Making the Grade: The Impact of Childhood Asthma on High School Completion

by

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Abstract

Based in a life course approach, this study examined the relationship between childhood asthma and high school completion by age 20 using a longitudinal cohort of 6,393 respondents from the National Longitudinal Survey of Children and Youth. Parental resources, parental behaviours, and critical periods of development were included as controls. Childhood physical and mental conditions (aside from asthma) were included as comparators. School absenteeism was included as a potentially mediating factor in the relationship between asthma and high school completion. Multinomial logistic regression analysis revealed no relationship between the presence of asthma at any time during childhood and high school completion by age 20. Instead, results revealed a statistically significant relationship between having a physical or mental condition (aside from asthma) and high school completion by age 20. Results also showed that parental resources and behaviours were significant predictors of high school completion. Additionally, absenteeism was not a mediating variable, but rather, an independently statistically significant predictor of high school completion by age 20.

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Chapter 1: Introduction

Educational attainment is a "powerful predictor of future earnings" (Beblavy, Thum, & Veselkova, 2011, p. 5) and is often used as a marker of life chances (Elo, 2009). Educational attainment is also an important way of thinking about intergenerational mobility, which reflects the movement in social position from one generation to the next (Van De Gaer, Schokkaert, & Martinez, 2001). Intergenerational mobility is also seen as a measure of equality in society, reflecting the degree of equality in life chances and opportunities (Van De Gaer, Schokkaert, & Martinez, 2001). Societies are concerned with intergenerational mobility because of the notion of fairness. Black and Devereux (2011) state that "Many people favor equality of opportunity as an underlying goal of society–the idea that poor children should have the same opportunities for success as rich children. Those who work hard should be able to succeed, regardless of family background" (Black & Devereux, 2011, p.1488). From a welfare state perspective, societies are concerned about intergenerational mobility because downward mobility would result in an increased draw on social programs and benefits, whereas upward mobility would result in higher tax revenues (Bambra, 2009).

Knowing this and knowing the societal value placed on employment and earnings, it is important to identify the factors that influence an individual's ability to complete their education and move into employment. One such factor is childhood health. There is a well-researched body of literature linking education, income and childhood health. This cycle of low education, low income, and poor childhood health has been found consistently (Case, Fertig, & Paxson, 2005; Haas, Glymour & Berkman, 2011).

Recognizing that there are difficulties studying these relationships using a single point in time, particularly studying the temporal ordering of events, researchers have increasingly used a life course framework to disentangle these relationships (Corna, 2013; Jackson, 2015). I draw on the life course approach to help explore the links between childhood health and educational attainment in young adulthood in this thesis. The theory behind a life course approach is that human development and aging are lifelong processes and that early experiences, such as one's health status, can often predict many adult health and social outcomes (Elder & Johnson, 2002).

The research suggests that children with physical and mental conditions reach adulthood with lower educational attainment, lower social status, and poorer health than children with no health problems (Case et al., 2005; Eide, Showalter, & Goldhaber, 2010; Haas, 2006; Lê, Diez Roux, & Morgenstern, 2013). An accepted conduit through which

childhood health is linked to adult socioeconomic status (SES) is through the challenges with the educational system that chronically ill children encounter over the course of childhood (Eide et al., 2010; Haas & Fosse, 2008). While there are multitudes of physical and mental conditions that could ail children, asthma is the most common childhood condition (Fowler, Davenport & Garg, 1992; Milton, Whitehead, Holland, & Hamilton, 2004), and as such, will be the focus of this thesis.

Research Process

As an employee of the provincial department of Health, I have a particular interest in better understanding the social factors and mechanisms that link SES and health. From a welfare state perspective, it is in the best interest of the state to have a healthy population, which then is a strong, productive workforce. From a health system perspective, which is much of the work I do in my career, it is important to understand where health interventions can be most effective. Childhood health is naturally an area of interest. Originally, my intent was to use provincial administrative data housed by the Government of Alberta to examine this topic. As an Alberta public servant, I was interested in exploring this topic in the Alberta context. Administrative data would allow for ample sample size, access to health records which would enable a more in-depth study of those with asthma, and test scores from standardized provincial tests. While the data required for this type of analysis is collected provincially, it is collected by different ministries and would require the linking of personal health information with educational records. Initial work to do this linking is underway in the Alberta Child and Youth Data Lab; however, the data is not accessible to public servants or researchers. Thus, while there is potential to do this type of research in the future, at the time that I was embarking on my study the information was not available and required me to find another source.

The data for this thesis came from the National Longitudinal Survey of Children and Youth (NLSCY), which is a nationally representative sample of Canadian children tracked from childhood into early adulthood. I chose this source because it included variables on health and educational attainment over time. However, the sample size for an Alberta-specific study was insufficient, meaning the scope of my study grew to become a study of Canadian children. In order to gain access to this dataset, I applied to the Statistics Canada Research Data Centre (RDC). This process required submitting a proposal for evaluation by the Social Sciences and Humanities Research Council (SSHRC) and Statistics Canada evaluators, along with a copy of my curriculum vitae. The proposal outlined the objectives of the study, the proposed statistical methodology, and the data requirements of the research. Statistics Canada approval took approximately two months. Prior to

submission to Statistics Canada, my proposal was approved by my committee members and was accompanied by a letter from my thesis supervisor. No ethics approval was required for the analysis of a secondary dataset.

All of the data analysis took place in the RDC at the University of Alberta. Data analysis included cleaning, coding, and merging eight cycles of the NLSCY. The existing literature, as described in the following chapter, on childhood health, asthma, absenteeism, and high school completion guided much of the coding and interpretation of findings. The analysis was performed using multinomial logistic regression models in SAS 9.4. As the coding and analysis proceeded, regular reviews and meetings took place with my thesis supervisor. Upon completion of the analysis, the final weighted regression models were submitted to Statistics Canada for approval to release. As part of the agreement to use Statistics Canada data, upon completion, this thesis will be provided to Statistics Canada.

Chapter 2: Literature Review

A Life Course Approach

My thesis is theoretically grounded in a life course approach. Life course research developed over several decades, beginning during the time between the two World Wars. This concept has been described as a theory (Elder & Johnson, 2002), as a perspective (Mayer, 2009; Riley, 1998), and as a method or framework for research (Giele & Elder, 1998). Life course as a theoretical orientation came from the desire to understand social pathways, developmental effects, and their relation to social-historical conditions (Kaplan et al., 2003).

The underlying concept of life course is that human development and aging are interdependent lifelong processes and no single phase of a person's life can be understood apart from the preceding events and consequences (Elder & Johnson, 2002; Riley, 1998). A key insight of this approach is that people's lives are uniquely shaped by the timing and sequencing of life events and that events that take place affect individuals differently based on their age, location and social context (Giele & Elder, 1998). Giele and Elder (1998) have described four key elements that interact to create life course trajectories: location in time and place; linked lives; human agency; and timing of lives.

Location in time and place includes both the cultural experiences and historical events that are individually patterned across time (Giele and Elder, 1998). These include both a general societal location in time as well as an individual location in time (Giele and Elder, 1998). For example, living through a certain era, such as the Great Depression, leaves a distinct impression on both society and individuals. For individuals, the same event may have different effects depending on where they are at in their life course.

Linked lives are the social networks and relationships that individuals form over time. As described by Giele and Elder (1998), " all levels of social action (cultural, institutional, social, psychological, and sociobiological) interact and mutually influence each other not only as parts of a whole but also as the result of contact with other persons who share similar experiences" (p.9). Human lives are interconnected and social norms and expectations are often passed on through social and family interactions across the life span (Elder, 1994). For example, children's lives are shaped by their parents' experiences; if one parent loses their job, the whole family is affected.

Human agency refers to individual choices, goals, and motives. Giele and Elder (1998) describe this element as "the motives of persons and groups to meet their own

needs [by] actively making decisions and organizing their lives around *goals* such as being economically secure, seeking satisfaction, and avoiding pain" (p. 10). For example, individuals may be motivated to achieve high educational attainment, or own their own home.

Timing of lives refers to the ways in which the sequencing, duration, and timing of events can alter or influence an individual's development and life course. As Giele and Elder (1998) state, "timing covers the chronologically ordered events of an individual's life that simultaneously combine personal, group, and historical markers" (p. 2). For example, some women choose to marry and start a family earlier in life, and may sacrifice higher educational attainment to do so. Elder (1994) uses the example of men entering the World Wars; those that entered when they were 18 generally had fewer family responsibilities, whereas the impact on the families and responsibilities of older men entering the war were far greater (Elder, 1994). Another example is poverty. Poverty has been known to have an impact on educational attainment with poverty in early childhood having the largest effect (Duncan, Magnuson, Kalil, and Ziol-Guest, 2012).

A life course approach has particular relevance to understanding why conditions and events throughout childhood may be determinants of educational attainment. Children do not present at the threshold of adulthood with the same experiences, contexts, or social networks, and thus it is important to consider the factors that shaped them along the way as predictors of educational attainment. A life course approach affords an understanding of the social norms and institutions in which children grow up, including the social networks and relationships built over time, as well as events and experiences during childhood. For example, children currently living in a single parent household may have had very different experiences leading up to this family arrangement; some may have divorced parents, some may have experienced the death of a parent, and others may have grown up with a single parent since birth (Strohschein, Roos, & Brownell, 2009). Although all of the situations led to a child living in a single parent household, the path and experiences along the way shaped the individuals differently. Elder, Johnson, and Crosnoe (2003) echo this argument stating that human lives cannot be adequately represented when removed from relationships with significant others (in Kaplan et al., 2003). Stated differently, individuals are not immune to the context and environments around them. In the case of children, parents tend to have the largest influence in shaping their futures and transmitting values; parental SES is one of the strongest predictors of children's educational attainment (Nam & Huang, 2009). The timing of events during childhood can also have lifelong effects on an

individual. For example, in utero disturbances at critical periods of fetal development may result in lifelong disabilities and diseases.

A life course approach provides a way to understand why conditions throughout childhood are examined as predictors of educational attainment. Educational attainment is a determinant of adult outcomes and has the ability to tell us about the potential, or human capital, of an individual.

Predictors of Educational Attainment

Educational attainment is an important contributor to an individual's future SES. Education is an investment in one's future that will lead to benefits for both the individual and society (Statistics Canada, 2012). Education is a significant determinant of income and is one of the major factors affecting income inequality (DeGreggorio, 2002). Higher levels of education are typically associated with higher employment rates. According to Statistics Canada, in 2009, "82% of the adult population aged 25 to 64 with a tertiary education were employed, compared with 55% of this age group with less than high school education" (Statistics Canada, 2012, p. 3). In Alberta, since 2009, the 5-year high school completion rate has risen from 79% to 82%, meaning that within 5 years of entering Grade 10, 82% of students complete high school (Alberta Education, n.d.a.) [1]. In addition to being a significant predictor of earnings, education is also a measure of human capital and life expectancy (Elo, 2009; Muller, 2002).

Drawing on a life course approach, there are three main concepts that may influence educational attainment: parental resources and family structure; parental behaviours; and critical periods of development, including the capacities of children at birth.

Parental Resources and Family Structure

Parental resources, such as family income and parental education level, are key determining factors in future outcomes (Conger & Donnellan, 2007; Duncan, Yeung, Brooks-Gunn, & Smith, 1998; Ermisch & Francesconi, 2001; Nam & Huang, 2009; Sternthal, Coull, Chiu, Cohen, & Wright, 2011). Haas and Fosse (2008) have stated that "the intergenerational transmission of socioeconomic outcomes, including educational attainment, is among the most studied and well established social phenomenon of the last 40 years" (p. 179). Crosnoe and Elder (2004) argue that one of the reasons for this is the ability for families to use their resources to stabilize environments as children develop.

