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Primary health service use by mothers and children from London-Middlesex, Ontario

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A thesis submitted in partial fulfillment of the requirements for the Doctor of Philosophy degree in Epidemiology and Biostatistics

PRIMARY HEALTH SERVICE USE BY MOTHERS AND CHILDREN FROM LONDON-MIDDLESEX, ONTARIO

(Thesis format: Integrated Article)

by

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Abstract

Primary health service use (P-HSU) may be influenced by predisposing and enabling factors measured at individual- and contextual-levels but is equitable when driven by need factors. *Objectives:* 1) Estimate the effect of residential location on maternal and child P-HSU; 2) Assess P-HSU inequity by determining whether the effects of need factors on P-HSU are dependent on predisposing and enabling factors; 3) Describe perceived unmet healthcare needs in the maternal-child population observed to have inequitable P-HSU. *Methodology:* The sample of 1451 mother-child pairs was from a prenatal cohort recruited from London, Ontario between 2002 and 2004, with follow-up until children were toddler/preschooler-aged. Individual-level data were linked by residential address to contextual-level data sourced from Statistics Canada. Two multilevel logistic regression models were built to assess the multilevel characteristics associated with P-HSU by mothers and children, and interactions of need factors with covariates were tested to assess P-HSU inequity. The prevalence of perceived unmet healthcare need was described, and a discussion on limitations of its measurement in the literature was performed. *Results:* P-HSU varied between neighbourhoods but only for mothers ($p=0.02$). Maternal obesity's effect on P-HSU was different for rural mothers living in low-income households ($OR=0.26$, $p<0.05$) and in middle-income households ($OR=0.15$, $p<0.05$), and for urban mothers living in high-income households ($OR=2.82$, $p<0.05$). The effect of having a health condition on maternal P-HSU was greater in mothers with three or more children. Child health condition's effect on P-HSU was lowest in children of Canadian-born mothers with one child only ($OR=1.58$, $p=0.04$) and highest in children of Canadian-born mothers with three or more children ($OR=3.52$, $p<0.01$). Perceived unmet healthcare need in this cohort was similar in prevalence to

previous studies in Canadian populations. *Conclusion:* Results indicate that differences in maternal P-HSU exist between neighbourhoods, partially explained by urban/rural residence. Several enabling factors modified the effect of need factors on both maternal and child P-HSU, providing evidence for inequitable P-HSU. This research has the potential to inform Canadian healthcare policy with regards to contextual effects, P-HSU inequity, and perceived unmet healthcare needs in mothers and children.

Keywords

Health service utilization, maternal, child, inequity, unmet need, neighbourhood, London-Middlesex, Ontario, effect measure modification, multilevel modeling

Co-Authorship Statement

The three manuscripts contained within this thesis are based upon research that was conceived of, designed, and analyzed by the author, Catherine Holtz, as a component of her doctoral work. This research was completed under the guidance of the author's doctoral supervisor, Dr. M. Karen Campbell. The study sample for this research was obtained from the Prenatal Health Project (Principal Investigator Dr. M. Karen Campbell). Additional data were sourced from Statistics Canada by the Department of Geography, under the supervision of Dr. Jason Gilliland. Contributions in the form of regular feedback and methodological and statistical advice were provided by each of the four co-authors throughout the course of this research. Catherine Holtz was the primary author of each manuscript; Drs. M. Karen Campbell, Jason Gilliland, Amardeep Thind, and Piotr Wilk were co-authors of the manuscripts associated with Chapters 4, 5, and 6 of the thesis.

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Chapter 1

1 Introduction

1.1 Introduction

Health service use may be influenced by individual and contextual characteristics and is equitable when driven by need. This thesis used individual-level data from the Prenatal Health Project (PHP) (Principal Investigator Dr. M. Karen Campbell), linked to contextual-level data of residential neighbourhoods, to study primary health service use (P-HSU) by mothers and children from London-Middlesex, Ontario.

Mothers and children may engage with the healthcare system for various reasons during the toddler/preschooler years, some of which may be unique to this population. Behaviours of health service use are established early in life, pointing to the importance of understanding maternal and child health service use during this period (1). Early health care encounters can positively influence both maternal and child health, since this period of time is essential for fostering their wellbeing (2). Further, it has been demonstrated that health service use by mothers and children is highly correlated (3). Yet, there is limited research on health services used by mother-child pairs from the same population.

The study of individual characteristic influences on health service use is well established. Socioeconomic factors are associated with health service use in complex ways. For example, women are higher users of health services compared to their male counterparts (4). However, findings from studies of the effects of educational attainment, racial-ethnicity, and income are inconsistent and often dependent on the population and type of health service under investigation. On the other hand, health status has been demonstrated to affect health service use in a consistent manner. In general, poorer health is positively associated with the use of health services in numerous populations and for various types of health services.

Contextual determinants of health have gained popularity in epidemiological research. The body of literature reveals that multiple contextual aspects, such as residential location, are associated with health outcomes (5). Contextual characteristics of residential location may include the social and physical structures of neighbourhoods (6). It is reasonable to hypothesize that along with characteristics of the individual, factors related to residential location also affect the use of health services. However, few studies have critically examined this relationship in maternal and child populations. The statement that contextual aspects of the healthcare system and health service use have not been well studied has been repeated by many researchers (4,7,8), for example: "Variation of effects across municipalities is an important area for further study and should include factors such as physician supply; travel distance required for health care; and socio-economic factors such as community income levels..." (4). This thesis includes a comprehensive set of residential location variables to study the use of health service by mothers and children.

Examining equity of health service use is an important component of health services research. One definition is that health service use is equitable when it is driven by need (i.e. health status) (9). In the context of Andersen's behavioural model, health service use equity is assessed by examining the relative contribution of need factors compared to covariates such as socioeconomic status. Work in this thesis proposes that predisposing and enabling factors may modify the effects of need factors on health service use. Hence, examining how need behaves in the presence of these covariates may be a novel method to identify subpopulations that experience inequitable health service use.

This thesis aims to fill to gaps in the health service research literature by investigating the multilevel factors associated with maternal and child primary health service use in a Canadian population, while also exploring concepts of inequity and unmet healthcare need.

1.2 Thesis outline

Chapter 2 presents a review of the Canadian health services research literature. The objectives, rationale, hypotheses, and conceptual frameworks of the thesis are presented in Chapter 3. Objectives 1 and 2 are addressed in both manuscripts presented in Chapters 4 and

5. A third manuscript, prepared to address Objective 3, is presented in Chapter 6. The thesis concludes with an integrated discussion of the work. Detailed methodology and supplementary analyses are provided in the appendices.

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Chapter 2

2 Literature review

2.1 Primary health services in Canada

In Canada, it is possible to distinguish primary health services from secondary and tertiary health services. Primary healthcare is defined as "a set of universally accessible first-level services that promote health, prevent disease, and provide diagnostic, curative, rehabilitative, supportive and palliative services" (1) . Furthermore, primary health services may include the "treatment of common diseases and injuries, basic emergency services, referrals to/coordination with other levels of care, primary mental health care, health promotion, healthy child development, [and] primary maternity care" (2). As such, physicians providing primary health services in Canada are those who provide patients' first contact with the healthcare system, and may include physicians working in family practices, pediatric practices, walk-in clinics, and emergency departments. In Canada, these primary health services are integral to maternal and child wellbeing.

Primary health services may be further categorized by continuity of care with regular care providers (e.g. family physicians) having the greatest degree of continuity of care, and physicians providing healthcare at emergency departments with the least (3). Regular care providers are of particular importance. As well as being most continuously involved in patient care, they are equipped to connect families with the most appropriate health services, thus acting as the predominant gatekeepers to the higher levels of the healthcare system (4).

2.2 Health service use

Multiple factors may influence a population's use of health services. It has been reported that health status only accounts for approximately 16% of the variance in health service use (5), pointing to the importance of considering a complex framework when examining population health service use. In addition to health status, these dimensions could include socioeconomic factors and the context in which populations live. Andersen's behavioural model is commonly applied to conceptualize health service use in populations, and includes predisposing, enabling, and need factors as variables that may influence health service use (6).

Andersen defines health service use as the "actual use of personal health services and everything that facilitates or impedes the use of personal health services", and that health service use is equitable when driven by need (6). To understand this concept, Andersen's behavioural model incorporates three components: predisposing, enabling, and need (6). First, Andersen describes health service use as a function of individuals' predisposition for using those services. Age, sex, and education are commonly included factors of this component. Second, potential access to health services is defined by factors that are part of the enabling component, and include income, employment status, and transportation. Finally, individuals' need for healthcare, whether perceived or evaluated, may include many measures of health.

The model has undergone several revisions since its inception in the late 1960s. It was originally developed to understand health service use by families but after recognition that families may not be homogeneous units, especially with regards to health status, the model was revised to consider the individual as the unit of analysis. In 1978, Andersen introduced the concept of factor mutability as the degree that a factor can be changed, hence altering its influence on health service use (7). Predisposing factors have low mutability (e.g. cannot change sex, ethnicity, age); enabling factors have high mutability (i.e. the potential access to health services may be improved by changing enabling factors, such as transportation) and; need factors have medium mutability (i.e. health can be improved with appropriate health care). It has also been recognized that the factors in the model may be measured at levels above the individual level. Contextual characteristics may contribute to and enhance the

measurement of factors of the predisposing, enabling, and need components. In particular, Andersen argues that enabling factors that affect whole communities have the potential for high mutability as changes made at the community level may affect the group as a whole (6). Andersen's revised model published in 1995 includes contextual- and individual-level predisposing, enabling, and need factors as components contributing to health service use (6).

2.3 Context and health

Differences in health outcomes across geographic places are often assumed to arise from the characteristics of people who live there (8). This assumption may not always be just as multiple aspects of geography have been associated with public health outcomes, independent of individual factors (9). Hence, the concept that neighbourhood contexts can shape health outcomes should not be ignored. Despite this, contextual characteristics have not been extensively considered in health services research. For example, a systematic review of studies that applied Andersen's behavioural model when investigating health service use found that only 45% of studies included a limited representation of environmental factors and community-level enabling factors (10).

Common barriers to accessing health services in the United States include income and insurance status. Since Canada's healthcare system is publicly funded, those enabling factors should not impact health service use to the same degree in this country. Because of this, health service researchers believe that considering the role of geography can optimize healthcare access in Canada (11,12). Should barriers to health services exist in Canada, it is speculated that they may result from contextual characteristics, such as those that describe one's residential location, rather than individual-level characteristics.

Defining the contextual unit may be challenging in studies that examine contextual-level characteristics. Contextual units in which Canadians reside exist on several levels. For example, Statistics Canada provides data at numerous contextual levels including by province, census division, census subdivision, census tract, and dissemination area. Further, customized contextual units may be chosen to address a particular research question, such as natural neighbourhoods that are derived from common social and physical structures of the

geographical place. In other instances, it may be meaningful to examine contextual differences between city planning boundaries. The choice of contextual unit necessitates careful consideration as it may impact statistical power and policy recommendations that may be implemented from study results.

2.4 Maternal and child health service use

Primary health services specifically include healthy child development and primary maternal care hence, mothers and children should be assessed as unique populations in health services research. It is well documented that maternal and child health service use is highly correlated (5,13-17), suggesting that this relationship should be considered when studying health service use in these populations. Previous studies have mainly focused on the effect of maternal health service use on child health service use, finding that the former is positively associated with latter. Mothers are the primary decision makers when it comes to pediatric health service use, so it is understandable that maternal use of health services influences their children's. However, limited research evaluates the factors associated with both maternal and child health service use, especially using mothers and children from the same population and from the same point in time. Therefore, it is unclear whether similar factors of Andersen's behavioural model impact maternal and child health service use.

2.5 Primary health service use in Canada

A review of the literature was conducted on studies of primary health service use (P-HSU) in Canadian populations. Efforts were made to limit the literature review to mothers and children of toddler/preschooler age. However, due to scarce studies in this particular area of health services research, the review was expanded to include studies of P-HSU by adults and children of all ages. Details of the Canadian studies included in the review of P-HSU are provided in Appendix A.

2.5.1 Predisposing factors

2.5.1.1 Sex

Canadian studies consistently demonstrate that sex is a significant risk factor for P-HSU among adults. Compared to their male counterparts, women had increased odds of using primary health services (11,18-21), as well as higher rates of P-HSU (22). Women have different medical needs than men because of varying morbidity between the sexes. Further, women of reproductive age may have additional needs that may include pregnancy planning, prenatal, and postnatal care.

Two Canadian studies found that in children younger than 14 years of age, boys had higher rates of emergency department use compared to girls (23,24). When investigating the odds of family physician use, another study found no significant difference between girls and boys who were between 12 and 14 years of age (21). While findings are limited, these studies suggest a sex difference in emergency department use in children, but not necessarily for regular care providers in older children. In reviewing the literature, it was found that numerous studies adjust for child sex in multivariable analyses without reporting its effect on P-HSU (25-27). The literature suggests that while child sex may not be a predisposing factor of interest, it is adjusted for in analyses to control for possible inherent biological differences between the sexes.

2.5.1.2 Age

In adults, it may be speculated that P-HSU increases with age as health deteriorates. However, the effect of age on P-HSU is inconsistent in the Canadian literature. One study found that adults aged 20-24 years had increased odds of P-HSU compared to older age categories (18), while others have found that P-HSU increased with age (11,19). With regards to rates of P-HSU, one study found that rates were increased in women aged less than 30 years (28), while another found no age effect in women (29). Females of reproductive age may utilize more P-HSU, possibly explaining the observed increase in P-HSU in younger

ages. Despite mixed findings, the majority of studies adjust for age in multivariable analyses without reporting its effect on P-HSU (20,29-35) .

Similarly, the literature demonstrates an inconsistent effect of age on pediatric P-HSU. One study found that in a population of children aged 4 to 16 years, younger children were more likely to have visited a medical doctor, including emergency department and hospital use (36). However, this result was from unadjusted analyses. Nevertheless, like studies that have adjusted for sex, studies of P-HSU by children in Canada have adjusted for both child age (25-27) and maternal age (25,27), without explicitly stating their effects.

2.5.1.3 Racial-ethnicity and nativity

Many studies have investigated the effects of racial-ethnicity and/or nativity on P-HSU. The subjective assessment of racial-ethnicity may lead to discrepancies in its measurement across studies, affecting the ability to compare results between studies. Contrarily, nativity and immigrant status are easily measured and may be a more consistent measurement compared to race/ethnicity. Several studies have reported no association between race, culture and nativity with P-HSU by adults in Canada (19,21,22). However, one study found that visible minorities had increased odds of family physician use (18), while another demonstrated that adults of white ethnic origin had increased odds of family physician use (11). Both studies used data from the Canadian Community Health Survey and adjusted for many covariates however, they used different cycles of the survey. Results are also mixed for the effect of Canadian nativity on adult P-HSU. A community-based research project that conducted immigrant focus groups found that this population had experienced geographic, socio-cultural, and economic barriers in accessing healthcare in Canada (37) . Further, analysis of physician visit rates among British Columbia immigrants and the province's general population revealed that immigrants had lower rates of P-HSU (38) . Contrarily, it was found that among patients of primary healthcare practices, recent immigrants had more visits compared to Canadian-born adults (34) . The differing result for the effect of nativity of P-HSU in the former study is most likely a result of its study population. The authors sampled patients who were already connected to primary healthcare practices, which may be a large initial barrier for immigrants' access to primary health services (37) .

The literature is also mixed for the effects of racial-ethnicity and nativity on pediatric P-HSU in Canada. While one study found that white 12 to 14 year olds were more likely to have used a family physician compared to non-white 12 to 14 year olds (21), others have not found race or Canadian nativity to be associated with P-HSU (16,21,25). Inconsistent results for the effect of race/ethnicity and/or nativity suggest further investigation into their effects on P-HSU in Canadian populations.

2.5.1.4 Education

Higher educational attainment is typically associated with increased use of primary health services. While some studies have found no association between education level and P-HSU by adults (18,21,28,39) , several others have demonstrated increased odds of family physician use by people with higher education (11,20,29,40) . Two of these studies examined family physician use for mental health reasons in particular (20,40) . While research is limited in Canada, the effect of parental education on pediatric P-HSU is similar, in that children of parents with higher education are more likely to use primary health services. In univariable analyses, one study found that children of mothers with higher education were more likely to have visited a medical doctor (36). Another study adjusted for maternal education in analyses of infant P-HSU however did not report its effect (27). It may be speculated that higher educated populations engage with primary health services for preventative reasons. This may explain the findings in the reviewed literature where higher education status was associated with increased family physician use. The lack of consideration of maternal education status in pediatric P-HSU studies is surprising, since it is a predisposing factor that is commonly considered in adult P-HSU studies.

2.5.1.5 Gaps in the literature

Health service researchers have considered the predisposing factors of age, sex, racial-ethnicity and nativity, and education in the study of P-HSU in Canadian populations. Although findings are mixed, most studies adjust for age and sex. Evidently, contextual

predisposing factors, such as neighbourhood percentage of immigrants, have not been considered in the study of P-HSU in Canada. Studies that have specifically examined the use of primary health services in maternal-child populations are also scarce which limits the knowledge of predisposing factors' effects in these particular populations.

2.5.2 Enabling factors

2.5.2.1 Income

The effect of income on P-HSU in the Canadian literature is unclear. The majority of reviewed studies found no association between income and P-HSU, indicative that financial barriers to using primary health services in Canada are minimal (11,19-21,28,29,39,41,42). However, higher household income has been associated with both increased odds and higher rates of P-HSU in adult populations (18,22). In contrast, one study examining income at a contextual level found that adults residing in lower mean income neighbourhoods had increased rates of P-HSU, however this analysis was not adjusted for any covariates (43).

Similarly, several studies have mixed findings for the effect of income on pediatric P-HSU. One study did not find an association between children's family physician use and household income (21). When measured at the neighbourhood level, one study found that children living in higher income neighbourhoods were more likely to use a family physician (26), while another found that pediatric family physician use was higher in children living in lower income neighbourhoods (43) . Further, asthmatic children residing in the poorest neighbourhoods had increased rates of emergency department use (24). It appears that the effect of income on P-HSU may depend on whether it is measured at the individual or neighbourhood level, and may differ based on the population and type of primary health service under investigation. Further investigation of this enabling factor at the individual and contextual level is warranted in maternal-child populations.

2.5.2.2 Employment status

Employment status may affect the ability of mothers and children to utilize health services. For example, a mother who works full-time during regular working hours may be unable to use health services that operate only during those hours. Schoen and Doty (2004) suggest that employment status may impact the ability to attend appointments, advance one's "health agenda", and access additional medical resources (44) . On the other hand, unemployment may be associated with poorer health, suggesting a positive association with P-HSU. The literature on the effect of employment status is sparse, but one study found that women working full-time hours versus more than full-time hours have increased rates of general practitioner use, i.e. women working fewer hours, albeit full-time, enabled them to visit a general practitioner more frequently (28). Interestingly, another study found that unemployed adults had reduced odds of family physician use (45). Clearly, the effect of maternal employment status on maternal and child P-HSU in Canada needs to be further investigated.

2.5.2.3 Marital status

Marital status may act as an enabling factor for P-HSU, but results are inconsistent. In examining the effect of marital status on P-HSU, non-married adults were more likely to use a primary health service for a mental health reason (20,40), while married adults were more likely to use a primary health service for any reason (11). Other studies have failed to find an association between marital status and P-HSU (19,29).

One study adjusted for marital status in the analysis of infant P-HSU however did not report its effect (27). However, maternal marital status has been documented to affect pediatric emergency department use. Children of single-parent families had increased rates of emergency department use for asthma (24). Since single-parent families lack spousal support, they may be unable to arrange and/or attend appointments with a regular care provider. Spousal support may facilitate child supervision and feasibility of visiting a health service for both adults and children. The current Canadian literature has not extensively considered the effect of marital status on P-HSU in maternal and children populations. Marital status is an

important enabling factor to consider since it can help identify the role of social support systems in accessing primary health services.

2.5.2.4 Maternal parity

Literature on the effect of maternal parity on P-HSU is sparse. One Nigerian study found no effect of parity on antenatal or postnatal care (46). In contrast, an American study found that more children in the household reduced the odds of emergency department use in the previous twelve months (47). It may be that as parity increases, maternal ability to cope with children's needs also increases, reducing the number of encounters children have with primary health services. Alternatively, both maternal and child P-HSU may be negatively affected by parity because of difficulties in arranging childcare for multiple children. Either way, maternal parity may negatively affect P-HSU although this has not been repeatedly demonstrated, especially in the Canadian literature.

2.5.2.5 Transportation

Availability of transportation is an important factor of the enabling component. It may be hypothesized that people without access to a vehicle are less likely to utilize health services. With regards to public transit, it was shown that children had reduced rates of emergency department use when their regular care providers were located closer to a public transit stop (48). This was thought to occur because regular care providers were more accessible than the emergency department. Based on this finding, one could also hypothesize that accessible transportation facilitates all types of P-HSU. However, current literature has not considered the many dimensions of transportation that may facilitate or act as a barrier to P-HSU by Canadians.

2.5.2.6 Primary health service supply

The supply of primary health services in a given location may affect the population's use of those services. In general, women and children residing in areas with lower healthcare supply had reduced likelihood of using health services (26,46). Having a regular care provider has been consistently associated with the use of this type of primary health service (11,19,21,22,29,49). Further, higher regular care provider supply increased the number of pediatric preventative care visits, having a positive influence of child wellbeing (26). Regular care provider supply also has implications for the use walk-in clinics and emergency departments. It is thought that the emergency department is a major source of primary healthcare for children without a regular care provider (50). Regular care provider supply has been shown to affect the use of pediatric emergency department use. These use patterns exhibited a dose-response relationship; as regular care provider supply increased, emergency department use decreased (26). Evidently, without a regular care provider, individuals are restricted to seek primary health services from walk-in clinics and emergency departments. Health promotion and healthy child development, aspects of primary healthcare, may be less of a focus at walk-in-clinics and emergency departments, which may have negative implications on both maternal and child health. The supply of primary health services can facilitate P-HSU and also impact the types of primary health services that are utilized.

2.5.2.7 Residence

The effect of residence on P-HSU is mixed in the Canadian literature. Some research suggests that urban area residence is positively associated with regular care provider use (21,29), while other research has not reported this significant association (11,22,40). Urban or rural residence may affect P-HSU through a number of pathways. It is likely that urbanicity is closely related to other enabling factors associated with P-HSU, such as physician supply and transportation options. More developed locations may have increased supply of health services and more accessible transportation options. Since both of these are part of the enabling component, facilitating P-HSU, it is reasonable to speculate that urban areas also enable P-HSU.

2.5.2.8 Gaps in the literature

Several Canadian studies have considered income, marital status, and physician supply as enabling factors of P-HSU. To a lesser degree, employment status, maternal parity, and transportation have been considered. Similar to predisposing factors, few contextual-level enabling variables have been considered, with the exception of some investigation of the effects of neighbourhood income, residence, and area supply of physicians on P-HSU. Further, few studies specifically examined P-HSU in maternal-child populations, limiting the knowledge of enabling factors' effects in these particular populations.

2.5.3 Need factors

A large volume of literature has examined the effect of need factors on P-HSU and suggests that health status may have the greatest impact on a population's use of primary health services. Across studies, the definition and measurement of need varies depending on their research questions and target populations. For example, need factors are generally measured as self-reported health status and number of chronic conditions. On the other hand, need has been represented by one of many specific markers of health status for example, gestational age, obesity, and depression. The literature generally demonstrates that poorer health represents a greater need for healthcare, thus is positively associated with P-HSU.

2.5.3.1 Self-reported health status

Some studies use a self-reported measure of general health status ranging from poor to excellent health. The literature consistently shows that poorer self-rated health is associated with both an increased risk of and increased volume of P-HSU (11,15,16,18,19,22,29). The majority has demonstrated that poorer health is associated with increased odds of regular care provider use (11,18,20,29,40), increased odds of unspecified physician use (19), and higher rates of general practitioner use (22,28). Using self-reported health status is a feasible method

to measure need in health services research, and its effects on P-HSU have been repeatedly demonstrated.

2.5.3.2 Health condition

The presence of acute and chronic physical health conditions has been associated with increased use of primary health services (5,11,18,19,21,22,39,51). In several studies, the presence of chronic conditions was associated with increased odds of regular care provider use (11,18,20,40), and higher rates of general practitioner use (22,28). Further, Agborsangaya (2012) reported that chronic condition morbidity was associated with increased odds of emergency department use; multimorbidity also increased odds of emergency department use compared to those with only one chronic condition (30). This dose-response relationship between the number of chronic conditions and P-HSU has also been demonstrated for the use of other primary health services, including regular care provider (11,19). These studies have amalgamated numerous conditions into an overall measure of health, and demonstrate a consistent effect of health conditions on P-HSU.

2.5.3.3 Mental health

Several studies have considered the importance of mental health on P-HSU in adult populations. Asada et al. (2007) reported that adults with depressive symptoms and high stress had higher odds of regular care provider use (18). With regards to the use of regular care providers specifically for mental health reasons in adults, higher levels of distress, depression and mood disorder were associated with increased odds (20,40). Further, Doupe (2012) found that among emergency department users, those with a mental illness (personality disorder, schizophrenia, substance disorder) were more likely to be frequent users (52). The Canadian literature provides evidence that poorer mental health is positively associated with P-HSU by adults.

Few Canadian studies have examined the effect of maternal mental health on pediatric P-HSU. One Canadian study investigated the effects of maternal depression and anxiety on the

frequency of infant regular care provider use, and the odds of infant emergency department and walk-in-clinic use. After adjusting for several relevant predisposing, enabling, and need factors, maternal depression and anxiety were not found to affect infant P-HSU (27). Several studies of non-Canadian population have looked at maternal mental health and pediatric P-HSU however these study findings are mixed. Children of depressed mothers were reportedly more likely to use primary health services for acute illnesses, including increased odds of regular care provider and emergency department use (53-56). However, other studies including the one performed in Canada do not support these findings (16,27,47) Nonetheless, maternal mental health remains a popular research topic in the study of pediatric P-HSU, and its consideration is warranted in Canadian populations to fill a gap in the current literature.

2.5.3.4 Obesity

Obesity is a specific physical health condition that is a major burden to the healthcare system in many developed countries (18,33,57,58). The effect of obesity, sometimes represented by body mass index (BMI), on P-HSU has not been consistently demonstrated. Some research has found that obesity and morbid obesity were associated with the frequency of general practitioner visits (33,59,60). Further, one study demonstrated that overweight adults were more likely to have contact with a regular care provider compared to adults of normal weight (18). However, other studies have not replicated the association between obesity and P-HSU (19,21). While people may not utilize primary health services specifically because of their weight, it is likely that health complications arising from overweight and obesity (e.g. diabetes, high blood pressure) are associated with P-HSU. Hence, considering BMI in health services research may be an appropriate alternative when measuring other health conditions related to overweight and obesity is not possible.

2.5.3.5 Perinatal health status

Children born in poor health are at risk for complications later in life, therefore health status at birth may be associated with increased P-HSU throughout the life course. However, a

paucity of research exists on the effect of perinatal health status on P-HSU in Canadian children. Anderson et al. (2008) considered preterm birth, small for gestational age, and colic as confounding variables in their investigation of maternal depression and anxiety of infant P-HSU however, did not report their effects (27). In the United States, lower birth weight has been associated with increased volume of P-HSU in early childhood (53). Further, prematurity (gestational age less than 37 weeks) has been associated with increased risk for hospitalization in American, British, and New Zealand pediatric populations (61-63), although these findings were not replicated for the association between premature birth and volume of regular care provider visits (63). The literature from these other countries suggests that gestational age and birth weight, both components of size for gestational age, affect health service use in early childhood. The degree to which these effects last later into childhood and in Canadian populations has not been thoroughly investigated.

