previous descriptive findings for individual predictor variables generally hold true after statistically controlling for the effects of the other predictor variables.

Taking the findings of this chapter together, using different statistical techniques, we find a consistent picture. Children's vulnerability at age five can be traced back to biological vulnerability at birth and socioeconomic adversity through early childhood.

Additional multilevel logistic analyses are presented in Appendix 3 (Table A3.5 to A3.24) for Not Ready by domain and Very Ready by domain, for Manitoba, Winnipeg, and non-Winnipeg samples. All are consistent with our overall finding of the association of both biological vulnerability at birth and socioeconomic adversity with early childhood vulnerability at age five. As noted in Chapter 1, summaries of the predictors from the optimal models are presented in Tables A1.2 to A1.14 of Appendix 1.

[redacted]

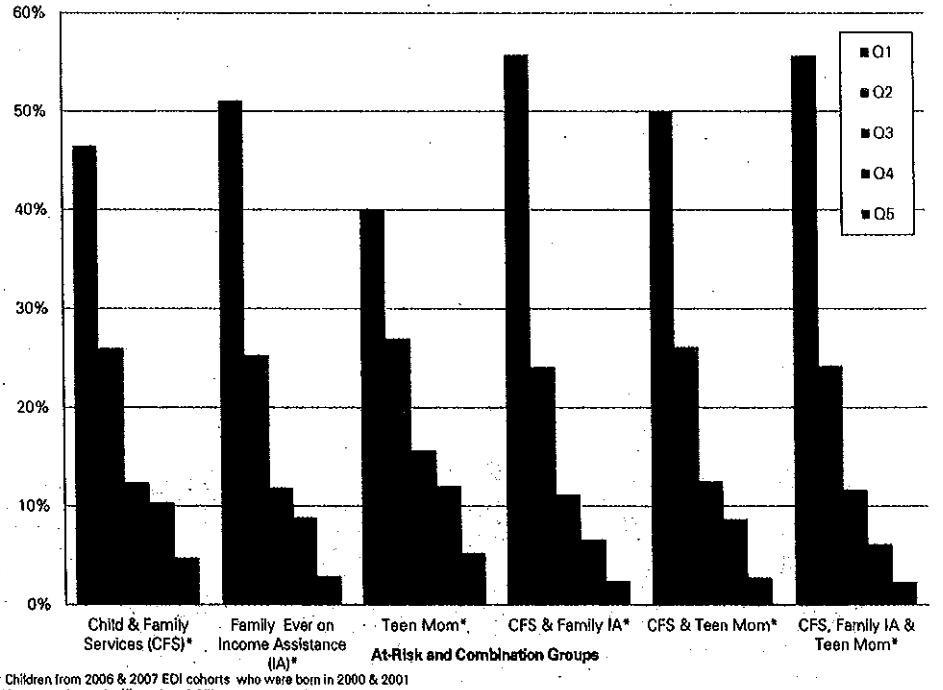
Chapter 4: Children's Vulnerability at Age Five in At-Risk Groups

What are the EDI Outcomes of Children of Mothers Who Were Teens at First Childbirth, Children in Families on Income Assistance, and Children Involved with Child and Family Services?

In this chapter, we describe the prevalence of early developmental vulnerability among children in three "at-risk" groups: being born to mothers who were teenagers at their first childbirth, being in families who were ever on IA, and being in CFS.[8] In the analyses reported in the previous chapter, with few exceptions, being in each of these at-risk groups was statistically significantly associated with poor EDI outcomes, particularly language and cognitive development and physical health and well-being. Of the combined 2000 and 2001 birth cohort for Manitoba, children born to mothers who were teens at first childbirth comprised 22.8% (4,942/21,676), children living in families on IA comprised 20.3% (4,403/21,676), and children in CFS comprised 11.4% (2,461/21,676).[9]

SES gradients can be seen for each of the three at-risk groups and their combinations, with the largest proportions found in the lowest income quintile, especially in urban areas (see Figures 4.1 to 4.3 and Tables A4.1–A4.3 in Appendix 4 for the corresponding counts). Missing CFS data (e.g., not collected or entered by rural/northern agencies) and missing IA data (e,g., First Nations communities outside the provincial IA system) account for the lower percentages of CFS and IA in Figure 4.3.

Figure 4.1: SES Gradients within At-Risk and Combination Groups by Winnipeg Income Quintiles†



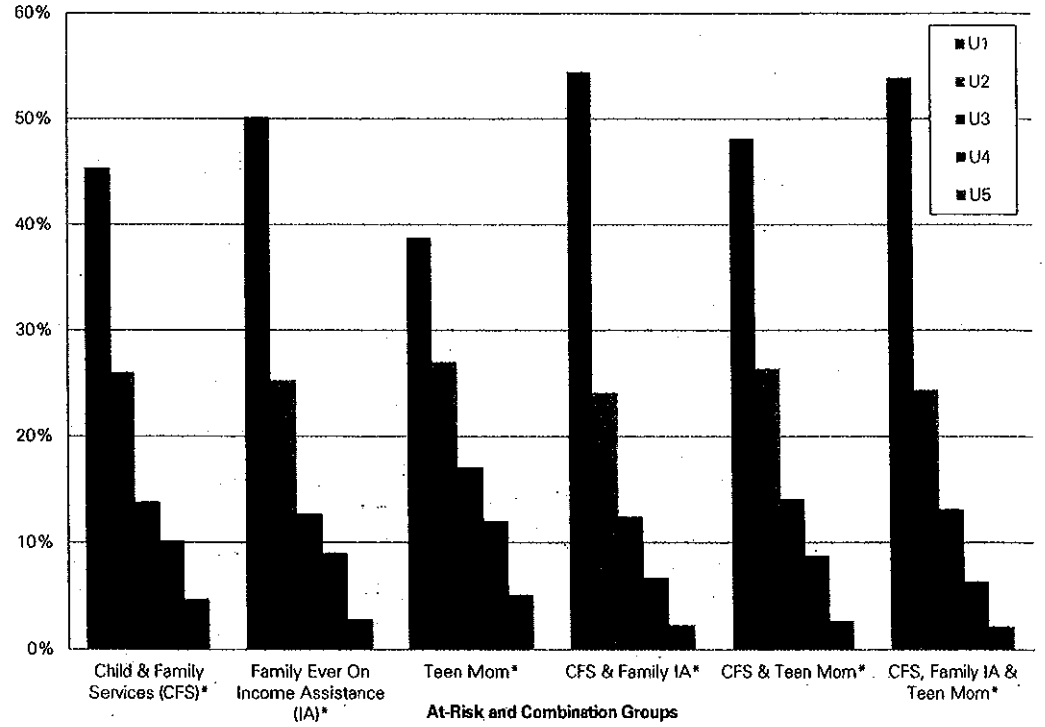
† Children from 2006 & 2007 EDI cohorts who were born in 2000 & 2001
*Linear trend test significant ($p < 0.05$)

Source: Manitoba Centre for Health Policy, 2011

8 As explained in Table 1.2, children in CFS include those in care and those receiving protection or support services.

9 Given our interest in replicating Brownell et al. (2010), our analyses in this chapter were completed with the 2000 and 2001 birth cohorts, rather than the EDI collection years.

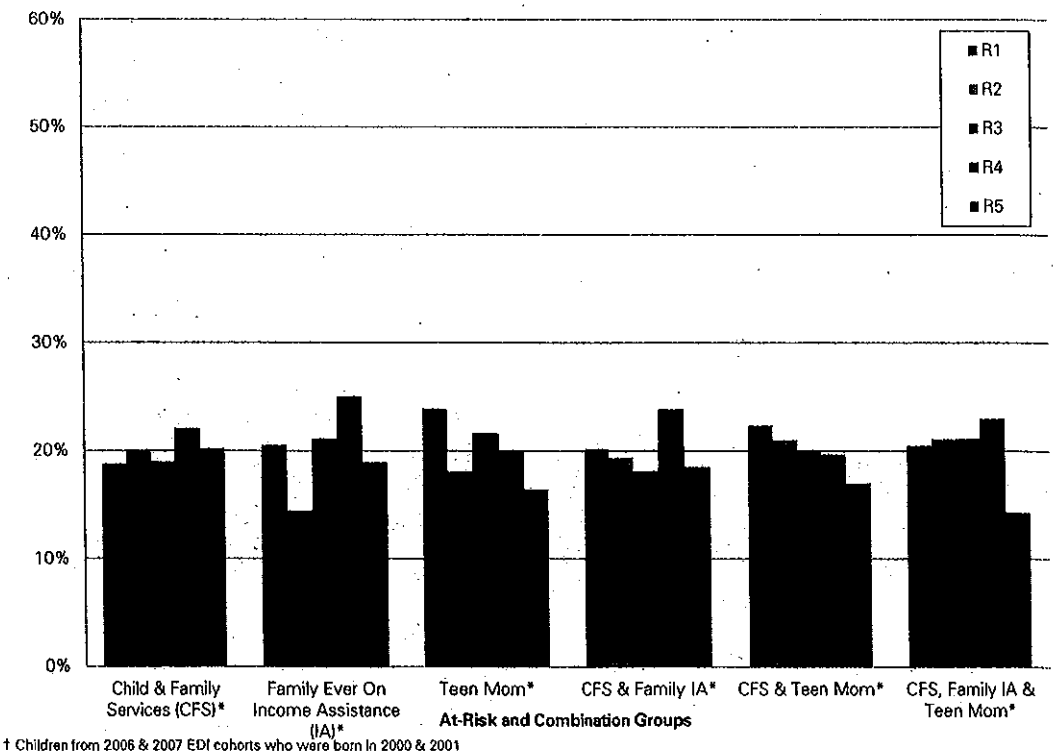
Figure 4.2: SES Gradients within At-Risk and Combination Groups: Urban Income Quintiles†



† Children from 2006 & 2007 EDI cohorts who were born in 2000 & 2001
*Linear trend test significant ($p < 0.05$)

Source: Manitoba Centre for Health Policy, 2011

Figure 4.3: SES Gradients within At-Risk and Combination Groups: Rural Income Quintiles†



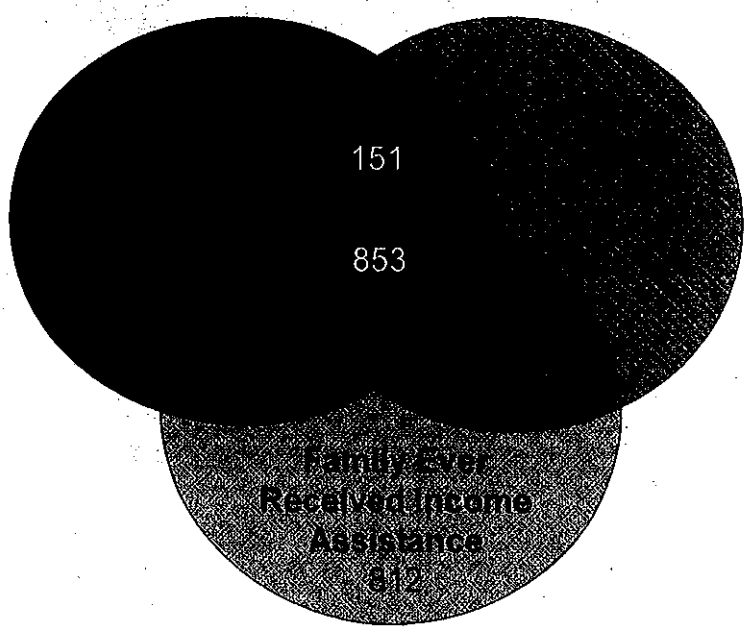
† Children from 2006 & 2007 EDI cohorts who were born in 2000 & 2001
*Linear trend test significant ($p < 0.05$)

Source: Manitoba Centre for Health Policy, 2011

Brownell et al. (2010) found dramatically high odds of poor outcomes in youth and young adulthood as a function of being in one or more of these three at-risk groups through childhood. Poor outcomes included failure to obtain eight credits in Grade 9, failure to complete high school, teenage parenthood, and requiring income assistance in early adulthood. We focused on our combined birth cohort for Winnipeg (n=11,954) and used the same at-risk groupings and control variables (child age, child sex, presence of intellectual disability or emotional behavioural disorder, number of children in family, area-level SES, area percent of Aboriginal population, mother not married at child's birth) as Brownell et al.

Figure 4.4 shows the overlap of the 3,883 children in our cohort (32% of the total sample) who were in one or more of the three at-risk groups.

Figure 4.4: Overlap of At-Risk Groups in Winnipeg Cohort (Five-Year Olds)†

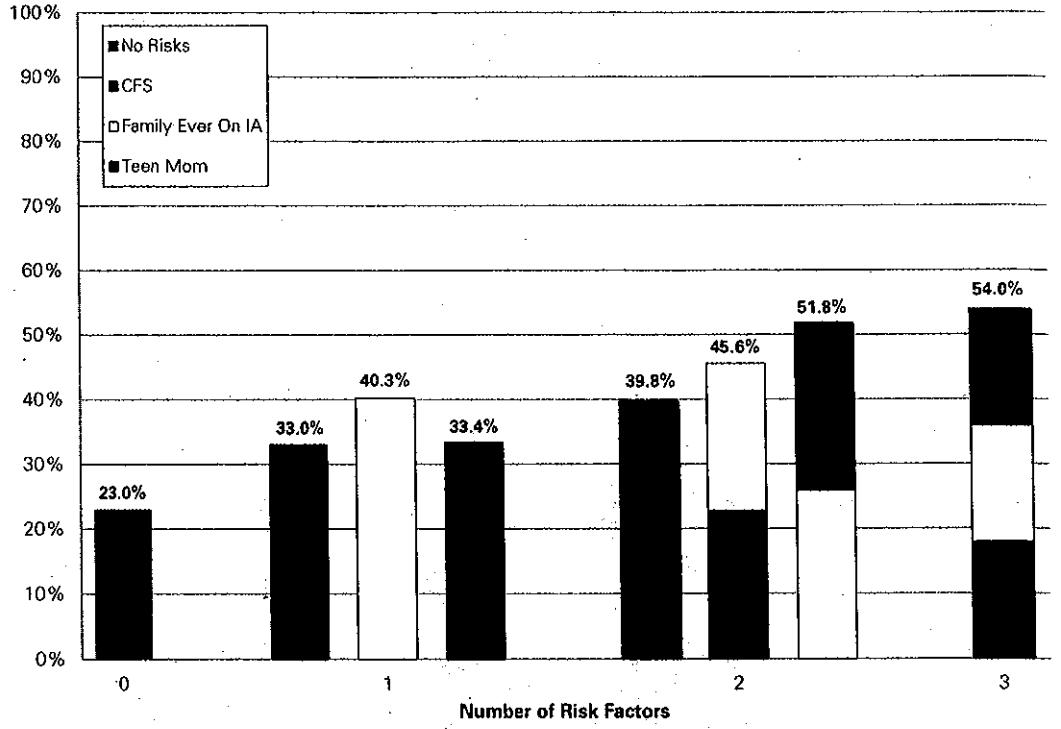


†Children from 2006 & 2007 EDI cohorts who were born in 2000 & 2001 Source: Manitoba Centre for Health Policy, 2011

In Figure 4.5, we present the prevalence of children's vulnerability at age five for each of the at-risk groups and their combinations. The pattern and relative magnitude of our findings are consistent with Brownell et al. (2010), shown in Figure 4.6, who followed a cohort born a decade and a half earlier than our EDI cohort and used outcomes measured much later in the life course. Although not as high as the prevalence figures for vulnerability at high school graduation (see Figure 4.6), the prevalence of vulnerability is already considerable at school entry in Kindergarten in our data. The prevalence of children's EDI vulnerability is 43% to 129% higher across the at-risk groups, compared to children who are not in any of the at-risk groups (see Figure 4.5)

In Figure 4.7, we present the ORs for children's vulnerability at age five for each of the varying combinations of the three at-risk groups, in comparison to the findings of Brownell et al. (2010) for poor outcomes in youth and early adulthood (not completing eight credits by the end of Grade 9, not completing high school, becoming a teen mom, receiving income assistance as a young adult).

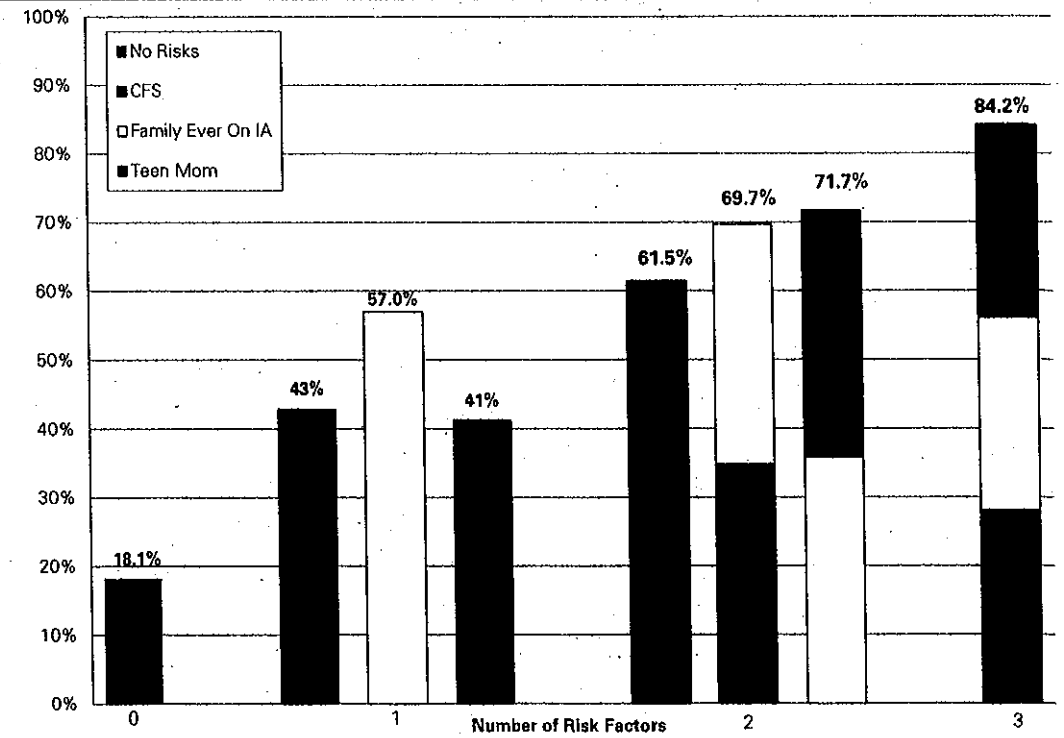
Figure 4.5: Percent Not Ready (≥ 1 EDI Domains) at Age 5 by Number of Risk Factors, Winnipeg†



† Children from 2006 & 2007 EDI cohorts who were born in 2000 & 2001

Source: Manitoba Centre for Health Policy, 2011

Figure 4.6: Percent Failing to Graduate within Seven Years of Entering Grade 9 by Number of Risk Factors, Winnipeg†

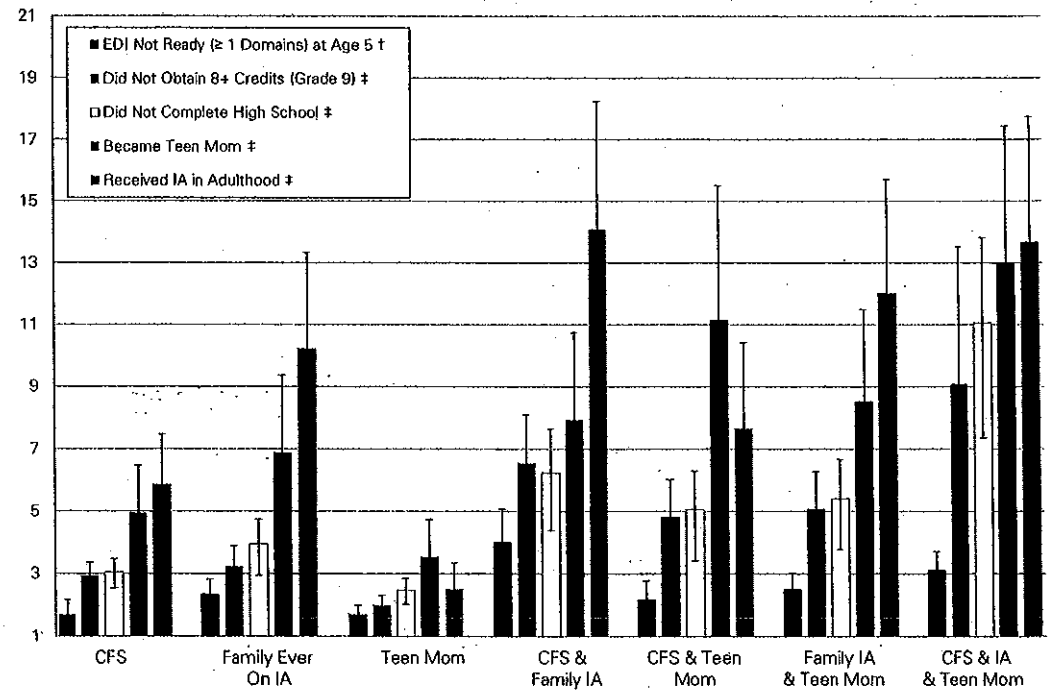


† Children from 2006 & 2007 EDI cohorts who were born in 2000 & 2001

Adapted from Brownell M, et al. (2010)

For all comparisons, the pattern and relative magnitude of results is similar. However, we found that the most vulnerable children are those in CFS and whose families have ever received IA; whereas in Brownell et al. (2010), it was the children in the triple combination that also included being born to a mother who was a teenager at first childbirth.

Figure 4.7: Odds Ratios for At-Risk Groups for Outcomes from Age 5 to Adulthood, Winnipeg†



† Children from 2006 & 2007 EDI cohorts who were born in 2000 & 2001
‡ 1984 & 1985 birth cohorts; Brownell M, et al. (2010)

Source: Manitoba Centre for Health Policy, 2011

The comparison between our findings and those of Brownell et al. (2010) suggests that the impact of being in an at-risk group accumulates and accelerates over time. The odds of poor outcomes grow rapidly from EDI at age five to credits in Grade 9, to high school completion, to becoming a teen parent, to receiving income assistance in early adulthood. While the odds of poor outcomes at age five are already considerable, they do not compare to the worse odds in later life. Taken together, these findings point to greater potential for preventing poor outcomes in youth and adulthood through early childhood intervention (prior to age five), which is long before much greater odds of poor life outcomes are stacked against our most at-risk children.

Our data indicate that being in one of these groups confers considerable risk; such that 38% of children born to mothers who were teens at first childbirth, 43% of children on income assistance, and 45% of children in child welfare are vulnerable (i.e., Not Ready) on EDI outcomes. Children from these three at-risk groups represent a considerable proportion (35%, 36%, and 25%, respectively) of all vulnerable Kindergarten children in the 2000 and 2001 combined Winnipeg birth cohort.[10]

10 In this section, we are indebted to the prior work of Harvey Stevens in looking at the risk of poor EDI outcomes in at-risk groups, and their relative share of the overall population.

By contrast, the three at-risk groups of children represent only 21%, 23%, and 13%, respectively, of the total 2000 and 2001 combined Winnipeg birth cohort. The ratios of vulnerable population prevalence and general population prevalence (e.g., for children born to mothers who were teens at first childbirth: 35%/21% = 1.67 or 67% overrepresentation) indicates that vulnerability is overrepresented in these groups by 67%, 57%, and 92%, respectively. Further, this overrepresentation exceeds or is comparable to those related to other well-established risk factors: living in a single parent family (27%), being a boy (29%), not being breastfed (36%), having a minor childhood illness (39%), requiring lengthy intensive care at birth (44%), having a major childhood illness (50%), or living in a family with four or more children (57%). Table A4.4 in Appendix 4 provides corresponding results for Not Ready, Very Ready, and MCI.

The overrepresentation of early developmental vulnerability in the three groups is even more apparent in the Multiple Challenge Index (MCI) of the EDI, which refers to children who are vulnerable in three or more EDI domains. Of our 2000 and 2001 combined Manitoba birth cohort, 5% were in the MCI group (930 of 17,220 children). By contrast, 10% of children born to mothers who were teens at first childbirth, 12% of children in families on income assistance, and 12% of children in child welfare were MCI children. Respectively, these three groups represented 42%, 36%, and 27% of all MCI children, in contrast to representing 24%, 17%, and 12% of the total study cohort. The ratios of vulnerable population prevalence and general population prevalence indicate that MCI vulnerability is overrepresented in these three groups by 77%, 118%, and 131%, respectively. These exceed or are comparable to the MCI overrepresentation related to living in a single parent family (42%), being a boy (46%), not being breastfed (49%), living in a family with four or more children (67%), having a minor childhood illness (85%), or requiring lengthy intensive care at birth (92%). They are exceeded in overrepresentation only by having a major childhood illness (192%).

The evidence presented in this and the preceding chapters outlines a consistent picture. The combination of biological and socioeconomic disadvantage from birth (and by extension, in utero) through early childhood is deleterious to children's developmental outcomes at age five. This is particularly evident in the three at-risk groups described in the present chapter. In the following chapters, we attempt to situate these findings in the larger, rapidly growing literature regarding the interaction of genes and environment in creating this "biology of disadvantage" (Adler & Stewart, 2010).

Chapter 5: Linking Biological Vulnerability and Socioeconomic Adversity

What Causes the Biology of Adversity in EDI Outcomes? Plausible Epigenetic Mechanisms for Children's Vulnerability at Age Five

Our findings relating biological vulnerability and socioeconomic adversity to EDI outcomes (Chapter 3) raise an important question: How does early experience "get under the skin" (Fox, Levitt, & Nelson, 2010; Hertzman & Boyce, 2009) to affect brain structure, behavioural development, and developmental health? Early experiences can affect adult health in two ways: cumulative damage over time or "biological embedding" of adversities during sensitive developmental periods where environmental experiences in early life "leave a mark" biologically and developmentally (Shonkoff, Boyce, & McEwen, 2009).

These early experiences have enduring effects on neural function through epigenetic mechanisms (described below). Taken together, our findings—(a) SES gradients in children's EDI outcomes at age five, (b) links between biological vulnerability at birth and children's EDI outcomes at age five, and (c) considerable concentrations of EDI vulnerability in groups living in significant socioeconomic adversity—are consistent with epigenetic evidence on the biological embedding of socioeconomic adversity during pregnancy and very early childhood.

What is epigenetics? Epigenetics refers to how the environment has an impact on the expression of genes (Zhang & Meaney, 2010). That is, our genes remain the same, but they can be turned on or off in a variety of ways, for better and worse, depending on the environment. Emerging evidence that environmental factors and experiences can directly modify the "epigenome"[11] (Szyf, 2009) and cause changes to gene structure, gene expression, and neural function is revolutionizing our understanding of gene–environment interactions (Meaney, 2010; National Scientific Council on the Developing Child, 2010; Petronis, 2010; Zhang & Meaney, 2010), particularly how the social environment in early life (Hackman, Farah, & Meaney, 2010; Szyf, McGowan, & Meaney, 2008) forms the "blueprint" of neural development (Fox et al., 2010).

Epigenetics provides a physical explanation for the influence of prenatal and perinatal environmental experiences on phenotype (the expression of the genotype or how our genes express themselves in terms of our health, learning, and behaviour) over the life course (Meaney, 2010; Szyf, 2009) particularly our responsiveness to stress and health status later in life (Ganzel, Morris, & Wethington, 2010; Szyf et al., 2008), including mental health (Schlotz & Phillips, 2009) and obesity and diabetes (Newnham et al., 2009). "In summary, epigenetics is emerging as *the hidden link* between early life exposure and late life events. Importantly, it provides an intellectual framework to understand the mysterious links between two disparate worlds, the social and economic environment and physical disease" (Szyf, 2009, p. 1084, italics added).

Being born at extremely low birth weight may have subtle effects on brain–behaviour relationships even in those without major impairments and evidence of these effects may not emerge until young adulthood (Schmidt et al., 2010). At best, the birth size measures in our analyses and other similar studies are but crude proxies for the nutritional and endocrine environment of the developing fetus

11 The epigenome is responsible for programming the genome "to express the appropriate set of genes in specific cells at specific time points in life" (Szyf, 2009; p 879).

(Gluckman & Hanson, 2010). Nonetheless, measures such as low birth weight and preterm birth were independent predictors of early developmental vulnerability in our findings. The future awaits the development of biological markers to detect altered developmental trajectories at an early stage (Gluckman & Hanson, 2010) to complement population-based early detectors such as the EDI, in a larger and integrated system of measuring and monitoring life course human development beginning in early life (Hertzman & Williams, 2009). The new research on DNA and brain development gives us an opportunity to take a fresh look at the impact of psychosocial and physical environments on human development starting at conception. There are specific areas of the brain that are impacted by different stressors and at different times during its development. We also know that some children are more sensitive to environments or stressors, which on one hand can cause them to excel beyond the norm if given a positive environment but, on the other hand, can lead to poorer health and well-being than expected if they grow up in a compromised environment. Further research looking at biological, social, and other environmental factors at specific ages can lead to better strategies that will enable positive human development for current and future generations (Hertzman & Boyce, 2009).

Of particular importance for policy and practice, unlike genetic mutations, epigenetic profiles are potentially reversible and hold "tremendous potential for not only individualized healthcare but also for population-wide disease diagnostic, screening, and prevention strategies" (Dolinoy & Jirtle, 2008, p. 8). Addressing the developmental origins of disparities in physical and mental health in early life, particularly during pregnancy and infancy (Gluckman & Hanson, 2004, 2006, 2010; Gluckman et al., 2009; Tremblay, 2010; see also chapters in Tremblay, van Aken, & Koops, 2009) may be more effective than improving access to healthcare or attempting to modify health-related behaviours in promoting health and preventing disease in adulthood (Shonkoff, Boyce, & McEwen, 2009).

Our findings are consistent with the "fetal programming hypothesis" in the context of adult disease, wherein small size at birth (developmental plasticity in utero), followed by rapid weight gain (compensatory growth) is associated with adverse effects in later life, particularly chronic diseases such as coronary heart disease, type 2 diabetes, and hypertension (Barker, Eriksson, Forsén, & Osmond, 2002; Barker, Osmond, Forsénm Kajantie, & Eriksson, 2005), associated with epigenetic mechanisms related to the hypothalamic-pituitary-adrenal axis (Ellison, 2010). "Growth restriction can be viewed as an appropriate immediate fetal adaptation to survive within the poor nutrient environment of the fetus" (Gluckman & Hanson, 2010, p. 22). This model of *predictive adaptive responses* (Gluckman & Hanson, 2006) or *adaptive plasticity* (Gluckman et al., 2009) describes the mismatch that occurs between the environment the fetus anticipates, based on in utero experiences, and the environment it actually encounters in postnatal life. This mismatch is the basis for poor developmental health over time. For example, maternal nutrition and stress exposure profoundly affect the epigenome of the developing fetus (Szyf et al., 2008). Other emerging evidence suggests that maternal cortisol and pregnancy-specific anxiety, such as that experienced by many pregnant mothers living in socioeconomic adversity, have programming effects on the developing fetus (Davis & Sandman, 2010). In a recent study, the first to link high-quality income data across the entire childhood period with adult outcomes measured as late as age 37, very early income poverty (prenatal to birth) appears to matter more in predicting adult body mass index than income after the birth year (Duncan, Ziol-Guest, & Kalil, 2010; Ziol-Guest, Duncan, & Kalil, 2009).

