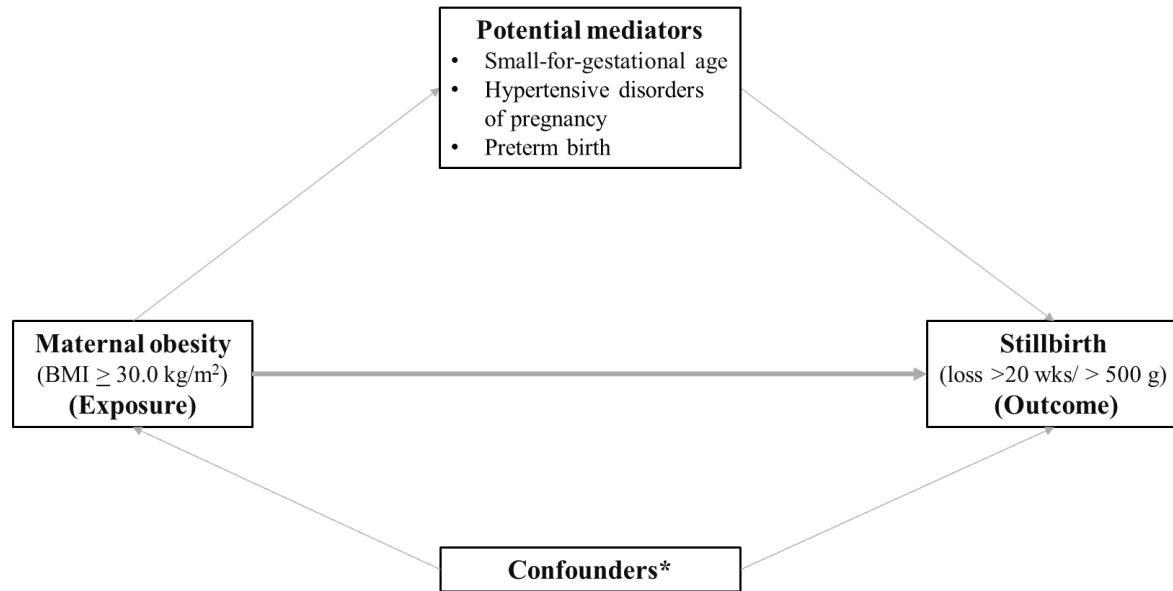


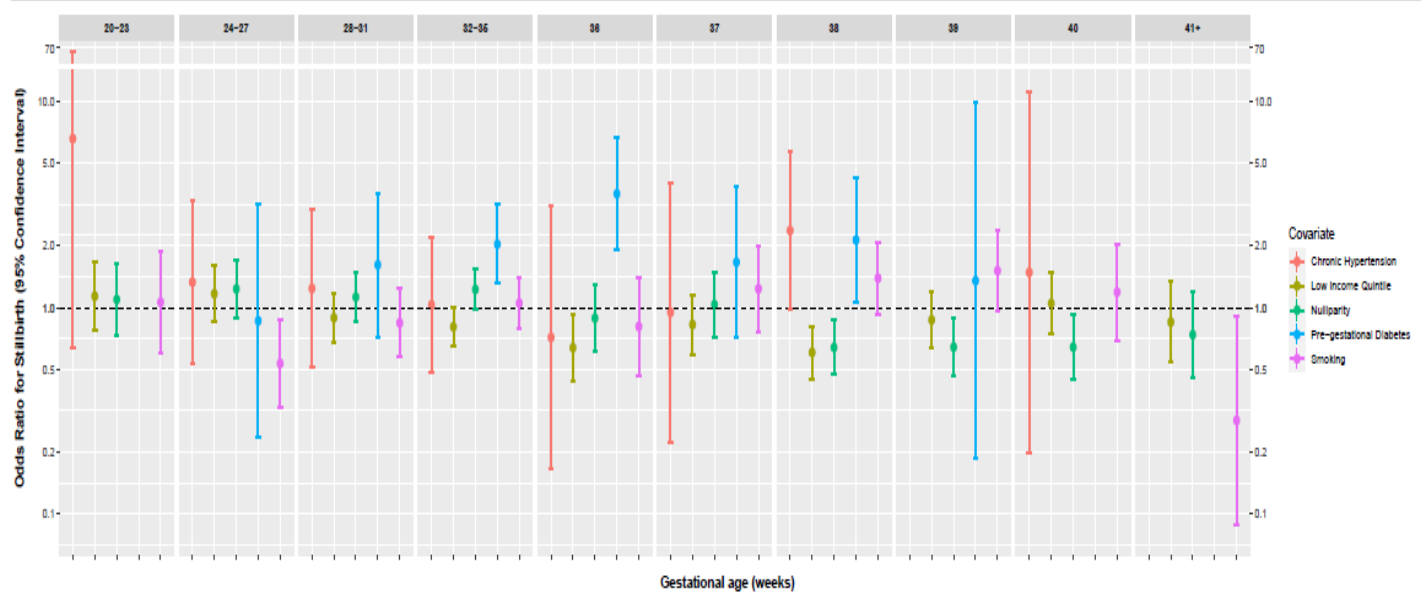
Supplemental Figures and Tables

Supplemental Figure 1. Causal pathways between obesity and stillbirth, with direct and indirect effects of potential mediators and confounders



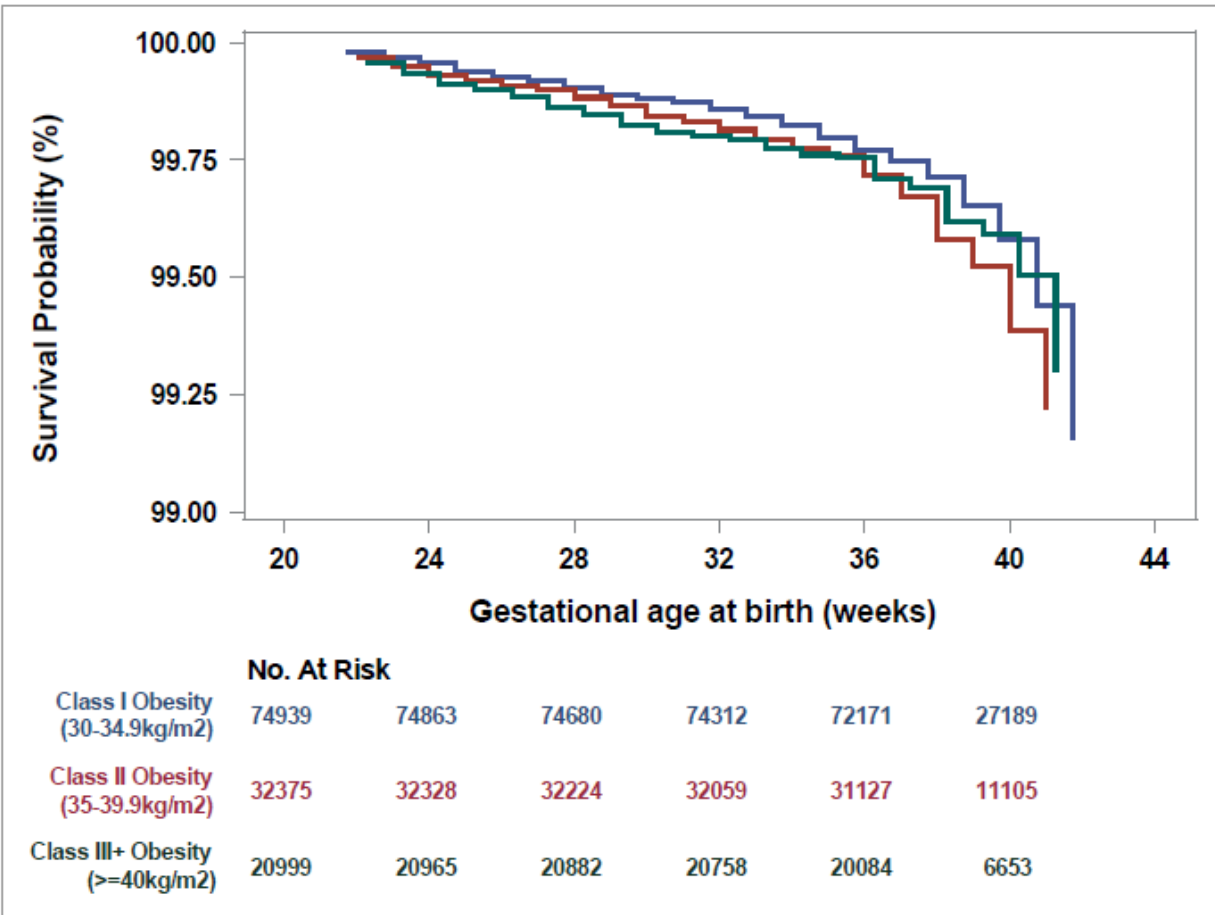
*Fully-adjusted model confounders: maternal age >35, nulliparity, smoking, low-income quintile, substance use, artificial reproductive technologies, chronic hypertension, pre-gestational diabetes, other pre-existing health conditions, previous stillbirth, previous Cesarean section, antenatal care, small for gestational age <10th centile, gestational diabetes, hypertensive disorders of pregnancy, placental abruption, congenital fetal anomalies. Partially-adjusted model confounders: maternal age >35, nulliparity, low-income quintile, artificial reproductive technologies, other pre-existing health conditions (not including chronic hypertension and pre-gestational diabetes), previous Cesarean section, antenatal care (representing population with additional/unknown HRFC). BMI: body mass index.

