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Original Research

Risk of unplanned caesarean birth in Vietnamese-born women in Victoria, Australia: A cross-sectional study

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ABSTRACT

Background: Understanding the prevalence of, and factors associated with, caesarean birth among immigrant populations is essential for appropriate antenatal and postnatal resource allocation.
Aims: To compare rates of caesarean birth between one of the largest immigrant populations of women giving birth in Australia (Vietnamese-born women) with those of Australian-born women and investigate the odds of unplanned caesarean in these women, controlling for maternal characteristics, pregnancy complications and labour management factors.
Methods: Cross-sectional analysis of data on singleton births in Victoria, Australia; using data from the routinely collected Victorian Perinatal Data Collection. Descriptive analyses comparing maternal and obstetric factors for Vietnamese-born women with Australian-born women were undertaken. Using the more recent nine years of routinely collected data, multivariable logistic regression explored the association between unplanned caesarean birth and maternal country of birth, adjusted for maternal and obstetric factors, admission status and time (n = 468,131). This association was also explored for 'standard primiparae' (n = 69,039).
Findings: Planned and unplanned caesarean births increased dramatically in both Australian-born and Vietnamese-born women between 1984 and 2007. After adjustment for obstetric and maternal factors, Vietnamese-born women were at greater odds of an unplanned caesarean birth compared to Australian-born women (adjusted odds ratio = 1.32, 95% confidence interval = 1.25–1.40). These greater odds were also found among the 'standard primiparae' (adjusted odds ratio = 1.22, 95% confidence interval = 1.07–1.40).
Conclusion: Factors other than clinical risk appear to predispose Vietnamese-born women to unplanned caesarean birth. These may include intrapartum communication, length of residence and familiarity with care systems, and variations in care practices for Vietnamese women.

Statement of significance

Problem or issue

Due to heterogeneity in terms of data and analytical approach, the literature provides limited evidence with respect to the extent to which unplanned caesarean birth is associated with maternal country of birth.

What is already known

A range of maternal and labour related factors are associated with unplanned caesarean birth. Hospital and more general population based studies typically show equivalent or lower rates of unplanned caesarean births for Vietnamese-born women compared to Australian-born women, but few adjust for potential confounders.

What this paper adds

Using representative routinely collected data, we show that Vietnamese-born women have an elevated risk of

Abbreviations: VPDC, Victorian Perinatal Data Collection; NES, non-English speaking; CCOPMM, Consultative Council on Obstetric and Paediatric Mortality and Morbidity; OES, overseas English-speaking; ABS, Australian Bureau of Statistics; SEIFA, Socio-Economic Index for Areas.

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unplanned caesarean birth compared with Australian-born women, after adjusting for a large range of salient maternal, pregnancy and labour management related factors.

1. Introduction

Wide variation in the prevalence of caesarean birth among immigrant populations has been noted over many years, both in Australia[1–6] and in other industrialised nations.[7–9] However, a recent systematic review of studies comparing caesarean birth in immigrant and non-immigrant populations showed that many studies made no adjustment for potential confounders or were ambiguous in the definitions of their study groups.[10] Many also collapsed maternal countries of birth into regions of origin, with the resultant risk of masking between-country differences.[10] Without appropriate adjustment for confounding or careful classification of the populations, efforts to understand the explanations for country of birth variations in caesarean birth are severely compromised and open to potentially misguided speculation, particularly about ethnic and cultural differences. In order to know whether it is a matter of concern that immigrant women from particular countries of origin have higher or lower rates of caesarean birth than non-immigrant women, it is important to understand the differential impacts of a range of maternal, pregnancy, obstetric and social factors for the particular groups studied.

Births to women who are immigrants or refugees account for over a quarter of all births in Australia[11] and have done so for many years. Women born in countries where English is not the principal language spoken account for the majority of these immigrant births, now about 20% of all births annually.[11] Until very recently, Vietnamese-born women have been the largest group of immigrant women from a non-English speaking (NES) country to give birth in the state of Victoria,[12] and Vietnamese-born women continue to be in the top three NES countries of maternal origin both in Victoria[12] and nationally.[11]

A number of Australian hospital and population-based studies have reported data on caesarean birth in Vietnamese-born women compared with their Australian-born counterparts, finding lower or similar rates of caesarean section,[3–5,13–15] but none to date has adjusted for potential confounders in the association between maternal country of birth and risk of caesarean section.