"Much of what we know about the impact of early experience on brain architecture comes from animal or human studies of deprivation. As we work to clarify further the patterns of genetic expression required for normal neural structure, we have also recognized that an optimal level of environmental

input or "expectable" environment must exist in parallel. Increasing evidence suggests that this "expectable environment" of early development requires not only the variation in light necessary for vision, or the tones heard in a spoken language, but also the emotional support and familiarity of a caregiver" (Fox, Levitt, & Nelson , 2010, p. 35). In other words, in the earliest moments of life, the developing child expects and needs love and nurturance to grow and thrive. By contrast, toxic relationship environments in early life can have lifelong destructive consequences. A recent landmark study provided the first evidence in humans of the effect of parental care on epigenetic regulation, specifically, hippocampal glucocorticoid receptor expression: childhood abuse alters hypothalamic–pituitary–adrenal stress responses and increases the risk of suicide in later life (McGowan et al., 2009).

Our findings are also relevant to understanding the intergenerational transmission of risk. Being in one or more of the three at–risk groups (born to moms who were teens at first childbirth, in families on income assistance, in the child welfare system) was strongly associated with early developmental vulnerability at age five. Cross–sectional survey sample evidence from Manitoba shows that this early vulnerability is associated with self–reported maternal harshness in parenting (Healthy Child Manitoba, 2005, 2010). Longitudinal population–based evidence from Manitoba shows that girls in one or more of these three vulnerable groups are significantly more likely to become teen mothers themselves (Brownell et al., 2010). Taken together, a series of possible intergenerational mechanisms underlying and connecting these findings is suggested in recent longitudinal analyses from the largest study of child care to date, wherein (a) greater maternal harshness toward children at age 54 months predicted earlier age of menarche (menstruation onset); (b) earlier age of menarche predicted greater sexual (but not other) risk taking; and (c) maternal harshness exerted a significant indirect effect, via earlier menarche, on sexual risk taking (i.e., greater harshness –> earlier menarche –> greater sexual risk taking) but only a direct effect on other risk taking (Belsky, Steinberg, Houts, Halper–Fisher, & NICHD Early Child Care Research Network, 2010).

The foregoing revolution in unraveling intergenerational gene by environment interactions through epigenetic mechanisms has also expanded our understanding of longstanding scientific concepts of diathesis (biological or genetic predisposition) and stress, risk factors and protective factors, and vulnerability and resilience. We turn to this expanded understanding in the next chapter.

[redacted]

Chapter 6: Beyond Vulnerability and Adversity

Differential Susceptibility/Biological Sensitivity to Context

"Evidence indicates that rather than some children, such as those with negatively emotional temperaments or certain genotypes, being simply more vulnerable to the adverse effects of negative experiences, as commonly assumed, they may actually be more susceptible to both positive and negative experiences" (Belsky & Pluess, 2009b, p. 345). Children vary in their susceptibility to environmental influences. In other words, some children develop for better *and* for worse, depending on their environments.

This **differential susceptibility** (Belsky, 1997; Belsky, Bakermans–Kranenburg, & van IJzendoorn, 2007; Belsky & Pluess, 2009a; Pluess & Belsky, 2009) or **biological sensitivity to context** (Boyce & Ellis, 2005) has been shown in a recent study of the school readiness of Kindergarten children, wherein high stress reactivity was associated with more maladaptive outcomes in the context of high adversity but with better adaptation in the context of low adversity (Obradović, Bush, Stamperdahl, Adler, & Boyce, 2010). Similar interaction effects between difficult/negative child temperament and attachment–focused parenting intervention (Klein Velderman, Bakermans–Kranenburg, Juffer, & van IJzendoorn, 2006), as well as the contexts of low–quality child care and high–quality child care (Pluess & Belsky, 2009) on early childhood outcomes, have also been reported recently. Additional evidence shows that differential susceptibility to parenting and child care quality extends from early to late middle childhood (Pluess & Belsky, 2010). Some children who appear to be highly vulnerable and seem less likely to benefit from intervention may actually be *more* responsive to it.

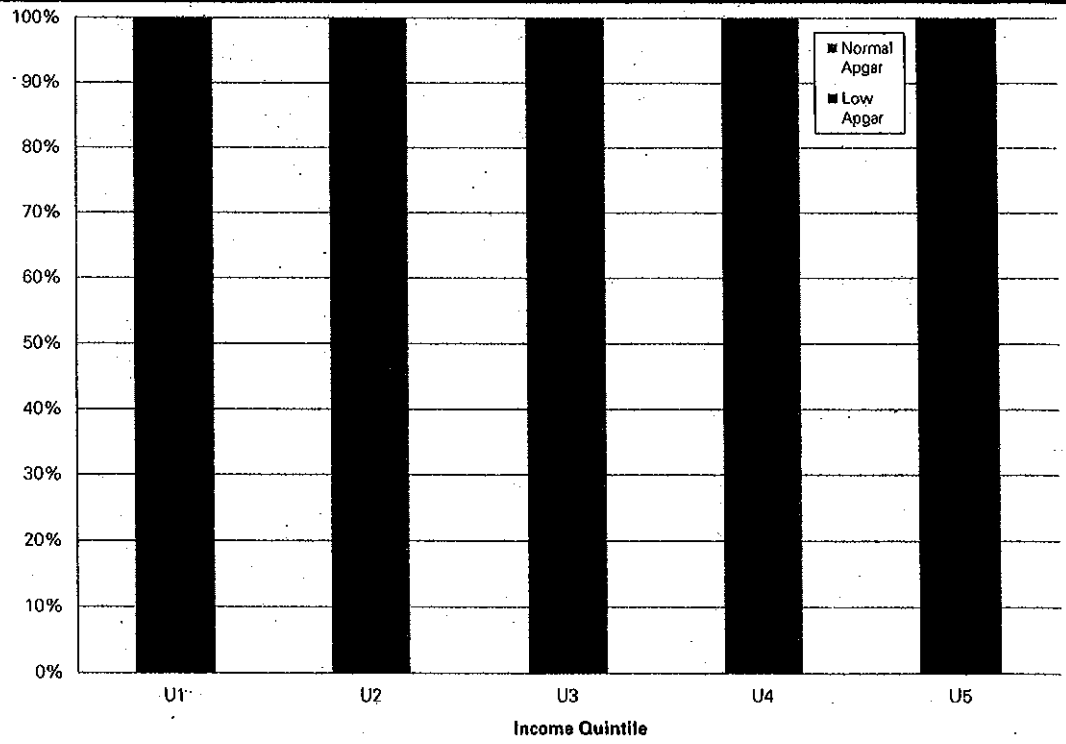
In the first experimental test of gene (measured) by environment (observed) interaction in human development, findings indicated that children may be differentially susceptible to intervention effects, depending on genetic differences in the presence or absence of the dopamine D4 receptor (DRD4) 7–repeat allele polymorphism (Bakermans–Kranenburg, van IJzendoorn, Pijlman, Mesman, & Juffer, 2008). Previous evidence indicated that children were differentially susceptible to insensitive parenting depending on the presence of this polymorphism; for example, maternal insensitivity was associated with externalizing behaviour (e.g., marked noncompliance, aggression toward peers, poor regulation of impulses) in preschoolers (Bakermans–Kranenburg & van IJzendoorn, 2006). Both studies link differential susceptibility/biological sensitivity to context to the epigenetic mechanisms as discussed in the previous chapter.

In light of the foregoing evidence, we wondered whether there was evidence of differential susceptibility/biological sensitivity to context in our data linking biological vulnerability at birth to children's developmental outcomes at age five. To test this, we used 5–minute Apgar at birth and breastfeeding initiation for children born in a Manitoba hospital.

Exploring the Differential Susceptibility Hypothesis: Biological Sensitivity to Context at Birth, Caregiving Context, and Children's Developmental Outcomes at Age Five

Over 50 years old now, the **Apgar score** remains a venerable population–based measure of children's stress reactivity and vulnerability at birth. While there is evidence that low Apgar scores also exhibit SES gradients, with larger proportions in lower SES groups (Odd et al., 2008), in Manitoba no such gradient appears in low Apgar scores (see Figures 6.1 and 6.2). In both urban and rural areas, low Apgar scores are relatively evenly distributed across income quintiles (see Tables A5.1 and A5.2 in Appendix 5 for corresponding counts).

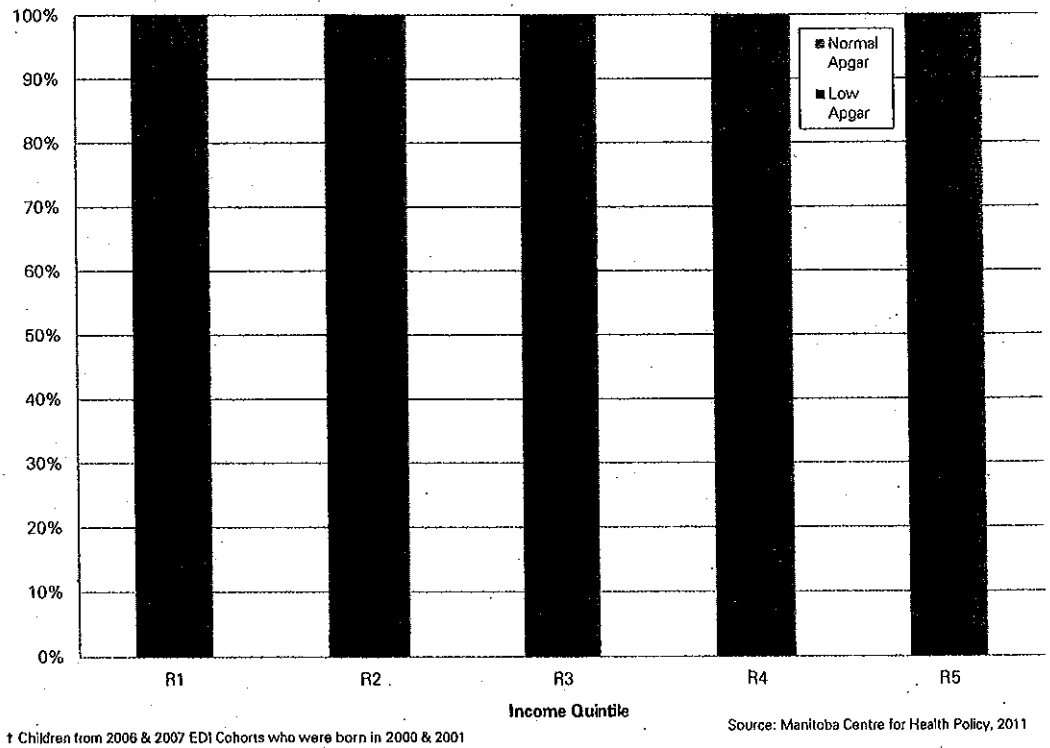
Figure 6.1: Percent of Normal and Low 5-Minute Apgar Scores by Urban Income Quintile, Manitoba†



† Children from 2006 & 2007 EDI Cohorts who were born in 2000 & 2001

Source: Manitoba Centre for Health Policy,

Figure 6.2: Percent of Normal and Low 5-Minute Apgar Scores by Rural Income Quintile, Manitoba†



† Children from 2006 & 2007 EDI Cohorts who were born in 2000 & 2001

Source: Manitoba Centre for Health Policy, 2011

As in low EDI scores, males are significantly overrepresented in low Apgar scores (<8), not only in high-risk births, but also full-term healthy male newborns; and this suggests a very early sex difference in adaptation to adverse circumstances at birth (Nagy, Orvos, Bakki, & Pal, 2009). "Such differential vulnerability however, could represent ... differential susceptibility, or differential sensitivity to biological context. This means that male infants in a more prolonged window of early development are not merely more vulnerable, but may also be more susceptible to positive interventions as well. This hypothesis however, requires further investigation," (Nagy et al., 2009, p. 899).[12]

Of the pertinent population-based data available from MCHP's Repository, low 5-minute Apgar scores appeared to represent the best measure of biological sensitivity to context (Boyce & Ellis, 2005; Obradović et al., 2010), and breastfeeding initiation appeared to represent the best measure for a high-quality caregiving context. Different Apgar score cut-offs can be selected to suit local needs and resources (Chong & Karlberg, 2004). For comparability to recent work using Repository data to link Apgar scores to long-term outcomes (Jutte et al., 2010), we used a cut-off score of less than 8 (<8) to denote low 5-minute Apgar scores.

To explore differential susceptibility, we looked at both positive and negative outcomes: "very ready" (VR) in one or more domains on the EDI and "not ready" (NR) in one or more domains on the EDI. If differential susceptibility/biological sensitivity to context is operative, then children with low 5-minute Apgar scores should show greater sensitivity *for better and for worse*. Rather than being merely more predisposed to poor outcomes, some children may be more predisposed to both better and worse outcomes, depending on context. Stated differently, some children may be epigenetically programmed for *both* success *and* failure depending on the social environment. In the context of poor-quality

12 This hypothesis goes beyond the scope of the current report.

caregiving (represented here by no breastfeeding), these highly-sensitive/susceptible children are more likely to have the worst EDI outcomes, compared to less-sensitive/susceptible ("normal") children in the same poor-quality context. In contrast, in the context of high-quality caregiving (represented here by breastfeeding initiation), these highly-sensitive/susceptible children are more likely to have the best or comparable EDI outcomes, compared to less-sensitive/susceptible ("normal") children in the same high-quality context.

In contrast to the literature, we found that being male was not statistically significantly associated with low Apgar scores (OR = 1.13, p = .16). Therefore, we did not incorporate this variable further in our analyses.

Out of our total sample of 17,215 children for whom we had data on Apgar score, breastfeeding, and EDI outcomes: (a) 607 (3.5%) had a low 5-minute Apgar score, (b) 2,885 (16.8%) were not breastfed, (c) 4,140 (24.0%) were NR on the EDI, and (d) 10,143 (58.9%) were VR on the EDI. As in our modeling analyses, we excluded VR from NR samples and NR from VR samples, creating non-overlapping subgroups.

We also found that 27.5% of the low 5-minute Apgar group (167/607) were NR on the EDI and 23.9% of the normal 5-minute Apgar group (3,973/16,608) were NR on the EDI. Further, we found that 55.7% of the low 5-minute Apgar group (338/607) were VR on the EDI and 59.0% of the normal 5-minute Apgar group (9,805/16,608) were VR on the EDI.

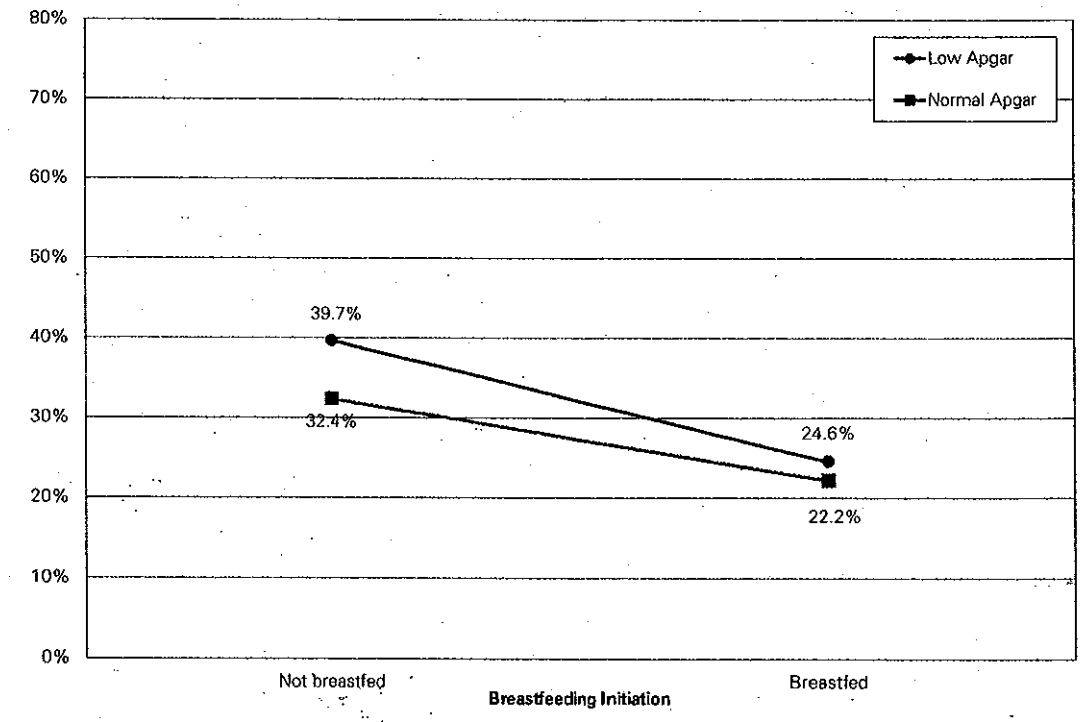
Evidence of Differential Susceptibility to Caregiving and EDI Outcomes

As predicted by the differential susceptibility/biological sensitivity to context hypothesis, we found that children with low 5-minute Apgar scores showed greater responsiveness to the presence or absence of breastfeeding on both VR and NR outcomes (overall and domain-specific) on the EDI (see Figures 6.3 and 6.4 and Appendix Figures A5.1 to A5.10). For all comparisons, children who are differentially susceptible (low 5-minute Apgar score) showed greater sensitivity to caregiving (breastfeeding) for better (VR) and worse (NR). This is shown in each of Figure 6.3 and Appendix Figures A5.1 to A5.5, where the difference between being breastfed and not breastfed (slope in lines) is larger for differentially susceptible children (steeper slope) than the difference between being breastfed and not breastfed for children with normal 5-minute Apgar scores. Breastfeeding appears to serve as a protective factor for low Apgar children, closing their gap in EDI outcomes with normal Apgar children. Tables 6.1 and 6.2 and Appendix Tables A5.3 to A5.12 present the odds ratios for contrasts between the different Apgar and breastfeeding group comparisons.

Of particular clinical interest is the fifth group contrast presented in each of these tables: low Apgar children who were breastfed versus normal Apgar children who were not breastfed. For example, low Apgar children who were breastfed were statistically significantly less likely to be vulnerable on the EDI (OR = 0.80, p = .05) and 1.24 times more likely to be Very Ready on the EDI (OR = 1.24, p = .03), compared to normal Apgar children who were not breastfed (Tables 6.1 and 6.2, respectively).

Table 6.3 presents the denominators for above mentioned figures (i.e., the numbers who were breastfed or not by low/normal Apgar score).

Figure 6.3: Percent Not Ready (≥ 1 EDI Domains) at Age 5 by Breastfeeding and 5-Minute Apgar Score, Manitoba†



† Children from 2006 & 2007 EDI Cohorts who were born in 2000 & 2001

Source: Manitoba Centre for Health Policy, 2011

Table 6.1: Odds Ratios for Not Ready (≥ 1 EDI Domains) at Age 5: Contrasts Between Different 5-Minute Apgar and Breastfeeding Group Comparisons, Manitoba†

Low apgar/breastfed vs Normal apgar/breastfed	1.13	0.25
Low apgar/not breastfed vs Normal apgar/not breastfed	1.39	0.10
Low apgar/breastfed vs Low apgar/not breastfed	**0.57**	0.01
Normal apgar/breastfed vs Normal apgar/not breastfed	**0.70**	<0.0001
Low apgar/breastfed vs Normal apgar/not breastfed	**0.80**	0.05

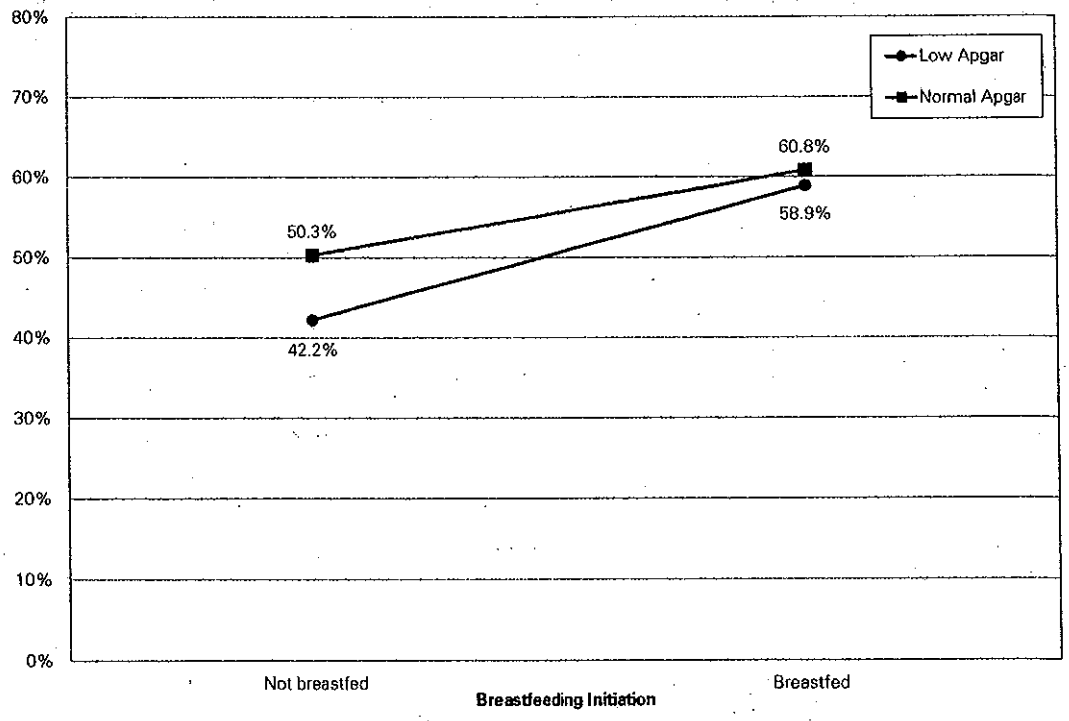
† Children from 2006 & 2007 EDI cohorts who were born in 2000 & 2001

Bolded values are significant ($p \leq 0.05$)

Note: Results are from multilevel modeling, controlling for area-level income.

Source: Manitoba Centre for Health Policy, 2011

Figure 6.4: Percent Very Ready (> 1 EDI Domains) at Age 5 by Breastfeeding and 5-Minute Apgar Score, Manitoba†



† Children from 2006 & 2007 EDI Cohorts who were born in 2000 & 2001

Source: Manitoba Centre for Health Policy, 2011

Table 6.2: Odds Ratios for Very Ready (≥ 1 EDI Domains) at Age 5: Contrasts Between Different 5-Minute Apgar and Breastfeeding Group Comparisons†

Low apgar/breastfed vs Normal apgar/breastfed	0.92	0.41
Low apgar/not breastfed vs Normal apgar/not breastfed	0.71	0.08
Low apgar/breastfed vs Low apgar/not breastfed	**1.74**	0.01
Normal apgar/breastfed vs Normal apgar/not breastfed	**1.35**	<0.0001
Low apgar/breastfed vs Normal apgar/not breastfed	**1.24**	0.03

† Children from 2006 & 2007 EDI cohorts who were born in 2000 & 2001

Bolded values are significant ($p < 0.05$)

Note: Results are from multilevel modeling, controlling for area-level income.

Source: Manitoba Centre for Health Policy, 2011

Table 6.3: Number of Children Breastfed, by 5-Minute Apgar Score, Manitoba[†]

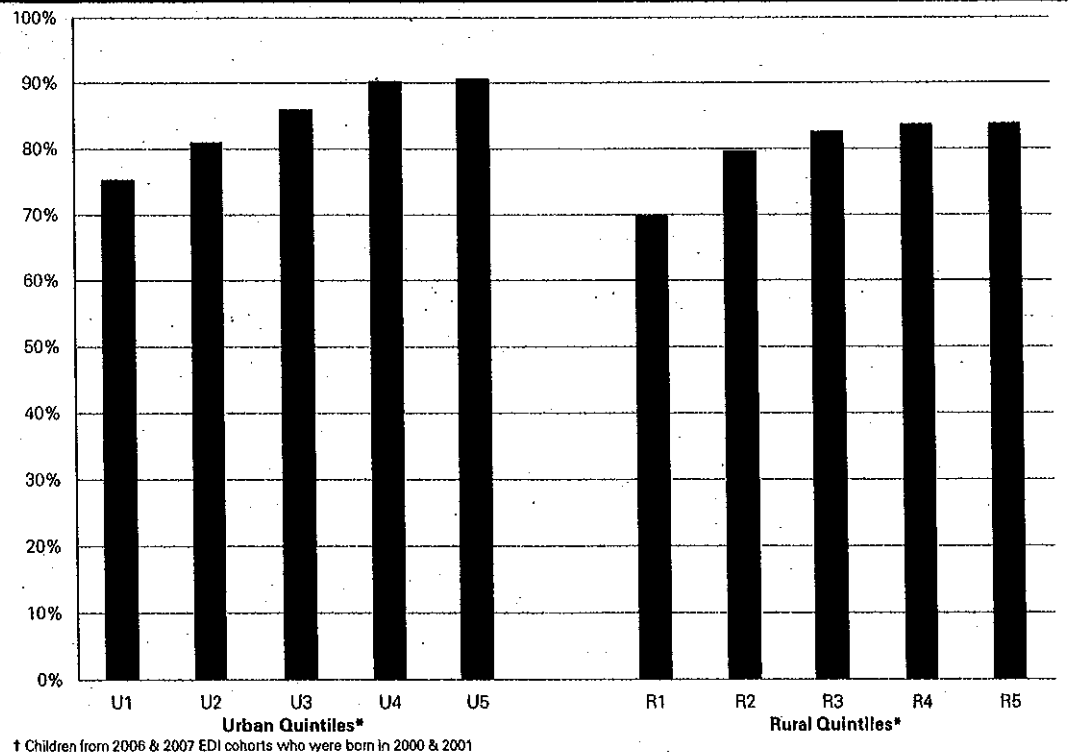
	Low (<8)	Normal (≥8)
Breastfed	[illegible]	[illegible]
Not Breastfed	116	2,769

[†] Children from 2006 & 2007 EDI cohorts who were born in 2000 & 2001

Source: Manitoba Centre for Health Policy, 2011

Our findings are also consistent even after controlling for SES (area–level income), which is related to breastfeeding, as shown in Figure 6.5. Higher levels of breastfeeding initiation are found in higher income areas.

Figure 6.5: Percent of Breastfeeding Initiation by Urban and Rural Income Quintiles, Manitoba[†]



† Children from 2006 & 2007 EDI cohorts who were born in 2000 & 2001

*Linear trend test significant ($p < 0.05$)

Source: Manitoba Centre for Health Policy, 2011

In Table 6.4, we present the odds ratios for EDI outcomes as a function of low Apgar score and breastfeeding initiation, for logistic models both with and without SES taken into account (multilevel model). Breastfeeding was a consistently statistically significant predictor of EDI outcomes, even after controlling for SES.

Table 6.4: Relationship between 5-Minute Apgar Scores, Breastfeeding, SES, and EDI Outcome, Manitoba†

	Odds Ratios			
	Model without SES		Model with SES	
	Low Apgar	Breastfed	Low Apgar	Breastfed
NOT READY				
Not Ready ≥ 1 EDI Domains	1.19 (0.99 - 1.43)	**0.69 (0.64 - 0.65)**	1.19 (0.99 - 1.43)	**0.70 (0.64 - 0.76)**
Physical Health and Well-Being	1.21 (0.95 - 1.54)	**0.59 (0.53 - 0.66)**	1.21 (0.95 - 1.54)	**0.69 (0.62 - 0.78)**
Social Competence	**1.31 (1.02 - 1.69)**	**0.64 (0.56 - 0.72)**	**1.32 (1.03 - 1.70)**	**0.75 (0.66 - 0.85)**
Emotional Maturity	1.15 (0.90 - 1.48)	**0.81 (0.72 - 0.92)**	1.14 (0.89 - 1.47)	**0.90 (0.79 - 1.02)**
Language and Cognitive Development	**1.41 (1.13 - 1.77)**	**0.55 (0.49 - 0.61)**	**1.42 (1.13 - 1.78)**	**0.68 (0.61 - 0.76)**
Communication Skills and General Knowledge	**1.40 (1.11 - 1.77)**	**0.55 (0.49 - 0.61)**	**1.39 (1.10 - 1.77)**	**0.63 (0.56 - 0.71)**
VERY READY				
Very Ready ≥ 1 EDI Domains	0.88 (0.75 - 1.04)	**1.55 (1.43 - 1.68)**	0.88 (0.75 - 1.04)	**1.36 (1.25 - 1.48)**
Physical Health and Well-Being	0.91 (0.76 - 1.08)	**1.39 (1.27 - 1.52)**	0.91 (0.76 - 1.08)	**1.27 (1.16 - 1.40)**
Social Competence	0.94 (0.79 - 1.12)	**1.25 (1.14 - 1.37)**	0.95 (0.79 - 1.13)	**1.16 (1.06 - 1.27)**
Emotional Maturity	0.97 (0.81 - 1.16)	**1.29 (1.17 - 1.41)**	0.96 (0.80 - 1.16)	**1.16 (1.06 - 1.28)**
Language and Cognitive Development	0.83 (0.68 - 1.02)	**1.64 (1.48 - 1.82)**	0.84 (0.68 - 1.02)	**1.45 (1.31 - 1.62)**
Communication Skills and General Knowledge	0.87 (0.73 - 1.04)	**1.53 (1.40 - 1.68)**	0.87 (0.73 - 1.04)	**1.40 (1.27 - 1.53)**

† Children from 2006 & 2007 EDI cohorts who were born in 2000 & 2001
Bolded values are significant ($p < 0.05$)

Source: Manitoba Centre for Health Policy, 2011

In contrast, and contrary to expectations, low 5–minute Apgar score was not often a statistically significant predictor of EDI outcomes. It was significant only for predicting vulnerability (NR) in social competence, language and cognitive development, and communications skills and general knowledge. This general lack of a main effect of low 5–minute Apgar scores may be due to the smaller sample size of this group, compared to the normal 5–minute Agpar group. This may have limited the statistical power of our analyses to detect a statistically significant interaction between Apgar score and breastfeeding initiation for EDI outcomes. This suggests that the effects of breastfeeding are constant across different Apgar levels and that the effects of Apgar are constant across different breastfeeding levels.

Our findings also indicate that low 5–minute Apgar scores are relatively evenly distributed across income quintiles, whereas breastfeeding initiation is unevenly distributed across income quintiles (i.e., less common in risk–augmenting contexts (Hertzman & Boyce, 2009), that is lower SES areas. Biologically susceptible children fortunate to be in protective environments where breastfeeding is provided may respond more strongly than biologically "unsusceptible" children in protective environments.

Recent population–based studies have found that low Apgar scores predict short–term health outcomes such as neonatal mortality in very low birth weight infants (Mori, Shiraishi, Negishi, & Fujimura, 2008), 180–day survival of extremely preterm infants (Forsblad, Källén, Maršál, & Hellström–Westas, 2006), long–term cognitive outcomes such as IQ at age 18 (Odd, Rasmussen, Gunnell, Lewis, & Whitelaw, 2007), and neurologic disability and low cognitive function at age 19 (Ehrenstein et al., 2009).

Our findings are consistent with other longitudinal evidence linking prenatal and perinatal adversity, including low Apgar scores, to language and cognitive outcomes (Marschik, Einspeler, Garzarolli, & Prechtl, 2007) and social and emotional problems in early childhood (Martini, Knappe, Beesdo–Baum,

Lieb, & Wittchen, 2010), behavioural problems in middle childhood (van den Broek, Kok, Houtzager, & Scherjon, 2010), and psychiatric disorders in early adulthood (Batstra, Neeleman, Elsinga, & Hadders-Algra, 2006).

