

# Comparison of Demographic and Obstetric Characteristics of Canadian Primiparous Women of Advanced Maternal Age and Younger Age

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## Abstract

**Objective:** The rate of pregnancy at advanced maternal age (AMA) has increased during recent decades. The purpose of this study is to compare demographic and obstetric characteristics of Canadian primiparous women of AMA with those aged 20 to 29 years.

**Methods:** We conducted a secondary analysis of data collected through the national Maternity Experiences Survey (MES) of the Canadian Perinatal Surveillance System. The sample included 301 primiparous women aged 35 years or over and 1564 primiparous women aged 20 to 29 years. Estimates of prevalence for each group and their odds ratios were calculated using sample weights of the survey, and variances were calculated using bootstrapping methods adjusting for sampling design and weights.

**Results:** Women of AMA were significantly more likely to be better educated, to have higher income, to be employed, and to continue to work until the end of pregnancy than younger women. They also reported having significantly more information on pregnancy, labour, and birth, and they were more likely to attend prenatal classes. They were more likely to have had a miscarriage or infertility treatment, to request or be offered a Caesarean section, and to have a higher rate of Caesarean section. There were no significant differences in rates of preterm birth, low birth weight, and small-for-gestational age infants.

**Conclusion:** Pregnant women of AMA differ from younger women in demographic characteristics, knowledge level, and some health behaviours and pregnancy outcomes. The growing number of pregnancies at AMA indicates the need for developing appropriate care plans to address the specific needs of this group.

**Key Words:** Advanced maternal age, survey, maternity experiences, pregnancy outcomes, risk factors

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## Résumé

**Objectif :** Le taux de grossesse à un âge maternel avancé (AMA) a connu une hausse au cours des dernières décennies. Cette étude avait pour but de comparer les caractéristiques démographiques et obstétricales des primipares canadiennes d'AMA à celles des femmes de 20 à 29 ans.

**Méthodes :** Nous avons mené une analyse secondaire des données recueillies au moyen de l'Enquête sur l'expérience de la maternité (EEM) nationale du Système canadien de surveillance périnatale. L'échantillon comprenait 301 primipares de 35 ans ou plus et 1 564 primipares de 20 à 29 ans. Les estimations de la prévalence pour chacun des groupes et leurs rapports de cotes ont été calculés au moyen des poids d'échantillonnage de l'enquête, et les variances ont été calculées au moyen de méthodes d'amorçage neutralisant l'effet du modèle et des poids d'échantillonnage.

**Résultats :** Les femmes d'AMA étaient considérablement plus susceptibles de disposer d'un meilleur niveau de scolarité, de présenter un revenu supérieur, d'avoir un emploi et de continuer à travailler jusqu'à la fin de la grossesse, par comparaison avec les femmes moins âgées. Elles ont également signalé qu'elles disposaient de considérablement plus de renseignements sur la grossesse, le travail et l'accouchement; de surcroît, elles étaient plus susceptibles de participer à des cours prénataux. Elles étaient également plus susceptibles d'avoir déjà connu une fausse couche ou d'avoir subi un traitement contre l'infertilité, de demander ou de se voir offrir une césarienne et de présenter un taux accru de césarienne. Nous n'avons constaté aucune différence significative en matière de taux d'accouchement préterme, de faible poids de naissance et d'hypertrophie fœtale.

**Conclusion :** Les femmes enceintes d'AMA présentent des différences en matière de caractéristiques démographiques, de niveau de connaissances et de certains comportements de santé et de certaines issues de grossesse, par comparaison avec les femmes moins âgées. Le nombre croissant des grossesses à un AMA souligne la nécessité de formuler des plans de soins appropriés répondant aux besoins particuliers de ce groupe.

