

# Effect of Induced Abortions on Early Preterm Births and Adverse Perinatal Outcomes

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## Abstract

**Objectives:** To examine the association between prior induced abortions and prematurity and to explore potential mechanisms for a relationship, including second trimester pregnancy losses and infections.

**Methods:** We conducted a retrospective review of the records of all women who delivered between April 2001 and March 2006 using data from the McGill Obstetric and Neonatal Database. Exposure was categorized as having had no prior induced abortions, one prior induced abortion, or two or more prior induced abortions. Our primary outcome was gestational age at delivery, categorized as < 24 weeks, < 26 weeks, < 28 weeks, < 32 weeks and < 37 weeks.

Secondary outcomes were intrapartum fever, NICU admission, and use of tocolysis.

**Results:** A total of 17 916 women were included in the study. Of these 2276 (13%) had undergone one prior induced abortion, and 862 (5%) had undergone two or more prior induced abortions. Women with a prior induced abortion were more likely to be smokers and to consume alcohol, and were less likely to be married. Women who reported one prior induced abortion were more likely to have premature births by 32, 28, and 26 weeks; adjusted odds ratios were 1.45 (95% CI 1.11 to 1.90), 1.71 (95% CI 1.21 to 2.42), and 2.17 (95% CI 1.41 to 3.35), respectively. This association was stronger for women with two or more previous induced abortions. Prior induced abortion was associated with an increased requirement for tocolysis in subsequent pregnancies, but there was no association between prior induced abortions and NICU admission, intrapartum fever, and preterm premature rupture of membranes.

**Conclusion:** Our study showed a significant increase in the risk of preterm delivery in women with a history of previous induced abortion. This association was stronger with decreasing gestational age.

**Key Words:** Induced abortion, prematurity, intrapartum fever, preterm birth

Competing interests:

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## Résumé

**Objectifs :** Examiner l'association entre les antécédents d'avortement provoqué et la prématurité, et explorer les mécanismes pouvant potentiellement expliquer une telle relation, y compris les fausses couches et les infections au cours du deuxième trimestre.

**Méthodes :** Nous avons mené une analyse rétrospective des dossiers de toutes les femmes qui ont accouché entre avril 2001 et mars 2006, en utilisant des données issues de la *McGill Obstetric and Neonatal Database*. L'exposition a été catégorisée comme suit : aucun antécédent d'avortement provoqué, un avortement provoqué ou deux avortements provoqués ou plus. Notre critère d'évaluation principal était l'âge gestationnel au moment de l'accouchement, lequel a été catégorisé comme suit : < 24 semaines, < 26 semaines, < 28 semaines, < 32 semaines et < 37 semaines.

Les critères d'évaluation secondaires étaient la fièvre intrapartum, l'admission à l'UNSI et le recours à la tocolyse.

**Résultats :** Au total, 17 916 femmes ont été admises à l'étude. Parmi celles-ci, 2 276 (13 %) avaient déjà subi un avortement provoqué et 862 (5 %) avaient déjà subi deux avortements provoqués ou plus. Les femmes ayant déjà subi un ou des avortements provoqués étaient plus susceptibles d'être des fumeuses et de consommer de l'alcool, et moins susceptibles d'être mariées. Les femmes qui ont signalé avoir déjà subi un avortement provoqué étaient plus susceptibles de connaître un accouchement préterme à 32, à 28 et à 26 semaines; les rapports de cotes corrigés étaient de 1,45 (IC à 95 %, 1,11 - 1,90), de 1,71 (IC à 95 %, 1,21 - 2,42) et de 2,17 (IC à 95 %, 1,41 - 3,35), respectivement. Cette association était plus forte chez les femmes qui avaient déjà subi deux avortements provoqués ou plus. Le fait d'avoir déjà subi un ou des avortements provoqués était associé à un besoin accru de mettre en œuvre une tocolyse dans le cadre des grossesses subséquentes; toutefois, aucune association n'a été constatée entre le fait d'avoir déjà subi un ou des avortements provoqués et l'admission à l'UNSI, la fièvre intrapartum et la rupture prématurée des membranes préterme.