Some evidence suggests higher Apgar scores are associated with increased breastfeeding (Sisk et al., 2009), whereas other evidence suggests lower Apgar scores are associated with increased breastfeeding (Espy et al., 2003). However, we found similarly high breastfeeding prevalence in children with low 5-minute Apgar scores (80.9%) and normal 5-minute Apgar scores (83.3%).

Using low 5-minute Apgar scores as a crude measure of biological sensitivity to context at birth and breastfeeding initiation at birth as a crude measure of high-quality caregiving, we found evidence of differential susceptibility to caregiving. To our knowledge, this is the first study to explore differential susceptibility in EDI outcomes. Further, we could not find any extant studies demonstrating a protective effect of breastfeeding in children with low Apgar scores.

In summary, our differential susceptibility findings are consistent with the working hypothesis that "those who are biologically sensitive to context will be distributed broadly across social partitions, but those from less privileged backgrounds will tend to find themselves in risk-augmenting contexts, whereas those from more privileged backgrounds will tend to find themselves in protective environments. Over time, the differences in developmental trajectories of those biologically sensitive to context will drive the expression of gradients" (Hertzman & Boyce, 2009, p. 342–343).

[redacted]

Chapter 7: Summary and Conclusions

The findings in this report suggest that children's developmental vulnerability in Manitoba has several characteristics. Taken together, previous and present results suggest that the underlying mechanisms driving vulnerability in health, learning, and behaviour over the life course begins early —in *prenatal* life through to *preschool* age (related to factors that are potentially modifiable). They are *pervasive* (affecting large numbers and a wide range of the population every year), *persistent* (manifesting effects over time within and across populations and across successive generations), and *pernicious* (affecting a wide range of developmental outcomes and disproportionately affecting more of the socioeconomically disadvantaged).

Key Findings

1. Socioeconomic inequities in health, learning, and behaviour appear very early in development. We found SES gradients in children's developmental outcomes at age five, at birth, and, by extension, in utero, alongside evidence of SES gradients in children's caregiving environments (e.g., breastfeeding initiation). We found considerable prevalence of children's EDI vulnerability at school entry (ranging from 21% to nearly 40% of children across income quintiles with 26% of all Manitoba children being vulnerable on EDI outcomes, representing thousands of children each year).[13]

2. Early life (in utero and at birth) matters for children's early developmental outcomes at age five. We found that the relationship between Winnipeg children's health at birth and their EDI outcomes was mediated by major and minor illnesses in early childhood, after controlling for SES and other variables. This parallels the findings of Fransoo et al. (2008) for literacy and numeracy outcomes measured at a later age (in Grade 3), in a Winnipeg population cohort born a decade earlier, and extends their outcome results to the physical, social, emotional, and communication domains of development. We found similar results for non–Winnipeg, but with health status at birth also demonstrating a direct effect on EDI outcomes five years later.

3. Three at–risk groups of children were especially vulnerable in their early development. Children falling into one or more of the of the following three at–risk groups were even more vulnerable on EDI outcomes: born to mothers who were teenagers at their first childbirth, children in families ever on income assistance (IA), and children involved with CFS. Our findings concur with those of Brownell et al. (2010) for developmental outcomes measured at later ages (e.g., Grades 9 to 12), in a population cohort born a decade and a half earlier. Further, our EDI findings for children in CFS are comparable to those recently reported for British Columbia (Representative for Children and Youth and the Office of the Provincial Health Officer, 2007).

Our 2000 and 2001 population birth cohorts were conceived, born, and reared in an era of growing socioeconomic inequality over time in terms of both risk factors (e.g., area level income, teen pregnancy) and protective factors (e.g., breastfeeding initiation), within and between regions of the province (Martens et al., 2010). Moreover, the prevalence of children born to mothers who were teenagers at first childbirth, in families ever on IA, and/or involved with CFS has remained largely unchanged over the past two decades, from just under 31% (Brownell et al., 2010) to 32% in the present study.

13 Our findings are consistent with other studies using different definitions and measures to estimate the prevalence of children's vulnerability, most of which find about one in four children are vulnerable (Willms, in press). For example, a recent study of another representative, healthy birth cohort at school entry (Carter et al., 2010) found a similar prevalence (22%) of vulnerability (defined as a DSM–IV disorder).

We found the first exploratory evidence, albeit preliminary and suggestive, of differential susceptibility or biological sensitivity to context using the EDI as the outcome measure. Both in terms of overall EDI and domain-specific (physical, social, emotional, language, and communication) outcomes, our results indicate larger outcome differences between highly-sensitive/susceptible children (low 5-minute Apgar score) in low- versus high-quality caregiving environments (as measured by breastfeeding initiation) than outcome differences between less-sensitive/susceptible ("normal") children in the same low- versus high-quality caregiving environments. Moreover, highly-sensitive/susceptible children with high-quality caregiving were more likely to do better than less-sensitive/susceptible ("normal") children with low-quality caregiving on both negative outcomes ("not ready" in one or more EDI domains) and positive outcomes ("very ready" in one or more EDI domains). Our admittedly crude measures of sensitivity-susceptibility and the caregiving environment provided suggestive population-based evidence of differential susceptibility to caregiving. These preliminary findings merit further exploration with larger samples and more refined measures. They add to growing evidence that requires us to reconceptualize our notions of diathesis (biological or genetic predisposition) and stress, risk factors and protective factors, and vulnerability and resilience.

Consistent with our SEM findings for breastfeeding initiation and language and communication outcomes (Winnipeg sample), the largest randomized trial of breastfeeding ever undertaken—the Promotion of Breastfeeding Intervention Trial (PROBIT)—provided strong evidence that prolonged and exclusive breastfeeding improves children's cognitive development at age six and a half (6.5) years, including teacher-rated academic reading and writing (Kramer, Aboud, et al., 2008). Also consistent with our findings for social and emotional outcomes (Winnipeg sample), the PROBIT study found no evidence of breastfeeding effects on children's behaviour problems (including parent- and teacher-rated emotional, hyperactivity, conduct, or peer problems) or on children's prosocial behaviour, at age 6.5 (Kramer, Fombonne, et al., 2008). The PROBIT study excluded infants with 5-minute Apgar scores less than 5 (Kramer et al., 2000), limiting its ability to discern differential susceptibility to breastfeeding as a function of very low Apgar scores. Future studies using more refined measures of sensitivity-susceptibility (e.g., genetic data) and experimental designs using breastfeeding (both initiation and duration) are needed to validate our findings.

Earlier evidence suggested that, even with effective early intervention, so-called vulnerable children never attained outcomes comparable to those of "normal" children. For example, a meta-analysis of the effects of early childhood intervention on the home environment found that interventions with middle-class, non-adolescent parents showed larger effect sizes than interventions with low-SES or adolescent parents, the so-called "Matthew effect" wherein families in better living conditions benefitted more from intervention (Bakermans-Kranenburg, van IJzendoorn, & Bradley, 2005). In contrast, more recent findings, including those from the present study, suggest that some so-called vulnerable children, (reconceptualized as highly-sensitive/susceptible children), may respond more strongly to intervention than so-called normal children (reconceptualized as less-sensitive/susceptible children) given the right environments (including the right interventions).

Study Limitations

While our findings confirmed the importance of breastfeeding initiation, we did not have data on breastfeeding continuation. Several other proximal process variables (see Guhn & Goelman, 2011) of particular (and empirically supported) importance, especially parenting behaviours such as reading with children (Willms, in press), are not (currently) available at a population level and therefore could not be included in our analyses. Further, data that differentiate the contributions of both mothers and fathers is important but also lacking. New findings from the U.S. NICHD Study of Early Child Care and Youth Development suggest that fathers may influence children's early cognitive and socioemotional development and school readiness primarily as potential buffers against unsupportive mother parenting (Martin, Ryan, & Brooks-Gunn, 2010).

Our analyses do not directly account for genetic contributions to predictors or outcomes of child development (e.g., as did Lemelin et al., 2007). For example, our predictor variables included both being in single parent families and having a mother who was a teenager at her first childbirth. On average, children raised without a biological father in the household have sexual intercourse at earlier ages than children raised in households with their fathers present. The prevailing view has been that this effect is attributable to biological father absence in socialization and physical maturation, but genetically sensitive study designs (e.g., twin, sibling, offspring, or adoption studies) have found that the role of family environment in reproductive maturation is overestimated—"genes affect timing of pubertal development, timing of first intercourse, and age at first childbirth, which subsequently predict likelihood of nonresidential fathers for offspring" (Mendle et al., 2009, p. 1476)—and confirms the environmental effects of early maternal age at childbirth in poor outcomes of offspring, especially later-born children (D'Onofrio et al., 2009).

Our measure of developmental vulnerability in Kindergarten, the EDI, is based on teacher observation and report. While there is strong and growing evidence of the reliability and validity of the EDI (see special journal issues edited by Guhn et al., 2007, 2011a), there is some evidence suggesting considerable individual differences in teachers' ability to evaluate school readiness relative to direct, child-based assessments (Hymel et al., 2011). But the current evidence base supports the validity of using EDI data as we did in the present study (Forer & Zumbo, 2011), including for looking at the overall vulnerability of children at a population level.

Implications and Recommendations for Research

We were surprised to find no robust statistically significant risk in EDI vulnerability related to maternal depression or residential mobility (family moving three or more times in the child's life).[14] The prevalence of early developmental vulnerability in children with depressed mothers or in frequently moving families was similar to the prevalence of early developmental vulnerability in children without these risk factors. Previous research using the EDI, through the Government of Canada's Understanding the Early Years (UEY) initiative, found both of these factors, as measured by sample-based parent surveys, to be strongly associated with EDI outcomes. Further research that, for example, elaborates on the timing and sequence of maternal depression and child development, using data available in MCHP's Repository, would be valuable, particularly in light of the considerable evidence on the deleterious effects of mothers' depression on their children's life course outcomes. For example, a new study suggests that the negative effects of maternal depression on child behaviour are specific to the first year of their children's lives, suggesting a sensitive period (Bagner, Pettit, Lewinsohn, & Seeley, 2010).

14 Our analyses suggested these findings were not due to multicollinearity.

Further work on unpacking the SES gradient (including social and material deprivation measures of SES) could shed further light on underlying mechanisms of health inequities. And further work on in utero (and preconception) predictors (including genetic and epigenetic predictors) embedded in socioeconomic circumstances at a population level is essential (Ganzel et al., 2010; Hackman et al., 2010).

Finally, continued research linking EDI to subsequent outcomes (e.g., Grade 3 academic performance) is especially crucial for elaborating developmental trajectories and building on our current EDI evidence base (Forget-Dubois et al., 2007; Lloyd & Hertzman, 2009, 2010; Lloyd et al., 2009, 2010). Perhaps most importantly, anchoring developmental trajectories within experimental prevention and intervention evaluation studies to improve EDI outcomes are imperative and could be closely linked to suggested strategies for policy action in the following section.

Implications and Recommendations for Policy

1. Target multiple risk factors for the most at-risk families.

Our findings are consistent with extensive evidence on the early family environment and "risky" families (Repetti, Taylor, & Seeman, 2002; Matthews, Gallo, & Taylor, 2010) The physical environment can influence child development both directly and indirectly through adult caregivers; childhood exposure to environmental conditions is not random (Evans, 2006). Children at the bottom of the SES distribution are disproportionately exposed to multiple adverse environmental conditions that can be regarded as a distinct environment of childhood poverty:

> Poor children confront widespread environmental inequalities. Compared to economically advantaged children, they are exposed to more family turmoil, violence, separation from their families, instability, and chaotic households. Poor children experience less social support, and their parents are less responsive and more authoritarian. Low-income children are read to relatively infrequently, watch more TV, and have less access to books and computers. Low-income parents are less involved in their children's school activities. The air and water poor children consume are more polluted. Their homes are more crowded, noisier, and of lower quality. Low-income neighborhoods are more dangerous, offer poorer municipal services, and suffer greater physical deterioration. .... The accumulation of multiple environmental risks rather than singular risk exposure may be an especially pathogenic aspect of childhood poverty (Evans, 2004, p. 77).

Multiple physical and psychosocial risk exposures, combined with socioeconomic disadvantage, are plausible major pathways or mechanisms leading to SES gradients in health from childhood to adulthood (Evans & Kim, 2010). Prenatal and early childhood periods appear particularly important, especially for families living in risky conditions of socioeconomic disadvantage (Berkman, 2009; Chen, Matthews, & Boyce, 2002; Cohen, Janicki-Deverts, Chen, & Matthews, 2010; Hackman et al., 2010; Matthews, Gallo, & Taylor, 2010).

A key policy implication of these findings is that interventions targeting singular risks are likely to be less effective than interventions targeting multiple risk exposures. Furthermore, families such as those in our three at-risk groups, who face the greatest amount of multiple risk exposure, should be prioritized for interventions (Evans & Kim, 2010). Each of our at-risk groups (children born to mothers who were teens at first childbirth, children in families living on IA, and children in CFS) are themselves strongly graded by SES and are highly overrepresented in the lowest income quintile.

2. Use provincially available information at birth (or earlier) to help identify and target at-risk groups for early intervention (prior to contact with social services).

Although it is unclear from our data whether the vulnerability of children in families on IA or involved with CFS is due to being in these social programs or due to the reasons for being in these social programs (e.g., poverty, child maltreatment), or both of these, it can be inferred that strategies that successfully prevent children and families from needing these services can contribute to improving developmental health during early childhood and into adulthood. For example, our previous work has shown that Manitoba's provincial postpartum Families First Screen strongly predicts later CFS involvement (Brownell et al., 2007; Brownell et al, 2011). A key policy implication is that Families First data at birth (or prenatally) could be used for early identification and targetting strategies in child maltreatment prevention efforts and other differential response interventions prior to, or instead of, apprehension by child welfare authorities; and this, in turn, would increase the odds of better EDI outcomes.

3. Use existing provincial social service infrastructure for reaching the most at-risk families with effective intervention.

For those children missed by the foregoing strategies, a key policy implication is that the provincial family services system itself provides opportunities and mechanisms (e.g., the existing infrastructure of income assistance, foster care, and child protection rosters) for efficiently identifying, reaching, and supporting children in these at-risk groups. Our data indicate that being in one or more of these groups confers considerable risk of poor EDI outcomes. Children from these three at-risk groups represent a considerable proportion (35%, 36%, and 25%, respectively) of all vulnerable Kindergarten children. Thus, targetting evidence-based strategies to families already known to and served by IA and CFS systems would make both scientific and practical sense.[15]

4. Use a proportionately universal approach to intervention.

Focusing solely on the most disadvantaged will not reduce health inequalities sufficiently. A clear policy implication of our findings is the need for "proportionate universalism" wherein actions are universal but with a scale and intensity that is proportionate to the level of disadvantage (Marmot et al., 2010). Supports for early childhood development should be available to all children and their families, with additional supports for children in at-risk groups or in low-income communities.

5. Accelerate public attention and investment in early childhood development (ECD).

The prenatal-to-preschool timing, pervasiveness, persistence, and perniciousness of the underlying mechanisms have a clear policy implication. Meaningfully improving the life course developmental health of current and future generations of Manitobans will require proportionately universal strategies of proven real-world effectiveness that reach large segments of both the general population and specific at-risk populations, prior to conception, in utero, and during early childhood prior to school entry. "From this perspective, the development of girls who become the next generation's mothers is especially important" (Tremblay, 2009, p. 126). A major policy implication of our findings is that significant additional public attention and public (and private) investment in ECD is needed in Manitoba.

15 We are grateful to Harvey Stevens who originated this line of evidence and thinking.

A population–level approach to policy holds considerable promise, given that "a very small shift in the population mean of the underlying symptoms or risk factors can do more to enhance well–being and reduce disorder than would any amount of intervention with individuals who need help" (Huppert, 2009, p. 108).

> Observational and experimental evidence increasingly supports a relation between growth and development during fetal and infant life and health in later years. This relation has two major implications. First, it reinforces the growing awareness that investment in the health and education of young people in relation to their responsibilities during pregnancy and parenthood is of fundamental importance. Second, any rational approach to healthcare should embrace a life–course perspective.
>
> Even in a developed nation, an imprudent diet before or during pregnancy may be common. Interventions could involve correction of micronutrient and macronutrient imbalances in the mother before conception or at critical periods of early development or, more broadly, could involve aspects of social structure, education, health information, nutrition, and behavior modification both before and after birth. Such complex interventions require novel thinking about trial design in a socially and culturally appropriate context (Gluckman, Hanson, Cooper, & Thornburg, 2008, p. 70).

6. Use cost–effective ECD strategies from the available scientific evidence base.

To the extent that our nonexperimental findings approximate underlying causal mechanisms, a combination of several specific ECD strategies are suggested:

1. Preconception interventions that reduce the odds of first childbirth in adolescence (e.g., teen pregnancy prevention) and increase the odds of healthy gametes (e.g., reducing use of alcohol,[16] tobacco, and other drugs in populations of child–bearing age at risk of engaging in unprotected sexual intercourse)
2. Scientifically established supports for maternal (including prenatal) physical health, mental health[17] and preventing and treating maternal addictions[18]
3. Pregnancy interventions that increase the odds of healthy full–term births with healthy birth weights (e.g., reducing toxic stress during pregnancy; reducing use of alcohol, tobacco,[19] and other drugs during pregnancy; increasing maternal intake of crucial but underconsumed macronutrients, e.g., healthy polyunsaturated fats such as omega–3 fatty acids,[20] and micronutrients, e.g., folic acid and vitamin D, during pregnancy)
4. Prevention and amelioration of major illnesses in early childhood (e.g., respiratory illness)
5. Promotion of breastfeeding and extended spacing between subsequent childbirths (to reduce the total number of children at a given time, thereby increasing available developmental resources to current children)[21]
6. Provision of sufficient socioeconomic resources during early childhood (e.g., parental leave, income supports, housing supports, food security)[22]
7. Provision of scientifically established developmental resources and opportunities for early childhood health, learning, and behaviour (e.g., adequate primary care, such as immunizations and well–child visits; nutritional supplementation, such as omega–3 fatty acids for children[23])

16 See for example Floyd et al. (2007).
17 See for example Miller and LaRusso (2011).
18 See for example Petry (2007).
19 See for example Heil et al. (2008).
20 See for example Iams, Romero, Culhane, & Goldenberg (2008).
21 See review by Center on the Developing Child at Harvard University (2007).
22 Ibid.
23 See for example Sinn, Milte, and Howe (2010).

8. Provision of scientifically established parenting and family supports for children's early literacy and numeracy development, such as interactive book reading[24] and dialogic reading[25]
9. Provision of scientifically established parenting and family supports for children's early social and emotional development, such as the Triple P–Positive Parenting Program[26]
10. Provision of scientifically established, high–quality early learning and care,[27] such as the Carolina Abecedarian program[28]

7. Evaluate population–level impact of ECD strategies, particularly regarding impacts on socioeconomic disparities in ECD outcomes.

For more than a decade, international research through interdisciplinary structures, such as the John D. and Catherine T. MacArthur Network on Socioeconomic Status and Health and the Canadian Institute for Advanced Research, has amassed considerable scientific evidence on the population health consequences of social disadvantage; the developmental origins of SES gradients in population health; allostatic load, hypothalamic–pituitary–adrenal axis function, and the stress pathway in brain regulation of SES–related stress as a common cumulative pathway to the onset and progression of disparate diseases; and the biological embedding of socieoconomic adversity through epigenetic mechanisms (Adler, Marmot, McEwen, & Stewart, 1999; Adler & Stewart, 2010; Ganzel et al., 2010; Hall & Lamont, 2009; Keating, 2011; Keating & Hertzman, 1999; Meaney, 2010; Szyf, 2009).

International authorities such as the World Health Organization's Commission on Social Determinants of Health have used this evidence to recommend multisystemic strategies and mobilize intersectoral action for "closing the gap in a generation" (CDSH, 2008). However, there are relatively few studies that rigorously establish the effectiveness of specific policies or interventions to reduce SES gradients in population health (Dow, Schoeni, Adler, & Stewart, 2010). The ECD strategies suggested above, if implemented with evaluability (i.e., making possible the use of strong evaluation designs such as cluster random assignment, individual random assignment, regression–discontinuity, interrupted time series), could advance not only population health but the evidence base for population health policy and interventions.

8. Evaluate both intended and unintended impacts of ECD strategies on the population, particularly disadvantaged populations.

Yet even when evidence–based strategies are deployed, a major policy challenge in closing the gap is that some population–level strategies are (a) effective for all but leave SES gradients unchanged or (b) are disproportionately effective for the least disadvantaged—the so–called "Matthew effect" (Bakermans–Kranenburg & van Ijzendoorn, 2005) wherein the rich get richer and the poor get poorer, named after a verse from the biblical Gospel of Matthew[29]. The growing evidence of differential susceptibility/biological sensitivity to context suggests that some population–level strategies may disproportionately benefit some children, including those living in unhealthy environments and social disadvantage.

24 See for example Mol, Bus, and de Jong (2009).
25 See for example Mol, Bus, de Jong, and Smeets (2008).
26 See for example Prinz, Sanders, Shapiro, Whitaker, and Lutzker (2009) and Sanders et al. (2008).
27 See review by Reynolds and Temple (2008).
28 See for example Campbell et al. (2012), Muennig et al. (2011), and Pungello et al. (2010).
29 "For to all those who have, more will be given, and they will have an abundance; but from those who have nothing, even what they have will be taken away" (Matthew 25:29, New Revised Standard Version).

9. "Shift and squish" the shape of population-level outcomes.

Population-level strategies that reduce SES gradients and close the gap need to both improve outcomes and change the shape of the socioeconomic distribution of those outcomes, especially at the tail end of the distribution. Recently, a ladder metaphor has been used to classify policies and interventions that could reduce SES gradients in population health (Dow et al., 2010). Herein, the ladder reflects the SES distribution in a society, from low SES (the bottom rung of the ladder) to high SES (the top rung of the ladder). For example, in our findings on SES gradients in children's early developmental outcomes, we used income quintiles, which would be represented as five rungs on the ladder. In this taxonomy of policies and interventions, there are three ways society can attempt to reduce SES gradients in population health: (a) shrinking the gradient through redistribution (i.e., bringing the rungs closer together), (b) investing in population-wide social determinants of health (e.g., flattening and raising the ladder), and (c) reducing the gradient by targeting risks and improving buffers among the lowest SES groups (i.e., raising the lowest rungs) (Dow et al., 2010).

This approach is consistent with recent recommendations for population-level "shift and squish" strategies, involving the moving of outcome distributions for the better (shifting) and attenuating (squishing) the variation in outcomes toward reducing inequities (Martens et al. 2010) and other Canadian work elaborating different types of intervention to raise and level SES gradients in child and youth developmental outcomes (Willms, in press).

10. Prevent ECD syndemics through evidence-based kernels and behavioural vaccines.

Our findings can also benefit from reference to recent work on syndemics (Singer, 2009, 2010). Syndemic refers to "a concentration and deleterious interaction of two or more diseases or other health conditions in a population, especially as a consequence of social inequity and the unjust exercise of power" (Singer, 2009, p. 226). The term derives from words that mean epidemics that happen together (i.e., are in synch). Our EDI findings for Manitoba, along with other recent EDI evidence from British Columbia (Carpiano, Lloyd, & Hertzman, 2009; Forer & Zumbo, 2011; Guhn, Gadermann, Hertzman, & Zumbo, 2010; Lloyd & Hertzman, 2010; Lloyd et al/, 2009; Lloyd et al., 2010), Saskatchewan (Cushon et al., 2011; Muhajarine et al., 2011), and Ontario (Janus & Duku, 2007), converge in conceptualizing children's poor outcomes across the five EDI domains—particularly in the context of socioeconomic adversity—as a major syndemic for Canada and other developed and developing countries worldwide. The international evidence base points to a common set of contributing and causal mechanisms at the interface of biology and society (Hackman et al., 2010; Huston & Bentley, 2010; Miller, Chen, & Cole, 2009), social determinants (CSDH, 2008; Fernandez, MacKinnon, & Silver, 2010), that lead to an interconnected set of early developmental problems that are biologically unnecessary yet highly prevalent, persistent, and pernicious with long-term implications for health, learning, and behaviour across the life course, as well as the economy (Kershaw et al., 2010).

Considerable scientific evidence indicates that the major new epidemics of mental, emotional, and behavioural disorders; overweight and obesity; substance abuse; and violence affecting children and youth are better regarded as syndemic in nature (National Research Council & Institute of Medicine, 2009) and may be effectively prevented with simple, low-cost microstrategies ("evidence-based kernels" and "behavioural vaccines") that may be more easily implemented at a population level than entire evidence-based programs. Kernels are the smallest unit of proven behaviour change (Embry, 2011). They can improve infant health and development, family life, and educational outcomes, as well as reduce substance abuse and violence (Embry & Biglan, 2008). They are often the effective ingredients

of the evidence–based programs noted above. Kernels are simple, low–cost, rapidly implemented, easily shared (e.g., by word of mouth) and can have powerful, long–lasting effects (Embry, 2004). Behavioural vaccines refer to simple procedures (a kernel or a "recipe" of kernels) that, when used repeatedly, reduce morbidity and mortality and/or increase health or well–being (Embry, 2002, 2004).

Nationally and internationally, Manitoba is recognized as being unique in its scientific and intersectoral policy potential (Chief Public Health Officer of Canada, 2009; Hancock, 2011; Health Council of Canada, 2006; Leitch, 2007; Mustard, 2008) to close the gap between what we know and what we do (McCain, Mustard, & Shanker, 2007; Shonkoff, 2010) in the everyday lives of children and families. This is the potential to "give every child the best start in life" (Marmot et al., 2010), to address and redress inequalities in children's developmental opportunities, reduce inequities in their developmental outcomes, and "close the gap in a generation" (CSDH, 2008; see also Chief Provincial Public Health Officer of Manitoba, 2011). Investments in the early years are empirically warranted and, ultimately, are investments in a democratic and just society. While Manitoba has made considerable progress in recent years (McCain, Mustard, & McCuaig, 2011), considerable additional public support and political will are needed to significantly increase evidence–based action for Manitoba's youngest children.

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Glossary

Administrative Data

Information collected "usually by government, for some administrative purpose (e.g., keeping track of the population eligible for certain benefits, paying doctors or hospitals), but not primarily for research or surveillance purposes" (Spasoff, 1999). MCHP's research uses administrative data from hospital abstracts, physician billing claims, claims for prescription drugs, and other health related data. Using these data, researchers can study the utilization of health resources over time and the variations in rates within and across the provinces.

(Spasoff, RA. Epidemiologic Methods for Health Policy. New York, NY: Oxford University Press; 1999)

Aggregated Diagnosis Group (ADG)

Formerly known as Ambulatory Diagnostic Groups, ADGs continue to be part of the Adjusted Clinical Group (ACG) case-mix system. The ACG method groups every ICD-9, ICD-9-CM, and ICD-10-CA diagnosis codes assigned to a patient into one of 32 different ADGs based on five clinical and expected utilization criteria:

- duration of the condition (acute, recurrent, or chronic)
- severity of the condition (e.g., minor and stable versus major and unstable)
- diagnostic certainty (symptoms focusing on diagnostic evaluation versus documented disease focusing on treatment services)
- etiology of the condition (infectious, injury, or other)
- specialty care involvement (medical, surgical, obstetric, haematology, etc.)

Akaike Information Criterion (AIC)

A criterion used to measure the relative goodness of fit of a statistical model (i.e. how well a model fits the observed data). Given a particular dataset, potential models can be ranked according to their AIC values in order for one to be selected.

Apgar Score

A measure of the physiological well-being of newborn babies; it is recorded for virtually all births in hospital. A score of zero, one, or two is given for each of five vital signs that are assessed at one and five minutes after birth. These five scores are summed to give a total score between 0 and 10. The five vital signs are: appearance, pulse, reflex, muscle tone, and breathing pattern.

Biological Sensitivity to Context – see Differential Susceptibility

Child and Family Services (CFS)

A branch of the Community Service Delivery division of the Department of Manitoba Family Services and Consumer Affairs that provides a comprehensive continuum of child protection and family support services in Winnipeg in accordance with The Child and Family Services Act and The Adoption Act.

Child and Family Services Information System (CFSIS)

A data management system that supports case tracking and reporting of services provided to children and families as they pass through Winnipeg Child and Family Services (CFS). CFSIS includes information on families receiving protective services as well as support services.

Communication Skills and General Knowledge Early Development Instrument (EDI) Domain

Set of eight items on the EDI used to assess a kindergarten child's readiness for school in terms of their "ability to clearly communicate one's own needs and understand others, active participation in story-telling, interest in general knowledge about the world," and other similar characteristics.

http://www.councilecd.ca/internationaledi/09.%20The%20EDI%20-%20A%20Brief%20Description.pdf

Differential Susceptibility Hypothesis

The theory, posited by Jay Belsky, that individuals vary in the degree they are affected by experiences or qualities of the environment to which they are exposed. Some individuals are more susceptible to such influences (both positive and negative) than others.

Drug Programs Information Network (DPIN)

An electronic, on-line, point-of-sale drug database. It links all community pharmacies (but not pharmacies in hospitals or nursing homes/personal care homes) and captures information about all Manitoba residents, including most prescriptions dispensed to status Indians. DPIN contains information such as unique patient identification, age, birthdate, sex, medication history, over-the-counter medication history, patient postal code, new drugs prescribed, date dispensed, and unique pharmacy identification number. DPIN is maintained by the Government of Manitoba's Ministry of Health.

Early Development Instrument (EDI)

"A short, teacher-administered checklist measuring children's readiness to learn at school according to five domains of development: physical health and well-being; social knowledge and competence; emotional health/maturity; language and cognitive development; and general knowledge and communication skills." It is administered at the Kindergarten level.

http://www.councilecd.ca/internationaledi/Consortium_Resources.html

Emotional Maturity Early Development Instrument (EDI) Domain

Set of 30 items on the EDI used to assess a kindergarten child's readiness for school in terms of their pro-social and helping behaviours; ability to concentrate; patience; lack of anxious, fearful, or aggressive behaviour; and other similar characteristics.

http://www.councilecd.ca/internationaledi/09.%20The%20EDI%20-%20A%20Brief%20Description.pdf

Gestational Age

The age of a newborn infant, approximated from the first day of the woman's last menstrual period to birth and is often reported in weeks of gestation. The average gestational age of a newborn is 37 weeks.

Hospital Abstract

A form/computerized record filled out upon a patient's discharge (separation) from an acute care hospital. The abstract contains information from the patient's medical record based on their stay in hospital, such as gender, residence (postal code), diagnoses and procedure codes, admission and discharge dates, length of stay, and service type (inpatient/day surgery/ outpatient). Abstract records are stored in the Hospital Abstracts Database.

Income Assistance (IA)

Financial assistance provided by the province to those who require help to meet basic personal and family needs.

http://www.gov.mb.ca/fs/assistance/eia.html

Income Quintile

A method to measure the average (mean) household income of residents, ranking them from poorest to wealthiest, and then grouping them into five income quintiles (1 being poorest and 5 being wealthiest). Each quintile contains approximately 20% of the population.

Language and Cognitive Development Early Development Instrument (EDI) Domain

Set of 26 items on the EDI to assess a kindergarten child's readiness for school in terms of their "basic literacy, interest in reading, recognition of numbers and shapes, awareness of time concepts", and other similar characteristics.

http://www.councilecd.ca/internationaledi/09.%20The%20EDI%20-%20A%20Brief%20Description.pdf

Large for Gestational Age

An indicator of accelerated fetal growth and a marker for increased risk of birth complications and infant morbidity. Infants in this category are at or above the 90th percentile in birth weight from an infant population of the same sex and gestational age.

