

# The Influence of Socio-economic Status on Adverse Birth Outcomes

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### ABSTRACT

Adverse birth outcomes are associated with infant morbidity and mortality and with an increased likelihood of type 2 diabetes, hypertension, and cardiovascular disease in adulthood. Socio-economic status (SES) is one of the most reliable predictors of health disparities, and although the association between SES and birth outcomes has been studied previously, this is, to our knowledge, the first review that encompasses several dimensions of SES and their influence on birth outcomes in a single article. Our review indicates that education, income, neighbourhood SES, and occupation all play a role at influencing birth outcomes. We contend that, because lifestyle approaches to reducing health disparities (e.g., better diet, more exercise) are in turn related to SES, public discourse and policy interventions would be better suited to focusing attention on more fundamental causes of adverse birth outcomes—particularly low SES—if we are to see major improvements in the health of our citizens.

### KEYWORDS

socio-economic status, social class, premature birth, infant low birth weight, small for gestational age

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# Influence du statut socio-économique sur les issues de naissance indésirables

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## RÉSUMÉ

Les issues de naissance indésirables sont associées à la morbidité et à la mortalité néonatales, en plus d'accroître les risques de voir le diabète de type 2, l'hypertension et les maladies cardiovasculaires se manifester à l'âge adulte; et le statut socio-économique (SSÉ) est l'un des facteurs prédictifs les plus fiables en ce qui concerne les inégalités en matière de santé. Bien que l'association entre le SSÉ et les issues de naissance ait déjà fait l'objet d'études, la présente étude constitue, pour autant que l'on sache, la première analyse se penchant (dans le cadre d'un même article) sur plusieurs dimensions des SSÉ et leur influence respective sur les issues de naissance. Notre analyse indique que l'éducation, le revenu, le SSÉ du quartier et la profession sont tous des facteurs qui exercent une certaine influence sur les issues de naissance. Puisque les approches liées au mode de vie qui sont déployées en vue de réduire les inégalités en matière de santé [p. ex. adopter un meilleur régime alimentaire, faire plus d'exercice] sont également associées au SSÉ, nous soutenons qu'il vaudrait mieux que le discours public et les interventions en matière de politique ciblent les causes plus fondamentales des issues de naissance indésirables, particulièrement la présence d'un faible SSÉ, pour que l'on puisse constater des améliorations au niveau de la santé de nos citoyens.

## MOTS CLÉS

statut socio-économique, classe sociale, naissance prématurée, faible poids de naissance, hypotrophie fœtale

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## INTRODUCTION

It is well known that people of high socio-economic status (SES) tend to have better health than those of lower SES. For example, women of lower SES have greater exposure to stress resulting from poor living conditions, unemployment, limited access to food, and interpersonal factors such as violence or single motherhood.<sup>1,2</sup> Low-SES individuals also engage in more risky behaviours, such as smoking and excessive alcohol use,<sup>3</sup> which are in turn known to increase the likelihood of adverse birth outcomes, including low birth weight (LBW), preterm birth (PTB), and infants who are small for gestational age (SGA).

Infant birth weight is linked to experiences both before and during pregnancy and is a measure of newborn health and nutritional status.<sup>4</sup> Low birth weight increases the risk of several developmental and health outcomes in infancy and childhood, including poor cognitive development and higher rates of respiratory distress and asthma.<sup>5</sup> It is also associated with type 2 diabetes, hypertension, and cardiovascular disease in adulthood.<sup>6,7</sup>

This review will investigate the strength of the association between SES and adverse birth outcomes—particularly low-birth-weight, preterm birth, and small-for-gestational-age infants. While most research on the association between SES and adverse birth outcomes has been conducted in the United States, it is unclear to what extent results from the United States are generalizable to Canada.

To our knowledge, this is the first conceptual overview to encompass several dimensions of SES, including education, household income, neighbourhood SES, and occupation, along with their respective influences on birth outcome, in a single article. The purpose of this review is to articulate the multifaceted nature of SES and to assess the relative influence of various components of SES on the likelihood of an adverse birth outcome.

