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Maternal Morbidity and Perinatal Outcomes Among Foreign-Born Cambodian, Laotian, and Vietnamese Americans in Washington State, 1993–2006

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Abstract This study examined differences in perinatal outcomes of Southeast Asian (SEA) women compared with non-Hispanic white women in Washington. Using linked birth certificate and hospitalization discharge records for the years 1993–2006, we compared singleton births of Cambodian (3,858), Laotian (2,223), and Vietnamese (12,949) women with a random sample of white women (35,581). Associations between maternal nativity and perinatal outcomes were assessed using multivariable logistic regression. There are clear nativity differences among SEAs for gestational diabetes mellitus, anemia, placenta previa and febrile illness. SEAs had increased risks for these disorders when compared with white women. Compared with infants delivered of white women, infants of SEAs had increased risks for moderate to heavy meconium, birth injury and low birth weight. Differences in nativity among SEAs (populations that are traditionally studied in aggregate) should be considered when designing and carrying out interventions to prevent adverse pregnancy morbidity and outcomes among immigrants.

Keywords Antepartum complications · Perinatal outcomes · Cambodian · Laotian · Vietnamese

Introduction

Cambodians, Laotians and Vietnamese have been reported to have the worst maternal risk profiles among Asians [1, 2]. As of 2007, foreign-born individuals comprised 12.6% (38.1 million) of the total United States (US) population [3], of which 2.2% (795,179) were in Washington state [4]. According to the US Census 2000, Vietnamese immigrants accounted for 0.7% of the total Washington state population [5], while foreign-born Cambodians and Laotians accounted for 0.2 and 0.1% of the total state population, respectively [6]. Early waves of Southeast Asian (SEA) immigrants to the US were mostly Vietnamese of higher socioeconomic status. This initial wave was subsequently followed by new groups including Laotians and Cambodians, who generally, had fewer years of education, were of lower-socioeconomic status and less accustomed to urban living [7–9]. Consequently, tremendous heterogeneity in health, socioeconomic status, and cultural characteristics exists across these groups of SEA immigrants [2]. The heterogeneity may be further amplified by differences in duration of residence in the US [10, 11].

Heterogeneity in prenatal characteristics and perinatal outcomes among Asians have been previously reported [11–13]. However, most studies have focused on one or just a few of the most populous Asian subgroups such as immigrants from China and Vietnam [10, 11, 13]. Relatively little research has been conducted to fully characterize perinatal outcomes among other SEAs such as immigrants from Cambodia and Laos. This is due to limited numbers [12, 13], and the inability to distinguish them as separate ethnic groups because they are included within the "Other Asian" category by the Census Bureau [14]. Consequently, any heterogeneity in the health of SEA immigrants is usually masked, and health problems and healthcare needs of these immigrant groups have not been adequately recognized or addressed [13, 15].

In order to better offer care and counsel to specific ethnic groups regarding their individual perinatal risk and to optimize perinatal health, it is important to identify

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immigrant groups with increased risks for pre-gestational disorders and intrapartum complications. Therefore, we conducted this research to better understand the perinatal risks of Cambodians, Laotians and Vietnamese women, traditionally less studied groups. The purpose of this study was to use the Washington state birth certificates for 1993–2006 to determine if these SEA women vary by nativity status and differ from those of non-Hispanic white women in obstetric and perinatal outcomes. Findings from this study will not only fill a gap in the literature, but may contribute to optimization of the delivery of health care and counsel to these diverse groups.

Methods

Data Source and Participants

This study used the University of Washington Birth Events Records Database (UW_BERD), a database of linked birth certificate information and birth hospitalization discharge data for both the mother and child for all nonfederal hospitals in Washington state [Comprehensive Hospital Discharge Reporting System (CHARS)]. Birth certificate information includes maternal and paternal demographic characteristics, pregnancy, delivery, infant status, maternal morbidity, and neonatal outcomes. Additional information acquired from UW_BERD included method of payment for medical services rendered, and International Classification of Diseases (9th Revision) (ICD-9) diagnosis and procedure codes for both mother and infant. For this study, 92% of the Washington state births were successfully linked to CHARS records for the delivery hospitalizations via UW_BERD. We used the UW_BERD for this study and did not used the birth certificate as the only data source in order to improve accuracy of information on pre-existing maternal morbidity and pregnancy complications. Several investigators reported that birth certificate and hospital discharge data combined had substantially higher true-positive fractions than did birth certificate alone for many conditions, including established diabetes mellitus (97 vs. 52%), chronic hypertension (70 vs. 47%), placenta previa (70 vs. 33%), and abruptio placentae (85 vs. 68%) [16, 17].

