

## ORIGINAL ARTICLE

## Inadequate prenatal care use among Canadian mothers: findings from the Maternity Experiences Survey

Y Debessai<sup>1</sup>, C Costanian<sup>1</sup>, M Roy<sup>2</sup>, M El-Sayed<sup>2</sup> and H Tamim<sup>1</sup>**OBJECTIVE:** This study aims to investigate predictors of inadequate prenatal care (PNC) use among pregnant women in Canada.**STUDY DESIGN:** Data for this secondary analysis was drawn from the Maternity Experiences Survey, a cross sectional, nationally representative survey that assessed peri- and post-natal experiences of mothers aged 15 and above in the Canadian provinces and territories. PNC use was measured by the Adequacy of Prenatal Care Utilization Index. Multivariate logistic regression analysis was conducted to determine socio-economic, demographic, maternal, delivery related and health service characteristics associated with inadequate PNC use.**RESULTS:** Prevalence of inadequate PNC was at 18.9%. Regression analysis revealed that mothers who were immigrants (odds ratio (OR) = 1.40; 95% (confidence interval) CI: 1.13–1.74), primiparous (OR = 1.22; 95% CI: 1.04–1.44), smoked (OR = 1.33; 95% CI: 1.04–1.69) or consumed alcohol (OR = 1.32; 95% CI: 1.03–1.68) during their pregnancy were more likely to receive inadequate PNC. Mothers with a family doctor as PNC provider versus those with an obstetrician (OR = 1.26; 95% CI: 1.08–1.48) were more likely to have inadequate PNC.**CONCLUSIONS:** This is the first nationwide study in Canada to examine the factors associated with inadequate PNC use. Results of this study may help design interventions that target women with profiles of socio-demographic and behavioral risk to optimize their PNC use.*Journal of Perinatology* (2016) **36**, 420–426; doi:10.1038/jp.2015.218; published online 21 January 2016

## INTRODUCTION

Within the last two decades, prenatal care (PNC) has been one of the major health service interventions designed to improve maternal, fetal and infant health in both developed and developing countries.<sup>1</sup> The Society of Obstetricians and Gynecologists of Canada (SOGC) recommends that pregnant women have an initial PNC visit with their healthcare provider within 12 to 13 weeks from the time of their last menstrual period and are encouraged to increase the number of visits later in their pregnancy. Pregnant women are recommended to receive PNC every 4 to 6 weeks in early pregnancy, every 2 to 3 weeks after 30 weeks' gestation and every 1 to 2 weeks after 36 weeks' gestation.<sup>2</sup> PNC is considered late if commenced after the first trimester (after 13 weeks of pregnancy) or insufficient if less than 50% or more of the recommended number of prenatal care visits were made (12 on average).<sup>3–5</sup> PNC has implications on the present mental and physical health of mothers and future birth outcomes of infants. Adequate PNC provision during pregnancy has been shown to reduce maternal mortality and the risk of miscarriage, premature birth, low birth-weight, still birth and sudden unexpected death in infancy.<sup>6</sup> In contrast, obtaining PNC in a group setting may lower a woman's stress level, potentially leading to improved birth outcomes since lower stress levels may affect the physiology of the pregnant woman and her fetus.<sup>7</sup> Nonetheless and despite the value of this care, there are still pregnant women who do not receive an adequate amount of or/and who do not timely initiate PNC.

PNC utilization varies across the globe; with pregnant women in developing countries having minimal, late or no PNC compared

with women in developed countries.<sup>8</sup> Inadequate PNC ranges from 25%<sup>9</sup> to 43%<sup>10</sup> in developing countries. On the other hand, inadequate PNC in developed countries, on average, does not exceed 17%.<sup>11,12</sup> Various psychosocial, attitudinal, economic and structural barriers to obtaining adequate PNC have been noted especially among low-income women.<sup>13</sup> Some barriers to adequate PNC use included women reporting absence of any medical problems and an ignorance of their pregnancy.<sup>14</sup>