In this study we had two primary aims and a third secondary aim:

1) To provide a descriptive overview of caesarean birth, both planned and unplanned, in Vietnamese and Australian-born women giving birth in Victoria since routine data have been available, from 1984 to 2007;
2) To estimate the odds of unplanned caesarean birth in Vietnamese and Australian-born women in the more recent period 1999–2007, firstly for all women who gave birth with adjustment for maternal characteristics, pregnancy and labour management factors, and secondly, examining odds in 'standard primiparae'; and
3) For comparative purposes (i.e. to Australian- and Vietnamese-born), to provide an additional descriptive overview of planned and unplanned caesarean birth; and estimate the adjusted odds of unplanned caesarean birth in all women who gave birth and for a 'standard primiparae' subsample for those born in other non-English speaking and other overseas English speaking countries.

2. Methods

2.1. Data source and participants

The data source for this study was the Victorian Perinatal Data Collection (VPDC) which collects information on every birth (both maternal and child data) in Victoria at 20 or more weeks' gestation, or with a birthweight of at least 400 g if gestation is unknown, on behalf of the Consultative Council on Obstetric and Paediatric Mortality and Morbidity (CCOPMM). The VPDC data are routinely collected by midwives for all births in Victoria and form the basis for annual birth surveillance reporting in the state. For the purpose of the analyses conducted here, data were requested for the period 1984–2007, with multivariable analyses restricted to the most recent period 1999–2007. All multiple births have been excluded. Validation of the VPDC data for births in 2003 found high levels of accuracy.[16]

2.2. Ethics approval

Ethics approval for this research was granted by La Trobe University Human Ethics committee (application UHEC No. 05-062) and permission to access the VPDC data was granted by the Consultative Council on Obstetric and Paediatric Mortality and Morbidity (CCOPMM).

2.3. Measures

2.3.1. Outcome variable of interest

Caesarean section birth. We report both unplanned and planned caesarean section (CS) births over time for descriptive purposes. However, our primary interest here is comparisons between Vietnamese-born and Australian born women and the proportions experiencing *unplanned caesarean birth* taking into account potential confounding socio-demographic, maternal, obstetric and labour related factors. In this paper, unplanned caesarean birth is defined as a caesarean section where the women giving birth had experienced labour and did not plan a caesarean birth at the onset of labour. Both women who had planned caesarean births and unplanned caesarean births without experiencing labour, were therefore excluded from the multivariable analyses.

2.3.2. Exposure variables of interest

2.3.2.1. Socio-demographic factors. Maternal country of birth. Women's country of birth is recorded at the time of birth in Victoria using Australian Bureau of Statistics country classifications.[17] Maternal countries of birth were then grouped into four categories: Australia, Vietnam, overseas English-speaking (OES) countries and overseas non-English speaking (NES) countries. The main focus of this paper is a comparison between Australian and Vietnamese-born women, however in all analyses women giving birth who originated from other English speaking or non-English speaking countries were also included in the model to enable comparisons. The reference category in multivariable analyses is women born in Australia.

Maternal age. Women's age was measured ordinally, with women grouped into either 'younger than 20 years', '20–34 years' or' 35 years or above' age categories. In all regression analyses women aged between 20 and 34 years were treated as the reference category.

Marital status. Marital status was a nominal measure with women treated as either; 'Married', 'De facto' or 'Single'. In addition to women identifying as single, women were also considered single if they were divorced, widowed or currently separated.

Married women were treated as the reference category in multivariable analyses.

Admission status (only collected from 1999). Women's hospital admission status was classified as either public or private. Women birthing as public patients were treated as the reference category in multivariable analyses.

Socio-economic status. Women's socio-economic status was measured using 2006 Australian Bureau of Statistics' (ABS) Socio-Economic Index for Areas (SEIFA) which uses aggregated statistical local area household characteristics to measure relative area specific advantage and disadvantage.[18] Each birth record was given a SEIFA index score using VPDC place of residence postcode data, then re-scored to an ordinal measure using ABS developed SEIFA deciles. Using the SEIFA decile rankings, women were then trichotomised (i.e. using sample tertiles) as living in either 'low', 'medium' or 'highly' ranked socio-economic areas. In multivariable analyses, women with 'high' SEIFA scores were treated as the reference group.

