Wanigaratne *et al* - Supplementary Material
Refugee maternal and perinatal health in Ontario, Canada: a retrospective population-based study

SUPPLEMENTARY TABLES

Table S1: List of 10th revision of the *International Statistical Classification of Diseases and Related Health Problems*, Canadian enhancement, and *Canadian Classification of Health Interventions* (ICD-10-CA/CCI) codes for maternal and perinatal outcomes

Maternal or Perinatal Outcome	Definition	Source Database	ICD-10-CA/CCI
Complicated urinary tract infection		CIHI-DAD	O23, O86, N39
Pre-existing hypertension		CIHI-DAD	O10, O11
Gestational hypertension		CIHI-DAD	O13
Preeclampsia			O14
Eclampsia		CIHI-DAD	O15
Pre-pregnancy diabetes mellitus		CIHI-DAD	O24.0-O24.3
Gestational diabetes mellitus (GDM)		CIHI-DAD	O24.4
Caesarean delivery		CIHI-DAD	5.MD.60.^^
Post-partum hemorrhage		CIHI-DAD	O72
Maternal intensive care unit (ICU) admission		CIHI-DAD	Special Care Unit 1-6
Severe maternal morbidity		CIHI-DAD	See Joseph et al, 2010*
HIV	Three physician diagnoses within three years.	Ontario HIV DB	
Congenital anomaly	An abnormality of structure or function present at birth	CIHI-DAD	ICD-10: Q00-Q99
Moderate preterm birth (PTB)	Live birth with gestational age 32-36 weeks	CIHI-DAD	32-36 weeks gestation recorded on CIHI-DAD birth record
Very preterm birth (VPTB)	Live birth with gestational age <32 weeks	CIHI-DAD	< 32 weeks gestation recorded on CIHI-DAD birth record
Neonatal mortality	Death <28 days of life	RPDB, ORG-VSD	
Neonatal intensive care unit (NICU) admission		CIHI-DAD	Special care unit admission, any level
Perinatal mortality	Stillbirth or death of live born infant < 7 days of life	RPDB, ORG-VSD	
Stillbirth	Intrauterine fetal death ≥ 20 weeks gestation and > 500 g birthweight	CIHI-DAD	Maternal record: Z371, Z373-7, O364. Infant record: P95

Abbreviations
ICD-10-CA/CCI - 10th revision of the *International Statistical Classification of Diseases and Related Health Problems*, Canadian enhancement, and *Canadian Classification of Health Interventions* (ICD-10-CA/CCI)
CIHI-DAD – Canadian Institute for Health Information – Discharge Abstract Database
RPDB – Registered Persons Database (referred to as "Ontario Health Care Registry" in paper)
ORGD-VSD – Office of the Registrar General's Vital Statistics-Death Registry

* Joseph KS, Liu S, Rouleau J, Kirby RS, Kramer MS, Sauve R, et al. Severe maternal morbidity in Canada, 2003 to 2007: surveillance using routine hospitalization data and ICD-10CA codes. J Obstet Gynaecol Can. 2010;32(9):837

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Table S2: Unadjusted Odds Ratios (OR) (95% CI) for Figures 1 and 2
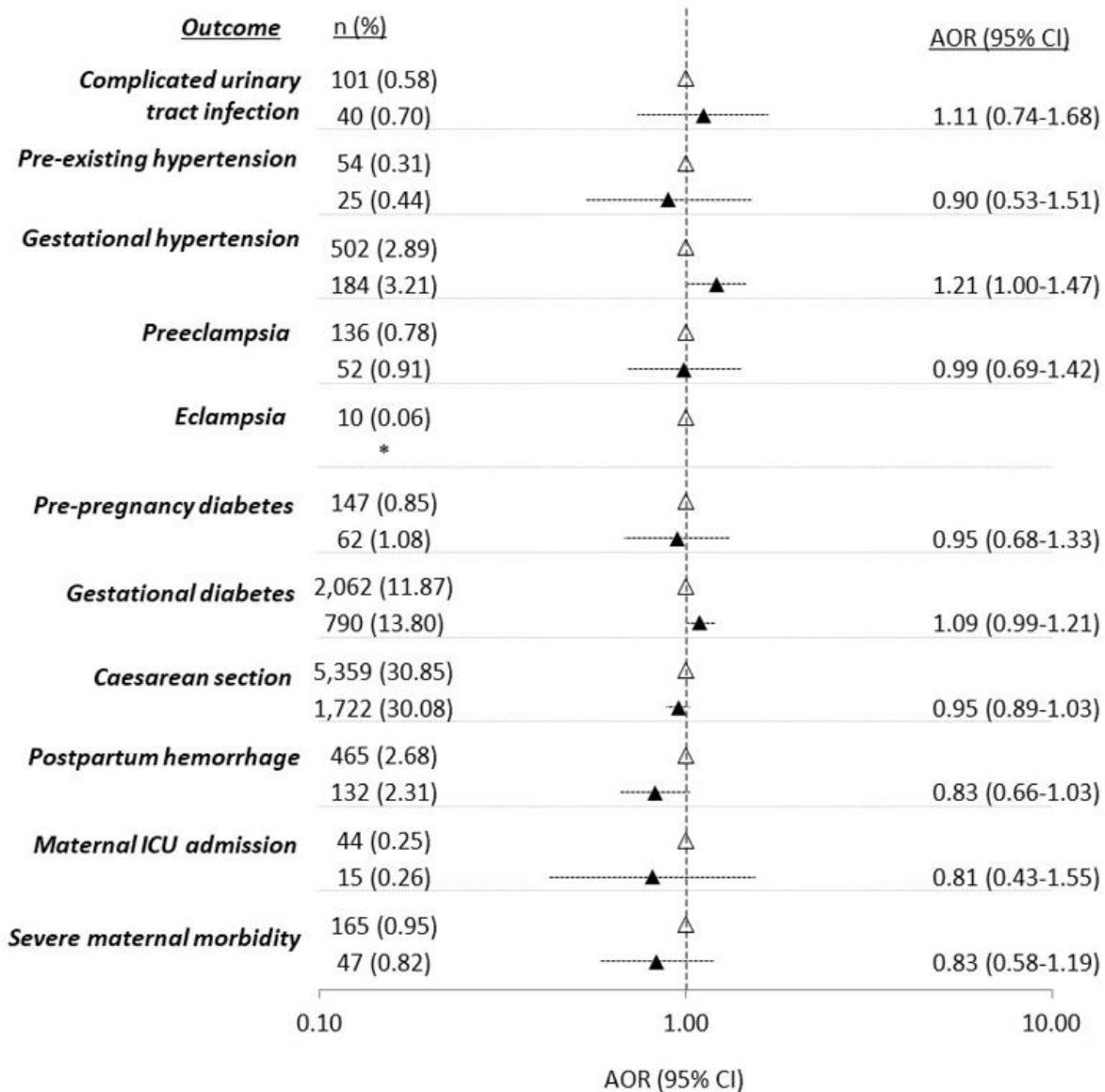
FIGURE 1	
OUTCOME	**UNADJUSTED OR (95% CI)**
Complicated urinary tract infection	0.88 (0.75-1.04)
Pre-existing hypertension	1.32 (1.03-1.69)
Gestational hypertension	1.09 (0.99-1.20)
Preeclampsia	0.97 (0.83-1.13)
Eclampsia	0.96 (0.53-1.72)
Pre-pregnancy diabetes mellitus	1.22 (0.96-1.55)
Gestational diabetes mellitus (GDM)	1.17 (1.09-1.25)
Caesarean delivery	1.03 (0.99-1.07)
Post-partum hemorrhage	1.00 (0.91-1.09)
Maternal intensive care unit admission	1.31 (0.98-1.75)
Severe maternal morbidity (SMM)	1.12 (0.97-1.28)
SMM excluding HIV	1.04 (0.89-1.20)
HIV	2.06 (1.48-2.85)
FIGURE 2	
OUTCOME	**UNADJUSTED OR (95% CI)**
Congenital anomaly	0.93 (0.86-1.01)
Moderate preterm birth (MPTB)	1.11 (1.03-1.20)
Very preterm birth (VPTB)	1.13 (0.95-1.34)
Neonatal mortality	1.00 (0.68-1.48)
Neonatal intensive care unit admission	1.02 (0.97-1.07)
Perinatal mortality	1.15 (0.96-1.37)
Stillbirth	1.10 (0.91-1.34)