Despite universal access to health care in Canada, disparities in utilization of PNC persist. According to the Maternity Experience Survey (MES), 5% of pregnant women in Canada received had an inappropriate number (six or fewer) of prenatal visits<sup>15</sup> and around 9% initiated PNC after the first trimester.<sup>5</sup> Furthermore, higher proportions of teenage, lower education and income level mothers initiated PNC after the first trimester.<sup>16</sup> A study based in Alberta examined the characteristics of 1561 pregnant women who were not retained in a PNC randomized control trial with three interventional groups, one receiving the current standard of care, and the other two receiving an additional support package in terms of nursing staff or home visit support. It found that young maternal age, single marital status, low education and low levels of social support were associated with dropping out of any intervention.<sup>17</sup> Previous studies, conducted outside Canada have identified several important factors to prenatal examinations. Such factors include: low maternal age,<sup>9,10</sup> having other children,<sup>10,14</sup> low socio-economic status, such as low educational level, low income, uninsured status,<sup>9,18</sup> as well as the mother's ethnicity and marital status.<sup>19</sup>

Although the prevalence rates of inadequate PNC are known in Canada, the factors that influence women's inadequate prenatal

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care practices have yet to be addressed in a single national study. Results of this study will help elucidate more effective ways of increasing antenatal service use and therefore help lower the prevalence of adverse pregnancy outcomes. By using data from the MES, this study aims to investigate the predictors of inadequate PNC among pregnant women in Canada.

## METHODS

### Study design and participants

The analysis of this study was based on data collected from the MES that was sponsored by the Public health agency of Canada and conducted by Statistics Canada in 2006.<sup>20</sup> Participants eligible for the study were women aged 15 years and above, who had singleton live births between the period of 15 February 2006 and 15 May 2006 in the provinces of Canada and between 1 November 2005 and February 2006 in the territories of Canada and who lived with their baby at least one night per month. Mothers who lived on First Nation reserves and in collective residences were excluded. A stratified random sample of 8545 Canadian women was selected, however, a total of 6421 (78%) women responded to the survey. Non-response to the survey was mainly from inability to establish contact with the mothers. Before data collection, an introductory letter and survey pamphlet were mailed to the women inviting them to participate in the survey.<sup>20</sup>

### Data collection and measures

The data was collected through telephone interviews using a computer-assisted telephone interview application. In an attempt to recruit the highest number of mothers possible, a total of 25 calls per non-respondent case were made during different days of the week and different hours of the day. The MES questionnaire was also available in 15 different languages. Interviews were conducted between the 5th and 14th month after delivery and lasted on average 45 min. The majority (96.9%) of the interviews were performed between the 5th and 9th month postpartum. The MES project was presented to Health Canada's Science Advisory Board, Health Canada's Research Ethics Board and the Federal Privacy Commissioner and was approved by Statistics Canada's Policy Committee. The MES has been previously described elsewhere.<sup>20,21</sup>

**Outcome definition and assessment.** PNC use, the main outcome, was assessed by the Adequacy of Prenatal Care Utilization Index (APNCUI).<sup>12</sup> The APNCUI is a composite of two adequacy components: the adequacy of the initiation, measuring the timing of PNC visits in weeks, and the adequacy of services received, measuring the frequency of visits adjusted for gestational age during the time of PNC. Specifically in the MES, adequacy of PNC use was assessed by answering the following questions: 'How many weeks pregnant were you when you had your first visit for prenatal care?' and 'How many prenatal care visits did you have?' The care received by the respondents was characterized into four possible categories of utilization: 'inadequate', 'intermediate', 'adequate' and 'adequate plus'. According to the APNCUI, inadequate care requires initiation after the 4th month (17 weeks of pregnancy) and receiving less than the recommended number of visits; intermediate care requires initiation on the 4th month and receiving 50 to 79% of the number of visits; adequate care requires initiation on the 4th month and receiving 80 to 109% of the recommended number of visits, and adequate plus care requires initiation on the 4th month and receiving 110% or more of the recommended number of visits. The expected number of visits is consistent with the American College of Obstetricians and Gynecologists' (ACOG) guidelines for PNC use and is the ratio of actual visits to the recommended number of visits. It is also important to note that the APNCUI is designed to avoid incorrectly including underutilization of care due to preterm birth by adjusting the required number of visits according to the gestational age at delivery. The dependent variable was made dichotomous for the use in the bivariate and regression analysis; APNCUI's 'adequate' and 'adequate plus' categories were combined into the adequate care group (coded as 0) while 'intermediate' and 'inadequate' categories were combined into another labeled as the inadequate care group (coded as 1).<sup>22</sup>

