

OBSTETRICS

Second-trimester abortion and risk of live birth



Nathalie Auger, MD, MSc, FRCPC; Émilie Brousseau, MSc; Aimina Ayoub, MSc; William D. Fraser, MD, MSc, FRCSC

BACKGROUND: Second-trimester abortion may result in a live birth, but the extent to which this outcome occurs is unknown.

OBJECTIVE: This study aimed to examine rates of live birth after pregnancy termination in the second trimester and identify associated risk factors.

STUDY DESIGN: We conducted a retrospective cohort study of 13,777 second-trimester abortions occurring in hospital settings between April 1, 1989 and March 31, 2021 in Quebec, Canada. The exposure was induced abortion between 15 and 29 weeks of gestation, including the indication for (fetal anomaly, maternal emergency, other) and use of feticidal injection (intracardiac/intrathoracic or intraamniotic). The primary outcome was live birth following abortion. We measured the rate of live birth per 100 abortions and used adjusted log-binomial regression models to estimate risk ratios and 95% confidence intervals for the association of fetal and maternal characteristics with the risk of live birth. We assessed the extent to which feticidal injection reduced the risk.

RESULTS: Among 13,777 abortions between 15 and 29 weeks of gestation, 1541 (11.2%) led to live birth. Fetal anomaly was a common

indication for termination (48.1%), and most abortions were by labor induction (72.2%). Compared with abortion between 15 and 19 weeks, abortion between 20 and 24 weeks was associated with 4.80 times the risk of live birth (95% confidence interval, 4.20–5.48), whereas abortion between 25 and 29 weeks was associated with 1.34 times the risk (95% confidence interval, 1.00–1.79). Feticidal injection reduced the risk of live birth by 57% compared with no injection (risk ratio, 0.43; 95% confidence interval, 0.36–0.51). Intracardiac or intrathoracic injection was particularly effective at preventing live birth (risk ratio, 0.02; 95% confidence interval, 0.01–0.07).

CONCLUSION: Second-trimester abortion carries a risk of live birth, especially at 20 to 24 weeks of gestation, although feticidal injection may protect against this outcome.

Key words: autopsy, congenital abnormalities, gestational age, induced abortion, live birth, neonatal intensive care, palliative care, perinatal mortality, pregnancy complications

Introduction

Abortion in the second trimester of pregnancy is increasingly frequent,^{1,2} but the risk of complications is poorly understood. Second-trimester abortions are common when fetuses have severe anomalies that are incompatible with life.³ Critical heart defects and serious chromosomal anomalies have become easier to detect in the first or second trimester owing to advancements in maternal serum screening, ultrasound technology, and fetal echocardiography.^{4,5} Second-trimester abortions can also be performed for medical emergencies such as severe preeclampsia or other life-threatening morbidities,³ many of which appear to be increasing over time.⁶ However, second-trimester abortions may be associated with underrecognized complications, especially the possibility of live birth.⁷

Data are beginning to suggest that unintentional live birth may be frequent following an abortion, with rates ranging between 3% and 50%.^{5,8,9} A retrospective study of 3189 patients from the United Kingdom found that, at any gestational age, 3.2% of abortions resulted in live birth.⁵ A study of 241 patients from Austria found that 50.6% of abortions between 20 and 24 weeks led to live birth.⁸ However, both studies focused on abortions for major birth defects only.^{5,8} The only study that assessed other indications for abortion, including medical emergencies, found that 40% of terminations between 22 and 27 weeks led to live birth.⁹ These studies were all descriptive reports that were not representative of abortions in the second trimester and did not investigate risk factors associated with live birth.^{5,8,9} The objective of this study was to examine the extent to which second-trimester abortion was associated with the risk of live birth, and identify maternal characteristics that could be targeted to decrease the likelihood of this outcome.

Materials and Methods

We conducted a population-based cohort study of second-trimester abortions

between 15 and 29 weeks of gestation in Quebec, Canada from April 1, 1989 to March 31, 2021. We included abortions in hospital settings, excluding spontaneous abortions or abortions for ectopic or molar pregnancies. Abortion is legal throughout pregnancy in Canada,¹⁰ but we focused on the period between 15 and 29 weeks because fetuses born at earlier gestational ages are unlikely to survive birth, and because abortions later in pregnancy are uncommon.

We extracted patient data from the Maintenance and Use of Data for the Study of Hospital Clientele registry, which contains discharge summaries for all inpatient abortions beginning in 1989.¹¹ Data in the registry are coded by trained medical archivists and undergo rigorous validation.¹¹ Although surgical abortion is sometimes provided in ambulatory clinics after 14 weeks of gestation via dilation and evacuation,^{12–14} most abortions in the second trimester are performed by labor induction in hospitals in Quebec.¹⁴ Hospital discharge abstracts therefore capture most second-trimester abortions in the population. A discharge summary is present for each patient who undergoes an abortion and for neonates who are born alive.