Table S3: Unadjusted Odds Ratios (OR) (95% CI) for Figures 3 and 4

FIGURE 3	UNADJUSTED OR (95% CI)	
OUTCOME	REFUGEES VS. CDN	NON-REFUGEES VS. CDN
Complicated urinary tract infection	0.66 (0.60-0.73)	0.76 (0.73-0.79)
Pre-existing hypertension	0.92 (0.81-1.05)	0.86 (0.81-0.91)
Gestational hypertension	0.65 (0.62-0.69)	0.67 (0.65-0.68)
Preeclampsia	0.83 (0.76-0.91)	0.72 (0.69-0.75)
Eclampsia	0.58 (0.40-0.84)	0.76 (0.66-0.87)
Pre-pregnancy diabetes mellitus	0.90 (0.79-1.02)	0.72 (0.67-0.76)
Gestational diabetes mellitus (GDM)	2.38 (2.29-2.47)	2.40 (2.36-2.45)
Caesarean delivery	1.05 (1.02-1.07)	1.07 (1.06-1.09)
Post-partum hemorrhage (PPH)	0.79 (0.75-0.84)	0.78 (0.76-0.79)
Maternal intensive care unit admission	1.47 (1.26-1.71)	1.24 (1.15-1.33)
Severe maternal morbidity (SMM)	1.30 (1.20-1.41)	0.98 (0.95-1.02)
SMM without HIV	1.04 (0.96-1.13)	0.96 (0.92-0.99)
HIV	13.91 (11.37-17.01)	1.85 (1.51-2.26)
FIGURE 4		
OUTCOME		
Congenital anomaly	0.88 (0.84-0.92)	0.88 (0.86-0.89)
Moderate preterm birth (MPTB)	0.92 (0.88-0.96)	0.90 (0.88-0.92)
Very preterm birth (VPTB)	1.16 (1.06-1.28)	1.08 (1.03-1.13)
Neonatal mortality	1.08 (0.87-1.35)	1.10 (1.00-1.21)
Neonatal intensive care unit (NICU) admission	1.15 (1.12-1.19)	1.11 (1.10-1.13)
Perinatal mortality	1.37 (1.24-1.51)	1.17 (1.12-1.23)
Stillbirth	1.41 (1.26-1.57)	1.18 (1.12-1.24)

SUPPLEMENTARY FIGURES

Figure S1a: Adverse maternal outcomes comparing 5,724 births to Sri Lankan refugee immigrants (▲ triangles) vs. 17,373 births to Sri Lankan non-refugee immigrants (△ triangles). Odds ratios adjusted for maternal age, parity, income quintile, official language ability, education and duration of residence.

Outcome	n (%)	AOR (95% CI)
Complicated urinary tract infection	101 (0.58)	
	40 (0.70)	1.11 (0.74-1.68)
Pre-existing hypertension	54 (0.31)	
	25 (0.44)	0.90 (0.53-1.51)
Gestational hypertension	502 (2.89)	
	184 (3.21)	1.21 (1.00-1.47)
Preeclampsia	136 (0.78)	
	52 (0.91)	0.99 (0.69-1.42)
Eclampsia	10 (0.06)	
	*	
Pre-pregnancy diabetes	147 (0.85)	
	62 (1.08)	0.95 (0.68-1.33)
Gestational diabetes	2,062 (11.87)	
	790 (13.80)	1.09 (0.99-1.21)
Caesarean section	5,359 (30.85)	
	1,722 (30.08)	0.95 (0.89-1.03)
Postpartum hemorrhage	465 (2.68)	
	132 (2.31)	0.83 (0.66-1.03)
Maternal ICU admission	44 (0.25)	
	15 (0.26)	0.81 (0.43-1.55)
Severe maternal morbidity	165 (0.95)	
	47 (0.82)	0.83 (0.58-1.19)

AOR (95% CI)

AOR – adjusted odds ratio; CI – confidence interval; ICU – intensive care unit; HIV – human immunodeficiency virus

Figure S1b: Adverse perinatal outcomes comparing births to Sri Lankan refugee immigrants (▲triangles) vs. births to Sri Lankan non-refugee immigrants (△triangles). Odds ratios adjusted for maternal age, parity, income quintile, official language ability, education and duration of residence.
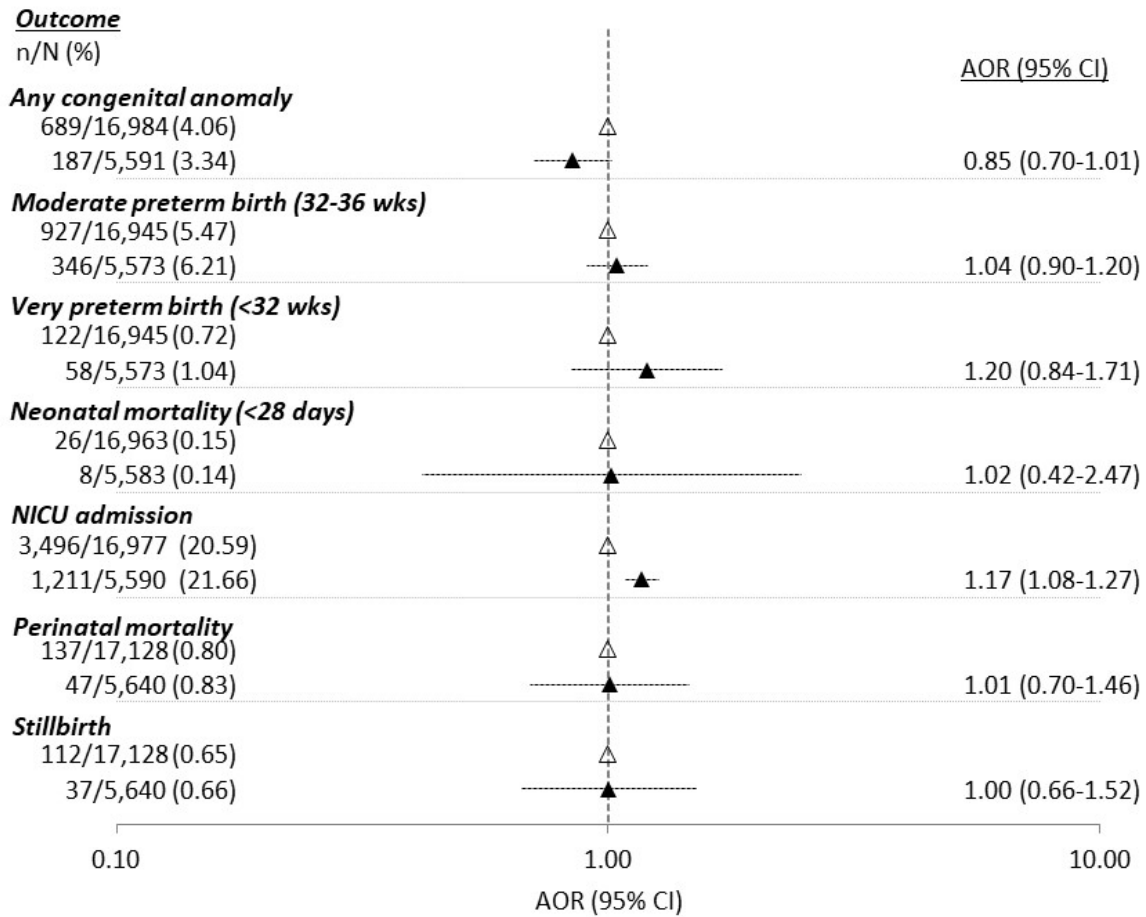
AOR – adjusted odds ratio; CI – confidence interval; NICU – neonatal intensive care unit

Figure S2a: Adverse maternal outcomes comparing 2,453 births to Somali refugee immigrants (▲ triangles) vs. 4,499 births to Somali non-refugee immigrants (△ triangles). Odds ratios adjusted for maternal age, parity, income quintile, official language ability, education and duration of residence.