**Exposure and other covariates assessment.** A wide range of independent variables was used to investigate the characteristics of pregnant women with inadequate prenatal care. These variables were: (i) socio-demographic

factors including mother's age at selected birth, total household income, urban–rural residence, province of residence, immigration status, maternal level of education and marital status; (ii) maternal health characteristics including the mother's stress level during pregnancy, and pre-pregnancy Body Mass Index (BMI); (iii) pregnancy-related factors including number of live births including current pregnancy, wanting the pregnancy, health problems during pregnancy, working during pregnancy, smoking and alcohol consumption during pregnancy and overall support during pregnancy; and (iv) delivery characteristics including type of PNC healthcare provider (obstetrician/ gynecologist family doctor, midwife, nurse, nurse practitioner and so on). All variables were self-reported. Mother's stress level during pregnancy was ascertained by answering the following question: 'Thinking about the amount of stress in your life during the 12 months before the baby was born, would you say that most days were (a) not stressful, (b) somewhat stressful or (c) very stressful'.

### Statistical analysis

The prevalence of inadequate PNC use and its two separate dimensions (adequacy of services and initiation) were estimated through population weights and examined at the national level. Applying the appropriate sample weights to the MES data allowed the survey data to be representative of the population. Please refer to Statistics Canada's *Maternity Experiences Survey, 2006- User guide* for more information: [http://www23.statcan.gc.ca/imdb-bmdi/pub/document/5019\\_D1\\_T1\\_V1-eng.pdf](http://www23.statcan.gc.ca/imdb-bmdi/pub/document/5019_D1_T1_V1-eng.pdf).

At the bivariate level, differences in the proportion of inadequate prenatal care use were assessed among the different levels of each predictor using normalized weights. Unadjusted odds (ORs) and 95% confidence intervals (CIs) to assess the association between inadequate prenatal care and socio-demographic, maternal health, pregnancy and delivery indicators were also obtained. Multivariable logistic regression analysis adjusting for all independent variables was conducted to predict the likelihood of having inadequate prenatal care. Adjusted odds ratios (ORs) and their 95% CIs were estimated. To account for the complex sampling design, bootstrapping was performed to calculate the 95% CI estimates. Population weights, normalized weights and bootstrap weights were all created by Statistics Canada and provided with the MES data file. All analyses, in exception to bootstrapping, were conducted using the Statistical Package for Social Sciences (SPSS, version 22.0). Bootstrapping was performed using Stata Data Analysis and Statistical Software (Stata, version 13.0). Statistical significance for all analyses was set at  $\alpha < 0.05$  for a two-tailed test.

## RESULTS

The final sample considered 5662 MES mothers (88.1%) who had full information on the components that make up the main outcome variable, adequacy of PNC, for analysis. The sample was weighted to represent 67,369 Canadian women. Table 1 presents the estimated population and distribution of the two components that make the PNC use outcome variable and adequacy of initiation and adequacy of services as well as their composite index. According to the APNCUI, 4.1% (95% CI: 3.80–4.70) of Canadian women had inadequate prenatal care, and almost 15% (95% CI: 13.9–15.3) received intermediate prenatal care, while around 40% (95% CI: 38.2–40.8) had adequate and 42% (95% CI: 40.3–42.9) had adequate plus prenatal care, respectively. The prevalence of inadequate PNC use among Canadian women (based on the dichotomous outcome variable) was 18.9 % (results not shown).

