The effect of changing screening practices and demographics on the incidence of gestational diabetes in British Columbia, Canada from 2005-2019

Supplemental material

Appendix 1, as submitted by the authors. Appendix to: Nethery E, Law MR, Kotaska A, et al. The effect of changing screening practices and demographics on the incidence of gestational diabetes in British Columbia, 2005–2019. *CMAJ* 2023. doi: 10.1503/cmaj.221404.

Supplemental Methods and Results

Adjustment for two-step methods (before and after October 2010) – Sensitivity analysis

Methods

In British Columbia, prior to October 2010 (1), the "two-step" method of screening included a 1-hour-50g glucose challenge screening test, followed by a 3-hour-100g oral glucose tolerance test diagnostic test using Carpenter-Coustan criteria. After October 2010, the "two-step" method continued to use a 1-hour-50g but the diagnostic test used a 2-hour-75g test with the Diabetes Canada 2013 criteria (2). These two screening approaches are similar, but will result in a slightly different diagnostic threshold. In the primary analysis, all two-step screening was analyzed as the same screening approach. In sensitivity analysis, we used an additional variable to control for the differences between the two-step methods (before and after October 2010).

Results

Overall results were unchanged and the additional variable was not statistically significant in models, thus we considered all two-step screening as the same approach for the main analysis (Supplemental Figure 4).

Missing pre-pregnancy body mass index: Imputation of missing data – Sensitivity analysis

Methods

Approximately 30 % of the study population had missing data for pre-pregnancy body mass index (BMI) (Table 1). Our primary analysis categorized pre-pregnancy BMI and included missing data as a separate category for the regression models. To assess the effect of missingness in our models we also imputed missing BMI data for the study population using a multiple imputation with chained equations (3) for 20 data sets (4). We considered all available covariates and the primary outcome (with an absolute correlation with the response/ imputed variable > 0.05) as predictors for imputation. We repeated our sequential regression models among imputed data sets to obtain pooled effect estimates.

Results

Using pooled effect estimates with imputed data for pre-pregnancy BMI, model estimates comparing 2019 to 2005 were essentially unchanged from the primary analysis. Only model (4) incorporated BMI data; all other models were unaffected by missing data. Results from model (4) (adjustment for trends in population characteristics with imputed pre-pregnancy BMI data) comparing 2019 to 2005 found a 1.23-fold increase, 95% CI 1.15 to 1.32 in gestational diabetes risk. This is highly comparable to the primary analytic models (1.25-fold increase, 95% CI 1.2 to 1.3 (Table 1)).

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Supplemental Table 1. Risk estimates with additional population characteristics and risk factors