## METHODS

A search of PubMed, ProQuest, PsychInfo, Cochrane Library, and Google Scholar was conducted for articles published in English. The following search terms were used: socio-economic status; income, education, community, neighbourhood, and occupation; birth outcome(s); preterm birth; low

birth weight; small for gestational age. The search was limited to human studies. Reference lists of all relevant studies were examined.

## DISCUSSION

### *Education and Adverse Birth Outcomes*

Education is the most commonly used indicator of SES.<sup>8,9</sup> Education impacts health such that well-educated people tend to have better physical and mental health than poorly educated people.<sup>10,11</sup> One way by which education can influence health is through its impact on occupation and income. People with high educational attainment are more likely to have higher status jobs. These jobs, in turn, increase the likelihood of greater earnings.

From a biomedical standpoint, people with high educational attainment are more apt to make lifestyle choices that promote health and well-being. Women of high educational attainment may be more likely to eat healthier food and less likely to be overweight or obese than women of low educational attainment, which is negatively linked to many health outcomes, including birth outcomes.<sup>6,10</sup>

To date, there has been very little research assessing the strength of the relationship between education and birth outcomes in Canada. The first large population-based study on SES and birth outcomes in Canada was from Quebec. The study found that maternal education and neighbourhood income were independent predictors of adverse birth outcomes but that the effect of maternal education was stronger than that of neighbourhood SES.<sup>12</sup> Specifically, mothers without a high school diploma were 1.48 times more likely to have a PTB and 1.86 times more likely to have an SGA infant than were mothers with at least some post-secondary education.

Another study of Canadian women (n = 6,421) found that women without a high school diploma were 1.6 times more likely to have a PTB but that education had no effect on the likelihood of their giving birth to an SGA infant [OR 1.0; 95% CI 0.7, 1.5].<sup>13</sup> Studies from the United States have had similar results. For example, Young et al. found that mothers with some college education gave birth to infants weighing 128 g more than those born to women with only a high school education, and that

education was a stronger predictor of adverse birth outcomes than neighbourhood income was.<sup>4</sup>

Research examining the association between paternal education and birth outcomes is even scarcer. The one exception is a California study that found that women whose infants' fathers had not graduated from high school had a higher odds (OR 1.26; 95% CI 1.01, 1.58) of having a preterm infant than were fathers who had graduated from college, even after controlling for household income and maternal education.<sup>14</sup> It is challenging to discern the relative effects of paternal and maternal education on PTB because paternal education had a larger influence for all women, whereas maternal education was a better predictor of PTB for married women. In both cases, the risk of PTB for women of low education was modest.

The influence of education on birth outcomes is not limited to that of formal education; as one example, promoting health through educational sessions during pregnancy can predict birth outcomes. Women who take prenatal classes are less likely to have an adverse pregnancy outcome, and these classes have been shown to improve both maternal and child health.<sup>15</sup> Women who take prenatal classes also know more about pregnancy and have fewer emergency room visits than women who receive traditional care.<sup>14,15</sup> Ickovics et al. examined the impact of CenteringPregnancy, a program consisting of group prenatal care and childbirth education classes versus traditional care.<sup>16,17</sup> Among 458 participants mostly of low SES, birth weight and gestational age at birth were higher for infants of women who received group prenatal care. These results are consistent with a randomized controlled trial demonstrating that women who attend group prenatal care sessions have a healthier pregnancy, higher breastfeeding intention rates, and a lower likelihood of PTB among black and Hispanic mothers of low SES.<sup>18</sup>

The beneficial effect of academic performance and aspirations also holds for the adolescent population. Using a national representative sample from the United States, Xie et al. found that high academic performance and aspiration for college education is related to higher birth weight among infants of nonblack adolescents, and that grade skipping is associated with higher birth weight and

gestational age among infants of nonblack and black girls.<sup>19</sup> Likewise, another study found that adolescents who were receiving group prenatal care were less likely to have an adverse birth outcome than adolescents who were not receiving group prenatal care.<sup>20</sup>

### ***Income and Adverse Birth Outcomes***

Income is an important indicator of SES because it influences how much opportunity people have to meet their daily needs, including affordable housing, access to nutritious foods, and higher levels of education. Although it is well known that economically disadvantaged individuals tend to have poorer health than people with high incomes,

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## ***The influence of education on birth outcomes is not limited to that of formal education.***

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few studies have identified the biological pathways through which income disparities affect health or the extent to which income interacts with social infrastructure to influence health.

