Changes in Maternal Characteristics in Nova Scotia, Canada from 1988 to 2001

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ABSTRACT

Background: Maternal characteristics such as age, parity, smoking status, pre-pregnancy weight and pregnancy weight gain have changed in many industrialized countries in recent years. Many of these changes have not been adequately described at a population level. The purpose of this study was to describe recent trends in selected maternal characteristics in Nova Scotia.

Methods: Data from a population-based perinatal database were used to examine changes in maternal age, parity, smoking, pre-pregnancy weight, delivery weight and pregnancy weight gain among all deliveries between 1988 and 2001.

Results: The proportion of deliveries to women ≥ 35 years increased by 84% over the study period from 7.0% in 1988-1991 to 12.9% in 1998-2000, while deliveries to women ≥ 40 years increased by more than 100%. The number of nulliparous women ≥ 35 years also increased significantly. The overall prevalence of smoking decreased from 32.7% in 1988-1991 to 25.1% in 1998-2001, however the prevalence of smoking among women < 20 years did not change over the study period and was almost 50%. The proportion of women with a pre-pregnancy weight of ≥ 90 kilograms (kg) increased by 165% from 4.1% in 1988-1991 to 10.7% in 1998-2001. The proportion of women with pregnancy weight gain of < 7 kg and ≥ 18 kg increased by 37% and 13%, respectively.

Conclusion: Dramatic changes have occurred in several important maternal characteristics and there is evidence of ongoing change. Continuation of these trends is likely to impact on future obstetric practice and perinatal health.

MeSH terms: Maternal age; parity; smoking; body weight; trends

La traduction du résumé se trouve à la fin de l'article.

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The distribution of maternal characteristics has changed in many industrialized countries over the past few decades. Maternal age has increased.¹⁻⁴ In Canada, 30% of all live births in 1997 were to women 30-34 years, a 58% increase over 1981.³ In the US, the birth rate to women 40-44 years increased by 44% from 5.5 per 1,000 in 1990 to 7.9 per 1,000 in 2000.⁴ Smoking rates during pregnancy have decreased in many,³⁻⁹ but not all,¹⁰ industrialized countries. In Canada, maternal smoking decreased from 23.5% in 1994-1995 to 19.4% in 1998-1999.³ The prevalence of obesity among women of reproductive age has been increasing in Canada,¹¹ the US^{9,12,13} and other countries.⁹ This has been reflected in increased maternal pre-pregnancy weight and delivery weight.¹⁴⁻¹⁷ Although mean pregnancy weight gain has been relatively stable since the 1980s, women are increasingly gaining below and above recommended guidelines.^{4,13,18} In the US, the proportion of women who gained < 7 kilograms (kg) increased from 9.4% to 11.6% between 1989 and 2000, as did the proportion gaining ≥ 21 kg (from 9.1% to 12.4%).⁴

While maternal characteristics are known determinants of obstetric practice^{14,17,19-24} and perinatal morbidity and mortality,^{4,5,9,17,18,20,21} recent changes have not been adequately described at a population level. The present study was undertaken to describe changes in selected characteristics of women who gave birth during the 14-year period, 1988 to 2001.

METHODS

The study population included all women resident in Nova Scotia, Canada who delivered a live birth or stillbirth between 1988 and 2001. Data for the study were obtained from the population-based Nova Scotia Atlee Perinatal Database (NSAPD). Maintained by the Reproductive Care Program of Nova Scotia, the NSAPD has collected detailed information on all deliveries in the province since 1988. NSAPD data are abstracted from standardized clinical forms and hospital records by trained health records personnel. The NSAPD contains information on labour and delivery and infant outcomes, as well as maternal information on lifestyle and other characteristics. Validation studies^{25,26} and

ongoing quality assurance studies have found the information in the database to be reliable.