2.3.2.2. Pregnancy and labour management factors. Birthweight. Birthweight was measured in grams and modelled as a continuous covariate. Effect estimates for birthweight in multivariable analyses were re-scaled to show odds per 100 g unit change.

Low birthweight. Low birthweight was measured dichotomously and indicated whether the birthweight for a newborn was below 2500 g.

Gestation. Ordinal gestation categories were defined in the following way: 20–27, 28–31, 32–36, 37–41 or 42+ completed weeks. Women with a gestational age between 37 and 41 weeks were treated as the reference group.

Presentation. Presentation was dichotomised as vertex or any other presentation (breech, face, shoulder etc.). Women with vertex presentation were treated as the reference group.

2.3.2.2.5. Complications of pregnancy. Complications of pregnancy were reported by midwives using ICD-10AM codes. These data were dichotomised into 'any complication of pregnancy reported' or 'no complication of pregnancy reported'. 'No complication of pregnancy' was treated as the reference group.

Maternal medical complications. Maternal medical complications was measured dichotomously, and indicated whether a women reported any pre-existing medical conditions prior to birth. For example, conditions could include diabetes, hypertension, renal and psychosocial conditions.

Parity. Parity was measured dichotomously and compared primiparous and multiparous women. Multiparous women were the reference in multivariable analyses.

Table 1
Characteristics of Vietnamese and Australian-born women giving birth during the two main time periods, 1984–1998 and 1999–2007: counts and per cent (%).

1984–1998	Aust. (n = 692,119)	Viet. (n = 18,372)	OES (n = 68,392)	NES (n = 137,140)
Age				
<20 years	30,354 (4.4)	485 (2.6)	1622 (2.4)	3616 (2.6)
20–34 years	589,515 (85.2)	14,841 (80.8)	56,233 (82.2)	110,361 (80.5)
35+ years	72,250 (10.4)	3046 (16.6)	10,537 (15.4)	23,163 (16.9)
Marital status				
Married	559,737 (80.9)	15,597 (84.9)	56,978 (83.3)	128,421 (93.6)
De facto	52,310 (7.5)	392 (2.1)	4980 (7.3)	3011 (2.2)
Single/divorced/separated	80,072 (11.6)	2383 (13.0)	6434 (9.4)	5708 (4.2)
Parity				
Primiparous	278,312 (40.2)	7754 (42.2)	26,132 (38.2)	51,392 (37.5)
Multiparous	413,807 (59.8)	106,18 (57.8)	42,260 (61.8)	85,748 (62.5)
Standard primiparae[a]	122,534 (17.7)	2949 (16.1)	11,447 (16.7)	21,556 (15.7)
1999–2007	**Aust. (n = 352,247)**	**Viet. (n = 13,251)**	**OES (n = 25,504)**	**NES (n = 77,129)**
Age				
<20 years	13,689 (3.9)	172 (1.3)	585 (2.3)	1497 (1.9)
20–34 years	273,888 (77.7)	10,613 (80.1)	17,635 (69.1)	59,163 (76.7)
35+ years	64,670 (18.4)	2466 (18.6)	7284 (28.6)	16,469 (21.4)
Marital status				
Married	241,397 (68.5)	10,038 (75.7)	17,927 (70.3)	66,571 (86.3)
De facto	58,481 (16.6)	565 (4.3)	4237 (16.6)	3971 (5.2)
Single/divorced/separated	52,369 (14.9)	2648 (20.0)	3340 (13.1)	6587 (8.5)
Admission status				
Public	227,375 (64.5)	11,784 (88.9)	16,608 (65.1)	60,551 (78.5)
Private	124,872 (35.5)	1467 (11.1)	8896 (34.9)	16,578 (21.5)
Socio-economic status (SEIFA)				
Low	117,863 (33.4)	7414 (56.0)	5824 (22.8)	28,138 (36.5)
Medium	137,972 (39.2)	3980 (30.0)	9412 (36.9)	26,696 (34.6)
High	96,412 (27.4)	1857 (14.0)	10,268 (40.3)	22,295 (28.9)
Parity				
Primiparous	160,894 (45.7)	5818 (43.9)	10,941 (42.9)	33,578 (43.5)
Multiparous	191,353 (54.3)	7433 (56.1)	14,563 (57.1)	43,551 (56.5)
Standard primiparae[a]	52,989 (15.0)	1783 (13.5)	3507 (13.7)	10,760 (13.9)

OES = overseas English speaking country; NES = non-English speaking country; Aust. = Australia; Viet. = Vietnamese.