Figure 1 denotes the distribution of PNC use across the Canadian provinces ( $P$ -value  $< 0.001$ ). Nunavut and the Northern Territories showed the highest prevalence rate of inadequate PNC (28.8% and 24.9%, respectively). Nova Scotia, on the other hand, had the lowest prevalence rate, with 11.7% of women receiving inadequate PNC. Table 2 outlines the unadjusted and adjusted odds of inadequate PNC during pregnancy and its potential predictors. The final adjusted model showed that mothers who resided in the Eastern-Central (OR = 1.36; 95% CI: 1.08–1.70) and Western-Prairies provinces (OR = 1.62; 95% CI: 1.27–2.08) were more likely to report having inadequate PNC than women residing

in other provinces. Immigrant women were 1.40 (95% CI: 1.13–1.74) times more likely to receive inadequate PNC than native-born women. Women who were primiparous, wanted their pregnancy later or not at all, had no health problems, and did not work during their pregnancy were at significantly increased odds of having inadequate PNC. Furthermore, mothers who smoked (OR = 1.33; 95% CI: 1.04–1.69) and/or consumed alcohol (OR = 1.32; 95% CI: 1.03–1.68) during pregnancy were more likely to have inadequate PNC. Finally, mothers whose PNC provider was a family doctor were more likely to have inadequate PNC (OR = 1.26; 95% CI: 1.08–1.48).

## DISCUSSION

This study is the first to investigate the prevalence and predictors of inadequate PNC use defined by combining the timing of the first visit and frequency of visits based on gestational age among a national sample of Canadian mothers. The prevalence of

inadequate PNC was 18.9%. Results of the regression analysis showed that the odds of having inadequate PNC was found to be significantly increased among women who were immigrants, resided in the Central or Prairie Provinces, primiparous, did not want their current pregnancy or wanted it later on, did not work during their pregnancy, smoked and/or consumed alcohol while pregnant and received PNC from a family doctor rather than an obstetrician/gynecologist. Findings may be used to improve prenatal screening practices, to help identify recently pregnant women who may be potentially at risk for receiving inadequate PNC.

Inadequate PNC prevalence rate obtained by this study (18.9%) was similar to rates found in developed countries, such as the United States at 16.7%,<sup>12</sup> and southern Spain at 16.5%.<sup>11</sup> It may be inaccurate to do a cross comparison of inadequate PNC prevalence rates due to differences in PNC use ascertainment by the employment of different indexes or categorizations as well as differences in study designs, however previous reported estimates ranged between 11% across 10 European countries<sup>14</sup> to 75.5% in Ecuador.<sup>23</sup> Previous research in the Canadian province of Manitoba found wide variation in rates of inadequate PNC, ranging from 1.1 to 21.5% across 25 neighborhoods in the capital city of Winnipeg.<sup>24</sup>

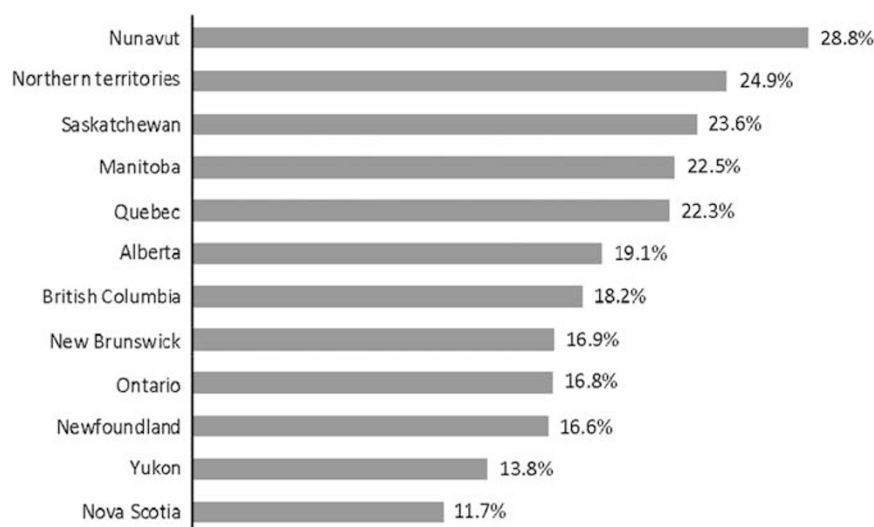
In the adjusted model, mothers from the Central (OR = 1.36; 95% CI: 1.08–1.70) or Prairie Provinces (OR = 1.62; 95% CI: 1.27–2.08), compared with mothers from the Atlantic Provinces, had an increased odds of having inadequate PNC. The differences in PNC provision could be attributed to differences in healthcare system resources and population characteristics within each province. An alternative explanation might lie in the findings study conducted by Jarvis *et al.*<sup>25</sup> at two family practice centers in Montreal, Quebec which found that over 60% of uninsured pregnant women had inadequate PNC compared with insured pregnant women ( $P$ -value < 0.001). These women were more likely to be immigrants; nonetheless, such results suggest a role for financial cost in seeking PNC.