Blumenshine et al. showed that socio-economic disadvantages, including low income, increase the probability of SGA newborns and PTB, and found a significant association between income and birth outcomes in 93 of 106 [88%] articles reviewed between 1999 and 2007 in English-language industrialized nations.<sup>21</sup> Similarly, in a study from the United States, Huynh et al. found that non-Hispanic black mothers living in counties with low levels of income inequality, maternal education, and maternal race/ethnicity as defined by the Gini coefficient had twice as many PTBs as white mothers had [14.8% versus 7.9%] and that an increasing proportion of PTBs for all income categories remained significant in terms of maternal education level.<sup>22</sup>

The association between income and birth

outcomes has also been investigated in Canada, but the relationship in Canada may not be as strong as that found in the United States.<sup>23,24</sup> A study of 76,440 births in Nova Scotia found that although household income was weakly associated with PTB, it was strongly correlated with SGA newborns.<sup>25</sup> A large part of the relationship between income and SGA newborns could be explained, however, by higher rates of smoking among economically disadvantaged women. Furthermore, although the rate of SGA births was 49% higher among women who did not contribute to a Registered Retirement Savings Plan, this difference was abolished completely after adjusting for potential confounders such as maternal age, pre-pregnancy weight, and urban versus rural residence.<sup>25</sup> It is therefore possible that, despite considerable economic

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***Economically disadvantaged individuals tend to have poorer health than people with high incomes.***

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inequality in developed countries, differences in social policy and health care opportunities may contribute to variations among different nations in disparities of birth outcomes as related to SES.

Canadian Aboriginal women have been identified as a group at high risk for poor birth outcomes, but most of what is known about this population has been acquired retrospectively. In a rare prospective study from Edmonton, Alberta, being Aboriginal did not increase the odds of having a PTB or an LBW infant relative to the odds for non-Aboriginal Canadian women, once other confounding factors such as smoking and household income were accounted for.<sup>26</sup> What did matter, however, was income. Women whose family income was less than \$12,000 were more than two times more likely to have a LBW baby [OR 2.06; 95% CI 1.02, 4.15], although family income was not associated with PTB.

### **Neighbourhood SES and Adverse Birth Outcomes**

As with other indicators of SES, little Canadian research has examined the association between neighbourhood SES and birth outcomes. There has also been considerable variability in how neighbourhood SES is measured; using Statistics Canada's dissemination areas, with populations of 400 to 700, is the most common method of measurement.

A study from Manitoba examining area-level income found that the SGA birth percentage was 8% in the lowest income group, 7.4% in the middle income group, and 7% in the highest income quintile.<sup>27</sup> In a study from British Columbia, Luo et al. found that women in the lowest neighbourhood income quintile had a moderately greater risk of delivering a SGA infant compared to women in the highest income quintile, but this difference was significant only for women living in urban areas.<sup>28</sup> These results were replicated in another study that found that, compared to women residing in rural areas, those living in urban areas experienced higher income inequality, and this inequality was related to adverse birth outcomes.<sup>12</sup>

A study from Quebec found that Canadian-born mothers of low SES were more than two times more likely to have an LBW infant than high SES Canadian-born mothers of a high SES. However, compared to Canadian-born mothers of high SES, Caribbean-born and South Asian-born mothers of low SES were paradoxically less likely to have an LBW baby than were high SES Caribbean-born and South Asian-born mothers of high SES.<sup>29</sup> This suggests that, for various unexplored reasons, low SES may not be as detrimental to foreign-born mothers as to Canadian-born mothers. A key limitation of this study, however, is that several maternal and behavioural risk factors known to be associated with adverse birth outcomes are not available in the Quebec birth registry and hence could not be controlled for in regression models.

### **Occupation and Adverse Birth Outcomes**

Occupational status is another indicator of socio-economic attainment. The higher the education of an individual, the greater the probability of having a job requiring credentials that offer higher monetary

rewards. These jobs are more likely to provide better working conditions than jobs that require minimal skills and education.