Women were selected from a cohort who had singleton births in Washington state between January 1, 1993 and December 31, 2006. We classified each birth based on maternal country of birth and race as reported on the birth certificate. We included cases as SEA neonates with maternal country of birth reported as Cambodia ($n = 4{,}110$), Laos ($n = 2{,}395$), and Vietnam ($n = 13{,}793$). We selected at random a total of 39,327 singleton births of US-born non-Hispanic white mothers with the same birth year as the matching case (Vietnamese births) as our reference group. Vietnamese births were used as the matching case because they are the largest group among these SEA births. US-born non-Hispanic white women will be referred to, hereinafter, as white women. Records of cases with missing information on mother's race ($n = 11$) along with records that indicate mothers of non-Hispanic white or black race ($n = 276$) born in any of these three SEA countries were excluded from the case group. This resulted in 4,061 Cambodians, 2,378 Laotians, and 13,572 Vietnamese birth records in the case group. Finally, we excluded singleton births for which complete linkage of maternal and infant hospitalization with birth certificate data were not achieved (981 case births and 3,746 control births). As a result, there were a total of 3,858 Cambodian, 2,223 Laotian, 12,949 Vietnamese, and 35,581 white births included in the final analyses of our study. The Institutional Review Board of the University of Washington approved this population-based retrospective cohort study.

Measures

We coded pre-gestational disorders, antepartum complications, and obstetric and neonatal outcomes from the data recorded on the birth certificates and hospital discharge data. These included GDM, chronic hypertension, anemia, cardiac disease, acute or chronic lung disease, genital herpes, preeclampsia, eclampsia, abruptio placentae, placenta previa, and febrile illness defined as intrapartum fever >38°C. Perinatal outcomes were evaluated among the three groups of SEAs and compared with white women. These included mode of delivery (normal vaginal or vaginal birth after cesarean section, cesarean section), moderate to heavy meconium, fetal distress, neonatal demise, infant birthweight <2,500 g and birth injury (yes, no), gestational age at delivery (<37 weeks, ≥37 weeks), requirement of assisted ventilation (≤30 min, >30 min), 5-min Apgar score (<7, ≥7), and neonatal length of stay (≤72 h, >72 h). Seventy-two hours was chosen as the cutoff to reflect the average length of stay following a cesarean delivery and, therefore, is a good surrogate marker for whether the mother may take her infant home upon maternal discharge after any type of delivery [18]. Fetal distress and birth injury were defined using both birth certificate and hospital discharge data. Fetal distress was indicated as "Yes" or "No" on the birth certificate. From hospital discharge data, fetal distress was identified using the International Classification of Diseases, Ninth Revision (ICD-9) hospital discharge diagnosis codes, 656.3–656.33 and 768.2–768.4. Birth injury in the birth certificate data was defined as skeletal fracture(s), peripheral nerve injury, and/or soft tissue/solid organ hemorrhage that requires intervention, and is present immediately following delivery or manifesting soon after delivery. From hospital discharge

data, birth injury was identified using the International Classification of Diseases, Ninth Revision (ICD-9) hospital discharge diagnosis codes, 767.0–767.9.

Statistical Analyses

Data were uploaded in SPSS (version 14.0, Chicago, Illinois), and analyzed using STATA (version 8, College Station, Texas). Frequency distributions of maternal sociodemographic and prenatal care characteristics according to maternal nativity were examined. Comparison of categorical variables was made between SEA and white mothers using Chi-square tests for differences of proportions. Approximately 12% of women in the analysis group had one birth during the study period. As a result, we used generalized estimating equation (GEE) models to account for correlated data in this study period, and to compute odds ratios (ORs) and 95% confidence interval (CIs) estimates via the maximal likelihood method. Multivariable GEE analyses were conducted to calculate adjusted ORs and 95% CIs for dependent obstetric and perinatal outcomes. Models were adjusted according to the outcome being evaluated based on a priori assumptions and confounders. The confounders considered were maternal age, gestational age, birth weight, method of delivery, and parity. All reported tests of statistical significance were two-sided set at $\alpha = 0.05$.

Results

Sociodemographic characteristics and prenatal care utilization varied across SEAs. Laotian women, on average, were younger, and had the highest proportion of teen births (8.2%) among SEAs (Table 1). Among SEAs, Vietnamese women were most likely (37.5%) to have more than 12 years of education. However, this proportion was considerably lower than that observed among white women (56.1%). SEAs were statistically significantly more likely than white women to be unemployed, non-smokers, in the lowest quartile of pre-pregnancy weight (<103 lbs), to have delayed initiation of prenatal care, and lower expected prenatal care visit index (Table 1).