2.6 Opportunities to advance current knowledge

There exists numerous opportunities to advance the current state of health services research knowledge. Many studies examined specific types of primary health services separately from one another, focus on secondary health services (e.g. hospitalization), or even combine health service use as encounters with both primary and secondary health services. Use of primary health services should be examined holistically with the opportunity to distinguish types of services from one another. Furthermore, few studies have examined P-HSU by mothers and children from the same population hindering the ability to compare the main determinants of P-HSU for mothers and for children. Studies that include a comprehensive set of variables conceptualized in Andersen's behavioural model are also scarce. A systematic review was performed on studies from 1998 and 2011 that used Andersen's behavioural model as the theoretical framework. Of the reviewed studies, age, marital status, sex, education, and ethnicity were considered as predisposing factors; income, health insurance, and usual source of care were considered as enabling factors; and an array of need factors were considered (64). As expressed by the authors of the systematic review and evident from this review of health services research in Canada, the complexity of factors in Andersen's behavioural model has not been thoroughly investigated. Babitsch et al., (2012) suggest the use of

primary data sources so that the richness of variables conceptualized in Andersen's behavioural model can be purposely measured and considered in health services research (64). Hence, a comprehensive examination of the multilevel predisposing, enabling and need factors associated P-HSU by mothers and children in Canada is warranted.

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Chapter 3

3 Objectives, rationale, hypotheses, conceptual framework

3.1 Objectives and rationale

The primary objective of this thesis was to investigate the role of residential location in the study of maternal and child primary health service utilization (P-HSU). The consideration of residential location in health services research, measured by neighbourhood contextual characteristics, contributes to a gap in the literature. Health services research that focuses on the role of residential location may be important to inform public health policy, as strategies that consider geography may benefit populations.

The first two research objectives were to:

1. Estimate the effect of residential location on maternal and child P-HSU.
    a. Does P-HSU vary between neighbourhoods after taking into account maternal/child predisposing, enabling, and need factors?
    b. Do neighbourhood contextual characteristics affect P-HSU after controlling for maternal/child predisposing, enabling, and need factors? If so, what are their effects on P-HSU?
2. Assess P-HSU inequity by determining whether the effects of maternal and child need factors on P-HSU are dependent on predisposing and enabling factors.

Examining how need factors behave in certain subgroups of predisposing and enabling factors may prove to be a novel approach to investigate inequity in health services research. The identification of subpopulations with inequitable P-HSU is important as they may benefit from targeted changes in healthcare policy.

Upon completion of the first two research objectives, additional questions arose about the concept of unmet healthcare needs in this population. As such, a third objective was generated to:

3. Describe perceived unmet healthcare needs in the maternal-child population observed to have inequitable P-HSU.

3.2 Hypotheses

1.a. The odds of P-HSU vary across the neighborhoods in which mothers and children reside.

1.b. Residential contextual characteristics conceptualized within the framework of Andersen's behavioural model are associated with P-HSU. Specifically, mothers and children residing in neighbourhoods with lower proportion of immigrants, higher proportion of high school graduates, lower proportion of single parenthood, higher family income, and urban makeup have increased odds of primary health care service use.

2. The effects of need factors on P-HSU vary depending on subgroups of predisposing and enabling factors. Specifically, the hypothesized effect measure modifiers are: maternal nativity to Canada, parity, education, marital status, income, access to a vehicle, having a regular care provider, and urban/rural residence.

3.3 Conceptual Framework

The conceptual frameworks of maternal and child P-HSU have been adapted from phase five of Andersen's behavioural model (1). Individual and contextual characteristics are organized according to predisposing, enabling, and need factors (Figures 3.1 and 3.2). Justification for the inclusion of predisposing, enabling, and need factors in the conceptual frameworks is provided in Appendix C.

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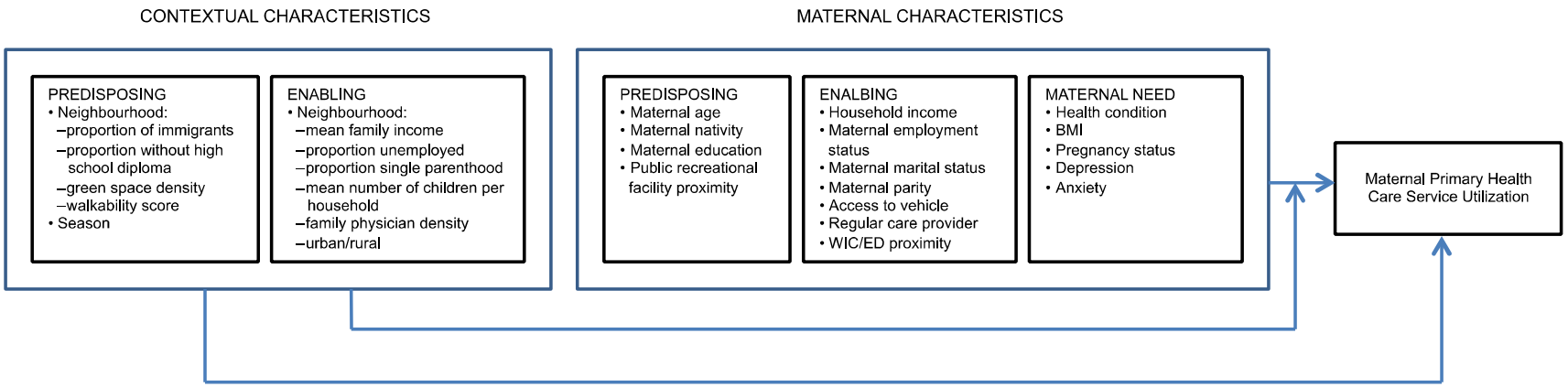

Figure 3.1 Conceptual framework of maternal primary health service use

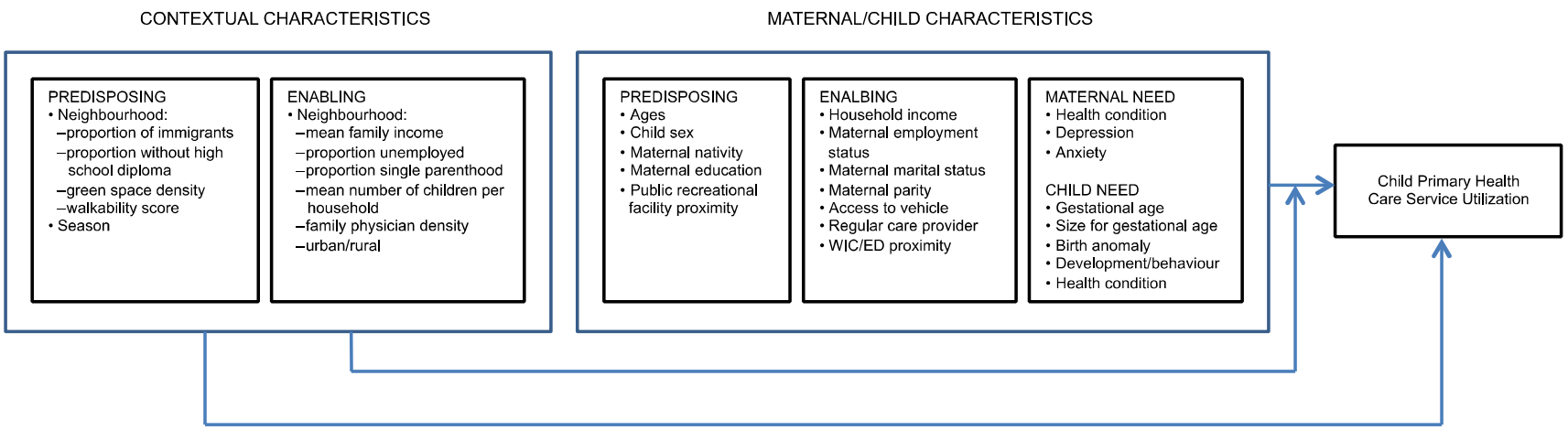

Figure 3.2 Conceptual framework of child primary health service use

Chapter 4

4 Neighbourhood variation and inequity of primary health service use by mothers from London-Middlesex, Ontario[a]

4.1 Introduction

Epidemiological studies often consider social factors as determinants recognizing that factors other than biological ones may impact disease risk. Furthermore, literature reveals that multiple aspects of one's context, such as residential location and its corresponding social and physical structures are associated with health outcomes (1). Precedence has been placed on the role of social determinants measured at both individual and contextual levels to inform policy on social inequities of health, including those that may exist in Canada (2).

The importance of social and contextual determinants has been extended to health services research. Andersen's behavioural model conceptualizes predisposing, enabling and need factors measured at individual and contextual levels to influence health service use (3). The study of individual characteristic influences on primary health service use (P-HSU) is well established in adult populations. It is known from health services research in Canadian adults that predisposing and enabling factors are associated with utilization in complex ways. For example, women are higher users of health services compared to their male counterparts (4-9). However, findings from studies of the effects of age, educational attainment, racial-ethnicity, marital status and income on P-HSU are inconsistent (5,7,9-11). On the other hand, need factors have been consistently associated with P-HSU in that poorer health is generally positively associated with P-HSU in numerous populations and for various forms of primary health services (4-7,9-12). A paucity of contextual characteristics in health service research is evident (9,13,14), for example: "Variation of effects across municipalities is an important

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[a] A version of this chapter has been accepted for publication at *World Health and Population*.

area for further study and should include factors such as physician supply; travel distance required for health care; and socio-economic factors such as community income levels...” (9).

Further, health service use is conceptualized to be equitable when driven by need factors and not the socio-economic characteristics that comprise predisposing and enabling factors (15). Understanding who is using health services and why, and which groups of people are disadvantaged in their use can help effectively allocate resources and identify where changes in health care delivery may be required to maximize those resources.

This study explored the multilevel factors conceptualized within Andersen’s behavioural model of health service utilization, in a population of mothers residing in London-Middlesex, Ontario, Canada. The city of London spans 420.6 square kilometres, has an approximate population of 366,000 with about 153,000 private households, half of which are single-detached houses (16). Middlesex county is a mostly rural region surrounding the city of London, spanning close to three thousand square kilometres.

The first study objective was to determine whether maternal P-HSU varies between the neighbourhoods in which mothers reside, and if so, to estimate the effects of contextual characteristics on P-HSU. A variety of contextual characteristics were assessed in an exploratory manner, but based from Andersen’s model. Two hypotheses were tested for this objective: 1) Maternal P-HSU varies across neighbourhoods in which mothers reside; and 2) residential contextual characteristics conceptualized within the framework of Andersen’s behavioural model are associated with maternal P-HSU. The second objective was to assess inequity by determining whether the effects of maternal need characteristics on P-HSU are dependent on a priori selected predisposing and enabling factors. To investigate the second objective, it was hypothesized that the effects of maternal need factors on P-HSU vary depending on subgroups of predisposing and enabling factors.

4.2 Methods

4.2.1 Data sources and sample

The study population was from the toddler/preschooler stage of the Prenatal Health Project, a cohort study that recruited pregnant women from seven ultrasound clinics in the city of London, Ontario from 2002 to 2004. Inclusion criteria for women at recruitment were: residence in the London-Middlesex region of Ontario, singleton pregnancy, maternal age of 16 years or more, gestational age 11.5–20.5 weeks, no known fetal abnormalities and adequate knowledge of English. Of 2357 participants who gave birth, follow-up was conducted during the toddler/preschooler stage on 1607 participants from 2005 to 2007 (on average 34 months postpartum). This follow-up study population was no different than the original cohort based on known characteristics of the women. The study population had many attributes making them favourable in addressing the research objectives. Namely, the rich dataset of the Prenatal Health Project contained a multitude of maternal individual-level factors conceptualized in Andersen's behavioural model. Further, maternal residential addresses were available to link maternal characteristic data to contextual characteristics data sourced from the 2006 Census of Canada (17). After elimination of participants with unknown addresses or who were no longer residing in London-Middlesex during the toddler/preschooler stage, the available study population was 1451 mothers residing in 471 unique neighbourhoods. Although data were collected from 2005 to 2007, results continue to be representative of the study population, as London-Middlesex has undergone minimal social and structural change over the past five years (16).

4.2.2 Measures

Primary health service use was defined as a visit to a medical doctor who provided mothers with first-line contact with the Canadian health care system. Mothers who reported during the toddler/preschooler stage visiting their regular care provider, a walk-in clinic and/or emergency department in the previous two months were classified as having used a primary health service. Of the 1451 London-Middlesex residents linked to the residential location

dataset, 29 mothers had incomplete data on P-HSU, resulting in a final study population of 1432.

All but three maternal characteristic variables for the study were collected by telephone interview during follow-up. Maternal nativity and education were collected prenatally, and the presence of a chronic health condition was derived from prenatal and perinatal data. Contextual characteristic variables were measured at the dissemination area level, the smallest geographical unit for which Statistics Canada provides relevant social and economic variables and were therefore used to define neighbourhoods in this study. Descriptions of the maternal and contextual characteristics, grouped by predisposing, enabling and need factors, are shown in Table 4.1.

4.2.3 Data analysis

Analyses were performed using the statistical software package SAS®9.2 (SAS, Windows build 9.2, SAS Institute Inc., Cary, NC, USA). Descriptive analyses were performed on maternal and contextual characteristics. Univariable associations of maternal P-HSU with independent variables were investigated using logistic regression where associations with $p<0.20$ were considered in multivariable analyses.

A multilevel model was estimated using the GLIMMIX procedure and built in three stages, using a conservative level of significance ($p<0.20$). First, maternal characteristics were added as fixed effects to the random intercept model. Each maternal characteristic in the model was assessed for having a random effect on P-HSU by examining the Wald test statistic of the estimated random slope's variance (18). Contextual characteristics were then added as fixed effects. Maternal characteristics were entered to the model prior to contextual characteristics as individual-level variables have precedence over higher-level variables (18). The third stage of model building tested for effect measure modification between significant maternal need characteristics and a priori chosen covariates (i.e. maternal nativity to Canada, education, parity, marital status, income, access to a vehicle, regular care provider and residence) in the multivariable model. To achieve a final parsimonious model, variables whose effects were not significant ($p\geq0.05$) were removed from the model one at a time.

4.3 Results

About half of mothers (53.4%) had used a primary health service. Descriptive statistics of the maternal and contextual characteristics, grouped by predisposing, enabling and need factors, are shown in Table 4.1. Univariable associations between independent variables considered in multivariable analyses and maternal P-HSU are presented in Table 4.2.

The final multilevel parsimonious model is presented in Table 4.3. All maternal characteristics were estimated as fixed effects. The final model included four measures of maternal need, of which the effects of maternal health condition and maternal BMI were modified by maternal and contextual enabling factors. The variance of the model's random intercept was statistically significant with the addition of maternal characteristics, contextual characteristics and interaction terms (p=0.02), indicating that the odds of P-HSU varied depending on maternal neighbourhood residence.

No predisposing factors were retained in the final model and the only enabling factors retained were included as effect measure modifiers of need factors. Several measures of maternal need had significant effects on P-HSU. Mothers who were pregnant during follow-up had increased odds of P-HSU compared to non-pregnant mothers. Higher depression scores were also associated with increased odds of P-HSU. The effects of maternal health condition and BMI on P-HSU were dependent on the presence of enabling factors, as demonstrated by the significant interaction terms in Table 4.3. As the interpretation of interaction term odds ratios is not straightforward, the odds ratios for the effects of maternal health condition and BMI on P-HSU in subgroups of their effect measure modifiers are presented in Table 4.4.

Analysis of the effect of maternal health condition on P-HSU for each subgroup of maternal parity revealed differences in magnitude and significance levels, indicative that P-HSU by mothers with a health condition was not equitable across subgroups of maternal parity. For example, in mothers with three or more children, having a health condition increased the odds of P-HSU by 2.41 (1.43, 4.05), whereas the odds ratios for having a health condition were lower in magnitude and not significant in other subgroups of parity. Therefore, mothers

with a health condition were more apt to use primary health services if they had three of more children.

Analysis of the effect of obesity on P-HSU for each subgroup of household income and residence resulted in three significant combinations of subgroups, revealing that not all obese mothers had equitable P-HSU. First, in mothers living in rural residences and middle-income households, being obese decreased the odds of P-HSU by 0.26 (0.08, 0.89) compared to not being overweight. Similarly, in mothers living in rural residences and low-income households, the odds of P-HSU in obese mothers were 0.15 (0.04, 0.56) compared to mothers who were not overweight. Therefore, compared to non-overweight mothers, obese mothers were less likely to use primary health services when residing in rural residences and low- or middle-income households. Contrarily, being obese increased the odds of P-HSU by 2.82 (1.61, 4.94) when mothers lived in urban residences and high-income households. These results demonstrate qualitative effect measure modification in that urban and high-income household residence increased obesity's odds on P-HSU while other subgroups of residence and household income reduced obesity's odds on P-HSU.

4.4 Discussion

This multilevel study of maternal P-HSU contributes to a gap in the health services research literature. Beyond health status, enabling factors may influence maternal P-HSU, including characteristics of the context in which mothers reside. Health services research that focuses on the role of context, defined by residential neighbourhoods, may be important to inform health care policy as strategies that consider these contexts may result in place-based action (2). Further, changes in health care policy may be targeted to reduce inequities in P-HSU by identifying subpopulations whose need for P-HSU is modified by predisposing and enabling factors.

Urban/rural residence was an effect measure modifier on the effect of maternal BMI and the only contextual characteristic retained in the final model, which demonstrated significant variance in the odds of maternal P-HSU between residential neighbourhoods. The degree of urbanicity may affect the physical and social structures of geographical environments that in

turn, may contribute to patterns of P-HSU. It has been shown that urban residence is associated with a greater degree of accessibility to primary health services, for example, higher physician density, more flexible hours of operation, transportation options and shorter travel distances (19-22). The effect of urban/rural residence on P-HSU in Canada is mixed in the literature. Some suggest that living in more urban areas is associated with P-HSU (8,10), while others have not reported a significant association (6,9,12). Despite the mixed findings in the literature, residence was found to play a significant role in influencing the effect of maternal BMI on P-HSU in this study, and therefore should be considered as a covariate in future health services research. Should future studies replicate these findings, then health care system stakeholders should be cognizant that P-HSU has the potential to vary according to the geographical environment in which patients reside and that residence may be an important contextual characteristic to consider.

Health service use is defined as equitable when driven by need factors (15). This study contributes to the notion of equity by testing how need factors behave in subgroups of predisposing and enabling factors. Effect measure modification of need factors provides evidence that the effect of need on health service use differs in magnitude, direction and/or significance depending on the subgroup of the effect measure modifier, suggestive of inequitable health service use. Future health services research may consider such interactions as an analytic method to test for inequity in equity studies.

This study found that the effect of maternal health condition on P-HSU varied across subgroups of maternal parity. As an enabling factor, maternal parity may be conceptualized to facilitate P-HSU in opposing ways. First, it may be speculated that lower maternal parity enables P-HSU in that mothers responsible for fewer children have more flexibility in their ability to utilize health services. Contrarily, higher maternal parity may enable P-HSU as maternal-child health service use is highly correlated (23). In this study population, the latter situation may explain the more than doubled effect size of maternal health condition in mothers with three or more children compared to mothers of lower parity however, more research on the role of maternal parity as an effect measure modifier is warranted.

Obese mothers living in rural and either low- or middle-income households may have inequitable P-HSU compared to obese mothers living in urban and high-income households

for a number of reasons. As one author suggests, people may have to invest extra time and money to seek health services which are limited in rural areas (22). This requires taking time off work, securing childcare and arranging for transportation, all of which have financial implications. Mothers with lower household income may also fear financial costs of health care resulting from P-HSU that are not covered by government plans and private insurance, such as prescriptions and treatment from other health care professionals. Therefore, these mothers represent a potentially vulnerable population who may not be receiving the appropriate health care for obesity-related health issues.

While inequity of P-HSU was observed in obese mothers and mothers with a health condition, there was no evidence to suggest that the effect of depression and pregnancy varied across subgroups of predisposing and enabling factors. While this study found that pregnant mothers and mothers with higher depression scores were more likely to use primary health services, there was no evidence to suggest that any of them were disadvantaged in their P-HSU. This indicates that these mothers received health care from primary care providers regardless of predisposing and enabling factors.

It is important to note that P-HSU was based on maternal recall of the past two months, and that this time frame may not represent poor access of P-HSU. Rather, results indicate the existence of inequities in the odds of P-HSU in subgroups of enabling factors over this time period. Future research should explore effect measure modification of need factors on P-HSU captured over a longer time frame to solidify this approach of testing for inequity. The study was limited to mothers from one region in Ontario, and therefore may not be generalizable to mothers elsewhere in Canada. Future work should broaden the geographic area of study to comparatively examine these results with other regions. However, the neighbourhoods defined by the dissemination areas in which mothers resided represented small area profiles that aid in understanding how the associations of contextual characteristics with P-HSU play out (2).

Medical doctors who engage with patients in private practices, walk-in clinics and emergency departments are the gatekeepers to secondary health care services (e.g. hospitalization, medical specialists), and have an integral role in the flow of patients through the Canadian health care system. It is important to understand who are using these services

and why, and whether inequity of use exists. Health services research that focuses on the role of residential location may be important to inform public health policy, as strategies that consider this have the potential to affect whole groups. Examining how need factors behave in certain subgroups of predisposing and enabling factors is an analytic approach to investigate equity of health service use. The identification of subpopulations disadvantaged in their use is important as they may benefit from targeted changes in public health policy. This research may be used as a methodological model for studying health service use in other Canadian populations. Gathering firm evidence from multilevel studies of health service use has the potential to inform Canadian public health policy with regards to inequity and the influence of place of residence on maternal primary health care service use.

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Table 4.1 Descriptive statistics of maternal and contextual characteristics grouped by predisposing, enabling and need factors from a population of mothers living in London-Middlesex

Variable	Categorical: Frequency (%) Continuous: Mean (SD)
Maternal Characteristics	
Predisposing	
Age in years	33.8 (4.80)
Native to Canada	1265/1449 (87.30%)
Education	
high school or less	331/1448 (22.86%)
college or trade	489/1448 (33.77%)
university or more	628/1448 (43.37%)
Survey season	
winter	549/1451 (37.84%)
spring	404/1451 (27.84%)
summer	193/1451 (13.30%)
fall	305/1451 (21.02%)
Enabling	
Household income	
low (<$40,000)	168/1335 (12.58%)
middle ($40,000-79,999)	468/1335 (35.06%)
high ($80,000+)	699/1335 (52.36%)
Employment status	
full time	647/1446 (44.74%)
part time	279/1446 (19.29%)
not working	520/1446 (35.96%)
Marital status	
married or common-law	1317/1449 (90.89%)
single or equivalent	132/1449 (9.11%)
Parity	
1 child	406/1449 (28.02%)
2 children	763/1449 (52.66%)
3 or more children	280/1449 (19.32%)
Access to vehicle	1335/1451 (92.01%)
Has a regular care provider	1384/1451 (95.38%)
Child has a regular care provider	1432/1451 (98.69%)
Need	
Health condition	662/1451 (45.62%)
Pregnant	89/1451 (6.13%)
BMI	
not overweight (<25 kg/m^2)	764/1367 (55.89%)
overweight (25-29.9 kg/m^2)	395/1367 (28.90%)
obese (30+ kg/m^2)	208/1367 (15.22%)
Depression score (CES-D)	8.8 (8.00)
Anxiety score (STAI)	19.2 (5.25)
Contextual Characteristics	
Predisposing	
Neighbourhood % immigrants	19.75 (8.241)
Neighbourhood % visible minority	11.57 (9.919)
Neighbourhood % without high school education	16.59 (7.531)

Variable	Categorical: Frequency (%) Continuous: Mean (SD)
Enabling	
Neighbourhood average income	
<20th percentile	285/1444 (19.74%)
20-80th percentile	869/1444 (60.18%)
>80th percentile	290/1444 (20.08%)
Neighbourhood % unemployed	5.69 (3.868)
Neighbourhood % single parenthood	14.70 (10.357)
Neighbourhood mean # children per household	1.16 (0.253)
Residence	
urban	1305/1451 (89.93%)
rural	146/1451 (10.07%)

Table 4.2 Univariable associations of predisposing, enabling, and need variables considered in multivariable analyses of maternal primary health service use

Variable	Odds Ratio (95% CI)
Maternal Characteristics	
Predisposing	
Age in years	0.96 (0.94, 0.98)[a]
Education *(ref=university or more)*	
high school or less	1.52 (1.16, 2.00)[a]
college or trade	1.31 (1.03, 1.66)[a]
Enabling	
Household income *(ref=high)*	
low	1.24 (0.89, 1.74)
middle	1.21 (0.96, 1.52)[b]
Parity *(ref=1 child)*	
2 children	0.72 (0.56, 0.92)[a]
3 or more children	0.63 (0.46, 0.86)[a]
Has a regular care provider	1.59 (0.96, 2.62)[b]
Child has a regular care provider	2.51 (0.95, 6.65)[b]
Need	
Health condition	1.37 (1.12, 1.69)[a]
Pregnant	3.11 (1.86, 5.18)[a]
BMI (*ref=not overweight)*	
overweight	1.31 (1.03, 1.67)[a]
obese	1.93 (1.41, 2.65)[a]
Depression score (CES-D)	1.03 (1.02, 1.04)[a]
Anxiety score (STAI)	1.03 (1.01, 1.05)[a]
Contextual Characteristics	
Predisposing	
Neighbourhood % immigrants	0.99 (0.98, 1.00)[b]
Enabling	
Neighbourhood mean income (*ref=>80th percentile)*	
<20th percentile	1.25 (0.90, 1.74)[b]
20th–80th percentile	1.28 (0.98, 1.67)[b]
Residence *(ref=rural)*	0.75 (0.53, 1.07)[b]

[a]$p<0.05$; [b]$p<0.20$

Table 4.3 Multilevel characteristics and interaction terms retained in the parsimonious logistic regression model of maternal primary health service use estimated with a random intercept

Variable	OR (95% CI)
Maternal Characteristics	
Enabling	
Parity *(ref=1 child)*	
2 children	0.89 (0.62, 1.28)[b]
3 or more children	0.54 (0.34, 0.86)[a,b]
Household income *(ref=high)*	
low	1.13 (0.68, 1.88)[b]
middle	1.21 (0.87, 1.68)[b]
Need	
Health condition	1.19 (0.77, 1.84)[b]
Pregnant	2.77 (1.60, 4.80)[a]
BMI *(ref=not overweight)*	
overweight	1.34 (0.59, 3.03)[b]
obese	0.48 (0.15, 1.47)[b]
Depression score (CES-D)	1.03 (1.01, 1.04)[a]
Contextual Characteristics	
Enabling	
Residence *(ref=rural)*	0.60 (0.35, 1.03)[b]
Interactions	
Health condition & Parity	2.04 (1.04, 4.01)[a]
*condition*3 or more children*	
BMI & Household income	
*obese*low*	0.31 (0.11, 0.85)[a]
BMI & Residence	
*obese*urban*	5.93 (1.81, 19.47)[a]

[a]$p<0.05$; [b]Variable included in interaction term. Main effect odds ratios do not maintain their usual interpretation, as they are dependent on their effect measure modifier.