	Final model results (Model 4 from Table 1)		**Add rural**		**Add neighbourhood income per person quintiles**		**Add prior macrosomia**		**Add ≥2 prior cesarean deliveries**	
Estimated Year	RR	CI	RR	CI	RR	CI	RR	CI	RR	CI
2005	Baseline		Baseline		Baseline		Baseline			
2006	0.96	0.91 to 1.01	0.96	0.91 to 1.01	0.96	0.91 to 1.01	0.96	0.91 to 1.01	0.96	0.91 to 1.01
2007	1.04	0.99 to 1.09	1.04	0.98 to 1.09	1.04	0.98 to 1.09	1.04	0.98 to 1.09	1.04	0.98 to 1.09
2008	1.04	0.99 to 1.09	1.04	0.99 to 1.09	1.04	0.98 to 1.09	1.04	0.99 to 1.09	1.04	0.99 to 1.09
2009	1.09	1.03 to 1.14	1.09	1.03 to 1.14	1.08	1.03 to 1.14	1.09	1.03 to 1.14	1.09	1.03 to 1.14
2010	1.02	0.97 to 1.07	1.02	0.97 to 1.07	1.02	0.97 to 1.07	1.02	0.97 to 1.07	1.02	0.97 to 1.07
2011	1.02	0.97 to 1.07	1.02	0.97 to 1.07	1.02	0.97 to 1.07	1.02	0.97 to 1.07	1.02	0.97 to 1.07
2012	0.98	0.93 to 1.03	0.98	0.93 to 1.03	0.97	0.93 to 1.02	0.98	0.94 to 1.03	0.98	0.93 to 1.03
2013	1.04	0.99 to 1.09	1.04	0.99 to 1.10	1.04	0.99 to 1.09	1.05	1.00 to 1.10	1.04	0.99 to 1.09
2014	1.01	0.96 to 1.06	1.01	0.97 to 1.06	1.01	0.96 to 1.06	1.02	0.97 to 1.07	1.01	0.96 to 1.06
2015	1.13	1.07 to 1.18	1.13	1.08 to 1.18	1.13	1.08 to 1.18	1.13	1.08 to 1.19	1.13	1.07 to 1.18
2016	1.16	1.11 to 1.22	1.16	1.11 to 1.22	1.16	1.11 to 1.22	1.17	1.12 to 1.22	1.16	1.11 to 1.22
2017	1.19	1.13 to 1.24	1.19	1.14 to 1.25	1.19	1.13 to 1.24	1.20	1.14 to 1.25	1.19	1.13 to 1.24
2018	1.17	1.11 to 1.22	1.17	1.12 to 1.22	1.17	1.11 to 1.22	1.17	1.12 to 1.23	1.16	1.11 to 1.22
2019	1.25	1.19 to 1.31	1.25	1.20 to 1.31	1.25	1.20 to 1.31	1.26	1.20 to 1.32	1.25	1.19 to 1.31

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Supplemental Table 2. Population characteristics by gestational diabetes diagnosis in British Columbia, Canada (2005-2019)

Characteristic	Overall N = 551,457	No gestational diabetes diagnosed N = 495,175	Gestational diabetes diagnosed N = 56, 282
Nulliparous	254,588 (46%)	230,370 (47%)	24,218 (43%)
Pre-pregnancy body mass index (kg/m^2)			
<24.9	265,155 (48%)	244,370 (49%)	20,785 (37%)
25.0-29.9	87,533 (16%)	76,192 (15%)	11,341 (20%)
30.0-34.9	34,047 (6%)	28,060 (6%)	5,987 (11%)
>35.0	20,765 (4%)	15,970 (3%)	4,795 (9%)
Missing data	143,957 (26%)	130,583 (26%)	13,374 (24%)
Age of birthing person/mother (years)			
less than 25	73,118 (13%)	70,291 (14%)	2,827 (5%)
25-34	342,918 (62%)	310,705 (63%)	32,213 (57%)
35+	135,421 (25%)	114,179 (23%)	21,242 (38%)
Multifetal pregnancy (v singleton)	8,488 (2%)	7,247 (1%)	1,241 (2%)
Medical/obstetric complications (composite)[b]	39,945 (7%)	34,053 (7%)	5,892 (10%)
Mother's region of birth (infant birth certificate)			
All other regions	373,582 (68%)	346,355 (70%)	27,227 (49%)
Asia	127,945 (23%)	103,821 (21%)	24,124 (43%)
Canada or USA (or missing (<0.5%))	47,701 (9%)	42,943 (9%)	4,758 (8%)
Registered Midwife (v other health care provider)	87,951 (16%)	82,120 (17%)	5,831 (10%)
Inadequate prenatal care (APNCU index)	35,524 (6%)	32,485 (7%)	3,039 (5%)
Neighbourhood income per person			
lowest income quintile	116,961 (21%)	103,426 (21%)	13,535 (24%)
mid-low income quintile	115,957 (21%)	102,396 (21%)	13,561 (24%)
middle income quintile	112,081 (20%)	100,630 (20%)	11,451 (20%)
mid-high income quintile	112,230 (20%)	101,960 (21%)	10,270 (18%)
highest income quintile	86,984 (16%)	80,149 (16%)	6,835 (12%)
missing	7,244 (1%)	6,614 (1%)	630 (1%)
Rural or urban local health area			
Urban	533,929 (97%)	478,568 (97%)	55,361 (98%)
Rural	17,528 (3%)	16,607 (3%)	921 (2%)
Year (July-June)			
2005	33,341 (6%)	30,940 (6%)	2,401 (4%)
2006	34,284 (6%)	31,918 (6%)	2,366 (4%)
2007	35,955 (7%)	33,256 (7%)	2,699 (5%)
2008	36,496 (7%)	33,704 (7%)	2,792 (5%)
2009	37,703 (7%)	34,674 (7%)	3,029 (5%)
2010	38,115 (7%)	35,224 (7%)	2,891 (5%)
2011	38,153 (7%)	34,653 (7%)	3,500 (6%)
2012	37,158 (7%)	33,316 (7%)	3,842 (7%)
2013	37,263 (7%)	32,978 (7%)	4,285 (8%)
2014	36,927 (7%)	32,917 (7%)	4,010 (7%)
2015	37,089 (7%)	32,668 (7%)	4,421 (8%)
2016	37,606 (7%)	32,895 (7%)	4,711 (8%)
2017	37,670 (7%)	32,639 (7%)	5,031 (9%)
2018	37,280 (7%)	32,313 (7%)	4,967 (9%)
2019	36,417 (7%)	31,080 (6%)	5,337 (9%)
Gestational diabetes screen completion (v. unscreened)	500,619 (91%)	445,255 (90%)	55,364 (98%)
Screening method			