[a] Primiparous women aged 20–34 years without medical or obstetric complications with a singleton pregnancy at term (37–41 weeks) with a non small for gestational age baby with cephalic presentation.

Standard primiparae. Women were classified as standard primiparae if they were: primiparous, aged 20–34 years without obstetric or specified medical complications, having a singleton, term (37–41 weeks) pregnancy with a non-small-for-gestational-age baby and cephalic presentation.

Labour onset. Onset of labour was grouped into three categories: spontaneous onset with no subsequent augmentation; spontaneous onset with later augmentation by amniotomy or oxytocin infusion; or induction of labour. Women experiencing spontaneous onset of labour without augmentation were treated as the reference group.

Epidural analgesia (only collected between 1999 and 2007). If epidural analgesia was used to relieve pain in labour, this variable was coded 'yes' (but not if an epidural was inserted *de novo* to facilitate operative birth); and 'no' otherwise.

2.4. Analysis

There were three stages to data analysis undertaken in this study. The first involved bivariate descriptive analyses where rates of caesarean birth and other obstetric factors were examined over time and compared across maternal country of birth categories and across public and private admission populations. In order to provide more parsimonious comparisons of rates of caesarean birth and over time, birth observations were grouped into three-year temporal bands. The second stage of the analysis involved sequential multivariable logistic regression of nested models, where the association between unplanned caesarean birth and maternal country of birth was estimated, adjusted for socio-demographic, maternal/pregnancy, and labour management factors. The multivariable regression models estimated (a) the unadjusted association, (b) the association adjusted for socio-demographic (incl. admission status and year band) factors, (c) the association adjusted for socio-demographic and maternal/pregnancy characteristics and (d) the association adjusted for socio-demographic, maternal/pregnancy and labour management factors. In the final stage, multivariable logistic regression was used to explore the association between unplanned caesarean births and maternal country of birth for standard primiparae only. In order to test the temporal consistency of any observed effect of maternal country of birth on unplanned caesarean birth, extended models including partial interaction terms for maternal country of birth and year band were estimated. Post-estimation Wald tests were undertaken to compare differences in effects (model coefficients) between categories of discrete covariates and to assess the joint significance of partial interaction terms. In all analyses, despite the likelihood that any bias would be small given the large sample, we nonetheless specified Huber/White sandwich estimator standard errors[19] to appropriately account for the implied lack of independence in observations given women could provide birth observations across multiple years. A complete case approach to multivariable analyses was undertaken and all statistical analyses were performed using Stata Version 13.[20]

3. Results

3.1. Demographic characteristics of women giving birth for the periods 1984–1998 and 1999–2007

Table 1 shows the demographic characteristics of Australian and Vietnamese-born women giving birth for the two main time periods: 1984–1998 and 1999–2007.

In the first time period (1984–1998), compared to Australian-born women, Vietnamese-born women were more likely to be aged 35 and older (17% vs. 10%) and to be married (85% vs. 81%). In the second time period (1999–2007), compared to Australian-born women, Vietnamese-born women were more likely to live in socio-economically disadvantaged areas (Low SEIFA: 56% vs. 33%), give