Cite this article as: Auger N, Brousseau É, Ayoub A, et al. Second-trimester abortion and risk of live birth. *Am J Obstet Gynecol* 2024;230:679.e1–9.

0002-9378/\$36.00

© 2023 Elsevier Inc. All rights reserved.

<https://doi.org/10.1016/j.ajog.2023.11.004>



Click here to download the full article PDF. Materials and Methods are available in Contents at [ajog.org](https://doi.org/10.1016/j.ajog.2023.11.004)

AJOG at a Glance

Why was this study conducted?

The risk of live birth following second-trimester abortion is poorly understood.

Key findings

In this population-based study of >13,000 late pregnancy terminations, 11.2% resulted in live birth, and most were secondary to labor induction. Compared with abortion between 15 and 19 weeks, abortion between 20 and 24 weeks was associated with 4.8 times the risk of live birth. Intracardiac or intraamniotic feticidal injection reduced the risk by up to 98%.

What does this add to what is known?

Feticidal injection is effective at preventing unintended live birth and should be considered for second-trimester abortions before 24 weeks.

To identify abortions, we used diagnostic codes from the 9th and 10th revisions of the International Classification of Diseases (ICD), intervention codes from the Canadian Classification of Diagnostic, Therapeutic, and Surgical Procedures (CCP) and Canadian Classification of Health Interventions (CCI), and service codes in the data registry (Supplemental Table 1). Patients had to have at least 1 abortion diagnosis, procedure, or service code to be included in the study. Before 2006, however, procedure codes could not be used to identify abortions after 24 weeks. We determined if abortion was performed by labor induction or dilation and evacuation.

Study variables

The primary outcome was live birth following abortion. In Quebec, live birth is defined as the presence of any sign of life, including breathing, heartbeat, umbilical cord pulsation, or muscle movement, in a fetus that is removed from a mother, whether or not the cord is cut or placenta attached.¹⁵ By law, all live births in Quebec are registered, regardless of gestational age, reason for birth, and length of time before death. According to death certificates, 10% of infants born alive after a pregnancy termination in Quebec survive >3 hours.⁷ Mean survival time is 110 minutes, with a range of 1 minute to 1 day.⁷

There were 3 possible indications for abortion in this study: (1) fetal anomaly;

(2) maternal emergency requiring pregnancy termination; and (3) other personal factors. Fetal anomalies included chromosomal and nonchromosomal structural defects of the central nervous system, heart, musculoskeletal system, urinary system, respiratory system, and other organs.^{16,17} Maternal emergencies included preeclampsia, severe hemorrhage, acute renal failure, sepsis, surgical complications, cardiac arrest, and other severe life-threatening morbidity.¹⁸ If no anomaly or maternal emergency was listed on the discharge abstract, we considered that patients had other personal or unspecified indications.

We determined if a feticidal injection was administered before termination, and classified the injection as either intracardiac/intrathoracic or intraamniotic. For pregnancies in the second trimester, intracardiac injection of digoxin and potassium chloride or intraamniotic injection of cytotoxic agents under ultrasound guidance may stop the fetal heart and prevent live birth.¹⁹

We examined factors that could influence the risk of live birth among abortions, such as maternal age (<25, 25–34, ≥35 years), week of gestation (15–19, 20–24, 25–29 weeks), comorbidity (including essential hypertension, preexisting diabetes, obesity, dyslipidemia, mental health disorders, and alcohol, tobacco, or other substance use disorders) (yes, no), socioeconomic disadvantage (yes, no, unknown), place of residence (rural, urban, unknown), and time period (1989–2000, 2001–2010, 2011–2021).

Socioeconomic disadvantage corresponded to the 2 most materially deprived quintiles of the population, following a composite index of low education, unemployment, and low income within neighborhoods.²⁰

Finally, we assessed the types of care provided for live births after delivery, including admission to a neonatal intensive care unit, provision of palliative care, and use of autopsy upon death.

Statistical analysis

We determined the rate of live birth per 100 abortions for each gestational age and time period, and calculated the frequency of live birth according to abortion indication and other maternal characteristics. We applied log-binomial regression models to estimate risk ratios (RRs) and 95% confidence intervals (CIs) for the association of patient characteristics with live birth. We adjusted the models for maternal age, maternal comorbidity, socioeconomic disadvantage, place of residence, and time period. In secondary analyses, we examined the association of feticidal injection with risk of live birth and identified characteristics that influenced the provision of critical or palliative care to newborns. In sensitivity analyses, we stratified the analysis by time period to rule out the possibility that associations changed over time.

We performed the analysis in SAS, version 9.4 (SAS Institute Inc., Cary, NC). Because the data were anonymized and informed consent was not needed, we received an ethics waiver from the review board of our institution.

