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Supplementary appendix

This appendix formed part of the original submission and has been peer reviewed. We post it as supplied by the authors.

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Supplementary material

Information about variables used in sensitivity analyses.

Data on the mode of delivery, induction of labour, gestational diabetes, pregnancy-induced hypertension (PIH) or pre-eclampsia, birth weight were obtained directly from the medical record using the facility worksheet. Small for gestational age was defined as birthweights below the 10th percentile for babies of the same gestational age.

Table S1. The rate of pre-pregnancy BMI categories according to maternal characteristics: the National Vital Statistics System 2016-2017 (N=7,141,630)

Variables	Sample size	BMI categories					
		<18·5	18·5-24·9	25-29·9	30-34·9	35-39·9	≥40
Overall, n (%)	7141630	252685 (3·5)	3189165 (44·7)	1874668 (26·2)	1017698 (14·3)	482914 (6·8)	324500 (4·5)
Age, years, n (%)							
<20	384699	28301 (7·36)	197036 (51·22)	89347 (23·23)	43067 (11·19)	17787 (4·62)	9161 (2·38)
20-24·9	1465686	73756 (5·03)	635925 (43·39)	368918 (25·17)	214044 (14·60)	104104 (7·10)	68939 (4·70)
25-29·9	2099891	70841 (3·37)	905581 (43·13)	552649 (26·32)	309975 (14·76)	153388 (7·30)	107457 (5·12)
30-34·9	2003581	53700 (2·68)	925653 (46·20)	532406 (26·57)	275631 (13·76)	128544 (6·42)	87647 (4·37)
35-39·9	977659	22006 (2·25)	436203 (44·62)	269919 (27·61)	142019 (14·53)	64818 (6·63)	42694 (4·37)
≥40	210114	4081 (1·94)	88767 (42·25)	61429 (29·24)	32962 (15·69)	14273 (6·79)	8602 (4·09)
Race/ethnicity, n (%)							
Hispanic	1692126	44855 (2·65)	650956 (38·47)	511782 (30·24)	288936 (17·08)	123728 (7·31)	71869 (4·25)
Non-Hispanic White	3723040	129001 (3·46)	1792361 (48·14)	923433 (24·80)	480309 (12·90)	237436 (6·38)	160500 (4·31)
Non-Hispanic Black	981654	32426 (3·30)	340359 (34·67)	266745 (27·17)	174593 (17·79)	92637 (9·44)	74894 (7·63)
Other	744810	46403 (6·23)	405489 (54·44)	172708 (23·19)	73860 (9·92)	29113 (3·91)	17237 (2·31)
Education levels, n (%)							
Lower than high school	954384	43536 (4·56)	386870 (40·54)	267941 (28·07)	150177 (15·74)	65209 (6·83)	40651 (4·26)
High school	1791583	73496 (4·10)	711091 (39·69)	470555 (26·26)	288071 (16·08)	145205 (8·10)	103165 (5·76)
Higher than high school	4315516	132434 (3·07)	2054126 (47·60)	1114338 (25·82)	568412 (13·17)	268148 (6·21)	178058 (4·13)

Missing	80147	3219 (4.02)	37078 (46.26)	21834 (27.24)	11038 (13.77)	4352 (5.43)	2626 (3.28)
Marital status, n (%)							
Yes	4036400	123445 (3.06)	1914338 (47.43)	1056465 (26.17)	534291 (13.24)	247963 (6.14)	159898 (3.96)
No	2669954	113400 (4.25)	1078195 (40.38)	700779 (26.25)	420915 (15.76)	208018 (7.79)	148647 (5.57)
Missing	435276	15840 (3.64)	196632 (45.17)	117424 (26.98)	62492 (14.36)	26933 (6.19)	15955 (3.67)
Smoking during pregnancy, n (%)							
Yes	497527	29935 (6.02)	205624 (41.33)	119673 (24.05)	74703 (15.01)	39349 (7.91)	28243 (5.68)
No	6616141	221618 (3.35)	2971861 (44.92)	1747581 (26.41)	938762 (14.19)	441513 (6.67)	294806 (4.46)
Missing	27962	1132 (4.05)	11680 (41.77)	7414 (26.51)	4233 (15.14)	2052 (7.34)	1451 (5.19)
Parity, n (%)							
1	2757355	121578 (4.41)	1359507 (49.30)	678888 (24.62)	335503 (12.17)	156774 (5.69)	105105 (3.81)
2	2292577	76099 (3.32)	1024714 (44.70)	604965 (26.39)	325747 (14.21)	155895 (6.80)	105157 (4.59)
3	1205538	33525 (2.78)	487219 (40.42)	335201 (27.81)	194556 (16.14)	92355 (7.66)	62682 (5.20)
≥4	868564	20837 (2.40)	309980 (35.69)	251020 (28.90)	159326 (18.34)	76685 (8.83)	50716 (5.84)
Missing	17596	646 (3.67)	7745 (44.02)	4594 (26.11)	2566 (14.58)	1205 (6.85)	840 (4.77)
Preterm birth ^a , n (%)							
Overall	527637	23804 (4.51)	217098 (41.15)	133593 (25.32)	80838 (15.32)	41462 (7.86)	30842 (5.85)
Extremely preterm birth	25031	968 (3.87)	8948 (35.75)	6279 (25.08)	4503 (17.99)	2490 (9.95)	1843 (7.36)
Very preterm birth	43690	2016 (4.61)	17152 (39.26)	10915 (24.98)	7052 (16.14)	3783 (8.66)	2772 (6.34)
Moderately preterm birth	458916	20820 (4.54)	190998 (41.62)	116399 (25.36)	69283 (15.10)	35189 (7.67)	26227 (5.71)
Initiation of prenatal care, n (%)							

1st to 3rd month	5399926	180678 (3·35)	2432460 (45·05)	1410552 (26·12)	763592 (14·14)	365861 (6·78)	246783 (4·57)
4th to 6th month	1162737	46575 (4·01)	501107 (43·10)	309626 (26·63)	171718 (14·77)	80013 (6·88)	53698 (4·62)
7th to final month	319100	13188 (4·13)	135895 (42·59)	87213 (27·33)	47609 (14·92)	21284 (6·67)	13911 (4·36)
No prenatal care	103625	5316 (5·13)	47668 (46·00)	27014 (26·07)	13872 (13·39)	6010 (5·80)	3745 (3·61)
Missing	156242	6928 (4·43)	72035 (46·10)	40263 (25·77)	20907 (13·38)	9746 (6·24)	6363 (4·07)
Previous preterm birth							
Yes	212163	7900 (3·72)	83518 (39·37)	56476 (26·62)	34690 (16·35)	17281 (8·15)	12298 (5·80)
No	4169248	123098 (2·95)	1744855 (41·85)	1138563 (27·31)	647083 (15·52)	608664 (7·40)	206985 (4·96)
Nulliparous	2755067	121484 (4·41)	1358442 (49·31)	678328 (24·62)	335199 (12·17)	156613 (5·68)	105001 (3·81)
Missing	5152	203 (3·94)	2350 (45·61)	1301 (25·25)	726 (14·09)	356 (6·91)	216 (4·19)