Logistic Regression

The regression technique used when the outcome is a binary, or dichotomous, variable. Logistic regression models the probability of an event as a function of other factors. These models are only able to state that there is a relationship ("association") between the explanatory and the outcome variables. This is not necessarily a causal relationship since it is based on observational data for the most recent time period. The explanatory variable may be associated with an increase or decrease (not that it caused the increase or decrease).

Low Birth Weight (LBW)

Generally, a newborn weight of less than 2,500 grams at birth. In this study, we defined it as 1,500–2,499 grams and called a weight less than 1,500 grams 'very low birth weight'.

Maternal Depression

In this study, a measure of whether a mother was depressed during the time from the child's birth to their 4th birthday. A mother was person was defined as depressed if they satisfied any of the following criteria:

- at least one physician visit with an ICD–9–CM code of 311 (depressive disorder), 296 (affective psychoses), or 309 (adjustment reaction) OR
- at least one physician visit with an ICD–9–CM code of 300 (neurotic disorders) in conjunction with a prescription for an antidepressant medication or mood stabilizer (but excluding anti–anxiety medications) OR
- at least one hospitalization with an ICD–9–CM code of 296.2–296.8, 300.4, 300, 309, or 311, in conjunction with a prescription for an antidepressant medication or mood stabilizer (but excluding anti–anxiety medications)

Note: This definition includes, but is not limited to, post–partum depression.

Multicollinearity

"In multiple regression analysis, a situation in which at least some of the independent variables are highly correlated with each other. Such a situation can result in inaccurate estimates of the parameters in the regression model."

(Last, J. A Dictionary of Epidemiology. New York, NY: Oxford University Press; 1995).

Multiple Challenge Index (MCI)

A component of the Early Development Instrument (EDI) that indicates if a child is experiencing challenges in at least three EDI domains. The MCI is scored based on challenges in nine or more subdomains (see Table 1.1). The MCI is scored dichotomously as either having or not having multiple challenges.

Odds Ratio (OR)

The ratio of the odds of an event occurring in one group to the odds of it occurring in another group or to a data–based estimate of that ratio. These groups might be men and women, an experimental group and a control group, or any other dichotomous classification.

Personal Health Identification Number (PHIN)

A unique numeric identifier assigned by Manitoba Health to every person registered for health insurance in Manitoba and to non-residents who are treated at facilities that submit claims electronically. Introduced as a linkage key in 1984, it was issued to the public in 1994 as the basic access identifier for the Pharmacare/Drug Programs Information Network (DPIN). At MCHP, PHIN is either a scrambled version of the Manitoba Health PHIN or an alphanumeric identifier assigned via the Research Registry to individuals who do not have scrambled numeric PHINs.

Physical Health and Well-Being Early Development Instrument (EDI) Domain

A set of 13 items on the EDI used to assess a kindergarten child's readiness for school in terms of their "physical independence, general health, gross and fine motor skills" and other similar characteristics.

http://www.councilecd.ca/internationaledi/09.%20The%20EDI%20-%20A%20Brief%20Description.pdf

Physician Claims

Claims (billings) for payment that are submitted to the provincial government by individual physicians for services they provide. Fee-for-service physicians receive payment based on these claims, while those submitted by physicians on alternate payment plans (APP) are for administrative purposes only. The physician claims are collected and stored in the Medical Services Database, which is part of the Population Health Research Data Repository.

Population Health Research Data Repository (Repository)

A comprehensive collection of administrative, registry, survey and other databases primarily comprised of residents of Manitoba. This repository is housed at the Manitoba Centre for Health Policy (MCHP). It was developed to describe and explain patterns of healthcare and profiles of health and illness, facilitating inter-sectoral research in areas such as healthcare, education, and social services.

Public Trustee Office

"A provincial government Special Operating Agency that manages and protects the affairs of Manitobans who are unable to do so themselves and have no one else willing or able to act. This includes mentally incompetent and vulnerable adults, deceased estates, and children."

http://www.gov.mb.ca/publictrustee/index.html

Regional Health Authority (RHA)

Regional governance structure set up by the province to be responsible for the delivery and administration of health services in specified areas. In Manitoba, as of July 1, 2002, there are 11 RHAs: Winnipeg, Brandon, South Eastman, Assiniboine, Central, Parkland, North Eastman, Interlake, Burntwood, NOR-MAN and Churchill.

Small–for–Gestational–Age (SGA)

Infants that are at or below the 10th percentile in birth weight from an infant population of the same sex and gestational age. See Kramer et al. (2001) for more information.

(Kramer MS, Platt RW, Wen SW, et al. Fetal/Infant Health Study Group of the Canadian Perinatal Surveillance System. A new and improved population-based Canadian reference for birth weight for gestational age. Pediatrics 2001;108(2):1-7.)

Social Competence Early Development Instrument (EDI) Domain

A set of items on the EDI used to assess a kindergarten child's readiness for school in terms of their "responsibility and respect for others, approaches to learning, readiness to explore new things, sharing" and other similar characteristics.

http://www.councilecd.ca/internationaledi/09.%20The%20EDI%20–%20A%20Brief%20Description.pdf

Social Assistance Management Information Network

The SAMIN Research Data set combines variables from the various tables in the SAMIN database into a single SAS data set. The data set contains one record per person (client) for each month that they are present in the SAMIN database by fiscal year. Some variables are recorded on a person basis (client) and others on a family basis (case). This data set includes information on income/employment assistance recipients in Manitoba.

Socioeconomic Status (SES)

Characteristics of economic, social, and physical environments in which individuals live and work, as well as, their demographic and genetic characteristics. As done in this study, it is often ranked from 1 (poor) to 5 (wealthy), based on income quintiles that measure mean household income, and grouped into five income quintiles, each quintile assigned to 20% of the population.

Stepwise Logistic Regression

A regression technique used when the outcome is a binary, or dichotomous, variable. Logistic regression models the probability of an event as a function of other factors. Stepwise logistic regression involves the stepwise (or one–by–one) selection of variables, providing a fast and effective method to screen a large number of variables, and to fit multiple logistic regression equations simultaneously. These models are only able to state that there is a relationship ("association") between the explanatory and the outcome variables. This is not necessarily a causal relationship, since it is based on observational data for the most recent time period. The explanatory variable may be associated with an increase or decrease (not that it caused the increase or decrease).

(Hosmer D & Lemeshow S. Applied Logistic Regression. 2nd edition. New York, NY: John Wiley and Sons; 2000. pg 116).

Structural Equation Modeling (SEM)

Sometimes known as simultaneous equation modeling or analysis of covariance structures, it is a statistical technique for modeling complex relationships among variables. Some of the variables in SEM can be unobserved (latent). A response variable in one regression equation in an SEM can appear as a predictor in another equation. Indeed variables in SEM may influence one another either directly or through other variables as intermediaries.

Very Low Birth Weight

In this study, a birth weight of less than 1500 grams.

Vital Statistics

A Manitoba government department responsible for keeping records and registries of all births, deaths, marriages, and stillbirths that take place in Manitoba.

Winnipeg Community Areas (CAs)

The 12 planning districts within the Winnipeg Regional Health Authority (WRHA) that have similar populations to the rural and northern Regional Health Authorities (RHAs). The 12 CAs are: St. James–Assiniboia, Assiniboine South, Fort Garry, St. Vital, St. Boniface, Transcona, River East (includes East St. Paul), Seven Oaks (includes West St. Paul), Inkster, Point Douglas, Downtown, and River Heights.

Appendix 1: Figures and Tables for Chapter 1

Appendix Table A1.1: Aggregated Diagnostic Group (ADG) Codes Used in this Study

Time Limited: Minor 558.9 Noninfectious Gastroenteritis 691.0 Diaper or Napkin Rash	**Time Limited: Major** 451.2 Phlebitis of Lower Extremities 560.3 Impaction of Intestine
Time Limited: Minor – Primary Infections 079.9 Unspecified Viral Infection 464.4 Croup	**Likely to Recur: Progressive** 250.10 Adult Onset Type II Diabetes with ketoacidosis 434.0 Cerebral Thrombosis
Time Limited: Major – Primary Infections 573.3 Hepatitis, Unspecified 711.0 Pyogenic Arthritis	**Chronic Medical: Unstable** 282.6 Sickle-Cell Anemia 277.0 Cystic Fibrosis
Allergies 477.9 Allergic Rhinitis, Cause Unspecified 708.9 Unspecified urticarial	**Chronic Specialty: Stable – Orthopedic** 721.0 Cervical sponsylosis without myelopathy 718.8 Other joint derangement
Asthma 493.0 Extrinsic Asthma 493.1 Intrinsic Asthma	**Chronic Specialty: Stable – Ear, Nose, Throat** 389.14 Central Hearing Loss 385.3 Cholesteatoma
Likely to Recur: Discrete 274.9 Gout, unspecified 724.5 Backache, unspecified	**Chronic Specialty: Unstable – Eye** 365.9 Unspecified Glaucoma 379.0 Scleritis / Episcleritis
Likely to Recur: Discrete – Infections 474.0 Tonsillitis 599.0 Urinary tract infection	**Psychosocial: Recurrent or Persistent, Unstable** 295.2 Catatonic Schizophrenia 291.0 Alcohol Withdrawal with Delirium Tremens
Chronic Medical: Stable 250.00 Adult-onset Type I Diabetes 401.9 Essential hypertension	**Malignancy (Cancer)** 174.9 Malignant Neoplasm of Breast NOS 201.9 Hodgkin's Disease, Unspecified
Chronic Specialty: Stable – Eye 367.1 Myopia 372.9 Unspecified disorder of conjunctiva	
Chronic Specialty: Unstable – Orthopedic 724.02 Spinal Stenosis of Lumbar Region 732.7 Osteochondritis Dissecans	
Chronic Specialty: Unstable – Ear, Nose, Throat 383.1 Chronic Mastoiditis 386.0 Meniere's Disease	
Dermatologic 078.1 Viral Warts 448.1 Nevus, Non-Neoplastic	
Injuries/Adverse Events: Minor 847.0 Neck Sprain 959.1 Injury to Trunk	
Injuries/Adverse Events: Major 854.0 Intracranial Injury 972.1 Poisoning by Cardiotonic Glycosides and Similar Drugs	
Psychosocial: Time Limited, Minor 305.2 Cannabis Abuse, Unspecified 309.0 Brief Depressive Reaction	
Psychosocial: Recurrent or Persistent, Stable 300.01 Panic Disorder 307.51 Bulimia	

Minor ADGs	Major ADGs
Signs/Symptoms: Minor	
784.0 Headache	
729.5 Pain in Limb	
Signs/Symptoms: Uncertain	
719.06 Effusion of Lower Leg Joint	
780.7 Malaise and Fatigue	
Signs/Symptoms: Major	
429.3 Cardiomegaly	
780.2 Syncope and Collapse	
Discretionary	
550.9 Inguinal Hernia NOS	
706.2 Sebaceous Cyst	
See and Reassure	
611.1 Hypertrophy of Breast	
278.1 Localized Adiposity	

Appendix Table A1.2: Summary of Predictors from Optimal Logistic Models: Not Ready (≥ 1 EDI Domains)†

Predictors	Manitoba	Winnipeg	Non-Winnipeg
Child's Age	x	x	x
Low Birth Weight	x		x
Long Birth Stay		x	
2+ Major ADGs	x	x	x
Physician Visits	x	x	x
ICU		x	
Family Ever on IA	x	x	x
Teen Mom	x	x	x
Maternal Depression			
3+ Moves			

† 2006 & 2007 EDI cohorts

x -indicates relevant variables included in final model

Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services

Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A1.3: Summary of Predictors from Optimal Logistic Models: EDI Not Ready in Language and Cognitive Development†

Predictors	Manitoba	Winnipeg	Non-Winnipeg
Child's Age	x	x	x
Low Birth Weight	x		x
Long Birth Stay		x	
2+ Major ADGs	x	x	
Physician Visits		x	x
ICU		x	
Family Ever on IA	x	x	x
Teen Mom	x	x	x
Maternal Depression			
3+ Moves			

† 2006 & 2007 EDI cohorts

x -indicates relevant variables included in final model

Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services

Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A1.4: Summary of Predictors from Optimal Logistic Models: EDI Not Ready in Physical Health and Well-Being†

Predictors	Manitoba	Winnipeg	Non-Winnipeg
Child's Age	x	x	x
Low Birth Weight	x		x
Long Birth Stay	x	x	
2+ Major ADGs	x	x	x
Physician Visits	x	x	x
ICU	x	x	
Family Ever on IA	x	x	x
Teen Mom	x	x	x
Maternal Depression			
3+ Moves			

† 2006 & 2007 EDI cohorts

x -indicates relevant variables included in final model

Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services

Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A1.5: Summary of Predictors from Optimal Logistic Models: EDI Not Ready in Communication Skills and General Knowledge †

Predictors	Manitoba	Winnipeg	Non-Winnipeg
Child's Age	x	x	x
Low Birth Weight	x	x	
Long Birth Stay	x	x	
2+ Major ADGs	x	x	x
Physician Visits	x	x	x
ICU		x	
Family Ever on IA	x	x	x
Teen Mom			x
Maternal Depression			
3+ Moves			

† 2006 & 2007 EDI cohorts
x -indicates relevant variables included in final model
Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services
Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A1.6: Summary of Predictors from Optimal Logistic Models: EDI Not Ready in Social Competence †

Predictors	Manitoba	Winnipeg	Non-Winnipeg
Child's Age	x	x	x
Low Birth Weight	x		x
Long Birth Stay	x	x	
2+ Major ADGs	x	x	x
Physician Visits		x	
ICU	x	x	x
Family Ever on IA	x	x	x
Teen Mom	x		x
Maternal Depression			x
3+ Moves			

† 2006 & 2007 EDI cohorts
x -indicates relevant variables included in final model
Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services
Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A1.7: Summary of Predictors from Optimal Logistic Models: EDI Not Ready in Emotional Maturity[1]

Predictors	Manitoba	Winnipeg	Non-Winnipeg
Child's Age	x	x	x
Low Birth Weight			
Long Birth Stay		x	
2+ Major ADGs	x	x	x
Physician Visits	x	x	
ICU			
Family Ever on IA	x	x	x
Teen Mom	x		x
Maternal Depression			x
3+ Moves			

† 2006 & 2007 EDI cohorts
x -indicates relevant variables included in final model
Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services
Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A1.8: Summary of Predictors from Optimal Logistic Models: Very Ready (≥ 1 EDI Domains)[1]

Predictors	Manitoba	Winnipeg	Non-Winnipeg
Child's Age	x	x	x
Low Birth Weight			
Long Birth Stay		x	
2+ Major ADGs	x	x	x
Physician Visits		x	x
ICU	x	x	
Family Ever on IA	x	x	x
Teen Mom	x	x	x
Maternal Depression		x	
3+ Moves			

† 2006 & 2007 EDI cohorts
x -indicates relevant variables included in final model
Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services
Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A1.9: Summary of Predictors from Optimal Logistic Models: EDI Very Ready in Language and Cognitive Development†

Predictors	Manitoba	Winnipeg	Non-Winnipeg
Child's Age	x	x	x
Low Birth Weight	x	x	x
Long Birth Stay		x	
2+ Major ADGs		x	
Physician Visits	x	x	
ICU			
Family Ever on IA	x	x	x
Teen Mom	x	x	x
Maternal Depression	x	x	x
3+ Moves			

† 2006 & 2007 EDI cohorts

x -indicates relevant variables included in final model

Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services

Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A1.10: Summary of Predictors from Optimal Logistic Models: EDI Very Ready in Physical Health and Well-Being†

Predictors	Manitoba	Winnipeg	Non-Winnipeg
Child's Age	x	x	x
Low Birth Weight	x		x
Long Birth Stay		x	
2+ Major ADGs	x	x	
Physician Visits		x	
ICU			
Family Ever on IA	x	x	x
Teen Mom	x	x	x
Maternal Depression			
3+ Moves			

† 2006 & 2007 EDI cohorts

x -indicates relevant variables included in final model

Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services

Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A1.11: Summary of Predictors from Optimal Logistic Models: EDI Very Ready in Communication Skills and General Knowledge†

Predictors	Manitoba	Winnipeg	Non-Winnipeg
Child's Age	x	x	x
Low Birth Weight			
Long Birth Stay		x	x
2+ Major ADGs	x	x	
Physician Visits		x	x
ICU	x	x	
Family Ever on IA	x	x	x
Teen Mom	x	x	x
Maternal Depression			x
3+ Moves			

† 2006 & 2007 EDI cohorts
x -indicates relevant variables included in final model
Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services
Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A1.12: Summary of Predictors from Optimal Logistic Models: EDI Very Ready in Social Competence†

Predictors	Manitoba	Winnipeg	Non-Winnipeg
Child's Age	x	x	x
Low Birth Weight	x	x	
Long Birth Stay		x	
2+ Major ADGs	x	x	
Physician Visits		x	
ICU			
Family Ever on IA	x	x	
Teen Mom	x	x	x
Maternal Depression			x
3+ Moves			

† 2006 & 2007 EDI cohorts
x -indicates relevant variables included in final model
Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services
Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A1.13: Summary of Predictors from Optimal Logistic Models: EDI Very Ready in Emotional Maturity†

Predictors	Manitoba	Winnipeg	Non-Winnipeg
Child's Age	x	x	x
Low Birth Weight			
Long Birth Stay	x	x	
2+ Major ADGs			
Physician Visits	x	x	x
ICU			
Family Ever on IA	x	x	
Teen Mom	x		x
Maternal Depression			x
3+ Moves			

† 2006 & 2007 EDI cohorts
x -indicates relevant variables included in final model
Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services
Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A1.14: Summary of Predictors from Optimal Logistic Models: Multiple Challenges (≥ 9 EDI Sub-Domains) at Age 5†

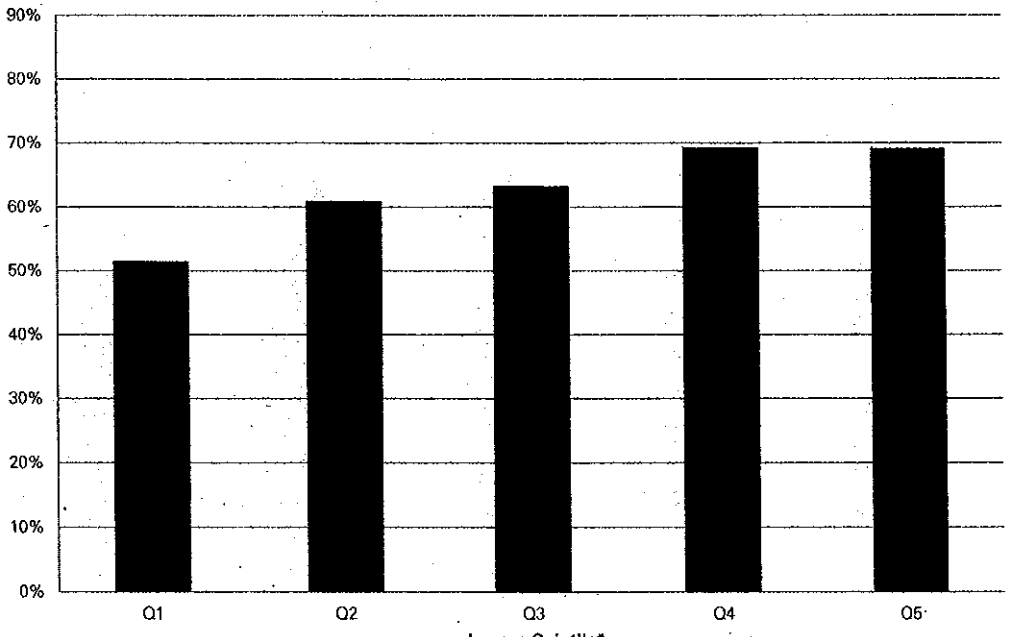
Predictors	Manitoba	Winnipeg	Non-Winnipeg
Child's Age	x	x	x
Low Birth Weight			x
Long Birth Stay	x	x	x
2+ Major ADGs	x	x	x
Physician Visits		x	x
ICU			x
Family Ever on IA	x	x	x
Teen Mom	x		x
Maternal Depression			x
3+ Moves			

† 2006 & 2007 EDI cohorts
x -indicates relevant variables included in final model
Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services
Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix 2: Figures and Tables for Chapter 2

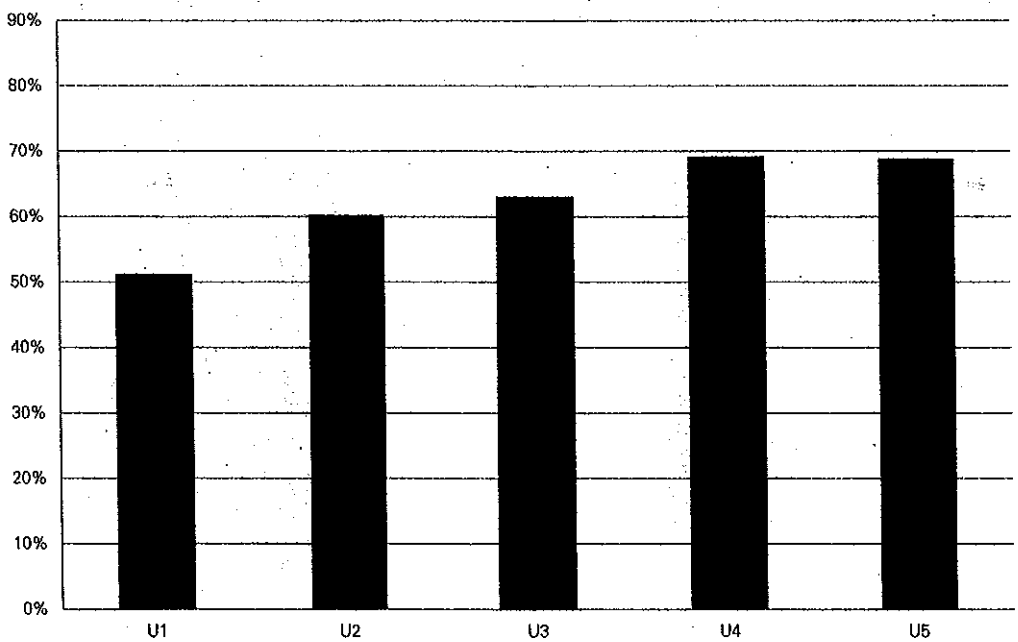
Appendix Figure A2.1: Percent Very Ready (>1 EDI Domains) at Age 5 by Income Quintile, Winnipeg†



† 2006 & 2007 EDI cohorts
*Linear trend test significant ($p < 0.05$)

Source: Manitoba Centre for Health Policy, 2011

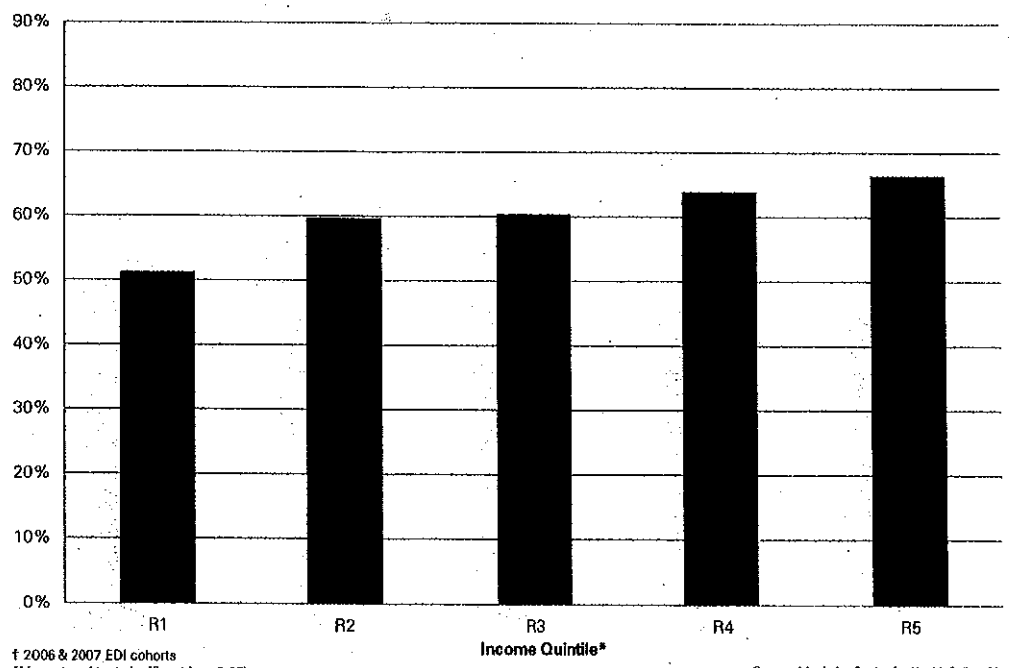
Appendix Figure A2.2: Percent Very Ready (>1 EDI Domains) at Age 5 by Urban Income Quintile, Manitoba†



† 2006 & 2007 EDI cohorts
*Linear trend test significant ($p < 0.05$)

Source: Manitoba Centre for Health Policy, 2011

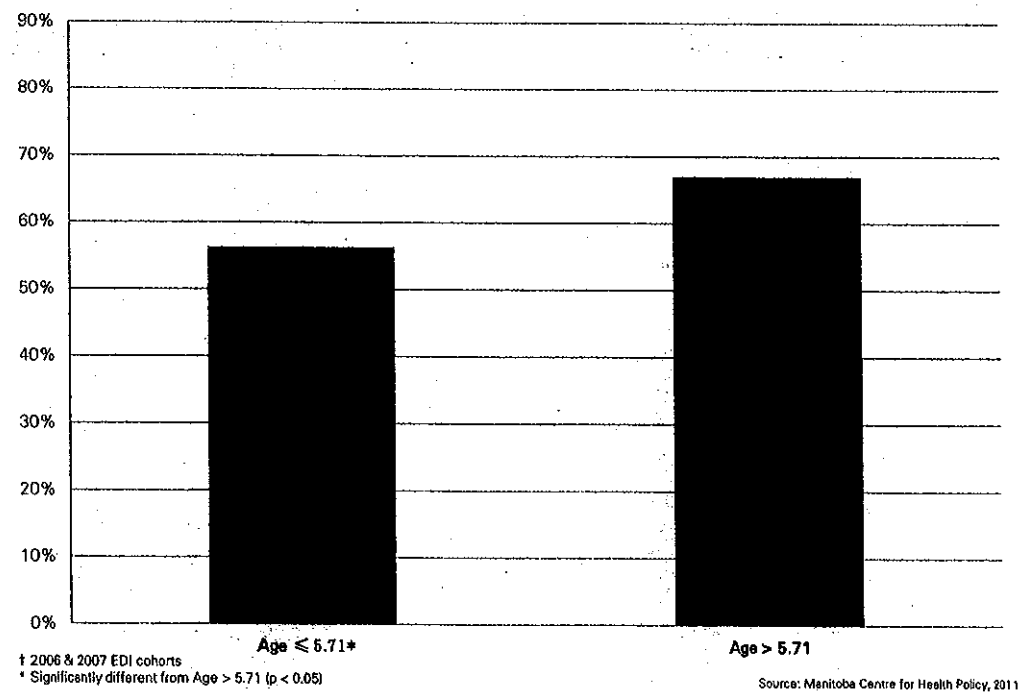
Appendix Figure A2.3: Percent Very Ready (>1 EDI Domains) at Age 5 by Rural Income Quintile, Manitoba†



† 2006 & 2007 EDI cohorts
*Linear trend test significant ($p < 0.05$)

Source: Manitoba Centre for Health Policy, 2011

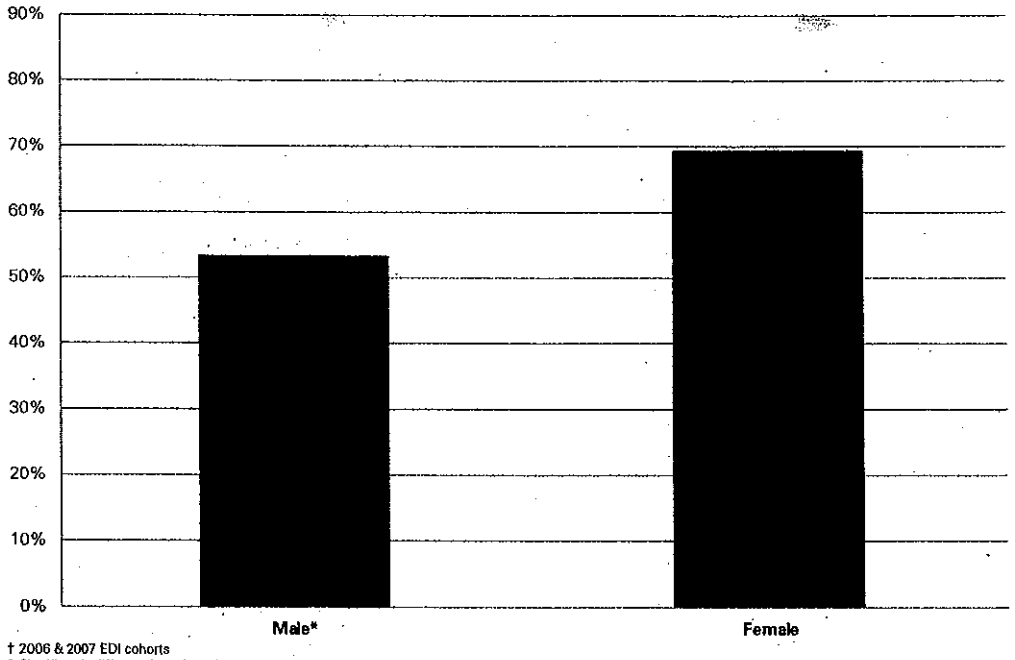
Appendix Figure A2.4: Percent Very Ready (>1 EDI Domains) by Age, Winnipeg†



† 2006 & 2007 EDI cohorts
* Significantly different from Age > 5.71 ($p < 0.05$)

Source: Manitoba Centre for Health Policy, 2011

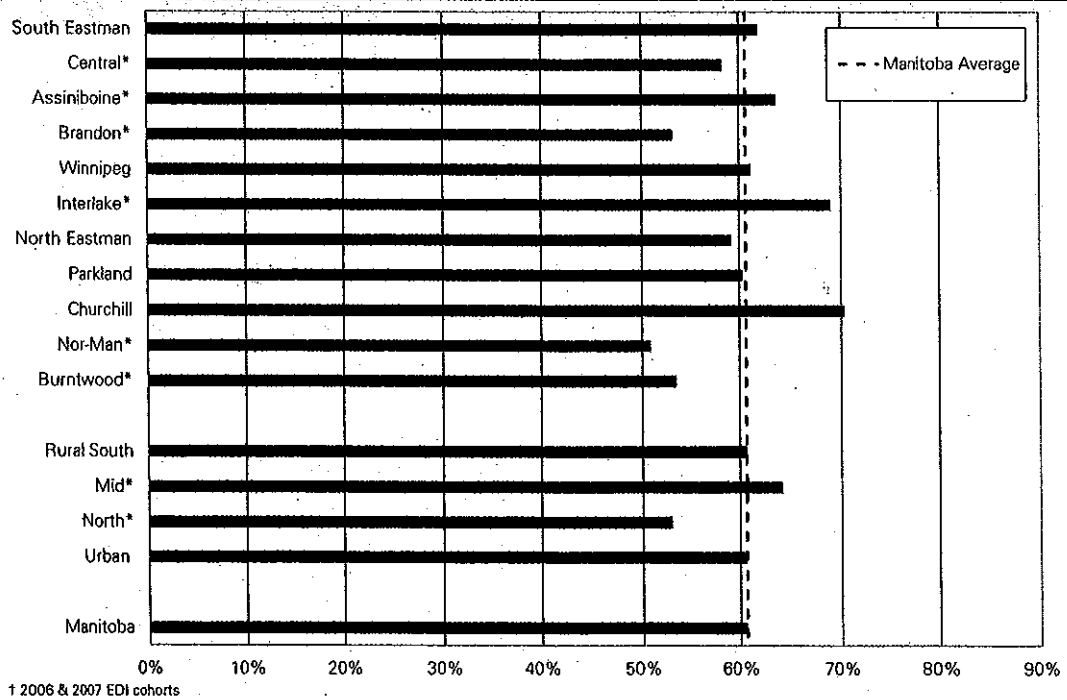
Appendix Figure A2.5: Percent Very Ready (>1 EDI Domains) at Age 5 by Gender, Winnipeg†



