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Prevalence of Low Birth Weight, Premature Birth, and Stillbirth Among Pregnant Adolescents in Canada: A Systematic Review and Meta-analysis

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ABSTRACT

Although most studies show that adolescent pregnant women are at a higher risk for adverse birth outcomes, there has been limited research examining this relationship in Canada. This systematic review and meta-analysis investigated the prevalence of low birthweight (LBW), preterm birth (PTB), and stillbirth in Canadian adolescent women compared to adult women. Studies were included if they were primary research and included a sample of adolescent mothers (≤19 years) and adult mothers (≥20 years) who gave birth to singleton infants in Canada. Birth outcomes must have been measured consistently in at least 3 studies for inclusion. Comprehensive electronic literature searches were conducted from database inception until August 2020 in 5 databases. Random effects meta-analysis models were used to estimate pooled odds ratios (pOR) for LBW, PTB, and stillbirth between adolescent and adult pregnant women. Outcomes reported included PTB (8 studies), LBW (6 studies), and stillbirth (3 studies). Compared to adult mothers, adolescent mothers had a 56% increase in the prevalence of LBW (pOR 1.56, 95% confidence interval [CI] 1.24, 1.97), a 23% increase in PTB (pOR 1.23, 95% CI 1.06, 1.42), a 20% increase in stillbirth (pOR 1.20, 95% CI 1.05, 1.37). Heterogeneity, as assessed by I^2, was high for LBW and PTB and was low for stillbirth. A subgroup analysis did not remove the high heterogeneity, and some studies did not adjust for confounding variables and were missing information on sociodemographic and behavioral factors. Future research is needed to investigate the mechanisms surrounding these differences by maternal age.

Key Words: pregnancy in adolescence, infant, low birth weight, premature birth, stillbirth, Canada

Introduction

Adolescent pregnancy in Canada refers to pregnancy in female individuals under the age of 20 years[1,2] and is calculated as the number of recorded live births, induced abortions, and miscarriages per 1000 women aged 15-19 years.[1,3] Despite a 47% decline in adolescent pregnancies in Canada between 1990 and 2010, these pregnancies continue to draw attention to policy development and intervention strategies to mitigate their occurrence.[1,4,5] From 1998 to 2000, stillbirth occurrence averaged 929 events among adolescent mothers in Canada.[6]

Although adolescent pregnancies are more socially acceptable than in the past,[4,7,8] socioeconomic and psychological obstacles remain.[2,9] For example, adolescent motherhood is associated with financial hardship and social exclusion, and young mothers find it challenging to attend school and/or work when raising a child.[5,7] Compared to adult mothers, adolescent mothers are more likely to live in poverty, to experience more kinds and greater exposure to stress, to have worse mental health, to have higher substance abuse problems, and are at an elevated risk for posttraumatic stress disorder.[3,10–14] These clusters of disadvantage in young mothers' lives are associated with lower educational attainment.[15–19]

Although biological immaturity of young mothers was long believed to be the reason for maternal complications and adverse birth outcomes in adolescent pregnancies,[9] much research has shown that the correlation between adolescent pregnancies and poor birth outcomes is confounded by poverty and socioeconomic disadvantage in young women's lives.[3,10] Indeed, previous studies from Canada have shown that childhood family structure and socioeconomic status (SES) are associated with higher risk for adolescent pregnancy. Two recent systematic reviews and meta-analyses have been conducted on adolescent pregnancies and adverse birth outcomes. One evaluated the relationship between the social determinants of health and adverse birth outcomes in adolescent mothers without

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comparison to adult pregnancies.[10] This review of 31 studies (1 from Canada) found that African Americans, low SES, and rural residence are risk factors for poor birth outcomes. The other review[20] of 20 studies found that adolescent pregnancies are associated with adverse birth outcomes in developed countries, but only 1 study from Canada was included, and the authors noted considerable inconsistency in findings related to adolescent pregnancies and adverse birth outcomes among developed countries. The present systematic review and meta-analysis thus addresses the following question: Do pregnant adolescent women in Canada have a higher prevalence for preterm birth (PTB), low birthweight (LBW), and stillbirth compared to their adult counterparts? This question in PICOS format is as follows:

Population: pregnant women in Canada
Intervention-Exposure: adolescent pregnant women (≤ 19 years)
Comparator: adult pregnant women (≥ 20 years)
Outcomes: PTB, LBW, and stillbirth
Study design: observational studies

Materials and Methods

This review was planned, conducted, and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). A protocol was registered with The Open Science Framework (https://osf.io/xftzd).