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Characteristic	Overall N = 551,457	No gestational diabetes diagnosed N = 495,175	Gestational diabetes diagnosed N = 56, 282
Two-step	368,178 (67%)	336,723 (68%)	31,455 (56%)
One-step (IADPSG(6) criteria)	132,441 (24%)	108,532 (22%)	23,909 (42%)
Unscreened	50,838 (9%)	49,920 (10%)	918 (2%)
Prior history of GDM			
no	254,034 (46%)	229,879 (46%)	24,155 (43%)
no prior pregnancy in data	281,459 (51%)	258,152 (52%)	23,307 (41%)
yes	15,964 (3%)	7,144 (1%)	8,820 (16%)

a. Gestational diabetes defined from the gestational diabetes diagnosis variable in the BC-PDR (99.9% of cases)(9) with additional cases identified from the discharge summary of the delivery hospitalization data by ICD-10-CA codes (O24.8 – comparable to O24.4 in ICD-10-CM) (47, <0.1% additional cases)
b. Medical/obstetric complications composite(7) based ICD-10-CA codes in the discharge summary of the delivery hospitalization and the BC-PDR. Codes included pregnancy-complicating pre-existing diseases or conditions (O991, O994, O99803/04/09, O266, O981, O984 to 9, O360, O361), pre-existing hypertension (O100 to 4, O109) and from BC-PDR data: prior neonatal anomaly, stillbirth or neonatal death (direct coded variables)