## INTRODUCTION

In the past three decades, maternal age has increased worldwide. The fertility rate for women over the age of 35 is growing fast in developed countries. In Australia, since 2003, the fertility rate for women aged 35 to 39 years has surpassed that of women aged 20 to 24 years.<sup>1</sup> In the United States, the birth rate for women aged 35 to 39 years increased to 47.5 births per 1000 women in 2007, the highest rate since 1964, and the birth rate for women aged 40 to 44 years increased to 9.5 births per 1000 women in 2007, the highest rate since 1968.<sup>2</sup> In Canada, between 1994 and 2004, the number of live births per 1000 women aged 35 to 39 years increased by 33% (from 28.0 to 37.1 per 1000 females). Correspondingly, the live birth rate for women aged 40 to 44 years increased by 43% (from 4.2 to 6.0 per 1000 females), and the live birth rate for women aged 45 to 49 years increased by 59% (from 0.17 to 0.27 per 1000 females).<sup>3</sup> Delayed childbearing has become socially acceptable, and childbearing at an older age is becoming more common.<sup>4</sup> For various reasons, many women are delaying childbearing into their mid-thirties. Women who delay their childbearing are more likely to value the importance of establishing independence through education, secure employment, and financial stability than women who had their children earlier in life.<sup>4</sup> Tough et al. reported that Canadians consider four factors in timing childbearing: financial security, their partner's suitability to parent, their own interest in or desire for having children, and their partner's interest in or desire for having children.<sup>5</sup> Other contributing factors for delaying childbearing include changes in societal values, decreasing family size, later marriage, longer life expectancy, more effective contraceptive techniques, widespread acceptance of later commencement of childbearing, greater equality in the workplace, increasing workforce participation and educational and career opportunities, modern infertility treatment, and developments in obstetric care.<sup>6-9</sup>

Pregnancies at AMA are associated with more pregnancy complications and adverse outcomes than pregnancies at younger ages. There is an increase in the overall maternal mortality rate associated with increasing

maternal age in developed countries.<sup>10,11</sup> According to the Confidential Enquiries into Maternal Mortality in the United Kingdom,<sup>12</sup> the leading causes of maternal death from 1994 to 1996 among all ages were thrombosis and hypertension. While death as a result of thrombosis did not appear to be related to increasing maternal age, death as a result of hypertension was five times more likely in women aged  $\geq 40$  years than in women aged  $\leq 25$  years.<sup>12</sup> In Canada (excluding Quebec), from 1997 to 2000, women aged 35 to 39 years had a five-fold higher risk of maternal mortality than women aged 20 to 24 years.<sup>13</sup> Furthermore, several studies have demonstrated an association between AMA and preterm birth, low birth weight, stillbirth, chromosomal abnormalities, gestational diabetes, multiple births, and higher rates of Caesarean section.<sup>14-18</sup> AMA is also associated with increasing health care use and costs in relation to childbirth because of higher rates of Caesarean section, screening and diagnostic tests, infant mortality, and longer hospital stay.<sup>19,20</sup>

Although a postponed pregnancy may be risky for the mother and her fetus, the exact mechanisms underlying these greater risks for adverse pregnancy outcomes among women of AMA are not well understood. Some investigators have identified maternal characteristics as determinants of maternal morbidity and obstetric interventions. Recent trends in maternal characteristics such as increasing maternal age and pre-pregnancy weight have increased the risk factors for labour induction and Caesarean section.<sup>20</sup> For instance, the increase in primary Caesarean section rates has been identified as a consequence of changes in maternal characteristics such as age, parity, and weight.<sup>20,21</sup> Because of the growing number of women who are delaying pregnancies to later in life, it is important to understand the characteristics of these women in comparison with younger women at a population level. This knowledge will facilitate the development of strategies for reducing modifiable risk characteristics.

The purpose of this study was to compare demographic characteristics, health information and behaviours, obstetric characteristics, and pregnancy outcomes of primiparous women aged  $\geq 35$  years with those of women aged 20 to 29 years in a nationally representative sample of Canadian women.

## ABBREVIATIONS

AMA	advanced maternal age
LBW	low birth weight
MES	Maternity Experiences Survey
SGA	small for gestational age

## METHODS

We conducted a secondary analysis of data collected through the national Maternity Experiences Survey of the Canadian Perinatal Surveillance System, Public Health Agency of Canada.<sup>22</sup> The MES was designed to explore

Canadian women's experiences, knowledge, and practices during pregnancy, labour and birth, and the early months of motherhood. Detailed descriptions of the survey methodology, data quality, and overall findings are reported elsewhere.<sup>22-24</sup>

A randomly selected sample of 8542 women who had recently given birth, stratified by province or territory of birth, maternal age, rural/urban residential area, and the presence of other children in the home, was drawn from the May 2006 Canadian Census. Mothers were eligible to participate in the MES if they were at least 15 years of age, gave birth in Canada to a singleton live infant during the target period (from February 15 to May 15, 2006, in the provinces and from November 1, 2005, to February 1, 2006, in the territories), and were living with their infant at the time of the interview. Eligible women were asked to participate in a computer-assisted telephone interview when their infant was five to 10 months old (9 to 14 months in the territories). The interviews were conducted by trained female interviewers from Statistics Canada and lasted 45 minutes on average. Completed responses were obtained from 6421 women (78% response rate). Interviews were conducted in English, French, and 13 additional languages to accommodate the linguistic needs of the most common cultural groups in Canada.