Results

A total of 13,777 abortions were performed between 15 and 29 weeks, primarily through labor induction (72.2%) (Table 1). Most abortions (53.8%) were performed at 15 to 19 weeks, followed by 20 to 24 weeks (41.0%) and 25 to 29 weeks (5.2%). Fetal anomaly was a common indication for abortion (48.1%), whereas fewer abortions were performed for maternal emergencies (5.0%). The frequency of abortions for a fetal anomaly was higher among women aged ≥35 years and women who were

TABLE 1
Patient characteristics according to abortion indication

Characteristics	No. abortions (%) ^a			
	Any indication	Fetal anomaly	Maternal emergency	Other
Abortion method				
Labor induction	9940 (72.2)	5907 (89.1)	624 (90.4)	3614 (54.1)
Dilation and extraction	3837 (27.9)	723 (10.9)	66 (9.6)	3063 (45.9)
Week of gestation				
15–19	7415 (53.8)	2553 (38.5)	328 (47.5)	4619 (69.2)
20–24	5642 (41.0)	3573 (53.9)	307 (44.5)	1867 (28.0)
25–29	720 (5.2)	504 (7.6)	55 (8.0)	191 (2.9)
Maternal age, y				
<25	4092 (29.7)	994 (15.0)	216 (31.3)	2913 (43.6)
25–34	6580 (47.8)	3660 (55.2)	308 (44.6)	2729 (40.9)
≥35	3105 (22.5)	1976 (29.8)	166 (24.1)	1035 (15.5)
Maternal comorbidity ^b	716 (5.2)	317 (4.8)	100 (14.5)	321 (4.8)
Socioeconomic disadvantage	5544 (40.2)	2416 (36.4)	299 (43.3)	2911 (43.6)
Place of residence				
Urban	10,949 (79.5)	5298 (79.9)	553 (80.1)	5271 (78.9)
Rural	2320 (16.8)	1133 (17.1)	122 (17.7)	1109 (16.6)
Time period				
1989–2000	5202 (37.8)	1412 (21.3)	290 (42.0)	3584 (53.7)
2001–2010	4335 (31.5)	2384 (36.0)	167 (24.2)	1834 (27.5)
2011–2021	4240 (30.8)	2834 (42.8)	233 (33.8)	1259 (18.9)
Total	13,777	6630	690	6677

^a Fetal anomaly and maternal emergency are not mutually exclusive; ^b Preexisting diabetes or hypertension, obesity dyslipidemia, drug, alcohol, tobacco or substance use disorder, mental disorder. Auger. Termination of pregnancy and live birth. Am J Obstet Gynecol 2024.

socioeconomically advantaged. In contrast, the proportion of abortions for a maternal emergency was greater among young (<25 years) and socioeconomically disadvantaged women.

Overall, 1541 abortions (11.2%) resulted in live birth (Figure). Live birth rates were highest at 23 weeks of gestation (27.0 per 100 abortions), followed by 22 weeks (26.7 per 100 abortions) and 21 weeks (22.9 per 100 abortions). Live birth rates increased over time for every gestational age, but the increase was most apparent between 20 and 24 weeks.

Among abortion indications, fetal anomalies accounted for the greatest proportion of live births, especially later in gestation (Table 2). Overall, 88.5% of abortions that resulted in live birth at 25 to 29 weeks were for fetal anomalies, as

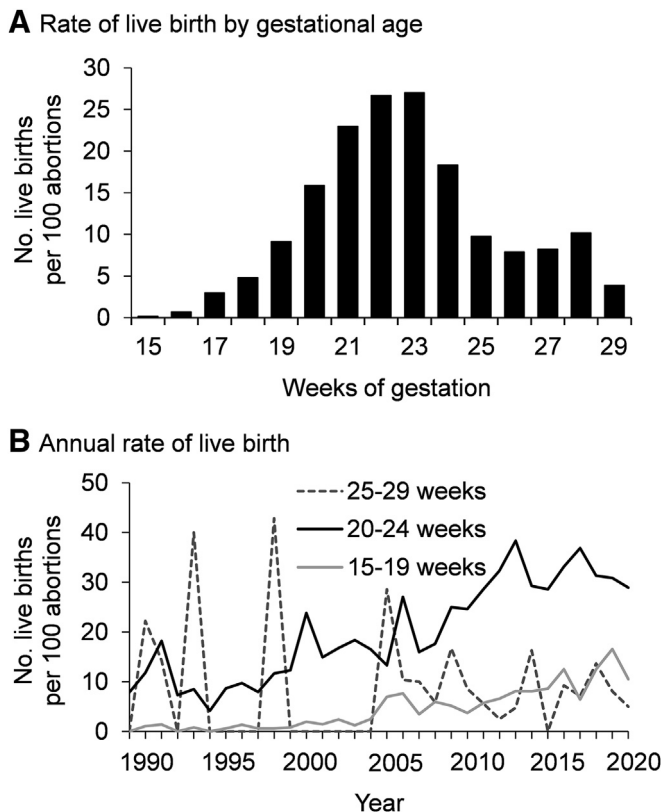
opposed to 69.4% at 20 to 24 weeks and 58.9% at 15 to 19 weeks. Heart, central nervous system, and chromosomal defects were the most common anomalies. Chromosomal anomalies were most frequent at 15 to 19 and 20 to 24 weeks, whereas heart defects were most prevalent between 25 and 29 weeks. Maternal emergencies accounted for 6% to 8% of abortions that resulted in live birth at 15 to 19, 20 to 24, and 25 to 29 weeks.