Table 4.4 Main effects of maternal need factors in subgroups of their effect measure modifiers

Main Effect	Subgroup	Odds Ratio (95% CI)
Health condition	Parity of 1 child	1.19 (0.77, 1.84)
Health condition	Parity of 2 children	1.11 (0.82, 1.50)
Health condition	Parity of 3 or more children	2.41 (1.43, 4.05)[a]
BMI (ref=not overweight)	Rural & high household income	
overweight		1.34 (0.59, 3.03)
obese		0.48 (0.15, 1.47)
BMI (ref=not overweight)	Rural & middle household income	
overweight		1.25 (0.54, 2.91)
obese		0.26 (0.08, 0.89)[a]
BMI (ref=not overweight)	Rural & low household income	
overweight		1.29 (0.56, 2.98)
obese		0.16 (0.04, 0.56)[a]
BMI (ref=not overweight)	Urban & high household income	
overweight		1.21 (0.84, 1.73)
obese		2.82 (1.61, 4.94)[a]
BMI (ref=not overweight)	Urban & middle household income	
overweight		1.11 (0.74, 1.68)
obese		1.58 (0.94, 2.66)
BMI (ref=not overweight)	Urban & low household income	
overweight		1.55 (0.85, 2.80)
obese		0.94 (0.45, 1.93)

[a]$p<0.05$

Chapter 5

5 Maternal characteristics contribute to inequitable pediatric primary health service use: A cross-sectional study[b]

5.1 Introduction

Early childhood is an important period for children to utilize primary health services, which may foster optimal health and developmental outcomes (1). Understanding the factors that drive pediatric primary health service use may inform healthcare policy and pediatric physicians, to ensure that children receive the appropriate medical care. Further, understanding why certain subgroups of children have inequitable health service use is helpful to reduce disparities and ultimately improve pediatric health and development. Applying a multilevel approach in studying primary health service use, as conceptualized by Andersen's behavioural model (2), may further ameliorate healthcare policy as strategies that consider residential contexts may result in place-based action (3). However, the consideration of contextual characteristics is sparse in health services research (4), notably in pediatric populations.

Andersen's behavioural model conceptualizes factors of health service use into three components: 1) predisposing factors, including socio-demographic characteristics; 2) enabling factors, which facilitate the use of health services and; 3) need factors, often represented by measures of health status (5). Further, these factors may be measured at individual and contextual levels resulting in a multilevel conceptual framework of health service use (2). Andersen's behavioural model may be applied to assess equity of health service use, using the notion that equity exists when use is driven predominantly by need factors (2). A novel method to analytically assess inequity may be to test for effect measure

[b] A version of this chapter is under review with the Journal *BMC Health Services Research*.

modification of need factors. If the effect of need does not behave the same for all members of the population then it is proposed that health service use is inequitable.

To investigate the effect of residential context on primary health service use by an Ontario pediatric population, two hypotheses were tested: 1) The odds of primary health service use vary across the neighborhoods in which children reside; and 2) residential contextual characteristics conceptualized within the framework of Andersen's behavioural model are associated with primary health service use. It may be speculated that health service use is equitable in populations with universal health care systems however, this has not always been reported (6). Therefore, a third hypothesis was tested to investigate inequity: 3) the effects of need factors on primary health service use vary depending on subgroups of predisposing and enabling factors. This article reports on the analyses of these hypotheses and conclusions drawn from results.

5.2 Methods

This is a cross-sectional study on a sample of children of mothers who participated in a larger cohort study, approved by the research ethics board at Western University, London, Canada. The cohort study recruited pregnant women from seven of ten ultrasound clinics in the city of London, Ontario, Canada from 2002 to 2004. The inclusion criteria at recruitment were: residence in the London-Middlesex region of Ontario, singleton pregnancy, maternal age of at least 16 years, gestational age 11.5-20.5 weeks, no known foetal abnormalities and adequate knowledge of English. Mothers were interviewed at prenatal, perinatal (N=2357) and toddler/preschooler stages (N=1607). Individual-level data (i.e. child and maternal characteristics) from the cohort completing the toddler/preschooler stage were linked by residential address to a second dataset sourced from Statistics Canada (2006) that included contextual characteristics of the neighbourhoods in which children resided. After dataset linkage and removal of participants no longer living in the London-Middlesex region, the final study sample included 1451 children residing in 471 neighbourhoods.

Individual maternal and child characteristics were collected during the toddler/preschooler stage survey, with the exception of maternal nativity and education which were captured prenatally, and child birth data at the perinatal stage. The contextual characteristics of the neighbourhoods in which children resided were measured at the dissemination area level, the smallest geographical unit provided by Statistics Canada. Descriptions of individual- and contextual-level characteristics, grouped by predisposing, enabling and need factors, are presented in Table 5.1.

Primary health service use was defined as at least one visit to children's regular care provider (i.e. family physician, pediatrician), walk-in clinic or emergency department, all of which are first-line contacts with the Canadian healthcare system. During the toddler/preschooler stage interview, children's primary health service use over the past two months was captured by maternal recall, and dichotomized as use versus no use.

Analyses were performed using the statistical software package SAS®9.2 (SAS, Windows build 9.2, SAS Institute Inc., Cary, NC, USA). Descriptive analyses were performed on individual and contextual characteristics. Univariable associations of primary health service use with independent variables were performed using logistic regression, where associations with $p<0.20$ were considered in multivariable analyses. The multivariable logistic model was estimated using the glimmix procedure, allowing for estimation of a random intercept to test the variance in primary health service use across neighbourhoods. Further, a conservative level of significance ($p<0.20$) was applied during model building. Individual characteristics were added as fixed effects to the random intercept model. Contextual characteristics were added to the model if significant variance in primary health service use existed across neighbourhoods after accounting for individual characteristics. The final stage of model building tested for effect measure modification by including interactions of need factors with predisposing and enabling factors. To achieve a final parsimonious model, variables whose odds ratios were not significant ($p\geq0.05$) were removed from the model one at a time.

5.3 Results

In the two months prior to survey administration, 48.9% of children had used a primary health service. Descriptive statistics of the factors conceptualized to influence primary health service use are presented in Table 1. Several were significant in univariable analyses with primary health service use ($p<0.20$) and considered in multivariable analyses (Table 5.2).

Results from the multivariable model building process are shown in Table 5.3. After controlling for individual characteristics, there was no significant variance of primary health service use across neighbourhoods ($p=0.29$). Hence, contextual characteristics were not included in the multivariable model and the model was re-estimated with a fixed intercept using the logistic procedure. The final model revealed that the odds of pediatric primary health service use increased with younger child age, low household income and maternal full-time employment. Further, the effect of child health condition was dependent on both maternal parity and nativity to Canada.

The main effects of child health condition, maternal parity and maternal nativity to Canada in subgroups of their effect measure modifiers are shown in Table 5.4. A dose-response relationship existed for the effect of child health condition in subgroups of maternal parity, but only reached statistical significance for children whose mothers were Canadian-born. In these children, the effect of child health condition increased the odds of primary health service use by 1.58 (95% CI 1.02, 2.44) for the subgroup of children whose mothers had one child only, further increased the odds by 2.86 (95% CI 2.08, 3.95) for the subgroup of children whose mothers had two children, and increased the odds by 3.53 (95% CI 2.08, 5.99) for the subgroup of children whose mothers had three or more children. The main effect of maternal parity on pediatric primary health service use revealed reduced odds as parity increased, but only for children without a health condition.

5.4 Discussion

There was no evidence to support neighbourhood variation of primary health service use in this pediatric population, suggesting that contextual characteristics of the neighbourhoods in which children reside are not influential in their utilization behaviours. While similar null

findings have been reported (7), several have found certain contextual characteristics to be associated with pediatric primary health service use (6,8-12). For example, children residing in urban contexts (11), and areas with higher physician supply (8,10), have experienced increased service use, and inequity in primary care geographic access has been observed (12). Neighbourhood mean income has also been associated with pediatric primary health service use, but variations in its effect have been observed (6,8,9). Children residing in neighbourhoods with lower mean income have experienced reduced regular care provider use (8), but increased general practitioner use (9), and emergency department use (6). In this study, children residing in lower mean income neighbourhoods had a tendency to experience increased primary health service use based on univariable analyses, but this variable was not included in multivariable analyses because of the lack of variation in primary health service use across neighbourhoods.

There may be several reasons why no variation in primary health service use was found across neighbourhoods. First, the study population was limited to one region of Ontario and perhaps neighbourhoods were homogenous in this area. Neighbourhoods were defined by dissemination area resulting in small geographic areas, which have been shown to lead to stronger contextual effect estimates (9,13,14). However, doing so resulted in several hundred artificial neighbourhoods with few children residing in each, which may inflate standard errors perhaps masking significant findings (15). Further, previous literature has found contextual characteristics to be associated with specific types of primary health services, e.g. regular care provider, emergency department, as opposed to primary health services as a composite measure.

Inequitable primary health service use was evident from significant interaction terms of child health condition with both maternal nativity to Canada and parity. In subgroups of maternal parity, the magnitude of health condition's effect increased as maternal parity increased. Further, the effect of health condition was greater in magnitude in children of Canadian-born mothers compared to children of mothers who had migrated to Canada, although the latter effect did not reach statistical significance. These results suggest that children with a health condition whose mothers were of lower parity and not Canadian-born had experienced inequitable primary health service use, because their odds of service use were lower in

magnitude compared to children with a health condition whose mothers were of higher parity and Canadian-born.

Maternal parity was conceptualized as an enabling factor in that mothers of lower parity would have fewer barriers in using health services for their child. Speculatively, they may not have to secure childcare for other children and have more time to focus on their child's health. Hence, it was surprising that lower parity reduced the effect of health condition, resulting in potential inequity. Perhaps the finding is a consequence of health condition severity and/or acuity in children of mothers with higher parity, since poorer health has been observed in larger-sized families (16). The finding that inequity for children of mothers not born in Canada was consistent with reports of increased difficulties accessing first-contact health services for immigrants compared to Canadian-born (17).

The consideration of effect measure modification in health services research may prove beneficial in enhancing the understanding of factors that drive health service use. The presence of significant interaction terms affects the way in which its covariates are interpreted and how they may be investigated in future studies. Factors may not be associated with the outcome but as effect measure modifiers, they may alter study findings in important ways. For example, the main effect of maternal nativity was not significant even in univariable analyses however, was found to significantly modify the association between child health condition and primary health service use. Likewise, prior to testing for effect measure modification, the effect of three children or more reduced the odds of health service use. However, after testing for effect measure modification, the effect of two children or more reduced the odds of health service use, but only in children without a health condition. In testing the study's third hypothesis, effect measure modification showed potential as an analytic method to assess inequity of health service use, since the effect of children's need for health care varied depending on maternal characteristics.

5.5 Conclusion

This study improves the understanding of pediatric primary health service use, in particular, how maternal characteristics may influence the effect of children's need for primary health

services. Subgroups of children who were potentially disadvantaged in their use of primary health services were identified, warranting further study, which may inform pediatric healthcare policy and practice. Analytic methods of this study may be adopted in future health services research to identify important nuances that may arise in subpopulations of the population of interest.

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Table 5.1 Descriptive statistics of individual and contextual characteristics of children living in London-Middlesex, Ontario

Variable	Categorical: Frequency (%) Continuous: Mean (SD)
Individual Characteristics	
Predisposing Factors	
Maternal age in years	33.8 (4.8)
Child age in months	34.1 (5.6)
Child sex	
female	725/1448 (50.1%)
male	723/1448 (49.9%)
Mother born in Canada	1265/1449 (87.3%)
Maternal education	
high school or less	331/1448 (22.9%)
college or trade	489/1448 (33.8%)
university or more	628/1448 (43.4%)
Survey season	
winter	549/1451 (37.8%)
spring	404/1451 (27.8%)
summer	193/1451 (13.3%)
fall	305/1451 (21.0%)
Enabling Factors	
Household income	
low (<$40,000)	168/1335 (12.6%)
middle ($40,000-79,999)	468/1335 (35.1%)
high ($80,000+)	699/1335 (52.4%)
Maternal employment status	
full time	647/1446 (44.7%)
part time	279/1446 (19.3%)
not working	520/1446 (36.0%)
Maternal marital status	
married or common-law	1317/1449 (90.9%)
single or equivalent	132/1449 (9.1%)
Maternal parity	
1 child	406/1449 (28.0%)
2 children	763/1449 (52.7%)
3 or more children	280/1449 (19.3%)
Mother has access to vehicle	1335/1451 (92.0%)
Mother has a regular care provider	1384/1451 (95.4%)
Child has a regular care provider	1432/1451 (98.7%)
Need Factors	
Mother has health condition	662/1451 (45.6%)
Maternal depression score (CES-D)	8.8 (8.0)
Maternal anxiety score (STAI)	19.2 (5.3)
Child gestational age in weeks	39.0 (1.7)
Child size for gestational age	
small	91/1444 (6.3%)
appropriate	1172/1444 (81.2%)
large	181/1444 (12.5%)
Child born with anomaly	67/1451 (4.6%)
Child has development/behaviour condition	203/1451 (14.00%)
Child has physical health condition	906/1451 (62.4%)

Variable	Categorical: Frequency (%) Continuous: Mean (SD)
Contextual Characteristics	
Predisposing Factors	
Neighbourhood % immigrants	19.8 (8.2)
Neighbourhood % visible minority	11.6 (9.9)
Neighbourhood % without high school education	16.6 (7.5)
Enabling Factors	
Neighbourhood average income	
<20th percentile	285/1444 (19.7%)
20-80th percentile	869/1444 (60.2%)
>80th percentile	290/144 (20.1%)
Neighbourhood % unemployed	5.7 (3.9)
Neighbourhood % single parenthood	14.7 (10.4)
Neighbourhood mean # children per household	1.2 (0.25)
Residence	
urban	1306/1452 (89.9%)
rural	146/1452 (10.1%)

Table 5.2 Univariable associations of predisposing, enabling, and need variables with pediatric primary health service use

Variable	Odds Ratio (95% CI)
Individual Characteristics	
Predisposing	
Maternal age	0.98 (0.96, 1.00)[a]
Child age	0.97 (0.95, 0.99)[a]
Child sex *(ref=female)*	1.16 (0.95, 1.43)[b]
Survey season *(ref=winter)*	
spring	0.83 (0.64, 1.07)[b]
summer	0.73 (0.53, 1.02)[b]
fall	0.82 (0.62, 1.08)[b]
Enabling	
Household income *(ref=high)*	
low	1.50 (1.07, 2.09)[a]
middle	1.16 (0.92, 1.46)
Maternal employment *(ref=full time)*	
part time	0.73 (0.55, 0.97)[a]
not working	0.81 (0.64, 1.02)[b]
Maternal parity *(ref=1 child)*	
2 children	0.75 (0.59, 0.95)[a]
3 or more children	0.57 (0.42, 0.78)[a]
Need	
Maternal anxiety (STAI)	1.02 (1.00, 1.04)[a]
Child has physical condition	2.38 (1.91, 2.97)[a]
Contextual Characteristics	
Enabling	
Neighbourhood mean income *(ref=>80th percentile)*	
<20th percentile	1.38 (0.99, 1.91)[b]
20th – 80th percentile	1.28 (0.98, 1.67)[b]
Neighbourhood % lone parenthood	1.01 (1.00, 1.02)[b]

[a]$p<0.05$; [b]$p<0.20$

Table 5.3 Variables associated with pediatric primary health service use through stages of multivariable logistic modeling

Variable	OR (95% CI)[c]	OR (95% CI)[c]	OR (95% CI)[d]
		Individual Characteristics	
Predisposing			
Child age	0.97 (0.95, 0.99)[a]	0.97 (0.95, 0.989)[a]	0.97 (0.95, 0.99)[a]
Child sex *(ref=female)*			
male	1.16 (0.93, 1.44)[b]	--	--
Season *(ref=winter)*			
spring	0.87 (0.67, 1.14)	--	--
summer	0.82 (0.58, 1.16)	--	--
fall	0.76 (0.57, 1.03)[b]	--	--
Maternal nativity *(ref=not born in Canada)*			
born in Canada	--	0.62 (0.39, 1.00)[a,e]	0.63 (0.39, 1.00)[b,e]
Enabling			
Household income *(ref=high)*			
low	1.61 (1.13, 2.31)[a]	1.61 (1.13, 2.31)[a]	1.60 (1.12, 2.29)[a]
middle	1.23 (0.97, 1.56)[b]	1.21 (0.95, 1.54)[b]	1.20 (0.95, 1.53)[b]
Maternal employment *(ref=full time)*			
part time	0.71 (0.52, 0.96)[a]	0.69 (0.51, 0.93)[a]	0.69 (0.51, 0.94)[a]
not working	0.83 (0.65, 1.07)[b]	0.83 (0.65, 1.07)[b]	0.84 (0.65, 1.07)[b]
Maternal parity *(ref=1 child)*			
2 children	0.89 (0.69, 1.16)	0.58 (0.38, 0.90)[a,e]	0.58 (0.38, 0.90)[a,e]
3 or more children	0.67 (0.48, 0.92)[a]	0.37 (0.21, 0.65)[a,e]	0.38 (0.22, 0.66)[a,e]
Need			
Child has physical health condition	2.27 (1.81, 2.85)[a]	0.73 (0.36, 1.48)[e]	0.74 (0.37, 1.48)[e]
		Interactions	
Child health condition & Maternal parity			
*condition*2 children*	--	1.87 (1.10, 3.17)[a]	1.86 (1.10, 3.13)[a]
*condition*3 or more children*	--	2.36 (1.19, 4.67)[a]	2.32 (1.18, 4.56)[a]
Child health condition & Maternal nativity			
*condition*born in Canada*	--	2.15 (1.13, 4.09)[a]	2.14 (1.13, 4.04)[a]

[a]$p<0.05$; [b]$p<0.20$; [c]Model estimated with a random intercept using the glimmix procedure; [d]Model estimated with a fixed intercept using the logistic procedure;
[e]Variable included in interaction term. Main effect odds ratios do not maintain their usual interpretation, as they are dependent on their effect measure modifier.

Table 5.4 Variable main effects on pediatric primary health service use in subgroups of effect measure modifiers

Main effect	Effect Measure Modifier Subgroup	Odds Ratio (95% CI)
Child health condition	Mother born in Canada & parity 1 child	1.58 (1.02, 2.44)[a]
Child health condition	Mother born in Canada & parity 2 children	2.86 (2.08, 3.95)[a]
Child health condition	Mother born in Canada & parity 3 or more children	3.53 (2.08, 5.99)[a]
Child health condition	Mother not born in Canada & parity 1 child	0.74 (0.37, 1.48)
Child health condition	Mother not born in Canada & parity 2 children	1.34 (0.72, 2.48)
Child health condition	Mother not born in Canada & parity 3 or more children	1.65 (0.77, 3.51)
Maternal parity *(ref=1 child)*		
2 children	No health condition	0.58 (0.38, 0.90)[a]
3 or more children	No health condition	0.38 (0.22, 0.66)[a]
Maternal parity *(ref=1 child)*		
2 children	Has health condition	1.08 (0.79, 1.48)
3 or more children	Has health condition	0.88 (0.59, 1.31)
Mother born in Canada	No health condition	0.63 (0.31, 1.00)
Mother born in Canada	Has health condition	1.34 (0.87, 2.07)

[a]$p<0.05$

Chapter 6

6 Perceived unmet healthcare need in an Ontario population of mothers and children

6.1 Introduction

Health services research explores several concepts including health service use, equity, and unmet healthcare needs. Earlier chapters in this thesis explored primary health service use (P-HSU) and equity. In this chapter, perceived unmet healthcare need will be discussed, with an example developed from the cohort studied in Chapters 4 and 5. As presented in earlier chapters, one viewpoint of health service use equity derives from Andersen's behavioural model of health service use. Andersen's behavioural model incorporates predisposing, enabling, and need factors to explain health service use, and defines use to equitable when driven predominantly by need factors (1).

Unmet need for healthcare is a construct that is distinct from equity. Health professionals may evaluate unmet healthcare need as the absence of or inadequate use of health services deemed necessary for a particular health problem (2). However, studies of unmet healthcare need more often measure perceived or self-reported unmet healthcare need, defined as "perceived healthcare need for which care is not provided" (3). This perceived unmet healthcare need, defined from the patient's point of view, reflects a myriad of things including need identification, utilization, and expectations of health services (4).

Although equity and perceived unmet healthcare need are distinct concepts in health services research, similar factors in Andersen's model may be explanatory of both phenomena. For example, it is speculated that income is associated with both inequity and perceived unmet healthcare need because of accessibility problems (5). After accounting for need factors, those with poor income have reduced odds of using primary health services (6-8), indicating that health service use is not equitable as a result of income status. Further, the prevalence of self-reported unmet need for health services is greater in people with poorer household

incomes (9,10), and studies using multivariable analyses found low income to be associated with self-reported unmet healthcare needs (5,11).

As previously defined, health service use is evaluated to be equitable when it occurs in the presence of a need factor, in which the need factor represents a health status requiring medical attention (1). However, a population with inequitable health service use may not report any perceived unmet healthcare need, and vice-versa. An example of health status and education in two scenarios is presented to illustrate this concept. In the first scenario, suppose a population has a low education level, is in poor health, and has not used health services. Even in the presence of poor health, a need factor requiring medical attention, this population's low education status may impede their perception to seek healthcare. Hence, this population would have inequitable health service use, but no perceived unmet healthcare need. Conversely, suppose in the second scenario a population has a high education level, is in good health, and has not used health services. This population has equitable health service use because they do not have a need factor requiring medical attention. Although in good health, this population may still report perceived unmet healthcare needs perhaps for reasons unrelated to health status (e.g. preventative medical exams). As the previous scenarios demonstrate, the assessment of perceived unmet healthcare need is subjective, therefore has the potential to detect perceived need for healthcare that is not clinically grounded and irrespective of clinical evaluation (5). As one author states, a "patient is the best judge of his/her health status and whether he/she has received appropriate health care" (5). Therefore, the measurement of perceived unmet healthcare need may enhance studies of health service equity.

A review of the current approach of measuring perceived unmet healthcare need is presented in the next section.

6.2 Perceived unmet healthcare need

Perceived unmet healthcare need has been defined as "the difference between services judged [by the individual] necessary to deal effectively with a health problem and services actually received" (12). This perception of unmet need, often captured by self-report, differs from the

evaluated counterpart for two main reasons. First, people may have varying perceptions on whether they require healthcare, independent of their health status which is captured as a need factor in Andersen's model (13). Second, assuming that health service use is an accurate measure of meeting healthcare needs does not provide any specific information on the experiences of services actually received (14). It is important to consider the quality of health services received as perceived unmet healthcare need may arise from personal circumstances of those using the healthcare system (2).

Several studies have examined perceived unmet healthcare need in Canadian populations. The measurements of perceived unmet healthcare need in these studies are summarized in Tables 6.1 – 6.3. Most of these use data collected by Statistics Canada, either through the National Population Health Survey (NHPS) or the Canadian Community Health Survey (CCHS). Both surveys asked participants: "During the past 12 months, was there ever a time when you felt that you needed health care but you didn't receive it?" If participants answered with an affirmative response, they were prompted to answer follow-up questions on why health care was not received, and the type of care not received.

Sanmartin et al. (2002) documented changes in perceived unmet healthcare need using data from three cycles of the NPHS (1994 to1999) and part of the first cycle of the CCHS (2000/01) (2). The prevalence of perceived unmet healthcare need was estimated from a dichotomous measure, and reasons for perceived unmet healthcare need and types of care needed were summarized. Similarly, Chen and Hou (2002) and Wilson and Rosenberg (2004) used the same three cycles of NPHS data to examine perceived unmet healthcare need, including reasons for perceived unmet healthcare need (9,10). Chen and Hou (2002) further classified reasons for perceived unmet healthcare need as: service availability (waiting time too long; not available when required; not available in area), accessibility (cost; transportation), and acceptability (too busy; didn't get around to it/didn't bother; felt it would be inadequate; decided not to seek care; didn't know where to go; dislikes doctors/afraid; personal/family responsibilities; language problems; other) (9). Further, Sibley and Glazier (2009) examined reasons for perceived unmet healthcare need across Canada by using the dichotomous measure of perceived unmet healthcare need from the second cycle of the CCHS (2002/03), and categorized reasons based on work by Chen and Hou (2002) (9,15).

Some authors have examined perceived unmet healthcare need in specific populations. Setia et al. (2011) investigated the effect of immigrant status on perceived unmet healthcare need over thirteen years using a dichotomous measure from the NPHS and CCHS data (16). Similarly, Wu et al. (2005) investigated perceived unmet healthcare needs in immigrant and non-immigrant Canadian populations, and further categorized type of care not received as: unmet physical need; unmet emotional or mental need; insufficient general practitioner examinations; insufficient injury treatment; and other (17). Studies have also used the CCHS' dichotomous measure of perceived unmet healthcare need to study the effect of young age and sexual orientation on perceived unmet healthcare need (18,19).

Perceived unmet healthcare need may also be examined within the context of specific health conditions. For example, perceived unmet healthcare need in people with chronic condition has been explored using data from three cycles of the CCHS (2000 to 2005) (20,21). Reasons for perceived unmet healthcare need were modified from Chen and Hou (2002) as: accessibility (cost; transportation), availability (waiting time too long; care not available when requested; care not available in area), acceptability (dislike doctor/afraid; language problems; didn't know where to go), and personal choice (too busy; didn't get around to it/didn't bother; felt it would be inadequate; decided not to seek care; personal/family responsibilities) (9,20,21).

Further, two studies examined perceived unmet mental healthcare needs using the following question from the second cycle of the CCHS (2002/03): "During the past 12 months, was there ever a time when you felt that you needed help for your emotions, mental health or use of alcohol or drugs, but you didn't receive it"? (14,22). Participants who reported an unmet mental healthcare need were then asked about reasons for not getting help. Similar to Chen and Hou (2002), Nelson and Park (2006) classified reasons as barriers to: accessibility (couldn't afford; problems with transportation, childcare, scheduling; language problems; personal/family responsibilities), acceptability (preferred to manage oneself; didn't think anything more could help; didn't know where to go; afraid to ask help; didn't get around to it/didn't bother), and availability (processional unavailable in area; professional unavailable when required; waiting time too long) (9,14).

In their study of the provision of mental health care services for people with major mental disorders, Sunderland and Findlay (2013) recognized that "not all persons with diagnosed [need] will perceive a need for treatment, and not all persons who perceive they have a need for [healthcare] will seek care" (23). Using the Mental Health portion of the 2012 CCHS, participants were asked if they had received a mental healthcare services in the previous 12 months, and if they felt they had received enough. The authors created a four-level need status variable as: no need; unmet need (did not receive help but perceived a need for it); partially met (received help but perceived a need for more); and met need (received help and did not perceive a need for more) (23).

Studies of perceived unmet healthcare need in Canada have utilized data other than from the NPHS and CCHS nation-wide surveys. For example, Levesque et al. (2008) assessed perceived unmet healthcare needs in two Quebec communities using a telephone survey conducted in 2005 (13). This survey documented health service utilization including the characteristics and results of services. Participants who reported an unmet healthcare need were asked about the nature of their problem, which was categorized as: perceived as threat to health; painful; perceived as causing complications; and perceived as limiting activities. Further, Bryant et al. (2009) surveyed three cities to investigate perceived unmet healthcare needs of urban British Columbia residents by using a dichotomous measure (3). Structured interviews have also been conducted, assessing self-reported unmet healthcare need by homeless adults in several major Canadian cities (24,25). Although the aforementioned are examples of studies focused on specific regions of Canada, they assessed perceived unmet healthcare need using similar definitions used in national surveys including the NPHS and CCHS.

Similar to Canada, several American studies have used data from nation-wide surveys to investigate perceived unmet healthcare needs. For example, Pagan and Pauly (2006) used the 2000-2001 Community Tracking Study Household Survey (CTSHS) (26). They estimated the prevalence of perceived unmet healthcare need from the CTSHS' question: "During the past 12 months was there anytime that you didn't get the medical care you needed?" Cunningham and Hadley (2007) used the same question from the 2003 CTSHS in conjunction with a measure of perceived unmet healthcare need for specific symptoms that could warrant healthcare use (27). From this, the authors were able to construct measures for

general perceived unmet healthcare need and perceived unmet healthcare need for a specific symptom.