BMI, body mass index;

^a extremely preterm birth: <28 gestational weeks; very preterm birth: 28-37 gestational weeks; moderately preterm birth 32-37 gestational weeks

Table S2. The associations between pre-pregnancy BMI and subtype of preterm birth: NVSS 2016-2017

Variables	Moderately preterm birth	Very preterm birth	Extremely preterm birth
Underweight	1.33 (1.31-1.35) ^a	1.38 (1.32-1.45)	1.24 (1.16-1.32)
Normal weight	1.00 (ref)	1.00 (ref)	1.00 (ref)
Overweight	1.01 (1.00-1.02)	1.05 (1.03-1.08)	1.15 (1.12-1.19)
Obese	1.15 (1.14-1.16)	1.31 (1.28-1.34)	1.61 (1.56-1.66)
Obesity I	1.10 (1.09-1.11)	1.23 (1.19-1.26)	1.49 (1.44-1.55)
Obesity II	1.17 (1.16-1.19)	1.38 (1.33-1.43)	1.72 (1.64-1.79)
Obesity III	1.30 (1.28-1.32)	1.47 (1.41-1.53)	1.82 (1.73-1.91)

^a OR; 95% CI in parentheses (all such values)

Maternal age, race/ethnicity, parity, education levels, smoking during pregnancy, previous history of preterm birth, marital status, infant sex, and initiation of prenatal care were adjusted in models.

Table S3. Crude ORs of the associations between pre-pregnancy BMI and preterm birth: NVSS 2016-2017

Variables	Underweight		Normal weight		Overweight		Obese		Categories of obesity					
	Cases/ participants	Crude OR (95% CI)	Cases/ participan ts	Crude OR (95% CI)	Cases/ participan ts	Crude OR (95% CI)	Cases/ participan ts	Crude OR (95% CI)	Obesity I		Obesity II		Obesity III	
									Cases/ participan ts	Crude OR (95% CI)	Cases/ participan ts	Crude OR (95% CI)	Cases/ participan ts	Crude OR (95% CI)
Overall	23804/ 252685	1.42 (1.40- 1.44)	217098/ 3189165	1.00 (ref)	133593/ 1874668	1.05 (1.04- 1.06)	153142/ 1825112	1.25 (1.25- 1.26)	80838/ 1017698	1.18 (1.17- 1.19)	41462/ 482914	1.29 (1.27- 1.30)	30842/ 324500	1.44 (1.42- 1.46)
Age group ^b														
< 20 years	3234/ 28301	1.31 (1.26- 1.36)	17660/ 197036	1.00 (ref)	6903/ 89347	0.85 (0.83- 0.88)	5676/ 70015	0.90 (0.87- 0.92)	3464/ 43067	0.89 (0.86- 0.92)	1407/ 17787	0.87 (0.82- 0.92)	805/ 9161	0.98 (0.91- 1.05)
20-24 years	7771/ 73756	1.43 (1.40- 1.47)	48269/ 635925	1.00 (ref)	26075/ 368918	0.93 (0.91- 0.94)	29001/ 387087	0.99 (0.97- 1.001)	15448/ 214044	0.95 (0.93- 0.97)	7870/ 104104	1.00 (0.97- 1.02)	5683/ 68939	1.09 (1.06- 1.13)
25-29 years	6215/ 70841	1.40 (1.37- 1.44)	58130/ 905581	1.00 (ref)	36213/ 552649	1.02 (1.01- 1.04)	44424/ 570820	1.23 (1.22- 1.25)	22697/ 309975	1.15 (1.13- 1.17)	12212/ 153388	1.26 (1.24- 1.29)	9515/ 107457	1.42 (1.39- 1.45)
30-34 years	4261/ 53700	1.35 (1.31- 1.40)	55426/ 925653	1.00 (ref)	36280/ 532406	1.15 (1.13- 1.16)	41886/ 491822	1.46 (1.44- 1.48)	21992/ 275631	1.36 (1.34- 1.38)	11235/ 128544	1.50 (1.47- 1.54)	8659/ 87647	1.72 (1.68- 1.76)
35-39 years	1929/ 22006	1.32 (1.26- 1.38)	29670/ 436203	1.00 (ref)	21747/ 269919	1.20 (1.18- 1.22)	25186/ 249531	1.54 (1.51- 1.57)	13357/ 142019	1.42 (1.39- 1.45)	6875/ 64818	1.63 (1.58- 1.67)	4954/ 42694	1.80 (1.74- 1.86)
≥ 40 years	394/ 4081	1.09 (0.98- 1.21)	7943/ 88767	1.00 (ref)	6375/ 61429	1.18 (1.14- 1.22)	6969/ 55837	1.45 (1.40- 1.50)	3880/ 32962	1.36 (1.30- 1.41)	1863/ 14273	1.53 (1.45- 1.61)	1226/ 8602	1.69 (1.58- 1.80)
Race/ ethnicity ^c														
Hispanic	4109/ 44855	1.34 (1.29- 1.38)	45625/ 650956	1.00 (ref)	37245/ 511782	1.04 (1.03- 1.06)	40632/ 484533	1.21 (1.20- 1.23)	23126/ 288936	1.15 (1.14- 1.17)	10706/ 123728	1.26 (1.23- 1.29)	6800/ 71869	1.39 (1.35- 1.43)
non-Hispanic white	12044/ 129001	1.59 (1.56- 1.62)	108900/ 1792361	1.00 (ref)	57646/ 923433	1.03 (1.02- 1.04)	65988/ 878245	1.26 (1.24- 1.27)	33710/ 480309	1.17 (1.15- 1.18)	18176/ 237436	1.28 (1.26- 1.30)	14102/ 160500	1.49 (1.46- 1.52)
non-Hispanic black	4480/ 32426	1.35 (1.31- 1.40)	36102/ 340359	1.00 (ref)	25797/ 266745	0.90 (0.89- 0.92)	57646/ 923433	0.995 (0.98- 1.01)	17735/ 174593	0.95 (0.94- 0.97)	10045/ 92637	1.03 (1.00- 1.05)	8350/ 74894	1.06 (1.03- 1.09)
Other	3171/ 46403	1.05 (1.01- 1.09)	26471/ 405489	1.00 (ref)	12905/ 172708	1.16 (1.13- 1.18)	12044/ 129001	1.36 (1.32- 1.39)	6267/ 73860	1.33 (1.29- 1.37)	2535/ 29113	1.37 (1.31- 1.43)	1590/ 17237	1.46 (1.38- 1.54)

Table S4. Sensitivity analysis for the associations between pre-pregnancy BMI and preterm birth: NVSS 2016-2017