Outcome	n (%)		AOR (95% CI)
Complicated urinary tract infection	14 (0.57)		
	39 (0.87)		1.41 (0.72-2.74)
Pre-existing hypertension	9 (0.37)		
	18 (0.40)		0.98 (0.41-2.36)
Gestational hypertension	51 (2.08)		
	109 (2.42)		1.10 (0.75-1.60)
Preeclampsia	28 (1.14)		
	46 (1.02)		0.80 (0.47-1.37)
Eclampsia	*		
	*		
Pre-pregnancy diabetes	24 (0.98)		
	33 (0.73)		0.86 (0.48-1.57)
Gestational diabetes	183 (7.46)		
	379 (8.42)		1.20 (0.98-1.48)
Caesarean section	583 (23.77)		
	1,124 (24.98)		0.97 (0.85-1.11)
Postpartum hemorrhage	98 (4.00)		
	173 (3.85)		1.00 (0.75-1.32)
Maternal ICU admission	13 (0.53)		
	23 (0.51)		1.19 (0.55-2.55)
Severe maternal morbidity (SMM)	42 (1.71)		
	68 (1.51)		0.82 (0.53-1.26)
SMM excluding HIV	36 (1.47)		
	36 (0.80)		0.89 (0.56-1.42)

0.10   1.00   10.00

AOR (95% CI)

AOR – adjusted odds ratio; CI – confidence interval; ICU – intensive care unit; HIV – human immunodeficiency virus

Figure S2b: Adverse perinatal outcomes comparing births to Somali refugee immigrants (▲triangles) vs. births to Somali non-refugee immigrants (△triangles). Odds ratios adjusted for maternal age, parity, income quintile, official language ability, education and duration of residence.
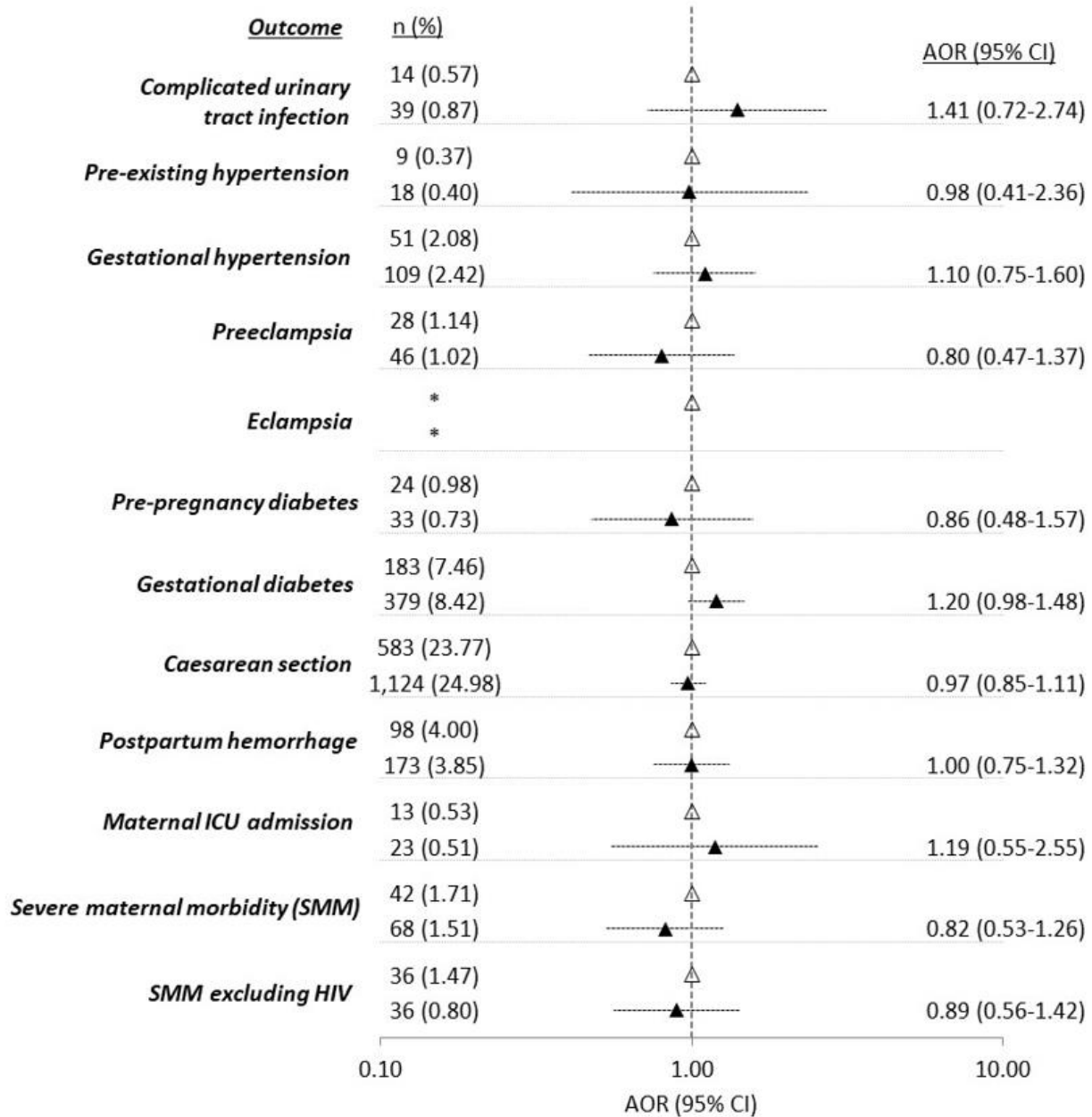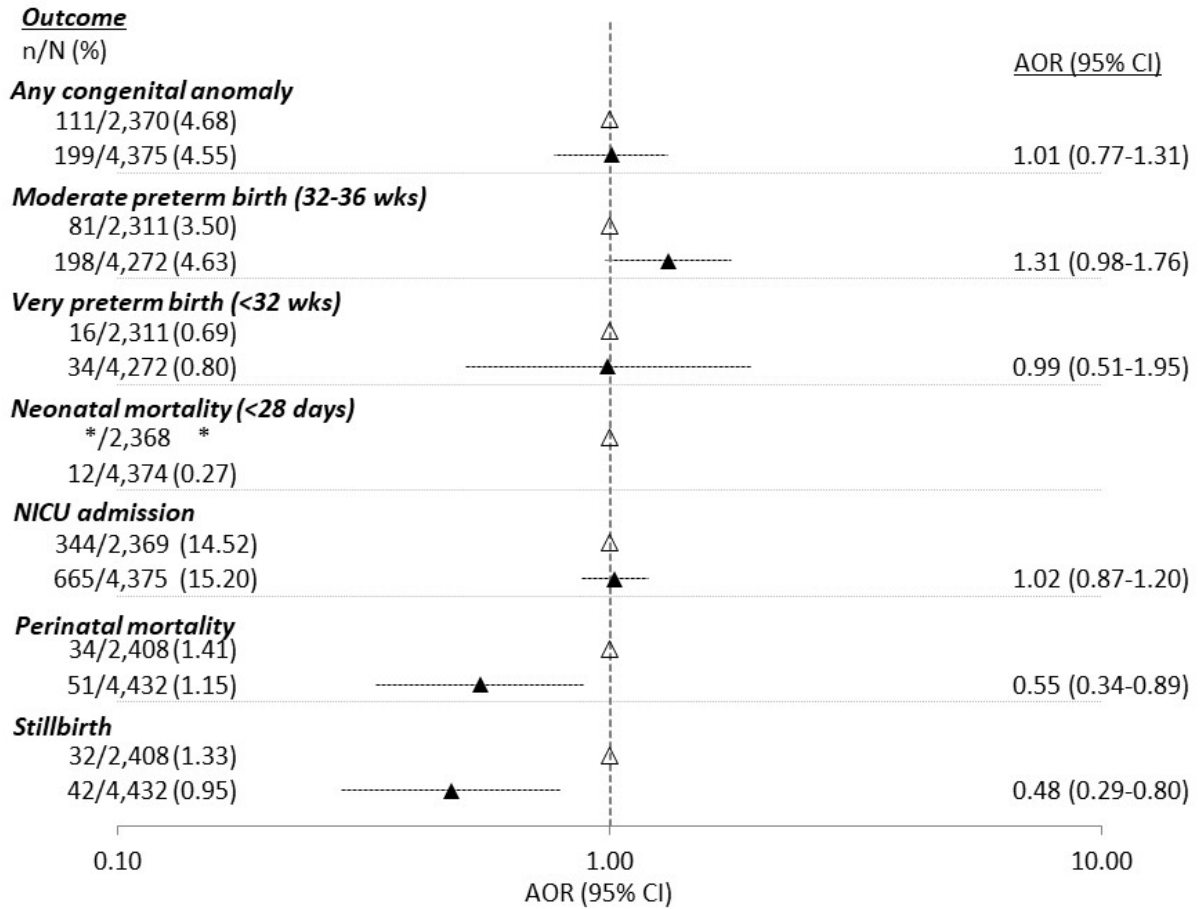