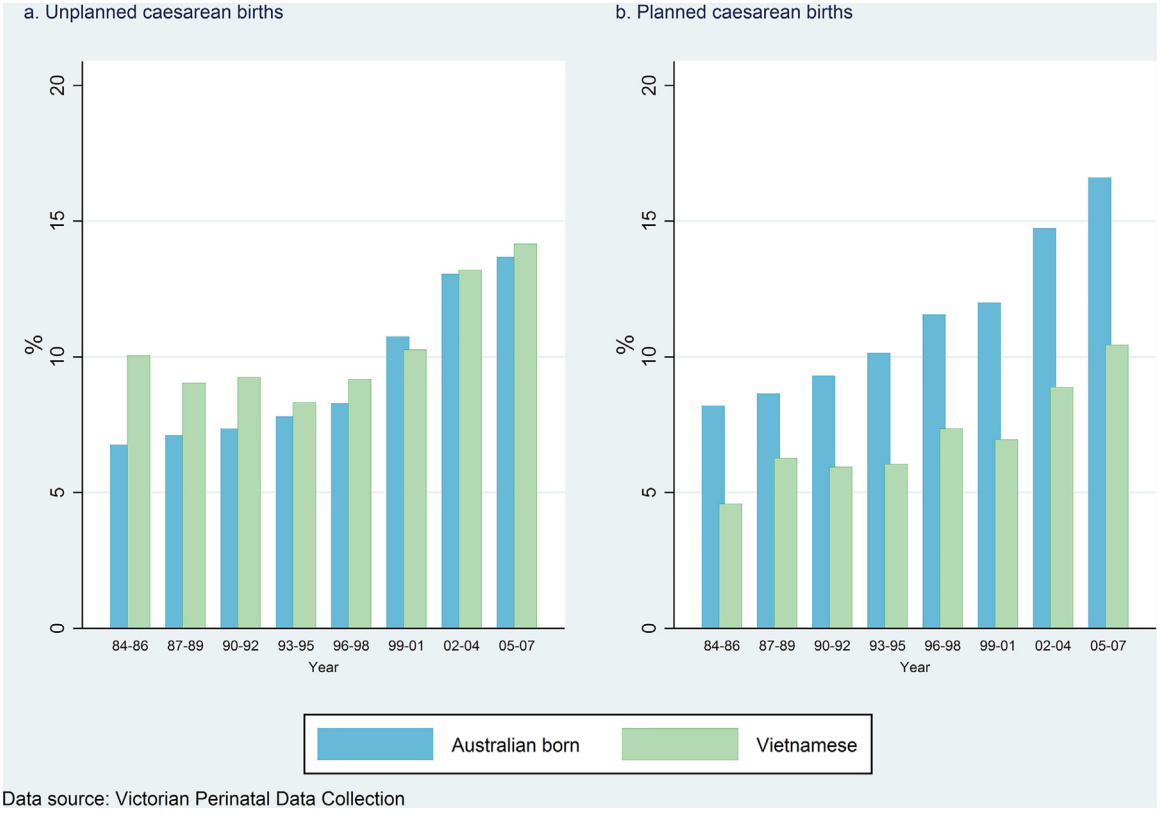

Fig. 1. Caesarean births by maternal country of birth: 1984–2007.

birth as public patients (89% vs. 65%), be married (76% vs. 69%) and were less likely to be aged under 20 years (1% vs. 4%).

3.2. Caesarean birth between 1984 and 2007

The proportions of women having both unplanned (Fig. 1a) and planned (Fig. 1b) caesarean births have increased significantly between 1984 and 2007. Ten per cent of Vietnamese-born women and 7% of women born in Australia had unplanned caesareans in the period 1984–1986; by 2005–2007 the rate for both groups of women had increased to 14%. In terms of planned caesarean births, between the periods 1984–1986 and 2005–2007 the rates for Vietnamese and Australian-born women had increased from 5% to 10% and 8% to 17% respectively. Furthermore, as Fig. 1b shows, over the past two decades, this relatively higher rate of planned caesarean births of Australian-born women has remained consistent over time. The pattern for unplanned caesarean births is quite different, however. As Fig. 1a shows, after initially higher rates in Vietnamese-born women in 1984, a convergence in rates begins to occur in the period up to 1995, after which the proportions of Australian and Vietnamese-born women having unplanned caesarean births have been relatively comparable.

3.3. Characteristics of the included study sample for univariable and multivariable analyses, 1999–2007

There were 566,202 women who had singleton births between 1999 and 2007 and valid mode of birth data. Of these women, 93,349 were excluded due to having either planned caesarean births with or without labour (n = 79,639), or unplanned caesarean births without labour (n = 13,710). Of the remaining 472,853 women who had eligible data for analysis during this period, a small proportion (1%, n = 4722) were excluded due to missing data on covariates given the complete case approach used in multivariable analyses. Compared to those included in the study sample, women excluded from analyses due to missing data on model covariates were less likely to have experienced an unplanned caesarean birth (10% vs. 13%). Of the women in the analysis sample (n = 468,131), approximately 13% (n = 59,249) experienced an unplanned caesarean section.