† 2006 & 2007 EDI cohorts
* Significantly different from Female ($p < 0.05$)

Source: Manitoba Centre for Health Policy, 2011

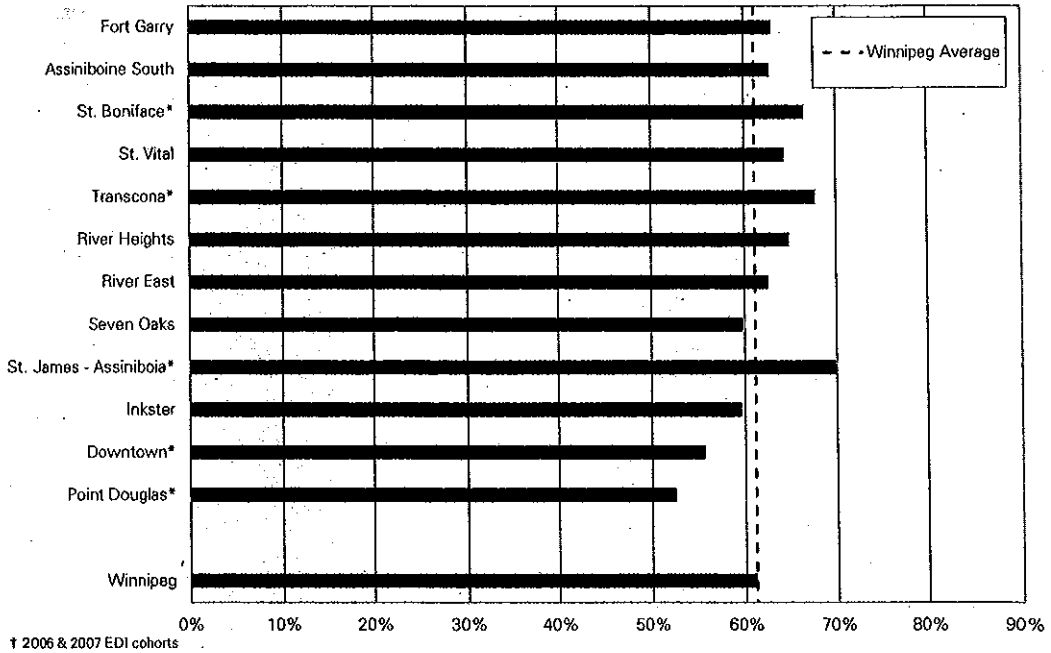
Appendix Figure A2.6: Percent Very Ready (≥1 EDI Domains) at Age 5 by RHA of Residence†



† 2006 & 2007 EDI cohorts
*Significantly different from Manitoba average ($p < 0.05$)

Source: Manitoba Centre for Health Policy, 2011

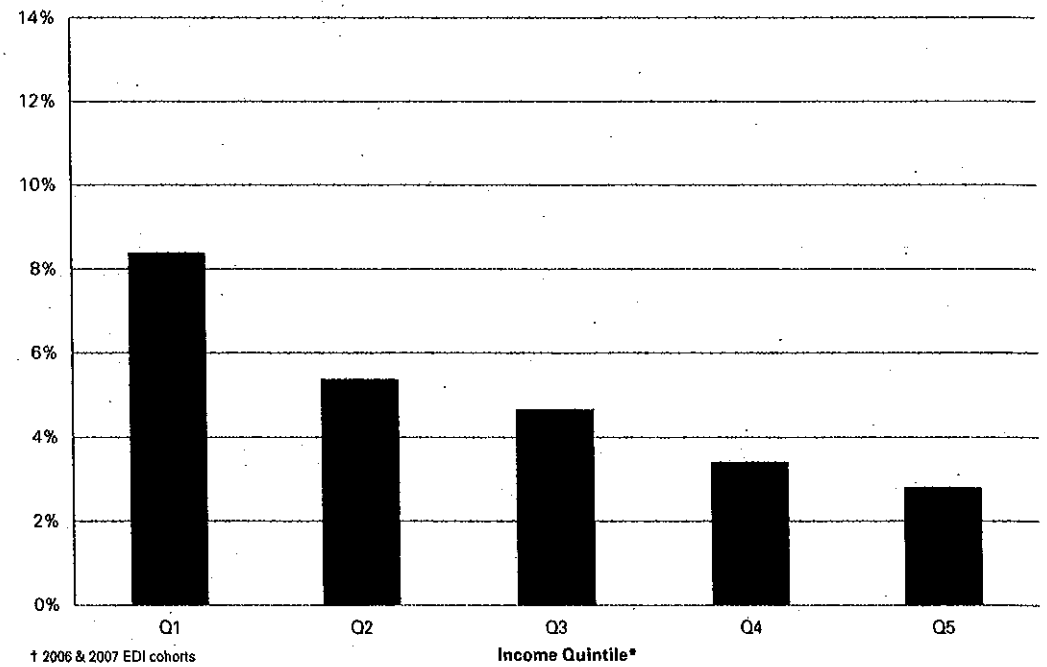
Appendix Figure A2.7: Percent Very Ready (>1 EDI Domains) at Age 5 by Winnipeg Community Area of Residence†



† 2006 & 2007 EDI cohorts
*Significantly different from Winnipeg average ($p < 0.05$)

Source: Manitoba Centre for Health Policy, 2011

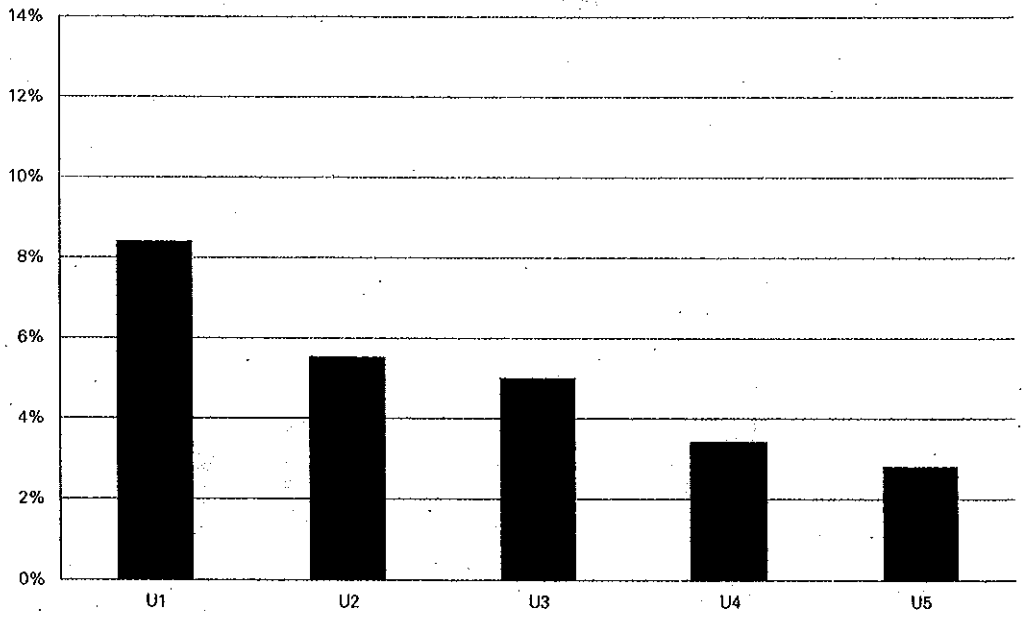
Appendix Figure A2.8: Percent with Multiple Challenges (≥ 9 EDI Sub-domains) at Age 5 by Income Quintile, Winnipeg†



† 2006 & 2007 EDI cohorts
* Linear trend test significant ($p < 0.05$)

Source: Manitoba Centre for Health Policy, 2011

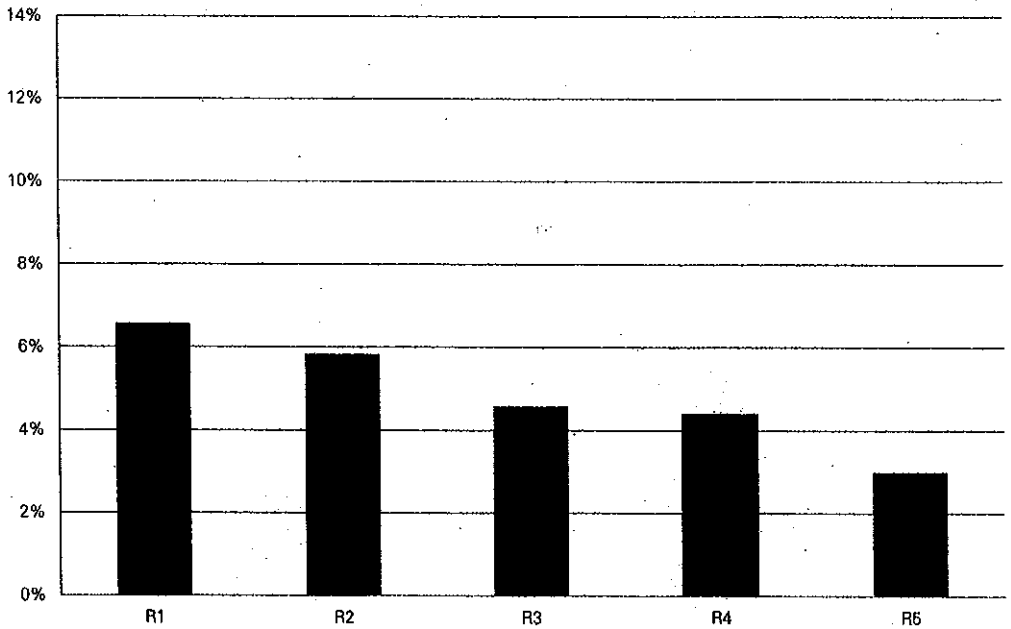
Appendix Figure A2.9: Percent with Multiple Challenges (≥ 9 EDI Sub-Domains) at Age 5 by Urban Income Quintile, Manitoba†



† 2006 & 2007 EDI cohorts
* Linear trend test significant ($p < 0.05$)

Source: Manitoba Centre for Health Policy, 2011

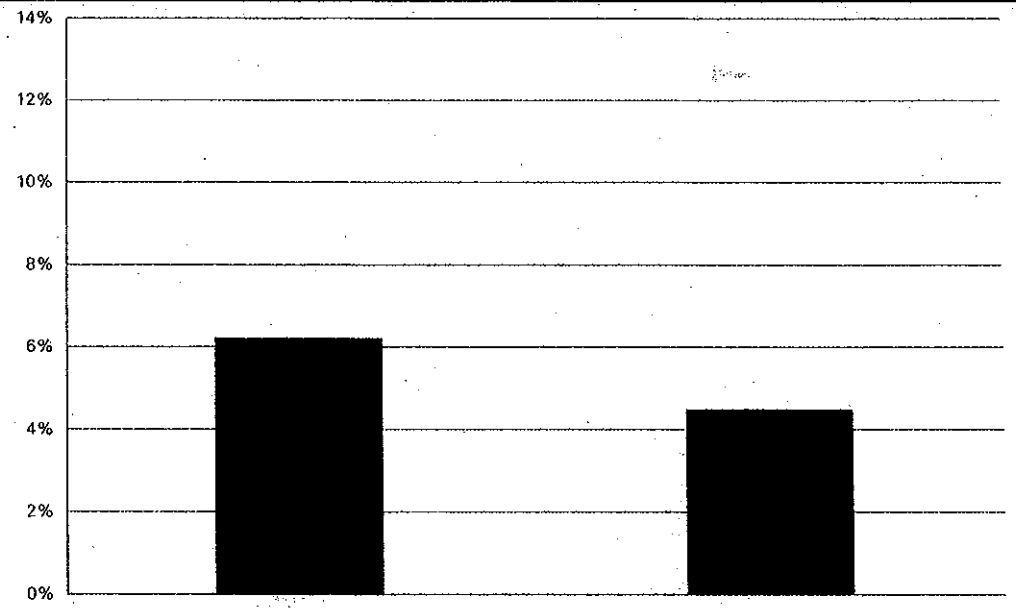
Appendix Figure A2.10: Percent with Multiple Challenges (≥ 9 EDI Sub-Domains) at Age 5 by Rural Income Quintile, Manitoba†



† 2006 & 2007 EDI cohorts
* Linear trend test significant ($p < 0.05$)

Source: Manitoba Centre for Health Policy, 2011

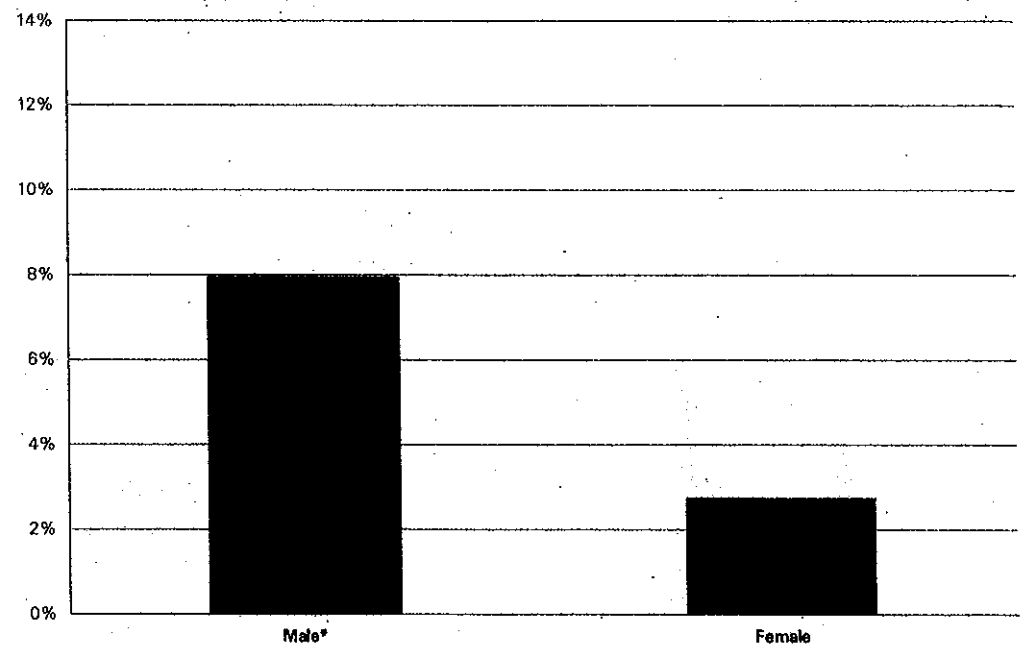
Appendix Figure A2.11: Percent with Multiple Challenges (≥ 9 EDI Sub-Domains) by Age, Manitoba†



† 2006 & 2007 EDI cohorts
* Significantly different from Age > 5.71 ($p < 0.05$)

Source: Manitoba Centre for Health Policy, 2011

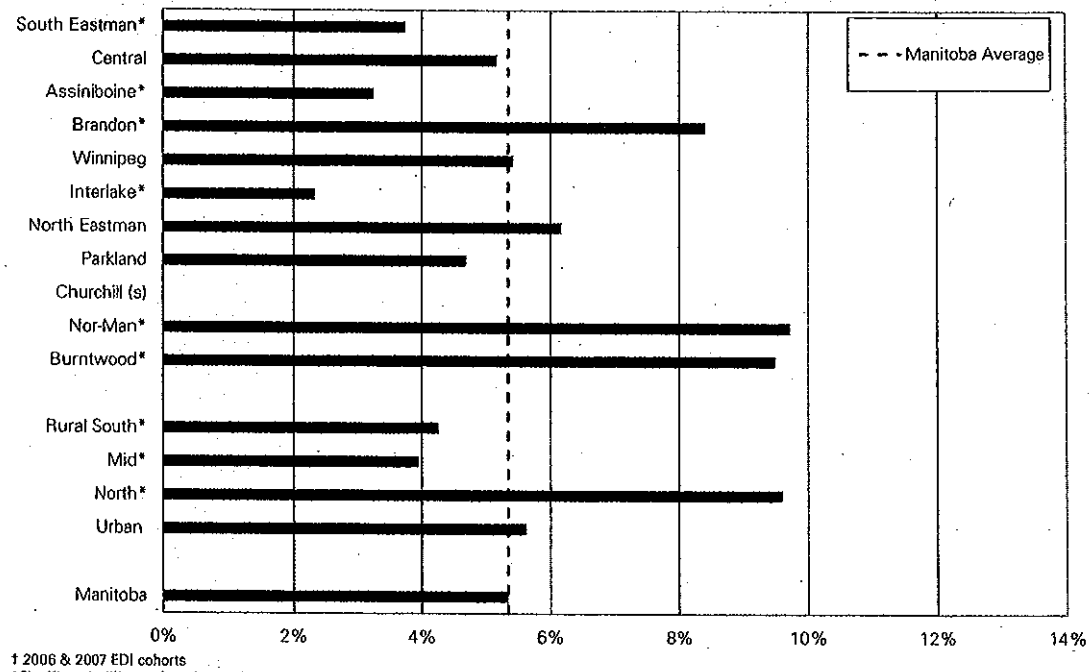
Appendix Figure A2.12: Percent with Multiple Challenges (≥ 9 EDI Sub-Domains) at Age 5 by Gender, Manitoba†



† 2006 & 2007 EDI cohorts
* Significantly different from Female ($p < 0.05$)

Source: Manitoba Centre for Health Policy, 2011

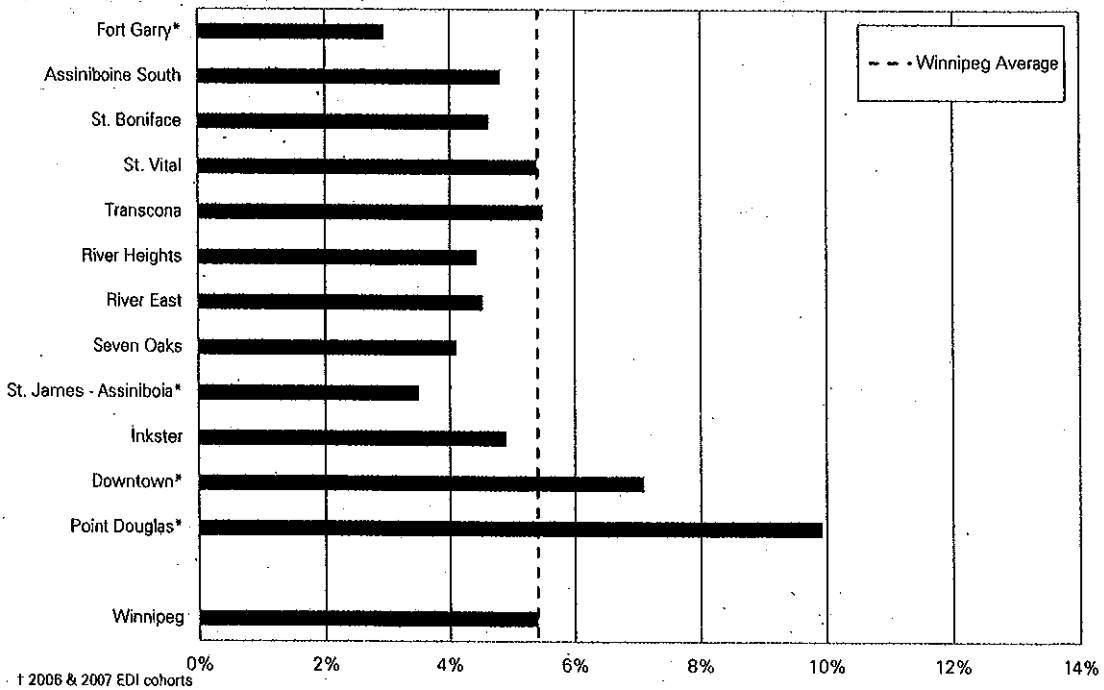
Appendix Figure A2.13: Percent with Multiple Challenges (≥ 9 EDI Sub-Domains) at Age 5 by RHA of Residence†



† 2006 & 2007 EDI cohorts
*Significantly different from Manitoba average ($p < 0.05$)
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2011

Appendix Figure A2.14: Percent with Multiple Challenges (≥ 9 EDI Sub-Domains) at Age 5 by Winnipeg Community Area of Residence†

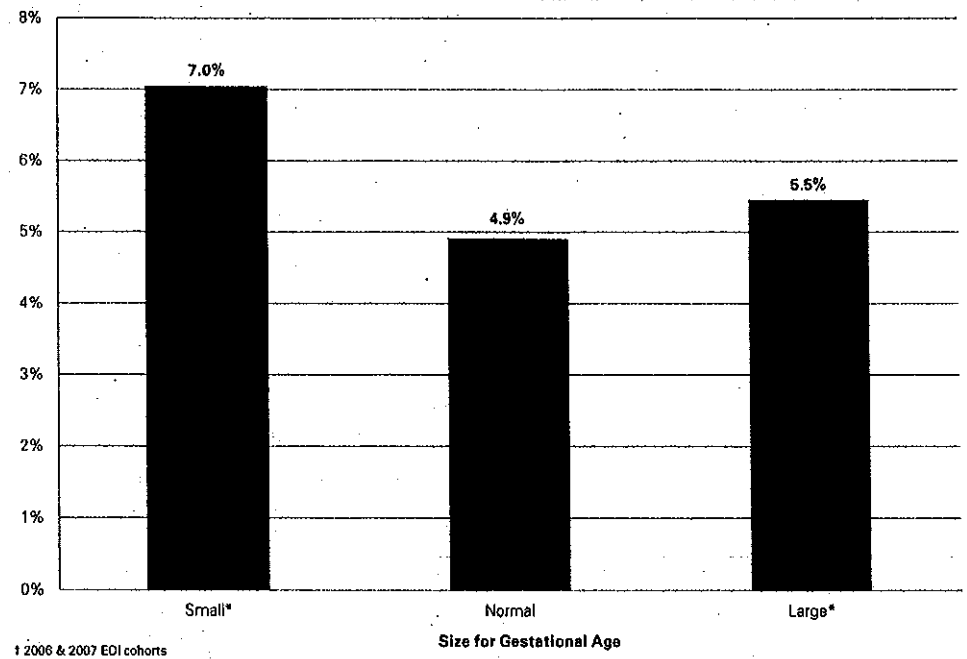


† 2006 & 2007 EDI cohorts
*Significantly different from Winnipeg average ($p < 0.05$)

Source: Manitoba Centre for Health Policy, 2011

Appendix 3: Figures and Tables for Chapter 3

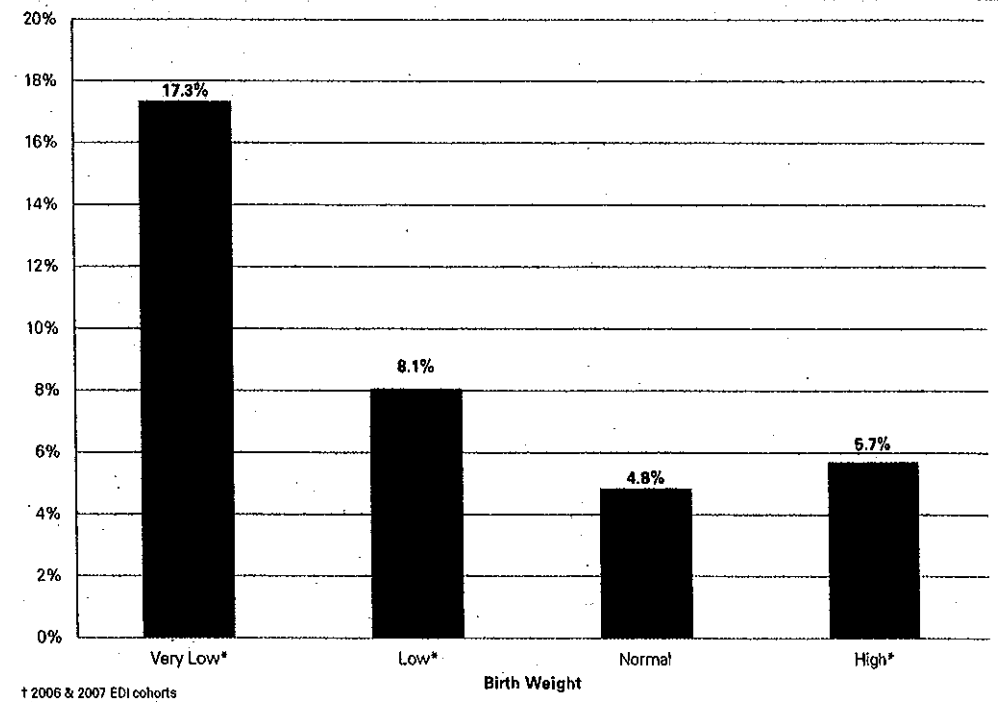
Appendix Figure A3.1: Percent with Multiple Challenges (≥ 9 EDI Domains) at Age 5 by Size for Gestational Age at Birth, Manitoba†



† 2006 & 2007 EDI cohorts
*Significantly different from Normal Gestational Age ($p < 0.05$)

Source: Manitoba Centre for Health Policy, 2011

Appendix Figure A3.2: Percent with Multiple Challenges (≥ 9 EDI Sub-Domains) at Age 5 by Birth Weight, Manitoba†



† 2006 & 2007 EDI cohorts
*Significantly different from Normal Birth Weight ($p < 0.05$)

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A3.1: Size for Gestational Age at Birth: Number of Children Not Ready and Very Ready (≥ 1 EDI Domains) and for Multiple Challenges (≥ 9 EDI Sub-Domains) at Age 5, Manitoba†

	Small	Normal	Large
Very Ready	754	8,835	1,627

† 2006 & 2007 EDI cohorts

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A3.2: Birth Weight: Number of Children Not Ready and Very Ready (≥ 1 EDI Domains) and for Multiple Challenges (≥ 9 EDI Sub-Domains) at Age 5, Manitoba†

	Very Low	Low	Normal	High
Very Ready	43	293	9,029	1,856

† 2006 & 2007 EDI cohorts

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A3.3: Number of Children in Each Size for Gestational Age Group by Urban and Rural Income Quintiles, Manitoba†

	Small	Normal	Large
U1	182	1,410	267
U3	171	1,568	267
U5	126	1,646	261
R1	60	713	185
R3	81	1,053	200
R5	82	1,136	240

† 2006 & 2007 EDI cohorts

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A3.4: Number of Children in Each Birth Weight Group by Urban and Rural Income Quintiles, Manitoba†

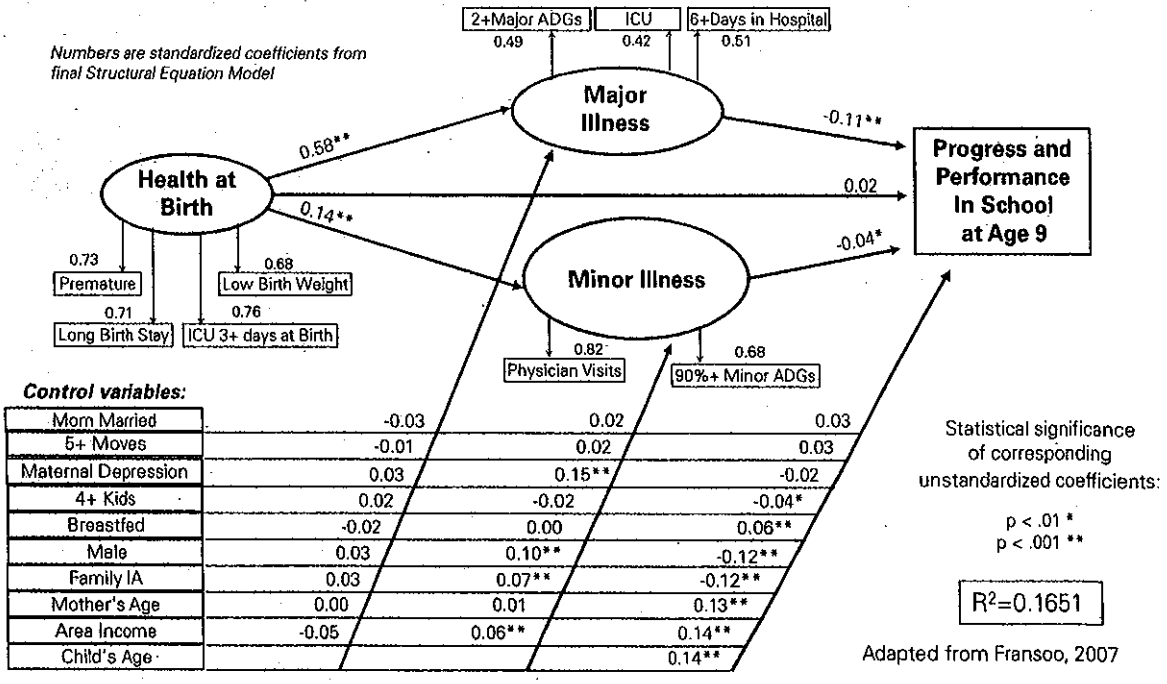
	Very Low	Low	Normal	High
Urban Quintiles				
U1	14	67	1,495	284
U2	[illegible]	[illegible]	[illegible]	[illegible]
U3	s	66	1,638	297
U4	[illegible]	[illegible]	[illegible]	[illegible]
U5	10	44	1,663	316
Rural Quintiles				
R1	9	30	712	207
R2	[illegible]	[illegible]	[illegible]	[illegible]
R3	s	17	1,071	244
R4	[illegible]	[illegible]	[illegible]	[illegible]
R5	14	36	1,128	285

† 2006 & 2007 EDI cohorts

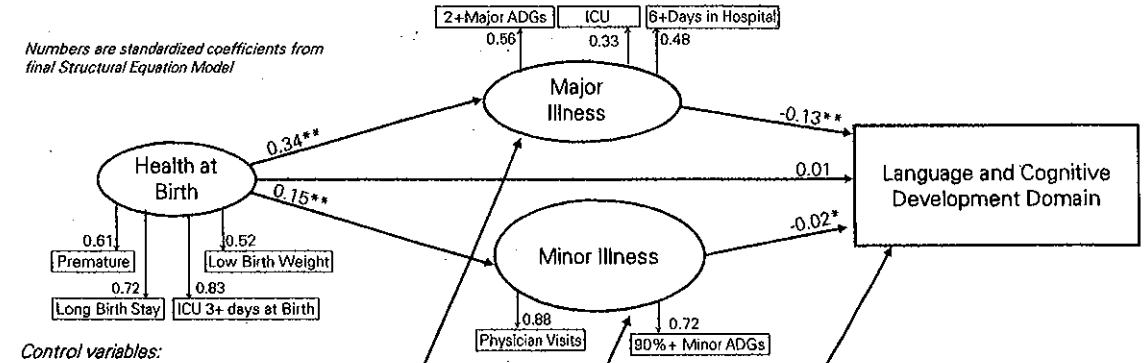
Source: Manitoba Centre for Health Policy, 2011

's' indicates data suppressed due to small numbers

Appendix Figure A3.3: Relationships Between Health at Birth and Progress and Performance in School at Age 9, Winnipeg