More recently, the 2007 Health Tracking Household Survey was used to estimate the prevalence of perceived unmet healthcare need from two questions: “During the past 12 months, was there any time when you didn’t get the medical care you needed” and; “Was there any time during the past 12 months when you put off or postponed getting medical care you thought you needed?” (28). Reasons for not getting or delaying healthcare were assigned to one of five categories in the Penchansky and Thomas model of access to care: affordability, accommodation, availability, accessibility, and acceptability (29).

Another nation-wide survey the National Health Interview Study (NHIS), conducted by the National Center for Health Statistics at the Center for Disease Control, includes several questions related to perceived unmet healthcare needs. Hoilette et al. (2009) used data from 1998 to 2006 to create a composite variable of perceived unmet healthcare need relating to prescription medicines, mental health, dental, and eye care and categorized it as any unmet medical need versus none (30). Perceived unmet mental healthcare need because of financial difficulties has also been assessed using NHIS data (31).

Researchers in both Canada and the United States often use nation-wide surveys to examine perceived unmet healthcare need, and its measurement is similar across studies. Studies that do not use nation-wide surveys adopted similar questions as the nation-wide surveys in their measurement of perceived unmet healthcare need. Most studies use a dichotomous measure of perceived unmet healthcare need, approximately half describe the reasons, and few explore the type of care not received for people’s perceived needs.

6.3 Perceived unmet primary healthcare need in the Prenatal Health Project cohort

In Chapters 4 and 5, P-HSU was found to be inequitable in a cohort of mothers and children residing in London-Middlesex, Ontario. However, as developed earlier in this chapter, perceived unmet healthcare need is a different issue than equity. Accordingly, this section describes perceived unmet healthcare need in this maternal-child population previously

observed to have inequitable P-HSU. In section 6.4, this example is put into the context of the usefulness of various measures of perceived unmet healthcare need.

The study population was mother-child pairs from the Prenatal Health Project (PHP), a cohort study that recruited women while pregnant from seven of ten ultrasound clinics in London, Ontario, and has previously been described. Perceived unmet need for health services was measured in two ways, based on maternal report during the toddler-preschooler stage interview.

First, mothers were asked “Have you had any difficulties accessing available services due to limited hours of operation, long wait time for an appointment, unable to get an appointment, transportation problems, childcare needed, or any other difficulties?”. Other questions prompted mothers to specify the service they were unable to access. In a prior analysis of these data, mother-child pairs were classified as having a perceived unmet healthcare need when mothers specified having difficulties accessing any healthcare service, for themselves or their child (32). The current analyses repeated the earlier analyses, but restricts the estimate of perceived unmet healthcare need to primary health services provided by regular care providers (family physician or pediatrician), walk-in clinics, or emergency departments. The frequency of and reasons for perceived unmet primary healthcare need in mother-child pairs were described. Data on perceived unmet healthcare need for primary health services was available for 1600 mother-child pairs (missing=7). Based on maternal report, 15.1% mother-child pairs were classified as having a perceived unmet need for primary health services. Reasons for perceived unmet healthcare needs are presented in Table 6.4. The most common reason for perceived unmet healthcare need was wait time for an appointment. Hours of operation and unable to get an appointment were also commonly cited reasons for perceived unmet need for primary health services. The majority of mothers reported only one reason for perceived unmet need, however 34 reported two reasons, seven reported three reasons, and one mother reported five reasons.

The second measure was from Liberatos’ symptoms-based measure of unmet healthcare need, and was used to assess mothers’ perceptions of unmet healthcare needs for their children (33). This measurement tool consists of three questions posed to mothers, each asked with regards to eight pediatric symptoms. The three questions are: 1) “At any time in

the past week, did your child seem to have [symptom]? (If no, skip)"; 2) "Did you call or visit a health professional regarding this?"; and 3) "Did you feel you needed to call or visit a health professional but were unable to?" The frequency of perceived unmet healthcare need in children assessed by this tool was reported by a former graduate student and is reprinted, with permission, in Appendix I.1. (32).

In addition, chi-square tests compared the prevalence of maternal-reported unmet primary healthcare need between subgroups of children and mothers identified to have inequitable P-HSU. For example, in Chapter 4, mothers with a health condition and three or more children were identified to have greater odds of P-HSU than mothers with a health condition and one or two children. Hence, P-HSU was inequitable for mothers with a health condition across subgroups of maternal parity. The prevalence of perceived primary unmet healthcare need in those mothers with one or two children was 15.7% and, in those mothers with three or more children was 12.9%, but these estimates were not significantly different from one another ($p=0.42$). Table 6.5 presents the remaining prevalence comparisons of perceived primary unmet healthcare need between subgroups in which inequitable P-HSU was observed. None of the prevalence estimates were significantly different from one another ($p<0.05$).

In summary, the PHP cohort was previously found to have inequitable P-HSU. In this cohort, 15.1% of mother-child pairs' perceived needs were unmet by primary health services, and 11.2% of children had a perceived unmet healthcare need for at least one of eight specific symptoms. Generally, the prevalence of perceived unmet healthcare need in this population was higher in comparison to studies of other Canadian populations. Studies that used data from the first three cycles of the NPHS (1994 to 1999) found that 4.2% to 6.6% of Canadians reported a perceived unmet healthcare need (2,9,10). Studies using the CCHS data after 2000 have found the prevalence of perceived unmet healthcare need in Canada to be between 11.7% and 12.5%, and increased to 13.6% in one non-immigrant population (15,17,34). The prevalence of perceived unmet healthcare need may be higher in the PHP cohort compared to the literature because research consistently demonstrates that women report more unmet need than their male counterparts (2,3,10,13,14,18). Also, when measuring the prevalence of unmet need for primary health services, mothers reported for both themselves and their children. It is speculated that the prevalence of perceived unmet need is higher than reports in the literature because it accounts for both maternal and child needs. It should be noted that,

perceived unmet healthcare need in mother-child pairs was limited to primary health services whereas most other studies included unmet need for any healthcare.

Regardless of how the prevalence of perceived unmet healthcare need in this cohort of mothers and children compares to the literature, an important consideration is the relevancy of the unmet need being described. Policy makers may benefit from knowing whether the prevalence of unmet need is acceptable and the details of that unmet need. The following section discusses the strength and limitations of how perceived unmet healthcare need is currently measured by health services researchers.

6.4 Discussion

6.4.1 Prevalence

To measure the prevalence of perceived unmet healthcare need, researchers should ensure that both the denominator and numerator are appropriate. Recalling that perceived unmet healthcare need is when a perceived need is not met by health services then measurement of its prevalence should be restricted to those who perceive a need. That is, the denominator should be the population with a perceived need, and the numerator should be the subpopulation whose needs were not met. It is important to note that including people in the denominator who do not perceive a need for healthcare would underestimate the true prevalence of perceived unmet healthcare need.

In the PHP cohort, 242 mothers reported having difficulties accessing primary health services. This numerator represents those that needed to use healthcare but had troubles doing so. The denominator (n=1600) captures those 242 mothers in addition to the 1358 mothers who answered ‘no’. It is possible that these 1358 mothers answered ‘no’ for two reasons: 1) They had a need for healthcare but did not have any difficulty accessing services; and 2) they had no need for healthcare. In this case, the denominator may include people without a perceived need for healthcare and so the estimate from this study underestimates the true prevalence of mother-child pair perceived unmet need for primary health services.

Researchers, who use data from the NPHS and CCHS, as well as the CTSHS and NHIS conducted in the United States, face a similar problem in estimating the prevalence of perceived unmet healthcare need. All of these surveys assess perceived unmet healthcare need by using a double-barreled question, such as, "… was there ever a time you felt that you needed health care [first question], but you didn't receive it [second question]?" The first question is whether the participants needed healthcare, and the second question is whether they received that healthcare. Similar to the question posed to mothers in the PHP cohort, the participants who answer "yes" have an *unmet need*, and those who answer "no" may have either *no need* or they have a *need that was met*. It is therefore proposed that the estimates of perceived unmet healthcare need that utilize data of this nature are underestimated.

Limitations may also exist when estimating the prevalence of perceived unmet healthcare need using the Liberatos measure of unmet healthcare need. Its first question evaluates whether children have experienced a symptom, hence a need factor. If so, mothers are prompted to answer the second and third questions, which are listed in the section 6.3 and in Appendix I. When asked whether they called or visited a health professional regarding the symptom, an affirmative answer indicates that the mother perceived the symptom as a need requiring healthcare, and that the need was met [need met]. Answering "no" to this question could mean one of two things: 1) the mother did not perceive the symptom as a need requiring healthcare [no need]; or 2) the mother perceived the symptom as a need requiring healthcare, but was unable to call or visit a health professional regarding it [need unmet]. When asked the third question, an affirmative answer indicates that the mother perceived the symptom as a need requiring healthcare but was unable to call or visit a health professional [unmet need]. However, answering 'no' could mean one of two things: 1) the mother did not perceive the symptom as a need requiring healthcare [no need], or 2) the mother perceived the symptom as a need requiring healthcare, but that need was met [met need]. Therefore, the true nature of those answering "no" to questions 2 and 3 of the Liberatos measure is unknown.

Because of this, the prevalence of perceived unmet healthcare need is estimated as the proportion of mothers answering "yes" to question 3 [unmet need] out of those answering "yes" to question 3 [unmet need] and question 2 [need met]. This estimation appropriately does not include those who do not perceive a need for healthcare in the denominator.

However, an answer of “no” to questions 2 and 3 may have multiple interpretations, and distinguishing them is only possible in theory (as outlined in previous paragraph). Hence, the proportion that is calculated to estimate perceived unmet healthcare need omits a portion of people with unmet need and a portion of people with met need. A summary of the theoretical interpretations from responses of Liberatos measure is presented in Appendix I.2.

In general, the use of double-barreled questions in nation-wide surveys including the NPHS and CCHS, and in several other studies including this one, does not allow for those with no perceived need to be identified. This underestimates the prevalence of perceived unmet healthcare need in the current health services research.

6.4.2 Quality of healthcare

Data often used in studies of perceived unmet healthcare need do not account for the quality of health services received. For example, if a mother reported contacting a health professional regarding a symptom from the Liberatos measure, then it is assumed that her child’s need was met. Moreover, the Liberatos measure refers to needs being met by calling or visiting a health professional. Having called a health professional may be a wrongful assumption that children’s healthcare needs were met. Perhaps a mother called a health professional, but was unable to actually use that health service. Further, some groups of people may report an unmet healthcare need for several reasons, including not receiving care in a timely manner. Therefore, the measurement of perceived unmet healthcare need may be limited because people who report unmet healthcare need for reasons related to quality cannot be distinguished from those who did not receive healthcare at all (2). Assessing the quality of healthcare received, as a component in the measurement in perceived unmet healthcare need may be beneficial in teasing apart subgroups with different expectations of those health services.

6.4.3 Reason for perceived unmet healthcare need

Several surveys have captured the reasons for perceived unmet healthcare need. Among these are the Canadian NPHS and CCHS. Many studies further classify reasons into categories of accessibility, availability, and acceptability (9,14,15,20,21). These classifications stem from Penchansky and Thomas' model of access to care, which includes categories of affordability, accommodation, availability, accessibility, and acceptability (29).

Fewer, but similar reasons for perceived unmet healthcare need were described in the PHP cohort. Wait time for appointment, hours of operation, and unable to get appointment could be classified as healthcare availability issues, and transportation problems as an accessibility issue. Common other reasons were identified as service not available, service location, and wait time, which are all specifically asked about in nation-wide surveys and classified as healthcare availability issues (9,15,20,21).

Just as Andersen's behavioural model is widely applied by health services researchers in the investigation of health service utilization, several health services researchers apply Penchansky and Thomas' model of access to care when studying unmet healthcare need. This aids in comparability of studies between populations and years, regardless of the data source. Health services researchers should be cognizant of how reasons for perceived unmet healthcare need may be captured and attempt to incorporate them into their studies.

6.4.4 Type of care not received

Some studies have gathered information on the type of care not received by those with perceived unmet healthcare needs. For example, the NPHS and CCHS categorized type of care for physical problem, emotional or health problem, injury treatment, and regular general practitioner examinations (2,17), while a Quebec telephone survey measured the type of medical threat (13). In the present study, mothers with perceived unmet healthcare needs were asked about the type of health service not received. For the current analyses, perceived unmet healthcare needs were restricted to those for primary health services. Previous work has described the reasons for perceived unmet healthcare needs by type of health services (32). Surprisingly, none of the reviewed studies did so. The patterns of health service use

may differ depending on the type of health service hence, knowing the reasons for perceived unmet need for each type of health service is important (35). It is especially important to distinguish primary from secondary health services in health services research, as barriers and reasons for perceived unmet healthcare needs may be quite different for differing levels of healthcare.

6.5 Conclusion

This chapter described perceived unmet healthcare need in the PHP cohort observed to have inequitable P-HSU in Chapters 4 and 5. It was found that perceived unmet healthcare need is present, with similar prevalence to national estimates, but an additional question about the relevance of that measure arose. The current measurement of perceived unmet healthcare need may warrant improvement. While several studies have captured the reasons for perceived unmet healthcare need, few report the health services for which those needs were unmet. Further, it was argued that the prevalence estimates of perceived unmet healthcare need are underestimated in the current literature.

The limitations identified in this discussion have led to three recommendations in the measurement of perceived unmet healthcare need by health services researchers. First, future research should aim to identify and remove the subpopulation that does not perceive a need for healthcare to accurately measure the prevalence. Second, after assessing the population that has a perceived need (denominator) and subset who perceive that need as being unmet (numerator), the specific types of health services for which needs were unmet should be identified. Finally, only after the prevalence of each type of perceived unmet healthcare need has been assessed, should the reasons for each be measured. The application of the recommendations will more accurately measure the prevalence and provide details that will prove useful for healthcare policy makers.

6.6 References

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Table 6.1 Measurement of perceived unmet healthcare need in Canadian studies

Data source	Question	Response
NPHS	"During the past 12 months, was there ever a time you felt that you needed health care but you didn't receive it?"	Yes/No (2,9,10,16)
CCHS	"During the past 12 months, was there ever a time you felt that you needed health care but you didn't receive it?"	Yes/No (15-17,19-21,36)
	"During the past 12 months, was there ever a time when you felt that you needed help for you emotions, mental health or use of alcohol or drugs, but you didn't receive it?"	Yes/No (14,22)
	Received a mental healthcare service in past 12 months, and was it enough.	No need (23) Unmet need (23) Need partially met (23) Need met (23)
Telephone survey (Quebec, two cities)	"In the past six months, did you feel the need to see a physician without actually doing it, that is, without seeing one?"	Yes/No (13)
	A need for receiving health care services that are not obtained	Yes/No (37)
Telephone survey (British Columbia, three cities)	Details not provided	Yes/No (3)
In-person interview (Toronto, Ontario)	"Have you needed mental health care in the past 12 months but were not able to get help?"	Yes/No (24)
	"Have you needed to see a doctor/nurse in the past 12 months but were not able?"(24)	Yes/No (24)
Structured interview (Toronto, Ottawa, Vancouver)	"Have you needed mental health care in the past 12 months but were not able to get help?"	Yes/No (25)

Table 6.2 Reason for perceived unmet healthcare need measured in Canadian studies

Data source	Question	Response
NPHS	"Thinking of the most recent time, why didn't you get care?"	Waiting time too long (2,9,10) Service n/a when needed (2,9,10) Service n/a in area (2,9,10) Didn't get around to it/didn't bother (2,9,10) Too busy (2,9,10) Felt care would be inadequate (2,9,10) Cost (2,9,10) Decided not to seek care (2,9,10) Didn't know where to go (2,9,10) Transportation problems (2,9,10) Dislikes doctors/afraid (2,9,10) Personal/family responsibilities (2,9,10) Other (2,9,10) Language problems (9,10)
CCHS	"Thinking of the most recent time, why didn't you get care?"	Not available in area (15,17,20,21) Not available when required (15,17,20,21) Waiting time too long (15,17,20,21) Felt would be inadequate (15,17,20,21) Cost (15,17,20,21) Too busy (15,17,20,21) Didn't get around to it (15,17,20,21) Didn't know where to go (15,17,20,21) Transportation problems (15,17,20,21) Language problems (15,17,20,21) Dislikes doctors/afraid (15,17,20,21) Decided not to seek care (15,17,20,21) Other (15,17,20,21) Personal/family responsibilities (15,17,20,21)
	"Why didn't you get this help" (help for emotions, mental health or use of alcohol or drugs)	Preferred to manage oneself (14,22) Didn't think anymore could help (14,22) Didn't know how or where to get help (14) Afraid to ask for help or of what others would think (14,22) Couldn't afford to pay (14,22) Problems with transportation, childcare or scheduling (14) Professional help n/a – in the area (14) Professional help n/a – at time required (14,22) Waiting time to long (14) Didn't get around to it/didn't bother (14,22) Language problems (14) Personal or family responsibilities (14) Other (14)

Table 6.3 Measurement of type of care not received for perceived unmet healthcare need in Canadian studies

Data source	Question	Response
NPHS	"Again, thinking of the most recent time, what was the type of care that was needed?"	Treatment of physical problem (2) Treatment of emotional or mental problem (2) Care of injury (2) Regular check-up (2) Other (2)
CCHS	Specify unmet need type	Unmet physical need (17) Unmet emotional or mental need (17) Insufficient general practitioner examinations (17) Insufficient injury treatment (17) Other (17)
Telephone survey (2 cities in Quebec)	Nature of the problem	Perceived as threat to health (13) Painful (13) Perceived as causing complications (13) Perceived as limiting activities (13)

Table 6.4 Reasons for perceived unmet healthcare need for primary health services, in a population of 1600 mother-child pairs

Reason	Frequency (N=1600)	% of unmet need (N=242)
Wait time for appointment	118	48.8%
Hours of operation	73	30.2%
Unable to get appointment	58	24.0%
Child care needed	10	4.1%
Transportation problems	5	2.1%
Other		
Service not available	12	5.0%
Service location	7	2.9%
Wait time at service	3	1.2%
Miscellaneous	8	3.3%
Any	**242**[a]	

[a]Sum of reasons for perceived unmet healthcare need exceeds the total for any perceived unmet healthcare need because mothers could report multiple reasons.

Table 6.5 Comparison of the prevalence of maternal-reported perceived unmet primary healthcare need in subgroups of children and mothers identified to have inequitable primary health service use

Need factor	Subgroup of predisposing and/or enabling factor(s)	Prevalence unmet need (95% CI)	p-value
Children with health condition	Mothers not Canadian-born (n=96)	11.5% (5.0, 17.9)	0.31
	Mothers Canadian-born (n=814)	15.4% (12.9, 17.8)	
Children with health condition	Mothers Canadian-born, 1 or 2 children (n=664)	16.0% (13.2, 18.8)	0.33
	Mothers Canadian-born. 3+ children (n=149)	12.8% (7.3, 18.2)	
Mothers with health condition	Mothers with 1 or 2 children (n=529)	15.7% (12.6, 18.8)	0.42
	Mothers with 3+ children (n=132)	12.9% (7.1, 18.7)	
Obese mothers	Urban, low- or middle-income households (n=107)	13.1% (6.6, 19.6)	0.54
	Urban, high-income households (n=67)	16.4% (7.3, 25.5)	
Obese mothers	Rural, low- or middle-income households (n=6)	33.3% (0.0, 87.5)	0.29[a]
	Urban, high-income households (n=67)	16.4% (7.3, 25.5)	

[a]Fisher's exact test statistic

Chapter 7

7 Integrated discussion

7.1 Introduction

This thesis investigated primary health service use (P-HSU) in a population of mothers and children from London-Middlesex, Ontario. Andersen's behavioural model conceptualizes health service use to be a consequence of predisposing, enabling, and need factors measured at individual and contextual levels (1). The primary focus was to examine the multilevel characteristics within Andersen's model in the analysis of maternal and child P-HSU. The specific research objectives were to:

1. Estimate the effect of residential location on maternal and child P-HSU.
2. Assess P-HSU inequity by determining whether the effects of maternal and child need factors on P-HSU are dependent on predisposing and enabling factors.
3. Describe perceived unmet healthcare needs in the maternal-child population observed to have inequitable P-HSU.

The results of this study have several implications with regards to contributions to the literature, including future directions for health services research that may inform healthcare policy.

7.2 Summary of Results

7.2.1 The sample

The sample for this thesis was from the Prenatal Health Project (PHP), a longitudinal cohort study that recruited pregnant women from ultrasound clinics in London, Ontario. The two outcomes, maternal and child P-HSU, were measured during the toddler/preschooler stage of the PHP. A total of 1,607 mothers-child pairs were available for data analysis from this stage.

The PHP sample was linked by maternal residential address to a dataset from Statistics Canada that contained contextual-level characteristics of the neighbourhoods in which mother-child pairs resided (N=1,523). Then, the sample was restricted to those residing in London-Middlesex during the toddler/preschooler stage, resulting in a final sample of 1,451 mother-child pairs living in 471 unique neighbourhoods. The sample was restricted to residents of London-Middlesex during the toddler/preschooler stage because they were a representative sample of the births that occurred in that area. Not only were mother-child pairs who moved away from London-Middlesex after their initial recruitment not a sample of the births of the place they moved, it was unknown when they moved away from the area. The dissemination area, the smallest geographical unit that is available from Statistics Canada, was chosen as the neighbourhood unit.

7.2.2 Maternal primary health service use

Just over half of mothers (53.4%) reported using a primary health service in the previous two months. Maternal P-HSU was found to vary between the neighbourhoods in which mothers resided however, no contextual characteristic was associated with P-HSU as a main effect. Urban/rural residence was retained in the final model because when assessing inequity with interaction terms, urban/rural residence and household income were found to modify the effect of maternal obesity on P-HSU. The dependence of the need factor, obesity, on these two enabling factors was demonstrative of qualitative effect measure modification. For example, mothers residing in urban and high-income households who were obese had 2.82 (95% CI 1.61, 4.94) odds of P-HSU compared to mothers of normal weight. Contrarily, the odds ratios for the effect of obesity on P-HSU were less than 1.0 in mothers residing in rural and either low- or middle-income households. Further evidence for inequitable P-HSU was found in this population of mothers. In mothers with three or more children, the presence of a health condition increased the odds of P-HSU 2.41 (95% CI 1.43, 4.05) times, whilst the effect of health condition on P-HSU was not significant in mothers with fewer than three children. This is suggestive of inequitable P-HSU for mothers with a health condition across subgroups of parity. In summary, maternal residential location affected P-HSU in this cohort of mothers, and their use of primary health services was not equitable across subgroups of three enabling factors.

7.2.3 Child primary health service use

Nearly half (48.9%) of mothers reported that their child had used a primary health service in the previous two months. Child P-HSU did not vary between the neighbourhoods in which they resided and so, multilevel analysis to investigate the influence of contextual characteristics was not pursued. Individual characteristics that were significant in the final model included child age, household income, and maternal employment status: Older children had slightly reduced odds of P-HSU, OR=0.97 (95% CI 0.95, 0.99); children residing in low-income households had increased odds of P-HSU, OR=1.60 (95% CI 1.12, 2.28), compared to high-income households and; children whose mothers worked part-time compared to full-time had reduced odds of P-HSU, OR=0.69 (95% CI 0.51, 0.94). In assessing inequity of P-HSU by including interaction terms in the regression model, it was observed that the effect of child health condition was modified by both maternal parity and nativity to Canada. In particular, a dose-response relationship existed for the effect of child health condition across subgroups of maternal parity, but only in children whose mothers were native to Canada. In summary, child residential location did not affect P-HSU in this cohort of children, but their use of primary health services was inequitable across subgroups of two enabling individual-level factors.

7.2.4 Perceived unmet healthcare need

Perceived unmet healthcare needs were described in the PHP cohort. While completing this third objective of the thesis, an important question arose about the relevance of the unmet need measures being described. As such, a discussion on the current state of measuring and researching perceived unmet healthcare need was pursued. Three recommendations came from this discussion. First, future research should aim to identify and remove the subpopulation that does not perceive a need for healthcare to accurately measure the prevalence. Second, after assessing the population that has a perceived need (denominator) and subset who perceive that need as being unmet (numerator), the specific types of health services for which needs were unmet should be identified. Finally, only after the prevalence of each type of perceived unmet healthcare need has been assessed, should the reasons for

each be measured. Application of the recommendations may improve the quality of health service research in the realm of unmet needs, and implications for healthcare policy.

7.2.5 Integration of results from Chapters 4, 5, and 6

Results from the maternal and child models of P-HSU provide new evidence for the role of residential location in health services research. It is unclear as to why P-HSU varied across neighbourhoods for mothers in the PHP cohort, but not for their children. Approximately half of the reviewed Canadian studies that investigated contextual characteristics, including urban/rural residence, found a significant difference in P-HSU across contextual units (2-5) . The majority of these studies examined adult populations, and none restricted to children of toddler/preschooler age, making it difficult to draw conclusions for the PHP cohort as to why residential location affected maternal but not child P-HSU. The analyses of maternal and child P-HSU also provide evidence for the role of enabling factors in modifying the effects of need factors on P-HSU. Inequity of P-HSU was observed for both mothers and children. In both analytic models, maternal parity modified the effect of health condition on P-HSU in the same manner. The odds of P-HSU for both maternal and child health condition increased as maternal parity increased. At the onset of this research, maternal parity was conceptualized as an enabling factor in that mothers of lower parity would have fewer barriers in using health services for their child. Hence, it was surprising that increased parity increased the effect of health condition. While residential location only affected maternal P-HSU in this cohort, subgroups of both mothers and children were subject to inequitable P-HSU.

Much of the existing health service research does not consider both mothers and children in the same study. This thesis is an innovative investigation of P-HSU using mothers and children from the same population, facilitating the comparison of P-HSU among mothers and their children. As already discussed, residential location only influenced maternal P-HSU but inequity was observed for both mothers and children. In reviewing the individual and contextual characteristics that were significant in the maternal and child models of P-HSU, there are striking differences. In mothers, no predisposing variables were significantly associated with P-HSU in the final multivariable model. Two enabling variables, household income and urban/rural residence, were included as effect measure modifiers of the need

factor, BMI and, the enabling variable maternal parity modified the effect of the need factor, maternal health condition. In contrast, children's P-HSU was influenced by their age, household income, and maternal employment status. Like in mothers, maternal parity was also an effect measure modifier of a need factor, child health condition, which was also modified by maternal nativity to Canada. Since mothers are the primary decision makers when it comes to their children's HSU, it was speculated that health service seeking behaviours would be similar in mother-child pairs. However, there were notable differences in maternal and child P-HSU; the same factors within Andersen's model did not influence maternal and child P-HSU. These results are consistent with Andersen's revision to the behavioural model of health service use, where the model's original unit of analysis, families, was revised to individuals alone (1). The results from this thesis indicate that the behaviours leading to maternal P-HSU are quite different than those leading to child P-HSU. This work fills a gap in the literature by studying mothers and children fro the same population and the same time point.

The results from Chapters 4 and 5 led to the formulation of the research objective pursued in Chapter 6. With the knowledge that P-HSU was not equitable for mothers and children in the PHP cohort, the goal was to determine whether healthcare needs were met. The prevalence of perceived unmet healthcare need was similar to reports from other Canadian studies. Further, there were no significant differences in the prevalence across subgroups of mothers and children identified to have inequitable P-HSU. The results from this analysis demonstrate that perceived unmet need for healthcare is a distinct construct from equity, and that health service use may be inequitable without differences in reported unmet healthcare need in the same population pointing to the importance that the "patient is the best judge… of whether he/she has received appropriate health care" (6). In conclusion, although perceived unmet primary healthcare need was present, there were no significant differences across the examined subgroups in the PHP cohort.