Supplemental Figure 2. Odds Ratios and 95% Confidence Intervals for Stillbirth by gestational age for select major pre-existing maternal risk factors, among singleton hospital births in Ontario, Canada, 2012-2018 (N = 681,178) (alternate depiction of Figure 4)



Data source: BIS data 2012/13-2017/18, restricted to births ≥ 500 g or 20+ completed weeks gestation; excluding intentional terminations. Note the change in gestational age interval between 32-35 and ≥ 36 weeks. This is based on the logistic regression model.

Supplemental Figure 3. Kaplan Meier curve of surviving fetuses following stillbirth by gestational age, stratified by obesity class



Data source: BIS data 2012/13-2017/18, restricted to births ≥ 500 g or 20+ completed weeks gestation; excluding intentional terminations

Supplemental Table 1a. Comparison of maternal baseline characteristics for the study cohort and the cohort with missing values among Singleton Hospital Births in Ontario, Canada, 2012-2018

Variable	Study cohort		Cohort with missing values		Standardized difference
	n=681,178		n=904,176		
	N (Mean)	% (SD)	N (Mean)	% (SD)	
<i>BMI, Mean (SD)</i>	(25.5)	(6.2)	(25.4)	(6.1)	0.02
Underweight (<18.5kg/m ²),	(17.4)	(1.0)	(17.4)	(1.0)	0.00
Normal Weight (18.5-24.9kg/m ²)	(21.9)	(1.8)	(21.9)	(1.8)	0.00
Overweight (25.0-29.9kg/m ²)	(27.2)	(1.4)	(27.2)	(1.4)	0.00
Class I Obesity (30-34.9kg/m ²)	(32.1)	(1.4)	(32.1)	(1.4)	0.00
Class II Obesity (35-39.9kg/m ²)	(37.1)	(1.4)	(37.1)	(1.4)	0.00
Class III+ Obesity (>=40kg/m ²)	(45.3)	(5.4)	(45.3)	(5.4)	0.00
<i>Maternal age, Mean (SD)</i>	(30.4)	(5.3)	(30.6)	(5.3)	0.04
<i>Parity</i>					
Nulliparous	294,429	43.2	386,430	42.7	0.01
Multiparous	386,749	56.8	507,567	56.1	0.01
Missing	-	-	10,179	1.1	-
<i>Smoker</i>					
Yes	69,983	10.3	87,868	9.7	0.02
No	611,195	89.7	784,433	86.8	0.09
Missing	-	-	31,875	3.5	-
<i>Income (quintiles)</i>					
1st (low)	122,004	17.9	197,257	21.8	0.10
2nd	138,184	20.3	154,274	17.1	0.08
3rd	152,230	22.3	162,793	18.0	0.11
4th	159,762	23.5	196,384	21.7	0.04
5th (high)	108,998	16.0	138,402	15.3	0.02
Missing	-	-	55,066	6.1	-
<i>Substance exposure</i>					
Yes	15,141	2.2	19,958	2.2	0.00
No	666,037	97.8	837,167	92.6	0.24
Missing	-	-	47,051	5.2	-
<i>Obstetrical history</i>					
Stillbirths	7,968	1.2	10,853	1.2	0.00
<i>Health conditions during pregnancy</i>					
Hypertensive disorders	34,658	5.1	43,682	4.8	0.01
Gestational diabetes	48,718	7.2	64,457	7.1	0.00