Participants	Underweight	Normal weight	Overweight	Obese	Categories of obesity		
					Obesity I	Obesity II	Obesity III
Overall	1.33 (1.31-1.35) ^a	1.00 (ref)	1.02 (1.01-1.03)	1.18 (1.18-1.19)	1.12 (1.11-1.13)	1.21 (1.20-1.23)	1.34 (1.32-1.35)
Excluding women with Caesarean section	1.34 (1.31-1.36)	1.00 (ref)	1.01 (0.996-1.02)	1.13 (1.12-1.14)	1.08 (1.07-1.10)	1.16 (1.14-1.18)	1.29 (1.27-1.32)
Excluding women with induction of labour	1.32 (1.30-1.34)	1.00 (ref)	1.04 (1.03-1.05)	1.23 (1.22-1.24)	1.16 (1.15-1.17)	1.27 (1.25-1.28)	1.42 (1.40-1.44)
Excluding women with PIH or pre-eclampsia	1.36 (1.34-1.38)	1.00 (ref)	0.98 (0.97-0.99)	1.07 (1.06-1.07)	1.03 (1.02-1.04)	1.08 (1.07-1.09)	1.15 (1.13-1.17)
Excluding women with gestational diabetes	1.33 (1.31-1.35)	1.00 (ref)	1.01 (0.998-1.01)	1.14 (1.13-1.15)	1.09 (1.08-1.10)	1.16 (1.14-1.17)	1.26 (1.24-1.28)
Excluding women with SGA	1.34 (1.32-1.37)	1.00 (ref)	1.01 (1.004-1.02)	1.17 (1.16-1.18)	1.11 (1.10-1.12)	1.20 (1.19-1.22)	1.33 (1.31-1.35)
Excluding women Caesarean section, induction of labour, PIH or pre-eclampsia, gestational diabetes, or SGA	1.35 (1.32-1.38)	1.00 (ref)	1.00 (0.99-1.02)	1.12 (1.11-1.14)	1.08 (1.06-1.10)	1.14 (1.11-1.17)	1.31 (1.28-1.35)

^a OR; 95% CI in parentheses (all such values)

Maternal age, race/ethnicity, parity, education levels, smoking during pregnancy, previous history of preterm birth, marital status, infant sex, and initiation of prenatal care were adjusted in models.

PIH indicates pregnancy-induced hypertension

Table S5. The associations between pre-pregnancy BMI and preterm birth after excluding participant with incomplete covariate data

Variables	Underweight	Normal weight	Overweight	Obese	Categories of obesity		
					Obesity I	Obesity II	Obesity III
Overall	1.34 (1.32-1.36) ^a	1.00 (ref)	1.02 (1.01-1.03)	1.18 (1.17-1.19)	1.12 (1.11-1.13)	1.21 (1.19-1.22)	1.33 (1.31-1.35)
Age group ^b							
< 20 years	1.33 (1.27-1.38)	1.00 (ref)	0.85 (0.82-0.88)	0.89 (0.86-0.92)	0.88 (0.85-0.92)	0.86 (0.81-0.91)	0.96 (0.89-1.04)
20-24 years	1.39 (1.36-1.44)	1.00 (ref)	0.93 (0.91-0.94)	0.98 (0.96-0.99)	0.94 (0.92-0.96)	0.99 (0.96-1.01)	1.07 (1.04-1.10)
25-29 years	1.31 (1.28-1.35)	1.00 (ref)	1.00 (0.99-1.01)	1.16 (1.15-1.18)	1.10 (1.08-1.12)	1.19 (1.16-1.22)	1.31 (1.27-1.34)
30-34 years	1.27 (1.23-1.32)	1.00 (ref)	1.09 (1.07-1.11)	1.32 (1.30-1.34)	1.24 (1.22-1.26)	1.35 (1.32-1.38)	1.51 (1.48-1.55)
35-39 years	1.21 (1.15-1.28)	1.00 (ref)	1.13 (1.11-1.15)	1.37 (1.35-1.40)	1.28 (1.25-1.31)	1.45 (1.40-1.49)	1.56 (1.51-1.62)
≥ 40 years	1.00 (0.88-1.12)	1.00 (ref)	1.14 (1.09-1.18)	1.37 (1.31-1.42)	1.28 (1.23-1.34)	1.44 (1.35-1.52)	1.56 (1.46-1.67)
Race/ ethnicity ^c							
Hispanic	1.34 (1.30-1.39)	1.00 (ref)	1.03 (1.02-1.05)	1.20 (1.18-1.21)	1.13 (1.11-1.15)	1.24 (1.21-1.27)	1.37 (1.33-1.41)
non-Hispanic white	1.42 (1.39-1.45)	1.00 (ref)	1.03 (1.01-1.04)	1.24 (1.22-1.25)	1.15 (1.14-1.17)	1.26 (1.24-1.28)	1.45 (1.43-1.48)
non-Hispanic black	1.34 (1.29-1.39)	1.00 (ref)	0.91 (0.89-0.93)	0.99 (0.97-1.01)	0.95 (0.93-0.97)	1.02 (0.99-1.04)	1.05 (1.02-1.08)
Others	1.06 (1.01-1.10)	1.00 (ref)	1.11 (1.08-1.13)	1.23 (1.19-1.26)	1.22 (1.18-1.26)	1.23 (1.17-1.29)	1.28 (1.21-1.36)

^a OR; 95% CI in parentheses (all such values)

Maternal age, race/ethnicity, parity, education levels, smoking during pregnancy, previous history of preterm birth, marital status, infant sex, and initiation of prenatal care were adjusted in models.

^b Maternal age was not included in this model.

^c Race/ethnicity was not included in this model.

Table S6. The associations between pre-pregnancy BMI and preterm birth after additional adjustment for gestational weight gain