[1] The high school completion rates are calculated differently in each province; there are no national completion rates available.

Children born to higher SES families will also have access to opportunities that children in lower SES families do not. For example, a higher SES family will have the resources to live in a safe neighbourhood, send their children to good schools, and provide appropriate food for the children. Those with limited access to resources may not be able to afford the same opportunities, imposing constraints on the child's life chances.

Parental resources also have tremendous influence on children's aspirations, goals and values by influencing a child's 'academic socialization' (Wu, Schimmele & Hou, 2015). Investments in out-of-school activities reinforce the parents' support for investing in their children and the importance of learning; however, the simple availability of resources also influences educational aspirations (Wu et al., 2015). For example, if a child knows there are no resources available they may reassess their post-secondary goals.

In examining the relationship between family income and children's educational attainment, Duncan et al., (1998) found that for children in low-income families, "a $10,000 increase in family income is associated with 1.3 years of additional schooling [for the child]" (p.414). Interestingly, and in line with a life course approach, Duncan et al., (2012) have argued that not only does poverty have an impact on educational attainment, but that it is the timing of the poverty that has the biggest impact; low income in early childhood has the largest effect. In addition to parental income, Nam and Huang (2009) found that parental assets play a significant role in predicting children's educational attainment. Their study found that parental liquid assets, such as cash, had more impact on children's educational outcomes than non-liquid assets, such as home ownership (Nam & Huang, 2009).

Other aspects of the relationship between parental resources and children's education have been examined, such as the influence of parental educational attainment on children's educational attainment. Parental educational attainment has been found to be a powerful predictor of children's educational attainment (Black, Devereux & Salvanes, 2005a; Ermisch & Francesconi, 2001). Ermisch and Francesconi (2001) found mother's education to be a stronger predicator than the father's and reported that as a mother's education increased so too did the educational attainment of her children. However, Black et al., (2005a) found a positive relationship between parents' education and children's level of education, noting that an increase of one year in parents' education increases the child's education by 0.2-0.25 of a year.

Family Structure

As the linked lives component of a life course approach indicates, our families play a significant role in shaping our futures. There is ample consensus that growing up in a single-parent family has a negative impact on educational attainment (Astone & McLanahan, 1991;

Carlson & Corcoran, 2001; Ermisch & Francesconi, 2001; Haveman & Wolfe, 1995). Astone and McLanahan (1991) state that "children who grow up in single-parent families are less likely to complete high school or to attend college than children who grow up with both parents" (p. 309). This finding is echoed by Carlson and Corcoran (2001), who find that children raised in single-parent families are "on average, regardless of race, education, or parental remarriage; more likely to experience increased academic difficulties and higher levels of emotional, psychological, and behavioural problems" (p. 779). Differences in parental resources and parental involvement (e.g. supervision, activities together, dedicated time for the children) seem to be the predominant explanation for the difference in educational attainment between children raised in single-parent vs dual parent households (Astone & McLanahan, 1991; Ermisch & Francesconi, 2001; Wu et al., 2015).

Another aspect of family structure that has been shown to have an influence on later life outcomes is the birth order of children. Many studies have shown that family size has a negative impact on educational attainment, and in fact, whole theories such as the resource dilution model have focused on the influence of family size on children's educational attainment (Blake, 1981). However, Black, Devereux, and Salvanes (2005b) found that when birth order was considered, the relationship between family size and educational attainment became negligible. Booth and Kee (2009) found similar results, although in their study the significance of family size did not vanish to the same extent it did in Black et al.'s study. While there is a relationship between number of siblings and educational attainment, Black et al. (2005b), and Booth and Kee's (2009) studies show that birth order may be the underlying reason for the association – the later the birth order, the lower the educational attainment. Reasons cited for the relationship have included parental time endowments and a dilution of parental resources as a family grows, meaning parents have more time to spend with children who are born earlier in the birth order and may have more financial resources to dedicate to them (Booth & Kee, 2009)

Educational attainment is not based solely on parental resources, which is why multiple factors that may influence educational attainment must be examined, such as parenting behaviours.

Parental Behaviours

Another aspect of childhood that affects a child's future outcomes is the transmission of values from parents to children. Parental behaviours are a main way that values transfer from one generation to the next; for example, parenting styles, and the expectations and attitudes parents exhibit toward a child's future outcomes.

Parenting style has an influence on children's outcomes. As Chen and Kaplan (2001) state, "warm and supportive parenting [is] repeatedly credited for its association with children's higher educational achievement, better psychosocial development, and lower rate[s] of deviant behaviours" (p. 17). Parental education has a direct impact on parenting style; the more education a parent has, the more supportive they are (Chen & Kaplan, 2001), which leads to higher educational outcomes for their children (Black et al., 2005a). Strohschein, Gauthier, Campbell, and Kleparchuk (2008) provide a similar argument that children with parents who provide "emotional support and establish firm boundaries are less likely to engage in delinquent behaviour, do better in school, and report better mental health than children whose parents are uninvolved or inconsistent in their discipline" (p.670, citing Amato & Fowler 2002; and Simons, Simons, Burt, Brody, & Cutrona, 2005).

Parental expectations about educational attainment also strongly influence children's educational aspirations, with children often adopting parental educational expectations as their own (Davis-Kean, 2005; Wu et al., 2015). Wu et al., (2015) argue "students who perceive that their parents place a high value on education tend to respond with positive academic behaviours" (p.207). Astone and McLanahan (1991) reiterate this point by arguing that the high educational aspirations of the parents are associated with high educational aspirations of children. A parent's own educational attainment influences their expectations for their children's educational attainment. For example, parents without a high school diploma may place less emphasis on the need for their children to graduate high school than parents who have higher educational attainment.

Ermisch and Francesconi (2001) used the term 'cultural transmission' to refer to the process of transmitting values to children and state that the correlation may be due to higher educated parents producing human capital for their children. For example, producing human capital for a child could be as simple as providing enriched home learning environments for their children by having more books around the house.

Critical Periods of Development

A third mechanism commonly used to understand the relationship between family and child outcomes is known as *critical periods of development*. This refers to a period of time when events or risks that take place can have a significant impact on an individual's development and capacities at birth (Hertzman & Boyce, 2010). If these events impair development, there may be lifelong effects on the individual. The effects of critical periods of development often present as biological impairments, such as low birth weight (Hallqvist, Lynch, Bartley, Lang, & Blane, 2004). The critical periods of development model also encompasses what are known as sensitive periods where exposures to risk have strong

effects on development, a greater effect than it would at other points of development, yet there is more ability to modify impacts during sensitive periods of development than during critical periods (Kuh & Ben-Shlomo, 2002; Lynch & Smith, 2005).

During this important period of development, parental endowments are also important. These are the genetic 'gifts' passed to children by parents that contribute to their capacities (Ermisch and Francesconi, 2001). For example, parents with above average educational attainment will produce children with high educational attainment (Haveman & Wolfe, 1995). Endowments may also be cultural, such as musical skill, or a commitment to learning (Haveman & Wolfe, 1995). The endowments translate into human capital, thus affecting the future outcomes of the children (Haveman & Wolfe, 1995). Parental endowments, whether positive or negative, contribute to the critical periods of development and to the capacities a child has at birth.

One way critical periods of development and parental endowments can present is through low birth weight. There are many reasons a child may have low birth weight, some common factors being low maternal SES (poverty), or genetic traits (Johnson and Schoeni 2011). Low birth weight (less than 2,500g) is often the first measurable indicator of health and is linked to educational attainment later in life (Case et al., 2005; Currie, 2009; Jackson, 2015; Lin & Liu, 2009). Currie (2009) cites findings from Black, Devereux and Salvanes who found that a "10 percent increase in birth weight lead to a one percentage point increase in the probability of graduating from high school" (citing Black, Devereux & Salvanes, 2007). In another study, Johnson and Schoeni (2011) examined the long-term effects of low birth weight and found that those with low birth weight earned 17.5 percent less annually, and were 6.4 percent more likely to be in poor health than healthy birth weight siblings.

In sum, parents exert a strong influence on the educational attainment of children through the economic resources they invest in their children, the socialization they provide to encourage and shepherd their children through the education system, and through the endowments that children have at birth. Parental resources, particularly SES, have also been shown to have an influence on the health of children which, in turn, is also a predictor of educational attainment (Haas, 2006). A life course approach has proven to be particularly useful in disentangling the association between SES and health over time (Corna, 2013; Elo, 2009; Smith, 2007), an issue to which my thesis is centrally concerned, and which will be discussed in the following sections.

Socioeconomic Inequalities in Health

A significant body of research examining the social inequities in health has developed in the United Kingdom over the past fifty years, including two major reports examining the socioeconomic inequalities in health: the Whitehall I and the Black Report. The Whitehall I study of British civil servants looked specifically at a range of diseases to determine whether there was any association between social class and health (Marmot et al., 1991). The study reported a steep inverse association between social class and health and found that differences in disease rates could only partially explain differences in mortality and thus there must be some other explanation for the association (Marmot et al., 1991). The study found a linear gradient within occupational classes of the British civil service; meaning the SES-health gradient existed across all class levels. Up until this point, it was largely thought that the SES-health gradient existed only between opposite ends of the SES spectrum, or that perhaps there was a certain income threshold, over which SES no longer had an impact (Adler & Stewart, 2010). Traditionally, factors such as poor sanitation, access to clean water, and access to medications separated the wealthy from the poor and were thought to be one of the main differences in the disparity between the health of the wealthy and the poor. The discovery of the SES-health gradient illustrated that this difference between income groups was in much smaller intervals and not just the extremes.

The 1980 Black Report, published in Britain, was the result of a government-commissioned working group whose mandate was to review the differences in health status between social classes in Britain and determine possible causes. Whereas the Whitehall I study focused on civil servants, the Black Report evaluated the entire population. The Black Report was the first to report a SES-health gradient: that individuals in higher socioeconomic echelons enjoyed better health and typically had lower rates of mortality and morbidity than those below (Adler et al., 1994; Pearlin, Schieman, Fazio, & Meersman, 2005).

The Black Report highlighted four possible theoretical explanations for the relationship between social class and health. The first was the *artefact* explanation: that the constructs of social class and health may themselves be artefacts and the relationship between them may be artificial (MacIntyre, 1997). Although later in the report, the working group acknowledged that health inequities may be explained by social class to some extent, and recognized that "the way social class or health is measured might influence the apparent magnitude of, and trends in, observed inequalities in health" (MacIntyre, 1997, p.727).

The second explanation was natural/social selection. This explanation has roots in Darwinian Theory, basing health inequities and social class on natural selection. This explanation indicates that *health* determines class position and not the other way around. The third explanation is the materialist/structural explanation, which relates to the role of economics and socio-economic factors in health inequities (MacIntyre, 1997). For example, socioeconomic status – wealth or poverty - contributes to an individual's health. The working group saw this explanation as the main explanation for the relationship between social class and health (MacIntyre, 1997). The fourth explanation is the cultural/behavioural explanation. This explanation focuses on both the individual and socially related health behaviours that may be culturally related, or class related. For example, certain behaviours such as smoking are more prevalent in lower social classes, and have negative impacts on health (MacIntyre, 1997).