In a recent systematic review examining paternal factors associated with birth outcomes, Shah et al. found a higher likelihood of PTB and LWB when paternal occupations entailed high and prolonged exposure to lead and found a higher risk for SGA births when employees were exposed to chromium and benzene.<sup>30</sup> Overall, however, the authors contend that paternal occupation does not consistently increase the risk of adverse birth outcomes and that the role of paternal occupation needs further investigation.

There is also evidence showing that job stress increases the risk for adverse birth outcomes. Brandt et al. found an elevated risk of delivering LBW infants for women experiencing high job stress, and Brett et al. found that work in high-strain jobs was associated with a small but nonsignificant increase in PTBs relative to working in a low-strain job.<sup>31,32</sup>

A recent systematic review found that occupations requiring considerable standing during pregnancy increases the likelihood of PTB.<sup>33</sup> This is important as it relates to SES because it is typically low income service sector jobs that require long periods of standing. Heavy lifting is also dangerous during pregnancy, due to the potential for the placenta to tear or produce a spontaneous abortion. Like jobs requiring considerable standing, individuals in low-SES occupations are more likely to be required to do heavy lifting. Such jobs are traditionally lower paid jobs as well.<sup>30</sup>

## RESULTS AND CONCLUSIONS

Our review indicates that education, income, neighbourhood SES, and occupation all play a role at influencing birth outcomes, although the association between occupation and birth outcomes has been less consistent. A summary of this review can be found in Table 1. Given the strong socio-economic gradient in birth outcomes and the fact that lifestyle approaches to reducing health disparities [e.g., by a better diet and more exercise] are in turn related to SES, it would be better if public discourse and policy interventions focused attention on the more fundamental causes of adverse birth outcomes—particularly low SES—if

we are to see major improvements in the health of all citizens. As a result, we believe it is imperative for health care professionals consulting with low-SES pregnant women to be aware of supports within their local communities.

Future research should also move beyond the mere investigation of the association between SES and birth outcomes and attempt to evaluate causal hypotheses. The fact that research spanning many decades and countries has consistently shown an association between SES and health does not tell us much about the causal role of socio-economic status in health. To effectively evaluate causality, more research will need to assess mediating factors associated with SES and birth outcomes. To date, most of these factors have included variables such as body mass index, nutrition, smoking, and alcohol use. We contend that more research on exposure to stress and on mental health must be considered in order to assess the indirect effects of socio-economic status on birth outcomes. A better understanding of causal pathways and mediating factors influencing the relationship between socio-economic status and birth outcomes would provide clinicians with the opportunity to develop strategies for reducing the influence of these factors with the aim of reducing overall social disparities in birth outcomes.