Search Strategy

Comprehensive electronic literature searches were conducted from database inception until August 17, 2020 in the following: PubMed/Medline, CINAHL, Web of Science, EMBASE, and ProQuest Dissertations & Theses Global. The search strategy was developed and conducted by a health sciences librarian at Brescia University College to encompass all relevant literature using keywords and MeSH terms adapted to each database and search engine. The search strategy was designed to include articles of all languages but that used keywords/subject headings in English. Reference lists of reviews and retrieved articles were examined to identify any additional studies not found in the original search. The advantage of searching unpublished documents is that it minimizes publication bias.[21] An outline of the keywords can be found in Appendix A.

Study Eligibility Criteria

Studies were included if they were primary research articles (ie, data were collected on research subjects) and included a sample of adolescent mothers (≤ 19 years) who gave birth to singleton infants in Canada. Although Statistics Canada defines adolescent pregnancies as 15-19 years,[4] most studies examine all adolescent pregnancies (ie, ≤ 19 years) without differentiating between younger and older women's pregnancies, so any study that included pregnant women ≤19 years of age was therefore included. Only primary studies were eligible for inclusion, because the purpose of a meta-analysis is to collate numeric data from primary studies to estimate the magnitude of the effect. Birth outcomes included PTB (<37 weeks' gestation), LBW (<2500 g), and stillbirth (fetal death between 20 weeks of pregnancy and the time of birth).[22] Each study must have examined at least 1 of the birth outcomes to be considered for inclusion. Articles that were not primary research (eg, narrative reviews), were not written entirely in English (ie, with no English keywords/subject headings), did not contain a control group (ie, mothers ≥20 years), and those that did not assess any of the birth outcomes were excluded.

All citations were screened from the literature search by 2 independent assessors, and those considered relevant for full-text retrieval were reviewed. In cases in which it was uncertain whether a study should be retrieved, the assessors erred on the side of caution and reviewed the full article. Both assessors independently determined which studies met the inclusion and exclusion criteria.

Study Quality Assessment

Two independent reviewers (ND and MD) assessed the methodological quality of the studies using the Newcastle–Ottawa Quality Assessment Form for Cohort Studies.[23] The tool uses 7 questions to provide an assessment of recruitment selection, outcomes, and methods of assessment for the outcomes. Disagreements in quality assessment were resolved by consensus between reviewers.

Data Extraction

A pre-tested coding manual was developed using Microsoft Excel (Microsoft Corporation, Redmond, WA) to extract data from each study. Information regarding study characteristics included author names, year of publication, sample size, geographic location (ie, province or territory), urban/suburban/rural, maternal age, ethnicity, SES, study design, inclusion and exclusion criteria, and each study's definition of LBW, PTB, and stillbirth. Statistical information was obtained, which included the independent variable(s), dependent variable(s), methods of data collection, statistical outcomes, the principal summary measure (ie, odds ratio), *P* values of models, percentages and mean differences, key findings, and methods for managing confounding variables. Each study was independently coded by the same 2 reviewers (ND and MD) to reduce bias for coding and for study quality assessments. If consensus could not be reached, an adjudicator (JAS) was introduced to resolve the issue.

Evidence Synthesis

Study characteristics and methodological quality assessment was summarized and presented in tables. It was determined, a priori, that a minimum of 3 articles per outcome variable were necessary to provide sufficient data for the meta-analysis. Although it is possible to statistically pool data from only 2 studies to calculate a summary effect size, similar recommendations for at least 3 studies have been made by others.[24] We began with a vote-counting method of all independent statistical tests, which is a

conservative approach that is more likely to accept the null hypothesis.[21] Specifically, vote counting was used to assess the relationship between adolescent pregnancies and LBW, PTB, and stillbirth by comparing the number of positive studies with the number of negative studies. We focused on the direction of the findings of the main effects, regardless of their statistical significance level. Once the number of findings in each direction were counted, a sign test was used to assess the cumulative result, such that $Z_{vc} = (N_p) - (½\ N) / (½\ \sqrt{N})$, where Z_{vc} = the Z-score for the overall series of findings, N_p = the number of positive findings, and N = the total number of findings (both positive and negative). Since the vote-count method does not provide information on effect size or sample size of each study, average odds ratios using unweighted and weighted effect sizes were computed using Review Manager (RevMan version 5.4, The Cochrane Collaboration), and a meta-analysis of the association between adolescent pregnancy and adverse outcomes was planned. Unadjusted odds ratios (OR) were pooled in a Mantel–Haenszel random-effects model meta-analysis. The random-effects model assumes that within-study error (ie, sampling or estimation) and between-studies variance are operating, and produces larger variances, confidence intervals (CI), and standard errors than fixed-effects models. The overall estimate in random-effects models gives neither too little weight for studies with a small sample size nor too much weight for studies with a large sample size. An I^2 statistic measured the portion of variance in effect sizes that was attributable to the variability between studies, with I^2 values of 25%, 50%, and 75% representing low, moderate, and high heterogeneity, respectively.[25]