Mothers who were immigrants were more likely to have inadequate PNC (OR = 1.40; 95% CI: 1.13–1.74). This is consistent with the findings from a systematic review reporting that migrant women residing in high-income countries were more likely than non-migrant women to have inadequate PNC.<sup>4</sup> As results from Dutch<sup>26</sup> and Canadian<sup>27</sup> studies suggested, immigrant mothers' inadequate PNC use could be attributed to various individual and contextual factors. For example, newcomers' limited knowledge of

**Table 1.** Distribution of adequate prenatal care use variables among Canadian mothers (2005/2006)

	N <sup>a</sup>	%	95% CI <sup>b</sup>
<i>Adequacy of services</i>			
Inadequate (< 50% or more)	1415	2.1	(1.70–2.50)
Intermediate (50–79%)	10 256	15.2	(14.3–16.2)
Adequate (80–109%)	26 957	40.0	(38.7–41.3)
Adequate plus (110% or more)	28 742	42.7	(41.3–44.0)
<i>Adequacy of initiation</i>			
Weeks 1–8	48 189	71.3	(70.1–72.5)
Weeks 9–17	17 913	26.5	(25.4–27.6)
Weeks 18–26	1273	1.9	(1.50–2.30)
Weeks 27–36	192	0.3	(0.20–0.50)
<i>Adequacy of prenatal care index</i>			
Inadequate	2762	4.1	(3.80–4.70)
Intermediate	10 019	14.8	(13.9–15.3)
Adequate	26 707	39.5	(38.2–40.8)
Adequate plus	28 080	41.6	(40.3–42.9)

<sup>a</sup>Sample size is estimated using normalized weights. <sup>b</sup>95% CIs were calculated using bootstrapping technique.



**Figure 1.** Distribution of inadequate prenatal care use across the Canadian provinces (2005/2006). Note:  $P$ -value < 0.001.

**Table 2.** Unadjusted and adjusted associations between inadequate prenatal care (PNC) use and potential predictors (*n* = 5662)