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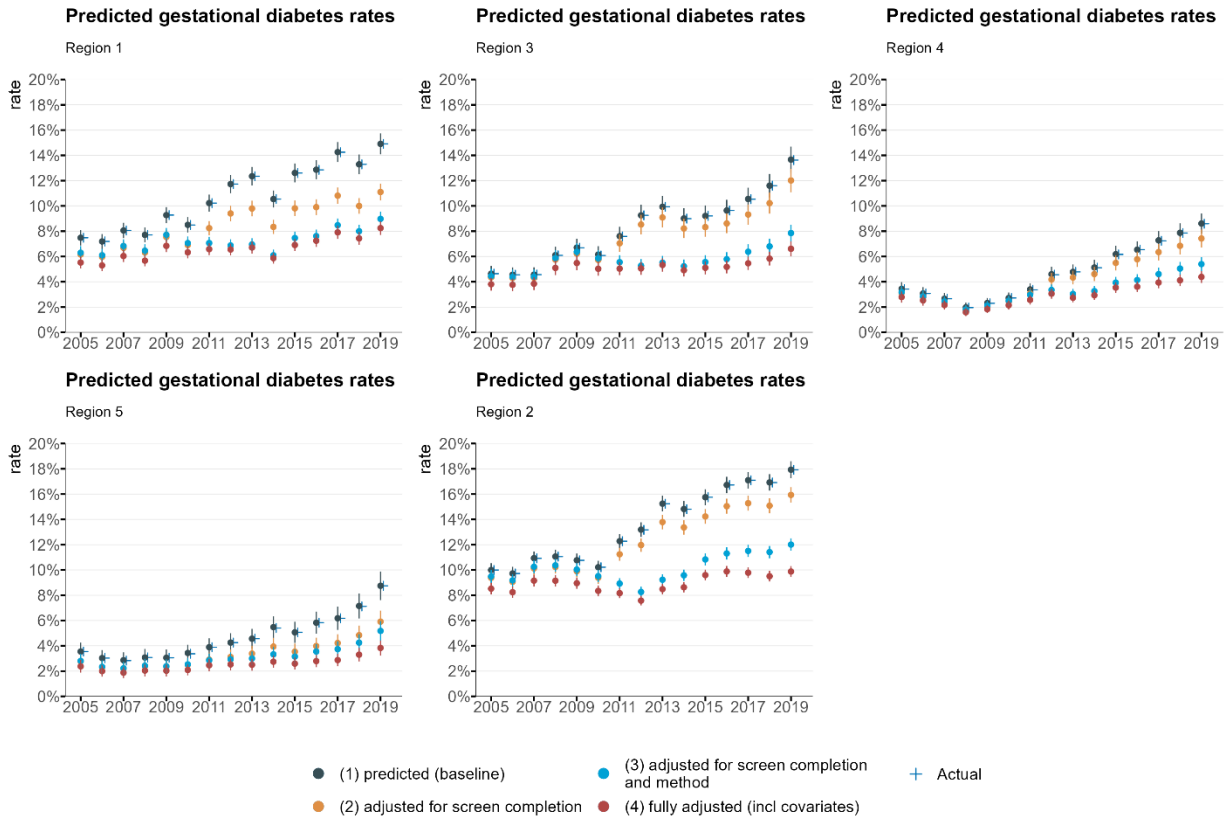
Supplemental Figure 1. Gestational diabetes risk models stratified by health region