Tables 2 and 3 summarize the prevalence of pre-gestational disorders and antepartum complications for the study population. SEAs had significantly increased risk for GDM and anemia compared with white women. Furthermore, we noted heterogeneity in risks of these complications across these three immigrant groups. The odds ratios for GDM across SEAs ranged between 1.65 and 2.14. Compared with white women, Vietnamese women had the highest risk of GDM (OR = 2.14, 95% CI 1.96–2.33). The odds ratios for anemia ranged between 1.55 and 2.07 for SEA compared with white women. For this outcome, however, Cambodians had the highest risk (OR = 2.07, 95% CI 1.84–2.32) among the SEAs. Notably, SEAs had significantly reduced risk for pre-gestational hypertension, cardiac disease, acute/chronic lung disease, genital herpes, and preeclampsia when compared with white women.

We next evaluated the relative risk of antepartum complications among SEAs in comparison with white women (Table 3). Overall, the risk of preeclampsia was 62–43% lower among SEAs as compared with white mothers. For this pregnancy complication, Vietnamese women were the least likely to have pregnancies complicated by preeclampsia (OR = 0.38, 95% CI 0.34–0.42). A similar pattern of reduced risk for eclampsia was noted for Vietnamese and Cambodian women. However, compared with white women, Laotian women had a statistically non-significant increased risk of eclampsia (OR = 1.48; 95% CI 0.79–2.75). Risks for abruptio placentae were largely similar for SEA and white mothers. However, risks for placenta previa was statistically significantly elevated for Cambodian (OR = 1.71, 95% CI 1.19–2.44) and Vietnamese women (OR = 2.06, 95% CI 1.65–2.58) compared with white women. Febrile illnesses were also statistically significantly more common among Cambodian (OR = 1.45, 95% CI 1.10–1.91) and Vietnamese women (OR = 2.02, 95% CI 1.73–2.37) compared with white women.

Relative risks of adverse obstetric and perinatal outcomes are summarized in Table 4. There are nativity differentials for mode of delivery, moderate to heavy meconium, low birth weight and birth injury. Compared with white women, SEAs were less likely to deliver by cesarean section. For instance, Cambodian and Laotian women had a 35% and 50% reduced risk for cesarean delivery when compared with white women. Risks for fetal distress, 5-min Apgar score of less than 7, neonatal stay >72 h, and neonatal demise were reduced among SEA pregnancies when compared with pregnancies of white women. However, pregnancies of SEAs were more likely to be complicated by moderate to heavy meconium. SEAs also had an increased risk for delivering low birth weight infants compared with white women. Vietnamese infants had the highest risk (OR = 1.47, 95% CI 1.30–1.65) for birth injury when compared with infants of white mothers. Only Cambodians and Laotians had a moderately increased risk for preterm delivery when compared with white women (Table 4).

Discussion

This study expands the literature by documenting "marked" heterogeneity in maternal characteristics, prenatal care

Table 1 Maternal characteristics by nativity status, 1993–2006 singleton live births to US-resident Cambodian, Laotian, Vietnamese and non-Hispanic white mothers

Characteristic	Cambodian (n = 3,858)	%	Laotian (n = 2,223)	%	Vietnamese (n = 12,949)	%	Chi-square P-value[b]	US born non-Hispanic white (n = 35,581)	%	Chi-square P-value[c]
Maternal age (years; mean ± SD)	28.2 ± 5.7[a]		24.4 ± 6.3[a]		29.6 ± 5.2[a]			27.7 ± 6.0		
Maternal age (years)										
<20	195	5.1	183	8.2	259	2.0	<0.0005	3,248	9.1	<0.0005
20–29	2,199	57.0	1,311	59.0	6,254	48.3		18,296	51.4	
30–34	913	23.7	506	22.8	4,185	32.3		8,942	25.1	
35 and older	431	11.2	161	7.2	1,697	13.1		3,826	10.8	
Missing	120	3.1	62	2.8	554	4.3		1,269	3.6	
Maternal education										
More than 12 years	1,130	29.3	669	30.1	4,861	37.5	<0.0005	19,972	56.1	<0.0005
7–12 years	1,686	43.7	940	42.3	5,355	41.4		14,105	39.6	
Less than or equal to 6 years	237	6.1	130	5.8	701	5.4		121	0.3	
Missing[e]	805	20.9	484	21.8	2,032	15.7		1,383	3.9	
Marital status										
Married	2,484	64.4	1,482	66.7	10,453	80.7	<0.0005	25,915	72.8	<0.0005
Unmarried	1,363	35.3	736	33.1	2,455	19.0		9,605	27.0	
Missing	11	0.3	5	0.2	41	0.3		61	0.2	
Maternal employment										
Yes	2,553	66.2	1,385	62.3	9,228	71.3	<0.0005	29,490	82.9	<0.0005
No	391	10.1	317	14.3	1,049	8.1		2,323	6.5	
Missing[e]	914	23.7	521	23.4	2,672	20.6		3,768	10.6	
Smoked during pregnancy										
No	3,612	93.6	2,085	93.8	12,348	95.4	<0.0005	29,226	82.1	<0.0005
Yes	98	2.5	44	2.0	119	0.9		5,714	16.1	
Missing	148	3.8	94	4.2	482	3.7		641	1.8	
Pre-pregnancy weight (lbs)										
<103	756	19.6	452	20.3	3,400	26.3	<0.0005	1,061	3.0	<0.0005
103–113	590	15.3	339	15.2	2,226	17.2		2,053	5.8	
114–125	758	19.6	454	20.4	2,259	17.4		6,305	17.7	
≥126	677	17.5	400	18.0	1,350	10.4		19,845	55.8	
Missing[e]	1,077	27.9	578	26.0	3,714	28.7		6,317	17.8	
Parity										
Primiparous	1,268	32.9	749	33.7	5,849	45.2	<0.0005	14,885	41.8	<0.0005
Multiparous	2,362	61.2	1,351	60.8	6,354	49.1		20,013	56.2	
Missing	228	5.9	123	5.5	746	5.8		683	1.9	