Variables	Sample size	Inadequate PNC	Unadjusted		Adjusted	
	N <sup>a</sup>	N <sup>b</sup> (%)	OR	(95% CI) <sup>c</sup>	OR	(95% CI) <sup>c</sup>
<i>Socio-demographic</i>						
Age (years)						
< 20	163	124 (75.8)	1.21	0.96–2.89	1.35	0.72–2.80
20–39	5319	4319 (81.2)	1.67	0.76–1.92	1.42	0.79–2.29
≥ 40	165	138 (84.0)	1		1	
Total household income						
< 30 000\$	904	208 (23.0)	1.47	1.16–1.86	1.19	0.88–1.59
30 000\$–100 000\$	3356	605 (18.0)	1.08	0.89–1.31	1.01	0.82–1.24
> 100 000\$	1103	186 (16.9)	1		1	
Urban–rural residence						
Rural area	993	191 (19.3)	1		1	
Urban, population < 499 999	2026	346 (17.1)	0.86	0.70–1.05	0.85	0.68–1.05
Urban, population > 500 000	2460	496 (20.2)	1.05	0.87–1.28	0.92	0.74–1.15
Province <sup>d</sup>						
Eastern-Atlantic	338	50 (14.7)	1		1	
Eastern-Central	3553	670 (18.9)	1.34	1.12–1.62	1.36	1.08–1.70
Western-Prairies	1083	224 (20.7)	1.51	1.22–1.87	1.62	1.27–2.08
Western-British Columbia	663	120 (18.1)	1.28	0.98–1.68	1.29	0.96–1.75
Northern Territories	25	6 (24.6)	1.88	1.45–2.44	1.35	0.94–1.92
Immigration status						
No	4429	781 (17.6)	1		1	
Yes	1209	283 (18.9)	1.43	1.20–1.69	1.40	1.13–1.74
Level of education						
High school or less	1152	248 (21.5)	1.23	1.03–1.46	0.98	0.78–1.21
Some post-secondary education	342	64 (18.7)	1.03	0.77–1.38	0.93	0.66–1.30
University education	4119	750 (18.2)	1		1	
Marital status						
No partner	472	103 (21.9)	1.22	0.97–1.54	0.86	0.63–1.18
Partner	5170	964 (18.6)	1		1	
<i>Health related</i>						
Mother's stress level during pregnancy						
Not stressful	2438	489 (21.5)	1		1	
Somewhat stressful	2535	442 (17.4)	0.84	0.73–0.97	0.85	0.73–1.00
Very stressful	672	139 (20.6)	1.04	0.82–1.30	1.16	0.90–1.50
Pre-pregnancy BMI (kg m <sup>-2</sup> )						
Underweight (< 18.5)	329	77 (23.3)	1.47	1.08–2.00	1.39	0.98–1.98
Normal (> 18.5 and < 25)	3312	643 (19.4)	1.17	1.00–1.37	1.13	0.95–1.35
Overweight (> 25 and < 30)/Obese(> 30)	1922	328 (17.1)	1		1	
<i>Pregnancy related</i>						
Parity						
Primiparous	2618	520 (19.9)	1.12	0.98–1.29	1.22	1.04–1.44
Multiparous	3028	545 (18.0)	1		1	
Wanted the pregnancy						
Then or sooner	4121	726 (17.6)	1		1	
Later or not at all	1504	336 (22.3)	1.35	1.16–1.56	1.30	1.08–1.53
Health problems during pregnancy						
No	4278	862 (20.2)	1.42	1.2–1.69	1.39	1.15–1.68
Yes	1379	208 (15.1)	1		1	
Work during pregnancy						
No	1690	367 (21.7)	1.29	1.11–1.49	1.19	1.00–1.41
Yes	3952	700 (17.7)	1		1	
Cigarette smoking during pregnancy						
No	5071	936 (18.5)	1		1	
Yes	582	132 (22.6)	1.29	1.05–1.58	1.33	1.04–1.69
Alcohol use during pregnancy						
No	5046	930 (18.4)	1		1	
Yes	589	134 (22.8)	1.30	1.05–1.62	1.32	1.03–1.68
Overall support during pregnancy						
All of the time	286	67 (23.4)	1		1	
Some of the time	433	99 (22.9)	1.37	0.99–1.88	1.27	0.89–1.81
None/little of the time	4929	900 (18.3)	1.33	1.04–1.70	1.31	0.99–1.73
<i>Delivery related</i>						
Type of PNC provider						
Obstetrician/Gynecologist	3273	586 (17.9)	1		1	
Family doctor	1965	410 (20.9)	1.21	1.04–1.39	1.26	1.08–1.48
Midwife	352	61 (17.2)	0.95	0.70–1.30	0.90	0.64–1.27
Nurse/nurse practitioner/other	50	13 (26.0)	1.60	0.89–2.88	1.59	0.76–3.28

<sup>a</sup>Sample size is estimated using normalized weights. <sup>b</sup>Frequencies are row percentages estimated using normalized weights. <sup>c</sup>95% CI's were calculated using bootstrapping technique. <sup>d</sup>Eastern Atlantic, Newfoundland and Labrador, Nova Scotia, Prince Edward Island and New Brunswick; Eastern Central, Quebec and Ontario; Western Prairies, Manitoba, Saskatchewan and Alberta; Western British Columbia, British Columbia; and Northern Territories, Yukon Territory, Nunavut and Northwest Territories.