**Conclusion :** Notre étude a indiqué une hausse significative du risque d'accouchement préterme chez les femmes présentant des antécédents d'avortement provoqué. Moins l'âge gestationnel était avancé, plus cette association était forte.

## **INTRODUCTION**

Preterm birth is a major problem in Canada. Despite recent advances in medical care, it continues to be the most important cause of neonatal morbidity and mortality.<sup>1</sup> It has been shown that the risk of developing neonatal morbidities increases with decreasing gestational age. The short-term complications of preterm birth, such as respiratory distress syndrome, necrotizing enterocolitis, intraventricular hemorrhage, and sepsis, are all severe illnesses that present a burden to overcrowded neonatal intensive care units.<sup>2</sup> Preterm delivery is also associated with long-term health consequences for the newborn, including neurodevelopment disability such as cerebral palsy and chronic medical conditions such as bronchopulmonary dysplasia.<sup>3,4</sup>

The rate of preterm birth has been increasing, and in 2006 in Canada it was estimated to be approximately 8.1%.<sup>5</sup> An association between induced abortion and prematurity in subsequent pregnancy has been demonstrated in several studies.<sup>6-10</sup> This relationship is very relevant for Canada because of the high number of abortions performed annually. In 2005, there were 96 815 abortions performed in Canada, with 342 176 births in that same year.<sup>11</sup>

Previous studies have examined the relationship between induced abortion (medical and surgical) and preterm birth and have suggested that abortion is associated with spontaneous labour, premature rupture of the membranes, and antepartum hemorrhage.<sup>12-14</sup> However, few studies have assessed the effect that induced abortions have on the severity of prematurity. Although the mechanism of premature delivery is largely unknown, it has been suggested that premature delivery may involve cervical insufficiency (in extreme prematurity), infection, or a combination of both.<sup>15-17</sup> In our study, we sought to examine the association between premature delivery and reported prior induced abortions.

## **METHODS**

We conducted a retrospective cohort study using perinatal data in the McGill Obstetrical and Neonatal Database from all deliveries that took place between April 1, 2001, and March 31, 2006, at the Royal Victoria Hospital in Montreal, Quebec. The database contains detailed obstetrical and neonatal information on all infants weighing  $\geq 500$  g who were live born or stillborn. The data are coded by a record room librarian, verified by an archivist who works full-time on the database, and, for cases needing special scrutiny, reviewed by a neonatologist or an obstetrician. We defined exposure as the occurrence of a prior induced abortion.

This information was collected at the initial prenatal visit and transcribed at the time of delivery. In cases of transfer from other hospitals, the information was obtained by the nurse performing the initial assessment and was then recorded in the McGill Obstetrical and Neonatal Database. For our analysis, women who reported a prior induced abortion were categorized as having had either one abortion or two or more abortions. In the province of Quebec the majority of induced abortions are performed surgically as dilatation and suction curettage. Our primary outcome was gestational age at delivery which was categorized as having occurred before 24 weeks, before 26 weeks, before 28 weeks, before 32 weeks, and before 37 weeks. The secondary outcomes were intrapartum fever, NICU admission, and use of tocolysis.

Baseline characteristics that we evaluated in our analysis included maternal age (categorized as  $< 25$ , 25 to 34,  $\geq 35$  years), maximum education level (high school, some college, university), smoking (yes/no), marital status (yes/no), multiparity (yes/no), BMI ( $< 20$ , 20 to 24, 25 to 29, 30 to 39,  $\geq 40$ ), intrapartum fever (having had a peak temperature  $> 38.3^{\circ}\text{C}$  during labour) and consumption of alcohol (occasional,  $\geq 1$  drink/day).