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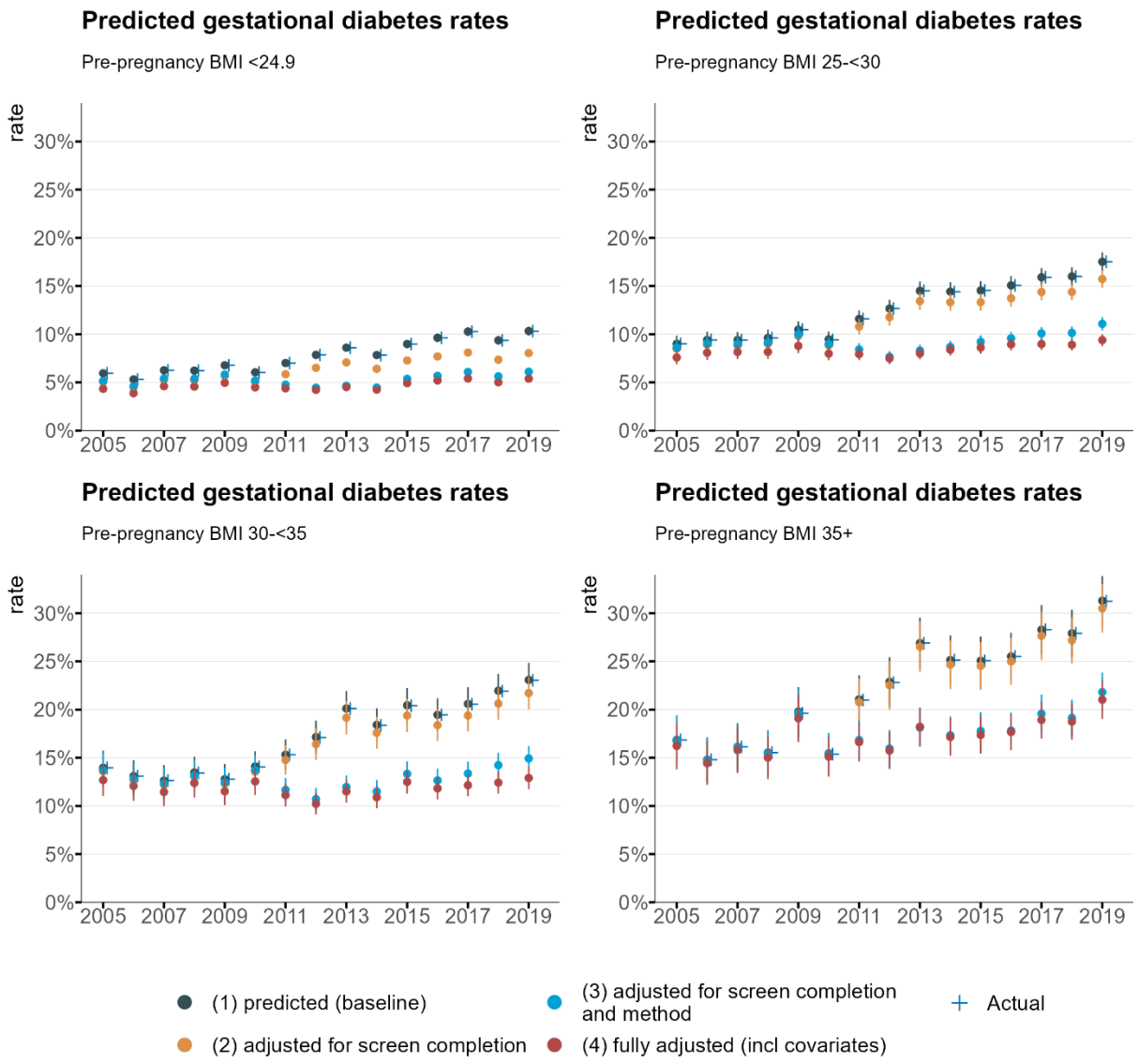
Supplemental Figure 2. Gestational diabetes risk models stratified by pre-pregnancy body mass index