Table 1 continued

Characteristic	Cambodian ($n = 3,858$)	%	Laotian ($n = 2,223$)	%	Vietnamese ($n = 12,949$)	%	Chi-square P-value[b]	US born non-Hispanic white ($n = 35,581$)	%	Chi-square P-value[c]
Month prenatal care initiation										
During first trimester	2,223	57.6	1,324	59.6	8,329	64.3	<0.0005	27,857	78.3	<0.0005
After first trimester	891	23.1	469	21.1	1,801	13.9		4,602	12.9	
Missing[e]	744	19.3	430	19.3	2,819	21.8		3,122	8.8	
Prenatal care initiation month[d]										
Adequate plus	1,316	34.1	764	34.4	5,482	42.3	<0.0005	19,884	55.9	<0.0005
Adequate	1,136	29.4	699	31.4	3,057	23.6		8,533	24.0	
Intermediate	352	9.1	158	7.1	610	4.7		1,534	4.3	
Inadequate	152	3.9	73	3.3	348	2.7		878	2.5	
Missing[e]	902	23.4	529	23.8	3,452	26.7		4,752	13.4	
Expected visit index										
Adequate plus	614	15.9	312	14.0	1,672	12.9	<0.0005	6,900	19.4	<0.0005
Adequate	1,311	34.0	774	34.8	4,633	35.8		15,779	44.3	
Intermediate	834	21.6	497	22.4	2,704	20.9		7,089	19.9	
Inadequate	197	5.1	111	5.0	488	3.8		1,061	3.0	
Missing[e]	902	23.4	529	23.8	3,452	26.7		4,752	13.4	

For each SEA group, the reference group was US-born non-Hispanic white women. Numbers may not add to totals because of missing data; percentages calculated with missing data included

[a] T-test: $P < 0.0005$

[b] Comparison among SEA groups

[c] Comparison among SEA groups and US-born non-Hispanic white

[d] Prenatal care initiation month index classifies the adequacy of the pregnancy month when prenatal care was initiated, i.e., adequate plus (pregnancy months 1 and 2), adequate (pregnancy months 3 and 4), intermediate (pregnancy months 5 and 6), and inadequate (pregnancy months 7–9)

[e] Data not routinely collected at all hospitals

Table 2 Pre-gestational disorders by nativity status, 1993–2006 singleton live births to US-resident Cambodian, Laotian, Vietnamese and non-Hispanic white mothers

	Cambodian ($n = 3,858$) (%)	Odds ratio (95% CI)	Laotian ($n = 2,223$) (%)	Odds ratio (95% CI)	Vietnamese ($n = 12,949$) (%)	Odds ratio (95% CI)	US born non-Hispanic white ($n = 35,581$) (%)
Gestational diabetes	252 (6.5)	1.67 (1.45–1.94)	150 (6.7)	1.65 (1.37–2.00)	1,059 (8.2)	2.14 (1.96–2.33)	1,477 (4.2)
Pre-gestational hypertension	32 (0.8)	0.39 (0.26–0.57)	29 (1.3)	0.56 (0.37–0.86)	128 (1.0)	0.47 (0.38–0.57)	780 (2.2)
Anemia[a]	427 (11.1)	2.07 (1.84–2.32)	231 (10.4)	1.84 (1.59–2.14)	1,006 (7.8)	1.55 (1.43–1.68)	1,973 (5.5)
Cardiac disease[a]	14 (0.4)	0.44 (0.25–0.77)	11 (0.5)	0.52 (0.28–0.63)	57 (0.4)	0.56 (0.42–0.76)	299 (0.8)
Acute/chronic lung disease[a]	29 (0.8)	0.35 (0.24–0.53)	13 (0.6)	0.27 (0.14–0.45)	130 (1.0)	0.51 (0.42–0.62)	721 (2.0)
Genital herpes	40 (1.0)	0.33 (0.24–0.46)	18 (0.8)	0.25 (0.16–0.40)	131 (1.0)	0.32 (0.27–0.39)	1,122 (3.2)