Our analysis was conducted in two steps. First, we performed a descriptive unadjusted comparison of baseline characteristics in our population with respect to the number of induced abortions. Second, we used an unconditional logistic regression to estimate the relative risk of having a premature birth with one previous induced abortion and two or more prior induced abortions. We conducted a third analysis that consisted of a linear regression to evaluate the effect of the number of abortions (as a continuous variable) on gestational age at birth. All analyses were two-tailed, and a  $P$  value  $< 0.05$  was considered statistically significant.

The Director of Professional Services and the Institutional Review Board of the McGill University Health Centre approved the use of the McGill Obstetrical and Neonatal database for research purposes.

## **RESULTS**

A total of 17 916 women were eligible for our study; the study population was defined as all deliveries taking place at the Royal Victoria Hospital between April 2001 and March 2006. The baseline maternal characteristics are shown in Table 1. Induced abortions were reported by 3138 women (18%); 2276 (13%) of these reported one prior induced abortion, and the remaining 862 (5%) reported two or more prior induced abortions. There were 14 778 women (82%) who reported no prior induced abortion. Women

**Table 1. Baseline maternal characteristics, N = 17 916**

Baseline characteristics	Number of induced abortions		
	0 (n = 14 778) %	1 (n = 2276) %	≥ 2 (n = 862) %
Age, years			
< 25	9.4	7.7	7.4
25 to 34	63.1	59.3	56.9
≥ 35	27.2	33.0	35.6
Multiparity	52.0	49.0	57.0
Smoking	7.0	12.0	16.0
Married	84.0	70.0	61.0
Alcohol use			
Occasional	4.5	7.2	9.0
One per day	0.5	1.2	2.7
BMI, kg/m <sup>2</sup>			
< 20	32.8	29.2	39.7
20 to 24	39.2	42.6	35.7
25 to 29	17.0	17.4	15.9
30 to 39	9.7	9.8	7.4
≥ 40	1.3	1.1	1.3
Education			
High school	23.2	25.3	27.3
Some college	31.9	33.6	36.1
University	44.8	41.1	36.7

who reported a prior induced abortion were more likely to be smokers and to be occasional or regular consumers of alcohol. Those who reported two or more prior induced abortions were slightly older and were less likely to be married. There were no significant differences between the three study groups with regard to parity, maternal age, education, and BMI.

The effect of prior induced abortions on gestational age at delivery is shown in Table 2. Prior induced abortions were strongly associated with prematurity. Women with one or more prior induced abortions had a significantly higher risk of delivering preterm in a subsequent pregnancy, and that association increased with decreasing gestational age. Common adjusted odds ratios (aOR) for women with one previous abortion to deliver prematurely were 1.45 (95% CI 1.11 to 1.90), 1.71 (95% CI 1.21 to 2.42), and 2.17 (95% CI 1.41 to 3.35) at before 32, before 28, and before 26 weeks, respectively. In linear regression analysis adjusting for education, smoking, age, marital status, and alcohol consumption, an increasing number of prior induced abortions was associated with decreasing gestational age at delivery (coeff  $-0.99$ ,  $P = 0.002$ ). The effect of prior induced abortions on the secondary

pregnancy outcomes is also shown in Table 2. Women who reported a prior induced abortion were more likely to require tocolysis in their subsequent pregnancy; that relationship became more significant when there were two or more prior induced abortions (OR 1.42; 95% CI 1.04 to 1.94,  $P = 0.02$ ). After adjusting for potential confounders, we did not find a significant association in our population between reported induced abortions and NICU admission, intrapartum fever, and preterm premature rupture of membranes.

## DISCUSSION

Our objective was to explore the relationship between a history of an induced abortion and subsequent preterm birth at a very early gestational age, using routinely collected perinatal data. Our study results clearly suggest that prior induced abortion increases the risk of having a spontaneous preterm delivery in a subsequent pregnancy and that this link becomes stronger in extremely premature births.