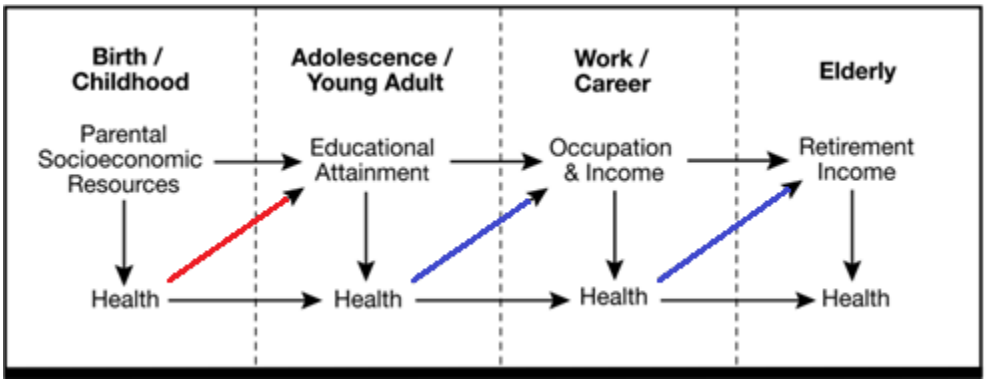
The Black Report prompted greater research into the field of social inequality than had been done previously, and especially in Britain, the topic stayed on the political and social agenda for decades following the release of the Report (MacIntyre, 1997). MacIntyre (1997) notes that there have been improvements in the measurement and reporting of SES as well as the gathering and use of longitudinal data, which have contributed to improvements in this field. Since the publication of the Black Report there have also been improvements in measurements of health; whereas before measurements were limited to measures such as infant mortality, causes of death, and reported chronic illnesses, there is now a much broader range of factors available to researchers (MacIntyre, 1997). This has meant that researchers have been able to delve deeper into each of the four explanations presented in the Black Report. Two explanations, the materialist/structural and the natural/social selection explanations have particular relevance for this thesis.

Causality versus Selection

As the Black Report outlined, causality has long been an issue in the field of SES-health research, giving rise to multiple explanations for the association between SES and health (MacIntyre, 1997). The materialist/structural explanation is that wealth (or poverty) contributes to an individual's health, whereas the natural/social selection explanation is that an individual's health determines their social position (MacIntyre, 1997). As these two explanations would imply, the direction of causality is not entirely evident; this is an area gaining increasing focus in the research community (Case et al., 2005; Haas, 2006; Willson, Shuey, & Elder, 2007). There is now the argument that it may not be one or the other, but perhaps a reciprocal and intertwined relationship between health and SES (Adler et al., 1994; Haas, 2006). Both explanations provide unique insights into the dynamic nature of

the relationship. Elovainio et al., (2011) argue that health can function as a selective mechanism in relation to SES, and "the relation between SES and health is reciprocal, bound in a reinforcing cycle where the direction of causality is difficult to determine" (p.780). As Figure 1 below illustrates, this reciprocal relationship between SES and health is dynamic and develops over a lifetime.

Figure 1 The dynamic relationship between SES and Health (Adler & Stewart, 2010, p. 10)[2]



Source: Adler, N., & Stewart, J. (2010). Health Disparities across the lifespan: Meaning, methods, and mechanisms. *Annals of the New York academy of Sciences*, *1186,* p.10.

Figure 1 illustrates the relationship between parental resources and educational attainment from childhood to adolescence, which was discussed in the previous section. In addition to that relationship, the first box in the diagram also illustrates the causal relationship between parental resources and childhood health; this is commonly referred to as social causation (Adler et al., 1994; Elovainio et al., 2011; Warren, Knies, Haas, & Hernandez, 2012). Social causation relates most directly to the materialist/structural explanation depicted in the Black Report. As described previously the materialist/structural explanation is about wealth, or lack thereof, and its influence on health.

When health influences SES – as illustrated by the red and blue arrows in Figure 1 above - it is known as health selection (Haas, 2006). Health selection relates most directly to the natural/social selection explanation described in the Black Report. Haas (2006) notes that social causation and health selection are not mutually exclusive and that there is a constant interaction between health and SES through both causation and selection across the life course, as illustrated in the remaining boxes in Figure 1. The bulk of existing research supports the social causation hypothesis; however, there is also research to

[2] Highlighting has been added to the figure

suggest that the health selection hypothesis has validity (Adler et al., 1994; Case et al., 2005; Haas, 2006). This thesis focuses on the health selection explanation.

Health Selection

The health selection explanation posits that at least part of the relationship between SES and health is due to the effect that poor health has on one's SES position (Haas, Glymour & Berkman, 2011). This explanation is related to the natural/social selection found in the Black Report. Health selection occurs when one's health has an adverse causal effect on their SES (Elovainio et al., 2011; Haas et al., 2011; MacIntyre, 1997; Warren et al., 2012). Palloni, Milesi, White, and Turner (2009) have stated that the criteria for health selection is that at some point over the life course, an individual's ability to access a social class –whether to maintain, move up, or move down in a social class - depends on their preceding health status. The relationship between health and SES can take place through two main processes: one is known as social drift, and the other, a newer concept called social stunting (Haas, 2006).

Social Drift

In the social drift model, individuals in poor health are 'selected' into lower SES because they are too sick to work and end up exhausting their financial resources or savings. The blue arrows in Figure 1 above illustrate this process. The literature suggests that poor health, whether chronic physical and mental conditions or sudden events, in adulthood may affect subsequent social mobility, albeit moderately (Manor, Matthews & Power, 2003; Palloni et al., 2009). For example, a sudden health event (e.g. stroke or cancer diagnosis) can lead to a reduced ability to participate in the labour force, reduced income, and in many cases, a dissolution of assets (Palloni et al., 2009). In their 2005 study, Himmelstein, Warren, Thorne & Woolhandler examined the relationship between illness and bankruptcy and found that "fifteen percent of all homeowners who had taken out a second or third mortgage cited medical expenses as a reason" (p. 68).

Although, as with SES, the literature has noted a gradient in social drift, meaning those who move downward in social status are still in better health than those in the receiving class, and those who are upwardly mobile are in poorer health than the class they are joining (Manor et al., 2003). In their study, Manor et al., (2003) sought to examine the health selection model by using self-rated health compared to occupational class at three different age categories. Their study found that health selection was evident in both males and females inter-generationally, meaning it affects multiple generations, and they also found health selection was evident intra-generationally for men only (Manor et al., 2003). The social drift process is most evident and applicable to adults.

Social Stunting

In the social stunting model, poor health during childhood may limit an individual's ability to maintain or improve their social standing (Haas, 2006; Haas et al., 2011), as illustrated by the red arrow in Figure 1. For example, children with serious health problems may face greater challenges completing their schoolwork. If these difficulties compound over time, they may find it difficult to keep up with other students or may not receive high enough grades to be eligible for postsecondary education. Haas (2006) is the first to use the term social stunting as a process of health selection, although the term is being used more frequently in recent studies.

The development of a chronic physical or mental condition or the onset of poor health in childhood plays a significant role in determining the educational and social trajectories of an individual. A growing body of literature has emphasized the importance of early-life health in shaping an individual's educational and socioeconomic path (Case et al., 2005; Haas & Fosse, 2008; Jackson, 2015) and there is vast agreement that childhood health has long term consequences on educational attainment (Case et al., 2005; Currie 2009; Haas, 2006; Haas et al., 2011; Palloni & Carolina, 2006; Palloni et al., 2009; Warren et al., 2012) and occupational attainment (Case et al., 2005; Palloni & Carolina, 2006; Palloni et al., 2009). Palloni et al., (2009) also indicate that serious illness during childhood can be linked to decreased educational attainment and increased risks of downward social mobility. As an example of the social stunting model, in a 2006 study, Haas (2006) found that individuals who had reported poor childhood health completed 1.8 fewer years of schooling than their peers reporting excellent health. These findings suggest that childhood health is significantly related to educational attainment, which is in support of the social stunting hypothesis. Case et al., (2005) found a significant relationship between health in childhood and educational attainment. Their study found that on average, every chronic condition a child had at age 7 was associated with a 0.3 reduction in the number of O-levels (exams) passed. Haas and Fosse (2008) found that a one unit decrease in adolescent self-rated health resulted in a 16% decrease in the odds that the adolescent would complete high school on time. Jackson (2015) found that those with poor school aged health (at one point in time), perform more poorly than their healthy peers, "ranging from 0.1 to 0.5 standard deviations below average" (p.269). Those with poor school aged health at multiple ages perform nearly a full standard deviation below their healthy peers (Jackson, 2015).

Other studies have sought to examine whether or not education is the mechanism linking childhood health to adult socioeconomic status. Lê et al., (2013) used three waves

of the Panel Study of Income Dynamics survey to examine how different patterns of health across early life are related to educational outcomes. They found a graded relationship in which schooling outcomes were best among adolescents who reported consistently good health status, followed by those with mixed health histories, and worse among those who reported consistently poor health (Lê et al., 2013). Schooling outcomes were measured by years of schooling which were then categorized into 'high school' (12 years), 'associate's degree' (14 years) or 'bachelor's degree' (16 years) (Lê et al., 2013).

In spite of the significant relationships found, it is also recognized that the impact of childhood health, and more specifically childhood chronic physical and mental conditions, on educational attainment may come from an effect of mediating variables, such as absenteeism, an ability to participate in activities, and social connectedness (Currie, 2009; Haas & Fosse, 2008; Jackson, 2015; Krenitsky-Korn, 2011; Newacheck & Halfon, 2000). Attendance at school is a necessary and normal activity for children to succeed in their education (Silverstein et al., 2001). Having poor health in childhood may impede a child's ability to attend school, thus affecting their education (Le et al., 2013). Haas and Fosse (2008) also note that chronic physical and mental conditions can have an impact on a child's ability to participate in activities, which may affect the development of peer relationships. They also note that social relationships are important during childhood years; poor relationships could affect self-esteem, which in turn, affects the child's commitment to school (Haas & Fosse, 2008).

Asthma

Asthma is the most commonly reported childhood chronic condition in the western world (Fowler et al., 1992; Milton et al., 2004) and is the leading cause of pediatric emergency hospital utilization (Currie, 2009). The prevalence of asthma in Canada increased between 1994/95 and 2000/01: in 1994/95, nearly 11% of children between the ages 0-11 had been diagnosed with asthma, rising to 13% by 2000/01 (Garner & Kohen, 2008); By 2008/09 this had fallen to 10% (Statistics Canada, 2010). Since 2000/01, the prevalence of asthma in the eastern provinces (Maritimes, Ontario and Quebec) has declined but the prevalence of asthma in the Prairie Provinces continued to rise until 2006/07 before beginning to decline (Statistics Canada, 2010).

Asthma is typically recognized by attacks of bronchitis or wheezing (Anderson, Bland, Patel, & Peckham, 1986), and can be thought of as a developmental disease due to disturbances in the normal development of the respiratory and immune systems (Sly, 2011). This disease most commonly begins in infancy (Reed, 2006). Asthma 'triggers' can be difficult to pinpoint because they vary across individuals; however, triggers can include

allergens, such as pets or environmental allergens, respiratory infections, and exercise in cold weather (Basch, 2011; Reed, 2006). Asthma can have lifelong impacts on an individual's health. As stated by Reed (2006), "the severity of asthma in early childhood substantially determines the severity of the symptoms in later years" (p. 544,). In addition, children wheezing or coughing when they are sick is related to a presence of asthma through childhood (Shapiro, 2006).

A number of studies have examined the major risk factors associated with developing asthma. These risk factors can include maternal smoking (Subbaro, Mandhane, Sears, 2009), a family history of asthma, and low birth weight (Midodzi, Rowe, Majaesic, Saunders, & Senthilselvan, 2010; Sly, 2011). Interestingly, the prevalence of asthma also tends to be higher for boys, for children in single-parent families, and for children in low income families (Kohen, 2010; Newacheck & Halfon, 2000).