**Table 1.** *The Influence of Socio-economic Status on Adverse Birth Outcomes*

| <b>Authors</b>                      | <b>Sample</b>  | <b>Study Design</b>  | <b>Measure of SES</b>  | <b>Key Outcome</b>  |
|-------------------------------------|--|--|--|---|
| Baldwin KA. <sup>16</sup>           | Women attending prenatal care in three U.S. geographic areas that offered traditional and CenteringPregnancy programs  | Non-equivalent control group, pre/post-test (n = 98)   | <ul style="list-style-type: none"> <li>• Education; informal knowledge of pregnancy</li> </ul>   | <ul style="list-style-type: none"> <li>• Post-test scores revealed an increase in knowledge of pregnancy in those receiving prenatal care through the CenteringPregnancy model (p = .03)</li> </ul>   |
| Blumenshine PM et al. <sup>14</sup> | Woman participating in the Maternal and Infant Health Assessment in California who gave birth February–May, 1999–2005  | Population-based cross-sectional postpartum survey, linked with birth certificates (n = 21,712). | <ul style="list-style-type: none"> <li>• Paternal education</li> </ul>   | <ul style="list-style-type: none"> <li>• Women whose infants' fathers did not graduate from high school were more likely to have a PTB [OR 1.26; 95% CI 1.01–1.58]</li> </ul>   |
| Blumenshine P et al. <sup>21</sup>  | Search strategy for articles on personal or household income, educational attainment, and occupational class. Birth outcomes included BW, GA, and IUG  | Systematic review (n = 106 studies)  | <ul style="list-style-type: none"> <li>• Personal or household income</li> <li>• Educational attainment</li> <li>• Occupation</li> </ul> | <ul style="list-style-type: none"> <li>• Socio-economic disadvantage was associated with increased risk of adverse birth outcomes</li> </ul>  |
| Bonzini M et al. <sup>33</sup>      | Search strategy for articles from 1966 to 2005 on pregnancy, reproductive health, pre-eclampsia, infant-premature, labour-premature, BW, GA, SGA, fetal growth retardation, labour and pregnancy complications (as outcomes), and lifting, work-schedule tolerance, exercise, fatigue, work, workload, employment, and occupational exposure | Systematic review (n = 49 studies)   | <ul style="list-style-type: none"> <li>• Occupation</li> </ul>   | <ul style="list-style-type: none"> <li>• Increased odds of having SGA infant for women standing &gt;5 hr/day compared to those standing 4 hr/day in second trimester [OR 2.0; 95% CI 0.7–5.4]</li> <li>• Increased work hours and shift work also associated with increased odds of SGA infant</li> <li>• Standing at least 3 hr/day was associated with increased odds of PTB [OR 1.26; 95% CI 0.96–1.66]</li> </ul> |
| Brandt LP et al. <sup>31</sup>      | Commercial and clerical female workers in Denmark, 1983–1985   | Case-based study within a cohort study (n = 24,362)  | <ul style="list-style-type: none"> <li>• Occupation</li> </ul>   | <ul style="list-style-type: none"> <li>• Increased odds of LBW [OR 1.46; 95% CI 1.05–2.04] for women with high job stress</li> </ul>  |
| Brett KM et al. <sup>32</sup>       | Women in North Carolina delivering between September 1988 and August 1989 in Orange and Durham counties and from September 1988 to April 1991 in Alamance County   | Population-based case-control study (n= 1,033)   | <ul style="list-style-type: none"> <li>• Occupation</li> </ul>   | <ul style="list-style-type: none"> <li>• Women with high job strain were more likely to have PTB [OR 1.3; 95% CI 0.9–1.8]</li> </ul>  |

**Table 1** continued ...

| <b>Authors</b>                   | <b>Sample</b>  | <b>Study Design</b>                               | <b>Measure of SES</b>   | <b>Key Outcome</b>  |
|----------------------------------|--|---|---|---|
| Grady MA et al. <sup>20</sup>    | Thirteen groups of adolescents who completed the CenteringPregnancy program        | Prospective study (n = 124)                       | <ul style="list-style-type: none"> <li>• Education, informal knowledge of pregnancy</li> </ul>                                      | <ul style="list-style-type: none"> <li>• CenteringPregnancy adolescents had lower rates of PTB and LBW infants (1998 comparison group, p &lt; .05; 2001 comparison group, p &lt; .02)</li> <li>• Additional outcomes were increased BF rates, higher satisfaction with prenatal care, and increased social support</li> </ul>                                 |
| Heaman M et al. <sup>13</sup>    | Analyzed data from the Canadian Maternity Experience Survey                        | Retrospective cohort study (n = 6,421)            | <ul style="list-style-type: none"> <li>• Education</li> </ul>   | <ul style="list-style-type: none"> <li>• Women with less than grade 12 education were more likely to have a PTB [OR 1.5; 95% CI 1.2–2.1]</li> </ul>   |
| Huynh M et al. <sup>22</sup>     | Births from the CDC's National Linked Birth/Infant Death Dataset from 1998 to 2000 | Retrospective cohort study (n = 9,175,832)        | <ul style="list-style-type: none"> <li>• Income based on tertiles of high, medium, low county level, based on Gini score</li> </ul> | <ul style="list-style-type: none"> <li>• Those who experienced greater income inequality reflective of a higher Gini score were more likely to have a PTB [aOR 1.06; 95% CI 1.03–1.09]</li> </ul>   |
| Ickovics JR et al. <sup>17</sup> | Women who attended clinics in Atlanta, Georgia, or New Haven, Connecticut          | Prospective cohort study (n = 458)                | <ul style="list-style-type: none"> <li>• Education, informal knowledge of pregnancy</li> </ul>                                      | <ul style="list-style-type: none"> <li>• Group prenatal care was associated with increased BW [p &lt; .01], even for PTB infants, compared to those receiving individual prenatal care [p &lt; .05]</li> </ul>  |
| Ickovics JR et al. <sup>18</sup> | Women who attended clinics in New Haven, Connecticut, and Atlanta, Georgia         | Multisite randomized controlled trial (n = 1,047) | <ul style="list-style-type: none"> <li>• Education, informal knowledge of pregnancy</li> </ul>                                      | <ul style="list-style-type: none"> <li>• Women randomized to a group setting were more likely to have increased prenatal knowledge [p &lt; .001], increased BF initiation [p &lt; .001], and increased overall satisfaction with their prenatal care experience</li> </ul>  |
| Joseph KS et al. <sup>25</sup>   | Births in Nova Scotia, 1988-1995 [Nova Scotia Atlee Perinatal Database]            | Retrospective cohort study (n = 76,440)           | <ul style="list-style-type: none"> <li>• Income was linked based on the database and federal income tax records</li> </ul>          | <ul style="list-style-type: none"> <li>• Lowest income groups had higher rates of PTB [crude RR 1.20; 95% CI 1.06–1.35], and SGA infants [crude RR 1.81; 95% CI 1.66–1.97]</li> <li>• SGA births were 49% higher among women who did not contribute to an RRSP than among those who did [but adjustment for confounders abolished this difference]</li> </ul> |