The MES questionnaire was based on existing evidence, available literature, and similar surveys conducted in other countries. The questionnaire comprised 309 questions addressing such topics as pre-conception; pregnancy, birth and postpartum care; infant feeding; maternal and infant health; smoking, alcohol, and drug use; stressful life events; postpartum depression; social support; satisfaction with care and caregivers; and work activity. The full questionnaire is available online.<sup>25</sup> The questionnaire, different sampling strategies, and questionnaire administration methods were assessed and amended following two pilot studies.<sup>26,27</sup>

For the purpose of this study, we compared participants in the MES who were primiparous women aged  $\geq 35$  years with primiparous women aged 20 to 29 years. The maternal age of 20 to 29 years has been used as a comparison group in previous studies.<sup>16,28</sup> Therefore, the sample for this study consisted of 1865 primiparous women in total, including 301 primiparous women aged  $\geq 35$  years (16%) and 1564 primiparous women aged 20 to 29 years (84%). The study compared women in four categories: demographic characteristics, obstetric characteristics, health information and behaviours, and pregnancy outcomes.

The demographic characteristics studied were marital status, level of education, recent immigrant status

(< 5 years living in Canada), family income below the low-income cut-off, and working during pregnancy. The low-income cut-off was determined for each respondent according to her family's total income, family size, and size of area of residence.<sup>22</sup>

Health-related information and behaviours consisted of 16 variables, including pre-pregnancy BMI, weight gain during pregnancy, knowledge of the benefits of taking folic acid before pregnancy, taking folic acid before pregnancy, smoking prior to pregnancy, feelings towards pregnancy, knowledge of pregnancy and labour and delivery (nine variables), and attendance at prenatal classes.

Variables studied in the obstetric characteristics category included a history of miscarriage, induced abortion, or use of fertility medications or medical procedures to become pregnant, and chronic medical conditions or health problems before pregnancy that required the woman to take medication for more than two weeks or have special care or extra tests during her pregnancy. Furthermore, some prenatal care characteristics were studied, including type of prenatal care provider, timing of initiation of prenatal care, and number of prenatal care visits.

Pregnancy outcomes consisted of type of delivery (vaginal or Caesarean section), labour interventions (induction of labour, episiotomy, and assisted vaginal delivery), and neonatal outcomes including low birth weight, preterm birth, and small for gestational age. In addition, maternal requests for Caesarean section and whether the care provider offered the woman a Caesarean section were studied.

A descriptive bivariate analysis was completed to identify statistically significant differences between women aged  $\geq 35$  ( $n = 301$ ) and younger women ( $n = 1564$ ). Because the MES did not draw a simple random sample, weighted estimates of prevalence and of variances are required to take into consideration the sampling design and rates of non-response.<sup>29</sup> In this study, each responding woman was assigned a sampling weight; therefore, 1865 respondents were weighted to represent an estimated 22 834 women in the population. All statistics were calculated using the final weighted sample. Estimates of prevalence of the characteristic for each group and their odds ratios were calculated using sample weights of the survey, and their variances were calculated using bootstrapping methods adjusting for sampling design and weights. As recommended by Statistics Canada, estimates with coefficients of variation < 16.6% are considered acceptable, coefficients of variation between 16.6% and 33.3% are considered to be marginal, and coefficients of variation > 33.3% are considered to be of low quality.<sup>22</sup> Also, statistics based

**Table 1. Odds ratios and 95% confidence intervals for the bivariate analysis of demographic characteristics of women aged 20 to 29 years and women aged  $\geq 35$  years from the Maternity Experiences Survey, Canada, 2006–2007**

Variable	Maternal age		OR (95% CI)	P
	Age $\geq 35$ (n = 301) Weighted %	Age 20 to 29 (n = 1564) Weighted %		
Single marital status	6.9*	9.8	0.68 (0.40 to 1.14)	0.15
Secondary education or higher	99.3	94.1	9.09 (1.89 to 50.0)	0.006
Living in rural area	12.2	16.6	0.71 (0.49 to 1.03)	0.07
Recent immigrant	6.8*	10.1	0.65 (0.37 to 1.15)	0.14
Working at a paid job or business	89.4	78.7	2.37 (1.54 to 3.65)	< 0.001
Working during pregnancy until birth of baby	16.1	11.8	1.34 (0.93 to 1.93)	0.12
Family income below the low income cut-off	8.0*	18.2	0.37 (0.23 to 0.60)	< 0.001

\* Coefficient of variation between 16.6% and 33.3%.

on cell sizes of < 5 (i.e., numerator with < 5 cases) were suppressed. Ninety-five percent confidence intervals were reported with each estimate. An alpha level of 0.05 was used for all statistical tests. Missing values were excluded from the analyses.