<i>Antenatal care</i>					
Family physician	69,070	10.1	95,412	10.6	0.01
Obstetrician	381,066	55.9	513,085	56.7	0.02
Family phys. + obs.	107,026	15.7	121,033	13.4	0.07
Midwife	110,113	16.2	120,115	13.3	0.08
None	1,981	0.29	3,915	0.43	0.02
Other	11,922	1.8	16,130	1.8	0.00
Missing	-	-	34,486	3.8	-
<i>Birth outcome</i>					
SGA (<3rd percentile)	18,774	2.8	25,830	2.9	0.01
SGA (<10th percentile)	64,618	9.5	88,034	9.7	0.01

Data source: BIS data 2012/13-2017/18, restricted to births ≥ 500 g or 20+ completed weeks gestation; excluding intentional terminations. SD: standard deviation, SGA: small for gestational age.

Standardized difference >0.10 suggests an imbalance between the cohorts.

Supplemental Table 1b. Number and percentage of missing demographic characteristic values, stratified by fiscal year among Singleton Hospital Births in Ontario, Canada, 2012-2018 (N = 904,176)

Variable	Fiscal Year*															
	Total		FY 12/13		FY 13/14		FY 14/15		FY 15/16		FY 16/17		FY 17/18**		Missing	
	n=904,176		n = 135,189		n = 133,220		n = 133,281		n = 133,445		n = 134,053		n = 234,950		n=38	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
BMI	105,270	11.6	26,112	19.3	18,807	14.1	16,695	12.5	13,451	10.1	9,606	7.2	20,599	8.8	<6	(S)
Maternal age	591	0.1	<6	(S)	-	-	<6	(S)	<6	(S)	140	0.1	451	0.2	0	-
Nulliparity	10,179	1.1	2,923	2.2	1,670	1.3	2,392	1.8	988	0.7	901	0.7	1,305	0.6	0	-
Smoking	31,872	3.5	2,062	1.5	3,246	2.4	10,346	7.8	7,387	5.5	4,611	3.4	4,220	1.8	<6	(S)
Income	55,061	6.1	5,270	3.9	5,900	4.4	6,378	4.8	7,655	5.7	9,269	6.9	20,589	8.8	<6	(S)
Substance use	47,048	5.2	12,652	9.4	7,712	5.8	7,055	5.3	7,555	5.7	5,394	4.0	6,680	2.8	<6	(S)
Antenatal care provider	34,483	3.8	1,391	1.0	1,091	0.8	5,667	4.3	6,888	5.2	6,897	5.1	12,549	5.3	<6	(S)

Data source: BIS data 2012/13-2017/18, restricted to births ≥ 500 g or 20+ completed weeks gestation; excluding intentional terminations. BMI: body mass index.