The abortion method was the strongest risk factor for live birth (Table 3). Compared with dilation and evacuation, abortion via labor induction was associated with 46.82 times the risk of live birth (95% CI, 24.32–90.11). Gestational age was the next most important risk factor, with abortion at 20 to 24 weeks being associated with 4.80 times

the risk of live birth (95% CI, 4.20–5.48) compared with 15 to 19 weeks. Abortions in the last decade of the study were 4.66 times more likely to result in live birth compared with the first decade (95% CI, 4.01–5.42). Other risk factors for live birth included fetal anomaly, maternal emergency, maternal age ≥25 years, and rural residence.

Feticidal injection markedly reduced the risk of live birth (Table 4). Compared with no injection, any feticidal injection reduced the risk of live birth by 57% (RR, 0.43; 95% CI, 0.36–0.51). The protective effect was most apparent for labor induction and was present regardless of gestational age. Intracardiac/intrathoracic injection reduced the risk by up to 98% (RR, 0.02; 95% CI, 0.01–0.07). Intraamniotic

FIGURE
Rate of live birth per 100 abortions according to gestational age



Auger. Termination of pregnancy and live birth. *Am J Obstet Gynecol* 2024.

injection also reduced the risk, but to a lesser extent (RR, 0.82; 95% CI, 0.69–0.98).

In analyses of live births, one-quarter of neonates (24.5%) were admitted to an intensive care unit and 5.5% received palliative care (Supplemental Table 2). Infants born between 15 and 19 weeks (RR, 0.14; 95% CI, 0.05–0.39) and 20 and 24 weeks (RR, 0.34; 95% CI, 0.17–0.66) were less likely to receive palliative care than infants born between 25 and 29 weeks. Most infants who received palliative or intensive care before 20 weeks had a gestational age of 19 weeks. Autopsy was performed for 45.9% of infants, but the likelihood of autopsy did not vary with gestational age.

In sensitivity analyses, there was no clear evidence that the associations between maternal characteristics and risk of live birth changed over time.

Comment

Principal findings

In this retrospective cohort study of 13,777 abortions between 15 and 29 weeks of gestation, 11.2% resulted in live birth. The risk of live birth increased throughout the study period, with most live births occurring secondary to labor induction. Abortion between 20 and 24 weeks was associated with a greater risk of live birth compared with abortion between 25 and 29 weeks. Advanced maternal age, maternal emergency, fetal anomaly, and rural residence were also associated with the risk of live birth. Feticidal injection was the only factor that reduced the risk, especially when injections were given by intracardiac or intrathoracic route. Overall, the findings suggest that second-trimester abortions commonly result in live birth, and that feticidal injection is underused to prevent this outcome.

Results in the context of what is known

Methods used for second-trimester abortion vary from country to country, but the 2 most common approaches are dilation and evacuation or labor induction.^{21,22} Dilation and evacuation is frequently used in the United States in ambulatory clinics.^{13,21} In other countries, labor induction is the preferred method because specialized training is not needed to provide this service.²² Labor induction also results in an intact fetus for postmortem examination and autopsy, which is more difficult to achieve after dilation and evacuation.^{21–23} Labor induction generally requires hospital admission, and is preferred at later gestational ages.²¹ However, labor induction can inadvertently result in live birth.⁷ Lack of data on the risk of live birth is a barrier to prevention.