The research protocol for the MES was reviewed by Health Canada's Science Advisory Board and Research Ethics Board and by the Federal Privacy Commissioner. Approval was received from Statistics Canada's Policy Committee prior to implementation of the survey.

## RESULTS

Primiparous women of AMA were significantly more likely to have secondary or higher level education than younger women (OR 9.09; 95% CI 1.89 to 50.0). These women were less likely to have a family income below the low-income cut-off than women aged 20 to 29 years (OR 0.37; 95% CI 0.23 to 0.60). Older women were more likely to work at a paid job or in business (OR 2.37; 95% CI 1.54 to 3.65) than younger women. Furthermore, women of advanced age were more likely to stop working later in pregnancy than younger women (31.50 weeks vs. 26.36 weeks). There were no significant differences between the two groups in marital status, recent immigration, or living in a rural area (Table 1).

There was no statistically significant difference between the two groups in the proportion of women with a pre-pregnancy BMI in the overweight or obese category (> 24.9 kg/m<sup>2</sup>). However, women of AMA were less likely to gain > 16 kg during pregnancy than women aged 20 to 29 years (OR 0.58; 95% CI 0.44 to 0.76). In fact 47.6 % of younger women gained excessive weight

(> 16 kg) compared with 34.7% of women aged  $\geq 35$  years. Primiparous women of AMA were significantly more likely to attend prenatal classes (74%) than younger women (62%) (OR 1.75; 95% CI 1.31 to 2.34). Women of AMA were three times more likely to report having knowledge of the benefits of taking folic acid before pregnancy than younger women (OR 3.07; 95% CI 2.14 to 4.41). The proportion of older women who took supplements containing folic acid in the three months before pregnancy was 73%. Among younger women, this proportion was 54%. Fewer women of AMA smoked (either daily or occasionally) before pregnancy than younger women (18% vs. 28%) (OR 0.55; 95% CI 0.40 to 0.76). The proportion of older women who smoked daily before pregnancy was less than half the proportion of younger women (9% vs. 21%) (Table 2).

The MES included a number of questions about whether women had enough information on topics related to pregnancy, labour, and birth. Women of AMA were significantly more likely than younger women to report having enough information about physical changes during pregnancy, emotional changes, warning signs of pregnancy complications, the process of labour and birth, what the husband or partner could do to support the mother during labour, pain management techniques during labour, the side effects of using pain medications and anaesthesia during labour, and medical tests or techniques during pregnancy. Information about the effects of taking medication during pregnancy was the only option for which younger women were as informed as older women. It is noteworthy that 20% of younger women and 10% of older women reported that they were not informed about warning signs of pregnancy complications (Table 3).

**Table 2. Odds ratios and 95% confidence intervals for the bivariate analysis of health-related information and behaviours of women aged 20 to 29 years and women aged  $\geq 35$  years from the Maternity Experiences Survey, Canada, 2006–2007**

Variable	Maternal age		OR (95% CI)	P
	Age $\geq 35$ (n = 301) Weighted %	Age 20 to 29 (n = 1564) Weighted %		
Pre-pregnancy BMI > 24.9 kg/m <sup>2</sup>	31.0	30.1	1.03 (0.78 to 1.37)	0.81
Weight gain > 16 kg during pregnancy	34.7	47.6	0.58 (0.44 to 0.76)	<0.001
Knew about benefits of taking folic acid before pregnancy	85.8	67.1	3.07 (2.14 to 4.41)	<0.001
Took folic acid before pregnancy	72.5	53.6	2.30 (1.71 to 3.08)	<0.001
Smoked prior to pregnancy	17.5	27.8	0.55 (0.40 to 0.76)	<0.001
Daily smoking prior to pregnancy	9.4*	20.5	0.40 (0.27 to 0.61)	<0.001
Attended prenatal classes	73.8	61.5	1.75 (1.31 to 2.34)	<0.001

\* Coefficient of variation between 16.6% and 33.3%.