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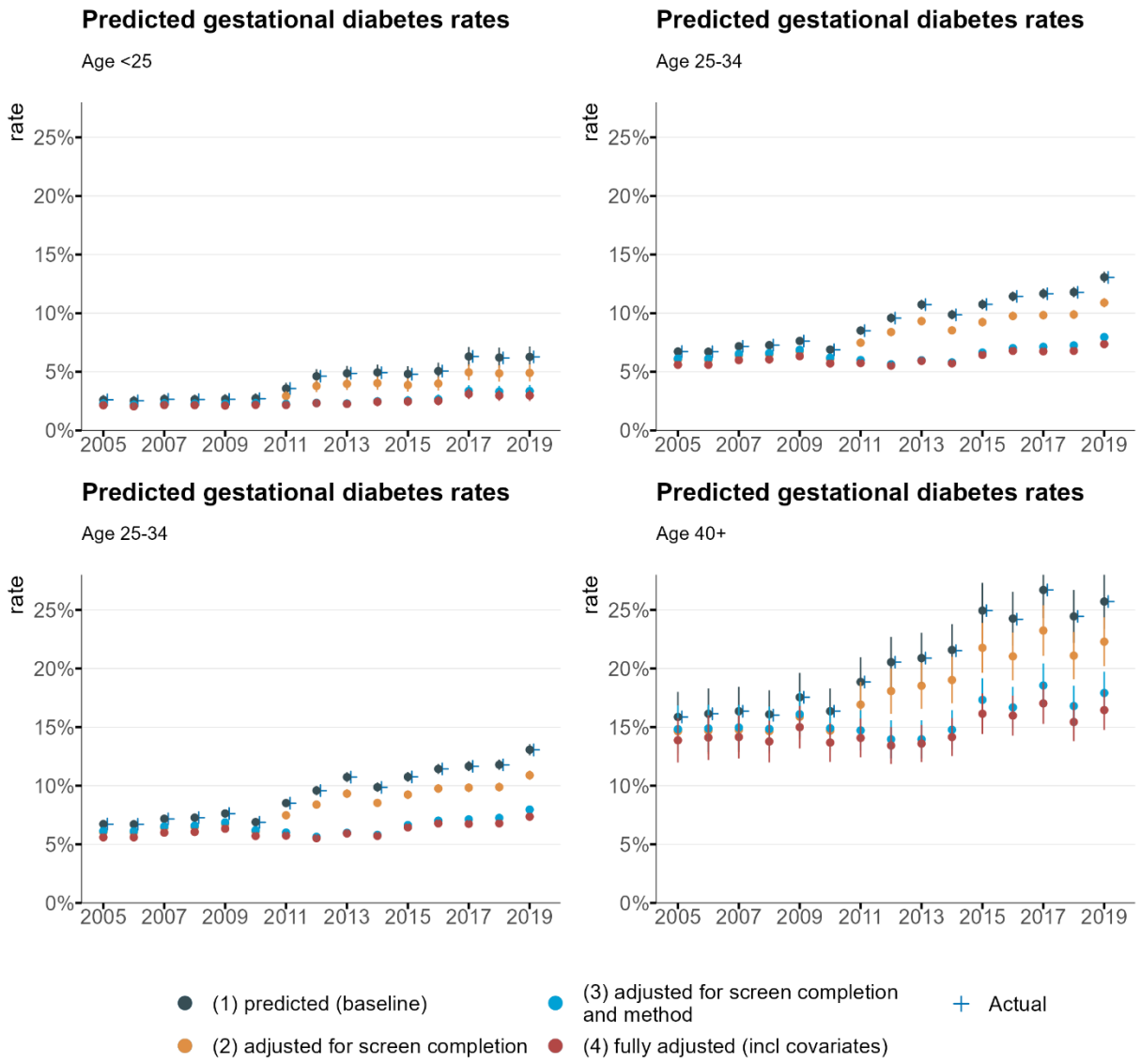
Supplemental Figure 3. Gestational diabetes risk models stratified by age of birthing person at delivery



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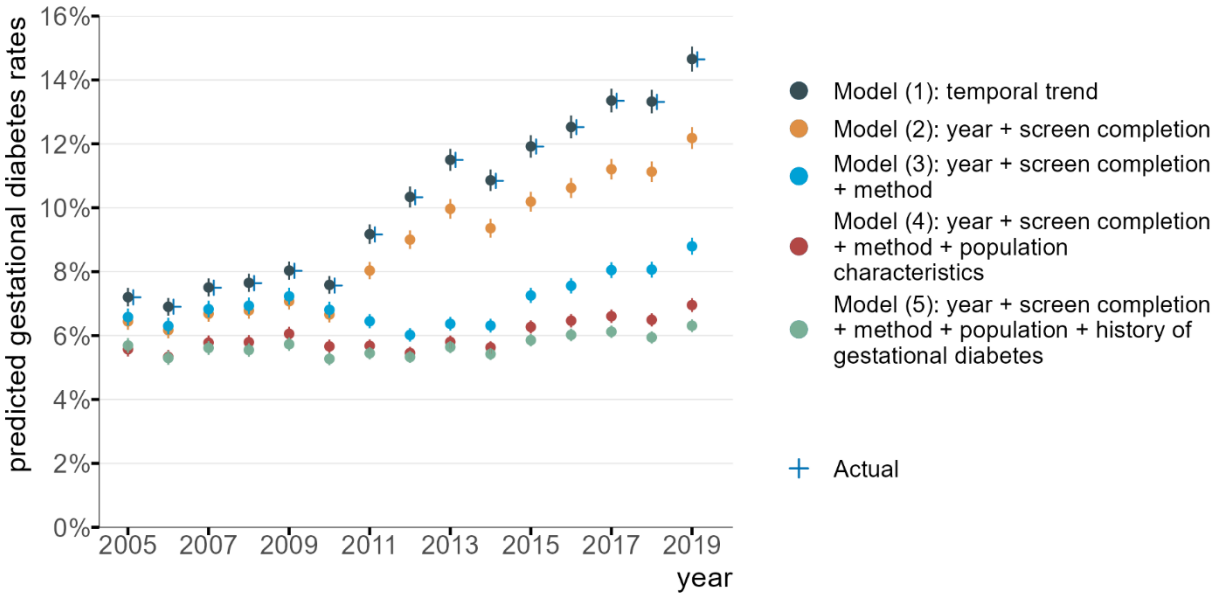
Supplemental Figure 4. Gestational diabetes risk modeled with addition of prior history of gestational diabetes (sensitivity analysis)