There are a number of reasons that asthma can influence a child's educational outcomes. According to Basch (2011), children with asthma tend to be less cognitively prepared for school, exhibit behaviours of anxiety and depression, and be absent from school more than their peers. Asthma can pose an academic risk to school-aged children by limiting the type and amount of activities in which children are able to participate (Fowler et al., 1992; Haas & Fosse, 2008; Krenitsky-Korn, 2011; Taras & Potts-Datema, 2005) and by impacting the number of days absent from school (Case et al., 2005; Fowler et al., 1992; Mazurek, Schleiff, & Henneberger, 2012; Silverstein et al., 2001; Taras & Potts-Datema, 2005).

In recent years, asthma has been reported as the most frequent reason for school absenteeism in the United States, accounting for more than one third of days absent (Krenitsky-Korn, 2011). Fowler et al., (1992) found that children with asthma missed on average 7.6 days of school compared to 2.5 days for well children. Using cycle 3 of the NLSCY, Kohen (2010) found that those with asthma were significantly more likely to have been absent from school than those with no physical or mental conditions. In a systematic review of literature on the long term effects of asthma, Milton et al., (2004) found that rates of absenteeism ranged from 7 days to 40 days, depending on the severity of asthma. Across all studies included in Milton et al.'s review, students with asthma were found to miss more school than their healthy peers (Milton et al., 2004). In a review of over 66 studies relating to asthma and educational outcomes, Taras and Potts-Datema (2005) found that absenteeism was not the sole factor influencing educational attainment for children with asthma; other factors such as acute exacerbations of the disease and limitations to a child's

ability to participate in activities also contribute to the child's ability to perform academically.

Asthma and Educational Attainment

In examining the effects of asthma on future outcomes, many researchers have examined the relationship between asthma and different measures of educational attainment and achievement. These measures have included asthma's effect on academic achievement (Krenitsky-Korn, 2011; Silverstein et al., 2001), grade failure (Fowler et al., 1992), or high school completion (Mazurek et al., 2012). In a study examining the relationship between asthma and academic achievement, Krenitsky-Korn (2011) surveyed a sample of high school students to examine the attitudes of students in relation to absenteeism, participation in extracurricular activities, and their attitudes toward school health services. This study found that students with asthma were twice as likely to be absent from school and have lower math scores than their healthy peers (Krenitsky-Korn, 2011). In a similar study also examining academic achievement, Silverstein et al., (2001) used medical and school administrative records to look at the relationship between asthma, school attendance, and school outcomes. Their study found that those with asthma had a higher number of days absent from school (2.2 more days absent than well children), but did not, however, find any significant differences in test scores, grade point average, grade promotion or class rank of graduating students (Silverstein et al., 2001). Moonie, Sterling, Figgs, and Castro (2008) looked at the presence and severity of asthma to understand if those with asthma were absent more and if it impacted their test scores. They found no significant difference in test scores for those with asthma compared to those without, but found that children with asthma were absent for 1.5 more days than those without asthma (Moonie et al., 2008).

Fowler et al., (1992) used cross-sectional survey data to compare children with asthma to those without by examining three measures of educational outcomes: grade failure, expulsion/suspension, and learning disability. In this case, asthma was measured by asking parents whether the child experienced asthmatic conditions over the past 12 months. Results illustrated that those with asthma had similar odds of grade failure and expulsion as compared to the well children (1.3 to 1.0, and 1.0 to 1.0, respectively) but children with asthma had a much higher risk of learning disability (1.7 times) compared with well children (Fowler et al., 1992). The authors also included measures of asthma severity (combining self-reported health status, school absenteeism and taking asthma medication), finding that those in fair or poor health had higher risks of learning disabilities (2.2 compared to 1.0) but found no significant relationship with grade failure or suspension/expulsion (Fowler et

al., 1992). When looking at the effects of school absenteeism on school outcomes, Fowler et al., (1992) found that those who missed more than 16 days tended to be at greater risk for grade failure and suspension when compared to well children. Another study, looking at a similar topic used data from the US National Health and Nutrition Examination Survey to examine retrospectively whether a childhood-asthma history (assessed in adulthood) was associated with longest held occupation and educational level (Mazurek et al., 2012). The findings of this study suggest that asthma during childhood is associated with higher educational levels as well as a preference to work in certain occupations (e.g. occupations that do not exacerbate the condition) (Mazurek et al., 2012). Similarly, Eide et al., (2010) examined how a variety of health conditions in children are related to performance on standardized math and reading tests; asthma being one of the health conditions of interest. Their findings suggest that those with asthma tend to have *higher* levels of math and reading achievement than those without (Eide et al., 2010).

While multiple studies have examined the relationship between asthma and educational outcomes, there are varying results. One reason for these differing results may be due to a difference in the way asthma has been defined in studies. For example, Mazurek et al., (2012) and Eide et al., (2010) defined asthma as persons under 18 ever being diagnosed by a health professional, whereas Fowler et al., (1992) defined asthma by asking the respondent if the condition had been experienced in the past 12 months. Conversely, Silverstein et al., (2001) and Krenitsky-Korn (2011) used medical records to determine an asthma diagnosis.

Despite such research, there remains a number of avenues and aspects to the asthma-educational attainment relationship that have not been explored. Of particular note is the use of a life course approach to demonstrate how asthma in childhood is related to educational attainment using a longitudinal study. This thesis used a life course approach to examine whether ever being diagnosed with asthma is related to educational attainment. Rather than capturing this information at one point in time, the use of a longitudinal study allows the diagnosis of asthma to be captured at any point in childhood, meaning a more robust analysis can take place.

In addition, many of the existing studies examining the relationship between asthma and educational attainment use cross sectional studies; for example, those done by Eide et al. (2010), Fowler et al. (1992), or Mazurek et al. (2012). While these studies examined aspects such as test scores, grade failure or high school completion as the conduit to occupational outcomes, none specifically focused on high school completion as the dependent variable. There have been some longitudinal studies that examined the

childhood health impacts on educational attainment; however, two particular studies that examined high school completion as a dependent variable did not include asthma in their studies (Haas and Fosse, 2008; Lê et al., 2013). Using longitudinal data from the NLSCY allows for the examination of asthma across childhood using a life course approach, which is not otherwise possible.

Hypotheses of the Current Study

Based on the previous literature review, I formulated the following hypotheses:

1. Respondents with a diagnosis of asthma at any time during childhood will be less likely to have completed high school by age 20 relative to respondents who were never diagnosed with asthma, controlling for the influence of parental resources, parental behaviours, critical periods of development, and the presence of other childhood chronic physical and mental conditions;

2. The relationship between childhood health and educational attainment will be mediated by school absenteeism.

Chapter 3: Methods

Data

In choosing a source of data for this analysis several factors were considered: time, availability of information; and feasibility. This meant weighing the use of secondary data, and whether using a longitudinal or cross-sectional study was most appropriate.

Secondary data analysis is when research is carried out on data that has already been collected (Smith, 2008). There may be many advantages to using secondary data particularly when the data are of high quality, the sample size is large and is collected in a way that allows findings to be generalized to the larger population (Smith, 2008). Smith (2008) has also argued that there are disadvantages to using secondary data, such as a disconnect from the original context of the data collection. In addition, problems may arise when variables are inadequately assessed or are not able to address the research question. However, for the purposes of this analysis, the use of a secondary data set afforded me access to a large-scale study which had been developed and implemented by Statistics Canada, and provided a cost-effective option for accessing information on Canadians.

My study design was also based in a life course approach which meant that a longitudinal survey was the best option for studying how childhood experiences were linked to young adult outcomes. Asking about experiences while they are occurring is superior to retrospective surveys that simply ask adults whether they had asthma as a child. That does not mean that longitudinal studies are without problem. In longitudinal studies, researchers must tackle the issue of non-random attrition. That is, researchers must ensure that results from longitudinal analyses are not biased when certain types of individuals drop out of the survey before it ends.

Data from the Statistics Canada National Longitudinal Survey of Children and Youth (NLSCY) were used for this study, which is both a secondary data set, and a longitudinal study. The NLSCY is a survey of a nationally representative sample of children who were aged 0 to 11 in 1994 and who were re-interviewed every two years until 2008/09. As described by Statistics Canada, "the NLSCY [was] designed to collect information about factors influencing a child's social, emotional and behavioural development and to monitor the impact of these factors on the child's development over time" (Statistics Canada, n.d.a).

The sampling frame for the NLSCY was drawn from Statistics Canada's Labour Force Survey's sample of respondent households. The survey covered the non-institutionalized Canadian population, meaning the sample did not include individuals who were incarcerated or institutionalized; those who belonged to the Canadian Armed Forces; those living on First

Nations reserves; or those living in the territories and other remote areas of Canada (Statistics Canada, n.d.a). In cycle 1, the child-level response rate was 86.5% (Statistics Canada, n.d.a). Over the course of the survey, a number of households and individuals dropped out of the study. In the final interviews, conducted in 2008/2009, the cumulative longitudinal response rate for the original cohort of children was 52.7% (Statistics Canada, n.d.a).

Due to the breadth of the NLSCY, different instruments and informants were used to capture information, depending on the child's age. These included the household and general survey, the parent questionnaires, the child questionnaires, vocabulary and math tests, neighbourhood observations, self-completed questionnaires, and teacher and principal questionnaires (Statistics Canada, n.d.b). Up until the age of 15, the Person Most Knowledgeable (PMK) about the child, usually the mother, completed the household, general, parent, and child questionnaires. Once the child turned 16 they were asked to complete their own questionnaires and the PMK no longer responded.

Sample Selection

There were 22,831 children aged 0 to 11 in the original cohort in cycle 1 of the NLSCY. Two changes in sample selection implemented by Statistics Canada after the first wave led to a smaller longitudinal cohort. First, children who were participating in another national survey in 1994 were included in the first wave of the NLSCY, but dropped from the sample after the initial interview. Second, a maximum of four children were selected from each household in the first wave of the NLSCY, but beginning in the second cycle, the survey restricted further analyses to a maximum of two children per household. Consequently, the longitudinal cohort consisted of 16,903 children (Statistics Canada, n.d.a).

Because this study focused on high school completion by age 20, the sample was further limited to children who would be eligible for high school graduation, and a minimum of 20 years old by cycle 8. This meant that the study was limited to those aged 6 to 11 in cycle 1 and therefore 20 to 25 in cycle 8. Thus, the size of the sample at cycle 1 aged 6 to 11 for respondents in the longitudinal survey was 6,691. The sample was then reduced to only include children from a two parent family (either biological, adopted, foster or step), or a single parent family in cycle 1. This resulted in the exclusion of a very small number of children living with their grandparents or in other atypical situations. This exclusion was made for two reasons. First, including information about caregivers who are not parents would contribute to greater measurement error in variables for parental SES and parental behaviour. Second, unique living arrangements are likely to be unstable, making it possible

that changes in the PMK would produce unreliable estimates of the child's health status at any given point in time. In a final step, I deleted cases where there were missing values on key variables of interest. This resulted in a final sample size of 6,393 respondents.

Missing data

In any study, missing data can pose challenges for researchers. There are a number of ways, or reasons, that data can be missing. One way is known as item non-response which occurs when there are missing cases in certain variables; for example, an individual did not answer one question in the survey but completed the majority of the survey (Little & Rubin, 2002, Schafer & Graham, 2002). Because of the rigorous methods used by Statistics Canada to produce a high quality survey, missing data due to item non-response was low (less than 5%). Analysis in this context is unlikely to produce bias. Because 4.4% of data was missing and is considered trivial, I did not implement further methods to address this type of missing data.

The second way that data can be missing is called unit non-response which occurs when an individual does not complete the questionnaire. In a cross-sectional survey, this may happen if an individual refuses to participate, the interviewer is unable to locate the selected individual, or for some other reason (Little & Rubin, 2002; Schafer & Graham, 2002). In a longitudinal survey, unit non-response occurs when an individual completes some of the survey cycles of a longitudinal survey but not all cycles. This form of unit non-response is more commonly referred to as attrition. In a survey spanning 14 years, such as the NLSCY, it is likely that attrition will occur and it is an important aspect to take into consideration in this analysis.