Delivery of premature infants represents a major financial burden for societies around the world. In the United States, the annual costs of medical care and loss of productivity

**Table 2. Adjusted effect of prior induced abortions on risk of preterm birth**

	1 prior induced abortion		2 or more prior induced abortions	
	OR (95% CI)*	P	OR (95% CI)*	P
Gestational age at delivery				
< 37 weeks	1.08 (0.95 to 1.26)	0.28	1.01 (0.81 to 1.25)	0.93
< 32 weeks	1.45 (1.11 to 1.90)	0.01	1.73 (1.20 to 2.50)	0.003
< 28 weeks	1.71 (1.21 to 2.42)	0.002	1.53 (0.90 to 2.61)	0.12
< 26 weeks	2.17 (1.41 to 3.35)	< 0.001	1.85 (0.94 to 3.64)	0.08
< 24 weeks	2.03 (1.17 to 3.54)	0.01	2.02 (0.90 to 4.56)	0.09
Need for tocolysis	1.20 (0.97 to 1.50)	0.10	1.42 (1.04 to 1.93)	0.02
Chorioamnionitis	1.22 (0.98 to 1.52)	0.078	1.18 (0.83 to 1.68)	0.346
NICU admission	1.06 (0.91 to 1.24)	0.445	1.20 (0.96 to 1.50)	0.109

\*Adjusted for maternal age, marital status, smoking, alcohol, education, and BMI

directly related to preterm birth were over US\$26 billion in 2005.<sup>18</sup> This represents an average of \$51 600 (from birth to the child's first birthday) per infant born preterm, which is more than 10 times the cost of the first year of a healthy full-term baby (\$4500).<sup>19</sup> Interestingly, extremely premature infants were responsible for more than one third of the total preterm medical costs, but only accounted for 6% of all preterm deliveries in 2005.<sup>19</sup>

As previously discussed, short-term morbidity (including respiratory distress syndrome, necrotizing enterocolitis, and intraventricular hemorrhage) can be very significant for the premature newborn.<sup>2</sup> The special education demands associated with cerebral palsy, mental retardation, vision impairment, and hearing loss are also quite substantial for the parents.<sup>3,4,20</sup> All of these factors contribute to the importance of our findings.

Our results are consistent with those of previous studies that showed a significant increase in the risk of preterm delivery in women with a history of previous induced abortions.<sup>6–10,15,21–23</sup> Most studies originate outside North America; one of the largest is the EUROPOP study, an unmatched case–control study based on surveys conducted in 60 maternity units from 17 European countries between 1994 and 1997.<sup>22</sup> This study, which included 2938 cases of preterm birth and 4781 control subjects and compared three groups of countries according to the frequency of induced abortion, showed that the risk of preterm delivery was significantly higher in women with a history of previous induced abortions than in those without such history (aOR 1.2 to 1.5 in the three groups). It also showed that the association with a history of induced abortion was stronger for very preterm birth than for moderate preterm birth (aOR 1.5 and 1.2, respectively). The findings from this study might

not necessarily be applicable to our population in North America because the study population included patients from over 10 European countries in which methods for performing abortion may differ.

Another large study published in 2008 examined over 45 000 live singleton births delivered between 1959 and 1966.<sup>24</sup> This study showed that, compared with women with no history of abortion, women who had one, two, or three or more previous abortions were 1.7 (95% CI 1.52 to 1.83), 2.0 (95% CI 1.73 to 2.37), and 3.0 (95% CI 2.47 to 3.70) times more likely to have a preterm birth, respectively.<sup>8</sup> However, it is uncertain whether data collected over 50 years ago can be applied to current populations, as health care and social context have evolved. In the mid-20th century, induced abortions were illegal in the United States; in addition this study did not differentiate between induced abortion and miscarriage.