Results

Description of Studies

The search strategy identified 4962 potentially relevant citations. After the removal of 718 duplicates, titles and abstracts of 4244 references were screened. From that list of references, 4216 articles were removed after independent review of the titles and abstracts, because they were unrelated to our research question and did not compare adolescent and adult pregnancies in Canada on any of the 3 birth outcomes of interest. Out of 28 studies that were assessed for eligibility by full-text retrieval, 8 studies[3,15,26–31] (which included 1 unpublished abstract in which the authors provided raw data)[30] were included in the review and met the eligibility criteria after removal of an additional 20 studies that did not meet the inclusion criteria. The PRISMA flowchart can be found in Fig. 1. The 8 studies were published between 1992 and 2020. The median sample size of adult women was 16,838 and of adolescent women was 909. The mean age of adult women was 28.7 years and for adolescent women was 18.0 years. All 8 studies were retrospective cohort designs. PTB was examined in every study, LBW in 6 studies, and stillbirth in 3 studies (stillbirth was included in the same category as “fetal/neonatal death” in 2 of 3 publications). A detailed description of the studies can be found in Table 1.

Study Quality Assessment

Quality assessment of the studies varied, with 4 of 8 studies being of “good quality”, 3 of 8 “fair quality”, and 1 of 8 “poor quality.” A summary of the quality assessment can be found in Table 2.

Association Between Adolescent Pregnancies and Adverse Birth Outcomes

Based on the direction of the findings, we used a vote-counting procedure for PTB and LBW. Although only 8 studies were evaluated in the meta-analysis, 9 studies were used for the vote-counting procedure. We were unable to use this ninth study[32] in the final synthesis due to missing data, but it provided information regarding the direction of the relationship between adolescent pregnancy, LBW, and PTB. Specifically, it showed that adult women aged 35+ years were 60% and 37% more likely to have an LBW and PTB, respectively, than were adolescents 12-19 years. According to the vote-count, 4 of 9 studies had positive findings between adolescent pregnancy and PTB ($P = .74$), and 3 of 7 studies described positive findings for LBW ($P = .70$). There were no positive relationships documented with respect to stillbirth for the vote-counting procedure.

Low Birthweight

For LBW, the combined number of adolescent participants across the 6 studies was 26,240 and for adults was 562,066. Using a random-effects model in Fig. 2, the pooled OR comparing the prevalence of LBW in adolescents to adults was 1.56 (95% CI 1.24, 1.97) with an I^2 statistic of 75%.

Preterm Birth

In Fig. 3, the total number of adolescent pregnancies was 38,809 and the total number of adult pregnancies was 674,033. Using a random-effects model, the pooled OR comparing the prevalence of PTB in adolescents to adult pregnancies was 1.23 (95% CI 1.06, 1.42). The I^2 statistic was 84%.

Stillbirth

Figure 4 describes the meta-analysis for stillbirth. The pooled OR was 1.20 (95% CI 1.05, 1.37), indicating that adolescent pregnancies had higher odds of stillbirth than adult pregnancies. The I^2 statistic was 0%.

Source Population Subgroup Analysis

The I^2 statistic of 75% and 84% for LBW for PTB, respectively, suggests high heterogeneity between studies. A post hoc subgroup analysis was explored between hospital-based and population-based studies in our meta-analysis to investigate sources of this heterogeneity.