Historically, researchers have tended to remove those who drop out of the survey from the analysis (Enders, 2010, p. 1). This is consistent with the approach taken in studies such as those done by Eide et al., (2010) and Mazurek et al., (2012). If this approach were taken in this study, the resulting data set would contain only those who had completed all 8 cycles of the survey. There are two main problems with this approach: the first is that given the wide age range of respondents in each cycle, it is possible that respondents could have completed high school in an earlier cycle, say cycle 5, but declined to participate in the final wave of the survey. Restricting analysis to those who participated in all waves would mean throwing out valid information for those who graduated from high school prior to the eighth wave. The second problem is that there may be a difference between those who attrited from the survey without reporting any high school completion information, and those who had complete high school information and then stopped participating. If attrition from the survey is random, then there should be no difference in

the characteristics of these two groups. To the extent that there are any differences, analyses can produce misleading (biased) results.

Due to the importance of capturing attrition in this analysis, the creation of a separate category in the dependent variable was required. Further details on this variable are described below. Treating those who had attrited from the survey as a separate category minimized the potential for bias in the models. In other words, biased results might have occurred if I had assigned attriters to either the 'completed high school' or 'did not complete high school' category or if I excluded them from the analysis.

Measures

Dependent variable:

High School Completion by age 20: Many definitions of educational attainment exist, ranging from years of education (Haas, 2006), to achievement on tests (Eide et al., 2010; Krenitsky-Korn, 2011; Silverstein, 2001), to high school completion (Haas & Fosse, 2008). Generally, in Canada, high school completion is based on completing 12 years of schooling. Given that education is under provincial jurisdiction, there are some differences in the years of schooling required. For example, in Quebec, students take 11 years of education before moving into post-secondary (Government of Quebec, n.d.a.), whereas in the remaining provinces, high school goes until Grade 12. The majority of students complete high school through a normal progression – meaning it takes them one year to complete each grade. However, because it can sometimes take students a bit longer to complete, many provinces, such as Alberta, calculate a 3, 4, and 5 year high school completion rate. This means that those on the normal progression would complete within 3 years of beginning Grade 10, whereas some may take 4 or 5 years. Students completing within 3 years are generally 17 or 18 years old at the end of Grade 12, meaning someone completing within 5 years of entering Grade 10 would be approximately 20 years old (Alberta Education, n.d.b). Similar calculations are done in other provinces. British Columbia calculates a 6-year high school completion rate from the time a student first enrols in Grade 8, meaning students completing within 6 years of entering Grade 8 would be approximately 19 years old (BC Ministry of Education, 2014). Manitoba uses a similar formula, by comparing high school completions to Grade 9 enrolments 4 years prior to arrive at their high school completion rate (Manitoba Education, n.d.a.).

The dependent variable has three categories: 1 = graduated high school by age 20, 2= attrited from survey prior to logging an educational status and 3 = did not graduate high school by age 20. Beginning in cycle 4, high school completion was calculated at the end of

each NLSCY cycle. In addition, each cycle contains a 'current educational status' variable. These two variables were combined to determine whether or not the respondent had completed high school. For example, in cycle 5, if the respondent was still in high school and in cycle 6 they were enrolled at a post-secondary institution, they would be considered to have graduated high school. To determine the age of graduation, a 'diploma age' variable was created. This variable returned the age at which the respondent had first reported completing high school. For example, take the situation where in cycle 5 a respondent was 17 years of age and still in high school, but by cycle 6 the respondent was aged 19 and indicated their current educational status as graduated from high school. The diploma age variable would return a value of 19. The diploma age variable was used in combination with high school completion to assign a value for the dependent variable.

Respondents who had not completed high school by age 20 were comprised of those who had completed high school after the age of 20, those who had dropped out of school before graduating, and those that were still in high school at age 20 (few respondents were in this latter category).

Attriters were those who dropped out of the survey before it was possible to assess whether they had completed high school. That is, respondents who indicated in cycle 5 that they were in high school and then attrited from the survey were treated as attriters because it was not possible to determine whether they had completed high school. In addition, because of the biennial nature of this survey, there was a group of respondents who were 19 in one cycle and 21 in the next. If their status switched from not graduated to graduated in the period between interviews, it was not possible to know whether this small number of respondents had graduated by age 20; they were treated as if they had graduated by age 20.

As noted previously, measures of educational attainment vary across the literature. The current measure has its precedent in many past studies (e.g., Haas and Fosse, 2008) and is comparable to the measure employed by Alberta Education, which uses completion within five years from high school entry (Alberta Education, n.d.b), meaning students are approximately age 20.

Independent measures:

There are two independent variables used in this study. Asthma is the primary focus of the study and as such, it forms one of the independent variables. However, the diagnosis of a physical or mental condition was also included as an independent variable to allow for more robust analysis.

Asthma: The main independent variable in this study is asthma. Asthma has been measured differently in many of the previously published studies: through medical diagnosis, through respondent assessments, and by examining medical records. In this analysis, asthma is measured using the parent's response as to whether or not the child (or youth) had ever been diagnosed with asthma by a health professional. There were three other questions relating to asthma: wheezing or whistling in the chest, whether the child had an asthma attack in the past 12 months, and whether asthma limits the child's activities. However, these three questions were only asked up until the child was age 15 so it was not possible to assess responses once the child was 16. For this reason, the independent variable is based solely on the initial asthma question which spanned all 8 cycles. Whether or not the child had asthma was turned into a dummy variable in each of the 8 cycles. In each cycle, a child who had been diagnosed with asthma is coded as 1, and 0 otherwise.

From this, I constructed a variable that evaluated whether in any cycle, the child or youth had indicated a diagnosis of asthma. A child that had been diagnosed with asthma in any cycle was coded 1; if a child had never received a diagnosis of asthma throughout the time they were in the survey, they were coded 0.

Physical and Mental Conditions: A similar independent variable was created for physical and mental conditions. Across each of the eight cycles, respondents were asked whether or not they had certain physical and mental conditions. The PMK responded to the questions until the child was aged 15, after which the youth responded to the questions on their own. There were approximately 9-12 physical and mental condition questions asked depending on the cycle. To create this variable, only those conditions that were asked in all eight cycles were used. This reduced the number of conditions to nine. These nine conditions: bronchitis, heart condition, epilepsy, cerebral palsy, kidney condition or disease, mental handicap, learning disability, emotional, psychological or nervous difficulties, and other long term condition were combined into a 'physical or mental condition' variable[3]. Asthma was not included in this variable.

Social and Demographic Controls:

Given the complex relationships that exist between education, SES and health, examining the specific relationship between health and education necessarily requires that analyses control for confounding factors. The variables chosen as controls were based on

[3] Physical and mental conditions excluded because they were not asked in each cycle include: allergies, attention deficit disorder, eating disorders, and diabetes.

three categories: parental resources, parenting behaviour, and critical periods of development. As mentioned in the literature review, these general categories represent much of the literature on the effects of parents on the educational attainment of their children. Parental resources were assessed as income adequacy, family structure, the highest level of education attained by the child's parents, and birth order. Parenting behaviour was represented by positive parenting[4]. Critical periods of development was the third category. Initially, birth weight was used to represent critical periods of development; however, once the analysis began, it was discovered that due to the high number of missing values it was not possible to include birth weight in the analysis. Thus, there are no variables specifically representing critical periods of development. In addition to the social variables, demographic control variables include age, gender, and province of residence. All social and demographic variables were drawn from cycle 1.

Income adequacy: parental income in cycle 1 was based on the income adequacy variable provided in the NLSCY. The original variable was made up of quintiles. The quintiles were recoded into four dummy variables for this analysis: Low and low-mid income, mid-income, upper-mid income, and high income. It was necessary to combine the lowest two income quintiles because of their small sample sizes. This low- to low-mid income category was used as the omitted reference category in regression models.

Family Structure: Family structure in cycle 1 was a three-level categorical variable, coded as dummy variables: 1) two biological parents; 2) two parents, where at least one parent was not a biological parent of the child; and 3) single parent family. Children who were living with two biological parents were the omitted reference category.

[4] The NLSCY also included a consistent parenting scale. This variable was not shown to have any effect in the model and was thus removed from the analysis.

Parent's highest level of education[5]*:* The variable for parent's highest level of education in cycle 1 was created by combining the family structure variable and categorical variables that captured educational attainment of the PMK and the spouse (1= did not complete high school, 2 = completed high school, 3 = some post-secondary education, 4 = attained a post-secondary degree or diploma or higher). In households where there was no spouse, the single parent's level of education automatically became the highest level of education. In households with two parents, the educational level of the parent with the highest education was recorded. From this, three dummy variables were created for completed high school, some post-secondary education, and completed post-secondary education. Households where no parent had completed high school was the omitted reference category.

Positive Parenting: The positive parenting scale, adapted from Strayhorn and Weidman (1988), is based on five questions assessed in wave 1 about the parenting practices of the PMK toward the selected child. The questions are 1) How often do you praise your child by saying something like 'good for you!'? 2) How often do you and your child talk or play with each other – focusing attention on each other – for more than 5 minutes, just for fun? 3) How often do you laugh together? 4) How often do you do something special for your child that they enjoy? 5) How often do you play sports, hobbies, or games with your child?. Scores from 0 to 4 were assigned respectively to the following responses: never, about once a week or less, a few times a week, one or two times a day, and many times a day. These items were summed to produce a score out of 20. High scores indicate positive parenting. The cronbach alpha value for this scale is 0.808 (Statistics Canada, n.d.b).

Birth order: Birth order, assessed in cycle 1, represents the birth order of the child (1 = eldest, 2 = second born, etc.).

Gender: Males are coded 1; females are coded 0.

Province of residence: Cycle 1 province of residence was used. As the literature indicates, there is often a difference in rates of physical and mental conditions and asthma across the Canadian provinces (Statistics Canada, 2010). Province of residence was recoded into dummy variables representing the Maritime Provinces (Newfoundland, Nova Scotia, New Brunswick, and Prince Edward Island), Quebec, and Ontario. Western Canada (Manitoba, Saskatchewan, Alberta, and BC) was the omitted reference category.

[5] Mother's highest education was also considered, however, parents' highest education proved to be stronger in the models.