Variables	Underweight	Normal weight	Overweight	Obese	Categories of obesity		
					Obesity I	Obesity II	Obesity III
Overall	1.36 (1.32-1.36)	1.00 (ref)	1.00 (0.99-1.00)	1.12 (1.11-1.12)	1.07 (1.06-1.08)	1.14 (1.12-1.15)	1.23 (1.22-1.25)
Age group ^b							
< 20 years	1.34 (1.28-1.39)	1.00 (ref)	0.82 (0.80-0.85)	0.81 (0.78-0.83)	0.82 (0.79-0.85)	0.77 (0.72-0.81)	0.82 (0.76-0.88)
20-24 years	1.41 (1.38-1.45)	1.00 (ref)	0.92 (0.89-0.92)	0.91 (0.89-0.92)	0.89 (0.87-0.91)	0.90 (0.88-0.93)	0.96 (0.93-0.99)
25-29 years	1.32 (1.28-1.35)	1.00 (ref)	0.98 (0.97-0.99)	1.09 (1.08-1.11)	1.05 (1.03-1.07)	1.10 (1.09-1.13)	1.21 (1.18-1.23)
30-34 years	1.26 (1.22-1.30)	1.00 (ref)	1.07 (1.06-1.09)	1.26 (1.25-1.28)	1.20 (1.18-1.23)	1.29 (1.26-1.32)	1.43 (1.39-1.47)
35-39 years	1.23 (1.18-1.30)	1.00 (ref)	1.12 (1.10-1.14)	1.35 (1.33-1.38)	1.27 (1.24-1.30)	1.43 (1.39-1.48)	1.54 (1.48-1.59)
≥ 40 years	1.01 (0.91-1.13)	1.00 (ref)	1.13 (1.09-1.17)	1.36 (1.31-1.41)	1.29 (1.23-1.34)	1.43 (1.35-1.51)	1.56 (1.45-1.67)
Race/ ethnicity ^c							
Hispanic	1.34 (1.29-1.38)	1.00 (ref)	1.01 (0.999-1.03)	1.16 (1.14-1.17)	1.11 (1.09-1.13)	1.19 (1.17-1.22)	1.31 (1.27-1.35)
non-Hispanic white	1.43 (1.40-1.46)	1.00 (ref)	1.00 (0.99-1.01)	1.14 (1.13-1.15)	1.08 (1.07-1.10)	1.15 (1.13-1.17)	1.30 (1.28-1.33)
non-Hispanic black	1.34 (1.30-1.39)	1.00 (ref)	0.89 (0.87-0.91)	0.94 (0.93-0.96)	0.91 (0.90-0.93)	0.96 (0.94-0.98)	0.98 (0.96-1.01)
Other	1.08 (1.04-1.12)	1.00 (ref)	1.09 (1.07-1.12)	1.20 (1.17-1.23)	1.19 (1.16-1.23)	1.19 (1.14-1.24)	1.23 (1.16-1.30)

^a OR; 95% CI in parentheses (all such values)

Maternal age, race/ethnicity, parity, education levels, smoking during pregnancy, previous history of preterm birth, marital status, infant sex, initiation of prenatal care, and weight gain (kg/week) were adjusted in models.

^b Maternal age was not included in this model.

^c Race/ethnicity was not included in this model.

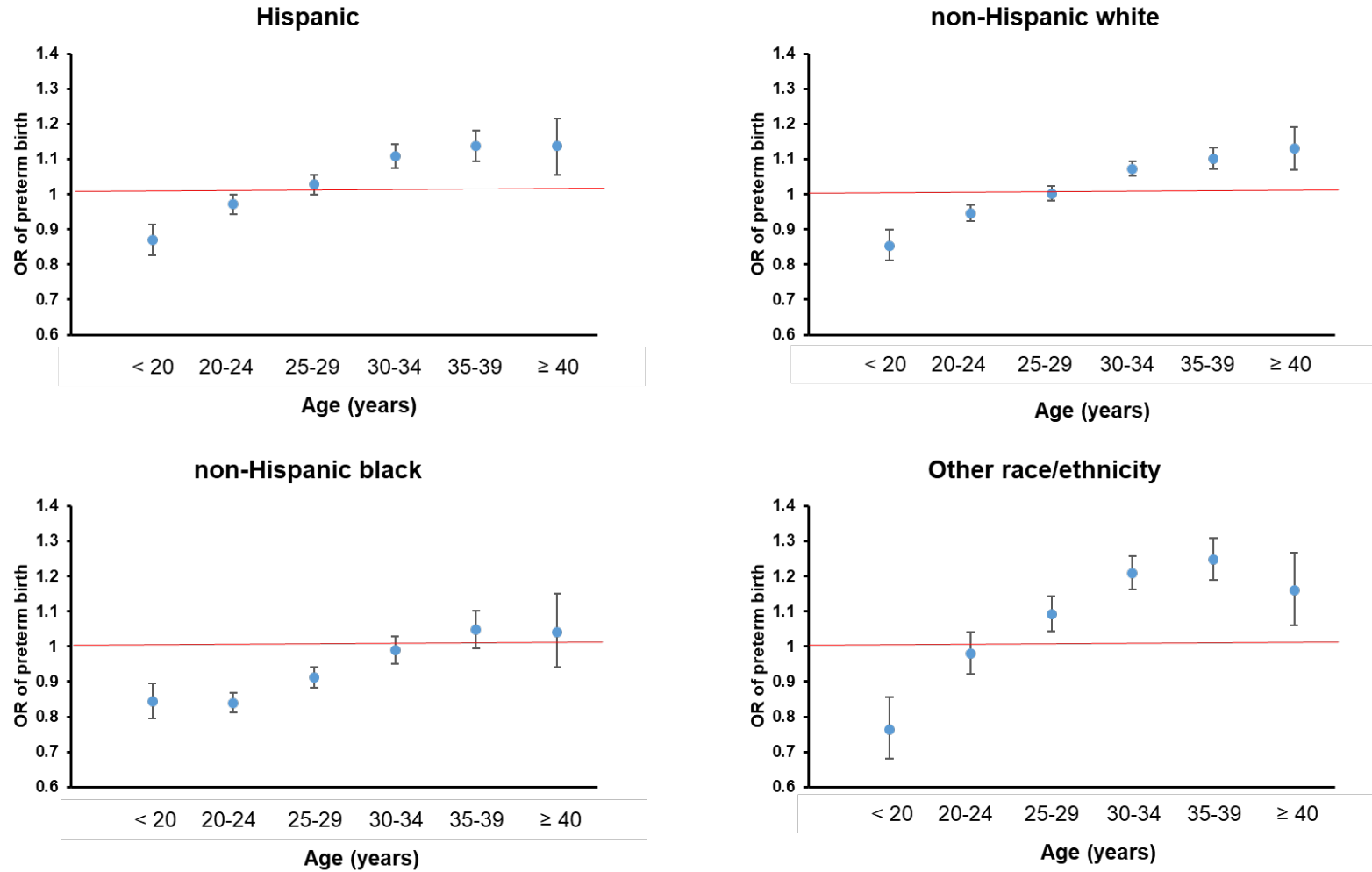


Figure S1. The associations between pre-pregnancy overweight and risk of preterm birth in each age*race/ethnicity subgroup: NVSS 2016-2017

Parity, education levels, smoking during pregnancy, previous history of preterm birth, marital status, infant sex, material status, and initiation of prenatal care were adjusted in models.

Women with normal weight was the reference group.

