Neighbourhood Variation and Inequity of Primary Health Service Use by Mothers from London–Middlesex, Ontario

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Abstract

Objective: Primary health service use (P-HSU) may be influenced by contextual characteristics and is equitable when driven by need. Contextual effects and inequity of maternal P-HSU were determined.

Methods: Participant data from a London–Middlesex, Ontario, prenatal cohort were linked by residential address to contextual characteristics. Multilevel logistic regression estimated contextual effects and tested for effect measure modification of need factors.

Results: Maternal P-HSU varied between neighbourhoods. The effect of obesity was different for rural mothers living in low- (OR = 0.26) and middle-income households (OR = 0.15) and for urban mothers living in high-income households (OR = 2.82). The effect of having a health condition was greatest in mothers with three or more children (OR = 2.41).

Discussion: Differences in maternal P-HSU exist between neighbourhoods, and enabling factors modified need factors' effects, identifying subgroups of mothers with inequitable P-HSU. Results have the potential to inform Canadian health policy with regard to contextual effects and inequity of P-HSU.

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 (Subramanian 2004). 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 (Denny and Davidson 2012).

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 (HSU) (Andersen 2008). 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 (Asada and Kephart 2007; Blackwell et al. 2009; Nabalamba and Millar 2007; Rhodes et al. 2006; Ryan et al. 2011; Sibley and Weiner 2011). However, findings from studies of the effects of age, educational attainment, racial-ethnicity, marital status and income on P-HSU are inconsistent (Asada and Kephart 2007; Blackwell et al. 2009; Diaz-Granados et al. 2010; Dunlop et al. 2000; Fell et al. 2007; Nabalamba and Millar 2007; Rhodes et al. 2006; Ryan et al. 2011; Sibley and Weiner 2011). 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 (Asada and Kephart 2007; Blackwell et al. 2009; Diaz-Granados et al. 2010; Dunlop et al. 2000; Fell et al. 2007; Nabalamba and Millar 2007; Rhodes et al. 2006; Sibley and Weiner 2011). A paucity of contextual characteristics in health service research is evident (Ludwick

et al. 2009; Phillips et al. 1998; Sibley and Weiner 2011); 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...." (Sibley and Weiner 2011: 28).

Further, HSU is conceptualized as equitable when driven by need factors and not the socio-economic characteristics that constitute predisposing and enabling factors (Andersen 1995). 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 healthcare 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 and has an approximate population of 366,000 with about 153,000 private households, half of which are single-detached houses (Statistics Canada 2012). Middlesex County is a mostly rural region surrounding the city of London, spanning close to 3,000 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 on 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.

Methods

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 to 20.5 weeks, no known fetal abnormalities and adequate knowledge of English. Of 2,357 participants who gave birth, follow-up was conducted during the toddler/preschooler stage on 1,607 participants from 2005 to 2007 (on average 34 months postpartum). This follow-up study population was no different from 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 and linked maternal characteristic data to contextual characteristic data sourced from 2006 Census data from Statistics Canada (Statistics Canada 2006). 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 1,451 mothers residing in 530

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 (Statistics Canada 2012).

Measures

P-HSU was defined as a visit to a medical doctor who provided mothers with first-line contact with the Canadian healthcare system. Mothers who reported during the toddler/preschooler stage visiting their regular care provider, a walk-in clinic and/or an emergency department in the previous two months were classified as having used a primary health service. Of the 1,451 London–Middlesex residents linked to the residential location dataset, 29 mothers had incomplete data on P-HSU, resulting in a final study population of 1,432.

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 1.

Table 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	1,265/1,449 (87.30%)
Education	
High school or less	331/1,448 (22.86%)
College or trade	489/1,448 (33.77%)
University or more	628/1,448 (43.37%)
Survey season	
Winter	549/1,451 (37.84%)
Spring	404/1,451 (27.84%)
Summer	193/1,451 (13.30%)
Fall	305/1,451 (21.02%)
Enabling	
Household income	
Low (<$40,000)	168/1,335 (12.58%)
Middle ($40,000–79,999)	468/1,335 (35.06%)
High ($80,000+)	699/1,335 (52.36%)
Employment status	
Full time	647/1,446 (44.74%)
Part time	279/1,446 (19.29%)
Not working	520/1,446 (35.96%)
Marital status	
Married or common-law	1,317/1,449 (90.89%)
Single or equivalent	132/1,449 (9.11%)
Parity	
1 child	406/1,449 (28.02%)
2 children	763/1,449 (52.66%)
3 or more children	280/1,449 (19.32%)

Table 1. Continued

Variable	Categorical: frequency (%) Continuous: mean (SD)
Has a regular care provider	1,384/1,451 (95.38%)
Child has a regular care provider	1,432/1,451 (98.69%)
Need	
Health condition	662/1,451 (45.62%)
Pregnant	89/1,451 (6.13%)
BMI	
Not overweight (<25 kg/m2)	764/1,367 (55.89%)
Overweight (25–29.9 kg/m2)	395/1,367 (28.90%)
Obese (30+ kg/m2)	208/1,367 (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)
Enabling	
Neighbourhood average income	
<20th percentile	285/1,444 (19.74%)
20th–80th percentile	869/1,444 (60.18%)
>80th percentile	290/1,444 (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	1,305/1,451 (89.93%)
Rural	146/1,451 (10.07%)

CES-D = Centre for Epidemiologic Studies Depression [scale]; SD = standard deviation; STAI = State-Trait Anxiety Inventory.