The maternal characteristics studied were age, parity, smoking, pre-pregnancy weight, delivery weight, and pregnancy weight gain. Women delivering twins, triplets, etc. contributed one observation to the study. Maternal age was grouped into 5 categories: <20 years, 20-29, 30-34, 35-39 and ≥ 40 years. Parity (number of previous viable pregnancies) was classified as 0, 1-2 and ≥ 3 . Information on smoking was collected at the time of hospital admission for delivery and included an estimate of the number of cigarettes smoked per day just prior to delivery. Women were categorized as non-smokers, light (1-9 cigarettes/day), moderate (10-19 cigarettes/day) and heavy smokers (≥ 20 cigarettes/day). Pre-pregnancy weight was categorized as <60 kg, 60-69, 70-79, 80-89 and ≥ 90 kg. Delivery weight was categorized as <80 kg, 80-99, 100-119 and ≥ 120 kg. Pregnancy weight gain categories, based on published guidelines,^{13,27} were <7 kg, 7-10, 11-14, 15-17 and ≥ 18 kg.

Percent change over time and 95% confidence intervals (95% CI) were calculated to quantify comparisons between earlier and later years of the study. A confidence interval that does not include the null value indicates a statistically significant change from the first to the second time period. A chi-square test for linear trend was used to address the statistical significance of trends for selected characteristics. Deliveries with missing information were excluded from rate calculations. Subjects with missing information for smoking and pre-pregnancy weight were compared to subjects with complete information using chi-square tests to determine if there were differences between the groups.

Institutional ethics approval was received prior to conducting this study.

RESULTS

There were 151,268 deliveries in Nova Scotia between 1988 and 2001, of which 1.2% involved a multiple pregnancy. Mean maternal age at delivery increased from 27.1 years in 1988 to 28.9 years in 2001. Deliveries to women ≥ 35 years increased from 7.0% in 1988-1991 to 12.9% in 1998-2001, a relative increase of

TABLE I

Temporal Trends in Maternal Age and Parity, Nova Scotia, 1988-1991 and 1998-2001

Maternal Characteristic	Time Period				Percent Change	95% CI
	1988-1991		1998-2001			
	Number	%	Number	%		
Age (years)						
<20	4,227	8.6	2,540	6.9	-19	-15 to -23
20-29	30,517	61.9	19,242	52.5	-15	-14 to -16
30-34	11,071	22.5	10,123	27.6	23	20 to 26
35-39	3,081	6.3	4,123	11.3	80	72 to 88
≥40	385	0.8	613	1.7	114	89 to 143
Parity*						
0	21,751	44.1	16,271	44.4	1	-1 to 2
1-2	24,552	49.8	18,261	49.8	0	-1 to 1
≥3	2,968	6.0	2,105	5.7	-5	-10 to 1
Nulliparity by age (years)*						
<20	3,651	86.4	2,145	84.4	-2	-4 to 0
20-29	14,503	47.5	9,575	49.8	5	3 to 7
30-34	2,910	26.3	3,331	32.9	25	20 to 31
35-39	623	20.2	1,064	25.8	28	17 to 39
≥40	64	16.6	156	25.4	53	18 to 99

* Information on parity was missing for 10 subjects between 1988-1991 and 4 subjects between 1998-2001

TABLE II

Temporal Trends in Maternal Smoking at Time of Delivery, Nova Scotia, 1988-1991 and 1998-2001

Maternal Characteristic	Time Period				Percent Change	95% CI
	1988-1991		1998-2001			
	Number	%	Number	%		
Smoking status						
Non-smoker	31,616	67.3	26,180	74.9	11	10 to 12
Smoker	15,333	32.7	8,790	25.1	-23	-21 to -25
Missing	2,332		1,671			
Level of smoking (cigarettes/day)						
Non-smoker	31,616	67.3	26,180	77.4	15	14 to 16
1-9	3,144	6.7	2,879	8.5	27	21 to 34
10-19	7,203	15.3	3,707	11.0	-29	-26 to -31
≥20	4,986	10.6	1,039	3.1	-71	-69 to -73
Missing	2,332		2,836			
Smoking by age (years)						
<20	1,873	47.2	1,145	47.5	1	-5 to 6
20-29	10,275	35.3	5,151	28.0	-21	-18 to -23
30-34	2,490	23.5	1,640	16.9	-28	-24 to -32
35-39	639	21.7	758	19.3	-11	-3 to -19
≥40	56	15.6	96	16.6	6	-21 to 44
Missing	2,332		1,671			