The etiology of prematurity is believed to be multifactorial; it likely has infectious and mechanical components, but the effect of prior induced abortion is uncertain.<sup>15,16</sup> Different studies have reviewed the hypotheses and have proposed specific mechanisms (such as intra-amniotic infection, antepartum hemorrhage, and cervical incompetence) leading to preterm delivery in women with a prior therapeutic abortion.<sup>12–17,25</sup> Intra-amniotic infection is the pathway that has been most studied. In a case–control study by Krohn et al.,<sup>17</sup> a strong association was found between intrapartum intra-amniotic infection and a history of an elective termination (OR 4.0, 95% CI 2.7 to 5.8). Although the mechanism for the association is uncertain, this study suggests a link with a well-known pregnancy complication (i.e., chorioamnionitis) but does not specify the pathophysiology and chronology of the infection process that arises from an induced abortion.

In contrast to these studies, we sought to focus our outcomes on the very early preterm birth (< 28 weeks). Few studies have taken this approach to date. The cervical trauma leading to cervical insufficiency appears to be an underlying mechanism. In most patients, the cervix is rigid and tightly closed. During an induced abortion, the cervix must be dilated with some force. During this forced dilatation there is almost always microscopic tearing of the cervical muscle. One study showed that cervical laceration was present in more than 22% of women undergoing an abortion.<sup>25</sup> In another study, up to 12.5% of women required cervical stitching at the time of the procedure, something rarely done in our abortion clinics.<sup>26</sup> Most of these research papers involve data from the 1970s, and in the last decade there have been changes in protocols for the surgical termination of pregnancy. Procedures are now done at an earlier gestational age, most often using aspiration instead of curettage, and the use of cervical priming agents is more widespread.<sup>27</sup> These newer techniques may decrease the severity of the cervical trauma. A more recent 2002 Danish cohort study showed a cervical injury rate of 0.89 per 1000 women.<sup>28</sup> However, the cervical damage, whether microscopic or macroscopic, could still result in a permanent weakening of the cervix. It is not unlikely that this mechanical change in the cervix could lead to an increased predisposition to ascending genital tract infection or to cervical insufficiency leading to prematurity. The fact that the association that we observed showed a stronger link with earlier gestational age suggests that a mechanical issue, as is typically seen in cases of cervical insufficiency or incompetence (in which the delivery will occur more commonly in the second trimester) is more likely.

One of the limitations of our study is that the history of induced abortion was disclosed by women at the time of their first prenatal visit and was not otherwise confirmed. However, a failure to disclose this information would likely have resulted in a bias towards the null; women with a prior abortion would be less likely to disclose it rather than vice versa. Additionally, despite having a full-time archivist working to ensure that the database is both valid and complete, errors in data entry are still possible. Since we have identified an association, it is unlikely that these misclassifications would have had a significant effect on our results, and such misclassification would, if anything, be more likely to potentiate our observed effect. A further limitation is that whether the induced abortion was performed surgically or medically, and whether it was performed in the first or second trimester, was not defined in our database. Although medical abortion is a frequently used option in many countries, in Quebec the use of misoprostol for medical abortion is not standard of care.

Because surgical abortion is readily available, the possibility of misclassification is unlikely to be an important limitation. A final limitation is that the database does not specify if recent immigrants had the induced abortions performed in Canada or in their country of origin. The technique used in surgical abortion may vary in different countries, and this may affect the incidence of cervical injury.

## CONCLUSION

We found a significant increase in the risk of preterm delivery in women with a history of prior induced abortion, and the association became stronger with decreasing gestational age. This may imply that cervical insufficiency is a part of the mechanism that leads to preterm birth. Women in the reproductive years are often not aware of all the potential short and long-term complications that may arise from an induced abortion; therefore, stronger public health policies should be established to ensure that effective contraception is available to limit the need for therapeutic abortion. Reducing the need for pregnancy termination by providing safe and effective contraception for all women who require it may be considered as an initial approach to reducing the rates of prematurity.

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