What is known comes from only a handful of studies.^{5,8,9} In an analysis of 241 abortions by labor induction in Austria, approximately half resulted in live birth.⁸ Gestational age was the only important predictor.⁸ However, data were restricted to abortions between 20 and 24 weeks of gestation, included fetuses with major anomalies only, and potential confounders were not specified.⁸ The remaining studies were all descriptive reports, where live birth occurred in 5.5% of 1222 abortions between 20 and 23 weeks in the United Kingdom,⁵ and in 39% of 465 abortions between 22 and 27 weeks in Switzerland.⁹ In our study, live birth occurred in 20.2% of abortions between 20 and 29 weeks. Some of the variation in rates could be due to study design given that most analyses had selective inclusion criteria or were restricted to abortions for anomalies only.^{5,8,9}

Implications

Abortion rates have increased over time following improvements in detection of anomalies.⁵ In our setting, the number of abortions performed for anomalies increased considerably, along with live birth rates among fetuses with anomalies. Although feticidal injection has potential to reduce the risk of live birth

TABLE 2
Distribution of live births according to abortion indication^a

Abortion indication	No. live births (%)		
	15–19 wk	20–24 wk	25–29 wk
Fetal anomaly			
Any	149 (58.9)	852 (69.4)	54 (88.5)
Central nervous system	15 (5.9)	243 (19.8)	12 (19.7)
Heart defect	12 (4.7)	178 (14.5)	16 (26.2)
Chromosomal	97 (38.3)	265 (21.6)	10 (16.4)
Musculoskeletal	8 (3.2)	82 (6.7)	6 (9.8)
Urinary	8 (3.2)	72 (5.9)	<5
Respiratory	0	18 (1.5)	<5
Other anomaly	14 (5.5)	118 (9.6)	44 (23.0)
Maternal emergency			
Any	15 (5.9)	83 (6.8)	5 (8.2)
Severe maternal morbidity	12 (4.7)	73 (6.0)	<5
Other indication	94 (37.2)	325 (26.5)	7 (11.5)
Total	253 (100)	1227 (100)	61 (100)

^a Fetal anomaly and maternal emergency are not mutually exclusive.

Auger. Termination of pregnancy and live birth. *Am J Obstet Gynecol* 2024.

by stopping the fetal heart,¹⁹ Canadian guidelines make no strong recommendation for feticidal injection before an abortive procedure.²³ Although the Quebec College of Physicians recommends injection from 21 weeks,¹⁰ there appears to be disparity in use of this procedure.²⁴ In the United Kingdom, live birth rates declined after guidelines for feticidal injection were introduced.⁵ Although no study has addressed the extent to which feticidal injection actually reduces the risk of live birth,^{5,8,9} our data suggest that feticidal injection is very effective, especially by intracardiac or intrathoracic route.

Gestational age also appears to be an important determinant of live birth, as we found that abortion was associated with 4.8 times the risk of live birth at 20 to 24 weeks and 1.3 times the risk at 25 to 29 weeks compared with abortion at 15 to 19 weeks. Other studies also suggest that live birth rates may be highest at 20 to 24 weeks.^{5,9} Given that feticidal injection is not always recommended early in gestation,²⁴ live birth rates may be paradoxically higher at 20 to 24 weeks than later on. Feticidal injection may also

be less successful for less mature fetuses that are smaller and more difficult to inject.

Maternal emergencies were weakly associated with the risk of live birth. Maternal emergencies accounted for approximately 5% of live births in our population, resembling Switzerland, where 10% of late abortions have this indication.⁹ In our data, severe maternal morbidity was the most frequent emergency. Severe maternal morbidity comprises serious events such as eclampsia, myocardial infarction, and heart failure that are considered life-threatening for the mother.¹⁸ These cases may be more urgent and provide insufficient time for feticidal injection. In Switzerland, 64% of abortions for emergencies lead to live birth; however, some are performed for acute psychiatric conditions and other non-life-threatening events.⁹ Advanced maternal age and rural residence were also weakly associated with live birth. Advanced maternal age may be a risk factor given that severe maternal morbidity is more prevalent after the age of 35 years.^{6,25} In rural areas, live birth rates may be elevated simply

because of limited access to feticidal injection.²⁴

Less is known about the type of care provided to infants born alive after an abortion. In Switzerland, 1.3% of such neonates receive palliative care,⁹ which is lower than the 5.5% observed in our population. An additional 25% in our cohort received intensive care, presumably as a stand-in for palliative services. Gestational age influenced the likelihood of receiving palliative care, with more care provided to infants born later in gestation. It may be that the benefits of palliative care are underrecognized among earlier abortions. In one survey, patients who received abortions were rarely informed of the option for palliative care.¹⁰ However, it is also possible that palliative care was provided but not documented in the neonate's chart. This may also be the case for autopsy given that less than half of infants in our sample had this procedure. Many would have been eligible for autopsy, as labor induction was the most common method used.