7.3 Strengths and Limitations

7.3.1 Strengths

A predominant strength of this research was its data sources. First, using mother-child pairs from the same population and the same time point facilitated the comparison of the factors associated with their P-HSU. The PHP offered a wealth of individual characteristics reflective of maternal and child predisposing, enabling, and need factors. Having these variables available from a primary dataset was advantageous for ensuring data completeness and minimizing data errors. Mother-child pairs' residential addresses were also available from the primary dataset, facilitating the linkage of PHP data to contextual characteristic data sourced from Statistics Canada. The resulting multilevel dataset provided the opportunity to investigate a wealth of individual and contextual characteristics contained within Andersen's behavioural model of health service use. Results from the models of maternal and child P-HSU fill an important gap in the literature as a thorough consideration of contextual characteristics in Canadian populations, especially mothers and children, was limited.

Previous studies have used provinces, health region boundaries, and census subdivisions as geographical units (4,7,8). For this research, mother-child pairs' street addresses were available and this information enabled the use of the small-scale dissemination areas to represent the neighbourhood units. Using dissemination areas as the neighbourhood unit was beneficial, as small geographic units have been shown to lead to stronger contextual effect estimates, should they exist (9-11).

Many studies of health service use do not distinguish secondary health services, such as specialists and hospitalizations, from the primary health services examined in this thesis. For example, Blackwell et al. combined primary care physicians and specialists in their measure of health service use (12), Woodward et al. considered any ambulatory medical care use (13), and others have used the term "physician" as their health service use measure (14,15) . It has been recognized that health service use differs depending on the level of service, which may implicate equity and unmet needs differently (16) . Strength of the work in this thesis is that health services were limited to those that were primary. Hence, the factors conceptualized within Andersen's model that were significant in data analyses are solely implicated with regards to primary health services.

The consideration of effect measure modification in health services research may prove beneficial in enhancing the understanding of factors that drive health service use. A novel feature of the P-HSU regression models presented in this thesis is that they tested for effect measure modification of need factors. Significant results provided analytic evidence that need factors' effects on both maternal and child P-HSU were not the same across subgroups of enabling factors, including urban/rural residence, household income, and maternal parity. Rather than looking at the contribution of predisposing and enabling factors as main effects, as have been done in previous research that has evaluated health service equity, testing for effect measure modification of need factors is an advantageous method to analytically test for inequity. The presence of significant interaction terms affects the way in which its covariates are interpreted and how they may be investigated in future studies.

7.3.2 Limitations

There were some limitations of this thesis. First, the measurement of P-HSU may be improved in future work. While the type of health services used was captured and was limited to solely primary services, the measurement was by maternal report and limited to the previous two months. It is possible that mother-child pairs engaged with the primary healthcare system just prior to or just after this two-month period. However, as period prevalence of P-HSU was the outcome measured in this work, it would be wrong to make assumptions about what happened outside of that two-month period. The measurement of P-HSU may have been subject to recall error but since the period of recall was the previous two months, it is unlikely. The vast majority of health service use studies rely on self-report over one year, the period of which may be subject to more recall error (2,5,7,8,12,17-25). Further, the reason for P-HSU by mothers and children in this cohort was unknown. It is possible that factors affecting P-HSU for preventative reasons, follow-up, injury, chronic and acute conditions may differ. While the primary data source for this thesis permitted the inclusion of a wealth of variables conceptualized within Andersen's model, an administrative database that captures specific date, location, and reason for healthcare encounters would be advantageous to measure additional details about health service utilization.

Andersen suggests using population indices such as mortality and disability to represent contextual need however, no such data exists from Statistics Canada at the dissemination level. Such population indices are possible at the county or local health integration network levels, but these were too large of geographical units for the sample of mothers and children studied in this thesis. Despite not having contextual-level need factors, which have low mutability, the consideration in this thesis of contextual-level predisposing and enabling factors, the latter of which has the highest degree of mutability, holds greater importance for healthcare policy implications.

Variables were available for the proximity from each residential address to the nearest walk-in clinic and emergency department. Family physician density was also considered however, the construct of a valid measure at the dissemination level was not feasible. While initially of interest, these variables were excluded from final analyses because the outcome measure, P-HSU, captured regular care provider, walk-in clinic, and emergency department use as one amalgamated variable. Health service distance and density variables may be considered in future work investigating specific types of health service utilized. These variables would be especially beneficial especially if the investigators know the location of the health service that was used.

The decision to use the dissemination area as the neighbourhood unit of analysis was because using smaller units have been shown to generate greater contextual effects should they exist. Because of this choice, there were hundreds of neighbourhoods in which mothers and children resided however, the majority had few mother-child pairs in each. Small numbers of observations within each neighbourhood may have compromised the ability to find differences in P-HSU between neighbourhoods by inflating standard errors perhaps masking significant findings (26); a type 2 error. As such, future work should build on the ideas presented in this thesis with a goal of increasing each neighbourhood's sample sizes without compromising the integrity of the neighbourhood unit itself.

7.4 Conclusions and future directions

In conclusion, this thesis applied several health services research concepts in the study of a population of mothers and children living in London-Middlesex, Ontario. Individual- and contextual-level characteristics were considered in the analytic modeling of P-HSU. A notable difference between maternal and child P-HSU was that it only varied across neighbourhoods for mothers. Effect measure modification was considered in multivariable analyses to test for inequity, and results show that subgroups of both mothers and children were observed to have inequitable P-HSU. Finally, the concept of perceived unmet healthcare need was explored and several recommendations were presented for its measurement.

Future research can build on the progress made by this work, by broadening the geographical area, increasing the sample size within contextual units, and integrating even more details in analytic models. The geographical area may be expanded to include more than one county to see if results are replicated in other areas. Increasing the sample size has the potential to increase the number of participants within each neigbourhood unit, perhaps alleviating the limitations associated with small geographic unit sample sizes. The focus of analytic models may be narrowed by separately examining types of primary health services (e.g. regular care provider, walk-in clinic, emergency department). Doing so would facilitate the use of health service density and proximity variables. Further, differences may exist for these specific types of health services having different equity and unmet need implications (16) . Capturing the reason for each healthcare encounter may be another way to narrow the focus of analytic models. The research presented in this thesis provides a framework for future studies to investigate multilevel factors, equity, and perceived unmet healthcare need in various populations.

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Appendices

Appendix A: Summary of Literature Review Studies

Table A.1. Studies of primary health service use in Canadian populations

Study	**Population**	**Study Design**	**P-HSU measurement**	**Variables positively associated with P-HSU** *(non significant results)*
(Agborsangaya et al. 2012)	Aged 18+ Alberta N=4,945	Cross-sectional survey (Health Quality Council of Alberta 2010 Patient Experience Survey).	ED ever use Recall of past 12 months	Chronic condition, multimorbidity [Adjusted for age, sex, education, income, family structure]
(Amre et al. 2002)	Aged 9 – 10 years Quebec N=404	Asthmatic children were recruited from ED at ages 3 and 4 years. Socioeconomic variables collected at baseline. Six-year follow-up period.	ED ever use for asthma Recall of past 3 years	*(father's occupation, crowding index, type of dwelling, race)* [Adjusted for child sex, maternal age, paternal smoking, hospitalization at first diagnosis, use of anti-inflammatory medication, routine physician follow-up for control of asthma]
(Anderson et al. 2008)	Aged 2 – 12 months London-Middlesex, Ontario N=651	Pregnant women recruited from ultrasound clinics at 10 to 12 weeks' gestation. Postpartum cross-sectional survey.	Number of RCP visits per month (FP/pediatrician) WIC ever use ED ever use Recall since birth	*(maternal depressive symptoms, maternal anxiety)* [Adjusted for maternal age, marital status, previous children, infant age, infant sex, maternal education, country of birth, language spoken at home, smoking status, alcohol consumption, income, access to car, access to bus, access difficulties, social support, financial strain, mother's employment status, preterm birth, SGA, colic]
(Asada, Kephart 2007)	Aged 20+ years Canada N=110,923	Cross-sectional survey (2000/01 Canadian Community Health Survey).	GP/FP ever use Recall of past 12 months	aged 20 to 24 years (vs. 35 to 49), female, minority, less than secondary education, highest household income, less than excellent self-rated health, high stress, depressive symptoms, chronic condition [Adjusted for many covariates]
(Blackwell et al. 2009)	Aged 18+ years Canada N=3,505	Cross-sectional survey (2002/03 Joint Canada/United States Survey of Health)	Medical doctor ever contact or ever use (combined primary care physicians and specialists) Recall of past 12 months	aged 65+ years (ref=18 to 44), female, less than high school, has regular doctor, less than excellent self-rated health, restriction of activities, chronic condition – *(race, nativity, marital status, income, obesity, smoking, depressive episode)*

Study	**Population**	**Study Design**	**P-HSU measurement**	**Variables positively associated with P-HSU** *(non significant results)*
(Blais, Maiga 1999)	Aged 15+ years Quebec N=1,182	Matched cohort (1987 Quebec Health Survey, Quebec Health Insurance Board).	Number of GP visits Retrospective collection of medical records over past year	*(ethnicity)* [Matched on sex, age, income, hospital access, perceived health, overall health]
(Dennis 2004)	Women, 8 weeks postpartum British Columbia N=498	Population-based prospective cohort	FP use ED use WIC use Recall of past8 weeks	FP: Univariable – depressive symptoms ED, WIC: Univariable – *(depressive symptoms)*
(DesMeules et al. 2004)	Immigrants British Columbia, Ontario, Quebec	Cohort study	Physician visit rate	Immigrants had lower physician visit rate compared to general B.C. population [adjusted for age]
(Diaz-Granados, Georgiades & Boyle 2010)	Aged 15+ years Canada N=36,034	Cross-sectional survey (2002 Canadian Community Health Survey) linked to Candian 2001 Census profiles. Recall of past 12 months	GP/FP ever use for mental health reason Recall of past 12 months	mood disorder, substance dependence disorder, fair-to-poor self-rated health, higher distress, chronic condition, higher density of GP/FP, age less than 60 years, lowest quartile of household income, post-secondary education, separated/widowed/divorced, non-immigrant, interaction between mood disorder and age (effect less for younger age), interaction between mood disorder and income (effect less for lower income) – *(measures of health region need, suicide attempt, density of specialists, measures of health region sociodemographics, rural residency)*
(Dunlop, Coyte & McIsaac 2000)	Aged 12+ years Canada N=17,626	Cross-sectional survey (National Population Health Survey).	GP/FP ever use Recall of past 12 months	Females: higher education, poorer health status, 4+ reported health problems, has a regular medical doctor, urban community, household member smokes – *(age, marital status, income, province)*

Study	**Population**	**Study Design**	**P-HSU measurement**	**Variables positively associated with P-HSU** *(non significant results)*
(Fell et al. 2007)	Aged 25 – 59 years Nova Scotia, Manitoba, Saskatchewan, British Columbia N=3,008 men N=2,609 women	Cross-sectional survey (1996/97 National Population Health Survey) linked to provincial administrative databases.	Rate of GP use Retrospective collection from administrative database over past 12 months	Women: full time work hours (vs. long work hours), age under 30 years, British Columbia and Saskatchewan (ref=Manitoba), poorer self-reported health status, two or more chronic health conditions – *(occupation, education, income adequacy)* [Adjusted for multiple jobs, working full year, marital status, rural/urban indicator, health care unavailable, 11 chronic conditions, restricted activity, smoking BMI, alcohol use, physical activity]
(Guttmann et al. 2010)	Aged 0 – 17 years Ontario N=2,794,162	Cross-sectional design using multiple administrative data sources.	RCP ever use (GP/pediatrician) Rate of ED use Retrospective collection of medical records over past 2 years	RCP: higher RCP supply, higher neighbourhood income ED: lower RCP supply – *(neighbourhood income)* [Adjusted for age, gender]
(Haggerty et al. 2007)	Adults Quebec N=2,725	Cross-sectional, multilevel survey of patients' care experiences, physicians' practice profiles and clinic organization	ED ever use Recall of past 12 months	Rural areas had significantly more ED users compared to urban areas (chi-square test) Rural, reduced number of medical procedures on clinic site In urban patients only: offering in-patient follow-up, reduced number of medical procedures on clinic site In rural patients only: low culture of rapid access, physician time spent in primary care site less than 50% (ref 90%+)
(Kurtz Landy, Sword & Ciliska 2008)	Women, 4 weeks postpartum Ontario		Physician use Recall of past 4 weeks	Univariable – *(socioeconomic status)*

Study	**Population**	**Study Design**	**P-HSU measurement**	**Variables positively associated with P-HSU** *(non significant results)*
(McCusker et al. 2012)	Aged 18+ years Quebec N=311,701	Retrospective cohort. Baseline characteristics measured during first two years of study; ED use measured during last year of study.	Number of ED visits Retrospective collection of provincial administrative databases over past 12 months	Main effects: No affiliation with a primary physician, fewer annual examinations with FP, lower continuity of care with specialist – *(continuity of care with FP)* Interactions: (age)*(affiliation with FP), (baseline physician visits)*(continuity of care with FP), (comorbidity score)*(continuity of care with specialist), (time spent in hospital)*(continuity of care with specialist)
(McIsaac, Goel & Naylor 1997)	Adults aged 16+ years Ontario N=46,010	Cross-sectional study (1990 Ontario Health Survey)	GP ever use Recall of past year	Need for medical care *(education, income)*
(Mian, Pong 2012)	Aged 16+ years Ontario N=8502	Population-based telephone survey (Primary Care Access Survey)	ED ever use Recall of past 6 months	Have a regular FP, have not seen a FP or had problems accessing FP when necessary, have a chronic disease, place of residence (southern-rural, northern-urban, northern-rural; REF was southern-urban), bachelor degree or more, less than $30,000 household income, immigration status (recent immigrants, nonimmigrants; REF was established immigrants) *(gender, age, marital status, employment status)*
(Muggah, Dahrouge & Hogg 2012)	Aged 18+ years Ontario N=5,269	Cross-sectional survey (Comparison of Models of Primary Care Study) administered to patients of participating primary care practices	Number of visits to primary care practice in past year Recall of past year	Recent immigrant [adjusted for age, sex, health status, number of years as patient in primary care practice]
(Mustard et al. 1998)	Winnipeg, MB N=657,871	Ecological cross-sectional design using several administrative databases.	Rate of neighbourhood ED use Retrospective collection of administrative records over 55-day study period	higher % of population with treaty Indian status, lower mean household income, % ED visits for mental illness – *(sex distribution, age distribution, distance to ED)* N.B. variables measured at neighbourhood-level

Study	**Population**	**Study Design**	**P-HSU measurement**	**Variables positively associated with P-HSU** *(non significant results)*
(Nabalamba, Millar 2007)	Aged 18 – 64 years Canada N=92,362	Cross-sectional survey (2005 Canadian Community Health Survey).	GP ever use Recall of past year	chronic condition, poorer self-perceived general health, poorer self-perceived mental health, women, aged 25 to 34 (vs. 18 to 24), higher household income, has a RCP – *(racial/cultural group, speaks English/French, residence)*
(Quan et al. 2006)	Aged 12+ years Canada N=7,057	Cross-sectional survey (2001 Canadian Community Health Survey).	FP/GP ever use Recall of past 12 months	visible minority (more results presented in Appendices…) [Adjusted for sex, age, marital status, education, income, immigrant status, speaking English or French, self-perceived health, chronic disease]
(Rhodes et al. 2006)	Aged 12+ years Ontario N=17,776	Prospective cohort of sample of respondents of the 1996/97 National Population Health Survey (linked to data from the Ontario Health Insurance Plan and the Canadian Institute for Health Information).	FP ever use for mental health reason Prospective collection of administrative records over 2 years	higher levels of distress, depression, female, partnered (ref=widowed), higher education, multiple chronic health problems, fair/poor perceived health status (ref=excellent) – *(labour force status, household income)* [Adjusted for age, ethnicity, disability days, alcohol dependence]
(Roos, Mustard 1997)	Population of Winnipeg, Manitoba	Cross-sectional Linkage of several administrative databases, including 1986 Census and provincial claims payment data	Family or general practitioner visit Retrospective collection from provincial claims payment database	Chi-square test – Highest income quintile has significantly fewer general practitioner visits than lowest income quintile. *(Income not associated with ever use of general practitioner)*
(Roos L, Walld 2007)			Rate of GP use	Chi-square test – rate of GP use increases as neighbourhood mean income reduces (measured in quintiles)
(Rosychuk et al. 2010)	Pediatric population (0-18 years old) of Alberta from 1999-2006	Retrospective cohort	Rate of ED use for asthma Retrospective collection from administrative database over past 6 years	Descriptive – rate greater for males from birth to age 14, in younger children, rate peak from April-May and in September

Study	**Population**	**Study Design**	**P-HSU measurement**	**Variables positively associated with P-HSU** *(non significant results)*
(Ryan et al. 2011)	Aged 20 – 24 years Canada N=6,681	Cross-sectional survey (2003 Canadian Community Health Survey).	FP ever use Recall of past 12 months	Manitoba and Alberta (ref=Ontario), female, community belonging, has RCP, urban residence, never smoker (ref=daily) – *(educational attainment, nativity, racial origin, household income, living arrangement, self-perceived health, self-perceived mental health, opinion of weight, BMI, chronic condition, physical activity, number of sexual partners, alcohol consumption)*
	Aged 12 – 14 years Canada N=4,985	Cross-sectional survey (2003 Canadian Community Health Survey)	FP ever use Recall of past 12 months	Ontario (ref=Quebec), white, has RCP, weight about right (ref=underweight), chronic condition – *(sex, nativity, community belonging, household income, residence, self-perceived health, self-perceived mental health, BMI, physical activity, smoking, alcohol consumption)*
(Sibley, Weiner 2011)	Aged 20+ years Canada N=111,258	Cross-sectional survey (Canadian Community Health Survey 2003).	FP ever use Recall of past 12 months	poorer self-rated health status, chronic health condition, older age, women, married, higher education, white ethnic origin, has a regular medical doctor – *(household income, residence)*
(Sin et al. 2003)	Aged 10 years Alberta N=90,845	Retrospective collection of physician claims database over past 10 years	Rate of asthma-related ED use	very poor, male, single-parent family, birth defect, low birth weight, prematurity, poorest area-based SES quintile
(Trakas, Lawrence & Shear 1999)	Aged 20 – 64 years Canada N=12,318	Cross-sectional survey (National Population Health Survey 1994).	Number of GP visits (0-2 vs. >2) Recall of past 12 months	Obese (BMI 27+) [Adjusted for age, sex]
(Twells, Knight & Alaghehbandan 2010)	20-64 years old Newfoundland and Labrador	Cross-sectional study (2001 Canadian Community Health Survey)	# GP visits Recall of past 12 months	Morbidly obese and obese had more visits than overweight and normal weight groups
(Twells et al. 2012)	Aged 20 – 64 years Newfoundland and Labrador N=2,345	Cohort study linking provincial health survey and health care use administrative data	Number of GP visits Collection from administrative database over 5 years	Morbidly obese [Adjusted for chronic conditions, among other covariates]

Study	**Population**	**Study Design**	**P-HSU measurement**	**Variables positively associated with P-HSU** *(non significant results)*
(Woodward et al. 1988)	4-16 years old Ontario N=1,412	Cross-sectional survey (Ontario Child Health Study)	Ambulatory medical care use (ED, medical doctor, hospital outpatient) Recall of past 6 months	Univariable regression – poorer general physical health, young age, urban, chronic medical condition, higher maternal education

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Appendix B: Methodological Methods

1. THEORETICAL FRAMEWORK

Andersen defines health care system access as the “actual use of personal health services and everything that facilitates or impedes the use of personal health services” (Andersen et al., 2001). Andersen's behavioural model is a conceptual framework that incorporates three components in the understanding of health service use: predisposing, enabling and need (Andersen, 1995). First, Andersen describes health service use as a function of an individual's predisposition for using those services. Age, sex and education are commonly included factors of the predisposing component. Second, potential access to health care services is defined by factors that are part of the enabling component that include income, employment status and transportation. Finally, an individual's need to utilize health care services, whether perceived or actual need, is represented by their health status.

The model has undergone some revisions since its inception in the late 1960s. It was originally developed to understand health service use in families but after recognition that families may not be homogeneous units, especially with regards to health status, the model was revised to consider the individual as the unit of analysis. It has also been recognized that factors that explain health service use in Andersen’s model may be measured at multiple levels. Aggregated and intrinsically ecological factors may contribute and enhance the measurement of the factors belonging to the predisposing, enabling and need components. In particular, enabling factors that affect whole communities have potential for high mutability as changes made at the community level may affect the group as a whole (Andersen, 1995).

Health service use is defined by Andersen to be equitable when driven by need. If the effect of need does not behave the same for all members of the population then it is proposed that health service use may be inequitable. This may be tested by introducing interaction terms between a need factor and covariate where the null hypothesis is that the effect of the need factor is the same across subgroups of the covariate. Should the null hypothesis be rejected then there is evidence that the effect of the need factor differs by subgroups of the covariate. These subgroups may be have inequitable health service use.

2. DATA

2.1. Data Sources

Data for this research project are from two linkable sources: 1) The Prenatal Health Project (PHP), a population-based longitudinal cohort study of women initially residing in the London-Middlesex area of Ontario and 2) a geographic database compiled by Dr. Jason Gilliland et al. which was sourced from Statistics Canada and linked to PHP data by maternal residential addresses.

The study population consists of mother-child paired participants from the PHP. Over a 34-month period from January 2002 to December 2004, pregnant women were recruited from seven of ten ultrasound clinics in the city of London. The criteria at recruitment for participating in the study was: residence in the London-Middlesex area of Ontario, singleton pregnancy, maternal age 16 years or more, gestational age 11.5-20.5 weeks, no known fetal abnormalities and knowledge of adequate English. Children were born over a 36-month period from June 2002 to June 2005.

This research utilized PHP data collected prenatally, perinatally and when children were of toddler/preschooler age (on average 34 months postpartum). The Prenatal Stage Survey was administered over the telephone by PHP staff to pregnant women. This survey collected information on maternal health, lifestyle and dietary intake. Perinatal data were abstracted from maternal and infant birth medical charts and included information on pregnancy risk factors and birth outcomes. PHP staff administered the Toddler/Preschooler Stage Survey to participating mothers over the telephone. This survey collected information on HSU, maternal and child health, and many predisposing and enabling factors. Hence, HSU data were collected during the toddler/preschooler stage, with maternal/child predisposing, enabling and need factors collected at all three stages. The PHP survey questions that provided the measurement of health service use and predisposing, enabling, and need factors considered in this thesis are presented in Appendix E.

The geographic database was sourced from Statistics Canada (2006) and DMTI Spatial (2009) and compiled by Dr. Jason Gilliland et al. from the Department of Geography at the University of Western Ontario. Data represent mother-child pairs' residential location and

include contextual characteristics measured at the neighbourhood-level and proximity variables measured at the individual-level. This research defines neighbourhood by dissemination area, the smallest geographic boundary defined by Statistics Canada.

2.3. Sample Available

A total of 2357 women completed both the prenatal and perinatal stages of the PHP. A sample of 1607 mother-child pairs was followed up and administered the Toddler/Preschooler Stage Survey, which contained the primary health service use outcomes analyzed in this research. Of the 1607 mother-child pairs who completed the child stage, 1523 were linked to the geographic database by maternal residential address, residing in 530 unique neighbourhoods. Of these, 182 dissemination areas had one participant, 129 dissemination areas had two participants, 202 dissemination areas had three to nine participants, sixteen dissemination areas had ten to twenty-nine participants and one dissemination area had more than thirty participants residing in that neighbourhood. The sample was further restricted to mother-child pairs still residing in London-Middlesex during the toddler/preschooler stage of the PHP, resulting in a final sample of 1451 mothers and children living in 471 neighbourhoods.

2.4. Variable Measurement

This project defined the outcome as *primary health care service use* (P-HSU) which is: a visit to a medical doctor who provides a patient's first contact with the health care system, i.e. regular care provider, walk-in clinic, emergency department. Cross-sectional measurement of use of these health care services in the previous two months was measured by maternal recall during the Toddler/Preschooler Stage Survey.

The factors from the PHP and geographic database that were considered to influence maternal and child P-HSU in this study are described in detail in Appendix D.

3. DATA ANALYSIS

3.1. General Methods

Univariable analyses to describe the distributional properties of variables were performed using the statistical software package of SAS®9.2 (SAS, Windows build 9.2, SAS Institute Inc., Cary, NC, USA) (Appendix H). Bivariate analyses of independent variables with the dependent variables identified associations with a p-value <0.20 that were considered in analytic models (Appendix H). Diagnostic testing of variables was performed to identify any potential issues with outliers and collinearity before entering variables in analytic models (Appendix H). Multilevel modeling (MLM) was applied to analyze the multilevel data for the research objectives, using SAS ®9.2. All analyses were based on two-sided hypothesis tests with type I error of α=0.05.

3.2. Multilevel modeling

Multilevel modeling was applied to study the role of residential location because of the possible non-independence in observations from mother-child pairs residing in the same neighbourhood. Single-level analysis assumes that observations are independent; violating this assumption by performing single-level analysis on data that are nested at a higher level may lead to incorrect standard errors and inefficient estimates of effect (Kawachi and Berkman, 2003). Furthermore, single-level analysis only examines the variation between individuals whereas MLM also examines the variation between groups. Multilevel modeling can determine if individual characteristics, contextual characteristics, or both, are associated with health variations from neighbourhood to neighbourhood (Gatrell and Elliott, 2009). This method is ideal for the research questions of this thesis since individuals are nested within neighbourhoods, determinants of health service use may operate at multiple levels, there is an interest in knowing whether the exposure effects differ between neighbourhoods, and cross-level interaction effects can be assessed (Kawachi and Subramanian, 2006).

There are two types of parameters that can be estimated in MLM. Fixed effects summarize the average relationship while random effects summarize the variation around the average at each level (Kawachi and Berkman, 2003). This is in contrast to single-level analysis where

the intercept and regression coefficients are fixed effects and only the residual is estimated as a random effect. In MLM, the intercept is usually estimated as a random effect allowing the mean outcome to vary between neighbourhoods. The choice of a random intercept is strengthened when interest is in making inferences about the effects of neighbourhood-level variables (Snijders and Bosker, 1999).

Likewise, the effect of independent variables may be fixed (i.e. constant across neighbourhoods) or random (i.e. allowed to vary between neighbourhoods). If it is thought than an independent variable's effect on the outcome variable will vary by group then this effect should be set as random (Hayes, 2006). Kawachi and Subramanian (2006) suggest treating individual-level variables as random in neighbhourhood studies as these differences may represent an important phenomenon predictive of HSU. Furthermore, treating a factor as a fixed effect when it actually varies between groups can affect the estimated standard errors of the other effects in the model (Snijders and Bosker, 1999). It is therefore recommended to use a Wald test to check the randomness of slopes for all variables of main interest when the decision between fixed and random effects cannot be theoretically rendered.

The dependent variables in this study are dichotomous. As such, a logit link was used for the multilevel generalized linear models. The same model building strategy was used to model maternal P-HSU and to model child P-HSU. For simplicity, the two outcomes will be referenced as "P-HSU" in the following discussion.

Objective 1: Estimate the effects of residential location on maternal and child primary health service use.

<u>Objective 1a:</u>

- An empty model of P-HSU as a function of Study ID (i.e. maternal/child identifier) and Neighbourhood ID (i.e. dissemination area unit identifier) was estimated. This random intercept-only model assessed whether the neighbourhood units differ on average on the odds of P-HSU, based on a Wald test statistic that evaluates the variance of the random component of the intercept (i.e. tests if variance of the random intercept is different than zero; if significant then evidence that neighbourhoods differ in odds of HSU).