In the only population-based study assessing the relationship between adolescent pregnancies and LBW,[28]

Table 1
Summary of All Canadian Studies Assessing the Relationship Between Adolescent Pregnancies and Preterm Birth (n = 8), Low Birthweight (n = 6), and Stillbirth (n = 3)

Authors, Year, Reference	Study Design	Sample Characteristics	Sample Size	Outcomes	Prevalence (%)
Briggs et al (2007) [15]	Retrospective chart review	Adolescent women (mean age 17.5 yr) and adult women (≥20 yr, mean age27.3 yr). Most participants (>95%) were Caucasian/White	207 Primiparous adolescents; 415 primiparous adults	LBW (<2500 g); PTB (<37 wk)	LBW: 10.1% in adolescents; 4.3% in adults PTB: 12.6% in adolescents; 7.5% in adults
Fleming et al (2013) [28]	Retrospective population-based cohort study	Adolescent mothers defined as women <20 yr of age, and adult mothers as women 20-35 yr of age	23,810 Adolescent pregnancies; 523,721 adult pregnancies	LBW (<2500 g); PTB (<37 wk); fetal /neonatal death	LBW: 6.3% in adolescents; 4.6% in adults PTB: 7.3% in adolescents; 6.0% in adults Fetal/neonatal death: 0.7% in adolescents; 0.6% in adults
Jacono et al (1992) [26]	Retrospective cohort study	Adolescent women aged <20 yr, adult women aged 20-34 and 35+	151 charts for mothers < 20 yr, 1,452 for mothers aged 20-34, and 78 for those 35+	LBW (<2500 g); PTB (<36 wk); stillbirth	LBW: 9.9% in adolescents; 8.0% in adults PTB: 9.3% in adolescents; 6.5% in adults Stillbirth: 1.9% in adolescents; 0.7% in adults
Jain et al (2018) [29]	Retrospective population-based cohort study	Adolescent women aged 12-19 yr (mean age: 17.9 yr) and adult women aged 20-35 yr (mean age 27.1 yr)	35,111 Births; 2005-2015 cohort: 11% adolescent and 82% adult, 39,907 births; 1996-2005 cohort: 13% adolescent and 82% adult.	PTB (< 37 wk); fetal/ neonatal death	PTB: 7.0% for adolescents; 7.2% for adults Fetal/neonatal death: 0.6% for adolescents; 0.5% for adults
MacSween et al (2016) [31]	Retrospective cohort study	Adolescent women (median age: 18.7 yr) and adult women (20-35 yr). Study population was 96% Caucasian/White	3,725 Adolescents; 50,400 adult women	PTB (<37 wk)	PTB: 5.7% for adolescents; 5.4% for adults
Murphy et al (2011) [30]	Retrospective cohort study	Adolescent women and adult women, aged 20-24 yr	742 Adolescent pregnancies, 2724 adult pregnancies	PTB (<37 wk)	LBW: 10.2% in adolescents; 9.1% in adults PTB: 13.2% in adolescents; 11.5% in adults
Shrim et al (2011) [27]	Retrospective cohort study	Adolescent mothers and adult mothers (20-39 yr)	250 Adolescent mothers; 9,494 adult mothers	LBW (<1500 g); PTB (<37 wk)	LBW: 7.2% in adolescents; 2.0% in adults PTB: 18.4% in adolescents; 8.9% in adults
Wong et al (2020) [3]	Retrospective cohort study	Adolescent mothers (aged 19 yr and younger) and adult mothers (aged 20-34, and 35 yr and older)	1080 Adolescent mothers; 24,182 adult mothers	LBW (<2500 g); PTB (<37 wk)	LBW: 7.4% in adolescents; 5.6% in adults PTB: 8.1% in adolescents; 7.5% in adults

LBW, low birth weight; PTB, preterm birth.

Table 2
Quality Assessment of the Retrospective Cohort Studies (N = 8) Investigating the Association Between Adolescent Pregnancies and Adverse Birth Outcomes in Canada Using the Modified Newcastle–Ottawa Scale

Authors, Year, Reference	Selection				Comparability		Outcome			Quality[a]
	Representativeness of Exposed Cohort	Selection of Non-exposed Cohort	Ascertainment of Exposure	Demonstration of outcome of interest not part of study	Comparable for Primary Items	Comparable for Secondary Items	Assessment of Outcomes	Follow-up Long Enough	Adequacy of Follow-up Cohorts	
Fleming et al, 2013 [28]	Y	Y	Y	N	Y	Y	Y	Y	Y	Good quality (8/9)
Jain et al, 2018 [29]	Y	Y	Y	N	Y	Y	Y	Y	Y	Good quality (8/9)
Briggs et al, 2007 [15]	N	Y	Y	N	Y	Y	Y	Y	Y	Fair quality (7/9)
Murphy et al, 2011 [30]	U	Y	Y	N	Y	U	Y	Y	Y	Fair quality (6/9)
MacSween et al, 2016 [31]	Y	Y	Y	N	Y	Y	Y	Y	Y	Good quality (8/9)
Shrim et al, 2011 [27]	N	Y	Y	N	Y	Y	Y	Y	Y	Fair quality (7/9)
Jacono et al, 1992 [26]	U	Y	Y	N	U	U	Y	Y	Y	Poor quality (5/9)
Wong et al, 2020 [3]	N	Y	Y	N	Y	Y	Y	Y	Y	Good quality (7/9)

N, no; Y, Yes; U, unclear.