Strengths and limitations

Because we used hospital records, we could not estimate the rate of live birth for surgical abortions in ambulatory clinics. However, surgical abortion is rare at advanced gestational ages because few centers offer training for dilation and evacuation in Quebec.²⁴ Live birth is less common after surgical abortion because the fetus is rarely intact.²³ We did not have data on the duration of labor and induction method, although prostaglandin, oxytocin, and osmotic dilators are commonly used in Quebec.²⁴ Information on the feticidal agent, dose, and timing before labor induction was not available. Some maternal morbidities may be underreported, potentially misclassifying the indication for abortion. Because maternal emergencies were rare, we could not investigate each type separately. We did not know for how many hours neonates survived, or whether survival time influenced the type of postnatal care. We did not have data on the type of palliative care or whether compassionate care was provided to live-born infants who did not

TABLE 3

Association of maternal and fetal characteristics with live birth following pregnancy termination

Characteristics	No. abortions (no. live births)	Live birth rate per 100 abortions	Risk ratio (95% CI)	
			Unadjusted	Adjusted ^a
Abortion method				
Labor induction	9940 (1532)	15.4	65.71 (34.16–126.39)	46.82 (24.32–90.11)
Dilation and extraction	3837 (9)	0.2	Reference	Reference
Week of gestation				
15–19	7415 (253)	3.4	Reference	Reference
20–24	5642 (1227)	21.7	6.37 (5.59–7.26)	4.80 (4.20–5.48)
25–29	720 (61)	8.5	2.48 (1.90–3.25)	1.34 (1.00–1.79)
Fetal anomaly				
Yes	6630 (1055)	15.9	2.34 (2.11–2.59)	1.53 (1.37–1.70)
No	7147 (486)	6.8	Reference	Reference
Maternal emergency				
Yes	690 (103)	14.9	1.36 (1.13–1.63)	1.36 (1.14–1.62)
No	13,087 (1438)	11.0	Reference	Reference
Maternal age, y				
<25	4092 (225)	5.5	Reference	Reference
25–34	6580 (926)	14.1	2.56 (2.22–2.95)	1.77 (1.54–2.04)
≥35	3105 (390)	12.6	2.28 (1.95–2.67)	1.48 (1.25–1.75)
Maternal comorbidity				
Yes	716 (101)	14.1	1.28 (1.06–1.54)	0.97 (0.81–1.17)
No	13,061 (1440)	11.0	Reference	Reference
Socioeconomic disadvantage				
Yes	5544 (620)	11.2	0.97 (0.88–1.07)	1.02 (0.92–1.12)
No	7334 (842)	11.5	Reference	Reference
Place of residence				
Urban	10,949 (1181)	10.8	Reference	Reference
Rural	2320 (314)	13.5	1.25 (1.12–1.41)	1.33 (1.18–1.50)
Time period				
1989–2000	5202 (214)	4.1	Reference	Reference
2001–2010	4335 (443)	10.2	2.48 (2.12–2.91)	2.23 (1.90–2.62)
2011–2021	4240 (884)	20.8	5.07 (4.39–5.85)	4.66 (4.01–5.42)

CI, confidence interval.

^a Adjusted for maternal age, maternal comorbidity, socioeconomic disadvantage, place of residence, and time period.

Auger. Termination of pregnancy and live birth. *Am J Obstet Gynecol* 2024.

receive intensive care. We could not assess the possible psychological impact on staff and parents, or potential difficulties experienced by the newborn. We could not account for ethnicity or patient income; however, it is unlikely that these are major confounders because abortion is publicly funded in Canada.²⁶

Our findings may not apply to populations where abortion legislation or definitions of live birth differ.

Conclusions

In this population-based study of >13,000 second-trimester abortions, 11% resulted in live birth, and the risk

appeared to increase over time. Gestational age between 20 and 24 weeks and abortion by labor induction were the most important risk factors. Feticidal injection was associated with a substantial reduction in risk. Palliative care was not used for most live births. The findings suggest that risk of live birth

TABLE 4
Reduction in risk of live birth following fetocidal injection

Characteristic of fetocidal injection	Live birth rate per 100 abortions			Risk ratio (95% CI) ^a		
	All abortions	Labor induction	Dilation and extraction	All abortions	Labor induction	Dilation and extraction
Fetocidal Any injection						
Yes	4.9	5.0	1.2	0.43 (0.36–0.51)	0.31 (0.26–0.37)	4.85 (0.61–38.21)
No	12.7	18.9	0.2	Reference	Reference	Reference
Week of injection						
Injection at 25–29 wk	3.2	3.2	—	0.17 (0.10–0.30)	0.14 (0.08–0.24)	—
Injection at 20–24 wk	7.5	7.5	4.3	0.61 (0.50–0.74)	0.45 (0.37–0.54)	15.58 (1.95–124.29)
Injection at 15–19 wk	1.6	1.7	—	0.24 (0.14–0.40)	0.15 (0.09–0.26)	—
No injection	12.7	18.9	0.2	Reference	Reference	Reference
Type of injection						
Intracardiac/intrathoracic	0.5	0.5	—	0.02 (0.01–0.07)	0.02 (0.01–0.06)	—
Intraamniotic	6.4	6.6	1.2	0.82 (0.69–0.98)	0.56 (0.47–0.68)	5.18 (0.66–40.79)
No injection	12.7	18.9	0.2	Reference	Reference	Reference

CI, confidence interval.