TABLE III

Temporal Trends in Maternal Pre-pregnancy Weight, Delivery Weight and Pregnancy Weight Gain, Nova Scotia, 1988-1991 and 1998-2001

Maternal Characteristic	Time Period				Percent Change	95% CI
	1988-1991		1998-2001			
	Number	%	Number	%		
Pre-pregnancy weight (kilograms)						
<60	22,789	50.7	11,068	35.1	-31	-29 to -32
60-69	12,279	27.3	8,570	27.2	-1	-3 to 2
70-79	5,732	12.7	5,435	17.2	35	31 to 40
80-89	2,348	5.2	3,066	9.7	86	77 to 96
≥90	1,824	4.1	3,389	10.7	165	151 to 180
Missing	4,309		5,113			
Delivery weight (kilograms)						
<80	28,572	65.0	14,356	47.5	-27	-26 to -28
80-99	12,884	29.3	11,581	38.3	31	28 to 33
100-119	2,170	4.9	3,462	11.5	132	120 to 144
≥120	337	0.8	835	2.8	260	218 to 309
Missing	5,318		6,407			
Pregnancy weight gain (kilograms)						
<7	2,524	6.0	2,303	8.2	37	29 to 44
7-10	6,689	15.9	4,360	15.5	-2	-6 to 1
11-14	12,346	29.3	7,354	26.1	-11	-9 to -13
15-17	9,235	21.9	5,571	19.8	-10	-7 to -12
≥18	11,357	26.9	8,574	30.4	13	10 to 16
Missing	7,130		8,479

Figure 1. Distribution of maternal age (upper panel) and pre-pregnancy weight (lower panel) by time period

Figure 2. Temporal trends in selected maternal characteristics and risk factors, Nova Scotia, 1988 to 2001

84% (95% CI, 76 to 92, Table I). There was a 15% decrease in the proportion of deliveries to women 20-29 years (from 61.9% in 1988-1991 to 52.5% in 1998-2001) and a 19% decrease among women <20 years (from 8.6% in 1988-1991 to 6.9% in 1998-2001). The entire frequency distribution of maternal age shifted to the right between 1988-1991 and 1998-2001 (Figure 1, upper panel).

Change in the parity distribution was minimal (Table I); however, there was an increase in the proportion of nulliparous women in all age groups ≥ 20 years. The largest increase in nulliparity occurred among women ≥ 35 years; almost 26% were nulliparous in 1998-2001 compared to 19.8% in 1988-1991, an increase of 30% (95% CI, 20 to 41).

The prevalence of maternal smoking decreased by 23% (95% CI, 21 to 25) from 32.7% in 1988-1991 to 25.1% in 1998-2001. The rates of moderate and heavy smoking fell even more substantially by 29% and 71%, respectively (Table II). The largest decrease in smoking prevalence occurred among women in their early thirties. Smoking prevalence was highest (almost 50%) among women <20 years and did not change over the study period.

Mean pre-pregnancy weight increased from 61.8 kg in 1988 to 69.6 kg in 2001. The proportion of women with a pre-pregnancy weight of ≥ 90 kg increased from 4.1% in 1988-1991 to 10.7% in 1998-2001, a relative increase of 165% (95% CI, 151 to 180, Table III). This trend was evident in both nulliparous and parous women; however, the relative change was slightly higher among parous women. Women <20 years had the lowest rate of pre-pregnancy weight ≥ 90 kg; nevertheless, the relative increase in this rate between 1988-1991 and 1998-2001 exceeded 100% in all age groups. The frequency distribution of pre-pregnancy weight underwent a shift to the right between 1988-1991 and 1998-2001 (Figure 1, lower panel). Mean delivery weight increased from 76.3 kg in 1988 to 84.7 kg in 2001. The proportion of women with a delivery weight of ≥ 120 kg increased by 260% (95% CI, 218 to 309) from 0.8% in 1988-1991 to 2.8% in 1998-2001.