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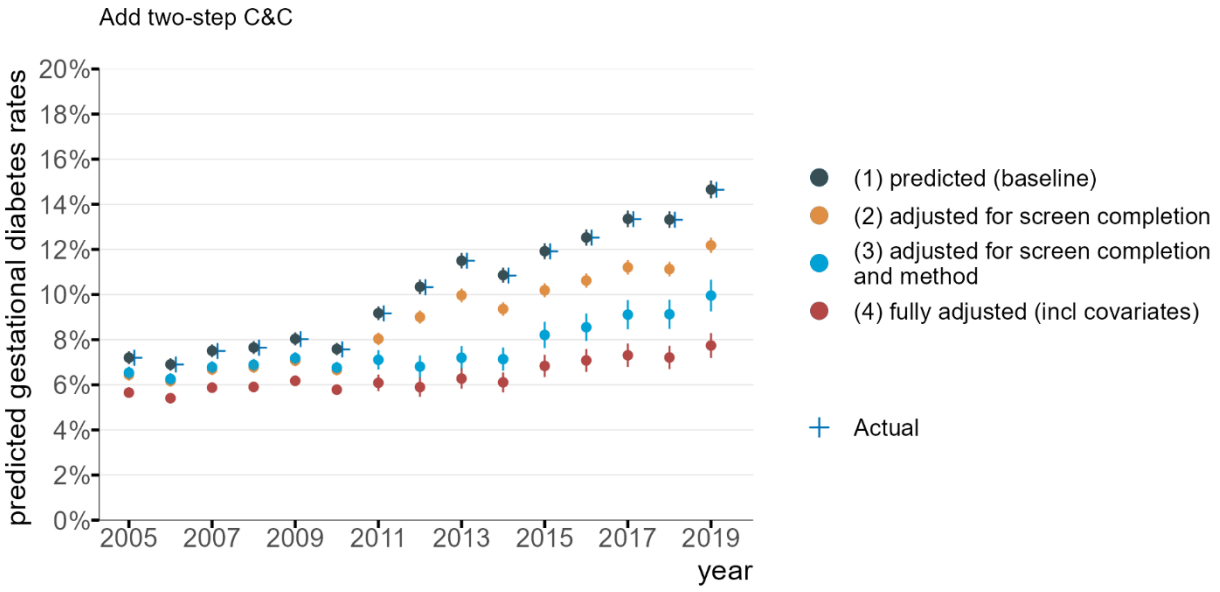
Supplemental Figure 5. Gestational diabetes risk modeled with a variable to adjust for the change in two-step screening from using a 3-hour-100g test with Carpenter-Coustan criteria (prior to October 2010) to using the 2-hour-75g test for two-step screening (Diabetes Canada criteria)



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