Appendix Figure A3.4: Relationships Between Health at Birth and EDI Language and Cognitive Development at Age 5, Manitoba†



Control variables:

Mom Married	-0.02	-0.00	0.07**
3+ Moves	0.00	-0.01	0.01
Maternal Depression	-0.00	-0.01	0.00
4+ kids	0.01	-0.10**	-0.10**
Breastfed	-0.07**	0.00	0.04**
Male	0.04**	0.06**	-0.15**
Family Ever on IA	0.02	0.18**	-0.12**
Mother's Age	-0.05**	-0.01	0.10**
Area Income	-0.04*	-0.01	0.06**
Child's Age			0.14**

Statistical significance of corresponding unstandardized coefficients:

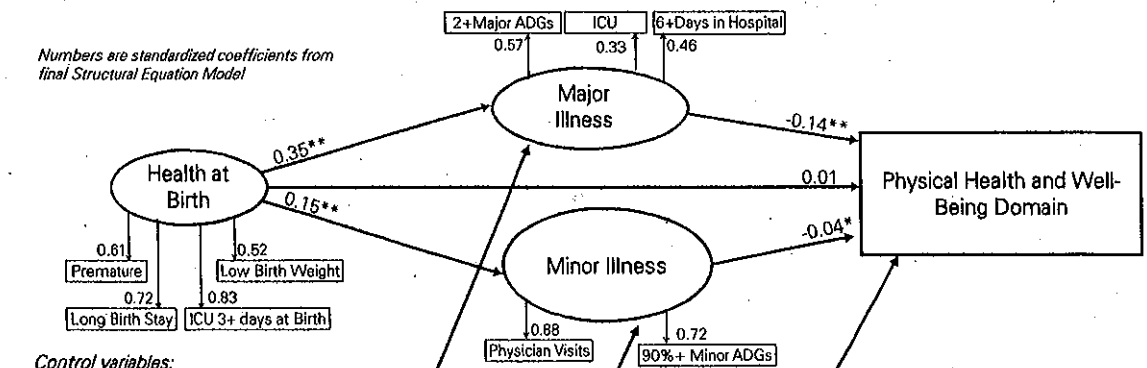
p < .01 *
p < .001 **

R^2=0.1578

Source: Manitoba Centre for Health Policy, 2011

† 2006 & 2007 EDI cohorts

Appendix Figure A3.5: Relationships Between Health at Birth and EDI Physical Health and Well-Being at Age 5, Manitoba†



Control variables:

Mom Married	-0.02	-0.00	0.07**
3+ Moves	0.00	-0.00	-0.01
Maternal Depression	-0.00	-0.01	-0.01
4+ kids	0.01	-0.10**	-0.07**
Breastfed	-0.07**	0.00	0.01
Male	0.04**	0.06**	-0.13**
Family Ever on IA	0.02	0.18**	-0.12**
Mother's Age	-0.05**	-0.01	0.08**
Area Income	-0.04*	-0.01	0.03**
Child's Age			0.09**

Statistical significance of corresponding unstandardized coefficients:

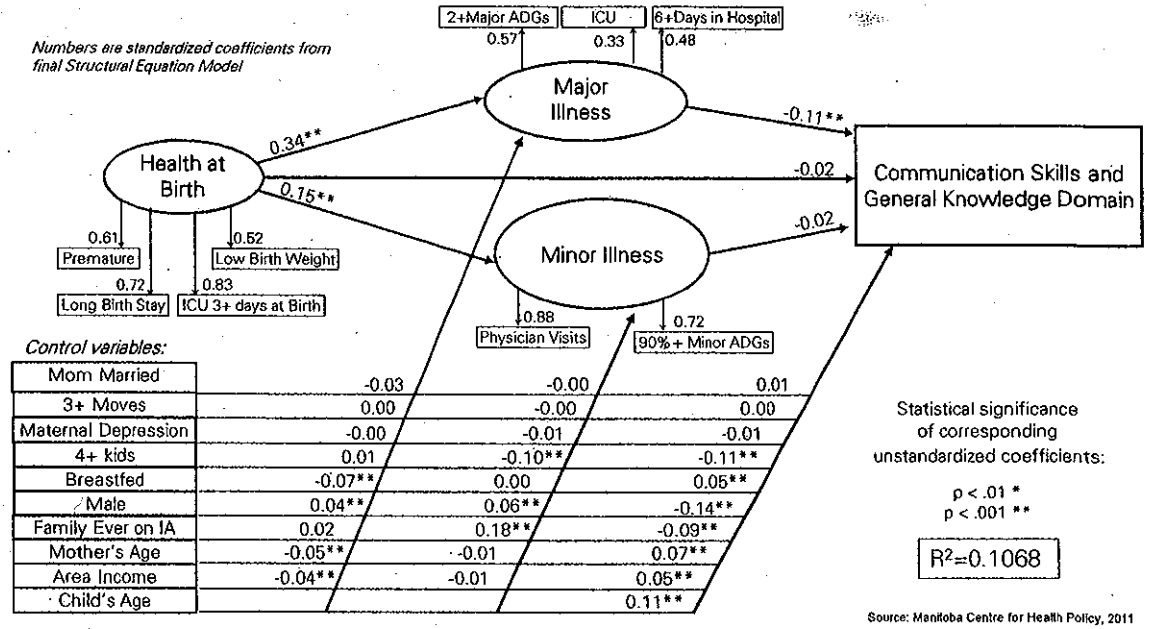
p < .01 *
p < .001 **

R^2=0.1195

Source: Manitoba Centre for Health Policy, 2011

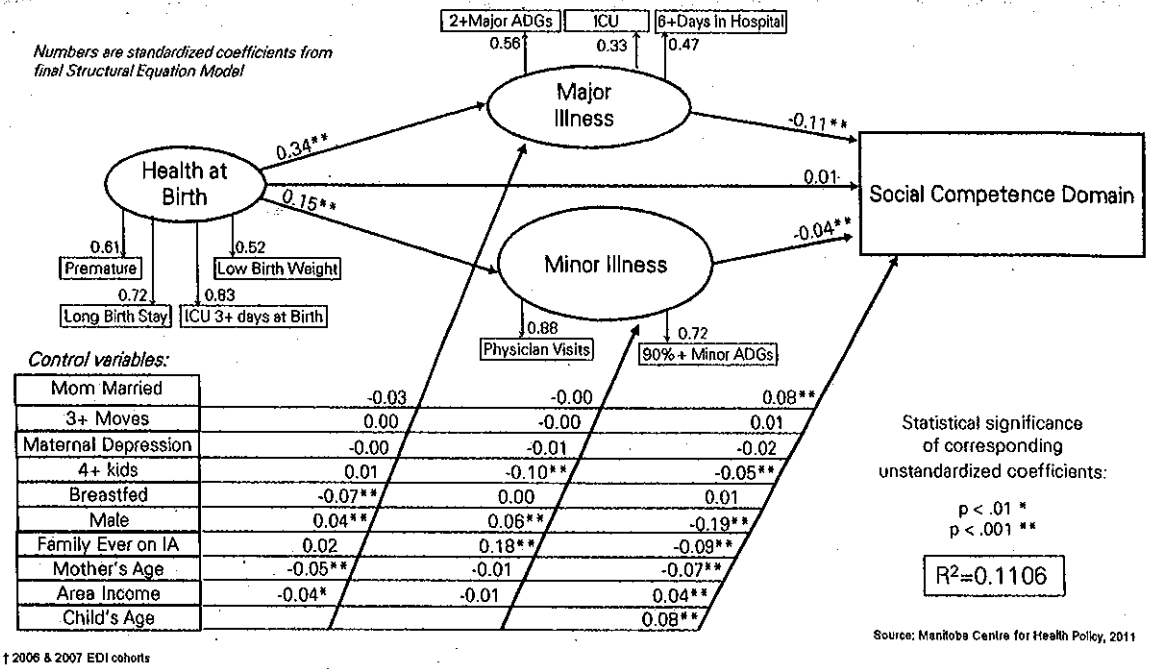
† 2006 & 2007 EDI cohorts

Appendix Figure A3.6: Relationships Between Health at Birth and EDI Communication Skills and General Knowledge at Age 5, Manitoba[1]



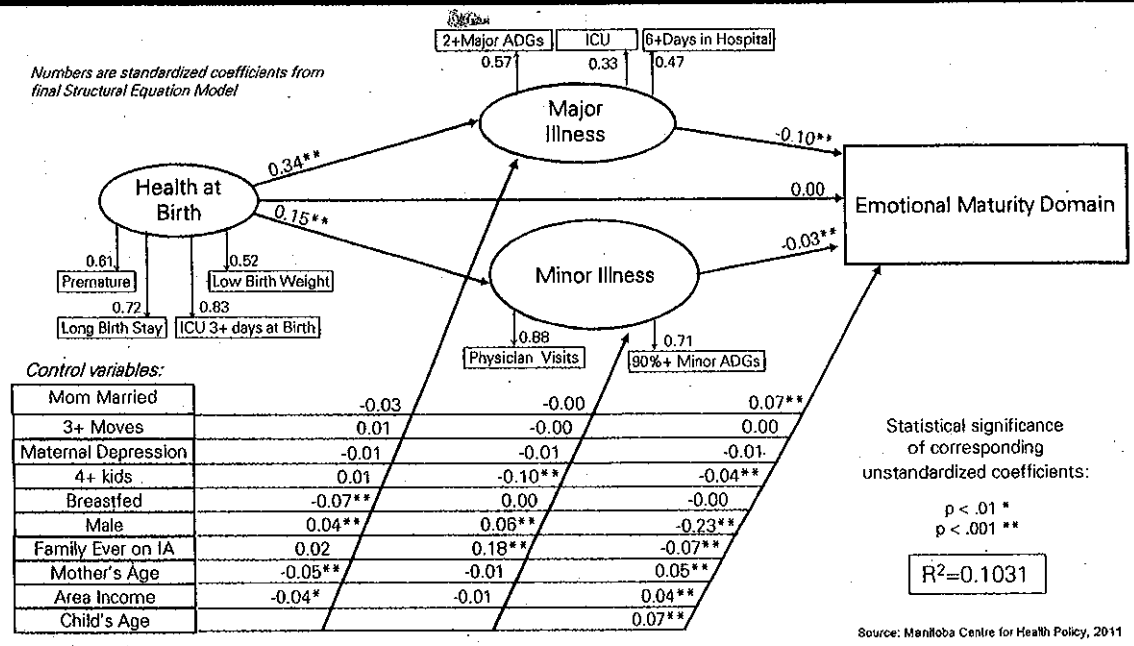
† 2006 & 2007 EDI cohorts

Appendix Figure A3.7: Relationships Between Health at Birth and EDI and Social Competence at Age 5, Manitoba[1]



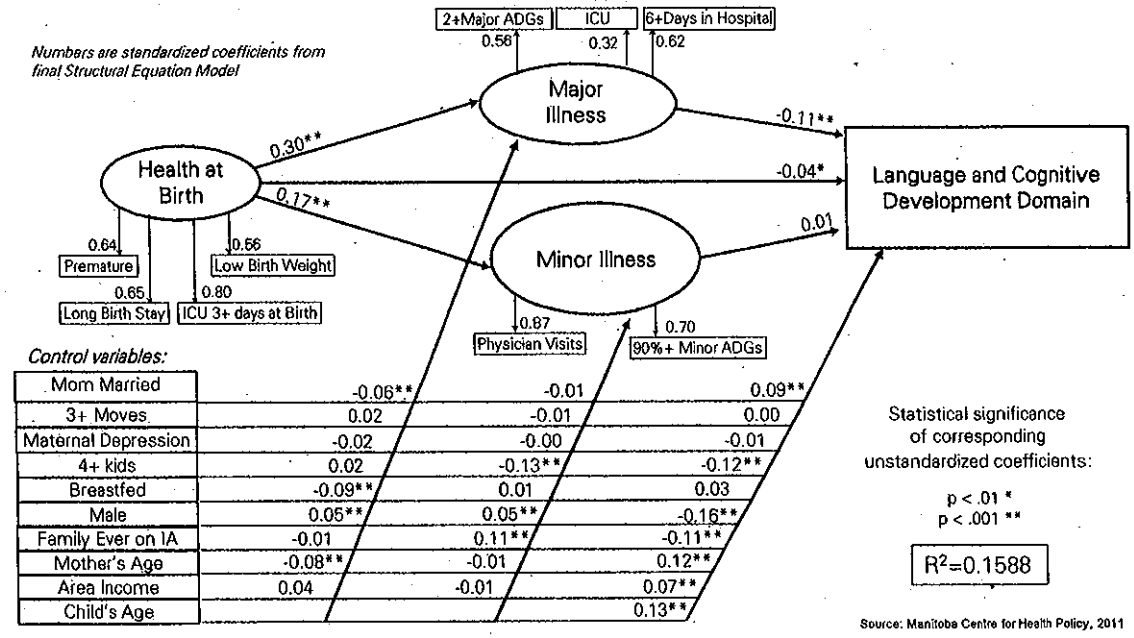
† 2006 & 2007 EDI cohorts

Appendix Figure A3.8: Relationships Between Health at Birth and EDI Emotional Maturity at Age 5, Manitoba†



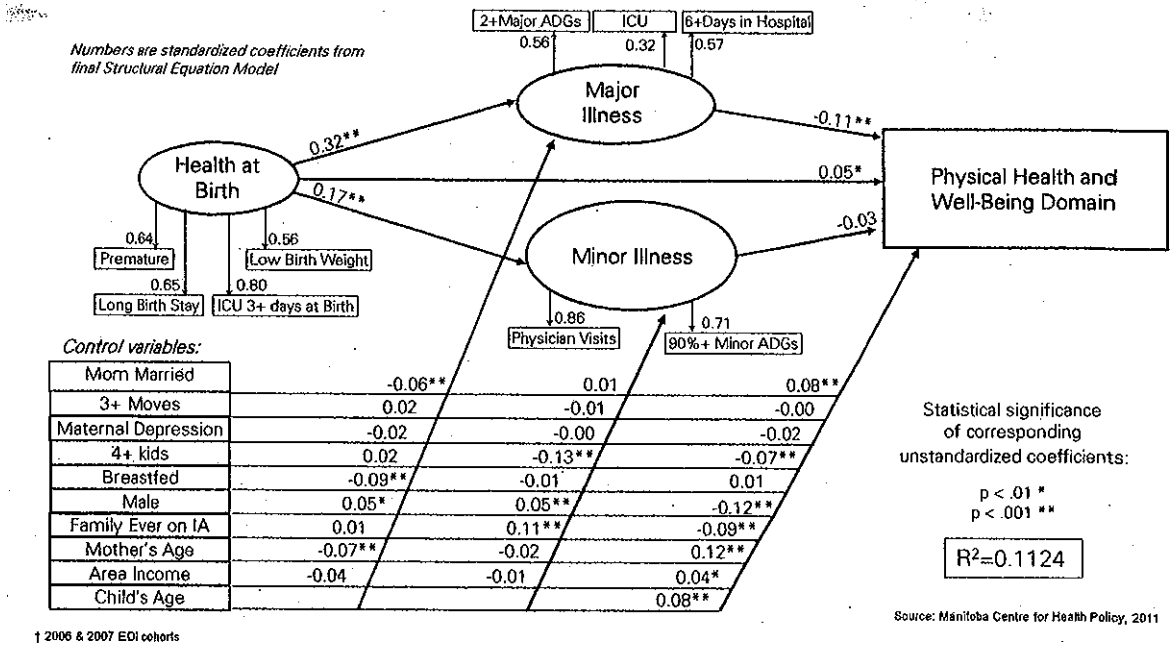
† 2006 & 2007 EDI cohorts

Appendix Figure A3.9: Relationships Between Health at Birth and EDI Language and Cognitive Development at Age 5, Non-Winnipeg†



† 2006 & 2007 EDI cohorts

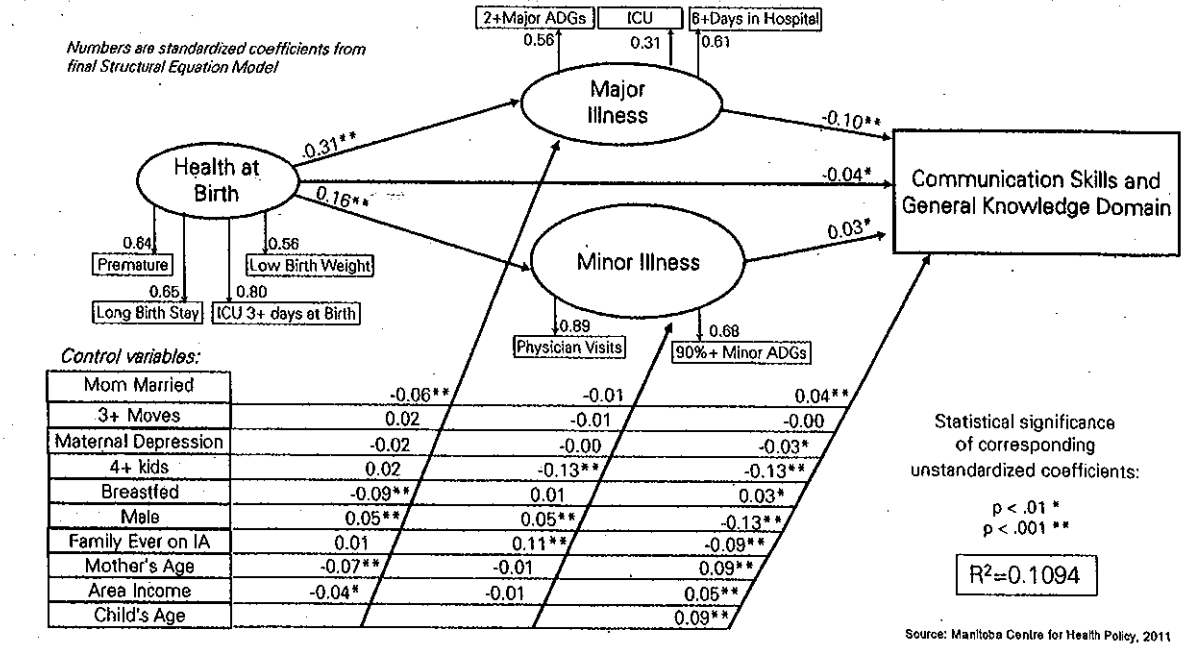
Appendix Figure A3.10: Relationships Between Health at Birth and EDI Physical Health and Well-Being at Age 5, Non-Winnipeg†



Source: Manitoba Centre for Health Policy, 2011

† 2006 & 2007 EDI cohorts

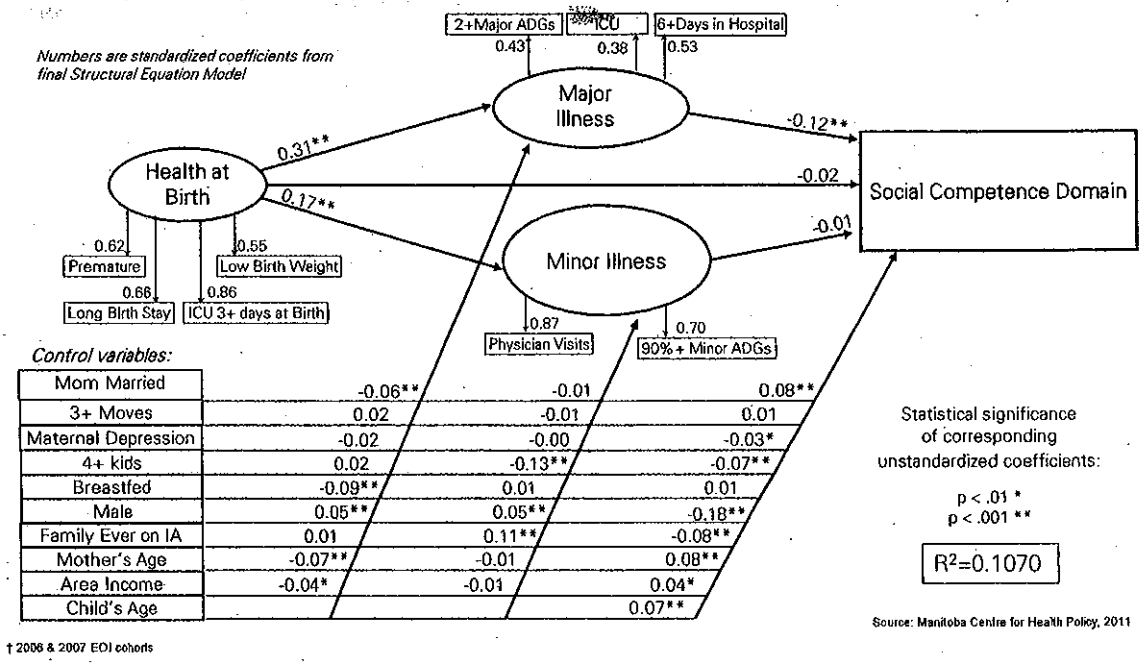
Appendix Figure A3.11: Relationships Between Health at Birth and EDI Communication Skills and General Knowledge at Age 5, Non-Winnipeg†



Source: Manitoba Centre for Health Policy, 2011

† 2006 & 2007 EDI cohorts

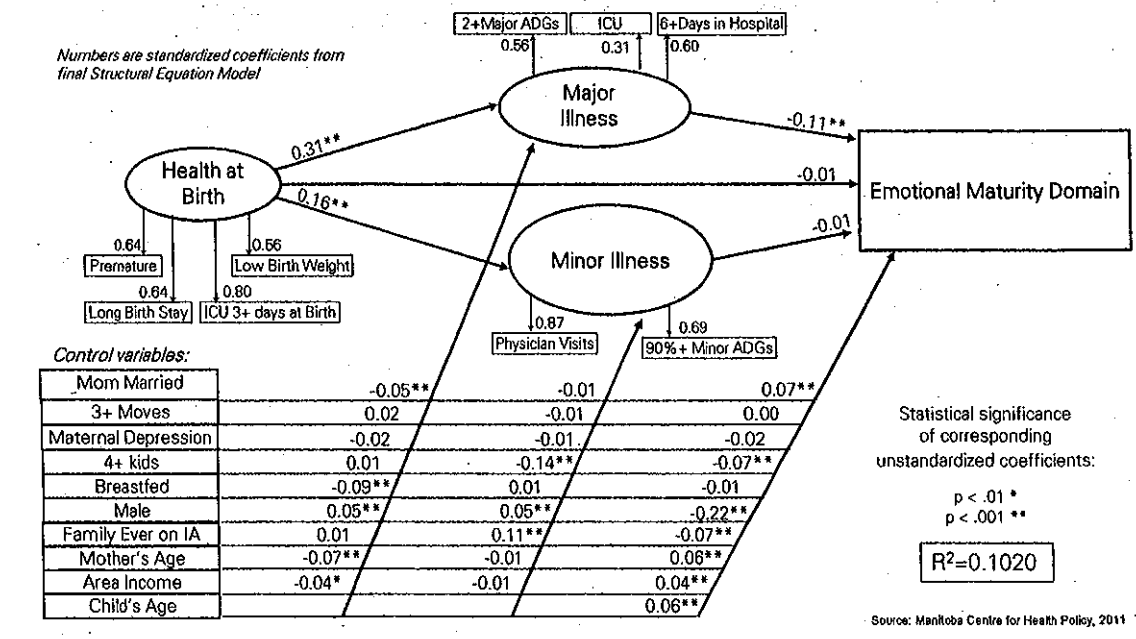
Appendix Figure A3.12: Relationships Between Health at Birth and EDI and Social Competence at Age 5, Non-Winnipeg†



Source: Manitoba Centre for Health Policy, 2011

† 2006 & 2007 EDI cohorts

Appendix Figure A3.13: Relationships Between Health at Birth and EDI Emotional Maturity at Age 5, Non-Winnipeg†



Source: Manitoba Centre for Health Policy, 2011

† 2006 & 2007 EDI cohorts

Appendix Table A3.5: Odds Ratios for Not Ready in EDI Language and Cognitive Development at Age 5, Manitoba†

Predictors	Odds Ratios	Confidence Intervals
Male	1.98	1.80 - 2.18
Child's Age	0.32	0.27 - 0.37
Low Birth Weight	1.23	0.95 - 1.59
ICU 3+ Days At Birth	1.22	0.76 - 0.95
Breastfed	0.85	1.23 - 1.55
2+ Major ADGs	1.67	1.20 - 1.57
90%+ Minor ADGs	1.22	1.44 - 1.88
6+ Days In Hospital	1.53	1.30 - 1.80
Area Income	0.39	0.98 - 1.52
Family Ever on IA	1.64	1.06 - 1.40
CFS	1.37	1.39 - 2.00
Teen Mom	1.38	1.57 - 1.98
Mom Married	0.75	0.68 - 0.84
4+ Kids	1.76	0.29 - 0.51

† 2006 & 2007 EDI cohorts

Bolded values are significant ($p < 0.05$)

Note: Results are from multilevel modelling

Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services

Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A3.6: Odds Ratios for Not Ready in EDI Physical Health and Well-Being at Age 5, Manitoba†

Predictors	Odds Ratios	Confidence Intervals
Male	1.80	1.63 - 1.99
Child's Age	0.53	0.45 - 0.63
Premature	0.80	0.63 - 1.03
Low Birth Weight	1.32	0.99 - 1.75
ICU 3+ Days At Birth	1.28	0.97 - 1.68
Long Birth Stay	1.18	0.97 - 1.43
Breastfed	0.74	0.66 - 0.84
2+ Major ADGs	1.73	1.44 - 2.09
90%+ Minor ADGs	1.42	1.18 - 1.71
Physician Visits	1.00	0.99 - 1.00
6+ Days In Hospital	1.44	1.21 - 1.71
Area Income	0.40	0.30 - 0.52
Family Ever on IA	1.56	1.37 - 1.79
CFS	1.20	1.04 - 1.38
4+ Kids	1.92	1.71 - 2.16

† 2006 & 2007 EDI cohorts

Bolded values are significant ($p < 0.05$)

Note: Results are from multilevel modelling

Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services

Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Apppendix Table A3.7: Odds Ratios for EDI Not Ready in EDI Communication Skills and General Knowledge at Age 5, Manitoba†

Predictors	Odds Ratios	Confidence Intervals
Male	1.80	1.63 - 1.99
Child's Age	0.53	0.45 - 0.63
Premature	0.80	0.63 - 1.03
Low Birth Weight	1.32	0.99 - 1.75
ICU 3+ Days At Birth	1.28	0.97 - 1.68
Long Birth Stay	1.18	0.97 - 1.43
Breastfed	0.74	0.66 - 0.84
2+ Major ADGs	1.73	1.44 - 2.09
90%+ Minor ADGs	1.42	1.18 - 1.71
Physician Visits	1.00	0.99 - 1.00
6+ Days In Hospital	1.44	1.21 - 1.71
Area Income	0.40	0.30 - 0.52
Family Ever on IA	1.56	1.37 - 1.79
CFS	1.20	1.04 - 1.38
4+ Kids	1.92	1.71 - 2.16

† 2006 & 2007 EDI cohorts

Bolded values are significant ($p < 0.05$)

Note: Results are from multilevel modelling

Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services

Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A3.8: Odds Ratios for Not Ready in EDI Social Competence at Age 5, Manitoba†

Predictors	Odds Ratios	Confidence Intervals
Male	2.36	2.12 - 2.63
Child's Age	0.65	0.55 - 0.76
Low Birth Weight	1.09	0.83 - 1.43
Long Birth Stay	1.15	0.97 - 1.37
2+ Major ADGs	1.50	1.23 - 1.83
90%+ Minor ADGs	1.17	1.01 - 1.36
6+ Days In Hospital	1.36	1.13 - 1.63
ICU	1.49	1.05 - 2.11
Area Income	0.59	0.44 - 0.78
Family Ever on IA	1.56	1.35 - 1.80
CFS	1.33	1.14 - 1.54
Teen Mom	1.21	1.06 - 1.37
Mom Married	0.71	0.63 - 0.80
4+ Kids	1.25	1.10 - 1.44

† 2006 & 2007 EDI cohorts

Bolded values are significant ($p < 0.05$)

Note: Results are from multilevel modelling

Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services

Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A3.9: Odds Ratios for Not Ready in EDI Emotional Maturity at Age 5, Manitoba†

Predictors	Odds Ratios	Confidence Intervals
Male	**2.99**	2.71 - 3.31
Child's Age	**0.68**	0.58 - 0.79
Breastfed	1.11	0.98 - 1.25
2+ Major ADGs	**1.61**	1.35 - 1.93
Physician Visits	**1.00**	1.00 - 1.01
6+ Days In Hospital	**1.26**	1.06 - 1.50
Area Income	**0.71**	0.56 - 0.91
Family Ever on IA	**1.45**	1.26 - 1.67
CFS	**1.40**	1.22 - 1.62
Teen Mom	1.10	0.98 - 1.24
Mom Married	**0.75**	0.68 - 0.83
4+ Kids	**1.19**	1.04 - 1.35

† 2006 & 2007 EDI cohorts

Bolded values are significant ($p < 0.05$)

Note: Results are from multilevel modelling

Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services

Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A3.10: Odds Ratios for EDI Very Ready (≥ 1 EDI Domains), Manitoba†

Predictors	Odds Ratios	Confidence Intervals
Male	**0.45**	0.42 - 0.48
Child's Age	**2.74**	2.45 - 3.06
Premature	1.09	0.92 - 1.28
ICU 3+ Days At Birth	**0.77**	0.64 - 0.92
Breastfed	**1.14**	1.04 - 1.25
2+ Major ADGs	**0.81**	0.69 - 0.94
90%+ Minor ADGs	**0.83**	0.74 - 0.92
6+ Days In Hospital	**0.70**	0.60 - 0.81
ICU	**0.73**	0.54 - 0.98
Area Income	**1.73**	1.45 - 2.05
Family Ever on IA	**0.63**	0.57 - 0.70
CFS	**0.66**	0.59 - 0.74
Teen Mom	**0.73**	0.67 - 0.80
Mom Married	**1.24**	1.15 - 1.33
4+ Kids	**0.63**	0.57 - 0.69

† 2006 & 2007 EDI cohorts

Bolded values are significant ($p < 0.05$)

Note: Results are from multilevel modelling

Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services

Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A3.11: Odds Ratios for Very Ready in EDI Language and Cognitive Development at Age 5, Manitoba†

Predictor	Odds Ratio	95% Confidence Interval
Male	**0.57**	0.53 - 0.61
Child's Age	**2.64**	2.33 - 2.98
Premature	1.15	0.95 - 1.40
Low Birth Weight	**0.74**	0.57 - 0.95
ICU 3+ Days At Birth	0.82	0.66 - 1.01
Breastfed	**1.24**	1.11 - 1.38
Physician Visits	1.00	1.00 - 1.00
6+ Days In Hospital	**0.80**	0.66 - 0.95
Area Income	**1.68**	1.40 - 2.01
Family Ever on IA	**0.61**	0.53 - 0.70
CFS	**0.75**	0.64 - 0.87
Teen Mom	**0.69**	0.62 - 0.76
Mom Married	**1.15**	1.06 - 1.25
Maternal Depression	**1.16**	1.03 - 1.29
4+ Kids	**0.62**	0.55 - 0.70

† 2006 & 2007 EDI cohorts
Bolded values are significant ($p < 0.05$)
Note: Results are from multilevel modelling
Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services
Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A3.12: Odds Ratios for Very Ready in EDI Physical Health and Well-Being at Age 5, Manitoba†