Outcome		
n/N (%)		AOR (95% CI)
Any congenital anomaly		
111/2,370 (4.68)	△	
199/4,375 (4.55)	▲	1.01 (0.77-1.31)
Moderate preterm birth (32-36 wks)		
81/2,311 (3.50)	△	
198/4,272 (4.63)	▲	1.31 (0.98-1.76)
Very preterm birth (<32 wks)		
16/2,311 (0.69)	△	
34/4,272 (0.80)	▲	0.99 (0.51-1.95)
Neonatal mortality (<28 days)		
*/2,368 *	△	
12/4,374 (0.27)		
NICU admission		
344/2,369 (14.52)	△	
665/4,375 (15.20)	▲	1.02 (0.87-1.20)
Perinatal mortality		
34/2,408 (1.41)	△	
51/4,432 (1.15)	▲	0.55 (0.34-0.89)
Stillbirth		
32/2,408 (1.33)	△	
42/4,432 (0.95)	▲	0.48 (0.29-0.80)

0.10   1.00   10.00
AOR (95% CI)

AOR – adjusted odds ratio; CI – confidence interval; NICU – neonatal intensive care unit

Figure S3a: Adverse maternal outcomes comparing 4,210 births to Afghan refugee immigrants (▲ triangles) vs. 3,905 births to Afghan non-refugee immigrants (△ triangles). Odds ratios adjusted for maternal age, parity, income quintile, official language ability, education and duration of residence.
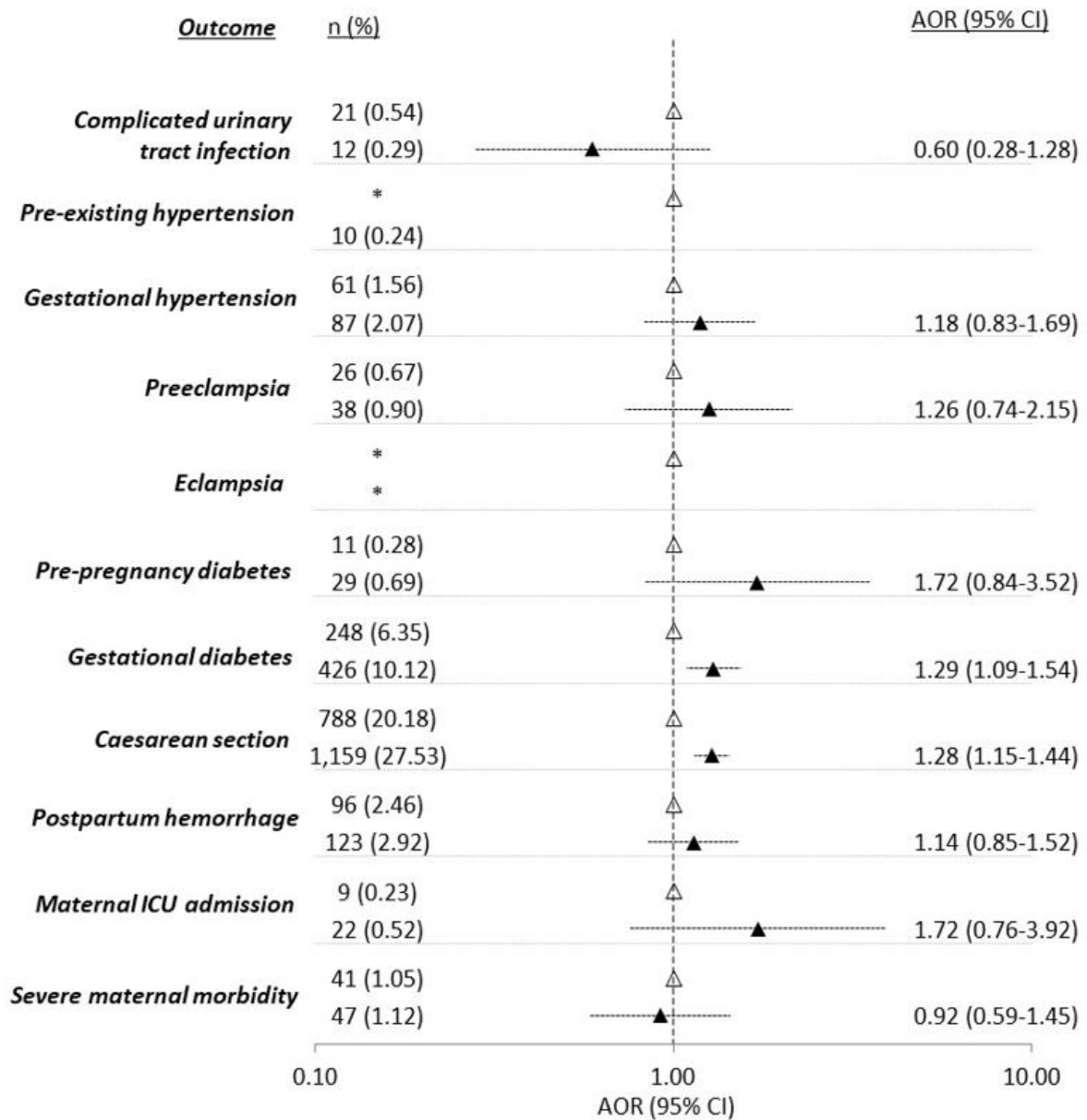

Outcome	n (%)	AOR (95% CI)
Complicated urinary tract infection	21 (0.54)	
	12 (0.29)	0.60 (0.28-1.28)
Pre-existing hypertension	*	
	10 (0.24)	
Gestational hypertension	61 (1.56)	
	87 (2.07)	1.18 (0.83-1.69)
Preeclampsia	26 (0.67)	
	38 (0.90)	1.26 (0.74-2.15)
Eclampsia	*	
	*	
Pre-pregnancy diabetes	11 (0.28)	
	29 (0.69)	1.72 (0.84-3.52)
Gestational diabetes	248 (6.35)	
	426 (10.12)	1.29 (1.09-1.54)
Caesarean section	788 (20.18)	
	1,159 (27.53)	1.28 (1.15-1.44)
Postpartum hemorrhage	96 (2.46)	
	123 (2.92)	1.14 (0.85-1.52)
Maternal ICU admission	9 (0.23)	
	22 (0.52)	1.72 (0.76-3.92)
Severe maternal morbidity	41 (1.05)	
	47 (1.12)	0.92 (0.59-1.45)

0.10   1.00   10.00
AOR (95% CI)

AOR – adjusted odds ratio; CI – confidence interval; ICU – intensive care unit; HIV – human immunodeficiency virus