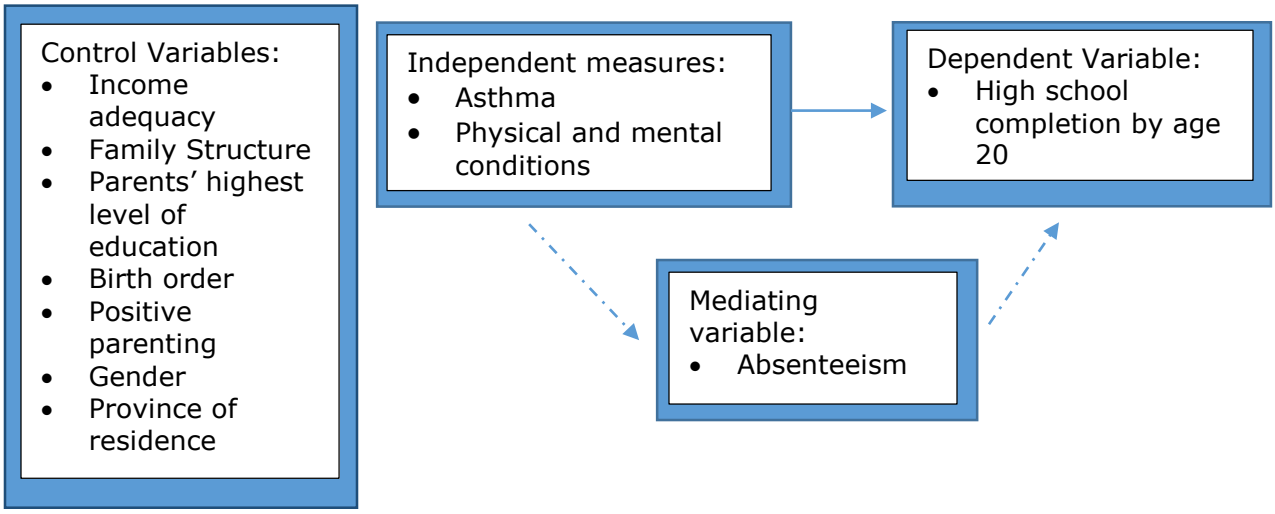
Mediating variables:

School absenteeism: The variable for school absenteeism was generated using information from cycles 1 through 5 (questions regarding school absence were not asked of those over the age of 16). In cycle 1 the school absenteeism variable was a categorical variable which asked the PMK if the child had been absent for 0 days, 1-3 days, 4-6 days, 7-10, 11-20 days, and 20 plus days. In subsequent cycles the PMK was asked for a specific number of absences, meaning cycles 2-5 were continuous variables rather than categorical. To make the measure comparable across waves, cycles 2-5 were categorized into the cycle 1 categories and then a mid-point was assigned to turn the variable back into a continuous variable. For example, the category for 1-3 days was given a midpoint of 2, the 4-6 days absent category was given a midpoint of 5, and so on. From this point the average days (midpoint) absent was derived ('the average number of days absent from school per year').

Because the NLSCY did not collect absenteeism data past the age of 15, testing for mediation was limited to respondents aged 6-8 in cycle 1. This meant I had a minimum of 4 cycles of data for each respondent. Those who had not responded to questions about school absenteeism on 2 or more cycles of the survey were removed from the calculation. This was to ensure that the maximum information was available on which to base this analysis.

The figure below illustrates the hypothetical model.

Figure 2: Hypothetical Model



Analysis

The primary method of analysis was multinomial logistic regression. Multinomial logistic regression is appropriate when the dependent variable has more than two categories (Agresti, 2013). As with binary logistic regression, multinomial logistic regression employs maximum likelihood estimation. In logistic regression models, regression coefficients are interpreted as the log of the odds of an event relative to the reference category before and after a one-unit change in an explanatory variable, with all other terms held constant. In the current analysis, the reference category is not completed high school by age 20. The analysis was conducted using the proc catmod procedure in SAS 9.4. The estimates are interpreted as statistically significant if $p<0.01$.[6]

Sampling Weights

Ideally, survey data would be collected using a pure random sampling technique. However, because collecting a pure random sample can be inefficient, costly, and in some cases not possible, most surveys use sampling designs that mean that those chosen to participate vary in their probability of being selected for participation. Sampling weights are intended to take into account the probability that a case was selected into the sample (UCLA, n.d.a.; Winship & Radbill, 1994). When weighted, results are generalizable to the Canadian population.

Weighting variables are available for the NLSCY data; data can be weighted longitudinally or cross-sectionally within their cycle. In this study, the cycle 1 weights were used rather than the cycle 8 longitudinal weights. This was done because the cycle 8 longitudinal weights take into account attrition and are only generated for those who participated in cycle 8. As noted earlier, the dependent variable in the analysis explicitly assessed attrition. Thus, using the cycle 1 weights avoids the problem of overcorrecting for attrition for those who remain in the sample in cycle 8 and resolves the issue of missing sampling weights for those who are no longer in the survey by cycle 8.

[6] The current study has a large N, meaning finding statistically significant results could occur more easily using $p<0.05$. I chose a more conservative criterion by using $p<0.01$.

Chapter 4: Results

Descriptive analysis

Table 1 presents the weighted sample characteristics for all of the measures used in this analysis. Of the full sample, 4,099 (64.1%) respondents had graduated high school by the age of 20 and 791 (12.4%) had not. An additional 1,504 (23.5%) respondents attrited from the survey before it was possible to know if they had completed high school. Among the 6,393 respondents, 1,748 (27.3%) had ever had asthma as a child, and 2,062 (32.2%) reported having a physical or mental condition as a child. Whereas Canadian statistics indicate that approximately 11% of children in any one year have asthma (Garner & Kohen, 2008), it is far lower than the more than one in four Canadian children who have the disease at some point in their childhood.

As is the case in the Canadian population, the majority of respondents came from two-biological parent families (77.3%), and at least one parent had completed post-secondary education (50.4%). Approximately 14.8% of children came from low- to low-mid income families. Over 45% of children were the first-born, and the mean age of respondents in 1994 was 8.5 years. The sample was nearly evenly split between males and females (50.6% and 49.4%, respectively), and the highest proportion of respondents (34.4%) were from Ontario.

Table 1: Weighted sample characteristics of longitudinal respondents aged 6-11 in cycle 1, NLSCY 1994-2008 (N = 6,393)

Variable	Mean (SD)
High School Completion	
Completed high school by age 20	64.1
Did not complete high school by age 20	12.4
Attrited from survey	23.5
Ever had asthma	
Yes	27.3
No	72.7
Ever had a physical or mental condition	
Yes	32.3
No	67.7
Family Structure in cycle 1	
Two biological parents	77.3
Two parents, at least one parent not biological parent	8.5
Single parent	14.2
Parent Highest Level of Education in cycle 1	
Less than high school	8.4
Completed high school	14.0
Some post-secondary	27.2

Table 1: Weighted sample characteristics of longitudinal respondents aged 6-11 in cycle 1, NLSCY 1994-2008 (N = 6,393)	
Variable	**Mean (SD)**
Completed post-secondary	50.4
Income adequacy in cycle 1	
Low- to low-mid income level	14.8
Mid income level	31.6
Upper-mid income level	36.5
High income level	17.1
Positive Parenting Scale, cycle 1	12.1 (2.9)
Birth Order, cycle 1	
One	45.3
Two	37.0
Three	13.5
Four	3.2
Five plus	1.0
Age, cycle 1	8.5 (1.7)
Gender	
Male	50.6
Female	49.4
Province, cycle 1	
Maritimes	8.4
Quebec	25.2
Ontario	34.4
Western Canada	32.1
Number of waves children participated in survey	6.4 (1.8)

Note: mean reported as mean or percentage as appropriate.

Respondents missed approximately 3.5 days of school per year over the course of their NLSCY participation (Table 2). The sample size reflects the exclusion of respondents who were missing information on this variable for more than two cycles.

Table 2: Weighted sample characteristics of Absenteeism (N = 2,914)	
Variable	**Mean (SD)**
Absent Average	3.5 (2.4)

Regression Models

The analysis proceeded in two stages. The first was to test the focal relationship between asthma and high school completion. I first evaluated whether ever being diagnosed with asthma would lower the odds of high school completion by age 20, controlling for all other terms in the model.

Second, I tested absenteeism as a mediating variable between childhood health and high school completion using a sub-analysis. Because the NLSCY did not collect absenteeism data past age 15, and given that I wanted to get as much longitudinal data as

possible for each of the respondents, the absenteeism sub-analysis was limited to those aged 6-8 in cycle 1. This gave me a minimum of 4 cycles of data on each respondent. Limiting the data to this smaller sub-sample meant that two separate analyses were required.

Full model

In arriving at the final model, a series of preliminary models were estimated (not shown). Initial models examined the bivariate relationship between an independent variable and the dependent variable. Different model specifications were tested to determine the best functional form of the relationship. It was determined through goodness of fit tests that the best fitting models were those in which the independent variables conformed to a linear pattern.

All models presented here reflect models that test factors associated with whether a respondent completed high school by age 20 relative to those who did not complete high school by age 20. Because attrition was included as an outcome to minimize bias, I present and describe in Appendix A models that evaluated predictors associated with attrition from the sample relative to those who did not complete high school by age 20.

Table 3 presents the estimates from the final multinomial logistic regression model comparing the odds of having graduated high school by age 20 relative to not graduating from high school by age 20. Model 1 presents results from evaluating whether ever having asthma was associated with high school completion by age 20. The coefficient for ever having asthma was not statistically significant (b=0.07), however the coefficient for ever having a physical or mental condition was statistically significant (b=-0.24). The odds of completing high school by the age of 20 relative to not completing high school by age 20 were 21.5% lower for respondents who ever had a physical or mental condition than those who had never reported a physical or mental condition.

Of the control variables, all three categories of parents' highest level of education were statistically significant: children whose parents completed high school (b= 0.53), had some post-secondary education (b= 0.39), and completed post-secondary (b=0.75) were more likely to have graduated high school by age 20 compared to those with parents who had not completed high school. In addition, respondents from upper-mid income families (b=0.40) as compared to low-and low-mid income families were more likely to have completed high school by age 20. Each increase in positive parenting was associated with a subsequent increase in the odds of completing high school by the age of 20 (b=0.05). Conversely, respondents who were male (b=-0.50), lived in a single-parent family at wave 1 (b=-0.70), and those from Quebec (b=-0.50) and Ontario (b=-0.41) were less likely to

have completed high school by the age of 20 than females, those living in a two-biological parent household, and those from western Canada, respectively.

Table 3: Analysis of Maximum Likelihood Estimates on Full Models		
High school completion by age 20 relative to no high school completion (N = 6,393)		
	Model 1	
Variable	**b (SE)**	**OR**
Intercept	0.94	
Ever had asthma	0.07 (0.09)	1.07
Ever had a physical or mental condition	-0.24 (0.08)**	0.79
Parent Highest Level of Education in cycle 1[a]		
Completed high school	0.53 (0.16)***	1.70
Some post-secondary	0.39 (0.14)**	1.48
Completed post-secondary	0.75 (0.14)***	2.12
Income adequacy in cycle 1[b]		
Mid income level	0.26 (0.13)	1.30
Upper-mid income level	0.40 (0.14)**	1.49
High income level	0.17 (0.16)	1.19
Positive Parenting Scale, cycle 1	0.05 (0.01)***	1.05
Birth order	0.03 (0.05)	1.03
Male	-0.50 (0.08)***	0.61
Family Structure in cycle 1[c]		
Two parents, other	-0.26 (0.14)	0.77
Single parent	-0.70 (0.12)***	0.50
Province, cycle 1[d]		
Maritimes	-0.05 (0.17)	0.95
Quebec	-0.50 (0.11)***	0.61
Ontario	-0.41 (0.10)***	0.66
Likelihood ratio	9,047.00	

Note: **p<.01. ***p<.001.

[a]Less than high school is the reference category.
[b]Low- to low-mid income level is the reference category.
[c]Two biological parents is the reference category.
[d]The western provinces are the reference category.

Sub-model

The literature often cites absenteeism as a primary reason that asthma affects high school completion. To test whether absenteeism is a mediating variable in this relationship, a sub-analysis was conducted. A sub-analysis was necessary because the NLSCY did not collect absenteeism data past the age of 15. As noted earlier, this analysis was limited to those aged 6-8 in cycle 1 to ensure a minimum of 4 cycles of data for each respondent, with a corresponding drop in sample size (N=2,914).

Table 4 below presents the results from the multinomial logistic regressions. Because of the smaller sample size, it was important to rerun the models presented in Table 3 to ensure that similar results were obtained. Model 1 tested the relationship between the presence of asthma and high school completion by age 20 using the smaller sample size. As the table shows, similar to the full model, the coefficient for ever having asthma was not statistically significant (b=-0.31). However, the coefficient for ever having a physical or mental condition was statistically significant (b=-0.50).