More than one half of women aged  $\geq 35$  years (61.5%; 95% CI 55.9 to 67.1) and women aged 20 to 29 years (55.3%; 95% CI 52.8 to 57.8) reported receiving most of their prenatal care from an obstetrician-gynaecologist (Table 4). Among women of AMA, 26.0% received most of their prenatal care from a family physician, 11.0% from a midwife, and 1.0% from other health care professionals. These percentages for women aged 20 to 29 were 37.7%, 4.9%, and 1.3%, respectively. There was no significant difference between the two groups in the proportion of women receiving care from each type of prenatal care provider. The majority of women initiated prenatal care in the first trimester. Only 2.6% of women of AMA and 5.1% of women aged 20 to 29 years initiated prenatal care after the first trimester of pregnancy. Women of AMA attended an average of 12.9 prenatal care visits and younger women attended an average of 12.2. There were no significant differences between the two groups in late initiation of care and number of prenatal care visits (Table 4).

Nearly 15% of older women and only 4% of younger women reported using fertility medications or medical procedures to become pregnant (OR 3.93; 95% CI 2.57 to 6.01). Older women were less likely than younger women to report having an unwanted pregnancy (14.7% vs. 28.7%, OR 0.43; 95% CI 0.30 to 0.60). Only a small proportion of each group reported being unhappy about being pregnant (women  $\geq 35$ , 4.3%; women 20 to 29, 5.8%), and this difference was not statistically significant.

Almost one quarter of women of AMA reported having a history of miscarriage, which was significantly more than younger women (23% vs. 13.1%; OR 1.94; 95% CI 1.42

to 2.66). There was no significant difference in reported history of induced abortion between the two groups. Older women were almost twice as likely as younger women to report having chronic medical conditions or health problems before pregnancy (OR 1.91; 95% CI 1.37 to 2.65).

Only 58.9% of older women gave birth vaginally, compared with almost three quarters (74.2%) of younger women. Women of AMA were more likely to have a vacuum-assisted vaginal delivery (21.1%) than younger women (15.3%). There were no significant differences between the two groups in the proportion reporting forceps-assisted vaginal delivery or episiotomy. Older women were twice as likely as younger women to have a Caesarean section (41.1% vs. 25.8%) (OR 2.01; 95% CI 1.54 to 2.62). There were no significant differences between the groups regarding unplanned Caesarean section. Older women were more likely to request a Caesarean section from their care provider at any point during their pregnancy (OR 1.91; 95% CI 1.07 to 3.41), and they were more likely than younger women to have a Caesarean section recommended by their care provider before labour (OR 1.51; 95% CI 1.04 to 2.21) (Table 5).

There were no significant differences in newborn outcomes between the two groups. The reported proportions of infants born at < 37 completed weeks of gestation (preterm birth) for older women and younger women were 7.9% and 7.4%, respectively. The reported proportion of infants born SGA was the same in each group (10%). Finally, the reported proportions of LBW infants (< 2500 g) in older women and younger women were 7.8% and 5.9%, respectively.

**Table 3. Odds ratios and 95% confidence intervals for the bivariate analysis of information received by women aged 20 to 29 years and women aged  $\geq 35$  years from the Maternity Experiences Survey, Canada, 2006–2007**

Variable	Maternal age		OR (95% CI)	P
	Age $\geq 35$ (n = 301) Weighted %	Age 20 to 29 (n = 1564) Weighted %		
Information about physical changes	95.6	90.6	2.27 (1.19 to 4.33)	0.01
Information about emotional changes	92.2	86.9	1.82 (1.13 to 2.93)	0.01
Information about warning signs of pregnancy complications	90.2	80.0	2.36 (1.54 to 3.63)	<0.001
Information about effects of taking medication on pregnancy	95.5	93.1	1.53 (0.79 to 2.95)	0.21
Information about process of labour and birth	92.2	88.4	1.65 (1.03 to 2.65)	0.04
Information about what husband or partner could do to support mother during labour	95.5	90.1	2.51 (1.34 to 4.71)	0.004
Information about pain management techniques during labour	95.5	90.1	2.35 (1.29 to 4.28)	0.005
Information about the side effects of using pain medications and anaesthesia during labour	86.0	79.1	1.63 (1.12 to 2.38)	0.01
Information about medical tests or techniques during pregnancy	95.0	90.0	2.16 (1.19 to 3.94)	0.01