[a] Good quality: 3 or 4 stars in selection domain AND 1 or 2 stars in comparability domain AND 2 or 3 stars in outcome/exposure domain; Fair Quality: 2 stars in selection domain AND 1 or 2 stars in comparability domain AND 2 or 3 stars in outcome/exposure domain; Poor Quality: 0 or 1 star in selection domain OR 0 stars in comparability domain or 0 or 1 star in outcome/exposure domain.

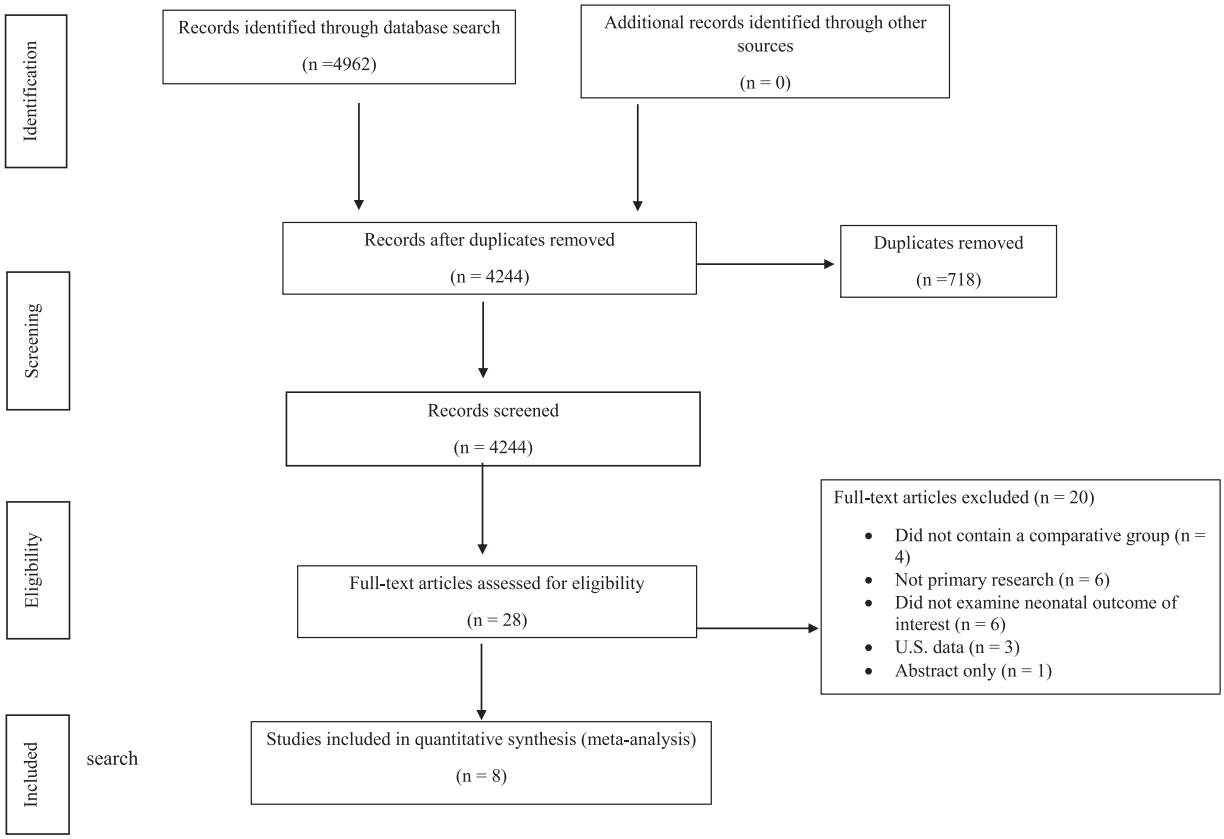

Fig. 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses PRISMA flow chart of the literature search and selection process.