^a Adjusted for maternal age, maternal comorbidity, socioeconomic disadvantage, place of residence, and time period. Results for dilation and evacuation should be interpreted with caution owing to low number of events.

Auger. Termination of pregnancy and live birth. *Am J Obstet Gynecol* 2024.

following abortion may be underestimated, and that fetocidal injection and palliative care are underused. We recommend that: (1) fetocidal injection be more widely encouraged for abortions between 20 and 24 weeks; and (2) mothers be counseled on the risk of live birth, use of fetocidal injection, and provision of palliative care. These efforts may also help mitigate the psychosocial impact of live birth on family members and medical professionals. ■

Acknowledgments

The authors thank Jungmin Chang, MScPH for research assistance.

References

- Canadian Institute for Health Information. Induced abortions reported in Canada in 2015. 2017. Available at: <https://www.cihi.ca/sites/default/files/document/induced-abortion-can-2015-en-web.xlsx>. Accessed March 13, 2023.
- Canadian Institute for Health Information. Induced abortions reported in Canada in 2020. 2022. Available at: [\[reported-in-canada-2020-en.xlsx\]\(#\). Accessed March 13, 2023.](https://www.cihi.ca/sites/default/files/document/induced-abortions-

</div>
<div data-bbox=)

- ACOG Practice Bulletin No. 135: second-trimester abortion. *Obstet Gynecol* 2013;121:1394–406.
- Edwards L, Hui L. First and second trimester screening for fetal structural anomalies. *Semin Fetal Neonatal Med* 2018;23:102–11.
- Wylides MP, Tonks AM. Termination of pregnancy for fetal anomaly: a population-based study 1995 to 2004. *BJOG* 2007;114:639–42.
- Aoyama K, Pinto R, Ray JG, et al. Association of maternal age with severe maternal morbidity and mortality in Canada. *JAMA Netw Open* 2019;2:e199875.
- Auger N, Bilodeau-Bertrand M, Sauve R. Abortion and infant mortality on the first day of life. *Neonatology* 2016;109:147–53.
- Springer S, Gorczyca ME, Arzt J, Pils S, Bettelheim D, Ott J. Fetal survival in second-trimester termination of pregnancy without fetocide. *Obstet Gynecol* 2018;131:575–9.
- Berger F, Bucher HU, Fauchère JC, Schulzke S, Berger TM. Overlapping borders: limit of viability and late terminations of pregnancy - a retrospective multicentre observational study. *Swiss Med Wkly* 2020;150:w20186.
- Sénéchal M, Taillefer C, Payot A. The medical process in pregnancy terminations for fetal

anomaly: an analysis of counselling and bereavement. *J Obstet Gynaecol Can* 2022;44:54–9.

- Ministry of Health and Social Services. Med-echo system normative framework – maintenance and use of data for the study of hospital clientele. Canada: Government of Quebec; 2017. Available at: <https://publications.msss.gouv.qc.ca/msss/fichiers/2000/00-601.pdf>. Accessed August 1, 2022.
- Government of Quebec. Abortion services eligibility. Available at: <https://www.quebec.ca/en/health/health-system-and-services/service-organization/abortion-services/eligibility>. Accessed January 10, 2023.
- Kerns JL, Turk JK, Corbetta-Rastelli CM, Rosenstein MG, Caughey AB, Steinauer JE. Second-trimester abortion attitudes and practices among maternal-fetal medicine and family planning subspecialists. *BMC Womens Health* 2020;20:20.
- Renner RM, Ennis M, Contandriopoulos D, et al. Abortion services and providers in Canada in 2019: results of a national survey. *CMAJ Open* 2022;10:E856–64.
- Statistics Canada. Data quality, concepts and methodology: definitions. 2022. Available at: https://www.statcan.gc.ca/en/statistical-programs/document/3231_D5_T9_V1. Accessed May 26, 2023.
- Auger N, Bilodeau-Bertrand M, Tith RM, Arbour L. Bariatric surgery and the risk of congenital anomalies in subsequent

pregnancies. *Am J Clin Nutr* 2019;110:1168–74.

17. Sattolo ML, Arbour L, Bilodeau-Bertrand M, Lee GE, Nelson C, Auger N. Association of birth defects with child mortality before age 14 years. *JAMA Netw Open* 2022;5:e226739.

18. Ukah UV, Dayan N, Potter BJ, Paradis G, Ayoub A, Auger N. Severe maternal morbidity and long-term risk of cardiovascular hospitalization. *Circ Cardiovasc Qual Outcomes* 2022;15:e008393.