- Maternal/child characteristics from the PHP were added to the 2-level logistic regression model as fixed effects, retaining characteristics whose regression coefficients have a p-value < 0.20. The variance of the random intercept was tested to inform about the variance in odds of HSU across neighbourhoods, after controlling for maternal/child characteristics.

- *Summary of method*: Testing the significance of the random intercept's variance informed whether P-HSU varies across neighbourhoods, before and after including individual-level characteristics.

Objective 1b:

- Neighbourhood contextual characteristics were added to the 2-level logistic regression model. The effects of contextual-level characteristics were estimated as fixed effects. Characteristics whose regression coefficients have a p-value of < 0.20 were retained.
- Maternal/child characteristics from the PHP were estimated as random effects. The slope randomness of each characteristic was tested using the Wald test statistic.
- If the slope is random then the effect varies by neighbourhood; if not, then there is no evidence that the effect varies by neighbourhood. In the latter case, maternal/child characteristics will be estimated as fixed effects by default.
- *Summary*: The significance and value of the regression coefficients estimated the effects of neighbourhood contextual characteristics and proximity variables on primary health care service use.

Objective 2: Determine whether the effect of maternal/child need on primary health care service use is influenced by *a priori* determined covariates.

- Test for interaction between significant maternal/child need characteristics and predisposing and enabling characteristics
- *Summary*: Testing for interactions between maternal/child need characteristics and other characteristics will determine whether the effect of maternal/child need on P-HSU is influenced by other characteristics.

3.4. Sample Size

The available sample consists of 1607 mother-child pairs who completed the toddler/preschooler stage of the PHP. The London-Middlesex sample linked to the geographical dataset included 1451 mother-child pairs living in 471 dissemination area neighbourhoods.

When applying MLM, the power of the Wald test for significance of level-1 independent variables depends on the total sample size whereas the power of the Wald test for higher-level independent variables more so depends on the number of groups (Hox, 2010). A general rule-of-thumb for the ratio of number of groups to individuals is 30:30 however if there is strong interest in the random component and variance then it has been suggestion that the ratio can be expanded to 100:10 (Hox, 2010). Simulation studies that have investigated how group size and number of groups affect estimates reveal that even smaller group sizes can produce valid results under certain circumstances (Maas and Hox, 2005; Theall et al., 2013). For example, groups with one or two subjects has little effect on fixed and random coefficient estimates, variances or intraclass coefficients although standard errors may be inflated especially as the proportion of groups with small group sizes increases (Theall et al., 2013). Therefore, caution should be exerted when interpreting the standard errors of coefficient estimates from multilevel studies that have very small group sizes.

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Appendix C: Rationale for Variables in the Conceptual Framework

Table C.1. Rationale for the predisposing factors included in the conceptual frameworks of maternal and child health service use

Predisposing Factor	Literature Support
Neighbourhood proportion of immigrants	• No literature on its relationship with HSU. • May be associated with the neighbourhood's social and physical structure, and the neighbourhood's health beliefs that may influence HSU.
Neighbourhood proportion without high school diploma	• No literature on its relationship with HSU. • May be associated with the neighbourhood's social and physical structure, and the neighbourhood's health beliefs that may influence HSU.
Neighbourhood green space density	• No literature on its relationship with HSU. • Green space associated with population health that influences HSU. • May be associated with the neighbourhood's social and physical structure that may influence HSU.
Neighbourhood walkability score	• No literature on its relationship with HSU. • Walkability associated with population health that influences HSU. • May be associated with the neighbourhood's social and physical structure that may influence HSU.
Public recreational facility proximity	• Canadian Studies - Asada and Kephart, 2007 (inactive adults have more primary care provider visits) • Proximity to public recreational facilities may be related to activity level, which is related to HSU. • May be associated with the neighbourhood's social and physical structure that may influence HSU.
Season	• Canadian Studies - Moineddin et al., 2008 (primary care provider rates highest in winter months) • Other Studies - Goldfeld et al., 2003 (HSU rates lowest in summer months) - Van Dole et al., 2009 (ED rates highest in fall and summer months) • HSU is lower in the summer months and higher in winter months. • Season related to patterns of disease and physical activity.
Maternal age	• Canadian Studies - Asada and Kephart, 2007 (older adults less likely to have contact with primary care provider) - Sibley and Weiner, 2011(older adults more likely to have physician contact) • Other Studies

Predisposing Factor	Literature Support
	- Babalola and Fatusi, 2009 (older mothers more likely to have ante-/postnatal care) • Older adults more likely to use health care services. • Key demographic variable to include because of its association with health status.
Child age	• Other Studies - Ludwick et al., 2009 (younger children have fewer ED visits) - Giannakopoulos et al., 2010 (null) • Mixed findings for different types of primary health care services and in different populations. • No literature for effect of age in toddlers/preschoolers. • Key demographic variable to include because of its association with health.
Child sex	• Canadian Studies - Ryan et al., 2011 (15-24 year old females more likely to have primary care provider contact) • Other Studies - Brooks-Gunn et al., 1998 (null) - Ludwick et al., 2009 (null) - Giannakopoulos et al., 2010 (null) • Mixed findings for different types of primary health care services and in different populations. • Effect may be dependent on age. Limited knowledge on its effect in toddlers/preschoolers. • Boys and girls may exhibit different play behaviours that may affect need. • Key demographic variable to include because of its association with health.
Maternal nativity	• Canadian Studies - Blais and Maïga, 1999 (null) - Asada and Kephart, 2007 (non-white more likely to have primary care provider contact) - Nabalamba and Millar, 2007 (null) - Blackwell et al., 2009 (null) - Ryan et al., 2011 (visible minorities less likely to have primary care provider contact) - Sibley and Weiner, 2011(non-white less likely to have primary care provider contact) • Other Studies - Brooks-Gunn et al., 1998 (non-white have fewer HSU visits) - Minkovitz et al., 2002 (non-white less likely to have HSU contact) - Cox et al., 2009 (black women less likely to have adequate prenatal care)

Predisposing Factor	Literature Support
	• Non-whites generally less likely to use health care services, but not consistently shown in Canadian literature. • Nativity less frequently examined in HSU studies but easily measured and may serve as proxy for racial-ethnicity in HSU study.
Maternal education	• Canadian Studies - Dunlop et al., 2000 (more educated more likely to have primary care provider contact) - Asada and Kephart, 2007 (more educated more likely to have primary care provider contact) - Blackwell et al., 2009 (more educated more likely to have physician contact) - Sibley and Weiner, 2011 (more educated more likely to have primary care provider contact) • Other Studies - Brooks-Gunn et al., 1998 (less educated have fewer ED visits) - Babalola and Fatusi, 2009 (more educated more likely to have ante-/postnatal care) - Giannakopoulos et al., 2010 (more educated more likely to have HSU contact) • Higher educated more likely to use primary health care services.

Table C.2. Rationale for the enabling factors included in the conceptual frameworks of maternal and child health service use

Enabling Factor	Literature Support
Neighbourhood mean family income	• Canadian Studies - Guttman et al., 2010 (positively associated with primary care provider contact) • Other Studies - Brooks-Gunn et al., 1998 (middle-income have more primary care provider and ED visits) • Mixed findings for different types of primary health care services and in different populations.
Neighbourhood proportion unemployed	• No literature on its relationship with HSU. • May be associated with the neighbourhood's social and physical structure that may influence HSU.
Neighbourhood proportion single parenthood	• No literature on its relationship with HSU. • May be associated with neighbourhood's social and physical structure, and health beliefs that may influence HSU.
Neighbourhood mean number of children per household	• No literature on its relationship with HSU. • May be associated with neighbourhood's social and physical structure, and health beliefs that may influence HSU.
Neighbourhood family physician density	• Canadian Studies - Guttman et al., 2010 (supply positively associated with primary care provider contact; negatively associated with ED rates) • Other Studies - Babalola and Fatusi, 2009 (reduced public health care facility supply less likely to have antenatal care) • Physician supply positively associated with primary care provider use and negatively associated with ED use.
Walk-in clinic and emergency department proximity	• Other Studies - Phelps et al., 2000 (caretakers brought children to ED because closer than regular care provider) - Ludwick et al., 2009 (living further from ED had fewer ED visits; living further from regular care provider had more ED visits) • Proximity to regular care provider and ED affects their use. • Not replicated in Canada.
Urban/rural residence	• Canadian Studies - Dunlop et al., 2000 (urban area more likely to have primary care provider contact) - Nabalamba and Millar, 2007 (null)

Enabling Factor	Literature Support
	- Ryan et al., 2011 (rural area less likely to have primary care provider contact) - Sibley and Weiner, 2011 (null) • Other Studies - Babalola and Fatusi, 2009 (urban area more likely to have ante-/postnatal care) - Giannakopoulos et al., 2010 (null) • People residing in urban areas more likely to have primary care provider contact, but not consistently shown in literature.
Household income	• Canadian Studies - Asada and Kephart, 2007 (higher income more likely to have primary care provider contact) - Blackwell et al., 2009 (null) - Dunlop et al., 2000 (null) - Kurtz Landy et al., 2008 (null) - Nabalamba and Millar, 2007 (higher income more likely to have PCP contact) - Ryan et al., 2011 (null) - Sibley and Weiner, 2011 (null) • Higher income more likely to have primary care provider contact, but not consistently shown in Canadian literature.
Maternal employment status	• Canadian Studies - Sibley and Weiner, 2011 (unemployed less likely to have primary care provider contact) • Unemployed less likely to have primary care provider contact, but not replicated in Canadian literature. • Proposed that employment may affect HSU through scheduling availability and through health status.
Maternal marital status	• Canadian Studies - Blackwell et al., 2009 (null) - Dunlop et al., 2000 (null) - Sibley and Weiner, 2011 (married more likely to have physician contact) • Other Studies - Brooks-Gunn et al., 1998 (single have fewer physician visits) - Cullen et al., 2009 (single more likely to have ED contact) - Zimmer et al., 2006 (single more likely to be high users of ED) • Married more likely to use health care services but not consistent in Canadian literature. • Parental marital status associated with pediatric HSU.
Maternal parity	• Other Studies - Babalola and Fatusi, 2009 (null)

Enabling Factor	Literature Support
	- Cullen et al., 2009 (more children less likely to have ED contact) • Mixed findings for different types of primary health care services and in different populations.
Access to vehicle	• No literature on its relationship with HSU. • Reasonable to hypothesize that this form of transportation is an important factor of the enabling component • Ludwick et al., 2009 studied proximity to public transit and HSU.
Regular care provider	• Canadian Studies - Blackwell et al., 2009 (having regular care provider more likely to have physician contact) - Dunlop et al., 2000 (having regular care provider more likely to have primary care provider contact) - Nabalamba and Millar, 2007 (having regular care provider more likely to have primary care provider contact) - Ryan et al., 2011 (having regular care provider more likely to have primary care provider contact) - Sibley and Weiner, 2011 (having regular care provider more likely to have primary care provider contact) • Having a regular care provider more likely to have a primary care provider contact.

Table C.3. Rationale for the need factors included in the conceptual frameworks of maternal and child health service use

Need Factors	Literature Support
Maternal health condition	• Canadian Studies - Asada and Kephart, 2007 (chronic conditions and poorer self-rated health more likely to have primary care provider contact) - Blackwell et al., 2009 (chronic conditions and poorer self-rated health more likely to have physician contact) - Dunlop et al., 2000 (poorer self-rated health more likely to have primary care provider contact) - Minkovitz et al., 2002 (poorer self-rated health associated with increased odds of child HSU) - Nabalamba and Millar, 2007 (chronic conditions and poorer self-rated health more likely to have primary care provider contact) - Sibley and Weiner, 2011 (chronic conditions and poorer self-rated health more likely to have physician contact) • Adults in poorer health and with chronic conditions more likely to use health care services. • Maternal health associated with child HSU.
Maternal BMI	• Canadian Studies - Asada and Kephart, 2007 (overweight more likely to have primary care provider contact) - Blackwell et al., 2009 (null) - Trakas et al., 1999 (obese more likely to be high primary care provider users) - Twells et al., 2010 and 2012 (obese have more primary care provider visits) • Obese adults generally are more likely to use health care services.
Maternal pregnancy status	• Canadian Studies - Asada and Kephart, 2007 (null) • Limited Canadian findings. • Proposed that recommended prenatal care throughout pregnancy would increase HSU.
Maternal depression	• Canadian Studies - Anderson et al., 2008 (null) - Asada and Kephart, 2007 (depressive symptoms more likely to have primary care provider contact) • Other Studies - Brooks-Gunn et al., 1998 (more depressive symptoms have more pediatric ED visits) - Cullen et al., 2009 (null)

Need Factors	Literature Support
	- Minkovitz et al., 2005 (depressive symptoms more likely to have pediatric ED contact) - Sills et al., 2007 (depression have higher pediatric PCP and ED rates) - Zimmer et al., 2006 (null) • Mixed findings for different types of primary health care services and in different populations.
Maternal anxiety	• Canadian Studies – Anderson et al., 2008 (null)
Child gestational age	• Other Studies - Petrou et al., 2003 (preterm children have more days in hospital) - Gray et al., 2006 (null, unadjusted analyses) - McLaurin et al., 2009 (preterm children have more days in hospital) • Evidence that preterm children are at increased risk for hospitalization. Proposed that relationship holds for use of primary health care services. Children born preterm may be at increased risk for morbidity in childhood, which may increase HSU.
Child size for gestational age	• Limited studies. Evidence that children born small for gestational age have increased risk for hospitalization. Size for gestational age may be associated with childhood morbidity, which may increase HSU.
Child birth anomaly	•
Child development and behaviour	• Limited studies. • Proposed that maternal concerns about child development and behaviour could result in consultation with primary care provider.
Child health condition	• Canadian Studies - Ryan et al., 2011 (chronic conditions more likely to have primary care provider contact) • Other Studies - Estabrooks and Shetterley, 2007 (obese have more urgent care visits) - Giannakopoulos et al., 2009 (chronic conditions more likely to have HSU contact) - Hering et al., 2009 (obese have more health clinic visits) - Janicke et al., 2001 (acute illness and pain have more HSU visits) - Minkovitz et al., 2002 (poorer rated health more likely to have HSU) • Children with physical health conditions are more likely to use health care services.

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Appendix D: Variable Measurement

Table D.1. Measurement of primary health service use

Outcome and Measurement	Components
Maternal primary health service use Primary health service use is defined as visits made to medical doctors who provide patients' first contact with the health care system. Mothers who reported visiting a regular care provider, walk-in clinic and/or emergency department in the previous two months were classified as having used a primary health care service.	*Maternal regular care provider use* Regular care provider use is defined as visits made to the medical doctor who provides patients' first contact with the health care system and ongoing medical care. Mothers who reported visiting a family physician during the previous two months were classified as having used a regular care provider.
	Maternal walk-in clinic use Mothers who reported visiting a walk-in clinic during the previous two months were classified as using a walk-in clinic.
	Maternal emergency department use Mothers who reported visiting an emergency department during the previous two months were classified as using an emergency department.
Child primary health service use Child primary health service use is defined in the same way as the maternal counterpart. Children whose mothers reported them visiting a regular care provider, walk-in clinic and/or emergency department in the previous two months were classified as having used a primary health care service. In addition, 25 mothers reported their children visiting a pediatrician who is the child's regular care provider (defined below). These 25 children were classified as using a primary health care service.	*Child regular care provider use* Regular care provider use is defined in the same way as the maternal counterpart. Children whose mothers reported them visiting a family physician during the previous two months were classified as having used a regular care provider. In addition, 25 children visited a pediatrician who was identified as fitting the definition of a regular care provider.
	Child walk-in clinic use Children whose mothers reported them visiting a walk-in clinic during the previous two months were classified as using a walk-in clinic.
	Child emergency department use Children whose mothers reported them visiting an emergency department during the previous two months were classified as using an emergency department.

Table D.2. Measurement of predisposing factors conceptually related to maternal and child primary health service use

Predisposing Factor	Data Source	Measurement
Neighbourhood proportion of immigrants	Geographic	Measured in two ways: 1) Proportion of immigrants per dissemination area and 2) Proportion of recent (within five years) immigrants per dissemination area.
Neighbourhood proportion without high school	Geographic	Measured. Percentage of residents aged 15 and older per dissemination area without a high school diploma.
Neighbourhood green space density	Geographic	Measured. Percentage of green space per dissemination area, defined as parks and woodlands.
Neighbourhood walkability score	Geographic	Measured. Ease of walking ability in census tract defined for example, by sidewalks and traffic.
Public recreational facility proximity	Geographic	Measured. Distance in metres from residential address to the nearest public recreational facility.
Season	Toddler-preschooler survey	Derived. Season in which the Child Stage Survey was administered determined by the survey month. Calendar year was partitioned into quarters: winter (January-March), spring (April-June), summer (July-September), fall (October-December).
Maternal age	Prenatal and toddler-preschooler surveys	Derived. Maternal age in years at the child stage was calculated as the difference in the date of Child Stage Survey administration and the mother's date of birth recorded at the prenatal stage.
Child age	Perinatal and toddler-preschooler surveys	Derived. Child age in months at the child stage was calculated as the difference in the date of Child Stage Survey administration and the child's date of birth recorded perinatally.
Child sex	Perinatal survey	Measured. Documented as male or female.
Maternal nativity	Prenatal survey	Measured. Mothers reported what country they were born in. Responses were categorized as being native to Canada or not.
Maternal education	Prenatal survey	Measured. Mothers selected their highest level of completed education from the following options: elementary school, some high school, completed high school, some college or university, college diploma, university degree, trade school, other. Reponses were categorized into four groups: less than high school, high school, college/trade school, university or more.

Table D.3. Measurement of enabling factors conceptually related to maternal and child primary health service use

Enabling Factor	Data Source	Description
Neighbourhood mean family income	Geographic	Measured. Mean family income per dissemination area.
Neighbourhood proportion unemployed	Geographic	Measured. Proportion of unemployed residents aged 15 and older per dissemination area.
Neighbourhood proportion single parenthood	Geographic	Measured. Proportion of single parents per dissemination area.
Neighbourhood mean children per household	Geographic	Measured. Mean number of children per household per dissemination area.
Neighbourhood family physician density	Geographic	Derived. Forward sortation area density of family physicians per population size and per km^2.
Walk-in clinic proximity	Geographic	Measured. Distance in metres from residential address to the nearest walk-in clinic or urgent care centre.
Emergency department proximity	Geographic	Measured. Distance in metres from residential address to the nearest emergency department or hospital.
Urban/rural residence	Geographic	Measured. Binary categorization of residence as urban or rural.
Household income	Toddler-preschooler survey	Measured. Mothers reported the total income of all household members from all sources before taxes and deductions for the previous year. Responses were categorized into five groups: <$30,000; $30,000-39,999; $40,000-59,999; $60,000-79,999; $80,000+.
Maternal employment status	Toddler-preschooler survey	Measured. Mothers selected their employment status from the following options: full time, part time, maternity leave, self-employed, leave of absence, looking for work, unemployed, homemaker, student. Responses were categorized into three groups: full time/self-employed, part time, other.
Maternal marital status	Toddler-preschooler survey	Measured. Mothers selected their marital status from the following options: married, common law, single/never married, separated/divorced, widowed. Responses were categorized into two groups: married/common law, single/equivalent.
Maternal parity	Prenatal and toddler-	Derived. The total number of live births from the Prenatal Stage Survey and the number of

Enabling Factor	Data Source	Description
	preschooler survey	additional children since that stage as recorded on the toddler/preschooler survey.
Access to vehicle	Toddler-preschooler survey	Measured. Mother report of having regular use of car.
Maternal regular care provider	Toddler-preschooler survey	Derived. Mothers reported if they had a regular family doctor and if not, who was looking after them at that time. Responses were classified as having a regular care provider if they had a regular family doctor or if the source looking after them was a medical doctor who provided first contact with the health care system and ongoing care (six women in the latter situation: health unit, immigrant health clinic, seeing child's, student clinic).
Child regular care provider	Toddler-preschooler survey	Derived. Mothers reported if their child had a regular family doctor and if not, who as looking after their child at that time. Responses were classified as having a regular care provider if the child had a regular family doctor or if a pediatrician was identified as the medical doctor looking after the child's medical care (60 children in the latter situation).

Table D.4. Measurement of need factors conceptually related to maternal and child primary health service use

Need Factor	Data Source	Description
Maternal health condition	Prenatal and perinatal stages	Derived. Dichotomous measure of health conditions reported prenatally and perinatally that could be reflective of an underlying chronic diagnosis, which would require ongoing use of health care services at the child stage. See Appendix F for details.
Maternal BMI	Prenatal and toddler-preschooler survey	Derived. Calculated from maternal reported prenatal height and weight at child stage (kg/m^2).
Maternal pregnancy status	Toddler-preschooler survey (tracking database)	Derived from notes of the Tracking database that indicated if women were pregnant at the child stage.
Maternal depression	Toddler-preschooler survey	Measured. Score on the Centre for Epidemiological Studies Depression scale.
Maternal anxiety	Toddler-preschooler survey	Measured. Score on the State-Trait Anxiety Inventory.
Child gestational age	Perinatal stage	Derived. Collected by mid-trimester ultrasound assessment records, self-reported last menstrual period, and delivery chart abstraction. Gestational age in weeks from delivery chart was used when estimates from the three collection methods agreed within one week. For estimates that disagreed, best estimate of gestational age based on available clinical data was determined by an expert. Gestational age may be categorized where infants born less than 37 weeks gestation are preterm and those born 37 weeks gestation or later are term.
Child size for gestational age	Perinatal stage	Derived using gestational age in weeks and birth weight in grams, according to Kramer's sex-specific cutoffs. Categorized into groups of small for gestational age (<10^{th} percentile), adequate for gestational age (10^{th}-90^{th} percentile) and large for gestational age (>90^{th} percentile) (Kramer et al., 2001).
Child birth anomaly	Perinatal stage	Measured. Perinatally reported whether birth anomaly was observed.
Perinatal health status	Perinatal stage	Derived. Children with one of more of the following were categorized as having a perinatal

Need Factor	Data Source	Description
		need: preterm birth, low birth weight, macrosomia, small for gestational age, large for gestational age, congenital anomaly.
Child development and behaviour	Toddler-preschooler survey	Derived. Dichotomous measure of child developmental and/or behavioural concerns derived from responses of the Ages and Stages Questionnaire and Functional Status II (R). See Appendix G for list of concerns included in this measure.
Child health condition	Toddler-preschooler survey	Derived. Dichotomous measure of child health condition derived from responses of the Ages and Stages Questionnaire, Functional Status II (R) and Liberatos' measure of unmet health care needs for pediatric populations. See Appendix G for list of health conditions included in this measure.

Appendix E: Prenatal Health Project Surveys

Table E.1 Questions from the PHP Prenatal Survey used to measure variables considered in this thesis

Question	Variable
1. What is your date of birth	Maternal age
5. How tall are you without shoes	Maternal BMI
10. I'm going to read a list of health conditions. For each, please say 'yes' if you currently have the condition or have had the condition in the past. If you do not have them, or have never had the condition please respond with 'no'	Maternal health condition
49. What country were you born in?	Maternal nativity
54. What is the highest level of formal education you have completed?	Maternal education

Table E.2 Questions from the PHP Perinatal Survey used to measure variables considered in this thesis

Question	Variable
Mom's DOB	Maternal age
Delivery date	Child age
Gestational age	Child gestational age Child size for gestational age
Infant weight	Child size for gestational age
Infant female or male	Child sex
Infant congenital abnormality observed	Child birth anomaly
Other risk factors during pregnancy	Maternal health condition

Table E.3 Questions from the PHP Toddler/Preschooler Survey used to measure variables considered in this thesis

Question	Variable
1. What is your year of birth?	Maternal age
2. Do you have regular use of a car?	Access to a vehicle
4. What is your current marital status?	Maternal marital status
5. We have been following you regarding your child born on [date]. Have you had any other children since then?	Maternal parity
6. How much do you weigh currently?	Maternal BMI
15. Do you have a regular family doctor?	Maternal regular care provider
16. Does your child have a regular family doctor?	Child regular care provider
17. In the last two months, how many visits have you and your child had with a: family physician; walk-in clinic; emergency room; paediatrician?	Maternal P-HSU, child P-HSU
20. Have you had any difficulties accessing available services due to limited hours of operation, long wait time for an appointment, unable to get an appointment, transportation problems, childcare needed or any other difficulties?	Perceived unmet primary healthcare need
21. Please indicate which service you were unable to access (e.g. family physician, walk-in clinic, emergency room, other medical doctors).	Perceived unmet primary healthcare need
29-36. Liberatos measure of unmet need	Child health condition Perceived unmet healthcare need
38-39. FSII-R	Child development and/or behaviour issue Child health condition
40. ASQ	Child development and/or behaviour issue Child health condition
64. STAI	Maternal anxiety
65. CES-D	Maternal depression
76. What is your current employment status?	Maternal employment status
84. What is your best estimate of the total income of all members of your household from all sources before taxes and deductions for the past year? By total income I mean total gross income from paid employment, government assistance, student loans or inheritance. Was the total income…	Household income

Appendix F: Measurement of Maternal Health Condition

Measurement of maternal health condition

The Maternal Health Conditions Survey was developed to determine which health conditions reported during the prenatal and perinatal stages could be representative of maternal need to utilize health care services during the toddler/preschooler stage. The survey was administered to four family physicians located in London, Ontario. The following guidelines were applied in rendering a decision about each reported health condition when consensus was not reached.

Responses	Decision
3 Yes, 1 Maybe	Yes
3 Yes, 1 No	Yes
2 Yes, 2 Maybe	Yes
2 Yes, 1 Maybe, 1 No	Yes
3 Maybe, 1 Yes	Yes
3 No, 1 Maybe	No
3 No, 1 Yes	No
2 No, 1 Maybe, 1 Yes	No
2 Maybe, 1 Yes, 1 No	No
2 Yes, 2 No	Drop (n=6)

Following is the Maternal Health Conditions Survey. Based on survey results, health conditions that are considered to represent a need for health care services by mothers are marked (X) in the “yes” column.

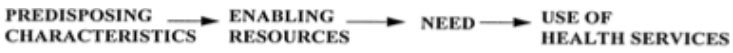
Maternal Health Conditions Survey

Catherine Moon: MSc, PhD Candidate
[redacted]

June 16, 2011

Dear Dr. _____,

Catherine Moon is PhD Candidate with the Department of Epidemiology & Biostatistics. Her research focuses on the relationships between maternal and child primary health system utilization (HSU). The conceptual framework of the Andersen Behavioural Model of HSU is being applied which involves predisposing, enabling and need components (Figure).



Ms. Moon is using data from the Prenatal Health Project (Principle Investigator: Dr. Karen Campbell). While pregnant, women were asked to report any past or current health conditions. Mother-child pairs were followed-up approximately four years postpartum at which time their primary HSU was captured.

The goal of the Maternal Health Conditions Survey is to develop a variable representative of mothers' self-reported morbidity burden, to be included in data analysis for Ms. Moon's PhD thesis. Your assistance is requested in determining, from a list of maternal health conditions reported pre/perinatally, those which would represent a need for HSU four years postpartum.

The survey should take between 10 and 15 minutes to complete. You may complete the survey in any location that is convenient for you. There are no known harms in completing this survey. Survey results may benefit the research performed by Ms. Moon which in turn may shed light on maternal and child HSU in a Canadian population.

Participation in this study is voluntary. You may refuse to participate, refuse to answer any questions of withdraw from the study at any time with no effect on your future. Your confidentiality will be respected. No information that discloses your identity will be released or published. By responding to and returning the survey, you provide consent to participate.