Mean pregnancy weight gain remained stable over the study period (14.5 kg in 1988 and 14.8 kg in 2001); however, the

proportion of women with weight gain below and above recommended guidelines^{13,27} increased. In 1988-1991, the proportion of women who gained <7 kg or ≥ 18 kg was 6.0% and 26.9%, respectively (Table III). By 1998-2001, this had increased to 8.2% and 30.4%, respectively. The rate of weight gain ≥ 18 kg was higher in multiple pregnancies than singleton pregnancies (55.2% compared to 30.1% in 1998-2001); however, the relative increase in this rate over the study period was lower in multiple pregnancies. Women whose pre-pregnancy weight was ≥ 90 kg had the lowest rate of pregnancy weight gain ≥ 18 kg (15%) and this rate did not change over the study period.

Figure 2 presents trends in selected maternal characteristics by year of delivery. Dramatic changes occurred between 1988 and 2001 in age (112% increase in the proportion of women ≥ 35 years), smoking (32% decrease), pre-pregnancy weight (253% increase in the proportion of women ≥ 90 kg) and pregnancy weight gain (17% increase in the proportion of women who gained ≥ 18 kg). All of these trends were statistically significant ($p < 0.0001$). Notably, the upward trends in age, pre-pregnancy weight and pregnancy weight gain and the downward trend in smoking did not appear to have leveled off.

Information on smoking and pre-pregnancy weight was missing from 4.3% and 10.2% of records, respectively. Compared to women with complete information on smoking, a larger proportion of women with missing information were single (28.1% vs. 22.1%, $p < 0.0001$) and <20 years (13.0% vs. 10.6%, $p < 0.0001$). A larger proportion of women with missing information on pre-pregnancy weight were single (28.8% vs. 21.6%, $p < 0.0001$), <20 years (12.5% vs. 10.5%, $p < 0.0001$) and in the heaviest delivery weight category (2.9% vs. 1.5%, $p < 0.0001$) compared to women with complete information on pre-pregnancy weight.

DISCUSSION

Our study shows dramatic changes in several maternal characteristics in Nova Scotia between 1988 and 2001. Mirroring trends in Canada^{1,3} and other industrialized countries,^{2,4} more Nova Scotia women are delaying childbearing, likely due to lengthened

education, career factors and economic reasons.²⁸⁻³⁰ While the majority of deliveries in 1998-2001 were to women 20-34 years, the increasing proportion of deliveries to women ≥ 35 years carries implications for clinical practice. Higher maternal age is associated with increased risk of pregnancy complications, preterm birth, restricted fetal growth and perinatal mortality.^{31,32} It is also associated with a higher rate of cesarean delivery,^{17,24,32} introducing additional health care costs due to longer length of post-partum hospital stay.³ Fetal chromosomal abnormalities such as trisomy 21 increase with maternal age,³³ implying the need for increases in prenatal screening and diagnostic services. In the context of increasing maternal age, it is noteworthy that rates of fetal and infant death due to chromosomal anomalies increased or remained unchanged in Canada between 1985-1987 and 1994-1996, despite substantial increases in prenatal diagnosis and selective pregnancy termination.^{34,35}

Although there was little change in the nulliparity rate overall, it did increase in higher maternal age groups. We observed a 30% increase in the proportion of nulliparous women ≥ 35 years in 1998-2001 compared to 1988-1991. Obstetric complications such as cesarean delivery¹⁹ and pre-eclampsia³⁶ are associated with nulliparity.

While it is encouraging that there has been a reduction in maternal smoking, the rate remains high despite the known adverse effects on maternal and fetal health.^{9,37} The particularly high prevalence among women <20 years contrasts with smoking rates in the general population of women this age. Recent surveys in Nova Scotia estimate that the prevalence of smoking in young women is between 24% and 29%.^{38,39} This discrepancy between young women overall and young women who deliver may indicate behavioural and lifestyle differences; cigarette smoking is associated with unplanned sexual intercourse, inconsistent condom use, multiple sexual partners⁴⁰ and pregnancy⁴¹ in this age group.