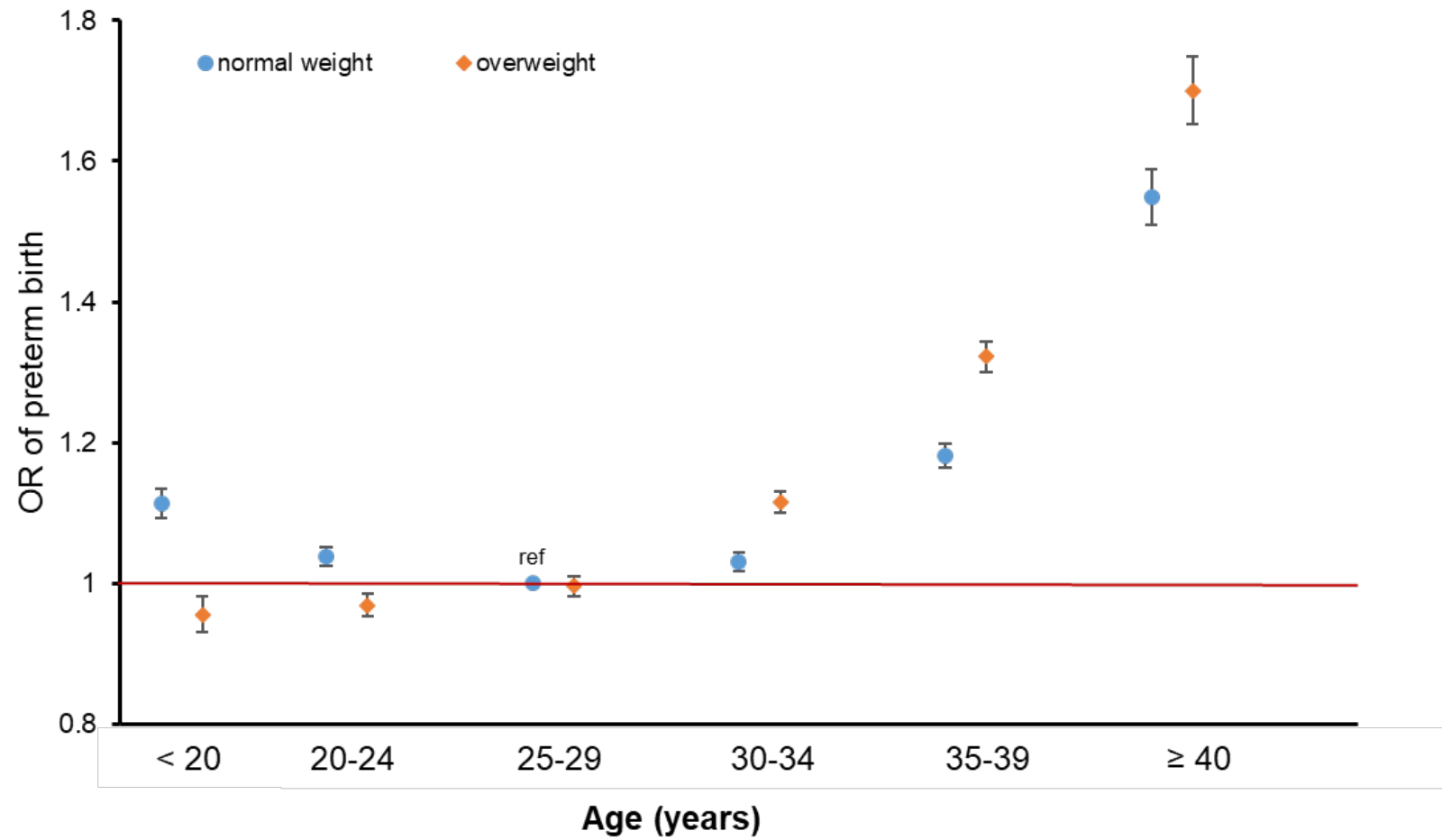


Figure S2. OR of preterm birth for women at different age and overweight compared with normal weight women aged 25-29 years old: NVSS 2016-2017

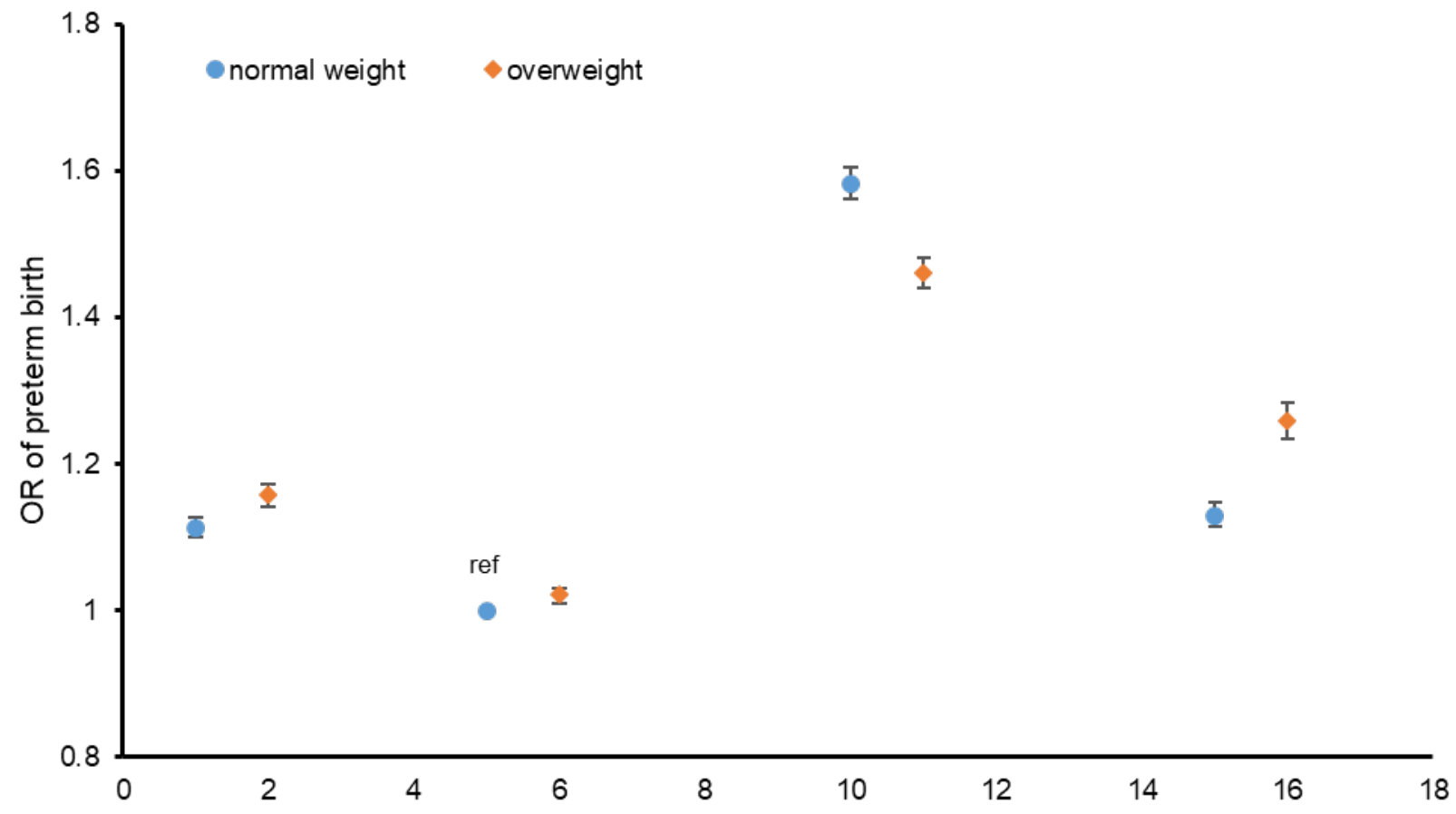
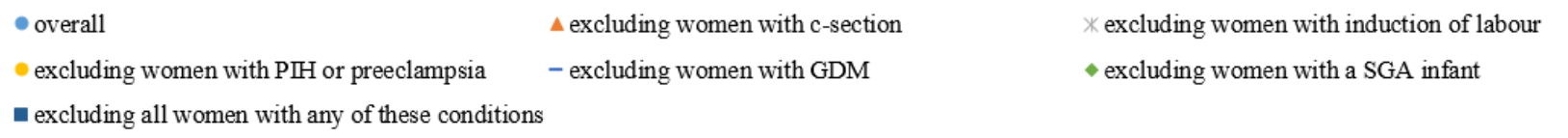
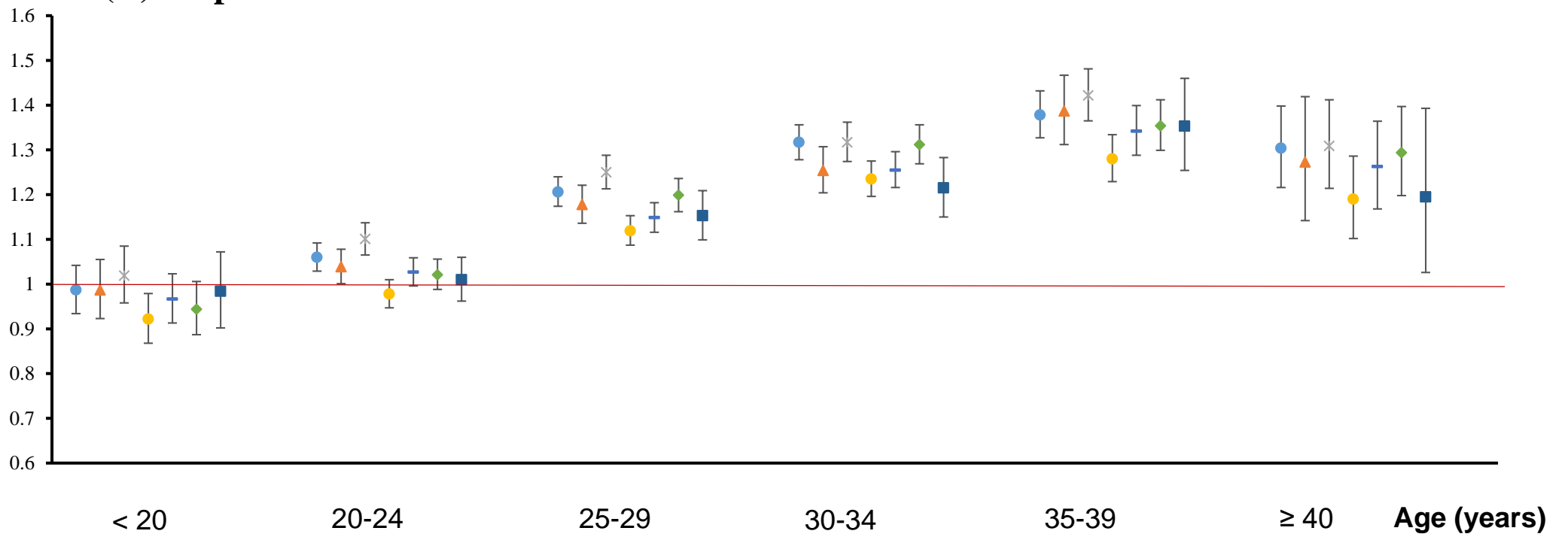