Please return the survey upon completion to Catherine Moon in the Campus Mail envelope provided. Please do not hesitate to contact the research office if you have any questions or concerns. If you have any questions about your rights as a research participant or the conduct of the study please contact the Office of Research Ethics at [redacted]

Sincerely,

Catherine Moon
Cc. Advisory Committee: Drs. Karen Campbell, Jason Gilliland, Amardeep Thind, Piotr Wilk

Maternal Health Conditions Survey

Catherine Moon, MSc.
Department of Epidemiology & Biostatistics
[redacted]

Instructions:

For each of the reported maternal health conditions listed, please respond to the following question by selecting "Yes", "No" or "Maybe" (comments may be included in additional space).

"Could the following health condition that was reported pre/perinatally, represent a *perceived* or *actual* need for health care services four years postpartum?"

Assumptions:

1) For conditions that have a definitive treatment after which health care is not required (e.g. gallstones), *please assume that the definitive treatment was offered and was successful*.

2) For conditions related to pregnancy (e.g. gestational diabetes), *please assume the best outcome in that the health condition resolved postpartum*.

Please return survey to Catherine Moon in the Campus Mail envelope provided.

Maternal Health Condition (Pre/Perinatal)	Yes	No	Maybe	Comments
BLOOD				
anemia	X			
antibody coagulant problem	X			
antiphospholipid syndrome	X			
clots	X			
clotting abnormality	X			
factor 5 deficiency	X			
hypercholesterolemia	X			
hypoglycemia	X			
low platelet count	X			
low RBC count	X			
microcytosis				
platelet disorder	X			
porphyria	X			
protein S deficiency	X			
prothrombin gene mutation	X			
sickle cell trait	X			
thalassemia minor	X			
thalassemia trait	X			
thrombocytopenia	X			
toxemia				
CANCER				
breast cancer	X			
Hodgkin's lymphoma	X			
leukemia	X			
skin cancer	X			
EYE				
eye health deteriorating	X			
proliferative retinopathy	X			
vision loss	X			
GALLBLADDER				

Maternal Health Condition (Pre/Perinatal)	Yes	No	Maybe	Comments
cholecystitis				
gallstones				
gallbladder attacks				
gallbladder condition				
gallbladderremoved				
polyps				
GASTROINTESTINAL				
acid reflux	X			
analsphincterotomy				
bowel obstruction				drop
celiac disease	X			
colitis	X			
crohn's disease	X			
gastric ulcer				
gastroesophageal reflux disease	X			
hemolytic uremic syndrome	X			
irritable bowel syndrome	X			
ulceratedproctitis	X			
ulcerative colitis	X			
HEART				
absent end diastolic flow	X			
bundle branch block	X			
heart condition	X			
heart palpitations	X			
heart surgery as a child	X			
mitral regurgitation	X			
pericardial effusion	X			
pericarditis	X			
tachycardia	X			
Wolff-Parkinson-White syndrome				
INFECTION				

Maternal Health Condition (Pre/Perinatal)	Yes	No	Maybe	Comments
chlamydia				
chronic bladder	X			
ear				
hepatitis A				drop
hepatitis B	X			
hepatitis C	X			
herpes	X			
meningitis				
mononucleosis				
respiratory infection				
streptococcus B				
urinary tract				
vaginosis				
yeast infection				
INFLAMMATORY				
appendicitis				
arthritis	X			
bursitis				
endometriosis	X			
pancreatitis	X			
sinusitis	X			
symphysispubitis				
chronic inflammatory demyelinating polyneuropathy	X			
multiple sclerosis	X			
myelitis	X			
INJURY/PAIN				
arm injury	X			
back pain	X			
knee injury	X			
leg injury	X			

Maternal Health Condition (Pre/Perinatal)	Yes	No	Maybe	Comments
Osgood disease				
KIDNEY				
alports syndrome	X			
colic kidney	X			
dialysis dependent	X			
duplex kidney				drop
hydronephrosis	X			
has one kidney only	X			
kidney damage	X			
kidney condition	X			
kidney function low	X			
kidney malfunction	X			
kidney stones	X			
kidney transplant	X			
nephroptosis	X			
polycystic kidney	X			
proteinuria	X			
pyelonephritis				
METABOLIC				
cystinuria	X			
diabetes	X			
glucose intolerance	X			
hypophosphatasia	X			
insulin resistant	X			
lactose intolerant	X			
MUSCULAR				
fibroids				
fibromyalgia	X			
Thomsen's disease	X			
NEUROLOGICAL				
chronic fatigue syndrome	X			

Maternal Health Condition (Pre/Perinatal)	Yes	No	Maybe	Comments
epilepsy	X			
genetic cerebellar degeneration	X			
intracranial hypertension	X			
seizures	X			
NEUROMUSCULAR/VASCULAR				
carpal tunnel syndrome				
chronic headaches	X			
dystonia	X			
migraines	X			
myasthenia gravis	X			
sciatica	X			
FEMALE REPRODUCTIVE SYSTEM				
infertility	X			
menstrual pains	X			
polycystic ovaries	X			
uterusbicornate				
uterus heart shaped				
PITUITARY				
excess prolactin production	X			
prolactinoma	X			
RESPIRATORY				
asthma	X			
bronchial spasms	X			
bronchitis	X			
trouble breathing at night	X			
virus induced asthma	X			
SKELETAL				
geneticosteochondromatosis	X			
back surgery				
curve in spine	X			

Maternal Health Condition (Pre/Perinatal)	Yes	No	Maybe	Comments
genetic disc disease	X			
scoliosis	X			
spondylolisthesis	X			
SKIN				
acne	X			
chronicurticaria	X			
dry skin				
ectodermal dysplasia	X			
eczema	X			
hives	X			
papular dermatitis	X			
psoriasis	X			
puerperalurticaria	X			
rosacea	X			
vaginal eczema	X			
SYSTEMIC				
lupus	X			
rheumatoid arthritis	X			
THYROID				
ablation				drop
decreased thyroid function	X			
goitre	X			
Grave's disease	X			
hyperthyroidism	X			
hypothyroidism	X			
thyroid condition	X			
thyroid cyst				drop
thyroid tumor	X			
VASCULAR				
brain aneurysm	X			
deep vein thrombophlebitis	X			

Maternal Health Condition (Pre/Perinatal)	Yes	No	Maybe	Comments
genital varicosities				
low blood pressure	X			
portal vein thrombosis	X			
pulmonaryembolli	X			
Raynaud's phenomenon	X			
stroke	X			
varicose veins				
Von Willebrand disease	X			
MISCELLANEOUS				
cardiovascular disease	X			
eating disorder	X			
excess pregnancy weight gain	X			
hernia				
learning disorder	X			
lesion on liver	X			
overweight	X			
neuropathologicaldisorder				
spina bifida occulta				drop
stress disorder	X			
ulcer (non specified)	X			

Appendix G: Measurement of Child Health

Table G.1. Measurement of child development/behaviour and health conditions during the Child Stage Survey

Need	Frequency
Development and/or Behaviour issue	225/1607 (14.00%)
Child health condition*	1001/1607 (62.29%)
(Physical health condition + symptomatic)	
Symptomatic	*750/1607 (46.73%)*
Physical health condition	*503/1607 (31.30%)*

*Frequency exceeds the summation of the two measurements because children may have one or both.

Table G.2. Responses from the FSII-(R) and ASQ contributing to the measurement of child development and/or behaviour issue

Development and/or Behaviour issue	Frequency*
speech development	153
behaviour concern (non-specified)	41
Eating behaviour	34
Sleeping behaviour	12
toileting	10
developmental delay	4
psychological concern (non-specified)	4
attention deficit hyperactivity disorder	1
autism	1

*Frequency may exceed 225 because children may have more than one development and/or behaviour issue.

Table G.3. Symptoms captured by Liberatos' measure of unmet health care needs contributing to the measurement of child health condition

Symptom	Frequency*
vomiting	111
coughing	539
fever	192
diarrhea	141
constipation	89
weight loss	17

*Frequency may exceed 750 because children may have more than one symptom.

Table G.4. Responses from the FSII-(R) and ASQ contributing to the measurement of child health condition

Physical health condition	Frequency*	Physical health condition	Frequency*
ear infection	68	colour blind	6
vision concern	50	reactive airway	6
allergy	49	skin rash	6
cold and flu	41	tonsilitis	6
physical development	41	bowels	5
asthma	39	bladder/urinary tract infection	4
hearing concern	20	fever	4
pneumonia	20	febrile seizure	3
constipation	18	fluid in ear	3
respiratory infection	17	reaction to bite	3
injury	16	blind	2
weight (under/over)	15	cold sore	2
croup	13	diabetes	2
heart condition	13	dietary restriction	2
throat infection	13	Down's syndrome	2
dental problems	10	fifths disease	2
diarrhea	10	global medical delay	2
eye infection	10	hearing impaired	2
eczema	9	low iron	2
respiratory issue	9	skin condition	2
chicken pox	8	sleep apnea	2
eye sight	8	small sized	2
adenoids and tonsils	7		

* Frequency may exceed 503 because children may have more than one physical health condition.
**Reported health conditions with a frequency of one: athletes foot, bacterial infection, bloody stool bowel clog from HUS, bowel interception, cancer, cerebral seizure, chiari 1 malformation, compensated hydrocephalus, conjunctivitis, cranial synistosis, dehydration incident, enlarged ventricles in brain, epilepsy, excessive blinking, excessive thirst, failure to thrive, foot and mouth disease, gag reflex, kidney damage, heart disease, herniated belly button, hypotonia, immune problems, jock itch, kidney reflux, lump on scrotum, meningitis, metopic sutercranio-synostosis, norwalk virus, operation on head, oral herpes, orthotics, osteomyelitis, otitis media, overactive glands, problems from invasive strep A, sensory integration dysfunction, skin infection, strawberry spot, surgery for ENT, surgery for hearing, surgery for lazy eye, surgery for thumb, surgery for undescended testicle, surgery on testicles, tear duct not opening, vaginal discharge, vertigo issue, viral dehydration, virus, vomiting, wax in ears.

Appendix H: Preliminary Statistics

Table H.1. Proportion of children and mothers using primary health care services

	By children	By mothers
Primary Health Care Service Use *(Outcome of interest)*	783/1606 (48.75%)	855/1586 (53.91%)
Primary Care Provider Use	728/1606 (45.33%)	833/1589 (52.42%)
Walk-in Clinic Use	255/1607 (15.87%)	177/1598 (11.08%)
Emergency Department Use	171/1607 (10.64%)	96/1598 (6.01%)

Table H.2. Descriptive statistics of categorical independent variables

Variable	Proportion (%)	Percentage of children in category with HSU	Percentage of mothers in category with HSU
Maternal nativity			
born in Canada	1395/1605 (86.92%)	48.67%	53.47%
born outside Canada	210/1605 (13.08%)	49.05%	51.90%
Maternal education			
less than high school	47/1604 (2.93%)	48.94%	61.70%
high school	308/1604 (19.20%)	50.32%	58.44%
college or trade	543/1604 (33.85%)	49.17%	55.80%
university or more	706/1604 (44.01%)	47.59%	48.44%
Child sex			
female	795/1604 (49.56%)	46.54%	52.33%
male	809/1604 (50.44%)	50.93%	54.14%
Season			
winter	611/1607 (38.02%)	51.88%	53.85%
spring	455/1607 (28.31%)	47.47%	52.97%
summer	207/1607 (12.88%)	45.41%	52.66%
fall	334/1607 (20.78%)	46.71%	52.69%
Family income			
<$30,000	102/1483 (6.88%)	50.98%	59.80%
$30,000-39,999	84/1483 (5.66%)	64.29%	54.76%
$40,000-59,999	170/1483 (11.46%)	51.18%	58.24%
$60,000-79,999	344/1483 (23.20%)	49.13%	55.23%
$80,000+	783/1483 (52.80%)	45.59%	49.30%
Maternal employment			
fulltime/self-employed	723/1602 (45.13%)	52.56%	54.08%
part time	312/1602 (19.48%)	43.91%	50.32%
other	567/1602 (35.39%)	46.56%	53.44%
Maternal marital status			
married or common-law	1464/1605 (91.21%)	48.57%	52.73%
single or equivalent	141/1605 (8.79%)	50.35%	58.16%
Access to vehicle			
yes	1483/1607 (92.28%)	48.42%	52.93%
no	124/1607 (7.72%)	52.42%	56.45%
Maternal RCP			
yes	1540/1607 (95.83%)	48.96%	53.64%
no	67/1607 (4.17%)	43.28%	43.28%

Variable	Proportion (%)	Percentage of children in category with HSU	Percentage of mothers in category with HSU
Child RCP			
yes	1586/1607 (98.69%)	48.74%	53.47%
no	21/1607 (1.31%)	47.62%	33.33%
Residence			
urban	1328/1589 (83.57%)	49.02%	52.96%
rural	261/1589 (16.43%)	47.31%	58.75%
Maternal health condition			
yes	733/1601 (45.78%)	50.34%	57.98%
no	868/1601 (54.22%)	47.70%	49.54%
Maternal pregnancy			
yes	100/1607 (6.22%)	53.00%	76.00%
no	1507/1607 (93.78%)	48.44%	51.69%
Size for gestational age			
small	104/1600 (6.5%)	46.15%	44.23%
appropriate	1291/1600 (80.69%)	48.80%	53.29%
large	205/1600 (12.81%)	49.27%	56.59%
Congenital anomaly			
yes	75/1607 (4.67%)	53.33%	58.67%
no	1532/1607 (95.33%)	48.50%	52.94%
Perinatal need			
yes	505/1606 (31.44%)	49.90%	54.65%
no	1101/1606 (68.56%)	48.14%	52.50%
Child development and behaviour			
yes	225/1607 (14.00%)	52.44%	56.89%
no	1382/1607 (86.00%)	48.12%	52.60%
Child health condition			
yes	1001/1607 (62.29%)	57.34%	56.24%
no	606/1607 (37.71%)	34.49%	48.18%

Table H.3. Descriptive statistics of continuous independent variables

Variable	Mean (SD)	Mean (SD) in children with HSU	Mean (SD) in mothers with HSU
Maternal age (years)	33.87 (4.7568)	33.52 (4.789)	33.46 (4.680)
Child age (months)	34.11 (5.610)	33.61 (5.680)	33.99 (5.525)
Neighbourhood % of immigrants	18.55 (9.042)	18.61 (9.006)	18.19 (9.0742)
Neighbourhood % with no education	16.19 (8.322)	16.23 (8.287)	15.97 (8.259)
Neighbourhood % of green space	2.65 (7.977)	2.61 (8.343)	2.77 (8.326)
Proximity recreational facility (metres)	4282.71 (2167.467)	4138.1 (2498.9)	4112.4 (2643.5)
Neighbourhood average family income ($)	85,462.96 (39,077.214)	84,077.1 (37,477.9)	83,163.8 (35,635.9)
Neighbourhood unemployment rate	5.44 (3.946)	5.46 (4.005)	5.32 (3.918)
Neighbourhood % of lone parenthood	13.99 (10.573)	14.26 (10.759)	14.10 (10.638)
Neighbourhood average number of children	1.11 (0.340)	1.11 (0.336)	1.10 (0.344)
Walkability score	23.47 (8.652)	21.56 (10.165)	21.73 (10.456)
Number of family physicians in FSA	25.64 (29.507)	25.39 (27.575)	24.59 (27.356)
Proximity to WIC (metres)	3886.32 (6810.741)	3952.3 (7216.2)	4251.6 (7737.3)
Proximity to ED (metres)	5116.57 (5948.723)	5190.8 (6482.3)	5382.4 (6460.2)
Maternal BMI	25.30 (5.1317)	25.46 (5.274)	25.83 (5.350)
CES-D score	8.71 (7.9196)	9.05 (7.864)	9.52 (8.478)
STAI score	19.19 (5.1873)	19.54 (5.227)	19.51 (5.517)
Gestational age (weeks)	39.04 (1.7098)	39.04 (1.612)	38.98 (1.740)

Table H.4. Frequencies of categorical variables from PHP (N=1607) and geographic data sources (N=1452).

Variable	**N=1607**	**N=1452**	
HSU	**Frequency (%)**	**Frequency (%)**	**P-value of Chi-square statistic**
Maternal HSU			
yes	854/1586 (53.85)	765/1432 (53.42)	0.8154
no	732/1586 (46.15)	667/1432 (46.58)	
Child HSU			
yes	783/1606 (48.75)	709/1451 (48.86)	0.9524
no	823/1606 (51.25)	742/1451 (51.14)	
PREDISPOSING	**Frequency (%)**	**Frequency (%)**	**P-value of Chi-square statistic**
Child sex			
female	795/1604 (49.56)	725/1448 (50.07)	0.7803
male	809/1604 (50.44)	723/1448 (49.93)	
Maternal nativity			
born in Canada	1395/1605 (86.92)	1265/1449 (87.30)	0.7509
born outside Canada	210/1605 (13.08)	184/1449 (12.70)	
Maternal education			
less than high school	47/1604 (2.93)	45/1448 (3.11)	0.9653
high school	308/1604 (19.20)	286/1448 (19.75)	
college or trade	543/1604 (33.85)	489/1448 (33.77)	
university or more	706/1604 (44.01)	628/1448 (43.37)	
Season			
winter	611/1607 (38.02)	549/1451 (37.84)	0.9792
spring	455/1607 (28.31)	404/1451 (27.84)	
summer	207/1607 (12.88)	193/1451 (13.30)	
fall	334/1607 (20.78)	305/1451 (21.02)	

Variable	N=1607	N=1452	
ENABLING	**Frequency (%)**	**Frequency (%)**	**P-value of Chi-square statistic**
Maternal household income			
<$30,000	102/1483 (6.88)	96/1335 (7.19)	0.9906
$30,000-39,999	84/1483 (5.66)	72/1335 (5.39)	
$40,000-59,999	170/1483 (11.46)	152/1335 (11.39)	
$60,000-79,999	344/1483 (23.20)	316/1335 (23.67)	
$80,000+	783/1483 (52.80)	699/1335 (52.36)	
Maternal household income			
<$40,000	186/1483 (12.54)	168/1335 (12.58)	0.9712
$40,000-79,999	514/1483 (34.66)	468/1335 (35.06)	
$80,000+	783/1483 (52.80)	699/1335 (52.36)	
Neighbourhood average income			
<$41,130	n/a	31/1452 (2.13)	n/a
$41,130-82,258		694/1452 (47.80)	
$82,259+		727/1452 (50.07)	
Maternal employment status			
fulltime/self-employed	723/1602 (45.13)	647/1446 (44.74)	0.9479
part time	312/1602 (19.48)	279/1446 (19.29)	
other	567/1602 (35.39)	520/1446 (35.96)	
Maternal marital status			
married or common-law	1464/1605 (91.21)	1317/1449 (90.89)	0.7535
single or equivalent	141/1605 (8.79)	132/1449 (9.11)	
Maternal parity			
1	441/1605 (27.48)	406/1449 (28.02)	0.9406
2	851/1605 (53.02)	763/1449 (52.66)	
3	231/1605 (14.39)	212/1449 (14.63)	
4+	82/1605 (5.11)	68/1449 (4.69)	

Variable	**N=1607**	**N=1452**	
ENABLING	**Frequency (%)**	**Frequency (%)**	**P-value of Chi-square statistic**
Maternal access to vehicle			
yes	1483/1607 (92.28)	1335/1451 (92.01)	0.7751
no	124/1607 (7.72)	116/1451 (7.99)	
Maternal RCP			
yes	1534/1607 (95.46)	1384/1451 (95.38)	0.9212
no	73/1607 (4.54)	67/1451 (4.62)	
Child RCP			
yes	1586/1607 (98.69)	1432/1451 (98.69)	0.9948
no	21/1607 (1.31)	19/1451 (1.13)	
Neighbourhood PCP supply			
1-999	n/a	363/1445 (25.12)	n/a
1000-1999		617/1445 (42.70	
2000-2999		280/1445 (19.38)	
3000+		185/1445 (12.80)	
Residence			
urban	n/a	1306/1452 (89.94)	n/a
rural		146/1452 (10.06)	
NEED	**Frequency (%)**	**Frequency (%)**	**P-value of Chi-square statistic**
Maternal health condition			
yes	733/1601 (45.78)	662/1451 (45.62)	0.9293
no	868/1601 (54.22)	789/1451 (54.38)	
Maternal pregnancy			
yes	100/1607 (6.22)	89/1451 (6.13)	0.9186
no	1507/1607 (93.78)	1362/1451 (93.87)	

Variable	**N=1607**	**N=1452**	
NEED	**Frequency (%)**	**Frequency (%)**	**P-value of Chi-square statistic**
Maternal BMI			
underweight	35/1518 (2.31)	31/1367 (2.27)	0.9956
normal weight	820/1518 (54.02)	733/1367 (53.62)	
overweight	436/1518 (28.72)	395/1367 (28.90)	
obese	227/1518 (14.95)	208/1367 (15.22)	
Maternal depression			
yes	235/1569 (14.98)	212/1417 (14.96)	0.9899
no	1334/1569 (85.02)	1205/1417 (85.04)	
Maternal anxiety			
<10th percentile	201/1581 (12.71)	179/1426 (12.55)	0.9677
10th-90th percentile	1197/1581 (75.71)	1078/1426 (75.60)	
>90th percentile	183/1581 (11.57)	169/1426 (11.85)	
Size for gestational age			
small	104/1600 (6.5)	91/1444 (6.30)	0.9446
appropriate	1291/1600 (80.69)	1172/1444 (81.16)	
large	205/1600 (12.81)	181/1444 (12.53)	
Birth anomaly			
yes	75/1607 (4.67)	67/1451 (4.62)	0.9481
no	1532/1607 (95.33)	1384/1451 (95.38)	
Perinatal need			
yes	436/1606 (27.15)	390/1450 (26.90)	0.8757
no	1170/1606 (72.85)	1060/1450 (73.10)	
Child development/behaviour			
yes	225/1607 (14.00)	203/1451 (13.99)	0.9931
no	1382/1607 (86.00)	1248/1451 (86.01)	

Variable	**N=1607**	**N=1452**	
NEED	**Frequency (%)**	**Frequency (%)**	**P-value of Chi-square statistic**
Child health condition			
yes	1001/1607 (62.29)	906/1451 (62.44)	0.9320
no	606/1607 (37.71)	545/1451 (37.56)	

Summary of analyses:

- Compared the frequencies of categorical variables from the PHP data source and from the geographic data source, to see if there were significant differences between the mother-child pairs who completed the child stage of the PHP (N=1607) and those who were linked to the geographic database (N=1452).
- Used a chi-square test statistic to compare the frequencies. There were no significant differences in the frequencies of categorical variables ($p<0.05$).

Table H.5. Descriptive statistics of continuous variables from PHP (N=1607) and geographic data sources (N=1452).

Variable	N=1607			N=1452			
PREDISPOSING	**Mean (SD)**	**Median**	**Skewness**	**Mean (SD)**	**Median**	**Skewness**	**t-test statistic***
Maternal age (years)	33.85 (4.753)	33.90	-0.0912	33.84 (4.797)	33.80	-0.0622	0.0578
Child age (months)	34.11 (5.61)	34.00	0.8295	34.08 (5.636)	34.00	0.8747	0.1473
Recreational facility proximity (metres)	n/a	n/a	n/a	4383.05 (2066.598)	4344.90	0.3599	n/a
Neighbourhood % of immigrants	n/a	n/a	n/a	19.75 (8.241)	19.30	0.3881	n/a
Neighbourhood % visible minority	n/a	n/a	n/a	11.57 (9.919)	9.42	1.0025	n/a
Neighbourhood % without high school	n/a	n/a	n/a	16.59 (7.531)	15.38	0.8271	n/a
Neighbourhood green space density	n/a	n/a	n/a	2.62 (7.487)	0.00	3.9349	n/a
Walkability score	n/a	n/a	n/a	23.25 (8.537)	22.00	0.2960	n/a
ENABLING	**Mean (SD)**	**Median**	**Skewness**	**Mean (SD)**	**Median**	**Skewness**	**t-test statistic***
Neighbourhood mean family income ($)	n/a	n/a	n/a	89,646.01 (36,011.512)	82,259.00	1.9950	n/a
Neighbourhood % unemployed	n/a	n/a	n/a	5.69 (3.868)	5.25	1.1252	n/a
Neighbourhood % of single parenthood	n/a	n/a	n/a	14.70 (10.357)	13.24	0.8870	n/a
Neighbourhood mean # of children per household	n/a	n/a	n/a	1.16 (0.253)	1.10	-0.0081	n/a
Neighbourhood FP density	n/a	n/a	n/a	9.48 (13.369)	7.91	5.3465	n/a
Neighbourhood PCP supply	n/a	n/a	n/a	2226.93 (2754.579)	1264.52	2.4871	n/a
Service proximity (km)	n/a	n/a	n/a	2.93 (3.406)	1.98	2.8383	n/a
NEED	**Mean (SD)**	**Median**	**Skewness**	**Mean (SD)**	**Median**	**Skewness**	**t-test statistic***
Maternal BMI	25.30 (5.132)	24.27	1.4403	25.36 (5.157)	24.35	1.4444	-0.3128
Maternal CES-D score	8.71 (7.920)	6.00	1.7415	8.76 (7.974)	7.00	1.7683	-0.1717
Maternal STAI score	19.19 (5.187)	18.00	0.9330	19.25 (5.251)	18.00	0.9495	-0.3148
Gestational age (weeks)	39.04 (1.710)	39.00	-2.2426	39.03 (1.744)	39.00	-2.2926	0.1598

*H_0: $\mu_1 = \mu_2$; H_1: $\mu_1 \neq \mu_2$; $t_{1-0.05/2} = 1.960$

Summary of analyses:

- Compared the means of continuous variables from the PHP data source and from the geographic data source, to see if there were significant differences between the mother-child pairs who completed the child stage of the PHP (N=1607) and those who were linked to the geographic database (N=1452).
- Used a t-test statistic to compare the frequencies. There were no significant differences in the means of continuous variables ($p<0.05$).