Of the control variables, the coefficient for parents completing post-secondary was statistically significant (b=0.74) as compared to those that did not complete high school. Family structure was negatively associated with completing high school by the age of 20; the coefficients for two parents, other (b=-0.76) and single parent families (b=-1.10) were also statistically significant as compared to two biological parent families. In addition, being from Quebec (b=-0.79) or from Ontario (b=-0.69) was statistically significant as compared to the western provinces.

In model 2, absenteeism was added ('absent average'). As with the full model, different model specifications were tested to determine the best functional form of the relationship. It was determined through goodness of fit tests that the best fitting model was that in which the mediating variable conformed to a linear pattern.

The original hypothesis of this thesis was that absenteeism would prove to be a mediating factor in the relationship between asthma and high school completion. As model 1 shows, there is no relationship between the presence of asthma and high school completion by age 20, meaning absenteeism could not operate as a mediator. However, because of the significant relationship between presence of a physical or mental condition and high school completion by age 20 in model 1, it was important to examine whether or not the average time a respondent was absent from school per year was a mediating factor in this relationship. If school absenteeism was a meaningful mediating variable, it would be

expected that the coefficient for the percentage of time with a chronic condition would no longer be statistically significant when absenteeism was added to the model.

As model 2 shows, this was not the case. The results show that the coefficient for the presence of a physical or mental condition remained largely unchanged and continued to be statistically significant (b=-0.40). This means that absenteeism was not a mediating factor in the relationship between the presence of a physical or mental condition and high school completion by age 20. However, the coefficient for absenteeism was also statistically significant (b=-0.11), meaning that both the presence of a physical or mental condition and school absenteeism are independently significant predictors of high school completion by age 20. As the average number of days the child missed school per year increased, the odds of completing high school by age 20 correspondingly decreased.

Within this model, several variables were statistically significant. Respondents whose parents had completed post-secondary were more likely to graduate from high school by age 20 (b=0.70) as compared to those whose parents did not complete high school. Similar to model 1, children in other two-parent households (b=-0.71) and single-parent households (b=-1.01) were less likely to complete high school by age 20, as compared to children in two-biological-parent families. Additionally, being from Quebec (b=-0.89), or from Ontario (b=-0.62) was associated with a significantly lower odds of completing high school by age 20 compared to those from the western provinces.

Table 4: Analysis of Maximum Likelihood Estimates Sub-Analysis				
Sub-analysis: Absenteeism (n=2,914)				
	Model 1		**Model 2**	
Variable	**b (SE)**	**OR**	**b (SE)**	**OR**
Intercept	3.01		3.34	
Ever had asthma	-0.31 (0.15)	0.73	-0.24 (0.15)	0.79
Ever had a physical or mental condition	-0.50 (0.15)***	0.61	-0.40 (0.15)**	0.67
Parent Highest Level of Education in cycle 1[a]				
Completed high school	0.09 (0.28)	1.09	0.04 (0.29)	1.04
Some post-secondary	0.11 (0.26)	1.12	0.07 (0.26)	1.08
Completed post-secondary	0.74 (0.27)**	2.10	0.70 (0.27)**	2.02
Income adequacy in cycle 1[b]				
Mid income level	-0.22 (0.23)	0.81	-0.26 (0.24)	0.77
Upper-mid income level	-0.06 (0.25)	0.94	-0.12 (0.26)	0.89
High income level	-0.07 (0.31)	0.93	-0.16 (0.31)	0.85
Positive Parenting Scale, cycle 1	0.02 (0.03)	1.02	0.02 (0.03)	1.02
Birth order	-0.07 (0.09)	0.94	-0.05 (0.09)	0.94
Male	-0.34 (0.14)	0.71	-0.34 (0.14)	0.71
Family Structure in cycle 1[c]				
Two parents, other	-0.76 (0.25)**	0.47	-0.71 (0.25)**	0.49
Single parent	-1.10 (0.20)***	0.33	-1.01 (0.21)***	0.36
Province, cycle 1[d]				
Maritimes	-0.28 (0.30)	0.76	-0.29 (0.30)	0.75
Quebec	-0.79 (0.20)***	0.45	-0.89 (0.20)***	0.41
Ontario	-0.69 (0.19)***	0.50	-0.62 (0.19)**	0.54
Absent average	-	-	-0.11 (0.03)***	0.90
Likelihood ratio	4,064.99		4,425.05	

Note: **p<.01. ***p<.001.

[a]Less than high school is the reference category.

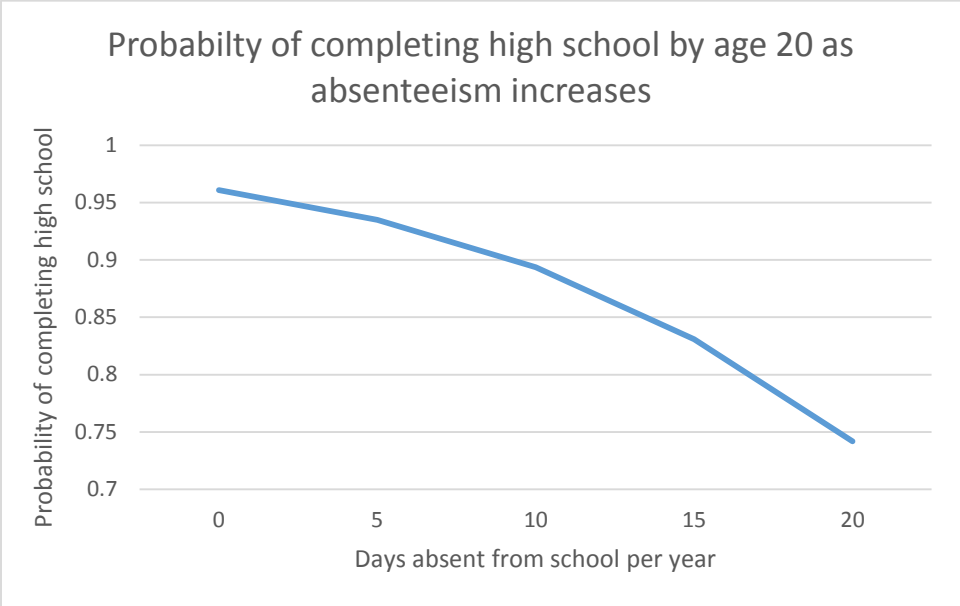
[b]Low- to low-mid income level is the reference category.

[c]Two biological parents is the reference category.

[d]The western provinces are the reference category.

Figure 3 illustrates the probability of completing high school by the age of 20 as the average number of days absent from school per year increases.

Figure 3: Predicted probability of completing high school by age 20 by average number of school days missed per year[7]



As Figure 3 illustrates that as the average number of days a respondent is absent from school increases, their probability of completing high school by age 20 decreases. The graph illustrates that while respondents who were never absent from school had a more than 96% probability of completing high school by age 20, those who were absent for more than 20 days per school year had approximately a 74% chance of completing high school by age 20, all else held equal.

[7] Note – the graph uses equal increments in days absent to illustrate the linear relationship, however, midpoints of 0, 2.5, 5, 8.5, 15.5, and 20 were used in the calculations.

Chapter 5: Discussion

The current study explored the relationship between childhood health conditions and high school completion by age 20, hypothesizing that children who had been diagnosed with asthma would be less likely to complete high school. I hypothesized that the relationship would be significant net of parental resources, parental behaviours, and critical periods of development, which are each recognized as predictors of children's educational attainment. I also hypothesized that the relationship between childhood asthma and educational attainment would be mediated by school absenteeism.

Asthma

The results of this analysis failed to find any relationship between the diagnosis of asthma at any time during childhood and high school completion by age 20. This is contrary to my original hypothesis and indicates that an asthma diagnosis in childhood is not associated with high school completion. These results differ from those found by Eide et al., (2010), Mazurek et al., (2012), and Fowler et al., (1992). Eide et al., (2010), found that boys with asthma had higher levels of reading, and both boys and girls with asthma had higher levels of math. Eide et al., (2010) used cross-sectional data with a single point-in-time reporting of asthma diagnosed by a health professional. Mazurek et al., (2012) found a higher prevalence of asthma for those with a high school diploma, meaning asthma was positively associated with education level. In this study, Mazurek et al., (2012) defined asthma as any reporting of asthma prior to age 18. Fowler et al., (1992) found that those with a diagnosis of asthma had slightly higher odds of grade failure and expulsion than those without. In all three studies, the presence of asthma over childhood was associated with educational outcomes.

While the current study used presence of asthma, other researchers have used measures of asthma severity. Silverstein et al., (2001) used nearly 20 years of medical records that had been reviewed and assessed by physicians to determine an asthma severity categorization. Their study found no statistically significant relationship between asthma and educational outcomes (Silverstein et al., 2001). In line with these results, Fowler et al., (1992) found that those with a diagnosis of asthma had slightly higher odds of grade failure and expulsion, but when measures for health status (as a proxy for asthma severity) were added, no significant relationship was found.

The findings to date in this field have been mixed, as demonstrated above. My efforts to provide clarity were not completely successful as my findings suggest the presence of asthma is not a contributor to educational attainment. This means that although the social

stunting explanation has validity (Case et al., 2005; Haas, 2006), the findings from my study would indicate that the presence of asthma across childhood is not a specific predictor of educational attainment. While the current study did not find any relationship between the presence of asthma and educational attainment, there may be reasons that this relationship does not exist. This could be because there are successful programs in place aimed at aiding students with asthma or it could be that students, parents, and schools are improving in medication management. It may also be that the Canadian health care system ameliorates the consequences of having a chronic health condition in ways that do not occur in the market based health care system of the United States. Further research on the Canadian population is needed to determine whether this explanation is plausible. Alternatively, it could be that no relationship was found because of the way asthma was measured in the current study. For example, because a diagnosis of asthma included the most severe asthmatics and those with very minor asthma, it was not possible to assess whether those who have severe asthma were worse off than those without asthma, or those with a less severe form of the disease.

Physical and mental conditions in childhood

In the initial study design, physical and mental conditions in childhood were included as a comparator to asthma and were not of analytical interest as a variable. Yet, there turned out to be a statistically significant relationship between having a physical or mental condition (aside from asthma) and high school completion by age 20, controlling for other terms in the model. These findings are consistent with a number of other studies including Case et al., (2005), Hass and Fosse (2008), Haas (2006), and Jackson (2015). Along similar lines, several researchers, such as Lê et al., (2013), used overall health status as opposed to specific physical and mental conditions to examine the relationship between health and education and found similar results. Thus while the findings of the current study align with the general literature, the current study goes further to highlight the interesting difference between having asthma (which is a physical health condition itself), compared to other physical and mental conditions and the relationship with high school completion. These findings support the social stunting explanation and conclude that the presence of childhood physical and mental conditions is a predictor of educational attainment.

Before making this conclusion, however, it is important to recognize that the significant association found in the current study may be due to the inclusion of learning disabilities in the physical and mental condition variable. Thus, because learning disability was the most prevalent condition within this variable and most likely to be a predictor of educational

attainment, any significant association observed in the current study may be largely attributable to the inclusion of learning disabilities in the measurement of physical and mental conditions. This highlights the importance of clarifying which conditions are most likely to hinder educational outcomes and which have relatively little impact. This is an area for future research.

Absenteeism

Another finding of the current study was that absenteeism did not mediate the relationship between asthma or physical and mental conditions and high school completion by age 20, but was itself independently related to high school completion. This is an important finding because in much of the existing literature, absenteeism is commonly cited as a reason childhood health is associated with educational outcomes. This finding differs from that found by Krenitsky-Korn (2011), who found absenteeism to be a mediating factor between asthma and lower grades. However, the findings of the current study are similar to results found by Silverstein et al., (2001), Moonie et al., (2008), and Haas and Fosse (2008) who did not find absenteeism to be a mediating factor. The finding that absenteeism is an independent predictor of high school completion is an important contribution to the existing literature. This finding suggests absenteeism should be recognized as a risk factor for high school completion in and of itself, and not just in relation to childhood health.