3.4. Obstetric factors by maternal country of birth by admission status between 1999 and 2007

Table 2 shows the univariable associations between maternal country of birth (Australian vs. Vietnamese-born) and obstetric factors, stratified by public and private admission status. In terms of mode of birth, the rates of unplanned caesarean birth were the same for Vietnamese (13%) and Australian-born women (13%) and for both groups of women, higher if they had been admitted as private patients (Vietnamese: 16% vs. 12%; Australian: 14% vs. 12%). Compared to Australian-born women, Vietnamese-born women had, on average: lower birthweight babies (mean: 3192 vs. 3440 g); were more likely to be small for gestational age (15% vs. 9%); and showed higher rates of obstetric complication (42% vs. 36%). Conversely, Vietnamese-born women were generally less likely to use any analgesia in labour (67% vs. 75%), use epidural analgesia (14% vs. 26%) and to have labour induced (17% vs. 33%). Generally,

Table 2
Obstetric and birth characteristics of Vietnamese and Australian-born women giving birth, by admission status (1999–2007): counts (n), per cent (%), means and standard deviations (sd).

Factor	Public		Private		All admissions	
	Aust. (n = 227,375)	Viet. (n = 11,784)	Aust. (n = 124,872)	Viet. (n = 1467)	Aust. (n = 352,247)	Viet. (n = 13,251)
Birthweight						
Mean grams (sd)	3418 (582)	3192 (467)	3480 (531)	3195 (485)	3440 (565)	3192 (469)
<2500 g (n (%))	11,889 (5.2)	595 (5.0)	3584 (2.9)	83 (5.7)	15,473 (4.4)	678 (5.1)
Gestation (mean weeks(sd))	39.2 (2.0)	38.9 (1.8)	39.2 (1.8)	38.8 (1.9)	39.2 (1.9)	38.9 (1.8)
Maternal medical complications (n (%))	67,049 (29.5)	2690 (22.8)	23,643 (19.0)	236 (16.1)	90,692 (25.8)	2,926 (22.1)
Complications of pregnancy (n (%))	86,710 (38.1)	4990 (42.4)	38,719 (31.0)	559 (38.2)	125,429 (35.6)	5549 (42.0)
Small for gestational age (n (%))	22,258 (9.8)	1827 (15.5)	8164 (6.5)	217 (14.8)	30,422 (8.6)	2044 (15.4)
Stillborn/neonatal death(n (per 1000 births))	1862 (8.2)	61 (5.2)	8961 (7.2)	109 (7.4)	2753 (7.8)	70 (5.3)
Preterm birth (n (%))	13,263 (5.8)	624 (5.3)	5439 (4.4)	82 (5.6)	18,702 (5.3)	706 (5.3)
Any analgesia	165,093 (72.6)	7806 (66.2)	99,311 (79.5)	1104 (75.3)	264,404 (75.1)	8910 (67.2)
Epidural analgesia	46,864 (20.6)	1426 (12.1)	44,753 (35.8)	449 (30.6)	91,617 (26.0)	1875 (14.1)
Labour						
Spontaneous	109,932 (48.4)	7120 (60.4)	44,948 (36.0)	605 (41.2)	154,880 (44.0)	7725 (58.3)
Induced	69,406 (30.5)	1930 (16.4)	48,195 (38.6)	354 (24.2)	117,601 (33.4)	2284 (17.2)
Augmented	48,037 (21.1)	2734 (23.2)	31,729 (25.4)	508 (34.6)	79,766 (22.6)	3242 (24.5)
Non-vertex presentation	5634 (2.5)	279 (2.4)	2319 (1.9)	31 (2.1)	7953 (2.3)	310 (2.3)
Mode of birth (n (%))						
Unassisted cephalic	171,428 (75.4)	8960 (76.0)	79,057 (63.3)	852 (58.1)	250,485 (71.1)	9812 (74.0)
Vaginal breech	1242 (0.6)	61 (0.5)	505 (0.4)	4 (0.2)	1,747 (0.5)	65 (0.5)
Forceps	13,084 (5.7)	508 (4.3)	14,695 (11.8)	202 (13.8)	27,779 (7.9)	710 (5.4)
Vacuum	15,433 (6.8)	837 (7.1)	12,787 (10.2)	177 (12.1)	28,220 (8.0)	1014 (7.6)
Unplanned CS	26,188 (11.5)	1418 (12.0)	17,828 (14.3)	232 (15.8)	44,016 (12.5)	1650 (12.5)

Aust. = Australia; Viet. = Vietnamese.

these differences in obstetric outcomes between Australian and Vietnamese-born women were consistent across public and private settings, although the difference in rates of epidural use in labour between the two groups of women was more pronounced for public patients. Similarly, privately admitted Vietnamese-born women had higher rates of labour augmentation (35%) than their Australian-born counterparts (25%), whereas this difference was smaller for those admitted as public patients (23% vs. 21%). Also noteworthy is the finding that Vietnamese and Australian-born women had comparable rates of preterm birth.