the host country's healthcare system as well as to their limited language proficiency may result in difficulties navigating the system, and thus being unaware of the free prenatal healthcare services available to them. Another explanation lies in the role of priorities and cultural expectations that may be present among new immigrants. Ng and Newbold<sup>28</sup> found that finding permanent housing and food was more important than seeking prenatal care among recent immigrants to Canada as reported by their PNC providers. Downe *et al.*<sup>29</sup> revealed that issues around the delivery of services such as the language used, cultural sensitivity, competency and quality of care, respect and trustworthiness also influenced women's decisions in obtaining PNC.

In contradiction to results of a systemic review on the determinants of PNC in high-income countries,<sup>4</sup> young maternal age was not found to be significantly associated with inadequate PNC in this study. Moreover, total household income, urban-rural residence, level of education and the mother's marital status were also not significantly associated with inadequate PNC. These results were contradictory to findings from studies conducted in Brazil and Europe, respectively, which found low family income, low maternal schooling<sup>30</sup> and being unmarried<sup>14</sup> to be significantly related to having inadequate PNC. These results should be interpreted with caution as low maternal age, income and educational level are confounded by one another as well as by immigrant status and ethnicity. Despite the universal healthcare system available in Canada, disparities in PNC use persist with a Manitoban study finding that women were more likely to receive inadequate PNC if they had low incomes, or identified themselves as Aborigines.<sup>31</sup>

Results of this study indicated that primiparous women were more likely to have inadequate PNC than multiparous mothers. This finding was inconsistent with a study conducted by Joshi *et al.*<sup>32</sup> which found that Nepalese women with more than one child were less likely to attend four or more antenatal care visits. This finding was also not consistent with studies conducted in southern Spain, rural north India and Kumasi, Ghana.<sup>11,18,33</sup> Further research on this association is needed. Yet, a plausible explanation might be a lack of or an overestimation of knowledge regarding PNC both of which may lead to obtaining inadequate PNC. Primiparous women are in their first pregnancy and may either overestimate the amount of knowledge they have or have little knowledge about pregnancy.<sup>34</sup>

Results of this study demonstrated that not wanting the pregnancy or wanting it later on was significantly associated with inadequate PNC. This was consistent with previous studies in the United States<sup>35</sup> (OR=1.65) and the Ecuador<sup>23</sup> (OR=1.7) which have shown that an undesired pregnancy was correlated with delayed or no prenatal care among mothers. On the other hand, Bassani *et al.*<sup>36</sup> found that mothers with unplanned pregnancies were two times significantly more likely to have had inadequate PNC than mothers with a planned pregnancy. Having an unplanned pregnancy incurs a higher risk of poor maternal behavior during pregnancy and the postpartum period, thereby increasing adverse birth outcomes, neonatal and child mortality.<sup>37</sup>

Interestingly, women who were unemployed during their pregnancy had a higher propensity of having inadequate PNC than women who were employed. This was consistent with the findings of Liang *et al.*<sup>22</sup> who reported that pregnant women with current employment in Taiwan were more likely to have adequate PNC than women with no employment. Miles-Doan and Brewster<sup>38</sup> using data from the Cebu Longitudinal Health and Nutrition Survey found that type of work was significantly associated with PNC use with women who are civil servants or white collar workers utilizing more PNC than housewives and the unemployed. Women who are employed may have an improved autonomy in making their decisions regarding the household and their own and children's health given their financial independence,<sup>11</sup> thereby maybe opting to have more or earlier PNC visits.