## DISCUSSION

The results of this secondary analysis confirm that women of AMA differ from younger women in several demographic and obstetric characteristics and in health behaviours and knowledge. Primiparous Canadian women of AMA were significantly more likely than younger women to have a high socioeconomic status. These results are consistent with the results of previous studies in Canada and other industrialized countries<sup>9,30–32</sup> and reflect the possibility that women of AMA may delay childbearing in order to obtain advanced education and establish their career. Joseph et al. reported that the birth rate for nulliparous and multiparous women of AMA in Nova Scotia increased between 1988 and 2007, and this trend was more prevalent among nulliparous women with higher socioeconomic status.<sup>32</sup>

Poor medical and reproductive histories were significantly more prevalent among women aged  $\geq 35$  years. Delbaere et al. found in a 2007 study that primiparous women aged  $\geq 35$  years were more likely than younger women to have become pregnant by means of assisted conception (13.4% vs. 4.0%) and to suffer from chronic complications during pregnancy such as hypertension (8.7% vs. 6.6%) and diabetes (2.5% vs. 1.1%).<sup>30</sup> Ziadeh and Yahaya reported in 2001 that, in comparison with women aged 20 to 29 years, women aged  $\geq 35$  years were at increased risk of higher weight gain, obesity, chronic and pregnancy-induced hypertension, antepartum hemorrhage, multiple gestation,

malpresentation, and premature rupture of membranes.<sup>28</sup> Joseph et al. reported similar results regarding a history of infertility and poor obstetric history among women of AMA.<sup>18</sup> Advancing maternal age can be associated with declining fecundity, and older women are more likely than younger women to require infertility treatment to become pregnant.<sup>33</sup> In addition, medical conditions and chronic diseases such as cardiovascular disease, arthritis, and diabetes are more prevalent among older women.<sup>7,14,30,34</sup>

The results of this study illustrated that women of AMA were more likely than younger women to engage in healthy behaviours before and during pregnancy. More older women in this study had more information about the benefits of taking folic acid before pregnancy, which may have contributed to more women taking folic acid before and during pregnancy. Older women were also less likely to smoke prior to pregnancy. Similarly, other investigators have noted that the proportion of mothers of AMA who reported smoking during pregnancy was lower than the proportion of younger mothers.<sup>9,18,35</sup> However, Prysak et al. in 1995 reported a non-significant association between maternal age and smoking.<sup>36</sup>

According to the results of this study, there was not a statistically significant difference between the proportion of women in the two groups who were overweight or obese ( $> 24.9 \text{ kg/m}^2$ ). However, almost one third of women in each group were overweight or obese before pregnancy.

**Table 4. Odds ratios and 95% confidence intervals for the bivariate analysis of obstetric characteristics of women aged 20 to 29 years and women aged  $\geq 35$  years from the Maternity Experiences Survey, Canada, 2006–2007**

Variable	Maternal age		OR (95% CI)	P
	Age $\geq 35$ (n = 301) Weighted %	Age 20 to 29 (n = 1564) Weighted %		
Used fertility medications or medical procedures to get pregnant	14.2	4.1	3.93 (2.57 to 6.01)	< 0.001
Unwanted pregnancy	14.7	28.7	0.43 (0.30 to 0.60)	< 0.001
Unhappy to be pregnant	4.4*	5.8	0.75 (0.42 to 1.34)	0.33
Late initiation of prenatal care ( $\geq 14$ weeks)	2.6*	5.1	0.49 (0.22 to 1.08)	0.08
PNC provided mostly by obstetrician-gynaecologist	61.5	55.3	1.43 (0.14 to 14.85)	0.76
PNC provided mostly by family doctor	26.0	37.7	0.89 (0.09 to 9.28)	0.92
PNC provided mostly by midwife	11.0*	4.9	2.86 (0.26 to 30.90)	0.39
History of miscarriage	22.6	13.1	1.94 (1.42 to 2.66)	< 0.001
History of induced abortion	12.4	10.1	1.26 (0.84 to 1.90)	0.27
Chronic medical conditions or health problems before pregnancy	21.9	12.9	1.91 (1.37 to 2.65)	< 0.001

\* Coefficient of variation between 16.6% and 33.3%.  
PNC: prenatal care

Furthermore, nearly one half of women aged 20 to 29 years and one third of women of AMA gained  $> 16$  kg during pregnancy. Younger women were significantly more likely to gain excessive weight ( $> 16$  kg) during pregnancy. The Canadian study of Crane et al. demonstrated that only one third of women with singleton pregnancies gained the recommended amount of weight during pregnancy, while 52% of women gained more than recommended.<sup>37</sup> This phenomenon is alarming, and strategies to reverse this trend are warranted. Obese and overweight pregnant women are at increased risk of developing health problems during pregnancy such as gestational diabetes mellitus, pregnancy-associated hypertension, and preeclampsia, and are less likely to have spontaneous onset of labour.<sup>38,39</sup> According to guidelines from the Institute of Medicine, women with a singleton pregnancy and a normal pre-pregnancy BMI should aim to gain 11.5 to 16 kg, overweight women 7 to 11.5 kg, and obese women 5 to 9 kg.<sup>40</sup> New strategies should be emphasized to encourage a healthy lifestyle during pre-conception care and to educate women at all reproductive ages about the optimal range for pre-pregnancy BMI and weight gain during pregnancy.