For each SEA group, the reference group was US-born non-Hispanic white women. Numbers may not add to totals because of missing data; percentages calculated with missing data included

[a] Data not available for births after 2002

Table 3 Antepartum complications by nativity status, 1993–2006 singleton live births to US-resident Cambodian, Laotian, Vietnamese and non-Hispanic white mothers

	Cambodian ($n = 3,858$) (%)	Odds ratio (95% CI)	Laotian ($n = 2,223$) (%)	Odds ratio (95% CI)	Vietnamese ($n = 12,949$) (%)	Odds ratio (95% CI)	US born non-Hispanic white ($n = 35,581$) (%)
Preeclampsia	168 (4.4)	0.57 (0.48–0.68)	92 (4.1)	0.51 (0.41–0.65)	451 (3.5)	0.38 (0.34–0.42)	2,937 (8.3)
Eclampsia[b]	8 (0.2)	0.65 (0.32–1.33)	11 (0.5)	1.48 (0.79–2.75)	19 (0.1)	0.51 (0.31–0.82)	109 (0.3)
Abruptio placentae[b]	46 (1.2)	0.95 (0.69–1.31)	24 (1.1)	0.82 (0.54–1.23)	155 (1.2)	1.05 (0.87–1.27)	432 (1.2)
Placenta previa[b]	36 (0.9)	1.71 (1.19–2.44)	19 (0.9)	1.49 (0.93–2.38)	133 (1.0)	2.06 (1.65–2.58)	188 (0.5)
Febrile illness[b] (>38°C)	62 (1.6)	1.45[a] (1.10–1.91)	31 (1.4)	1.20[a] (0.81–1.77)	282 (2.2)	2.02[a] (1.73–2.37)	443 (1.2)

For each SEA group, the reference group was US-born non-Hispanic white women. Numbers may not add to totals because of missing data; percentages calculated with missing data included

[a] Adjusted for gestational age, birth weight, and method of delivery

[b] Data not available for births after 2002

utilization, pre-gestational disorders (GDM and anemia), antepartum complications (placenta previa and febrile illness), and perinatal outcomes (mode of delivery) among SEAs. Our results suggest that foreign-born status is associated with significantly reduced risk of adverse perinatal outcomes for SEAs, with these differences persisting after adjustment for potential confounders. Ours is one of the few studies of that have evaluated pregnancy outcomes of SEAs, particularly for Cambodians and Laotians, relative to a single common reference group.

To our knowledge, no study has examined the risk of existing vascular (e.g., chronic hypertension, cardiac disease), respiratory (acute/chronic lung disease) and infectious diseases (e.g., genital herpes) among these SEAs. SEAs had a lower prevalence of the aforementioned diseases, but a higher prevalence of GDM when compared with white women. The high risk of GDM among SEAs in this study is consistent with findings reported among women of SEA origin in New York City [19]. The observed increased risk for GDM may be due to residual confounding because we lacked information on potential risk factors such as body mass index [20] and time since immigration to the US, a measure of acculturation in this study and an influential factor of lifestyle of immigrants [19]. The high prevalence of GDM among SEAs may also be due to the inclusion of existing Type 2 diabetes mellitus cases that had not been diagnosed prior to pregnancy. These SEAs are known to typically use traditional medicine rather than seek help from western medicine (http://ethnomed.org). Although, there is no definitive

Table 4 Obstetric and perinatal outcomes by nativity status, 1993–2006 singleton live births to US-resident Cambodian, Laotian, Vietnamese and non-Hispanic white mothers