Figure S3b: Adverse perinatal outcomes comparing births to Afghan refugee immigrants (▲triangles) vs. births to Afghan non-refugee immigrants (△triangles). Odds ratios adjusted for maternal age, parity, income quintile, official language ability, education and duration of residence.
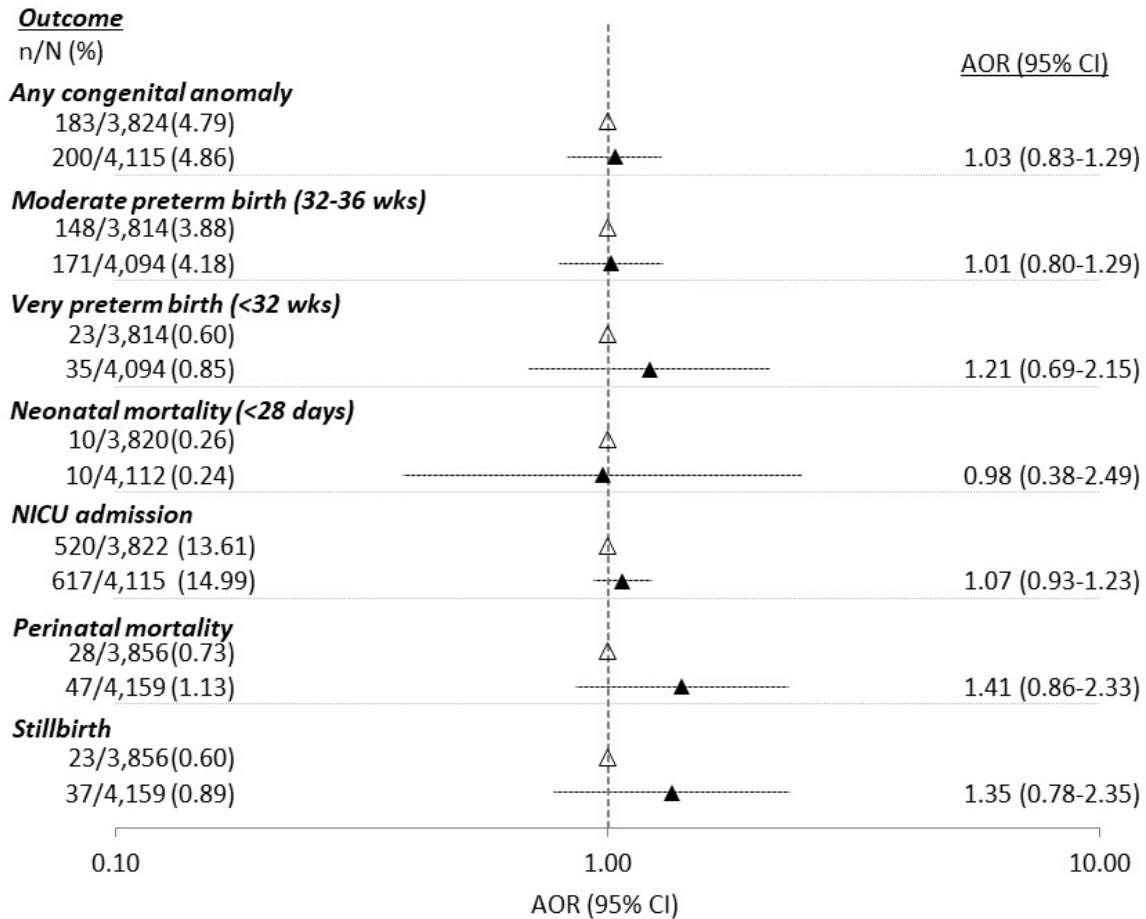

AOR – adjusted odds ratio; CI – confidence interval; NICU – neonatal intensive care unit

Figure S4a: Adverse maternal outcomes comparing 2,613 births to Iraqi refugee immigrants (▲ triangles) vs. 4,239 births to Iraqi non-refugee immigrants (△ triangles). Odds ratios adjusted for maternal age, parity, income quintile, official language ability, education and duration of residence.
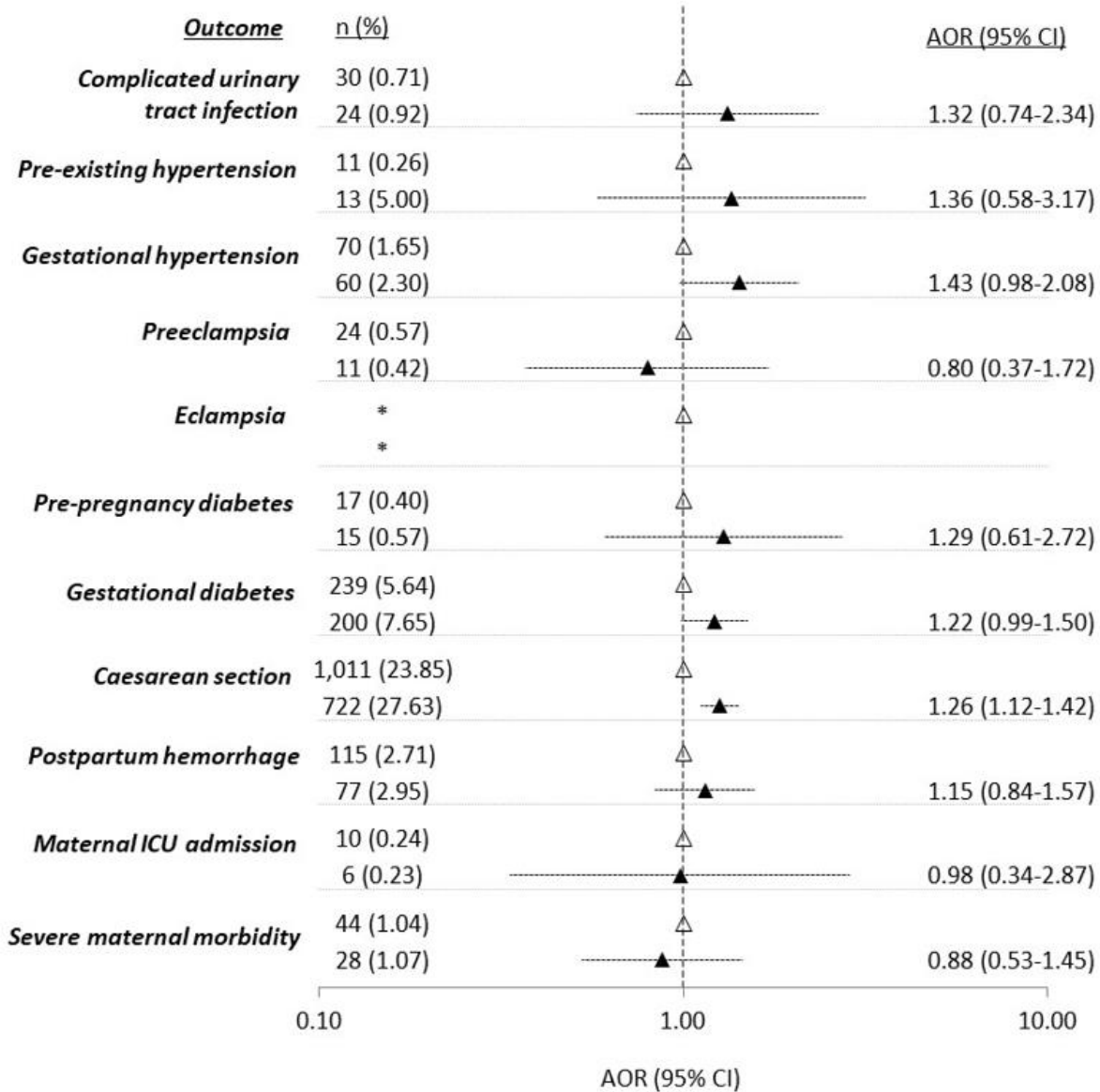

Outcome	n (%)		AOR (95% CI)
Complicated urinary tract infection	30 (0.71)		
	24 (0.92)		1.32 (0.74-2.34)
Pre-existing hypertension	11 (0.26)		
	13 (5.00)		1.36 (0.58-3.17)
Gestational hypertension	70 (1.65)		
	60 (2.30)		1.43 (0.98-2.08)
Preeclampsia	24 (0.57)		
	11 (0.42)		0.80 (0.37-1.72)
Eclampsia	*		
	*		
Pre-pregnancy diabetes	17 (0.40)		
	15 (0.57)		1.29 (0.61-2.72)
Gestational diabetes	239 (5.64)		
	200 (7.65)		1.22 (0.99-1.50)
Caesarean section	1,011 (23.85)		
	722 (27.63)		1.26 (1.12-1.42)
Postpartum hemorrhage	115 (2.71)		
	77 (2.95)		1.15 (0.84-1.57)
Maternal ICU admission	10 (0.24)		
	6 (0.23)		0.98 (0.34-2.87)
Severe maternal morbidity	44 (1.04)		
	28 (1.07)		0.88 (0.53-1.45)