Women of AMA and younger women also differed in their rates of unintended pregnancy. Similar trends were reported in a United States study, in which the rate of unintended pregnancy in 2001 among a nationally representative sample of women aged 35 to 39 years was 29%, while these rates for women aged 25 to 29 and aged 20 to 24

were 43% and 60%, respectively. The authors noted that unintended pregnancies were more common among young women (aged 18 to 24), low-income women, cohabiting women, and minority women.<sup>41</sup> The rates reported in this study might be higher than our rates because of the inclusion of both primiparous and multiparous women, or because of population differences. Unintended pregnancy might be related to a woman's socioeconomic status and differences in the rate of contraception use.<sup>42</sup>

Our results illustrate that primiparous Canadian women of AMA had significantly more information on pregnancy, labour, and birth and were more likely than younger women to attend prenatal classes. This is consistent with previous findings from another Canadian study.<sup>18</sup> Higher socioeconomic status, including education and income, may contribute to women attending prenatal classes. Over 60% of women aged  $\geq 35$  years had a total annual family income of \$60 000 or higher, compared with 40% of the younger group. Results of a longitudinal Canadian study showed that young mothers ( $< 25$  years) were less likely than primiparous women aged  $\geq 35$  years to attend prenatal classes. In that study, mother's age and education were identified as significant predictors of prenatal class attendance among primiparous women.<sup>43</sup> However, a Swedish study reported that there were no significant differences between age groups in the non-attendance rates at childbirth and parenthood education classes during pregnancy. Unemployment, smoking during pregnancy,

**Table 5. Odds ratios and 95% confidence intervals for the bivariate analysis of pregnancy outcomes of women aged 20 to 29 years and women aged  $\geq 35$  years from the Maternity Experiences Survey, Canada, 2006–2007**

Variable	Maternal age		OR (95% CI)	P
	Age $\geq 35$ (n = 301) Weighted %	Age 20 to 29 (n = 1564) Weighted %		
Caesarean section	41.1	25.8	2.01 (1.54 to 2.62)	0.001
Unplanned Caesarean section	30.1	19.6	0.87 (0.53 to 1.41)	0.56
Planned Caesarean (medical or non-medical reasons)	10.5*	6.0	0.87 (0.01 to 55.73)	0.95
Maternal request for Caesarean section	6.2*	3.4	1.91 (1.07 to 3.41)	0.03
Caesarean section recommended by health care provider before labour	15.6	10.9	1.51 (1.04 to 2.21)	0.03
Assisted vaginal delivery—forceps	11.6*	8.9	1.34 (0.86 to 2.11)	0.20
Assisted vaginal delivery—vacuum	21.1	15.3	1.48 (1.04 to 2.10)	0.03
Episiotomy	30.1	26.8	1.17 (0.85 to 1.61)	0.33
Preterm birth (< 37 weeks' gestation)	7.9*	7.4	1.10 (0.67 to 1.81)	0.71
SGA infant	10.3*	10.4	1.01 (0.65 to 1.56)	0.97
LBW infant	7.8*	5.9	1.34 (0.80 to 2.23)	0.27

\*Coefficient of variation between 16.6% and 33.3%.

having considered abortion, and having had few antenatal visits were associated with non-attendance in primiparous women.<sup>44</sup> A study in the United States in 2003 found that childbirth class attendance varied by ethnicity, education, household income, and marital status, but age was not significantly associated with childbirth class attendance.<sup>45</sup>