3.5. Caesarean birth by maternal country of birth adjusted for maternal and obstetric factors 1999–2007

When the association between unplanned caesarean birth and maternal country of birth was examined with adjustment for socio-demographic, maternal and obstetric factors Vietnamese born women were shown to be at greater odds of an unplanned caesarean section birth (Table 3).

As Table 3 shows, there was no significant difference in the odds of unplanned caesarean birth between Vietnamese-born and

Table 3
Unplanned caesarean birth by maternal country of birth adjusted for maternal and obstetric factors, 1999–2007: Unadjusted odds ratio (OR), adjusted odds ratio (Adj OR), 95% confidence interval (95%CI) and probability value (p-value) (n = 468,131).

Factor	Model A			Model B			Model C			Model D		
	OR	95%CI[a]	p-Value[a]	Adj OR	95%CI[a]	p-Value[a]	Adj OR	95%CI[a]	p-Value[a]	Adj OR	95%CI[a]	p-Value[a]
Maternal country of birth												
Australia	Ref	–	–	Ref	–	–	Ref	–	–	Ref	–	–
OES-country	0.96	0.92–0.99	0.046	0.95	0.91–0.98	0.007	0.96	0.92–0.99	0.043	0.97	0.93–1.01	0.176
NES-country	1.10	1.08–1.13	<0.001	1.15	1.12–1.18	<0.001	1.20	1.17–1.23	<0.001	1.25	1.22–1.28	<0.001
Vietnam	0.99	0.94–1.05	0.881	1.07	1.02–1.13	0.009	1.16	1.10–1.23	<0.001	1.32	1.25–1.40	<0.001
Marital status												
Married				Ref	–	–	Ref	–	–	Ref	–	–
De facto				1.12	1.09–1.15	<0.001	1.02	0.99–1.05	0.211	1.02	0.99–1.05	0.080
Single				1.12	1.09–1.15	<0.001	0.99	0.96–1.02	0.568	0.98	0.95–1.01	0.213
Maternal age												
<20 years				0.72	0.68–0.76	<0.001	0.49	0.46–0.52	<0.001	0.51	0.48–0.54	<0.001
20–34 years				Ref	–	–	Ref	–	–	Ref	–	–
35+ years				1.10	1.08–1.13	<0.001	1.48	1.44-1.51	<0.001	1.46	1.43–1.50	<0.001
Private admission				1.27	1.24–1.29	<0.001	1.22	1.20-1.25	<0.001	1.05	1.03–1.07	<0.001
Socio-economic status (SEIFA)												
Low				0.97	0.95–0.99	0.013	1.13	1.11–1.16	<0.001	1.27	1.15–1.30	<0.001
Medium				1.00	0.98–1.03	0.723	1.08	1.06–1.11	<0.001	1.16	1.14–1.20	<0.001
High				Ref	–	–	Ref	–	–	Ref	–	–
Year band												
1999–2001				Ref	–	–	Ref	–	–	Ref	–	–
2002–2004				1.22	1.19–1.25	<0.001	1.18	1.16–1.21	<0.001	1.18	1.15–1.21	<0.001
2005–2007				1.30	1.26–1.32	<0.001	1.18	1.16–1.21	<0.001	1.17	1.14–1.20	<0.001
Complications of pregnancy							1.77	1.73–1.80	<0.001	1.53	1.51–1.57	<0.001
Parity												
Primiparous							4.32	4.23–4.41	<0.001	3.25	3.18–3.32	<0.001
Birthweight (per 100 g)							1.06	1.06–1.06	<0.001	>1.05	1.05–1.05	<0.001
Gestation												
20–27 weeks							0.59	0.49–0.70	<0.001	0.55	0.46–0.66	<0.001
28–31 weeks							3.35	2.91–3.86	<0.001	3.64	3.13–4.23	<0.001
32–36 weeks							1.77	1.70–1.86	<0.001	1.97	1.88–2.06	<0.001
37–41 weeks							Ref	–	–	Ref	–	–
42+ weeks							1.80	1.70–1.92	<0.001	1.67	1.57–1.78	<0.001
Non-vertex birth							13.62	12.97–14.30	<0.001	16.90	16.07–17.77	<0.001
Labour onset												
Spontaneous										Ref	–	–
Induced										1.35	1.31–1.38	<0.001
Augmented										1.12	1.09–1.14	<0.001
Epidural analgesia										2.85	2.79–2.91	<0.001