Consistent with other studies, cigarette smoking and/or alcohol use during pregnancy were demonstrated to be significantly associated with having inadequate PNC in this study.<sup>4,30</sup> A clustering of risky behaviors among a small group of pregnant women has been reported in a study conducted by Passey *et al.*,<sup>39</sup> which might explain the association of smoking and alcohol consumption with inadequate PNC. This study found that Australian women using any one substance were significantly more likely to also use others, with 46% of women being current smokers and among these women, 50% reported current use of cannabis and/or alcohol. Engaging in risky behaviors during pregnancy such as smoking or consuming alcohol might be one coping strategy that mothers regardless of their socioeconomic status might resort to ease the stress they might feel during this period.

Women who obtained prenatal care from a family doctor were more likely to have inadequate PNC. This study is among the few studies to assess the role of provider type on antenatal care use. This was consistent with a population-based retrospective cohort study among pregnant women in Ontario which noted that women receiving first-trimester care from a family physician or midwife were more likely to have lower prenatal screening rates versus an obstetrician.<sup>40</sup> In Canada, a variety of healthcare providers deliver primary PNC services, most notably family physicians, obstetricians, midwives and nurse practitioners.<sup>41</sup> In fact, midwives and general practitioners (GPs) or family physicians are the first choice to provide maternity care for women with low-risk pregnancies, with their focus being on the physiology of pregnancy and childbirth thereby serving as primary care providers.<sup>42</sup> Obstetricians and gynecologists, on the other hand, are specialized in the care for women with obstetrical risks or complications that may lead to adverse outcomes for them or their baby. But recently and as the place of birth shifted from home to hospital in the developed world this shift being termed the 'medicalization' of childbirth, obstetricians more than midwives took over all aspects childbirth,<sup>42</sup> thereby eliminating the need for GPs to undergo further training in PNC provision to adapt to the needs of this era.

There were some limitations to this study. The present study had a high rate of respondents with complete information (88%) on the dimensions of the outcome; however, selection bias may have been a factor. Exposures and outcomes were self-reported, thereby introducing potential misclassification bias. Moreover, as interviews were conducted 5 to 9 months post delivery, recall bias of the outcome variables may have been introduced. Although the APNCUI is an accurate and widely used tool to measure PNC adequacy,<sup>12</sup> it only assesses its utilization and not the delivered quality. Furthermore, the cross-sectional nature of the study design does not allow inference of causality. Lastly, by excluding mothers living on First Nations Reserves, the MES sample may have excluded socially and economically disadvantaged mothers, thereby reducing generalizability of results. Despite the former caveats, the study had several strengths. Data for this study considered all the Canadian provinces, resulting in a representative picture of the population. This study also utilized a large sample size allowing for ample statistical power, with population weights accounting for nonresponse. In addition, confounding bias was minimized due to the variety of potential predictors that were controlled for in the analysis. This is the first nationwide study to examine predictors of PNC with an index that offers a more comprehensive set of measures of PNC use.

Finally, the Chief Public Health Officer's Report on the State of Public Health in Canada emphasizes that 'Ongoing prenatal care provides a pregnant woman with the opportunity to access health information and identify risks and underlying factors that can influence her health and the health of her fetus/child'.<sup>43</sup> Nonetheless, rates of inadequate PNC remain high. This study provides a profile of PNC utilization in Canada that showed PNC use to be affected by factors within the healthcare system, by population characteristics and by geographic location. Despite the universal

availability of free PNC through Canada's publicly funded healthcare system, disparities in utilization exist specially among immigrant mothers and those residing in the Central and Prairie Provinces. This study is among the first to highlight the importance of the type of prenatal care health provider (family doctor; OR=1.26; 95% CI: 1.08–1.48) in ensuring adequate PNC. Future research aiming to reduce disparities in PNC use should focus on devising, implementing and evaluating multifaceted interventions in the form of antenatal education programs targeting women with high-risk profiles during PNC screening.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

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## AUTHOR CONTRIBUTIONS

YD contributed to data interpretation, manuscript drafting and write-up. CC contributed to data analysis and interpretation, manuscript drafting and write-up; HT contributed to hypothesis conception, supervision of data analysis and interpretation, drafting and write-up of the paper. MR and MES critically reviewed drafts of the manuscript. All authors provided critical insight and revisions to the manuscript; all authors read and approved the final version of the manuscript submitted for publication.

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