AOR (95% CI)

AOR – adjusted odds ratio; CI – confidence interval; ICU – intensive care unit; HIV – human immunodeficiency virus

Figure S4b: Adverse perinatal outcomes comparing births to Iraqi refugee immigrants (▲triangles) vs. births to Iraqi non-refugee immigrants (△triangles). Odds ratios adjusted for maternal age, parity, income quintile, official language ability, education and duration of residence.
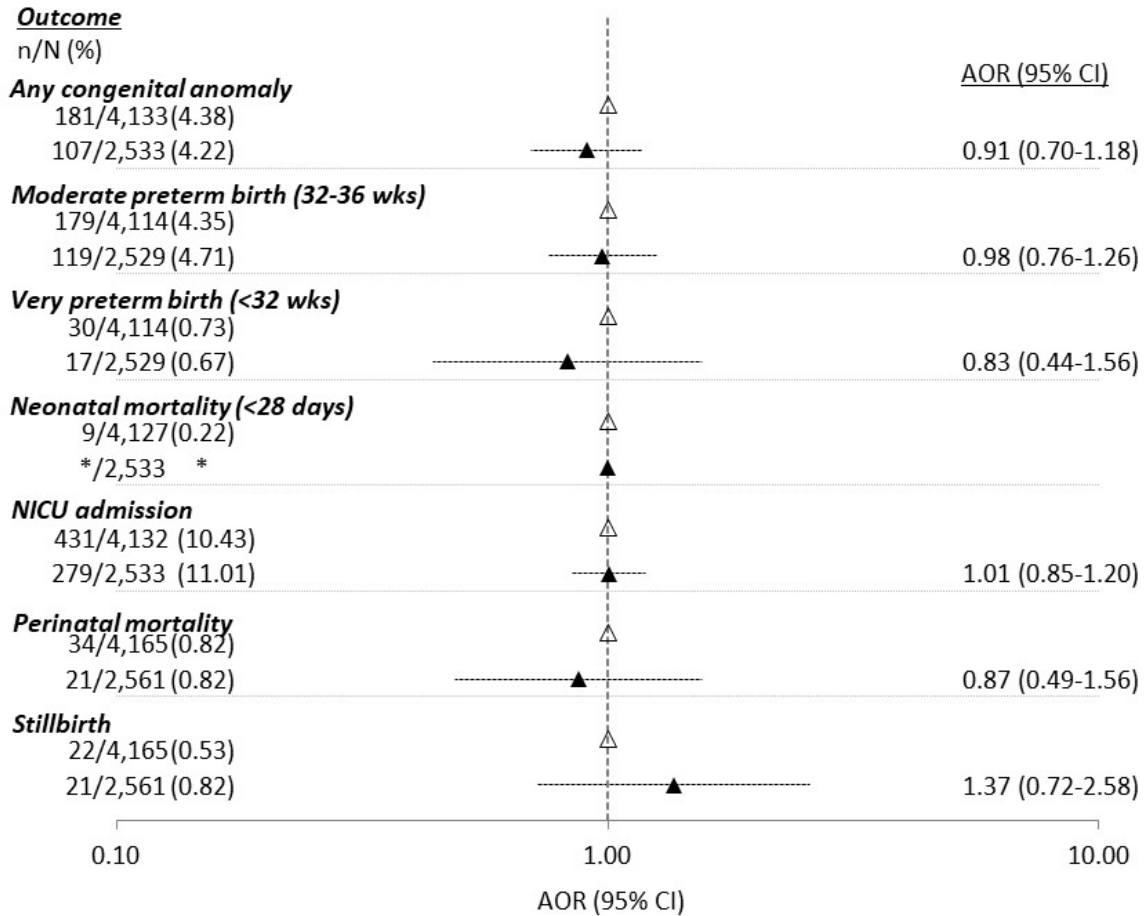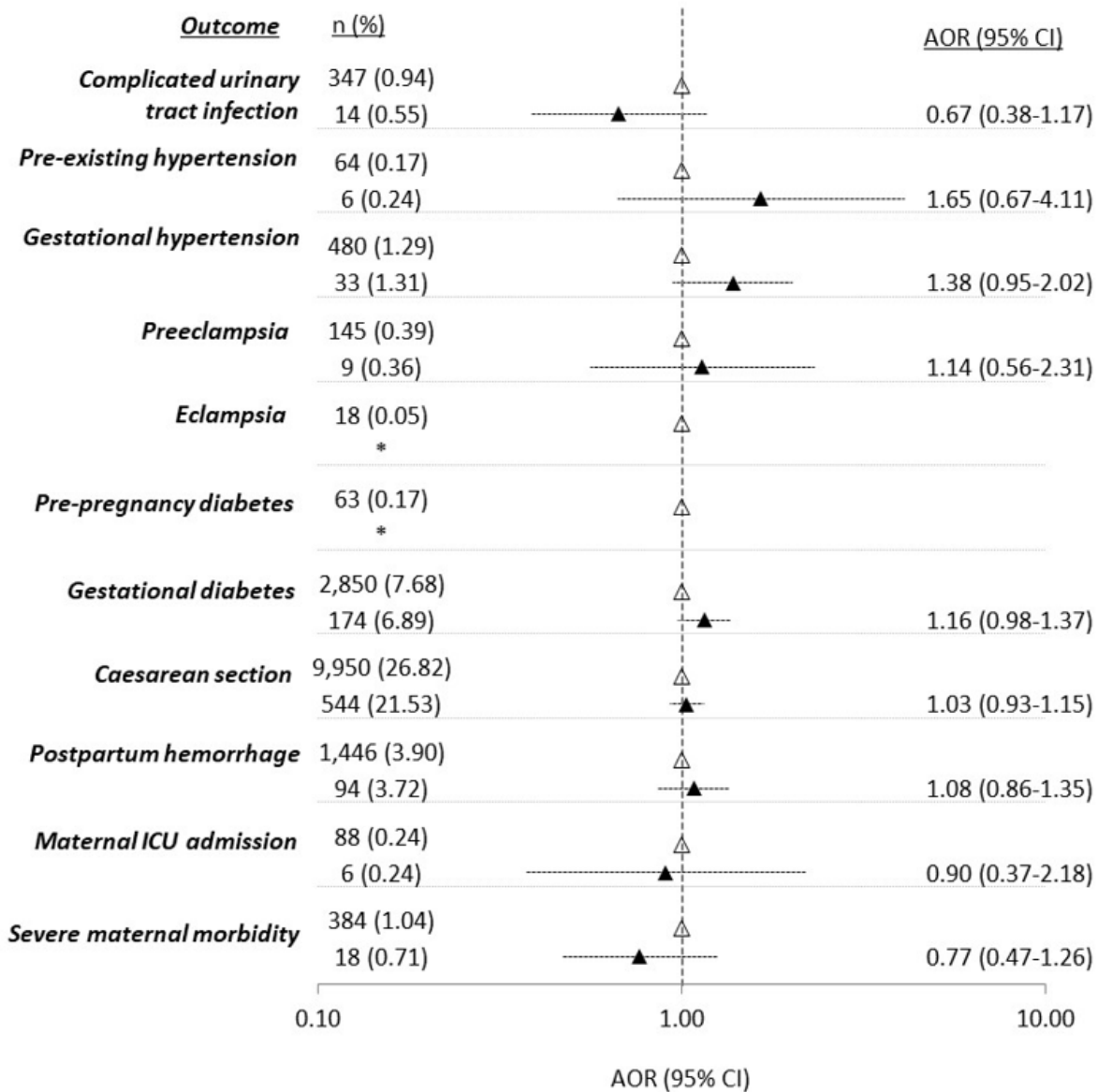