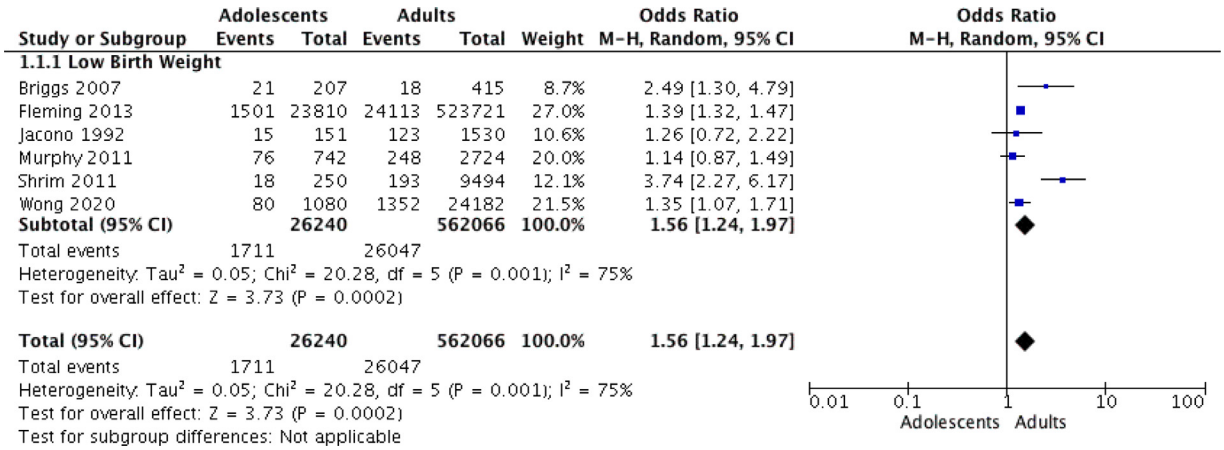

Fig. 2. Meta-analysis of the association between adolescent pregnancy and low birthweight.

adolescent pregnant women were 39% more likely to have an LBW infant than adult mothers (pooled odds ratio [pOR] 1.39, 95% CI 1.32, 1.47). Among the hospital-based studies,[3,15,26,27,30] adolescent mothers were 71% more likely to have an LBW infant than adult mothers (pOR 1.71, 95% CI 1.15, 2.53) ($I^2 = 80\%$).

When investigating the 3 population-based PTB studies,[28,29,31] adolescent pregnancies were not associated with a higher prevalence for PTB compared to adult pregnancies (pOR 1.08, 95% CI 0.91, 1.29; $I^2 = 92\%$). Among the hospital-based studies,[3,15,26,27,30] adolescent mothers had a 46% greater prevalence for PTB than adult mothers (pOR 1.46, 95% CI 1.07, 2.00; $I^2 = 76\%$). Thus, for LBW and PTB, subgroup analyses did not remove the heterogeneity found when examining the main effects between adolescent pregnancies and adverse birth outcomes.

Discussion

Main Findings

The primary objective of this study was to compare differences in the prevalence of LBW, PTB, and stillbirth between adolescent and adult pregnancies in Canada. The meta-analysis found a 56% increase in the prevalence of LBW, a 23% increase in PTB, and a 20% higher prevalence

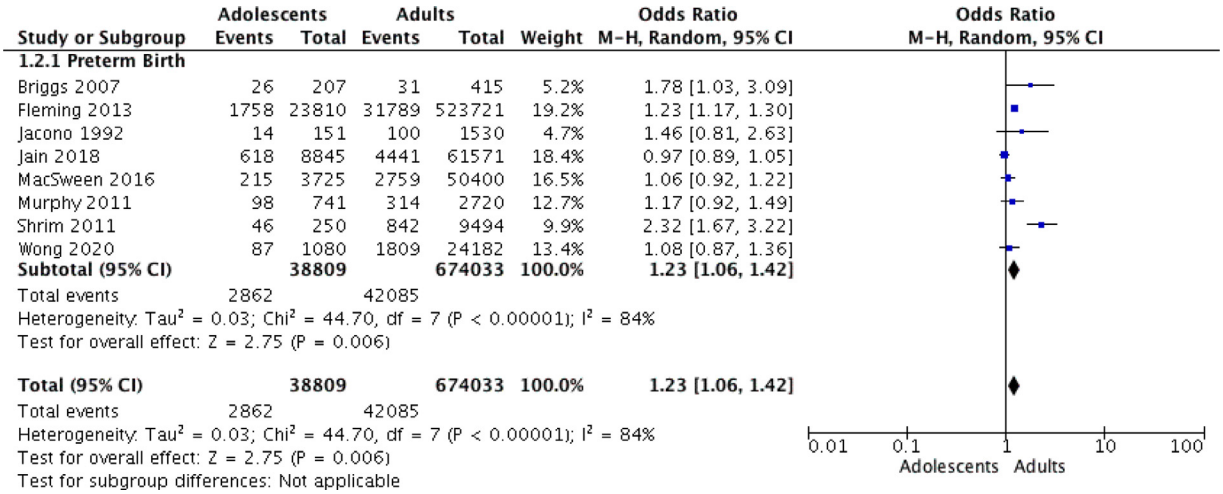

Fig. 3. Meta-analysis of the association between adolescent pregnancy and preterm birth.