Parental Influence

Recalling the life course approach, two main concepts were used as control variables in this study: parental resources and family structure; and parental behaviours. These variables were drawn from cycle 1 of the NLSCY, meaning they represented the family situation when children were aged 6-11. While the variables were included in the models as controls, interesting findings emerged that illustrate the extent to which parental factors at one point in time have an enduring influence on outcomes in young adulthood. For example, parental education was significantly related to the child's high school completion. Children whose parents had completed high school, had some post-secondary, or had completed post-secondary were more likely to complete high school by age 20 than those whose parents had not completed high school. This is consistent with results found by Black et al., (2005a). As discussed earlier, having an upper-mid income level (as compared to a low income level), and the positive parenting scale were also significant, meaning those whose parents had higher income levels and had parents who treated them positively were more likely to complete high school by age 20. This is consistent with results found by Duncan et al., (1998).

These findings support the linked lives explanation of the life course approach by illustrating that the influence of parents and families extends far beyond the immediate time period and influences children years later. These findings also illustrate that it was appropriate to control for parental factors in assessing the relationship between asthma and educational attainment. These findings emphasize the relationship between parental socioeconomic resources and educational attainment, as illustrated earlier in Figure 1. This means that the diagonal line from childhood health to educational attainment illustrated in Figure 1 matters much less than the horizontal line representing parental resources on educational attainment.

In sum, the current study contributes to the literature by providing further insight into the complex relationship between childhood health and high school completion, controlling for parental resources, and parental behaviours. The current study found no relationship between asthma and high school completion by age 20, but surprisingly found a statistically significant negative association between physical and mental conditions in childhood and high school completion by age 20. The current study also provides further understanding of the independent association of absenteeism and high school completion. The findings from the current study provide limited support for the social stunting explanation and instead make the point that parental resources such as education, income and parenting behaviour are more influential in determining whether children complete high school.

Childhood physical and mental conditions appear to be a significant predictor of high school completion, however data limitations and measurement issues make it difficult to say with certainty that the association is robust. Recognizing that there is no relationship between the presence of asthma and high school completion, there may be strategies being used for children with asthma that would benefit children suffering from other physical and mental conditions. As the results of this study indicate, childhood health has some influence on high school completion, but parental resources seem to be of greater influence.

Improving high school completion rates is a priority of most provinces, as it contributes to healthier populations and a better economy. For policy makers, completing high school is a common performance measure of provincial governments to gauge the success of future generations. For educators and school administrators, understanding the dynamic relationship between SES and health, and better understanding the influence of parental resources can allow for appropriate and timely interventions. The results of the present study suggest that policy makers would benefit from directing efforts to support children from low-income families, or those from families where the parents did not

complete high school. Emphasizing the benefits of high school completion, and providing appropriate resources and supports may improve high school completion rates. For example, this may involve providing after school programming, positive learning environments, and appropriate food, when required. Educators may also wish to continue to pay close attention to student absenteeism, as these students could be at greater risk of not completing high school by age 20.

For policy makers, it is important to recognize the significant influence of early childhood factors on high school completion. Efforts could be directed to support families during those formative years of life through early childhood programs, improving social benefits, or providing family supports. Many programs currently exist and are aimed at these factors, meaning future research may wish to examine which programs are proving most effective in improving children's life chances.

Future Directions

Reflecting on the original hypothesis of this study, future research could explore other factors that have been cited in the literature as potential mediating factors between childhood health and high school completion, for example school engagement or social connectedness, and activity limitations. Additionally, this study singled out asthma, controlling for all other physical and mental conditions. As the results of this study show, the focus on asthma is not important relative to other physical and mental conditions. Future researchers may benefit from a similar approach to examining physical and mental conditions individually, beginning with learning disabilities, to explore whether certain physical and mental conditions have more impact than others on an individual's ability to complete high school by the age of 20. In terms of the significance of parental influence on children's high school completion, future researchers may wish to focus on determining which interventions have been proving effective, and the appropriate timing of these interventions.

Limitations

There are several limitations of the current study, the majority of which are related to measurement. These are listed in turn.

First, data limitations often imposed restrictions on how variables were measured, which may have increased measurement error. The most noteworthy limitations to the current study are the problems with measurement and the inability to obtain more accurate and precise estimates. Many of the limitations encountered in the current study are due to the design of the NLSCY. For example, due to the biennial nature of the survey, it was not

possible to determine the exact age at which respondents completed high school. As mentioned in the Methods section, in the relatively few cases where an individual reported that they hadn't completed high school by age 19 but by the next cycle they had completed high school (now age 21), they were considered to have graduated by age 20.

While the NLSCY asks specific questions related to childhood asthma they are asked retrospectively of the PMK (e.g. has your child ever been diagnosed with asthma). This question, while informative, may not be as accurately reported as a diagnostic code in a child's health care records. This limitation in measurement is such that there may be greater error, which may have made it difficult to detect a significant association. Future researchers may wish to consider the inclusion of health care information, such as the study done by Silverstein et al., (2001), to provide a more objective measure of asthma.

Similarly, the physical and mental conditions variable was limited by the large range of conditions that were included. A significant relationship was found between physical and mental conditions and high school completion, but this relationship may have existed because of the inclusion of learning disabilities. Indeed, analyses (not shown) suggest that learning disabilities were the most prevalent among the conditions included in this measure. It is likely that the implications of having a learning disability and bronchitis are quite different. Learning disabilities could be hypothesized to have a stronger effect on a child's ability to learn, participate, and ultimately complete high school than bronchitis. However, because the main focus of the study was to examine the relationship between asthma and high school completion, the physical and mental conditions variable was included as a comparator; the focus was on asthma compared to other physical and mental conditions generally rather than asthma compared to specific conditions. In addition, many of the other physical and mental conditions were too small to form their own variable. Hence, a physical and mental conditions variable was used rather than specific condition variables.

Absenteeism is widely accepted as a mediator between childhood health and high school completion. In the NLSCY, questions regarding school absence were not asked of those over the age of 16, meaning there was a relatively small sample available to analyze absenteeism, hence the sub-analysis. Use of absenteeism as the sole mediating variable is limited in scope. The literature also suggests that one of the reasons children with asthma, or other physical and mental conditions, may have academic difficulty is that their participation in activities is limited, or they may lack social connectedness (Currie, 2009; Haas & Fosse, 2008; Krenitsky-Korn, 2011; Newacheck & Halfon, 2000). Sample sizes for activity limitation variables in the NLSCY were very small and as such, they were not included as mediating variables. In terms of social connectedness, peer relationships are

important aspects of child and youth development and self-esteem. As Haas and Fosse (2008) note, social networks are important in providing children and youth with social support. Social support networks also contribute to academic achievement (Haas & Fosse, 2008). More research is needed to understand how social connectedness may contribute to the association between childhood health and educational attainment. Future researchers may also wish to consider examining absenteeism in relation to social connectedness.

Additionally, birth weight is a significant predictor of future health status (Hallqvist et al., 2004) and is often used to represent critical periods of development. However, due to the high number of missing values, the inclusion of the birth weight variable would have meant a significant reduction in the final sample size of the models. It was decided to forego the inclusion of the birth weight information in favour of a larger sample size.

As a final limitation, there could be methodological limitations to the asthma and physical and mental conditions variables because responses from the PMK were combined with youth responses. The PMK provided responses until the child was age 15; once 16, the youth completed their own surveys. These responses were combined to allow for analysis across all 8 cycles of the survey. There may be slight reporting differences in the way the PMK responded compared to how the youth responded to questions about themselves. However, it was decided that the opportunity for analysis outweighed the methodological risks in these instances.

Conclusion

This study highlights the existence of a relationship between childhood health and educational attainment, thus providing limited support for the social stunting explanation. While there was no evidence to suggest that asthma in childhood was linked to high school completion, there was a statistically significant negative association between childhood physical and mental conditions and high school completion by age 20. Nonetheless, it is possible that the inclusion of learning disabilities in the measure of physical and mental conditions pushed the relationship to statistical significance. Further research is needed to determine which specific health conditions are most responsible for reducing rates of high school completion. Importantly, it appears that parental resources continue to be a more influential determinant of youth educational outcomes, suggesting that policies to strengthen families and improve their resources are the best approach to enhance high school completion rates. The findings reinforce a life course approach which emphasizes the importance of linked lives (parental resources exert a lasting influence on the lives of their children) and the need to understand how events at one point in time are causally related to outcomes in later life. Finally, findings from these results highlight an independent

relationship between school absenteeism and high school completion, which suggests that improving school attendance may be one means of identifying children at risk of dropping out of high school and may be a potential area of intervention for improving high school completion rates in Canada.

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Appendix A: Analysis of Attrition compared to not completing high school by age 20

The model presented here evaluates predictors associated with attrition from the sample relative to those who did not complete high school by age 20.

Table 5 presents the estimates from the final multinomial logistic regression model comparing the odds of attriting from the sample to not completing high school by age 20. Model 1 presents results from evaluating whether ever having asthma was associated with attrition. The coefficient for ever having asthma was not statistically significant (b=-0.20), however the coefficient for ever having a physical or mental condition was statistically significant (b=-0.62). The odds of attriting from the survey relative to not completing high school by age 20 were 46.3% lower for respondents who ever had a physical or mental condition than those who had never reported a physical or mental condition.

Of the control variables, parents completing high school was statistically significant (b=0.50) compared to parents who had not completed high school. Positive parenting was also associated with attrition (b=0.08). This means that both having parents whose highest level of education was high school and higher positive parenting scores were associated with attrition rather than with not completing high school. Conversely, respondents from upper-mid income families (b=-0.44), and high-income families (b=-0.88) were less likely to have attrited as compared to low-and low-mid income families. Finally, those from Quebec (b=-0.58) were less likely to have attrited than those from the western provinces.

These results show that there are significant differences between those that had attrited from the survey and those that did not complete high school. While the results do not indicate why a respondent would attrite, or why a respondent would not complete high school, the results indicate that it was appropriate to separate attriters from those who did not complete high school to reduce bias.

Table 5: Analysis of Maximum Likelihood Estimates on Full Models		
Attriters relative to no high school completion (N = 6,393)		
	Model 1	
Variable	**b (SE)**	**OR**
Intercept	0.17	
Ever had asthma	-0.20 (0.10)	0.82
Ever had a physical or mental condition	-0.62 (0.10)***	0.54
Parent Highest Level of Education in cycle 1[a]		
Completed high school	0.50 (0.18)**	1.65
Some post-secondary	0.25 (0.16)	1.28
Completed post-secondary	0.37 (0.16)	1.45
Income adequacy in cycle 1[b]		
Mid income level	-0.33 (0.14)	0.72
Upper-mid income level	-0.44 (0.15)**	0.64
High income level	-0.88 (0.18)***	0.41
Positive Parenting Scale, cycle 1	0.08 (0.02)***	1.08
Birth order	0.07 (0.05)	1.07
Male	-0.16 (0.09)	0.85
Family Structure in cycle 1[c]		
Two parents, other	0.09 (0.16)	1.09
Single parent	-0.18 (0.13)	0.84
Province, cycle 1[d]		
Maritimes	-0.19 (0.19)	0.83
PQ	-0.58 (0.12)***	0.56
ON	-0.02 (0.11)	0.98
Likelihood ratio	9,047.00	

Note: **p<.01. ***p<.001.

[a]Less than high school is the reference category.
[b]Low- to low-mid income level is the reference category.
[c]Two biological parents is the reference category.
[d]The western provinces are the reference category.

Appendix
A