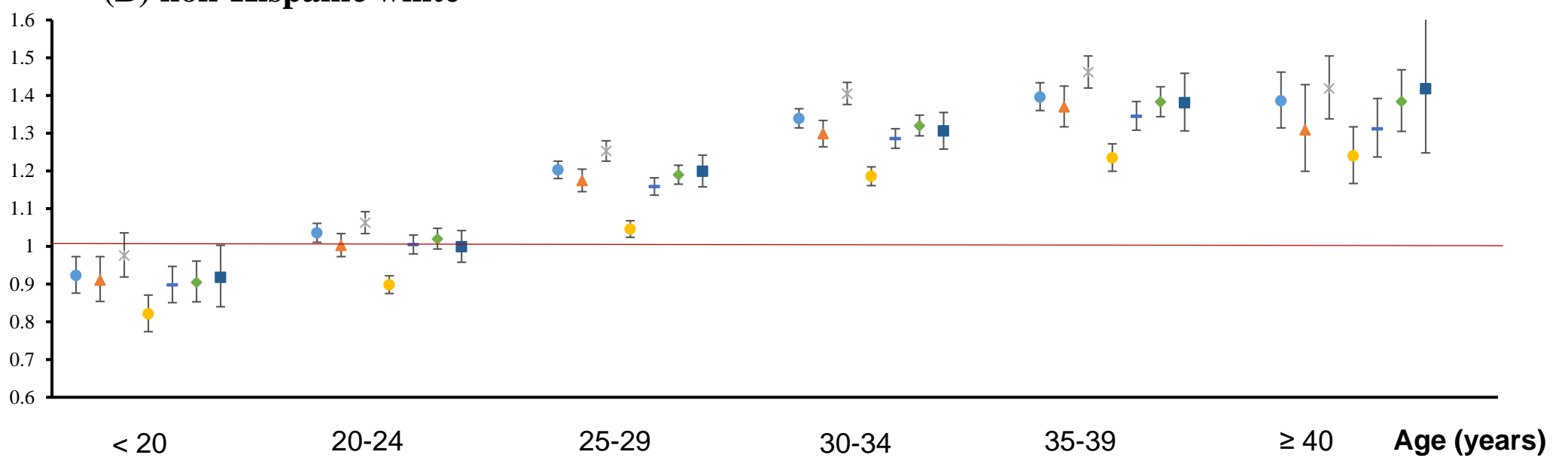
Figure S3. OR of preterm birth for women at different race/ethnicity and overweight compared with non-Hispanic whites with normal weight: NVSS 2016-2017.