Predictor	Odds Ratio	95% Confidence Interval
Male	**0.58**	0.55 - 0.62
Child's Age	**2.15**	1.92 - 2.40
Low Birth Weight	**0.84**	0.69 - 1.01
2+ Major ADGs	**0.79**	0.67 - 0.92
90%+ Minor ADGs	**0.76**	0.68 - 0.86
6+ Days In Hospital	**0.78**	0.66 - 0.91
Area Income	**1.18**	1.00 - 1.40
Family Ever on IA	**0.67**	0.59 - 0.75
CFS	**0.67**	0.59 - 0.77
Teen Mom	**0.72**	0.66 - 0.79
Mom Married	**1.19**	1.11 - 1.28
4+ Kids	**0.71**	0.64 - 0.79

† 2006 & 2007 EDI cohorts
Bolded values are significant ($p < 0.05$)
Note: Results are from multilevel modelling
Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services
Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A3.13: Odds Ratios for Very Ready in EDI Communication Skills and General Knowledge at Age 5, Manitoba†

Predictors	Odds Ratios	Confidence Intervals
Male	0.57	0.54 - 0.61
Child's Age	2.23	2.00 - 2.49
Premature	1.03	0.88 - 1.21
ICU 3+ Days At Birth	0.77	0.64 - 0.92
Breastfed	1.20	1.09 - 1.31
2+ Major ADGs	0.89	0.76 - 1.03
90%+ Minor ADGs	0.86	0.77 - 0.96
6+ Days In Hospital	0.72	0.62 - 0.85
ICU	0.75	0.54 - 1.05
Area Income	1.56	1.33 - 1.84
Family Ever on IA	0.67	0.60 - 0.75
CFS	0.73	0.65 - 0.83
Teen Mom	0.78	0.72 - 0.86
4+ Kids	0.62	0.56 - 0.69

† 2006 & 2007 EDI cohorts

Bolded values are significant ($p < 0.05$)

Note: Results are from multilevel modelling

Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services

Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A3.14: Odds Ratios for Very Ready in EDI Social Competence at Age 5, Manitoba†

Predictors	Odds Ratios	Confidence Intervals
Male	0.48	0.45 - 0.51
Child's Age	2.26	2.02 - 2.52
Premature	1.01	0.85 - 1.19
Low Birth Weight	0.81	0.65 - 1.01
2+ Major ADGs	0.83	0.71 - 0.97
90%+ Minor ADGs	0.81	0.72 - 0.91
6+ Days In Hospital	0.84	0.71 - 0.99
Area Income	1.39	1.17 - 1.64
Family Ever on IA	0.73	0.64 - 0.82
CFS	0.60	0.52 - 0.69
Teen Mom	0.80	0.72 - 0.88
Mom Married	1.23	1.14 - 1.32
4+ Kids	0.77	0.69 - 0.85

† 2006 & 2007 EDI cohorts

Bolded values are significant ($p < 0.05$)

Note: Results are from multilevel modelling

Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services

Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A3.15: Odds Ratios for Very Ready In EDI Emotional Maturity at Age 5, Manitoba†

Predictors	Odds Ratios	Confidence Intervals
Male	0.46	0.43 - 0.49
Child's Age	1.88	1.68 - 2.11
Long Birth Stay	0.87	0.77 - 0.98
90%+ Minor ADGs	0.82	0.70 - 0.95
Physician Visits	1.00	1.00 - 1.00
6+ Days In Hospital	0.66	0.55 - 0.79
Area Income	1.58	1.32 - 1.88
Family Ever on IA	0.76	0.67 - 0.85
CFS	0.75	0.66 - 0.86
Teen Mom	0.88	0.80 - 0.97
Mom Married	1.24	1.15 - 1.34
4+ Kids	0.81	0.73 - 0.90

† 2006 & 2007 EDI cohorts
Bolded values are significant ($p < 0.05$)
Note: Results are from multilevel modelling
Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services
Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A3.16: Odds Ratios for Not Ready in EDI Language and Cognitive Development at Age 5,Winnipeg†

Predictors	Odds Ratios	Confidence Intervals
Male	1.98	1.74 - 2.25
Child's Age	0.29	0.23 - 0.35
Long Birth Stay	1.23	1.01 - 1.51
Breastfed	0.78	0.67 - 0.91
2+ Major ADGs	1.68	1.32 - 2.14
Physician Visits	1.01	1.00 - 1.01
6+ Days In Hospital	1.28	0.99 - 1.66
ICU	1.62	1.06 - 2.48
Area Income	0.39	0.28 - 0.54
Family Ever on IA	1.70	1.42 - 2.03
CFS	1.41	1.18 - 1.68
Teen Mom	1.19	1.01 - 1.40
Mom Married	0.81	0.70 - 0.94
4+ Kids	1.58	1.33 - 1.88

† 2006 & 2007 EDI cohorts
Bolded values are significant ($p < 0.05$)
Note: Results are from multilevel modelling
Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services
Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A3.17: Odds Ratios for Not Ready in EDI Physical Health and Well-Being at Age 5, Winnipeg†

Predictors	Odds Ratios	Confidence Intervals
Male	2.02	1.78 - 2.29
Child's Age	0.56	0.45 - 0.68
Premature	0.85	0.65 - 1.12
Long Birth Stay	1.34	1.08 - 1.67
Breastfed	0.88	0.75 - 1.03
2+ Major ADGs	2.01	1.60 - 2.53
Physician Visits	1.00	1.00 - 1.01
6+ Days In Hospital	1.25	0.96 - 1.62
ICU	1.63	1.07 - 2.48
Area Income	0.70	0.52 - 0.95
Family Ever on IA	1.75	1.46 - 2.08
CFS	1.51	1.27 - 1.80
Teen Mom	1.21	1.03 - 1.42
Mom Married	0.75	0.65 - 0.87
4+ Kids	1.38	1.16 - 1.64

† 2006 & 2007 EDI cohorts
Bolded values are significant ($p < 0.05$)
Note: Results are from multilevel modelling
Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services
Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A3.18: Odds Ratios for Not Ready in EDI Communication Skills and General Knowledge at Age 5, Winnipeg†

Predictors	Odds Ratios	Confidence Intervals
Male	1.80	1.57 - 2.06
Child's Age	0.49	0.39 - 0.61
Low Birth Weight	1.34	0.97 - 1.84
Long Birth Stay	1.28	1.02 - 1.61
Breastfed	0.66	0.56 - 0.77
2+ Major ADGs	1.85	1.45 - 2.36
Physician Visits	1.01	1.01 - 1.01
ICU	1.36	0.88 - 2.10
Area Income	0.37	0.26 - 0.53
Family Ever on IA	1.32	1.10 - 1.59
CFS	1.29	1.07 - 1.56
4+ Kids	1.76	1.47 - 2.10

† 2006 & 2007 EDI cohorts
Bolded values are significant ($p < 0.05$)
Note: Results are from multilevel modelling
Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services
Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A3.19: Odds Ratios for Not Ready in EDI Social Competence at Age 5, Winnipeg†

Predictors	Odds Ratios	Confidence Intervals
Male	2.54	2.21 - 2.93
Child's Age	0.61	0.49 - 0.76
ICU 3+ Days At Birth	0.69	0.48 - 1.00
Long Birth Stay	1.43	1.09 - 1.89
2+ Major ADGs	1.69	1.31 - 2.18
Physician Visits	1.01	1.00 - 1.01
ICU	1.50	0.97 - 2.32
Area Income	0.57	0.40 - 0.80
Family Ever on IA	1.62	1.35 - 1.95
CFS	1.41	1.17 - 1.70
Mom Married	0.73	0.63 - 0.85
4+ Kids	1.18	0.97 - 1.43

† 2006 & 2007 EDI cohorts
Bolded values are significant ($p < 0.05$)
Note: Results are from multilevel modelling
Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services
Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A3.20: Odds Ratios for Not Ready in EDI Emotional Maturity at Age 5, Winnipeg†

Male	3.07	2.70 - 3.50
Child's Age	0.66	0.54 - 0.81
ICU 3+ Days At Birth	0.73	0.52 - 1.02
Long Birth Stay	1.31	1.02 - 1.70
2+ Major ADGs	1.71	1.36 - 2.15
Physician Visits	1.01	1.00 - 1.01
Area Income	0.64	0.47 - 0.87
Family Ever on IA	1.43	1.20 - 1.70
CFS	1.35	1.13 - 1.61
Mom Married	0.76	0.66 - 0.87

† 2006 & 2007 EDI cohorts
Bolded values are significant ($p < 0.05$)
Note: Results are from multilevel modelling
Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services
Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A3.21: Odds Ratios for Very Ready in EDI Language and Cognitive Development at Age 5, Winnipeg†

Predictors	Odds Ratios	Confidence Intervals
Male	0.60	0.55 - 0.66
Child's Age	2.65	2.25 - 3.11
Low Birth Weight	0.78	0.57 - 1.05
Long Birth Stay	0.81	0.66 - 0.98
Breastfed	1.33	1.15 - 1.55
2+ Major ADGs	0.73	0.58 - 0.92
Physician Visits	1.00	0.99 - 1.00
Area Income	1.71	1.39 - 2.11
Family Ever On IA	0.63	0.53 - 0.75
In CFS	0.78	0.64 - 0.95
Teen Mom	0.65	0.56 - 0.76
Mom Married	1.13	1.03 - 1.26
Maternal Depression	1.12	0.96 - 1.30
4+ Kids	0.66	0.55 - 0.80

† 2006 & 2007 EDI cohorts

Bolded values are significant ($p < 0.05$)

Note: Results are from multilevel modelling

Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services

Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A3.22: Odds Ratios for Very Ready in EDI Physical Health & Well-Being at Age 5, Winnipeg†

Predictors	Odds Ratios	Confidence Intervals
Male	0.58	0.53 - 0.63
Child's Age	2.28	1.97 - 2.63
Long Birth Stay	0.85	0.72 - 1.00
2+ Major ADGs	0.75	0.61 - 0.92
90%+ Minor ADGs	0.82	0.69 - 0.99
Physician Visits	1.00	0.99 - 1.00
6+ Days In Hospital	0.69	0.53 - 0.89
Family Ever On IA	0.59	0.50 - 0.68
In CFS	0.79	0.67 - 0.93
Teen Mom	0.79	0.69 - 0.90
Mom Married	1.18	1.08 - 1.30
4+ Kids	0.59	0.50 - 0.70

† 2006 & 2007 EDI cohorts

Bolded values are significant ($p < 0.05$)

Note: Results are from multilevel modelling

Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services

Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A3.23: Odds Ratios for Very Ready in EDI Communication Skills & General Knowledge at Age 5, Winnipeg†

Predictors	Odds Ratios	Confidence Intervals
Male	0.56	0.52 - 0.61
Child's Age	2.23	1.94 - 2.57
Premature	1.05	0.86 - 1.29
Long Birth Stay	1.24	1.10 - 1.41
Breastfed	0.79	0.67 - 0.94
2+ Major ADGs	0.76	0.62 - 0.93
Physician Visits	1.00	0.99 - 1.00
6+ Days In Hospital	0.77	0.60 - 0.98
ICU	0.70	0.46 - 1.08
Area Income	1.45	1.20 - 1.76
Family Ever On IA	0.66	0.57 - 0.76
In CFS	0.80	0.69 - 0.93
Teen Mom	0.83	0.73 - 0.94
4+ Kids	0.66	0.56 - 0.76

† 2006 & 2007 EDI cohorts

Bolded values are significant ($p < 0.05$)

Note: Results are from multilevel modelling

Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services

Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A3.24: Odds Ratios for Very Ready in EDI Social Competence at Age 5, Winnipeg†

Predictors	Odds Ratios	Confidence Intervals
Male	0.47	0.43 - 0.51
Child's Age	2.48	2.14 - 2.87
Low Birth Weight	0.82	0.63 - 1.08
ICU 3+ Days At Birth	1.42	1.07 - 1.88
Long Birth Stay	0.73	0.59 - 0.91
2+ Major ADGs	0.82	0.66 - 1.00
90%+ Minor ADGs	0.85	0.71 - 1.03
Physician Visits	1.00	0.99 - 1.00
Area Income	1.30	1.07 - 1.58
Family Ever On IA	0.73	0.63 - 0.85
In CFS	0.65	0.55 - 0.77
Teen Mom	0.81	0.71 - 0.92
Mom Married	1.26	1.15 - 1.39
4+ Kids	0.85	0.73 - 0.99

† 2006 & 2007 EDI cohorts

Bolded values are significant ($p < 0.05$)

Note: Results are from multilevel modelling

Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services

Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A3.25: Odds Ratios for Very Ready in EDI Emotional Maturity at Age 5, Winnipeg†

Predictors	Odds Ratios	Confidence Intervals
Male	**0.45**	0.42 - 0.50
Child's Age	**1.97**	1.69 - 2.28
Long Birth Stay	**0.75**	0.63 - 0.89
Physician Visits	**1.00**	0.99 - 1.00
6+ Days In Hospital	**0.72**	0.55 - 0.93
Area Income	**1.41**	1.15 - 1.73
Family Ever On IA	**0.67**	0.57 - 0.77
In CFS	**0.73**	0.62 - 0.86
Mom Married	**1.25**	1.13 - 1.37

† 2006 & 2007 EDI cohorts

Bolded values are significant ($p < 0.05$)

Note: Results are from multilevel modelling

Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services

Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A3.26: Odds Ratios for Not Ready in EDI Language and Cognitive Development at Age 5, Non-Winnipeg†

Predictors	Odds Ratios	Confidence Intervals
Male	**2.00**	1.73 - 2.31
Child's Age	**0.35**	0.28 - 0.44
Low Birth Weight	**1.31**	0.88 - 1.95
ICU 3+ Days At Birth	**1.40**	0.99 - 1.98
2+ Major ADGs	**1.54**	1.16 - 2.06
90%+ Minor ADGs	**1.20**	0.90 - 1.61
Physician Visits	**1.00**	0.99 - 1.00
6+ Days In Hospital	**1.62**	1.30 - 2.02
Area Income	**0.37**	0.23 - 0.59
Family Ever on IA	**1.74**	1.42 - 2.13
CFS	**1.42**	1.15 - 1.75
Teen Mom	**1.60**	1.36 - 1.88
Mom Married	**0.70**	0.60 - 0.83
4+ Kids	**1.89**	1.60 - 2.22

† 2006 & 2007 EDI cohorts

Bolded values are significant ($p < 0.05$)

Note: Results are from multilevel modelling

Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services

Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A3.27: Odds Ratios for Not Ready in EDI Physical Health and Well-Being at Age 5, Non-Winnipeg †

Predictors	Odds Ratios	Confidence Intervals
Male	1.80	1.56 - 2.07
Child's Age	0.64	0.51 - 0.81
Premature	1.18	0.86 - 1.62
Low Birth Weight	1.83	1.24 - 2.72
2+ Major ADGs	1.62	1.22 - 2.14
90%+ Minor ADGs	1.68	1.28 - 2.22
Physician Visits	1.00	0.99 - 1.00
6+ Days In Hospital	1.31	1.04 - 1.64
Area Income	0.41	0.26 - 0.66
Family Ever on IA	1.47	1.20 - 1.81
CFS	1.57	1.27 - 1.94
Teen Mom	1.44	1.22 - 1.70
Mom Married	0.70	0.60 - 0.83
4+ Kids	1.56	1.31 - 1.84

† 2006 & 2007 EDI cohorts
Bolded values are significant ($p < 0.05$)
Note: Results are from multilevel modelling
Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services
Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A3.28: Odds Ratios for Not Ready in EDI Communication Skills and General Knowledge at Age 5, Non-Winnipeg †

Male	1.81	1.56 - 2.09
Child's Age	0.58	0.46 - 0.74
Premature	0.84	0.60 - 1.19
ICU 3+ Days At Birth	1.59	1.10 - 2.30
Breastfed	0.87	0.73 - 1.04
2+ Major ADGs	1.66	1.24 - 2.23
90%+ Minor ADGs	1.82	1.36 - 2.44
Physician Visits	0.99	0.98 - 0.99
6+ Days In Hospital	1.71	1.36 - 2.15
Area Income	0.48	0.30 - 0.78
Family Ever on IA	1.92	1.56 - 2.37
Teen Mom	1.12	0.94 - 1.33
Mom Married	0.85	0.72 - 1.01
4+ Kids	2.01	1.70 - 2.36

† 2006 & 2007 EDI cohorts
Bolded values are significant ($p < 0.05$)
Note: Results are from multilevel modelling
Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services
Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A3.29: Odds Ratios for Not Ready in EDI Social Competence at Age 5, Non-Winnipeg†

Predictors	Odds Ratios	Confidence Intervals
Male	2.15	1.82 - 2.53
Child's Age	0.70	0.54 - 0.91
Low Birth Weight	1.93	1.35 - 2.77
2+ Major ADGs	1.30	0.95 - 1.78
6+ Days In Hospital	1.47	1.15 - 1.89
ICU	1.70	0.99 - 2.92
Area Income	0.55	0.32 - 0.93
Family Ever on IA	1.63	1.30 - 2.04
CFS	1.31	1.03 - 1.66
Teen Mom	1.37	1.14 - 1.65
Mom Married	0.70	0.58 - 0.84
Maternal Depression	1.15	0.91 - 1.45
4+ Kids	1.32	1.09 - 1.59

† 2006 & 2007 EDI cohorts
Bolded values are significant ($p < 0.05$)
Note: Results are from multilevel modelling
Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services
Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A.30: Odds Ratios for Not Ready in EDI Emotional Maturity at Age 5, Non-Winnipeg†

Predictors	Odds Ratios	Confidence Intervals
Male	2.90	2.48 - 3.38
Child's Age	0.68	0.54 - 0.86
Breastfed	1.16	0.97 - 1.40
2+ Major ADGs	1.47	1.10 - 1.95
6+ Days In Hospital	1.58	1.26 - 1.98
Family Ever on IA	1.56	1.26 - 1.94
CFS	1.55	1.24 - 1.94
Teen Mom	1.18	0.99 - 1.40
Mom Married	0.75	0.63 - 0.88
4+ Kids	1.45	1.22 - 1.72

† 2006 & 2007 EDI cohorts
Bolded values are significant ($p < 0.05$)
Note: Results are from multilevel modelling
Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services
Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A3.31: Odds Ratios for Very Ready in EDI Language and Cognitive Development at Age 5, Non-Winnipeg†

Predictors	Odds Ratios	Confidence Intervals
Male	**0.53**	0.48 - 0.60
Child's Age	**2.66**	2.21 - 3.21
Low Birth Weight	0.82	0.59 - 1.16
Breastfed	1.14	0.98 - 1.33
6+ Days In Hospital	0.80	0.63 - 1.01
Area Income	**1.62**	1.12 - 2.32
Family Ever On IA	**0.56**	0.45 - 0.71
In CFS	**0.68**	0.53 - 0.88
Teen Mom	**0.72**	0.62 - 0.84
Mom Married	**1.18**	1.04 - 1.34
Maternal Depression	**1.22**	1.03 - 1.44
4+ Kids	**0.59**	0.50 - 0.69

† 2006 & 2007 EDI cohorts

Bolded values are significant ($p < 0.05$)

Note: Results are from multilevel modelling

Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services

Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A3.32: Odds Ratios for Very Ready in EDI Physical Health and Well-Being at Age 5, Non-Winnipeg†

Predictors	Odds Ratios	Confidence Intervals
Male	**0.59**	0.54 - 0.66
Child's Age	**2.03**	1.72 - 2.40
Low Birth Weight	**0.72**	0.53 - 0.99
90%+ Minor ADGs	**0.74**	0.61 - 0.89
6+ Days In Hospital	0.88	0.71 - 1.08
Area Income	**1.49**	1.07 - 2.07
Family Ever on IA	**0.79**	0.65 - 0.96
In CFS	**0.50**	0.39 - 0.62
Teen Mom	**0.66**	0.58 - 0.76
Mom Married	**1.21**	1.07 - 1.35
4+ Kids	**0.82**	0.71 - 0.93

† 2006 & 2007 EDI cohorts

Bolded values are significant ($p < 0.05$)

Note: Results are from multilevel modelling

Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services

Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A3.33: Odds Ratios for Very Ready in EDI Communication Skills and General Knowledge at Age 5, Non-Winnipeg†

Predictors	Odds Ratios	Confidence Intervals
Male	**0.58**	0.53 - 0.64
Child's Age	**2.21**	1.87 - 2.62
ICU 3+ Days At Birth	**0.68**	0.50 - 0.91
Long Birth Stay	1.14	0.95 - 1.37
Breastfed	**1.15**	1.00 - 1.31
90%+ Minor ADGs	**0.76**	0.61 - 0.95
Physician Visits	**1.00**	1.00 - 1.01
6+ Days In Hospital	**0.69**	0.56 - 0.85
Area Income	**1.90**	1.37 - 2.63
Family Ever on IA	**0.67**	0.55 - 0.81
In CFS	**0.61**	0.49 - 0.75
Teen Mom	**0.76**	0.67 - 0.87
Mom Married	**1.15**	1.02 - 1.28
Maternal Depression	**0.85**	0.73 - 1.00
4+ Kids	**0.60**	0.52 - 0.69

† 2006 & 2007 EDI cohorts

Bolded values are significant ($p < 0.05$)

Note: Results are from multilevel modelling

Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services

Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A3.34: Odds Ratios for Very Ready in EDI Social Competence at Age 5, Non-Winnipeg†

Predictors	Odds Ratios	Confidence Intervals
Male	**0.49**	0.44 - 0.54
Child's Age	**1.99**	1.68 - 2.37
Premature	1.19	0.91 - 1.55
ICU 3+ Days At Birth	**0.65**	0.47 - 0.89
6+ Days In Hospital	**0.76**	0.62 - 0.94
Area Income	**1.53**	1.10 - 2.14
In CFS	**0.46**	0.37 - 0.57
Teen Mom	**0.76**	0.66 - 0.87
Mom Married	**1.25**	1.12 - 1.40
Maternal Depression	0.90	0.77 - 1.06
4+ Kids	**0.72**	0.62 - 0.82

† 2006 & 2007 EDI cohorts

Bolded values are significant ($p < 0.05$)

Note: Results are from multilevel modelling

Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services

Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A3.35: Odds Ratios for Very Ready in EDI Emotional Maturity at Age 5, Non-Winnipeg†

Male	0.46	0.41 - 0.51
Child's Age	1.74	1.46 - 2.08
90%+ Minor ADGs	0.72	0.57 - 0.92
Physician Visits	1.00	1.00 - 1.01
6+ Days In Hospital	0.62	0.49 - 0.79
Area Income	2.10	1.48 - 2.99
In CFS	0.68	0.54 - 0.84
Teen Mom	0.85	0.74 - 0.98
Mom Married	1.29	1.15 - 1.45
Maternal Depression	0.83	0.70 - 0.99
4+ Kids	0.70	0.61 - 0.82

† 2006 & 2007 EDI cohorts

Bolded values are significant ($p < 0.05$)

Note: Results are from multilevel modelling

Note: ADG- Adjusted Diagnostic Group, IA- Income Assistance, CFS- Child and Family Services

Note: See Table 1.2 for definitions of predictors

Source: Manitoba Centre for Health Policy, 2011

Appendix 4: Tables for Chapter 4

Appendix Table A4.1: Number of Children At-Risk and Combination Groups by Winnipeg Income Quintiles†

Q1	588	967	823	489	419	363
Q2	429	478	[illegible]	[illegible]	219	[illegible]
Q3	157	225	322	98	105	76
Q4	131	168	248	58	73	40
Q5	60	55	108	21	23	15

†Children from 2006 & 2007 EDI cohort who were born in 2000 & 2001

Note: IA- Income Assistance, CFS- Child and Family Services

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A4.2: Number of Children in At-Risk Groups by Urban Income Quintiles, Manitoba†

U1	611	997	862	503	434	373
U2	351	[illegible]	[illegible]	[illegible]	[illegible]	169
U3	186	253	380	115	127	91
U4	137	179	267	62	79	44
U5	63	56	114	21	24	15

† Children from 2006 & 2007 EDI cohort who were born in 2000 & 2001

Note: IA- Income Assistance, CFS- Child and Family Services

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A4.3: Number of Children in At-Risk and Combination Groups by Rural Income Quintiles, Manitoba†

R1	91	141	371	49	66	33
[illegible]	97	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
R3	92	145	336	44	59	34
[illegible]	[illegible]	172	[illegible]	[illegible]	[illegible]	[illegible]
R5	98	130	255	45	50	23

† Children from 2006 & 2007 EDI cohort who were born in 2000 & 2001

Note: IA- Income Assistance, CFS- Child and Family Services

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A4.4: Odds Ratios for Models 1 (Risk Factor Variable Only) and 2 (Includes Additional Predictors, by Type and Number of Risk Factors, Compared to No Risk Factors, Winnipeg†

			CFS	*Family Ever on IA*	*Teen Mom*	*CFS & Family Ever on IA*	*CFS & Teen Mom*	*Family Ever on IA & Teen Mom*	*Family Ever on IA & CFS & Teen Mom*
Not Ready ≥1 EDI Domains	1	0.09	2.03 (1.49, 2.76)	2.65 (2.18, 3.23)	1.92 (1.61, 2.30)	5.23 (4.04, 6.77)	2.92 (2.18, 3.91)	3.07 (2.56, 3.68)	4.5 (3.82, 5.30)
Very Ready ≥1 EDI Domains	1	0.07	0.55 (0.42, 0.73)	0.45 (0.37, 0.54)	0.57 (0.49, 0.67)	0.24 (0.18, 0.31)	0.36 (0.27, 0.48)	0.35 (0.30, 0.42)	0.25 (0.22, 0.30)
Multiple Challenges ≥ 9 EDI Sub-Domains	1	0.06	2.1 (1.20, 3.67)	2.63 (1.86, 3.72)	1.78 (1.26, 2.50)	6.59 (4.66, 9.31)	2.82 (1.71, 4.65)	2.95 (2.15, 4.04)	4.24 (3.27, 5.49)

† Children from 2006 & 2007 EDI cohort who were born in 2000 & 2001

‡ Model 1 included only the children at risk variable (the eight risk marker categories with "no risk" as the reference category).
Model 2 included children at risk, as well as the following additional predictors: age at Grade 9, presence of intellectual disability or emotional behavioural disorder, number of children in family, area-level SES at age 14 years, area-level percent Aboriginal residents, mother not married at child's birth, and sex.

Source: Manitoba Centre for Health Policy, 2011

Appendix 5: Figures and Tables for Chapter 6

Appendix Table A5.1: Number of Children with Low and Normal 5-Minute Apgar Scores by Urban Income Quintiles, Manitoba†

Urban Quintiles	Low	Normal
U1	71	1,793
U2	90	1,988
U3	93	2,117
U4	80	2,201
U5	63	1,967

† Children from 2006 & 2007 EDI cohorts who were born in in 2000 & 2001

Source: Manitoba Centre for Health Policy, 2011

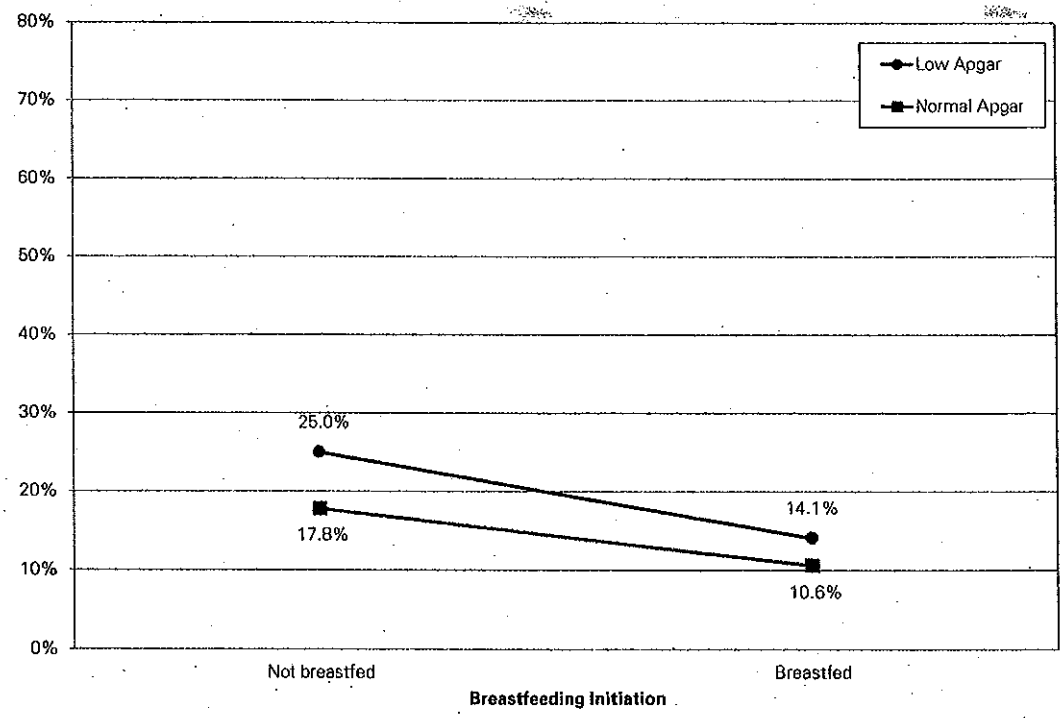
Appndix Table A5.2: Number of Children with Low and Normal 5-Minute Apgar Scores by Rural Income Quintiles, Manitoba†

Rural Quntiles	Low	Normal
R1	47	1,435
R2	38	1,065
R3	36	1,241
R4	36	1,372
R5	47	1,414

† Children from 2006 & 2007 EDI cohorts who were born in in 2000 & 2001

Source: Manitoba Centre for Health Policy, 2011

Appendix Figure A5.1: Percent Not Ready in EDI Language and Cognitive Development at Age 5 by Breastfeeding and 5-Minute Apgar Score, Manitoba†



† Children from 2006 & 2007 EDI cohorts who were born in 2000 & 2001

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A5.3: Odds Ratios for Not Ready in EDI Language and Cognitive Development at Age 5: Contrasts Between Different 5-Minute Apgar and Breastfeeding Group Comparisons, Manitoba†

Low apgar/breastfed vs Normal apgar/breastfed	**1.37**	0.02
Low apgar/not breastfed vs Normal apgar/not breastfed	**1.56**	0.05
Low apgar/breastfed vs Low apgar/not breastfed	**0.60**	0.05
Normal apgar/breastfed vs Normal apgar/not breastfed	**0.69**	<0.0001
Low apgar/breastfed vs Normal apgar/not breastfed	0.94	0.66

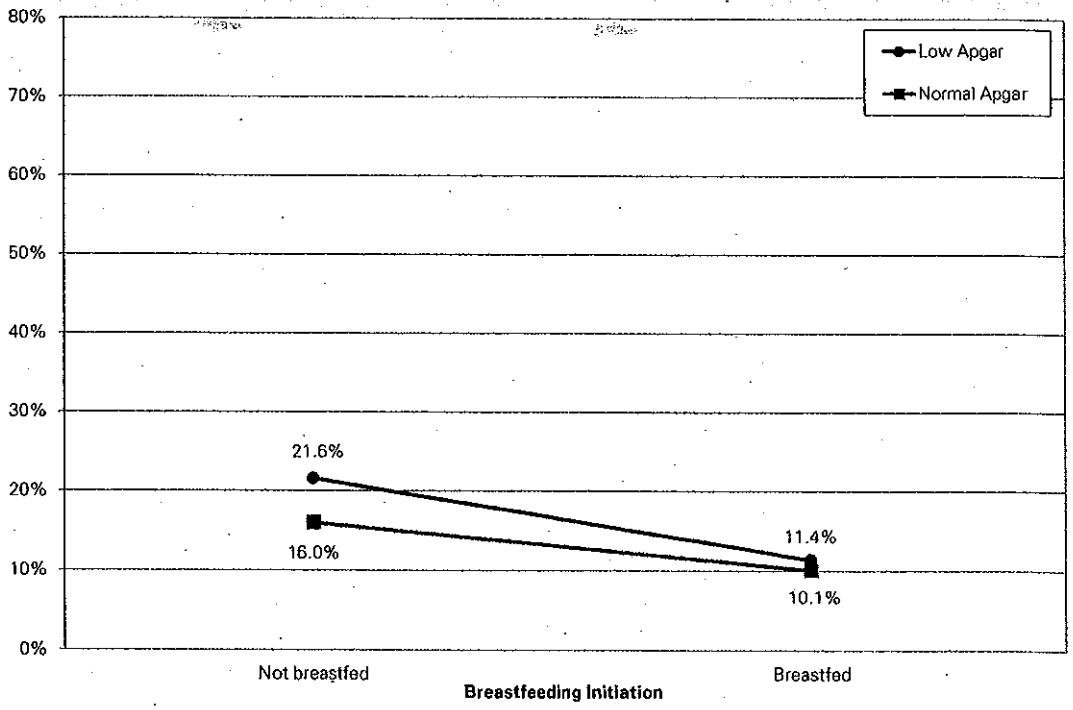
† Children from 2006 & 2007 EDI cohorts who were born in 2000 & 2001

Bolded values are significant ($p < 0.05$)

Note: Results are from multilevel modeling, controlling for area-level income.