Outcome n/N (%)	AOR (95% CI)
Any congenital anomaly	
181/4,133 (4.38)	
107/2,533 (4.22)	0.91 (0.70-1.18)
Moderate preterm birth (32-36 wks)	
179/4,114 (4.35)	
119/2,529 (4.71)	0.98 (0.76-1.26)
Very preterm birth (<32 wks)	
30/4,114 (0.73)	
17/2,529 (0.67)	0.83 (0.44-1.56)
Neonatal mortality (<28 days)	
9/4,127 (0.22)	
*/2,533 *	
NICU admission	
431/4,132 (10.43)	
279/2,533 (11.01)	1.01 (0.85-1.20)
Perinatal mortality	
34/4,165 (0.82)	
21/2,561 (0.82)	0.87 (0.49-1.56)
Stillbirth	
22/4,165 (0.53)	
21/2,561 (0.82)	1.37 (0.72-2.58)

0.10   1.00   10.00

AOR (95% CI)

AOR – adjusted odds ratio; CI – confidence interval; NICU – neonatal intensive care unit

Figure S5a: Adverse maternal outcomes comparing 2,527 births to Chinese refugee immigrants (▲ triangles) vs. 37,093 births to Chinese non-refugee immigrants (△ triangles). Odds ratios adjusted for maternal age, parity, income quintile, official language ability, education and duration of residence.


Outcome	n (%)		AOR (95% CI)
Complicated urinary tract infection	347 (0.94)		
	14 (0.55)		0.67 (0.38-1.17)
Pre-existing hypertension	64 (0.17)		
	6 (0.24)		1.65 (0.67-4.11)
Gestational hypertension	480 (1.29)		
	33 (1.31)		1.38 (0.95-2.02)
Preeclampsia	145 (0.39)		
	9 (0.36)		1.14 (0.56-2.31)
Eclampsia	18 (0.05)		
	*		
Pre-pregnancy diabetes	63 (0.17)		
	*		
Gestational diabetes	2,850 (7.68)		
	174 (6.89)		1.16 (0.98-1.37)
Caesarean section	9,950 (26.82)		
	544 (21.53)		1.03 (0.93-1.15)
Postpartum hemorrhage	1,446 (3.90)		
	94 (3.72)		1.08 (0.86-1.35)
Maternal ICU admission	88 (0.24)		
	6 (0.24)		0.90 (0.37-2.18)
Severe maternal morbidity	384 (1.04)		
	18 (0.71)		0.77 (0.47-1.26)

AOR (95% CI)

AOR – adjusted odds ratio; CI – confidence interval; ICU – intensive care unit; HIV – human immunodeficiency virus