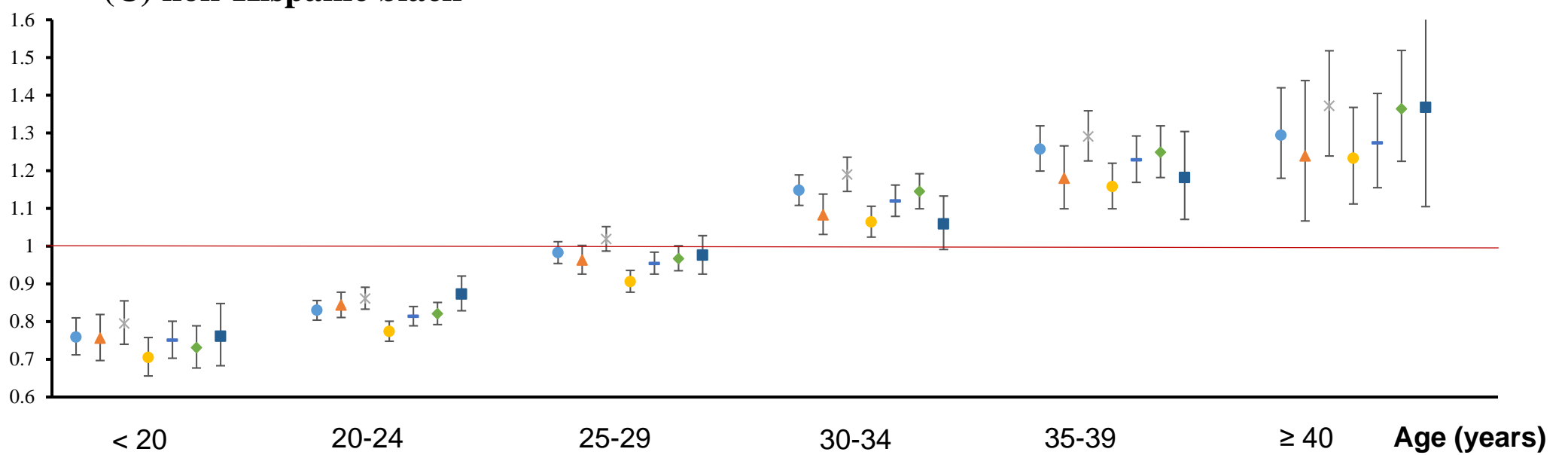
(A) Hispanic



(B) non-Hispanic white



(C) non-Hispanic black



(D) Other race/ethnicity

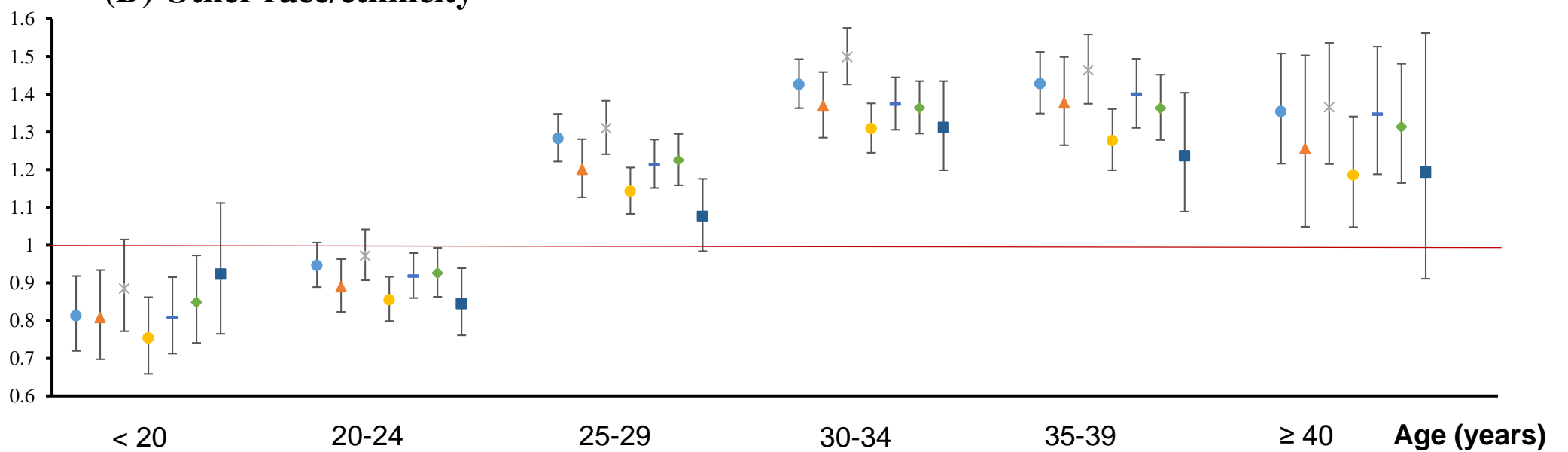


Figure S4. Sensitivity analyses for the association between pre-pregnancy obesity and risk of preterm birth in each age*race/ethnicity subgroup

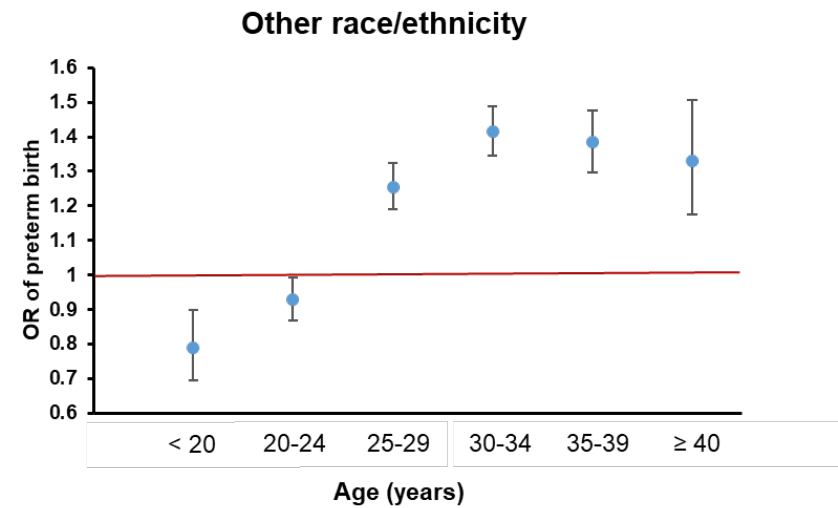
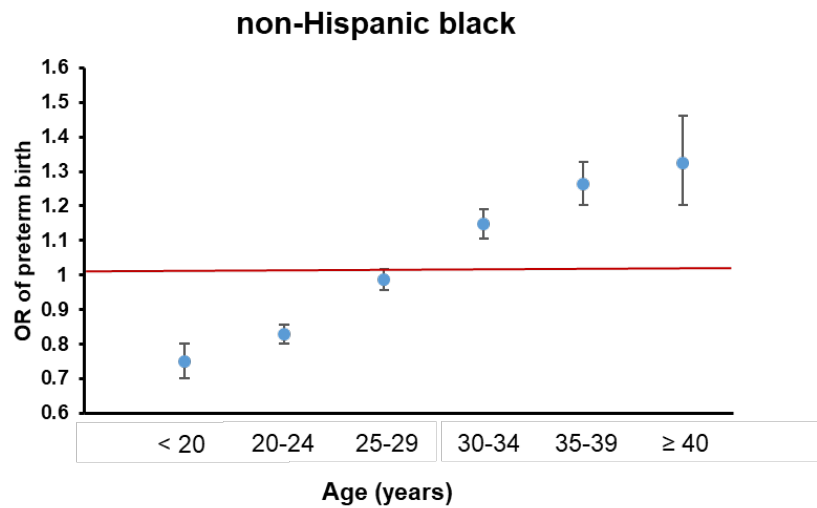
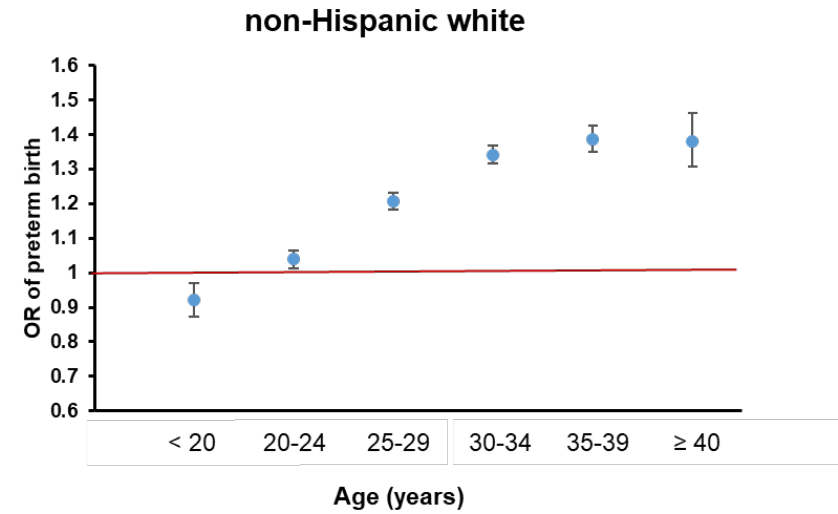
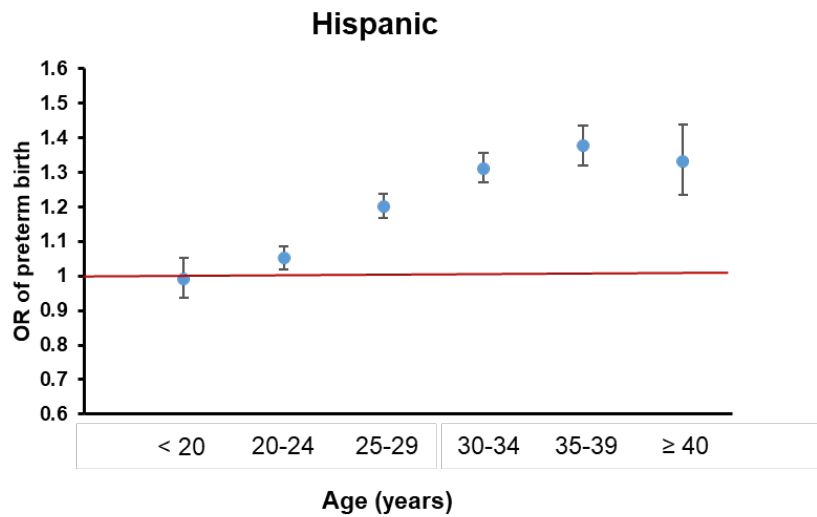