Obstetrical interventions such as induction of labour, Caesarean section, and assisted vaginal delivery by vacuum were significantly more common among women of AMA. These findings are consistent with previous reports.<sup>18,28,35,46,47</sup> Voigt et al. reported that the risks of premature rupture of membranes, non-cephalic presentation, abnormal cardiotocography, and prolonged labour increased with age, likely contributing to higher rates of these interventions.<sup>47</sup> An Australian population-based study demonstrated that from 1998 to 2007, the rate of induction of labour increased from 25.3% to 29.1%. Nulliparous women aged  $\geq 35$  years and/or at 41 weeks' gestation had a sharper increase in the labour induction rate. The predictors of failed labour induction in both nulliparous and multiparous women included increasing maternal age, preterm and post-term birth, and the use of prostaglandin or mechanical methods of induction.<sup>48</sup> Results of a systematic review illustrated that nulliparous women of AMA have a higher risk for Caesarean section than younger women; the relative risk of Caesarean section for a nulliparous woman of AMA in a developed country varied from 1.44 to 2.27. According to this review, the reasons for the increasing

Caesarean section rate in women of AMA are not fully understood. The following factors might contribute to this phenomenon: an aging reproductive system, a lower clinical threshold for intervention among women of AMA, higher socioeconomic status, advancing age of the father, and medical–legal concerns.<sup>17</sup> Interestingly, results of the current study illustrated women of AMA were more likely to be offered a Caesarean section or to request a Caesarean section before beginning labour. This finding suggests that women of AMA are more likely to consider a Caesarean section than younger women as are the providers of care for women of AMA. Joseph et al. stated that obstetric practice has adapted; that is, there have been reductions in midpelvic forceps use and increases in Caesarean section for breech presentation, labour induction, epidural anaesthesia, and delivery by an obstetrician because of changes in maternal characteristics and concerns related to fetal and maternal safety.<sup>21</sup>

In previous reports, AMA has been identified as a determinant for several adverse pregnancy outcomes including LBW,<sup>9,28,35,36</sup> SGA,<sup>9,28,30</sup> and preterm birth.<sup>28,30,35,36</sup> While the increased risk of preterm birth and LBW in women of AMA are both very well documented, the association with SGA is more controversial. Chan and Lao found no significant differences between younger and older women in rates of SGA,<sup>35</sup> but Prysak et al. reported a difference at the 0.04 alpha level.<sup>36</sup> In contrast to the findings of these previous studies, we found no significant differences in rates

of preterm birth, LBW, or SGA between the two groups. However, there were trends to higher rates of preterm birth and LBW among women of AMA. It must be noted that in the MES survey, only women living with their infant at the time of the interview were included in the survey, meaning that women having a neonatal death due to preterm birth or LBW were excluded from the survey. The possibility exists that women of AMA may have been over-represented in the women who were excluded from the survey.

There are several strengths associated with the MES. The MES used a large, randomly selected sample that is representative of the Canadian population. This survey provides a national perspective of maternity experiences among Canadian women. However, this survey has some limitations that should be considered in interpreting the results. There is a potential for recall bias, especially for pregnancy events, because of the varied timing of the interview (9 to 14 months postpartum). The number of respondents in the MES who were both primiparous and of AMA was relatively small ( $n = 301$ , representing 4.7% of sample), contributing to marginal coefficients of variation for some of the analyses. The survey did not include First Nations women living on reserves or women living in institutions, women who had a neonatal death, or women who were not residing with their infants during the survey time frame, and therefore the perspectives of these women are not reflected in the survey results.

## **CONCLUSION**

Pregnant women of AMA are different from younger women in their characteristics and in some pregnancy outcomes. Population level studies provide useful information to identify modifiable factors in adverse outcome pathways. Women of AMA were advantaged in many aspects that might have a positive impact on pregnancy outcomes; they had generally higher socioeconomic status and were more likely to have planned pregnancies, to be informed about pregnancy, and to practise healthy behaviours than younger women. Conversely, women of AMA were more likely to have chronic medical conditions or health problems before pregnancy than younger women. Women of AMA were at increased risk for some adverse pregnancy outcomes, mostly in the area of obstetrical interventions, such as higher rates of labour induction, Caesarean section, and assisted vaginal delivery. This raises a concern regarding increased obstetrical interventions for women of AMA. Whether this phenomenon is inevitable because of the effects of aging on the reproductive system, or whether it is mostly a result of labelling women of AMA as high risk should be explored in future studies.

Older and younger women had similar preterm birth, SGA, and LBW pregnancy outcomes. This might suggest that, in addition to biological aspects, socioeconomic factors play a significant role in the association between maternal age and adverse pregnancy outcomes. According to this study, primiparous Canadian women aged 20 to 29 years are more likely to engage in unhealthy behaviours before and during pregnancy than women of AMA. This suggests that strategies to promote a healthy lifestyle and decrease modifiable risk factors are needed in the younger population of pregnant women.

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