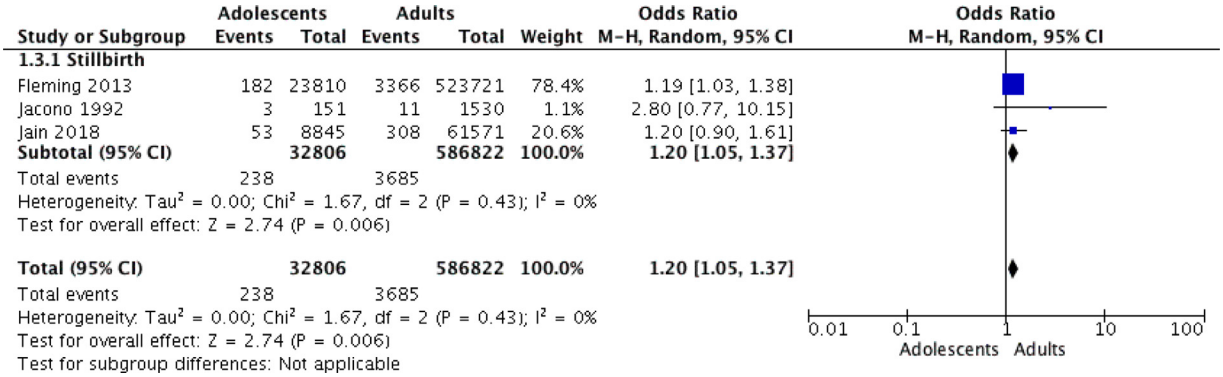

Fig. 4. Meta-analysis of the association between adolescent pregnancy and stillbirth.

for stillbirth among adolescent pregnancies compared to adult pregnancies. In subgroup analyses, adolescent pregnancies were associated with a higher prevalence than adult pregnancies for LBW and PTB in hospital-based studies than population-based studies. However, the subgroup analysis did not reduce the high heterogeneity of the main findings.

Interpretation

Our findings are consistent with existing research from other developed countries. A recent meta-analysis examining the relationship between adolescent pregnancies and adverse birth outcomes worldwide found that adolescent mothers have a higher risk of LBW and PTB infants.[20] Additionally, the incidence of neonatal and perinatal death is significantly higher among adolescent women, and this event is more likely among LBW and PTB infants.[20,33] Furthermore, race/ethnicity and neighborhood disadvantage are also risk factors for adverse birth outcomes among young mothers,[34] and research suggests that SES and behavioral factors are more correlated with LBW than biological characteristics alone.[35] Research has also found that the relationship between adolescent pregnancies and LBW is perpetuated among mothers without partners[35–38] and those with inadequate prenatal care.[37–39] This is problematic because adolescents are less likely to seek early prenatal care than older mothers, likely due to the stigma attached to pregnancies in young/adolescent women.[40,41]

Similar to findings from the United Kingdom[42] and the United States,[43] findings from this systematic review and meta-analysis from Canada demonstrate an increased prevalence of PTB among adolescent pregnancies compared to adult pregnancies. Although it remains unclear what puts adolescent pregnant women at greater risk for PTB, lower SES and poorer diet quality among young mothers compared to adult mothers are likely key factors.[44]

Our study found an increased prevalence of stillbirth among adolescent mothers. Stillbirth can occur for various reasons, including complications during pregnancy, infections, or significant birth defects.[22] Although these factors may not be directly correlated with maternal age, adolescent women are more likely to smoke and to use drugs during pregnancy,[3,9,10,28,29,44] which can contribute to congenital anomalies and complications causing stillbirth.