Figure S5. The associations between pre-pregnancy obesity and risk of preterm birth in each age*race/ethnicity subgroup after additional excluding women with excluding participant with incomplete covariate data

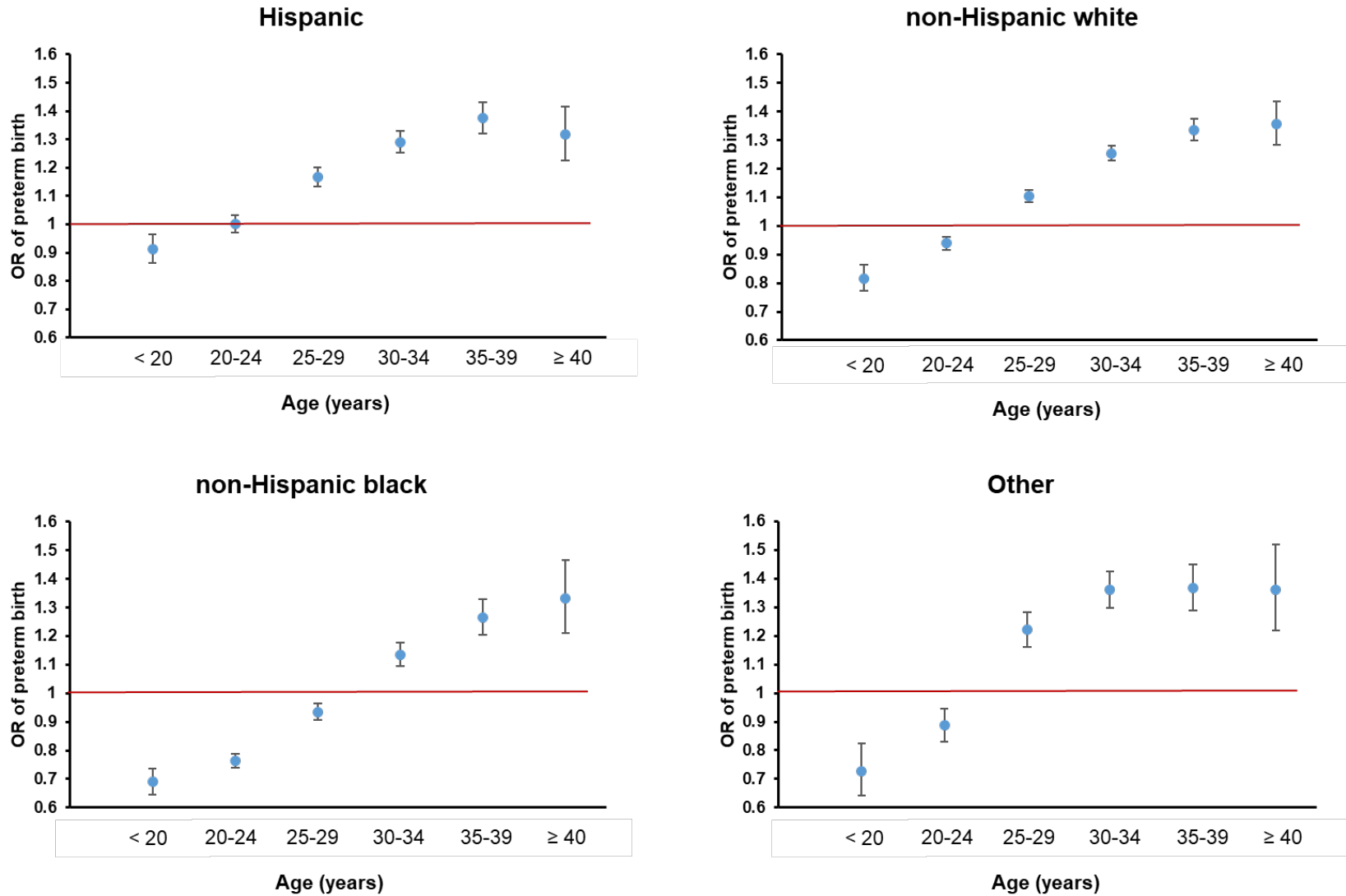


Figure S6. The associations between pre-pregnancy obesity and risk of preterm birth in each age*race/ethnicity subgroup after additional adjustment for gestational weight gain