**Table 1** *continued ...*

| <b>Authors</b>                 | <b>Sample</b>   | <b>Study Design</b>                      | <b>Measure of SES</b>  | <b>Key Outcome</b>   |
|--------------------------------|---|--|--|--|
| Joseph KS et al. <sup>25</sup> | Births in Nova Scotia, 1988-1995 [Nova Scotia Atlee Perinatal Database]   | Retrospective cohort study [n = 76,440]  | <ul style="list-style-type: none"> <li>Income was linked based on the database and federal income tax records</li> </ul>   | <ul style="list-style-type: none"> <li>Lowest income groups had higher rates of PTB [crude RR 1.20; 95% CI 1.06-1.35], and SGA infants [crude RR 1.81; 95% CI 1.66-1.97]</li> <li>SGA births were 49% higher among women who did not contribute to an RRSP than among those who did [but adjustment for confounders abolished this difference]</li> </ul>  |
| Luo ZC et al. <sup>12</sup>    | Quebec birth registration data  | Retrospective cohort study [n = 825,349] | <ul style="list-style-type: none"> <li>Maternal postal codes extrapolated to census enumeration areas to determine neighbourhood income levels</li> <li>Education collected on birth registration</li> </ul> | <ul style="list-style-type: none"> <li>Lower income was associated with increased risk of PTB [aOR 1.14; 95% CI 1.10-1.17], and SGA infants [aOR 1.18; 95% CI 1.15-1.21]</li> <li>Compared to mothers with at least some postsecondary education, mothers without a high school diploma had a higher risk for PTB [aOR 1.48; 95% CI 1.44-1.52] and SGA infants [aOR 1.86; 95% CI 1.82-1.91]</li> </ul>         |
| Luo ZC et al. <sup>28</sup>    | Cohort from births registered in British Columbia from 1985 to 2000, linked using stillbirth/live birth/infant death database of the British Columbia Vital Statistics Agency | Retrospective cohort study [n = 692,477] | <ul style="list-style-type: none"> <li>Income based on neighbourhood quintiles</li> </ul>  | <ul style="list-style-type: none"> <li>When comparing poorest versus richest quintile, risk of PTB remained consistent from 1985 to 2000; those in a lower income neighbourhood were more likely to have a PTB [aOR 1.26; 95% CI 1.17-1.35]</li> </ul>   |
| Moore S et al. <sup>29</sup>   | Singleton infants born to Quebec mothers grouped into nine regions by birthplace, using the 2000 Quebec birth registry  | Retrospective cohort study [n = 47,988]  | <ul style="list-style-type: none"> <li>Ethnicity derived from maternal birth place</li> </ul>  | <ul style="list-style-type: none"> <li>Mothers' birthplace before immigration influenced birth outcome</li> <li>Greater number of LBW infant births for South Asian [OR 2.84; 95% CI 1.90-4.24] and Caribbean-born mothers [OR 1.52; 95% CI 1.11-2.10]</li> <li>Low-SES Canadian-born mothers [OR 2.23; 95% CI 1.85-2.68] had higher likelihood of LBW outcomes than high-SES Canadian-born mothers</li> </ul> |