Table H.6. Proportion of <u>mothers</u> using primary health care services in strata of categorical variables (N=1432)

Variable	Maternal HSU (%)	P-value of Chi-square statistic
Maternal nativity		
born in Canada	667/1248 (53.45)	0.9194
born outside Canada	98/182 (53.85)	
Maternal education		
high school or less	193/326 (59.20)	**0.0056**
college or trade	268/483 (55.49)	
university or more	303/620 (48.78)	
Survey season		
winter	294/538 (54.65)	0.9142
spring	211/400 (52.75)	
summer	101/192 (52.60)	
fall	159/302 (52.65)	
Maternal household income		
<$40,000	93/164 (56.71)	**0.0847**
$40,000-79,999	257/459 (55.99)	
$80,000+	347/693 (50.07)	
Neighbourhood average income		
<20th percentile	154/284 (54.23)	**0.1498**
20-80th percentile	468/854 (54.80)	
>80th percentile	138/286 (48.25)	
Maternal employment status		
full time	346/638 (54.23)	0.6498
part time	140/275 (50.91)	
not working	275/514 (53.50)	
Maternal marital status		
married or common-law	690/1298 (53.16)	0.5243
single or equivalent	74/132 (56.06)	
Maternal parity		
1	241/402 (59.95)	**0.0056**
2	390/754 (51.72)	
3+	133/274 (48.54)	
Access to vehicle		
yes	700/1317 (53.15)	0.4871
no	65/115 (56.52)	
Mom has RCP		
yes	737/1366 (53.95)	**0.0667**
no	28/66 (42.42)	

Variable	Maternal HSU (%)	P-value of Chi-square statistic
Child has RCP		
yes	759/1413 (53.72)	**0.0547**
no	6/19 (31.58)	
Residence		
urban	679/1288 (52.72)	**0.1100**
rural	86/144 (59.72)	
Maternal health condition		
yes	379/657 (57.69)	**0.0029**
no	386/775 (49.81)	
Maternal pregnancy		
yes	67/87 (77.01)	**<0.0001**
no	698/1345 (51.90)	
Maternal weight		
not overweight	373/753 (49.54)	**0.0002**
overweight	219/391 (56.01)	
obese	135/207 (65.22)	
Maternal depression		
yes	130/210 (61.90)	**0.0076**
no	619/1190 (51.93)	
Maternal anxiety		
<10th percentile	89/178 (50.00)	**0.0002**
10th-90th percentile	550/1063 (51.74)	
>90th percentile	114/167 (68.26)	

Table H.7. The means of continuous variables for <u>mothers</u> who used primary health care services and those who did not (N=1432)

Variable		Mean (SD)	P-value of t-test statistic
Maternal age			
	user	33.45 (4.706)	**0.0007**
	non-user	34.30 (4.851)	
Recreational facility proximity			
	user	4.41 (2.122)	0.6766
	non-user	4.36 (2.005)	
Neighbourhood % immigrants			
	user	19.47 (8.274)	**0.1677**
	non-user	20.08 (8.247)	
Neighbourhood % visible minority			
	user	11.27 (9.865)	0.2197
	non-user	11.92 (10.051)	
Neighbourhood % without high school diploma			
	user	16.37 (7.346)	0.2232
	non-user	16.86 (7.790)	
Neighbourhood green space density			
	user	2.52 (6.993)	0.6206
	non-user	2.71 (7.919)	(unequal variances)
Neighbourhood walkability			
	user	23.45 (8.467)	0.3431
	non-user	23.02 (8.577)	
Neighbourhood % unemployed			
	user	5.58 (3.841)	0.2759
	non-user	5.80 (3.917)	
Neighbourhood % single parenthood			
	user	14.94 (10.418)	0.3588
	non-user	14.44 (10.281)	
Neighbourhood mean # of children per household			
	user	1.16 (0.250)	0.6466
	non-user	1.16 (0.256)	
Neighbourhood PCP density			
	user	7.67 (4.505)	0.3917
	non-user	7.88 (4.652)	
Health care service proximity (km)			
	user	3.13 (3.611)	**0.0176**
	non-user	2.71 (3.145)	(unequal variances)

Table H.8. Proportion of children using primary health care services in strata of categorical variables (N=1451)

Variable	Child HSU (%)	P-value of Chi-square statistic
Child sex		
female	341/725 (47.03)	**0.1561**
male	367/723 (50.76)	
Maternal nativity		
born in Canada	620/1265 (49.01)	0.7637
born outside Canada	88/184 (47.83)	
Maternal education		
high school or less	167/331 (50.45)	0.6341
college or trade	242/489 (49.49)	
university or more	298/628 (47.45)	
Survey season		
winter	287/549 (52.28)	0.2024
spring	192/404 (47.52)	
summer	86/193 (44.56)	
fall	144/305 (47.21)	
Maternal household income		
<$40,000	95/168 (56.55)	**0.0309**
$40,000-79,999	235/468 (50.21)	
$80,000+	320/699 (45.78)	
Neighbourhood average income		
<20th percentile	147/285 (51.58)	**0.1283**
20-80th percentile	432/868 (49.77)	
>80th percentile	127/290 (43.79)	
Maternal employment status		
full time	339/647 (52.40)	**0.0452**
part time	124/279 (44.44)	
not working	244/520 (46.92)	
Maternal marital status		0.9277
married or common-law	644/1317 (48.90)	
single or equivalent	64/132 (48.48)	
Maternal parity		
1	225/406 (55.42)	**0.0013**
2	367/763 (48.10)	
3+	116/280 (41.43)	
Access to vehicle		
yes	649/1335 (48.61)	0.5204
no	60/116 (51.72)	

Variable		Child HSU (%)	P-value of Chi-square statistic
Mom has RCP			
	yes	681/1384 (49.21)	0.2357
	no	28/67 (41.79)	
Child has RCP			
	yes	700/1432 (48.88)	0.8956
	no	9/19 (47.37)	
Residence			
	urban	640/1305 (49.04)	0.6829
	rural	69/146 (47.26)	
Maternal health condition			
	yes	334/662 (50.45)	0.2670
	no	375/789 (47.53)	
Maternal depression			
	yes	112/212 (52.83)	0.2070
	no	580/1205 (48.13)	
Maternal anxiety			
	<10th percentile	71/179 (39.66)	**0.0290**
	10th-90th percentile	539/1078 (50.00)	
	>90th percentile	87/169 (51.48)	
Size for gestational age			
	small	43/91 (47.25)	0.9494
	appropriate	574/1172 (48.98)	
	large	88/181 (48.62)	
Birth anomaly			0.2862
	yes	37/67 (55.22)	
	no	672/1384 (48.55)	
Perinatal need			
	yes	196/390 (50.26)	0.5091
	no	512/1060 (48.30)	
Child development/behavior			
	yes	105/203 (51.72)	0.3792
	no	604/1248 (48.40)	
Child health condition			
	yes	515/906 (56.84)	**<0.0001**
	no	194/545 (35.60)	

Table H.9. The means of continuous variables for <u>children</u> who used primary health care services and those who did not (N=1451)

Variable		Mean (SD)	P-value of t-test statistic
Maternal age			
	user	33.55 (4.819)	**0.0282**
	non-user	34.11 (4.763)	
Child age			
	user	33.56 (5.683)	**0.0006**
	non-user	34.58 (5.549)	
Recreational facility proximity			
	user	4.35(2.072)	0.5765
	non-user	4.41 (2.064)	
Neighbourhood % immigrants			
	user	19.75 (8.239)	0.9610
	non-user	19.77 (8.254)	
Neighbourhood % visible minority			
	user	11.82 (9.964)	0.3686
	non-user	11.35 (9.878)	
Neighbourhood % without high school			
	user	16.69 (7.648)	0.6259
	non-user	16.50 (7.426)	
Neighbourhood green space density			
	user	2.39 (7.015)	0.3076
	non-user	2.79 (7.747)	(unequal variances)
Neighbouhood walkability			
	user	23.12 (8.315)	0.5519
	non-user	23.38 (8.748)	
Neighbourhood % unemployed			
	user	5.74 (3.939)	0.6011
	non-user	5.64 (3.804)	
Neighbourhood % single parenthood			
	user	15.06 (10.644)	**0.1967**
	non-user	14.36 (10.077)	
Neighbourhood mean # children per household			
	user	1.16 (0.249)	0.3753
	non-user	1.15 (0.256)	
Neighbourhood PCP density			
	user	7.75 (4.529)	0.9487
	non-user	7.77 (4.629)	

Variable		Mean (SD)	P-value of t-test statistic
Health care service proximity (km)			
	user	2.84 (3.260)	0.3012
	non-user	3.02 (3.542)	(unequal variances)
Gestational age			
	user	39.03 (1.634)	0.9992
	non-user	39.03 (1.844)	(unequal variances)

Table H.10. Associations of independent variables with maternal and child primary health care service use from univariable logistic regression analyses

	Maternal HSU	Child HSU
Variable	**Odds Ratio (95% CI)**	**Odds Ratio (95% CI)**
Maternal age	**0.963 (0.942, 0.984)**	**0.976 (0.955, 0.997)**
Child age	n/a	**0.968 (0.950, 0.986)**
Child sex (ref=female)	n/a	**1.161 (0.945, 1.427)**
Maternal nativity (ref=not native)	0.984 (0.720, 1.344)	1.049 (0.769, 1.429)
Neighbourhood % immigrants	**0.991 (0.979, 1.004)**	1.000 (0.987, 1.012)
Neighbourhood % visible minority	0.993 (0.983, 1.004)	1.005 (0.994, 1.015)
Maternal education (ref=university+)		
high school or less	**1.523 (1.161, 1.997)**	1.123 (0.861, 1.466)
college	**1.308 (1.030, 1.660)**	1.081 (0.853, 1.369)
Neighbourhood %		
without high school diploma	0.991 (0.978, 1.005)	1.003 (0.990, 1.017)
Public recreational facility proximity	1.011 (0.961, 1.063)	0.986 (0.938, 1.036)
Neighbourhood green space density	0.996 (0.983, 1.010)	0.993 (0.979, 1.007)
Neighbourhood walkability	1.006 (0.994, 1.018)	0.996 (0.984, 1.008)
Survey season (ref=winter)		
spring	0.927 (0.715, 1.201)	**0.827 (0.639, 1.069)**
summer	0.921 (0.662, 1.282)	**0.734 (0.528, 1.020)**
fall	0.923 (0.696, 1.224)	**0.816 (0.617, 1.081)**
Maternal income (ref=high)		
low	1.244 (0.887, 1.744)	**1.497 (1.071, 2.092)**
middle	**1.208 (0.960, 1.520)**	1.160 (0.924, 1.457)
Neighbourhood mean income (ref=high)		
low	**1.251 (0.902, 1.737)**	**1.377 (0.993, 1.907)**
middle	**1.280 (0.982, 1.669)**	**1.280 (0.983, 1.669)**
Maternal employment (ref=full time)		
part time	0.868 (0.654, 1.152)	**0.730 (0.550, 0.967)**
not working	0.963 (0.763, 1.216)	**0.806 (0.640, 1.016)**
Neighbourhood % unemployed	0.985 (0.959, 1.012)	1.007 (0.981, 1.034)
Maternal marital status (ref=married/equivalent)	1.124 (0.784, 1.612)	0.984 (0.688, 1.407)
Neighbourhood % lone parenthood	1.005 (0.995, 1.015)	**1.007 (0.997, 1.017)**

	Maternal HSU	Child HSU
Variable	**Odds Ratio (95% CI)**	**Odds Ratio (95% CI)**
Maternal parity (ref=1)		
2	**0.717 (0.561, 0.916)**	**0.746 (0.586, 0.950)**
3+	**0.631 (0.463, 0.860)**	**0.570 (0.419, 0.775)**
Neighbourhood mean # children per household	0.908 (0.602, 1.370)	1.203 (0.800, 1.810)
Access to vehicle	1.146 (0.780, 1.683)	1.133 (0.775, 1.656)
Mom has RCP	**1.589 (0.964, 2.619)**	1.349 (0.821, 2.217)
Child has RCP	**2.514 (0.950, 6.651)**	1.062 (0.429, 2.630)
Health care service proximity	**1.038 (1.006, 1.072)**	0.984 (0.955, 1.015)
Neighbourhood PCP density	0.990 (0.968, 1.013)	0.999 (0.977, 1.022)
Residence (ref=rural)	**0.752 (0.530, 1.068)**	1.074 (0.762, 1.513)
Maternal health condition	**1.374 (1.115, 1.694)**	1.124 (0.914, 1.382)
Maternal pregnancy	**3.105 (1.863, 5.175)**	n/a
Maternal weight (ref=not overweight)		
overweight	**1.310 (1.029, 1.668)**	n/a
obese	**1.930 (1.406, 2.648)**	
Maternal depression	**1.504 (1.113, 2.032)**	1.207 (0.901, 1.617)
Maternal anxiety (ref=10-90th)		
<10th percentile	0.934 (0.680, 1.283)	**0.659 (0.477, 0.909)**
>90th percentile	**2.009 (1.420, 2.842)**	1.063 (0.769, 1.470)
Gestational age (ref=<37 weeks)	n/a	1.230 (0.783, 1.933)
Size for gestational age (ref=AGA)		
SGA	n/a	0.932 (0.608, 1.428)
LGA		0.984 (0.719, 1.346)
Birth anomaly	n/a	1.306 (0.798, 2.138)
Perinatal need	n/a	1.081 (0.857, 1.364)
Child development/behaviour	n/a	1.142 (0.849, 1.537)
Child physical health condition	n/a	**2.383 (1.914, 2.967)**

Bold p<0.20

Collinearity

Correlation coefficients of associations between continuous independent variables.

- Examined collinearity between continuous independent variables with the correlation coefficient and its p-value. Considered a significant ($p<0.05$) correlation coefficient greater or equal to 0.80 to signify potential collinearity.
- Identified collinearity were:
    - Neighbourhood % immigrants * Neighbourhood % visible minorities (0.7947)

Variance inflation factors of potential collinear variables identified from preliminary collinear diagnostics (correlation coefficients, chi-square test, t-test and ANOVA).

- Independent variables that showed signs of collinearity from preliminary diagnostics and that were significant ($p<0.20$) in bivariate analyses with maternal HSU and child HSU were further examined. Multiple regression was run for maternal HSU and for child HSU where potential collinear variables were entered as independent variables and the "vif" option was specified to calculate the variance inflation factor for each independent variable.
- Independent variables whose VIF was 10 or more were determined to have significant collinearity.
- No variables had VIF values of 10 or more.

Variables considered for MLM of <u>maternal</u> primary health care services use:

- PREDISPOSING
  - Maternal age (users have lower age on average)
  - Maternal education (lower educated have higher % of use)
  - Neighbourhood % immigrants (users tend to live in neigh with lower % of immigrants on average)
- ENABLING
  - Maternal parity
  - Maternal income
  - Neighbourhood family income
  - Maternal RCP
  - Child RCP
  - Residence
  - Service proximity
  - Neighbourhood PCP density
- NEED
  - Maternal health condition
  - Maternal pregnancy
  - Maternal BMI
  - Maternal depression
  - Maternal anxiety
- Possible confounding:
  - Residence confounded by service proximity
    - Unadjusted OR=0.752 (0.530, 1.068); Adjusted OR=1.248 (0.661, 2.359)

Variables considered for MLM of <u>child</u> primary health care services use:

- PREDISPOSING
  - Child sex
  - Maternal age
  - Child age
- ENABLING
  - Maternal household income
  - Maternal employment status
  - Maternal parity
  - Neighbourhood % single parenthood
- NEED
  - Child health condition
  - Maternal depression
  - Maternal anxiety

Appendix I: Liberatos Measure of Unmet Need

Table I.1. Children's perceived unmet healthcare need reported by 1596 mothers, determined by the Liberatos measure of unmet healthcare need (Yuan, 2009).

Need measure	Total	Prevalence of need[a]	Call/visit health professional[b]	Needed to but unable to[c]	Unmet Need[d]
Poor appetite	1596	344	35	3	3/38 (7.9%)
Vomiting	1595	111	19	3	3/22 (13.6%)
Coughing	1595	539	75	6	6/81 (7.4%)
Fever	1596	192	44	1	1/45 (2.2%)
Diarrhea	1596	141	10	1	1/11 (9.1%)
Constipation	1596	89	12	0	0/12 (0.0%)
Weight loss	1592	17	6	0	0/6 (0.0%)
Unusually cranky	1596	241	25	1	1/26 (3.9%)
Any	1596	**856**	**111**	**14**	**14/125 (11.2%)**

[a]Affirmative answer to Question 1 "At any time in the past week, did your child seem to have [symptom]?
[b]Affirmative answer to Question 2 "Did you call or visit a health professional regarding this?"
[c]Affirmative answer to Question 3 "Did you feel you needed to call or visit a health professional but were unable to?"
[d]Perceived unmet healthcare need estimated as the proportion of those needing to use a health service but unable to, from the total of those perceiving the symptom as a need to use healthcare

Theoretical interpretations of responses to questions 2 and 3 of Liberatos measure of unmet healthcare need

Question 2: "Did you call or visit a health professional regarding this?"

- "No" could be one of two groups
  - 2a: No because did not perceive as a need for healthcare *[no need]*
  - 2b: No because perceived as need for healthcare but unable *[unmet need]*
- "Yes" 2c: Yes because perceived as need for healthcare and able *[need met]*

Question 3: "Did you feel you needed to call or visit a health professional but were unable to?" (Double-barreled question)

- "No" could be one of two groups because of double-barreled question
  - 3a: No because did not perceive as need for healthcare *[no need]*
  - 3b: No because needed to and able *[need met]*
- "Yes" 3c: Yes because needed to but unable *[unmet need]*

In theory, unmet need would be calculated as:

$$(2b + 3c) / (2b + 3c + 2c + 3b)$$

However, the theorized distinctions between 2a and 2b, and between 3a and 3b, do not exist because Questions 2 and 3 were restricted to "yes/no" responses. Therefore Liberatos measure of unmet need omits a portion of people with unmet need (2b) in the numerator and denominator, and a portion of people with met need (3b) in the denominator.

Liberatos calculation of unmet need:

$$(3c) / (3c + 2c)$$

Appendix J: Ethics Approval

The UNIVERSITY *of* WESTERN ONTARIO

Research Ethics Office - Dental Sciences Building, London, ON, Canada N6A 5C1
Telephone: (519) 661-3036 Fax: (519) 850-2466 E-mail: ethics@uwo.ca

REVIEW BOARD FOR HEALTH SCIENCES RESEARCH INVOLVING HUMAN SUBJECTS (FULL BOARD)
CERTIFICATION OF APPROVAL OF HUMAN RESEARCH

ALL HEALTH SCIENCES RESEARCH INVOLVING HUMAN SUBJECTS AT THE UNIVERSITY OF WESTERN ONTARIO
OPERATES IN ACCORDANCE WITH AND CONFORMS TO THE TRI-COUNCIL POLICY STATEMENT
(ETHICAL CONDUCT FOR RESEARCH INVOLVING HUMANS)

2000-2001 REVIEW BOARD MEMBERSHIP

1) Dr. P.G.R. Harding, (Chair) (Obstetrics Gynaecology)
2) Ms. S. Hoddinott, Director of Research Services (Epidemiology)
3) St. Joseph's Health Centre Representative ()
4) Dr. R. McManus, London Health Sciences Centre - Victoria Campus Representative (Endocrinology Metabolism)
5) London Health Sciences Centre - University Campus Representative
6) Dr. L. Heller, Office of the President Representative (French)
7) Ms. S. Agranove, Office of the President Representative (Community)
8) Ms. S. Fincher-Stoll, Office of the President Representative (Legal)
9) Dr. D. Freeman, Faculty of Medicine Dentistry Representative (Clinical)
10) Dr. G. Woodbury, Faculty of Medicine Dentistry Representative (Basic)(Epidemiology)
11) Dr. G. McCarthy, School of Dentistry Representative (Oral Biology)
12) Ms. D. Travis, Faculty of Health Sciences Representative, (Nursing)
13) Dr. D. Jonker, London Regional Cancer Centre Representative, (Oncology)
14) Ms. N. Pus, London Clinical Research Association Representative (Nursing)
15) Dr. M. Gibson, Research Institutes Representative (Psychology)

Alternates are appointed for each member.

THE REVIEW BOARD HAS EXAMINED THE RESEARCH PROJECT ENTITLED:

Prediction of Preterm Birth

REVIEW NO: 08253E

AS SUBMITTED BY: Dr. M.K. Campbell - Epidemiology & Biostatistics, University of Western Ontario

AND CONSIDERS IT TO BE ACCEPTABLE ON ETHICAL GROUNDS FOR RESEARCH INVOLVING HUMAN SUBJECTS UNDER CONDITIONS OF THE UNIVERSITY'S POLICY ON RESEARCH INVOLVING HUMAN SUBJECTS.

APPROVAL DATE: April 26, 2001 (UWO Protocol, Letter of Information & Consent)

AGENCY CIHR

AGENCY TITLE: [redacted]

P. Harding, Chair

c.c. Hospital Administration

Western

Office of Research Ethics

The University of Western Ontario
Room 00045 Dental Sciences Building, London, ON, Canada N6A 5C1
Telephone: (519) 661-3036 Fax: (519) 850-2466 Email: ethics@uwo.ca
Website: www.uwo.ca/research/ethics

Use of Human Subjects - Ethics Approval Notice

Principal Investigator: Dr. M.K. Campbell
Review Number: 10787E
Revision Number:
Protocol Title: Maternal and Infant Health, Health Services Needs and Utilization
Department and Institution: Epidemiology & Biostatistics, UWO
Sponsor: CHRI & LHRI
Approval Date: 08-Sep-04
End Date: 30-Sep-05
Documents Reviewed and Approved: UWO Protocol

Documents Received for Information:

This is to notify you that the University of Western Ontario Research Ethics Board for Health Sciences Research Involving Human Subjects (HSREB) which is organized and operates according to the Tri-Council Policy Statement and the Health Canada/ICH Good Clinical Practice Practices: Consolidated Guidelines; and the applicable laws and regulations of Ontario has received and granted expedited approval to the above named research study on the date noted above. The membership of this REB also complies with the membership requirements for REB's as defined in Division 5 of the Food and Drug Regulations.

This approval shall remain valid until end date noted above assuming timely and acceptable responses to the HSREB's periodic requests for surveillance and monitoring information. If you require an updated approval notice prior to that time you must request it using the UWO Updated Approval Request Form.

During the course of the research, no deviations from, or changes to, the protocol or consent form may be initiated without prior written approval from the HSREB except when necessary to eliminate immediate hazards to the subject or when the change(s) involve only logistical or administrative aspects of the study (e.g. change of monitor, telephone number). Expedited review of minor change(s) in ongoing studies will be considered. Subjects must receive a copy of the signed information/consent documentation.

Investigators must promptly also report to the HSREB:

a) changes increasing the risk to the participant(s) and/or affecting significantly the conduct of the study;
b) all adverse and unexpected experiences or events that are both serious and unexpected;
c) new information that may adversely affect the safety of the subjects or the conduct of the study.

If these changes/adverse events require a change to the information/consent documentation, and/or recruitment advertisement, the newly revised information/consent documentation, and/or advertisement, must be submitted to this office for approval.

Members of the HSREB who are named as investigators in research studies, or declare a conflict of interset, do not participate in discussion related to, nor vote on, such studies when they are presented to the HSREB.

[redacted]

Chair of HSREB: Dr. Paul Harding

Karen Kueneman, BA (Hons), Ethics Officer HSREB (Expedited)
E-mail: kueneman@uwo.ca

Faxed: Y/N
Date:_____

This is an official document. Please retain the original in your files.

Office of Research Ethics

The University of Western Ontario
Room 00045 Dental Sciences Building, London, ON, Canada N6A 5C1
Telephone: (519) 661-3036 Fax: (519) 850-2466 Email: ethics@uwo.ca
Website: www.uwo.ca/research/ethics

Use of Human Subjects - Ethics Approval Notice

Principal Investigator: Dr. M.K. Campbell
Review Number: 10787E **Revision Number:** 1
Protocol Title: Maternal and Infant Health, Health Services Needs and Utilization
Department and Institution: Epidemiology & Biostatistics, University of Western Ontario
Sponsor:
Ethics Approval Date: September 1, 2005 **Expiry Date:** March 31, 2010
Documents Reviewed and Approved: Revised Sample Size, Revised End Date, Revised Study Instrument
Documents Received for Information:

This is to notify you that The University of Western Ontario Research Ethics Board for Health Sciences Research Involving Human Subjects (HSREB) which is organized and operates according to the Tri-Council Policy Statement and the Health Canada/ICH Good Clinical Practice Practices: Consolidated Guidelines; and the applicable laws and regulations of Ontario has reviewed and granted expedited approval to the above named research study on the approval date noted above. The membership of this REB also complies with the membership requirements for REB's as defined in Division 5 of the Food and Drug Regulations.

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a) changes increasing the risk to the participant(s) and/or affecting significantly the conduct of the study;
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Members of the HSREB who are named as investigators in research studies, or declare a conflict of interest, do not participate in discussion related to, nor vote on, such studies when they are presented to the HSREB.

[redacted]

Chair of HSREB: Dr. Paul Harding
Deputy Chair: Susan Hoddinott

Ethics Officer to Contact for Further Information			
☐ Karen Kueneman	☐ Janice Sutherland	☐ Susan Underhill	☐ Jennifer McEwen

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cc: ORE File
LHRI
Faxed: Y / N

Research Western

Use of Human Participants - Ethics Approval Notice

Principal Investigator: Dr. M. Karen Campbell
Review Number: 17951E
Review Level: Delegated
Approved Local Adult Participants: 6
Approved Local Minor Participants: 0
Protocol Title: Maternal Health Conditions Survey
Department & Institution: Epidemiology & Biostatistics, University of Western Ontario
Sponsor: Canadian Institutes of Health Research

Ethics Approval Date: June 06, 2011 **Expiry Date:** August 31, 2012
Documents Reviewed & Approved & Documents Received for Information:

Document Name	Comments	Version Date
UWO Protocol		
Letter of Information		

This is to notify you that The University of Western Ontario Research Ethics Board for Health Sciences Research Involving Human Subjects (HSREB) which is organized and operates according to the Tri-Council Policy Statement: Ethical Conduct of Research Involving Humans and the Health Canada/ICH Good Clinical Practice Practices: Consolidated Guidelines; and the applicable laws and regulations of Ontario has reviewed and granted approval to the above referenced revision(s) or amendment(s) on the approval date noted above. The membership of this REB also complies with the membership requirements for REB's as defined in Division 5 of the Food and Drug Regulations.

The ethics approval for this study shall remain valid until the expiry date noted above assuming timely and acceptable responses to the HSREB's periodic requests for surveillance and monitoring information. If you require an updated approval notice prior to that time you must request it using the UWO Updated Approval Request Form.

Members of the HSREB who are named as investigators in research studies, or declare a conflict of interest, do not participate in discussion related to, nor vote on, such studies when they are presented to the HSREB.

The Chair of the HSREB is Dr. Joseph Gilbert. The UWO HSREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

[redacted]

Ethics Officer to Contact for Further Information

Janice Sutherland (jsutherl@uwo..ca)	**Grace Kelly (grace.kelly@uwo.ca)**	**Shantel Walcott (swalcot@uwo.ca)**

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Curriculum Vitae

Name:	Catherine Holtz *(née Moon)*
Post-secondary Education and Degrees:	University of Guelph Guelph, Ontario, Canada 2003-2007 B.Sc. The University of Guelph Guelph, Ontario, Canada 2007-2009 M.Sc. The University of Western Ontario London, Ontario, Canada 2009-2014 Ph.D.
Honours and Awards:	Laforet Research Assistantship 2008-2009 Ontario Graduate Scholarship 2010-2011, 2011-2012 Queen Elizabeth II Graduate Scholarship 2012-2013
Related Work Experience	Teaching Assistant University of Guelph Guelph, Ontario, Canada 2007-2008 Teaching Assistant The University of Western Ontario London, Ontario, Canada 2010-2012 Research Assistant The University of Western Ontario London, Ontario, Canada 2009-2013 Sessional Professor Conestoga College Kitchener, Ontario, Canada January – May 2014 Epidemiologist Peel Public Health Mississauga, Ontario, Canada May 2014 – present

Publications *(N.B. Published as Catherine S Moon prior to 2013)*

Holtz C, Gilliland J, Thind A, Wilk P, Campbell MK. Neighbourhood variation and inequity of primary health service use by mothers from London-Middlesex, Ontario. World Health & Population 2014;15(2):31-41.

Scott L, Menzies P, Reid-Smith RJ, Avery BP, McEwen SA, Moon CS, Berke O. Antimicrobial resistance in fecal generic Escherichia coli and Salmonella spp. obtained from Ontario sheep flocks and associations between antimicrobial use and resistance. Canadian Journal of Veterinary Research 2012;76(2):109-119.

Scott L, Menzies P, Reid-Smith RJ, Avery BP, McEwen SA, Moon CS, Berke O. Antimicrobial resistance in Campylobacter spp. isolated from Ontario sheep flocks and associations between antimicrobials use and antimicrobial resistance. Zoonoses Public Health 2012;59:294-301.

Moon CS, Berke O, Avery BP, McEwen SA, Reid-Smith RJ, Scott L, Menzies P. Rates and determinants of antimicrobial use, including extra-label drug use, on Ontario sheep farms. Canadian Journal of Veterinary Research 2011;75(1):1-10.

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