Source: Manitoba Centre for Health Policy, 2011

Appendix Figure A5.2: Percent Not Ready in EDI Physical Health and Well-Being at Age 5 by Breastfeeding and 5-Minute Apgar Score, Manitoba†



† Children from 2006 & 2007 EDI cohorts who were born in 2000 & 2001

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A5.4: Odds Ratios for Not Ready in EDI Physical Health and Well-Being at Age 5: Contrasts Between Different 5-Minute Apgar and Breastfeeding Group Comparisons, Manitoba†

Low apgar/breastfed vs Normal apgar/breastfed	1.15	0.35
Low apgar/not breastfed vs Normal apgar/not breastfed	1.40	0.16
Low apgar/breastfed vs Low apgar/not breastfed	**0.57**	0.04
Normal apgar/breastfed vs Normal apgar/not breastfed	**0.70**	<0.0001
Low apgar/breastfed vs Normal apgar/not breastfed	0.80	0.15

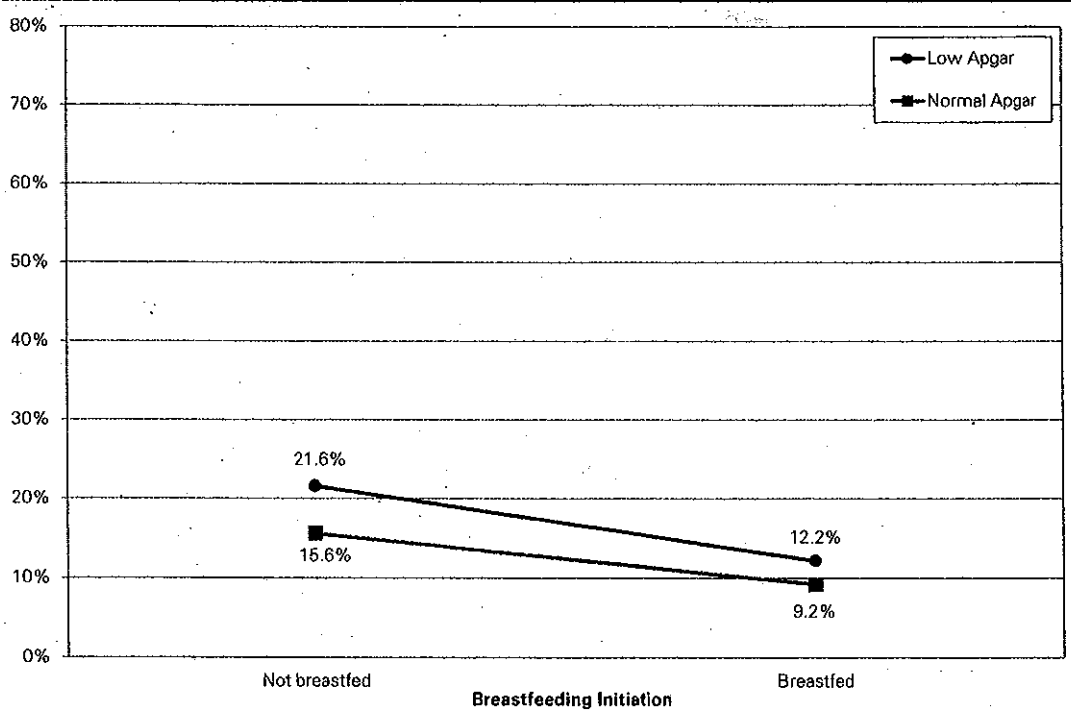
† Children from 2006 & 2007 EDI cohorts who were born in 2000 & 2001

Bolded values are significant ($p < 0.05$)

Note: Results are from multilevel modeling, controlling for area-level income.

Source: Manitoba Centre for Health Policy, 2011

Appendix Figure A5.3: Percent Not Ready in EDI Communication Skills and General Knowledge at Age 5 by Breastfeeding and 5-Minute Apgar Score, Manitoba†



† Children from 2006 & 2007 EDI cohorts who were born in 2000 & 2001

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A5.5: Odds Ratios for Not Ready in EDI Communication Skills and General Knowledge at Age 5: Contrasts Between Different 5-Minute Apgar and Breastfeeding Group Comparisons, Manitoba†

Low apgar/breastfed vs Normal apgar/breastfed	1.37	0.03
Low apgar/not breastfed vs Normal apgar/not breastfed	1.44	0.12
Low apgar/breastfed vs Low apgar/not breastfed	0.60	0.06
Normal apgar/breastfed vs Normal apgar/not breastfed	0.63	<0.0001
Low apgar/breastfed vs Normal apgar/not breastfed	0.87	0.34

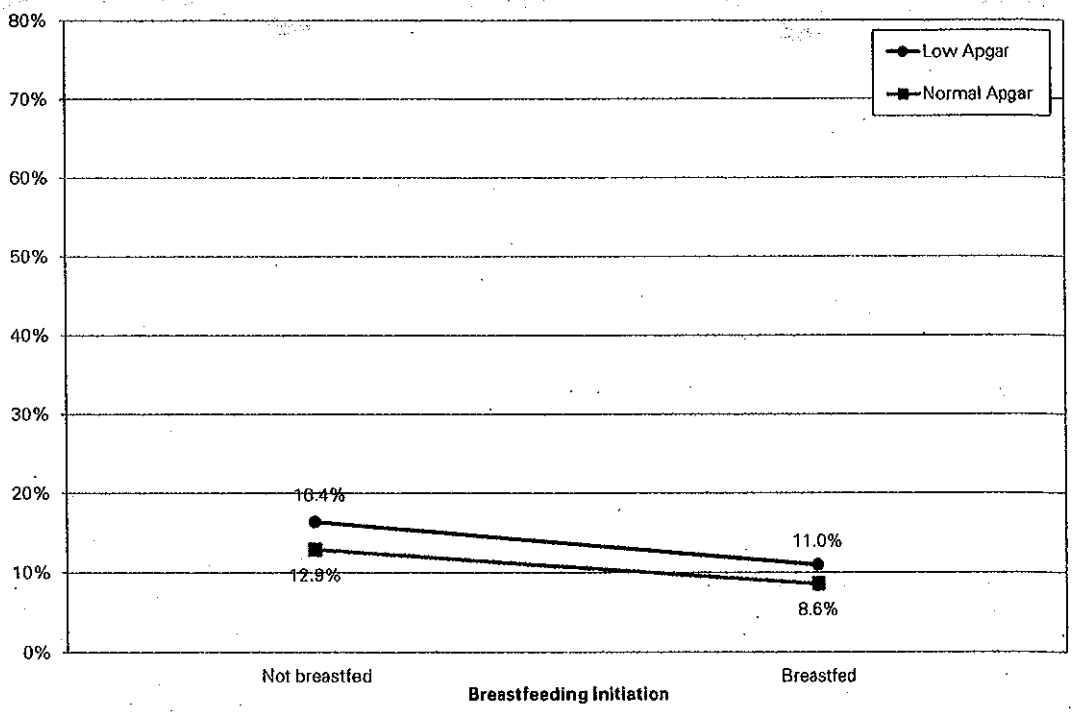
† Children from 2006 & 2007 EDI cohorts who were born in 2000 & 2001

Bolded values are significant ($p < 0.05$)

Note: Results are from multilevel modeling, controlling for area-level income.

Source: Manitoba Centre for Health Policy, 2011

Appendix Figure A5.4: Percent Not Ready in EDI Social Competence at Age 5 by Breastfeeding and 5-Minute Apgar Score, Manitoba†



† Children from 2006 & 2007 EDI cohorts who were born in 2000 & 2001

Source: Manitoba Centre for Health Policy, 2011

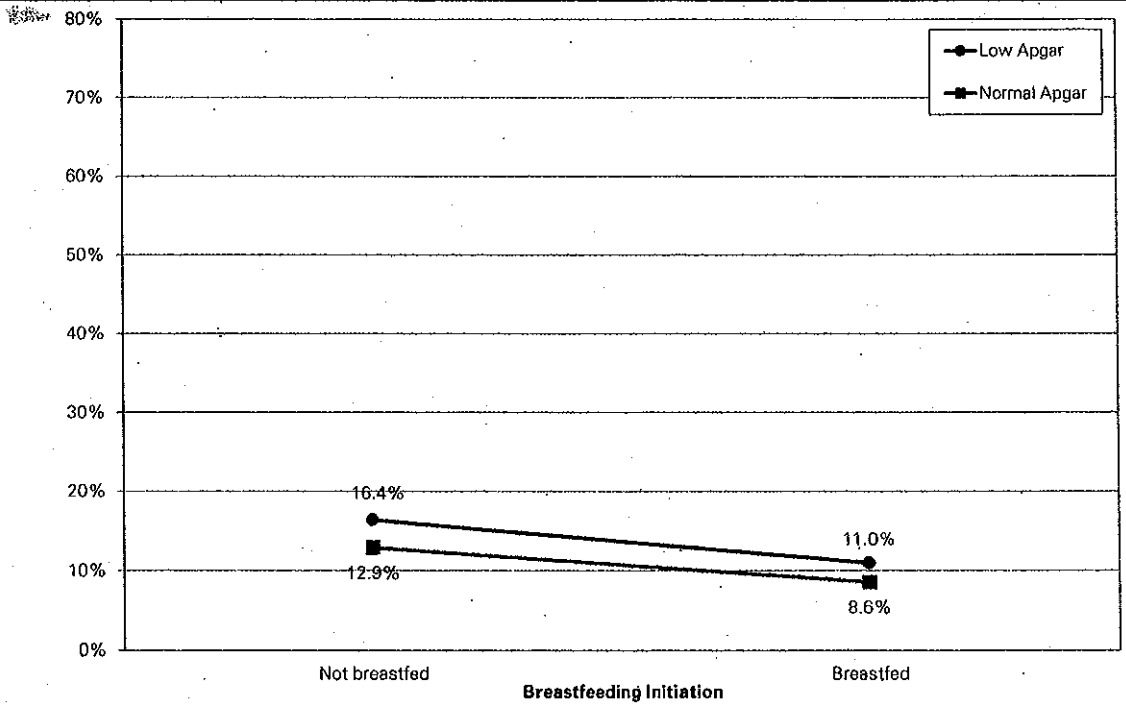
Appendix Table A5.6: Odds Ratios for Not Ready in EDI Social Competence at Age 5: Contrasts Between Different 5-Minute Apgar and Breastfeeding Group Comparisons, Manitoba†

Low apgar/breastfed vs Normal apgar/breastfed	1.32	0.06
Low apgar/not breastfed vs Normal apgar/not breastfed	1.34	0.27
Low apgar/breastfed vs Low apgar/not breastfed	0.74	0.30
Normal apgar/breastfed vs Normal apgar/not breastfed	0.75	<0.0001
Low apgar/breastfed vs Normal apgar/not breastfed	0.99	0.93

† Children from 2006 & 2007 EDI cohorts who were born in 2000 & 2001
Bolded values are significant ($p < 0.05$)
Note: Results are from multilevel modeling, controlling for area-level income.

Source: Manitoba Centre for Health Policy, 2011

Appendix Figure A5.5: Percent Not Ready in EDI Emotional Maturity at Age 5 by Breastfeeding and 5-Minute Apgar Score, Manitoba†



† Children from 2006 & 2007 EDI cohorts who were born in 2000 & 2001

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A5.7: Odds Ratios for Not Ready in EDI Emotional Maturity at Age 5: Contrasts Between Different 5-Minute Apgar and Breastfeeding Group Comparisons, Manitoba†

Low apgar/breastfed vs Normal apgar/breastfed	1.05	0.73
Low apgar/not breastfed vs Normal apgar/not breastfed	1.50	0.11
Low apgar/breastfed vs Low apgar/not breastfed	0.64	0.12
Normal apgar/breastfed vs Normal apgar/not breastfed	0.92	0.18
Low apgar/breastfed vs Normal apgar/not breastfed	0.96	0.82

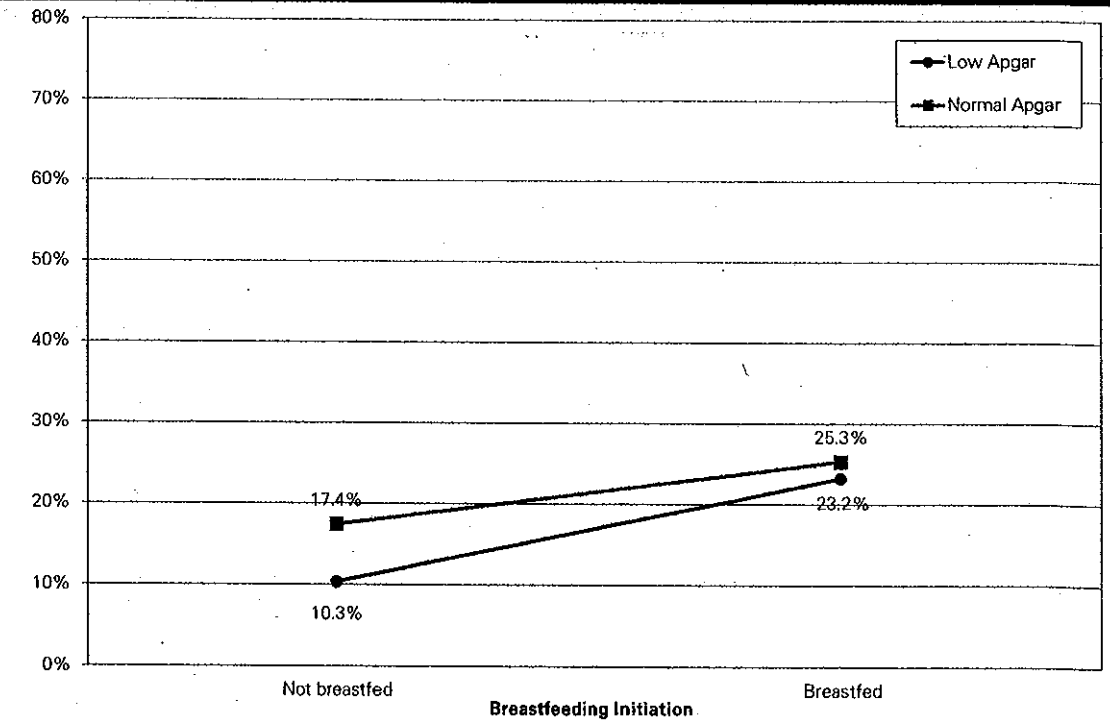
† Children from 2006 & 2007 EDI cohorts who were born in 2000 & 2001

Bolded values are significant ($p < 0.05$)

Note: Results are from multilevel modeling, controlling for area-level income.

Source: Manitoba Centre for Health Policy, 2011

Appendix Figure A5.6: Percent Very Ready in EDI Language and Cognitive Development at Age 5 by Breastfeeding and 5-Minute Apgar Score, Manitoba†



† Children from 2006 & 2007 EDI cohorts who were born in 2000 & 2001

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A5.8: Odds Ratios for Very Ready in EDI Language and Cognitive Development at Age 5: Contrasts Between Different 5-Minute Apgar and Breastfeeding Group Comparisons, Manitoba†

Low apgar/breastfed vs Normal apgar/breastfed	0.89	0.30
Low apgar/not breastfed vs Normal apgar/not breastfed	0.53	0.04
Low apgar/breastfed vs Low apgar/not breastfed	2.38	0.01
Normal apgar/breastfed vs Normal apgar/not breastfed	1.43	<0.0001
Low apgar/breastfed vs Normal apgar/not breastfed	1.27	0.04

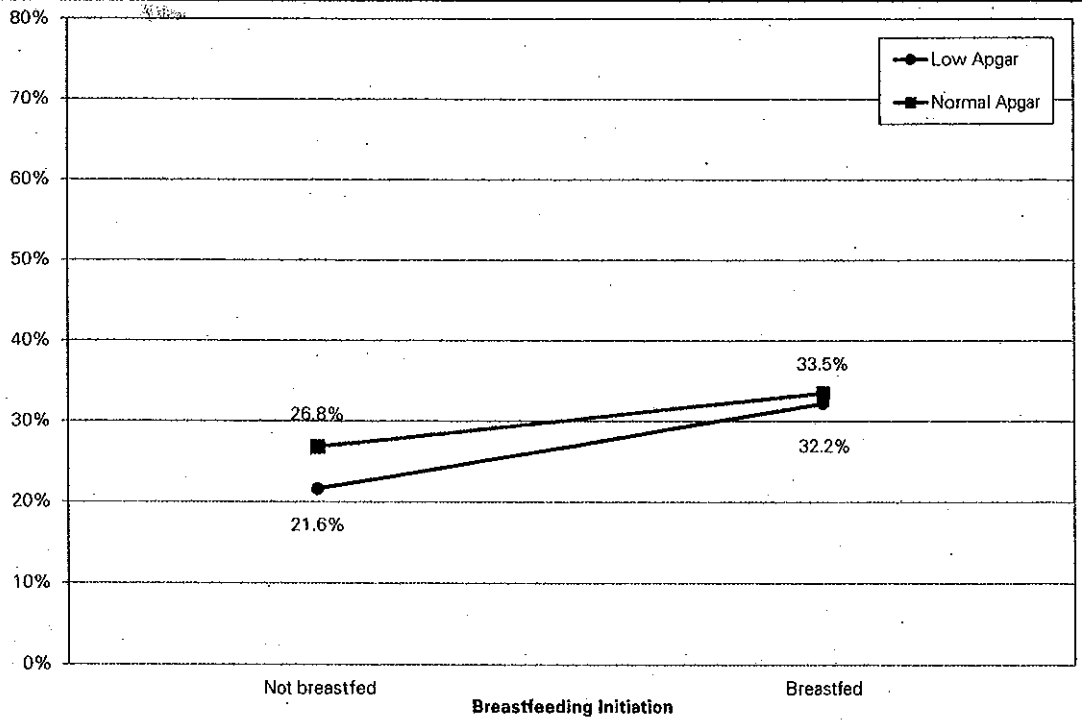
† Children from 2006 & 2007 EDI cohorts born in 2000 & 2001

Bolded values are significant ($p < 0.05$)

Note: Results are from multilevel modeling, controlling for area-level income.

Source: Manitoba Centre for Health Policy, 2011

Appendix Figure A5.7: Percent Very Ready in EDI Physical Health and Well-Being at Age 5 by Breastfeeding and 5-Minute Apgar Score, Manitoba†



† Children from 2006 & 2007 EDI cohorts who were born in 2000 & 2001

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A5.9: Odds Ratios for Very Ready in EDI Physical Health and Well-Being at Age 5: Contrasts Between Different 5-Minute Apgar and Breastfeeding Group Comparisons, Manitoba†

Low apgar/breastfed vs Normal apgar/breastfed	0.94	0.56
Low apgar/not breastfed vs Normal apgar/not breastfed	0.74	0.19
Low apgar/breastfed vs Low apgar/not breastfed	1.62	0.05
Normal apgar/breastfed vs Normal apgar/not breastfed	1.26	<0.0001
Low apgar/breastfed vs Normal apgar/not breastfed	1.19	0.10

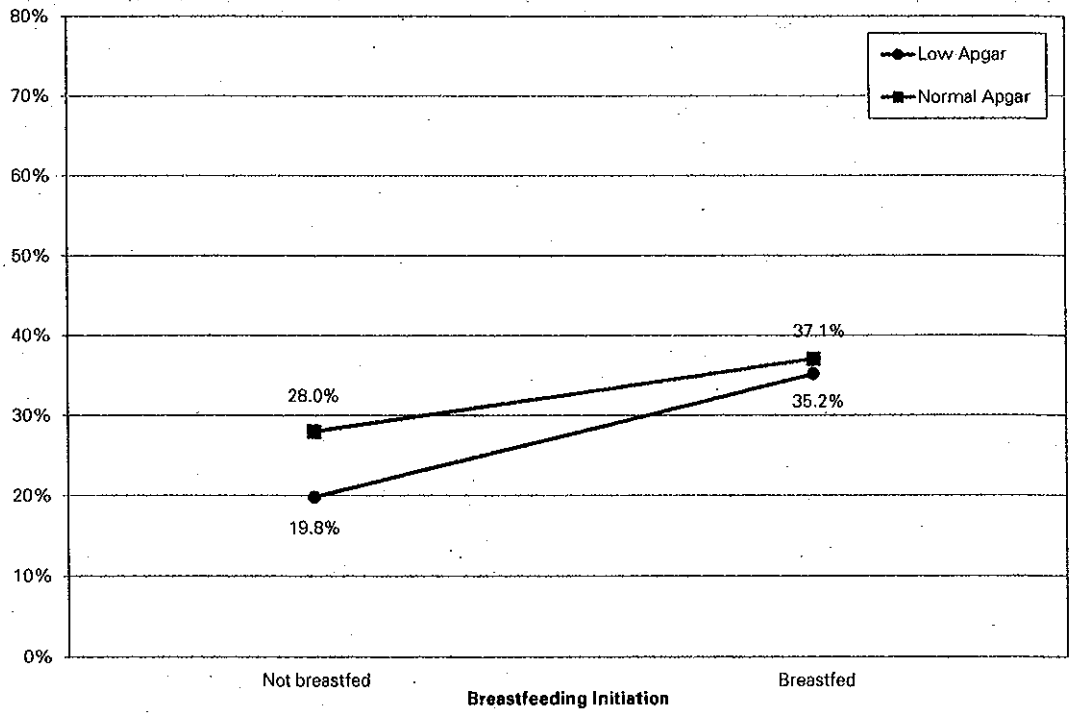
† Children from 2006 & 2007 EDI cohorts born in 2000 & 2001

Bolded values are significant ($p < 0.05$)

Note: Results are from multilevel modeling, controlling for area-level income.

Source: Manitoba Centre for Health Policy, 2011

Appendix Figure A5.8: Percent Very Ready in EDI Communication Skills and General Knowledge at Age 5 by Breastfeeding and 5-Minute Apgar Score, Manitoba†



† Children from 2006 & 2007 EDI cohorts who were born in 2000 & 2001

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A5.10: Odds Ratios for Very Ready in EDI Communication Skills and General Knowledge at Age 5: Contrasts Between Different 5-Minute Apgar and Breastfeeding Group Comparisons, Manitoba†

Low apgar/breastfed vs Normal apgar/breastfed	0.92	0.41
Low apgar/not breastfed vs Normal apgar/not breastfed	0.63	0.06
Low apgar/breastfed vs Low apgar/not breastfed	**2.01**	0.01
Normal apgar/breastfed vs Normal apgar/not breastfed	**1.38**	<0.0001
Low apgar/breastfed vs Normal apgar/not breastfed	**1.27**	0.02

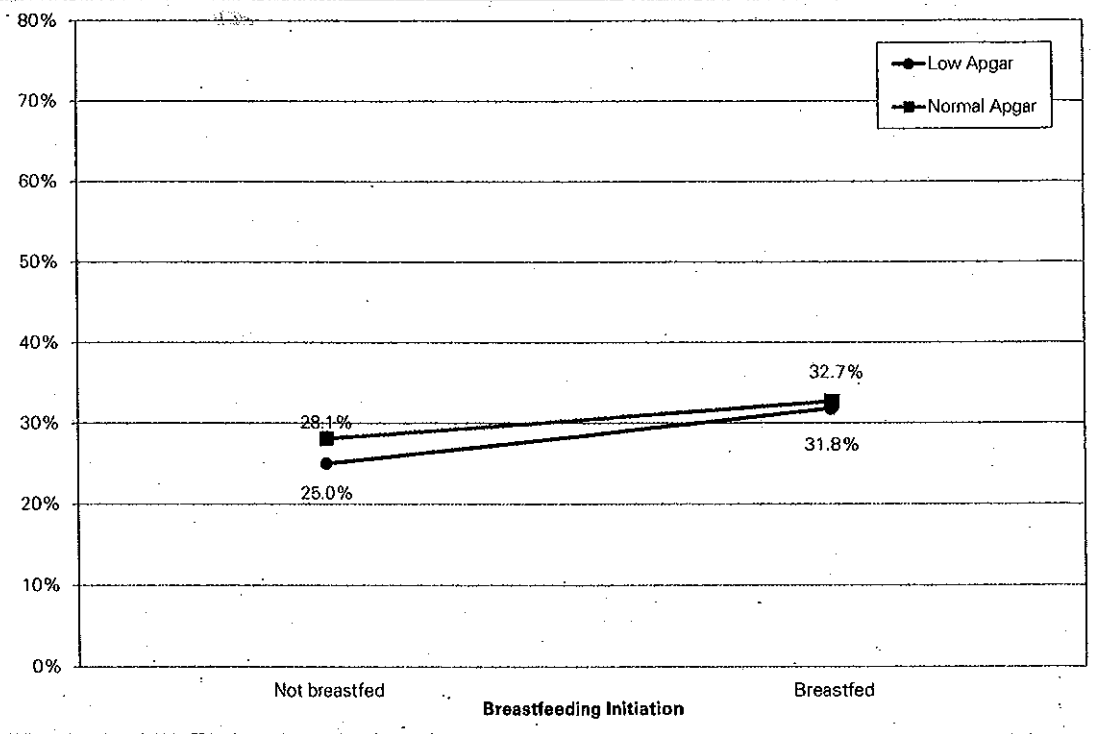
† Children from 2006 & 2007 EDI cohorts born in 2000 & 2001

Bolded values are significant ($p < 0.05$)

Note: Results are from multilevel modeling, controlling for area-level income.

Source: Manitoba Centre for Health Policy, 2011

Appendix Figure A5.9: Percent Very Ready in EDI Social Competence at Age 5 by Breastfeeding and 5-Minute Apgar Score, Manitoba†



† Children from 2006 & 2007 EDI cohorts who were born in 2000 & 2001

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A5.11: Odds Ratios for Very Ready in EDI Social Competence at Age 5: Contrasts Between Different 5-Minute Apgar and Breastfeeding Group Comparisons, Manitoba†

Low apgar/breastfed vs. Normal apgar/breastfed	0.96	0.71
Low apgar/not breastfed vs Normal apgar/not breastfed	0.86	0.48
Low apgar/breastfed vs Low apgar/not breastfed	1.29	0.28
Normal apgar/breastfed vs Normal apgar/not breastfed	**1.15**	0.003
Low apgar/breastfed vs Normal apgar/not breastfed	1.11	0.33

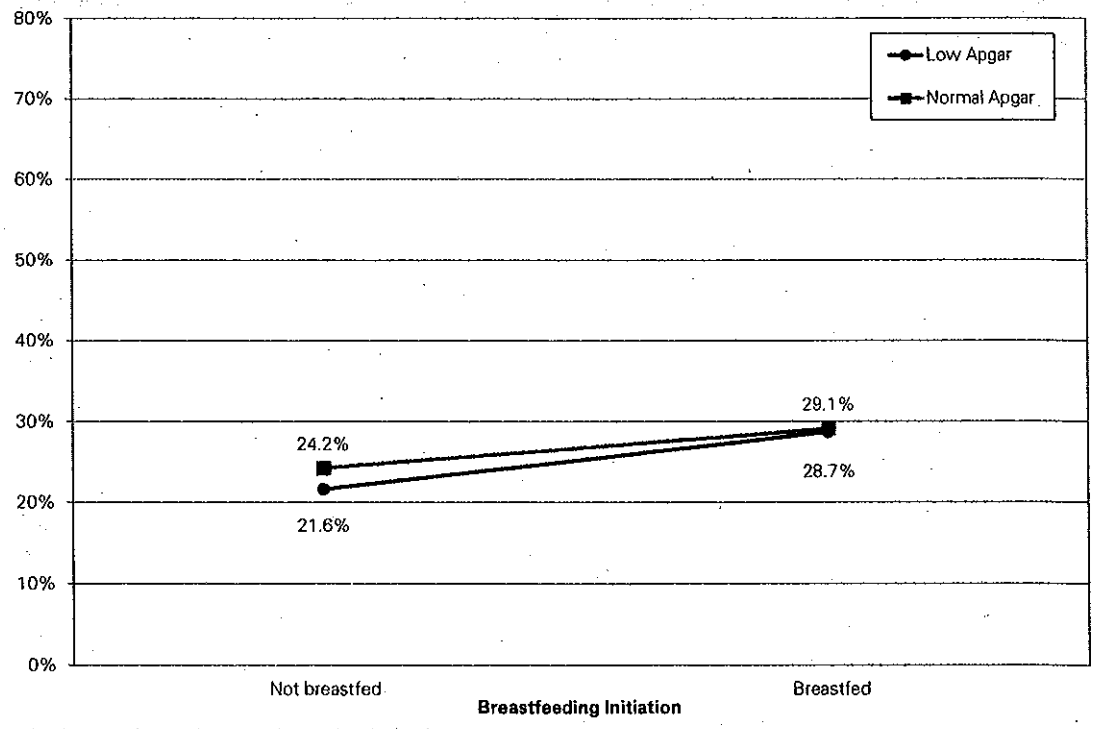
† Children from 2006 & 2007 EDI cohorts born in 2000 & 2001

Bolded values are significant ($p < 0.05$)

Note: Results are from multilevel modeling, controlling for area-level income.

Source: Manitoba Centre for Health Policy, 2011

Appendix Figure A5.10: Percent Very Ready in EDI Emotional Maturity at Age 5 by Breastfeeding and 5-Minute Apgar Score, Manitoba†



† Children from 2006 & 2007 EDI cohorts who were born in 2000 & 2001

Source: Manitoba Centre for Health Policy, 2011

Appendix Table A5.12: Odds Ratios for Very Ready in EDI Emotional Maturity at Age 5: Contrasts Between Different 5-Minute Apgar and Breastfeeding Group Comparisons, Manitoba†

Low apgar/breastfed vs Normal apgar/breastfed	0.99	0.89
Low apgar/not breastfed vs Normal apgar/not breastfed	0.86	0.53
Low apgar/breastfed vs Low apgar/not breastfed	1.32	0.26
Normal apgar/breastfed vs Normal apgar/not breastfed	1.16	0.003
Low apgar/breastfed vs Normal apgar/not breastfed	1.14	0.23

† Children from 2006 & 2007 EDI cohorts born in 2000 & 2001

Bolded values are significant ($p < 0.05$)

Note: Results are from multilevel modeling, controlling for area-level income.

Source: Manitoba Centre for Health Policy, 2011

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