	Cambodian ($n = 3,858$) (%)	Adjusted odds ratio (95% CI)	Laotian ($n = 2,223$) (%)	Adjusted odds ratio (95% CI)	Vietnamese ($n = 12,949$) (%)	Adjusted odds ratio (95% CI)	US born non-Hispanic white ($n = 35,581$) (%)
Cesarean section	559 (14.5)	0.65[a] (0.58–0.72)	248 (11.2)	0.50[a] (0.43–0.58)	2,687 (20.8)	0.94[a] (0.89–0.99)	7,691 (21.6)
Moderate to heavy meconium	268 (6.9)	1.68[b] (1.45–1.93)	140 (6.3)	1.43[b] (1.18–1.73)	803 (6.2)	1.43[b] (1.31–1.57)	1,751 (4.9)
Fetal distress	233 (6.0)	0.76[b] (0.65–0.87)	142 (6.4)	0.79[b] (0.66–0.94)	872 (6.7)	0.89[b] (0.82–0.97)	2,453 (6.9)
Low birth weight (<2,500 g)	300 (7.8)	1.57[d] (1.32–1.87)	146 (6.6)	1.42[d] (1.13–1.77)	663 (5.1)	1.11[d] (0.99–1.25)	1,498 (4.2)
Gestational age at delivery (<37 weeks)	315 (8.2)	1.25[e] (1.07–1.45)	153 (6.9)	1.11[e] (0.91–1.35)	819 (6.3)	0.92[e] (0.83–1.02)	2,257 (6.3)
Apgar score (5 min, <7)	52 (1.3)	0.86[c] (0.63–1.17)	31 (1.4)	0.78[c] (0.51–1.21)	191 (1.5)	0.89[c] (0.75–1.07)	565 (1.6)
Assisted ventilation[f] (>30 min)	11 (0.3)	1.02[c] (0.52–1.99)	7 (0.3)	1.07[c] (0.45–2.56)	34 (0.3)	1.09[c] (0.72–2.56)	93 (0.3)
Birth injury	129 (3.3)	1.42[c] (1.16–1.74)	61 (2.7)	1.16[c] (0.87–1.54)	490 (3.8)	1.47[c] (1.30–1.65)	1,053 (3.0)
Neonatal length of stay (>72 h)	261 (6.8)	0.90[c] (0.77–1.05)	128 (5.8)	0.81[c] (0.66–1.00)	808 (6.2)	0.82[c] (0.74–0.90)	2,347 (6.6)
Neonatal demise	10 (0.3)	0.47[c] (0.22–1.00)	8 (0.4)	0.67[c] (0.27–1.61)	41 (0.3)	0.69[c] (0.45–1.07)	153 (0.4)

For each SEA group, the reference group was US-born non-Hispanic white women. Numbers may not add to totals because of missing data; percentages calculated with missing data included

[a] Adjusted for maternal age, gestational age, birth weight, and prior cesarean section

[b] Adjusted for gestational age and birth weight

[c] Adjusted for gestational age, birth weight, method of delivery, and parity

[d] Adjusted for maternal age, years of education, marital status, and trimester of prenatal care initiation

[e] Adjusted for maternal age, years of education, marital status and parity

[f] Data not available for births after 2002

etiology for the observed risk of GDM among SEAs, the increased risk for GDM found among Asian populations and their overall lower prevalence of obesity, as evident in this cohort, may be attributable to genetic, lifestyle, and cultural (e.g., resulting from different religious and dietary traditions) factors in those countries, and immigration characteristics (e.g., differences in timing and reasons for emigration among these countries of origin that are proximal to one another) [19].

We found that SEAs have increased risk for anemia compared with whites. These findings are consistent with other studies [21, 22]. Blood disorders commonly identified among SEA populations include alpha-thalassemia trait, beta-thalassemia trait, hemoglobin E disease, and hemoglobin H disease [23]. However, a study on pregnancy outcomes among Cambodian refugees did not find anemia to be associated with adverse birth outcomes [21].

The significantly greater risk for placenta previa among SEAs is consistent with that reported by Taylor et al. [24] (aOR = 1.86, 95% CI 1.38–2.51) and Yang et al. [25] (aOR = 1.39, 95% CI 1.03–1.86). It has been hypothesized that this increased risk among Asians may be attributed to higher rates of abnormal placental migration or relatively large placentas (particularly those without a previous live birth) [24]. These results suggest more vigilance in early detection and diagnosis of placenta previa may be indicated for SEAs gravidas who are at higher risk of this complication. The increased risk for intrapartum fever and meconium-stained amniotic fluid observed in this study, may be due to prolonged labor and maternal morbidity during pregnancy (e.g., hypertensive disorders, diabetes or infection) [26].

Southeast Asians, particularly Cambodians and Laotians, tended to deliver healthier infants despite having a more adverse risk profile (e.g., older in age, multiparous, less educated, inadequate prenatal care) compared with white women. These findings are consistent with other reports including a study conducted among foreign-born Chinese women [27–29]. The favorable neonatal outcomes among SEAs may be another example of the epidemiological paradox phenomenon that is described in Hispanic immigrants [30–32] and also described for multiple births

among foreign-born Cambodian and Laotian women [33]. Further investigation of this phenomenon in SEA and other Asian populations is warranted.

Cambodian and Laotian women were at substantially reduced risk for cesarean delivery while Vietnamese women had comparable rates with white women. This could be attributable to the lower risk for pregnancy complications, such as preeclampsia among these SEA women, and smaller infant size. In this study, the mean birth weight (and standard deviation) for Cambodians, Laotians and Vietnamese infants were 3,159 ± 498, 3,170 ± 472, and 3,233 ± 474 g, respectively. These mean birth weights were significantly lower when compared with mean infant birth weight of white women (3,456 ± 555 g, $P < 0.005$). Other researchers working with SEA refugees discovered a belief in the importance of limiting the size of the infant in order to avoid a difficult labor through some restriction of food intake during pregnancy [21]. These researchers also posit that it is quite reasonable that there is fear of cesarean section given the risks of surgical delivery, for example, in rural Cambodia and the possible stigmatization of the cesarean newborn for religious or cultural reasons.