*Fiscal year (FY) includes births from April 1, 2012 to March 31, 2018. **Included births until December 31, 2018

Supplemental Table 2. Mediation analysis of both the partially-adjusted and fully-adjusted models for major potential mediators (total, direct and indirect effects) among singleton hospital births in Ontario, Canada, 2012-2018

	SGA3	SGA10	Preterm birth	Hypertensive disorders
Partially-Adjusted Model‡				
Overall obesity vs. Normal weight				
Total Effects	1.66 (1.42, 1.94)	1.66 (1.42, 1.94)	1.65 (1.42, 1.93)	1.66 (1.41, 1.94)
Direct Effects	1.77 (1.64, 1.92)	1.86 (1.72, 2.02)	1.48 (1.37, 1.60)	1.62 (1.49, 1.76)
Indirect Effects	0.94 (0.87, 1.01)	0.89 (0.83, 0.96)	1.12 (1.04, 1.20)	1.02 (0.95, 1.11)
Proportion of the total effect mediated	-13%	-22%	21%	5%
Class I Obesity vs. Normal weight				
Total Effects	1.47 (1.23, 1.76)	1.48 (1.23, 1.77)	1.46 (1.22, 1.76)	1.47 (1.22, 1.77)
Direct Effects	1.56 (1.42, 1.72)	1.62 (1.47, 1.79)	1.33 (1.21, 1.48)	1.43 (1.30, 1.58)
Indirect Effects	0.94 (0.87, 1.02)	0.91 (0.84, 0.99)	1.09 (1.01, 1.19)	1.02 (0.94, 1.12)
Proportion of the total effect mediated	-15%	-24%	24%	6%
Class II Obesity vs. Normal weight				
Total Effects	2.02 (1.64, 2.49)	2.02 (1.64, 2.51)	2.03 (1.65, 2.50)	2.02 (1.63, 2.52)
Direct Effects	2.15 (1.91, 2.43)	2.28 (2.02, 2.58)	1.80 (1.59, 2.03)	1.95 (1.72, 2.21)
Indirect Effects	0.93 (0.86, 1.02)	0.89 (0.81, 0.97)	1.13 (1.03, 1.23)	1.04 (0.94, 1.14)
Proportion of the total effect mediated	-9%	-16%	16%	5%
Class III Obesity vs. Normal weight				
Total Effects	1.77 (1.38, 2.27)	1.81 (1.41, 2.33)	1.73 (1.35, 2.22)	1.79 (1.37, 2.33)
Direct Effects	1.89 (1.61, 2.21)	2.07 (1.77, 2.43)	1.46 (1.25, 1.71)	1.71 (1.45, 2.01)
Indirect Effects	0.94 (0.86, 1.01)	0.87 (0.80, 0.96)	1.19 (1.08, 1.30)	1.05 (0.95, 1.16)
Proportion of the total effect mediated	-11%	-22%	31%	8%
Fully-Adjusted Model†				
Overall obesity vs. Normal weight				
Total Effects	1.62 (1.39, 1.90)	1.63 (1.39, 1.90)	1.61 (1.38, 1.88)	1.61 (1.38, 1.90)
Direct Effects	1.74 (1.60, 1.89)	1.82 (1.68, 1.98)	1.52 (1.41, 1.65)	1.60 (1.48, 1.74)
Indirect Effects	0.93 (0.87, 1.01)	0.89 (0.83, 0.96)	1.06 (0.98, 1.14)	1.01 (0.93, 1.09)