19. Tufa TH, Prager S, Lavelanet AF, Kim C. Drugs used to induce fetal demise prior to abortion: a systematic review. *Contracept X* 2020;2:100046.

20. Pampalon R, Hamel D, Gamache P, Simpson A, Philibert MD. Validation of a deprivation index for public health: a complex exercise illustrated by the Quebec index. *Chronic Dis Inj Can* 2014;34:12–22.

21. Borgatta L, Kapp N, Society of Family Planning. Clinical guidelines. Labor induction abortion in the second trimester. *Contraception* 2011;84:4–18.

22. Bryant AG, Grimes DA, Garrett JM, Stuart GS. Second-trimester abortion for fetal anomalies or fetal death: labor induction compared with dilation and evacuation. *Obstet Gynecol* 2011;117:788–92.

23. Costescu D, Guilbert É, No. 360-Induced abortion: surgical abortion and second trimester medical methods. *J Obstet Gynaecol Can* 2018;40:750–83.

24. Renner R, Ennis M, Guilbert E, Roy G, Barrett J. Second- and third-trimester medical abortion providers and services in 2019: results from the Canadian Abortion Provider Survey. *J Obstet Gynaecol Can* 2022;44:690–9.

25. Kim J, Nam JY, Park EC. Advanced maternal age and severe maternal morbidity in South Korea: a population-based cohort study. *Sci Rep* 2022;12:21358.

26. Duchaine G. Avortements tardifs. *La Presse*. 2020. Available at: <https://www.lapresse.ca/actualites/sante/2020-02-05/avortements-tardifs-des-services-desorganises-et-discriminatoires>. Accessed January 10, 2023.

Author and article information

From the Health Innovation and Evaluation Hub, University of Montreal Hospital Research Centre, Montreal, Canada (Dr Auger and Mses Brousseau and Ayoub); Department of Epidemiology, Biostatistics and Occupational Health, McGill University, Montreal, Canada (Dr Auger); Department of Social and Preventive Medicine, School of Public Health, University of Montreal, Montreal, Canada (Dr Auger); and Department of Obstetrics and Gynecology, Sherbrooke University Hospital Research Centre, Sherbrooke, Canada (Dr Fraser).

Received Sept. 5, 2023; revised Nov. 1, 2023; accepted Nov. 2, 2023.

The authors report no conflict of interest.

This study was funded by the Canadian Institutes of Health Research (PJT-162300) and the Fonds de recherche du Québec - Santé (296785). The funding sources had no involvement in the study design; the collection, analysis, or interpretation of data; the writing of the report; or the decision to submit the article for publication.

Corresponding author: Nathalie Auger, MD, MSc, FRCPC. nathalie.auger@umontreal.ca

SUPPLEMENTAL TABLE 1

Diagnostic and procedural codes for abortion and fetocidal injection

Exposure	International Classification of Diseases, 9th/10th revisions	Canadian Classification of Diagnostic, Therapeutic, and Surgical Procedures/Canadian Classification of Health Interventions
Abortion	635, 636, 637, 638, 639, 779.6 / 004, 005, 007, 008, P96.4	81.01, 81.61, 86.41, 86.42, 86.49, 87.0, 87.1, 87.21, 87.29 / 5.CA.20, 5.CA.24, 5.CA.88, 5.CA.89, 5.CA.90
Fetocidal injection		
Intracardiac/intrathoracic	-	5.CA.20, 5.CA.90.FK
Intraamniotic	-	87.0 / 5.CA.88.HA.A2, 5.CA.88.HA.D2, 5.CA.88.HA.G2, 5.CA.88.HA.I2, 5.CA.88.HA.M2, 5.CA.88.HA.Z9

Auger. Termination of pregnancy and live birth. Am J Obstet Gynecol 2024.

SUPPLEMENTAL TABLE 2

Type of care provided to neonates born alive following abortion

Timing	No. live births	Neonatal intensive care admission		Palliative care		Autopsy	
		No. (%)	Risk ratio (95% CI) ^a	No. (%)	Risk ratio (95% CI) ^a	No. (%)	Risk ratio (95% CI) ^a
Wk of gestation							
15–19	253	49 (19.4)	0.97 (0.56–1.67)	6 (2.4)	0.14 (0.05–0.39)	95 (37.6)	0.79 (0.57–1.09)
20–24	1227	316 (25.8)	1.23 (0.76–2.00)	68 (5.5)	0.34 (0.17–0.66)	584 (47.6)	1.04 (0.79–1.37)
25–29	61	13 (21.3)	Reference	10 (16.4)	Reference	28 (45.9)	Reference

CI, confidence interval.

^a Adjusted for maternal age, maternal comorbidity, socioeconomic disadvantage, place of residence, and time period.

Auger. Termination of pregnancy and live birth. Am J Obstet Gynecol 2024.