Cambodian and Laotian women were more likely than Vietnamese and white women to deliver low birth weight infants and have moderate risk for preterm deliveries. These findings are consistent with those reported by Fuentes-Afflick et al. [28]. Other studies reported that Asian women are at increased risk for low birth weight (aOR = 1.37, 95% CI 0.93–2.00) and preterm delivery (<37 weeks) (aOR = 1.10, 95% CI 0.67–1.83) when compared with white women [34, 35]. Gann et al. (1989) also found that a higher prevalence of premature births among Cambodian patients when compared with white clinic controls. The moderate risk for preterm deliveries among Cambodian and Laotian women in our cohort may be explained by a lower pre-pregnancy weight compared with white women [36]. Observed increased risk for birth injury among infants of SEA women compared with white women may be attributable to the smaller stature and pelvic size of SEA women [21, 37].

Although, Cambodia, Laos and Vietnam are neighboring countries and have been under French colonization and Communist rule, these countries differ in many factors. Our results suggest that the heterogeneity in maternal health, pregnancy complications and perinatal outcomes may be attributed to ethnicity and nativity (e.g., genetic, behavioral and environmental) variations in these SEAs [38, 39]. However, we were unable to test the genetic, behavioral, and environmental factors since the Washington state birth certificate does not provide information on immigration status.

Our results should be interpreted within the context of several limitations. Information on obstetric procedures, pregnancy complications, and medical conditions are consistently underreported in birth certificates [17] and were not obtained for some years of this study period. In addition some self-reported variables (e.g., number of prenatal visits, pre-pregnancy weight, cigarette smoking status) may not be accurate, and we lacked information on potential confounders, such as pre-pregnancy body mass index and prior cesarean section. Collectively, these limitations are likely to have attenuated our chances for controlling for confounding and to have contributed to some imprecision in reported estimates. Finally, we lacked detailed information on acculturation such as duration of residence in the US and language preferences. These could be potential mediators of the patterns of risk that were identified.

Conclusions

Our study highlights the importance of considering heterogeneity in maternal characteristics, pre-gestational and antepartum morbidity, and perinatal outcomes across SEA groups. Nativity status together with ethnicity may serve as important characteristics that differentiate pregnancy outcomes among Asian Americans. Differences in nativity among SEAs (populations that are traditionally studied in aggregate) should be considered when designing and carrying out interventions to prevent adverse pregnancy morbidity and outcomes among immigrants.

References

1. Qin C, Gould JB. The Asian birth outcome gap. Paediatr Perinat Epidemiol. 2006;20:279–89.
2. Frisbie WP, Cho Y, Hummer RA. Immigration and the health of Asian and Pacific Islander adults in the United States. Am J Epidemiol. 2001;153:372–80.
3. Terrazas A, Batalova J. The most up-to-date frequently requested statistics on immigrants in the United States. Found at: http://www.migrationinformation.org/USFocus/display.cfm?ID=714 (2008). Accessed 4 Mar 2009.
4. Terrazas A, Batalova J. 2007 American Community Survey and Census Data on Foreign-born by state. Found at: http://www.migrationinformation.org/DataHub/acscensus.cfm (2007). Accessed 22 May 2009.
5. Grieco E. The foreign born from Vietnam in the United States. Found at http://www.migrationinformation.org/USFocus/print.cfm?ID=197 (2004). Accessed 4 Mar 2009.
6. Census Bureau US: Census 2000 summary file 3. 2000.
7. Marsh RE. Socioeconomic status of Indochinese refugees in the United States—progress and problems. Soc Secur Bull. 1980; 43:11–20.
8. Schaefer UM, Songster G, Xiang A, et al. Congenital malformations in offspring of women with hyperglycemia first detected during pregnancy. Am J Obstet Gynecol. 1997;177:1165–71.