Proportion of the total effect mediated	-14%	-24%	12%	1%
Class I Obesity vs. Normal weight				
Total Effects	1.45 (1.20, 1.74)	1.45 (1.21, 1.74)	1.44 (1.20, 1.72)	1.44 (1.20, 1.74)
Direct Effects	1.54 (1.39, 1.70)	1.60 (1.44, 1.77)	1.37 (1.24, 1.52)	1.43 (1.29, 1.58)
Indirect Effects	0.94 (0.86, 1.02)	0.91 (0.84, 0.99)	1.05 (0.96, 1.14)	1.01 (0.93, 1.10)
Proportion of the total effect mediated	-17%	-26%	12%	3%
Class II Obesity vs. Normal weight				
Total Effects	1.96 (1.58, 2.42)	1.97 (1.59, 2.44)	1.95 (1.58, 2.40)	1.96 (1.57, 2.44)
Direct Effects	2.09 (1.85, 2.37)	2.21 (1.95, 2.51)	1.86 (1.64, 2.10)	1.92 (1.69, 2.18)
Indirect Effects	0.93 (0.86, 1.02)	0.89 (0.81, 0.97)	1.05 (0.96, 1.14)	1.02 (0.93, 1.12)
Proportion of the total effect mediated	-10%	-17%	7%	3%
Class III Obesity vs. Normal weight				
Total Effects	1.73 (1.33, 2.23)	1.77 (1.36, 2.30)	1.66 (1.28, 2.14)	1.70 (1.30, 2.22)
Direct Effects	1.85 (1.57, 2.19)	2.03 (1.71, 2.41)	1.56 (1.32, 1.84)	1.66 (1.40, 1.97)
Indirect Effects	0.93 (0.85, 1.02)	0.87 (0.80, 0.96)	1.06 (0.97, 1.16)	1.02 (0.93, 1.13)
Proportion of the total effect mediated	-13%	-24%	12%	4%

Data source: BIS data 2012/13-2017/18, restricted to births ≥ 500 g or 20+ completed weeks gestation; excluding intentional terminations. SGA3: small for gestation < 3rd centile; SGA10 = small for gestation < 10th centile.

Mediation analyses were carried out based on methods proposed by Lange T, Vansteelandt S, Bekaert M. A simple unified approach for estimating natural direct and indirect effects. *American Journal of Epidemiology*. 2012;176(3):190-195. R programs created by Rochon J, du Bois A, Lange T. Mediation analysis of the relationship between institutional research activity and patient survival. *BMC Med Res Methodol*. 2014;14(9). <https://doi.org/10.1186/1471-2288-14-9>.

‡Partially-adjusted for maternal age > 35, nulliparity, low-income quintile, artificial reproductive technologies, other pre-existing health conditions (not including chronic hypertension nor pre-gestational diabetes), previous Cesarean section, antenatal care.

†Fully-adjusted for maternal age > 35, nulliparity, smoking, low-income quintile, substance use, artificial reproductive technologies, chronic hypertension, pre-gestational diabetes, other pre-existing health conditions, previous stillbirth, previous Cesarean section, antenatal care, gestational diabetes, placental abruption, and congenital fetal anomalies.

Supplemental Table 3: Fully-Adjusted and Partially-Adjusted Hazard Ratios for Stillbirth by BMI category among Singleton Hospital Births in Ontario, Canada, 2012-2018 (N = 681,178)

Obesity Class	Fully-Adjusted† Hazard Ratio	95% Confidence Interval	Partially-Adjusted‡ Hazard Ratio	95% Confidence Interval
Reference: Normal	--	--	--	--
Underweight	0.96	(0.78-1.18)	1.06	(0.87-1.31)
Overweight	1.21	(1.08-1.35)	1.15	(1.03-1.28)
Class I Obesity	1.55	(1.35-1.78)	1.46	(1.27-1.67)
Class II Obesity	2.17	(1.83-2.57)	2.01	(1.70-2.38)
Class III Obesity	1.80	(1.44-2.24)	1.74	(1.40-2.16)

Data source: BIS data 2012/13-2017/18, restricted to births ≥ 500 g or 20+ completed weeks gestation; excluding intentional terminations. This is based on the Cox regression model.

†Fully-adjusted model is adjusted for maternal age > 35, nulliparity, smoking, low income quintile, substance use, artificial reproductive technologies, chronic hypertension, pre-gestational diabetes, other pre-existing health conditions, previous stillbirth, previous Cesarean section, antenatal care, small for gestational age <10th centile, gestational diabetes, hypertensive disorders of pregnancy, placental abruption, congenital fetal anomalies.

‡Partially-adjusted model is adjusted for maternal age > 35, nulliparity, low income quintile, artificial reproductive technologies, other pre-existing health conditions (not including chronic hypertension and pre-gestational diabetes), previous Cesarean section, antenatal care (representing population with additional / undiagnosed HRFC).