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 (Hayes 2006). Contextual characteristics were then added as fixed effects. Maternal characteristics were entered into the model prior to contextual characteristics, as individual-level variables have precedence over higher-level variables (Hayes 2006). The third stage of model building tested for effect measure
modification between significant maternal need characteristics and a priori chosen covariates (i.e., maternal education level, marital status, 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 ($p < 0.05$) were removed from the model one at a time.

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 1. Univariable associations between independent variables considered in multivariable analyses and maternal P-HSU are presented in Table 2.

Table 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]

BMI = body mass index; CES-D = Centre for Epidemiologic Studies Depression [scale]; CI = confidence interval; STAI = State-Trait Anxiety Inventory.
[a] $p < 0.05$. [b] $p < 0.20$.

The final multilevel parsimonious model is presented in Table 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 weight 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.

Table 3. Multilevel characteristics and interaction terms retained in the parsimonious model of maternal primary health service use estimated with a random intercept

Variable	Odds ratio (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]
Weight (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[c]	
Health condition and parity	
Condition*3 or more children	2.04 (1.04, 4.01)[a]
BMI and household income	
Obese*low	0.31 (0.11, 0.85)[a]
BMI and residence	
Obese*urban	5.93 (1.81, 19.47)[a]

BMI = body mass index; CES-D = Centre for Epidemiologic Studies Depression [scale]; CI = confidence interval.
[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. [c] Statistical interactions between two variables are denoted by an asterisk.

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 body mass index (BMI) on P-HSU were dependent on the presence of enabling factors, as demonstrated by the significant interaction terms in Table 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.

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 or more children.

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Table 4. Main effects of 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 and high household income	
Overweight		1.34 (0.59, 3.03)
Obese		0.48 (0.15, 1.47)
BMI (ref = not overweight)	Rural and middle household income	
Overweight		1.25 (0.54, 2.91)
Obese		0.26 (0.08, 0.89)[a]
BMI (ref = not overweight)	Rural and low household income	
Overweight		1.29 (0.56, 2.98)
Obese		0.16 (0.04, 0.56)[a]
BMI (ref = not overweight)	Urban and high household income	
Overweight		1.21 (0.84, 1.73)
Obese		2.82 (1.61, 4.94)[a]
BMI (ref = not overweight)	Urban and middle household income	
Overweight		1.11 (0.74, 1.68)
Obese		1.58 (0.94, 2.66)
BMI (ref = not overweight)	Urban and low household income	
Overweight		1.55 (0.85, 2.80)
Obese		0.94 (0.45, 1.93)

BMI = body mass index; CI = confidence interval.
[a] $p < 0.05$.

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 of P-HSU, while other subgroups of residence and household income reduced obesity's odds of P-HSU.

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 healthcare policy, as strategies that consider these contexts may result in place-based action (Denny and Davidson 2012). Further, changes in healthcare 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 (Arcury et al. 2005; Blazer et al. 1995; Goetz and Debertin 1996; Haggerty et al. 2007). 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 (Dunlop et al. 2000; Ryan et al. 2011), while others have not reported a significant association (Diaz-Grenados et al. 2010; Nabalamba and Millar 2007; Sibley and Weiner 2011). 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 healthcare 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.

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 …

HSU is defined as equitable when driven by need factors (Andersen 1995). 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 HSU differs in magnitude, direction and/or significance depending on the subgroup of the effect measure modifier, suggestive of inequitable HSU. 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 HSU is highly correlated (Minkovitz et al. 2002). 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 that are limited in rural areas (Haggerty et al. 2007). 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 healthcare resulting from P-HSU that are not covered by government plans and private insurance, such as prescriptions and treatment from other healthcare professionals. Therefore, these mothers represent a potentially vulnerable population who may not be receiving the appropriate healthcare for obesity-related health issues.

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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 healthcare 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 (Denny and Davidson 2012).

Medical doctors who engage with patients in private practices, walk-in clinics and emergency departments are the gatekeepers to secondary healthcare services (e.g., hospitalization, medical specialists) and have an integral role in the flow of patients through the Canadian healthcare system. It is important to understand who is 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 HSU. 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 HSU in other Canadian populations. Gathering firm evidence from multilevel studies of HSU has the potential to inform Canadian public health policy with regard to inequity and the influence of place of residence on maternal primary healthcare service use.

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