Figure S5b: Adverse perinatal outcomes comparing births to Chinese refugee immigrants (▲triangles) vs. births to Chinese non-refugee immigrants (△ triangles). Odds ratios adjusted for maternal age, parity, income quintile, official language ability, education and duration of residence.
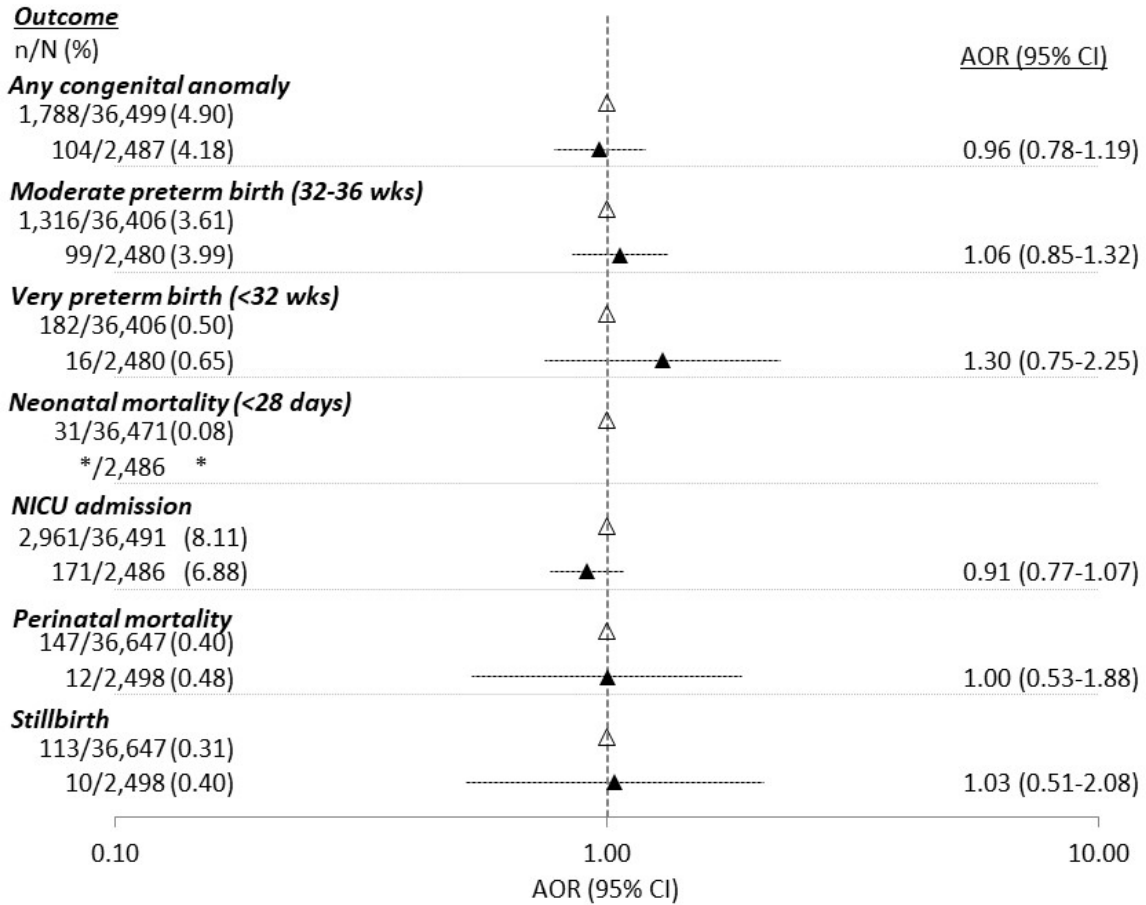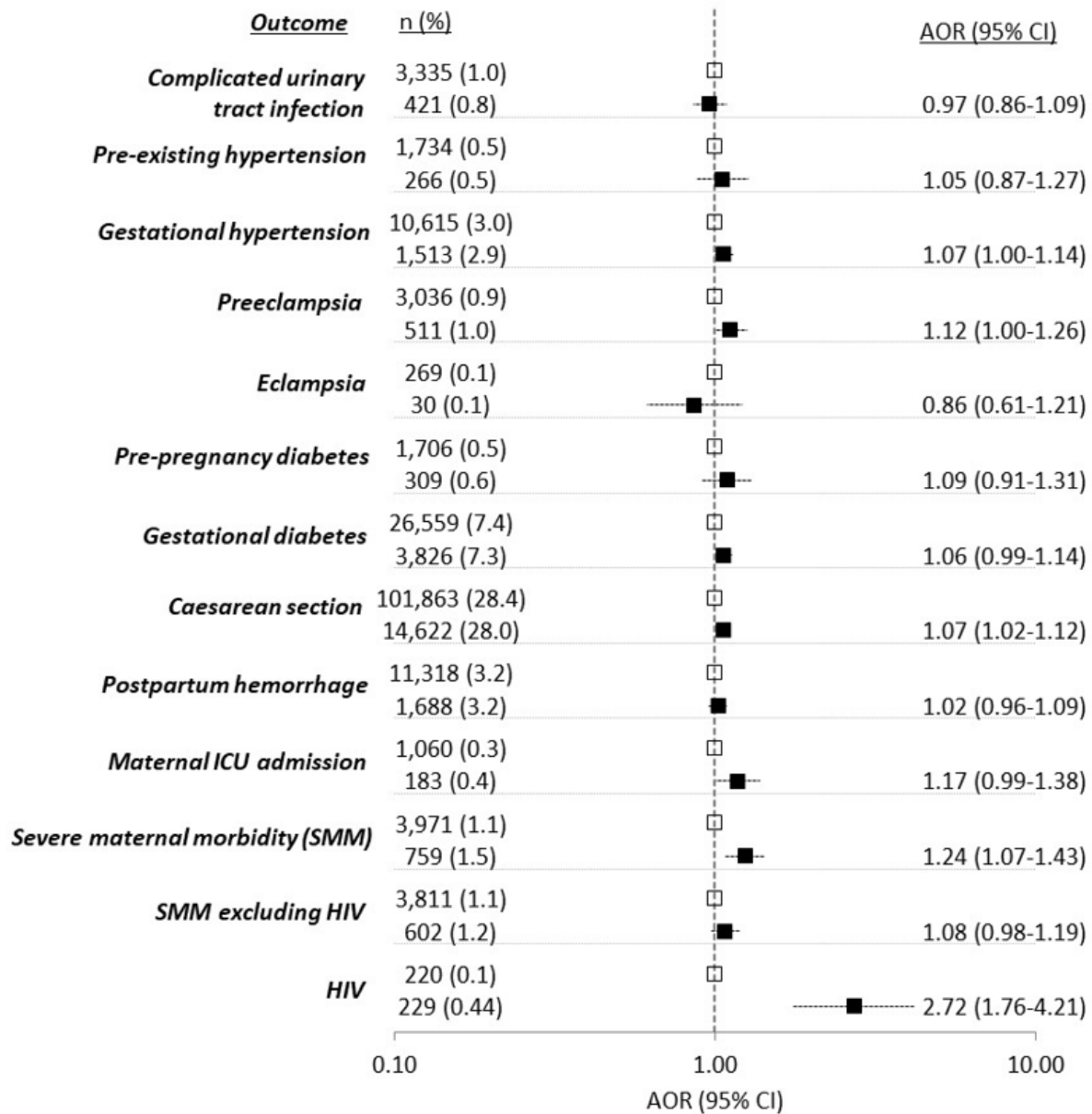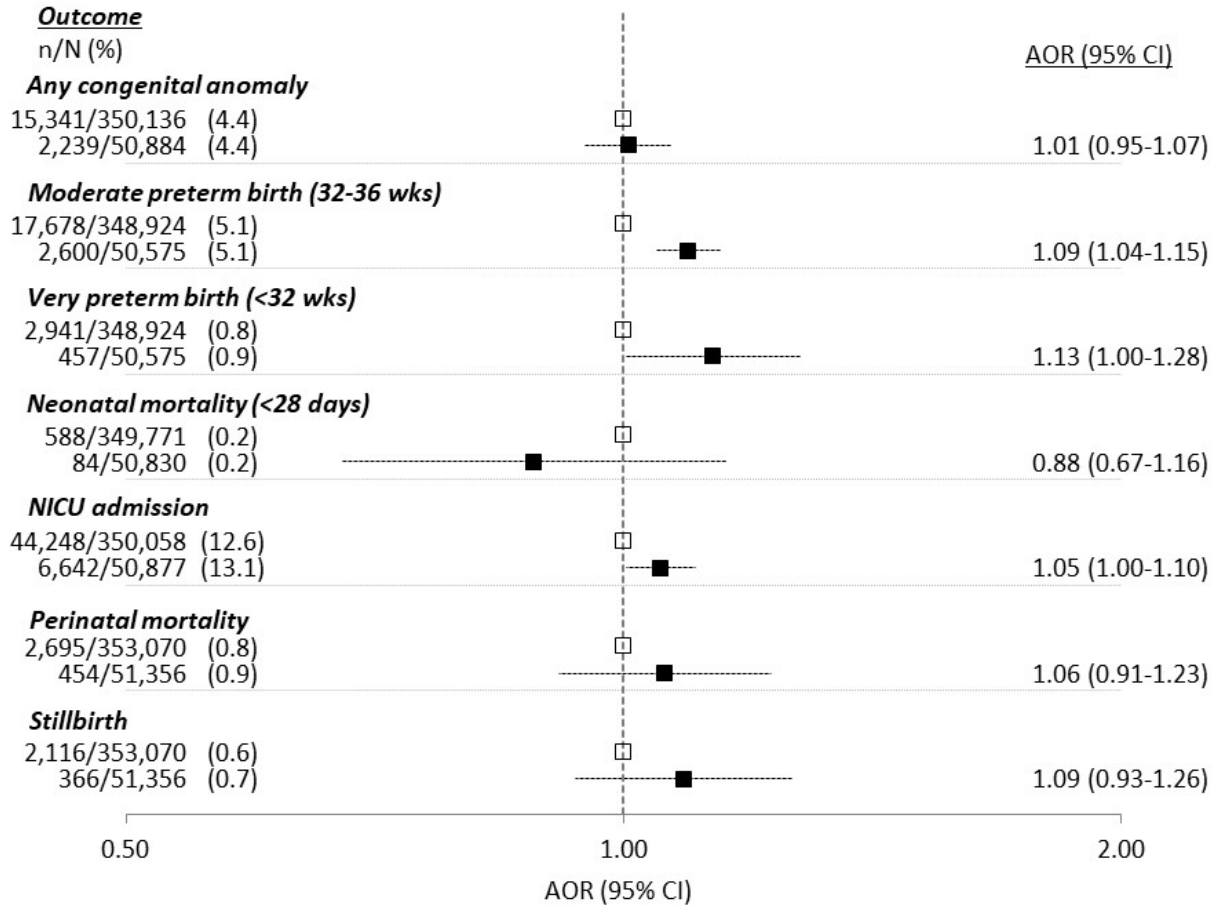

AOR – adjusted odds ratio; CI – confidence interval; NICU – neonatal intensive care unit

Figure S6: Adverse maternal outcomes comparing 52,158 births to ALL refugee immigrants (■ squares) vs. 358,589 births to ALL non-refugee immigrants (□ squares), UNMATCHED. Odds ratios adjusted for maternal age, parity, income quintile, official language ability, education and duration of residence.

Outcome	n (%)	AOR (95% CI)
Complicated urinary tract infection	3,335 (1.0)	
	421 (0.8)	0.97 (0.86-1.09)
Pre-existing hypertension	1,734 (0.5)	
	266 (0.5)	1.05 (0.87-1.27)
Gestational hypertension	10,615 (3.0)	
	1,513 (2.9)	1.07 (1.00-1.14)
Preeclampsia	3,036 (0.9)	
	511 (1.0)	1.12 (1.00-1.26)
Eclampsia	269 (0.1)	
	30 (0.1)	0.86 (0.61-1.21)
Pre-pregnancy diabetes	1,706 (0.5)	
	309 (0.6)	1.09 (0.91-1.31)
Gestational diabetes	26,559 (7.4)	
	3,826 (7.3)	1.06 (0.99-1.14)
Caesarean section	101,863 (28.4)	
	14,622 (28.0)	1.07 (1.02-1.12)
Postpartum hemorrhage	11,318 (3.2)	
	1,688 (3.2)	1.02 (0.96-1.09)
Maternal ICU admission	1,060 (0.3)	
	183 (0.4)	1.17 (0.99-1.38)
Severe maternal morbidity (SMM)	3,971 (1.1)	
	759 (1.5)	1.24 (1.07-1.43)
SMM excluding HIV	3,811 (1.1)	
	602 (1.2)	1.08 (0.98-1.19)
HIV	220 (0.1)	
	229 (0.44)	2.72 (1.76-4.21)

0.10   1.00   10.00

AOR (95% CI)

AOR – adjusted odds ratio; CI – confidence interval; ICU – intensive care unit; HIV – human immunodeficiency virus

Figure S7: Adverse perinatal outcomes comparing births to ALL refugee immigrants (■ squares) vs. births to ALL non-refugee immigrants (□ squares), UNMATCHED. Odds ratios adjusted for maternal age, parity, income quintile, official language ability, education and duration of residence.

AOR – adjusted odds ratio; CI – confidence interval; NICU – neonatal intensive care unit