**Table 1** *continued ...*

| Authors                        | Sample  | Study Design   | Measure of SES  | Key Outcome  |
|--------------------------------|---|--|---|--|
| Rising SS et al. <sup>15</sup> | Evaluation of a pilot program utilizing the <i>CenteringPregnancy</i> program, which highlights group prenatal care                                 | Evaluation of a pilot program [n = 111]  | <ul style="list-style-type: none"> <li>• Education, informal knowledge of pregnancy</li> </ul>  | <ul style="list-style-type: none"> <li>• Pilot group had significantly less third-trimester emergency dept. visits [26% vs. 74%, p = .001]</li> </ul>  |
| Ruth CA et al. <sup>27</sup>   | Population Health Research Data Repository [Manitoba Centre for Health Policy] for data of infants born during fiscal years 2004/2005 and 2005/2006 | Retrospective cohort study [n = 25,312]  | <ul style="list-style-type: none"> <li>• Individual and area-level income used to create SES groups</li> </ul>                                | <ul style="list-style-type: none"> <li>• Those in the lowest income area had a higher rate of SGA births [8% for low SES vs. 7.4% and 7%, respectively, for medium and high SES]</li> </ul>  |
| Shah PS et al. <sup>30</sup>   | Electronic databases searched from their inception to March 2009  | Systematic review [n = 50 studies]   | <ul style="list-style-type: none"> <li>• Paternal occupation</li> </ul>   | <ul style="list-style-type: none"> <li>• More and longer lead exposures were associated with higher risk of LBW birth and PTB</li> </ul>   |
| Wenman WM et al. <sup>26</sup> | Women attending prenatal care in Edmonton, Alberta, from July 1994 to June 1995   | Prospective study [n = 1,811]  | <ul style="list-style-type: none"> <li>• Family income</li> </ul>   | <ul style="list-style-type: none"> <li>• In an adjusted model for smoking, positive culture result, and family income, women whose family income was &lt; \$12,000/yr were more likely to have a LBW infant [OR 2.06; 95% CI 1.02–4.15]</li> </ul>   |
| Xie Y et al. <sup>19</sup>     | Data from Waves I and IV of the National Longitudinal Study of Adolescent Health  | National longitudinal study [n = 763]  | <ul style="list-style-type: none"> <li>• Education; academic performance and aspiration</li> </ul>  | <ul style="list-style-type: none"> <li>• High academic performance leading to skipping a grade is associated with higher BW [black adolescents, p = .04; non-black adolescents, p &lt; .01]</li> <li>• Higher education aspiration was associated with higher BW [p = .03]</li> <li>• GA at birth increased by approximately 1 week for non-black adolescents who skipped a grade [p = .03]</li> </ul> |
| Young RL et al. <sup>4</sup>   | Cape Cod Family Health Study—children born 1969–1983  | Retrospective cohort study; cross-classified model with family and community level groupings [n = 2,144] | <ul style="list-style-type: none"> <li>• Maternal Education</li> <li>• Community mean family income</li> <li>• Paternal occupation</li> </ul> | <ul style="list-style-type: none"> <li>• Fathers with “blue-collar” jobs were more likely to have a LBW infant than fathers with “white-collar” jobs [p = .03]</li> </ul>  |

**Abbreviations:**

aOR, adjusted odds ratio; BF, breastfeeding; BW, birth weight; CDC, Centers for Disease Control and Prevention; CI, confidence interval; GA, gestational age; IUG, intrauterine growth; LBW, low birth weight; OR, odds ratio; PTB, preterm birth; RR, relative risk; RRSP, Registered Retirement Savings Plan; SES, socio-economic status; SGA, small-for-gestational-age.

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