We observed a dramatic increase in the proportion of women with high pre-pregnancy weight, which is consistent with the increasing prevalence of overweight/obese women of reproductive age reported in the literature.^{9,11-13,24} The relationship between high pre-pregnancy weight and perinatal complications has been well

described. Overweight and obese women are at increased risk for hypertension,^{9,17,20,21} gestational diabetes,^{20,21} cesarean delivery^{14,17,20,21,23} and stillbirth.^{9,17}

Pregnancy weight gain outside of recommended guidelines is associated with a higher risk of adverse birth outcomes;⁴² thus, it is a concern that an increasing proportion of women are not falling within the recommended range for pregnancy weight gain. Although the relative increases in low and high pregnancy weight gain we observed were modest, almost a third of women delivering in 1998-2001 gained ≥ 18 kg. The women in this weight gain category were young and had a low pre-pregnancy weight. The reason for increased high pregnancy weight gain is unclear; however, it may be related to the relaxation of weight gain restriction that has occurred in recent decades.¹⁸ Excessive weight gain is a risk factor for cesarean delivery,^{22,23} infant macrosomia²¹ and post-partum maternal weight retention,⁴³ while low weight gain is associated with preterm birth and restricted fetal growth¹⁸ and is more common among young, thin women who smoke.⁴²

Study strengths include a large, population-based data source with detailed information on maternal characteristics. These results are generalizable to similar populations within Canada and possibly to other industrialized countries. A limitation of this study is the absence of maternal height data, which precluded calculation of body mass index. Another limitation concerns missing values for smoking, pre-pregnancy weight and delivery weight. Our analyses suggest that these data were not randomly missing but were related to other characteristics such as age and marital status. Nonetheless, the proportion of subjects with missing information was not large.

Our study has demonstrated that maternal characteristics have changed substantially in just one decade and that there is evidence of ongoing change. Given the higher potential for perinatal complications among older, nulliparous women and women with a high pre-pregnancy weight, a continuation of these trends is likely to impact on future clinical practice and perinatal health. From a public health perspective, the relative importance of these trends will increase as they become more prevalent. Thus, strategies directed toward

reducing modifiable risk characteristics such as pre-pregnancy obesity in the population and smoking among young, pregnant women are needed.

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RÉSUMÉ

Contexte : Les caractéristiques maternelles comme l'âge, le rang des naissances, l'usage du tabac, le poids avant la grossesse et le gain de poids durant la grossesse ont changé dans de nombreux pays industrialisés ces dernières années. Beaucoup de ces changements n'ont pas été convenablement décrits pour l'ensemble de la population. Notre étude visait donc à décrire les tendances récentes de certaines caractéristiques maternelles en Nouvelle-Écosse.

Méthode : À partir de données extraites d'une base de données périnatales représentatives, nous avons examiné l'évolution de l'âge des mères, du rang des naissances, du tabagisme, du poids avant la grossesse, du poids à l'accouchement et du gain de poids durant la grossesse pour tous les accouchements survenus entre 1988 et 2001.

Résultats : La proportion de femmes de plus de 35 ans ayant accouché a augmenté de 84 % sur la période de l'étude, passant de 7,0 % en 1988-1991 à 12,9 % en 1998-2000, et la proportion des femmes de plus de 40 ans ayant accouché a augmenté de plus de 100 %. Le nombre de nullipares de plus de 35 ans a également augmenté. La prévalence globale du tabagisme a diminué, passant de 32,7 % en 1988-1991 à 25,1 % en 1998-2001, mais elle est restée inchangée chez les femmes de moins de 20 ans, à près de 50 %, pendant cette période. La proportion des femmes pesant plus de 90 kg avant la grossesse a augmenté de 165 %, passant de 4,1 % en 1988-1991 à 10,7 % en 1998-2001. La proportion des femmes ayant pris moins de 7 kg ou plus de 18 kg durant la grossesse a augmenté de 37 % et de 13 %, respectivement.

Conclusion : Plusieurs caractéristiques maternelles importantes ont changé de façon spectaculaire, et les données semblent faire état d'une évolution continue. Si ces tendances se maintiennent, elles pourraient avoir un effet sur la pratique future de l'obstétrique et sur la santé périnatale.