In assessing the role of the social determinants of health on adolescent pregnancy outcomes, Canadian research has yielded mixed findings. In a population-based retrospective cohort study of all singleton, live deliveries (2010-2015) among adolescents 15-19 years registered in the Alberta Perinatal Health Program (n = 9,606), adolescents of low SES living in rural areas had the highest odds for cesarean delivery, LBW infants, PTB, and large for gestational age infants compared to adolescents aged 15-19 years living

in urban areas of high SES.[45] The authors suggest multiple other factors that may be contributing to poor perinatal outcomes among rural, low-SES adolescents, including multiparity, smoking, substance use, inadequate prenatal care, and barriers to accessing prenatal care delivery services. Wong et al[3] examined the extent to which SES, mental health, and substance use are associated with adolescent pregnancies (n = 1080) in southwestern Ontario, and whether these pregnancies are at higher risk for adverse birth outcomes compared to adult pregnancies (n = 24,183). They found that although adolescent pregnancy is associated with low SES and a greater risk for mental health problems and substance use than is adult pregnancy, adolescents were not at a higher risk for LBW or PTB once adjusting for pre-pregnancy body mass index, previous PTB, mental health, substance use, and SES. Another recent study[46] compared differences in adverse infant outcomes among adolescent mothers in Ontario (Canada), Sweden, Scotland, England, and New South Wales (Australia). The findings suggest that, irrespective of the degree or type of welfare support, infants born to adolescent mothers in all countries were at greater risk for PTB, infant mortality, unplanned hospital admissions, and emergency department visits within the first 12 months of postnatal discharge compared to births among women aged 30-34 years.

Nonetheless, the present systematic review and meta-analysis of Canadian studies reveals a weaker correlation between adolescent pregnancies and adverse birth outcomes compared to what is found in the United States. This may be attributable to the fact that the Canadian healthcare system is funded by the federal government, meaning that healthcare is universal and provided based on need. Conversely, in the United States, those who do not have health insurance may be faced with substantial out-of-pocket medical costs should they need to seek care. In theory, this would allow adolescent women to seek prenatal care more feasibly in Canada. Importantly, Canada also provides higher income supports for the poor than does the United States, and through its universal health care coverage is more effective at promoting women's health, reducing the extent of social inequality, and addressing unequal access.[5]

Strengths and Limitations

Our systematic review and meta-analysis compare differences in adverse birth outcomes between adolescent pregnancies and adult pregnancies in Canada. Using transparent and reproducible methodology, our study provides an overview of all primary research assessing this relationship in Canada, critically appraises and synthesizes the relevant studies, and increases the precision of the association between adolescent pregnancies and adverse birth outcomes through the use of a meta-analysis. Nevertheless, our study is not without limitations. Our sample size was limited to 8 studies, 4 of which were from Ontario,[3,15,26,28] 2 from Nova Scotia,[29,31] 1 from Newfoundland and Labrador,[30] and 1 from Quebec.[27] Some of the studies did not adjust for confounding variables, which may affect the results reported and the outcomes that we were able to compute in our analysis. Other limitations from studies included missing information on race and ethnicity,[3,28–31] and body mass index and gestational weight gain,[30,31] which may have residual confounding effects. We were also unable to investigate the influence of SES and substance use as moderating and mediating factors, respectively, which we suspect are important considerations in the association between adolescent pregnancies and adverse birth outcomes. We could also not compare differences in birth outcomes between younger and older adolescents, since studies categorized adolescent pregnancies as simply ≤19 years. Finally, we found high heterogeneity between studies assessing PTB and LBW, and because of the small sample size of studies, it was difficult to discern which factors were contributing to this.

Conclusion

Adolescent mothers in Canada are more likely to give birth to infants that are preterm, LBW, or stillborn than adult mothers. Although this meta-analysis demonstrates a higher prevalence of adverse birth outcomes among pregnant adolescents than among adult pregnant women, future research is needed to investigate the mechanisms surrounding these differences by maternal age and, ideally, also to compare differences between pregnancies in younger and older women. Several factors associated with adverse birth outcomes should be considered in future research, including socioeconomic disparities, as well as differences in substance use and mental health during pregnancy. Early and accessible prenatal care is also prudent in these vulnerable populations to mitigate these adverse outcomes and to maximize the health of young mothers and infants.

Appendix A

Key search terms included the following: pregnancy, teenage, adverse birth outcomes, and Canada, gestation, prenatal, perinatal, pregnant, teen, adolescent, high school, youth, young woman, pregnancy/birth/ prenatal/perinatal/maternal complications, preterm birth, low birthweight, placental abruption, pre-eclampsia, preeclampsia, eclampsia, hemorrhage/haemorrhage, caesarean section/c section/caesarean section, premature birth/premature labor/premature labour, still birth/still born/stillborn, maternal mortality, and placental previa/praevia, British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, Nova Scotia, Prince Edward Island, Newfoundland, Northwest Territories, Nunavut, and Yukon.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jpag.2021.03.003.

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