9. O'Hare WJ. A new look at poverty in America. Popul Bull. 1992;51:1–47.
10. Rao AK, Cheng YW, Caughey AB. Perinatal complications among different Asian-American subgroups. Am J Obstet Gynecol. 2006;194:e39–41.
11. Rao AK, Daniels K, El-Sayed YY, et al. Perinatal outcomes among Asian American and Pacific Islander women. Am J Obstet Gynecol. 2006;195:834–8.
12. Lin-Fu JS. Population characteristics and health care needs of Asian Pacific Americans. Public Health Rep. 1988;103:18–27.
13. Singh GK, Yu SM. Pregnancy outcomes among Asian Americans. Asian Am Pac Isl J Health. 1993;1:63–78.
14. Barnes JS, Bennett CE. The Asian population: 2000. Census 2000 Brief, C2KBR/01-16; 2002. 12 pp.
15. Singh GK, Yu SM. Adverse pregnancy outcomes: differences between US- and foreign-born women in major US racial and ethnic groups. Am J Public Health. 1996;86:837–43.
16. Lydon-Rochelle MT, Holt VL, Cardenas V, et al. The reporting of pre-existing maternal medical conditions and complications of pregnancy on birth certificates and in hospital discharge data. Am J Obstet Gynecol. 2005;193:125–34.
17. Lydon-Rochelle MT, Holt VL, Nelson JC, et al. Accuracy of reporting maternal in-hospital diagnoses and intrapartum procedures in Washington state linked birth records. Paediatr Perinat Epidemiol. 2005;19:460–71.
18. Johnson EB, Reed SD, Hitti J, et al. Increased risk of adverse pregnancy outcome among Somali immigrants in Washington state. Am J Obstet Gynecol. 2005;193:475–82.
19. Savitz DA, Janevic TM, Engel SM, et al. Ethnicity and gestational diabetes in New York City, 1995–2003. BJOG. 2008; 115:969–78.
20. Rudra CB, Sorensen TK, Leisenring WM, et al. Weight characteristics and height in relation to risk of gestational diabetes mellitus. Am J Epidemiol. 2007;165:302–8.
21. Gann P, Nghiem L, Warner S. Pregnancy characteristics and outcomes of Cambodian refugees. Am J Public Health. 1989;79: 1251–7.
22. Erickson RV, Hoang GN. Health problems among Indochinese refugees. Am J Public Health. 1980;70:1003–6.
23. Stein J, Berg C, Jones JA, et al. A screening protocol for a prenatal population at risk for inherited hemoglobin disorders: results of its application to a group of Southeast Asians and Blacks. Am J Obstet Gynecol. 1984;150:333–41.
24. Taylor VM, Peacock S, Kramer MD, et al. Increased risk of placenta previa among women of Asian origin. Obstet Gynecol. 1995;86:805–8.
25. Yang Q, Wu Wen S, Caughey S, et al. Placenta previa: its relationship with race and the country of origin among Asian women. Acta Obstet Gynecol Scand. 2008;87:612–6.
26. Maayan-Metzger A, Mazkereth R, Shani A, et al. Risk factors for maternal intrapartum fever and short-term neonatal outcome. Fetal Pediatr Pathol. 2006;25:169–77.
27. Qing L, Keith LG, Kirby RS. Perinatal outcomes among foreign-born and US-born Chinese Americans, 1995–2000. J Immigr Minor Health. 2009; doi 10.1007/s10903-008-9191-x.
28. Fuentes-Afflick E, Hessol NA. Impact of Asian ethnicity and national origin on infant birth weight. Am J Epidemiol. 1997;145:148–55.
29. Baker LC, Afendulis CC, Chandra A, et al. Differences in neonatal mortality among whites and Asian American subgroups: evidence from California. Arch Pediatr Adolesc Med. 2007;161: 69–76.
30. Fuentes-Afflick E, Lurie P. Low birth weight and Latino ethnicity. Examining the epidemiologic paradox. Arch Pediatr Adolesc Med. 1997;151:665–74.
31. de la Rosa IA. Perinatal outcomes among Mexican Americans: a review of an epidemiological paradox. Ethn Dis. 2002;12:480–7.
32. Buekens P, Notzon F, Kotelchuck M, et al. Why do Mexican Americans give birth to few low-birth-weight infants? Am J Epidemiol. 2000;152:347–51.
33. Patel A, Patel D, Keith L, et al. Epidemiologic paradox in multiple births among Asians in Illinois. Correlation between risk factors and outcomes. J Reprod Med. 1997;42:735–9.
34. Shiono PH, Klebanoff MA, Graubard BI, et al. Birth weight among women of different ethnic groups. JAMA. 1986;255: 48–52.
35. Shiono PH, Klebanoff MA. Ethnic differences in preterm and very preterm delivery. Am J Public Health. 1986;76:1317–21.
36. Peckham CH, Christianson RE. The relationship between prepregnancy weight and certain obstetric factors. Am J Obstet Gynecol. 1971;111:1–7.
37. Davis JM, Goldenring J, McChesney M, et al. Pregnancy outcomes of Indochinese refugees, Santa Clara County, California. Am J Public Health. 1982;72:742–4.
38. Jasso G, Rosenzweig M. The new chosen people: immigrants in the United States. New York: Russell Sage Foundation; 1990.
39. Hopkins DD, Clarke NG. Indochinese refugee fertility rates and pregnancy risk factors, Oregon. Am J Public Health. 1983;73: 1307–9.