OES-country = overseas English speaking country; NES-country = non-English speaking country.
Model A = maternal country of birth.
Model B = + socio-demographic factors, admission status and temporal period.
Model C = + maternal/pregnancy factors.
Model D = + labour management factors.
Ref = reference group.
[a] 95% confidence intervals and probability values based on Huber/White robust variance estimates.

Australian-born women in terms of the unadjusted association (Model A: OR = 0.99, 95%CI = 0.94–1.05, p = 0.881). However, accounting for socio-demographic factors, hospital admission status and year band showed that Vietnamese born women were at greater odds of unplanned caesarean birth (Model B: adjOR = 1.07, 95%CI 1.02–1.13, p = 0.009). Further, compared to Australian-born women and when obstetric factors (Model C; adjOR = 1.16, 95%CI 1.10–1.23, $p < 0.001$) and labour management factors (Model D; adjOR = 1.32, 95%CI 1.25–1.40, $p < 0.001$) were controlled for, Vietnamese-born women were found to be at elevated odds of unplanned caesarean birth. After adjustment for socio-demographic, maternal, obstetric and labour factors, compared to Australian-born women, women born in other non-English speaking countries were also more likely to exhibit greater odds of unplanned caesarean birth (Model D; adjOR = 1.25, 95%CI 1.22–1.28, $p < 0.001$); and a post-estimation Wald test showed that there was no significant difference in odds for women born in other NES-countries relative to Vietnamese-born women (Wald $\chi^2(1) = 3.19$, p = 0.07). Further, in order to assess the extent to which the observed association between maternal country of birth and unplanned caesarean birth was consistent across time (i.e. year band) the effect of maternal of country of birth was allowed to vary across the temporal groupings in a less constrained extension of model D, through estimation of a set of partial interaction terms. A post-estimation joint Wald test showed the effect of maternal of country of birth on unplanned caesarean birth was consistent across temporal bands (Wald $\chi^2(6) = 9.96$, p = 0.126).

3.6. Unplanned caesarean birth in standard primiparae by maternal country of birth, 1999–2007

The association between maternal country of birth and unplanned caesarean section was explored further for the group of women classified as standard primiparae. As Table 4 shows, in this sample of women considered to be at low-risk of birth complications, women born in Vietnam were also more likely to experience an unplanned caesarean birth than were Australian-born women (adjOR = 1.22, 95%CI = 1.07–1.40, p = 0.003). There were no differences in the effect of maternal country of birth on unplanned caesarean birth across time (i.e. year band) among standard primiparae women (Wald $\chi^2(6) = 6.89$, p = 0.332).

Table 4
Unplanned caesarean birth by maternal country of birth for standard primiparae,[a] 1999–2007: count (n), percent (%), adjusted odds ratio (Adj OR), 95% confidence interval (95%CI) and probability value (p-value) (n = 69,039).

Factor	n (%)	Adj OR	95% CI[b]	p-Value
Maternal country of birth				
Australia	8658 (16.3)	Ref	–	–
OES-country	530 (16.7)	0.94	0.85–1.04	0.245
NES-country	1720 (16.0)	1.09	1.03–1.16	0.005
Vietnam	268 (15.0)	1.22	1.07–1.40	0.003
Marital status				
Married	8603 (16.7)	Ref	–	–
De facto	1492 (15.5)	1.02	0.95–1.09	0.623
Single	1081 (13.4)	0.88	0.82–0.95	0.001
Admission				
Public	5967 (14.5)	Ref	–	–
Private	5209 (18.7)	1.06	1.04–1.15	<0.028
Socio-economic status (SEIFA)				
Low	3284 (16.2)	1.35	1.28–1.44	<0.001–
Medium	4272 (16.3)	1.18	1.12–1.25	<0.001
High	3620 (16.1)	Ref	–	–
Year band				
1999–2001	3452 (14.1)	Ref	–	–
2002–2004	3959 (17.6)	1.29	1.23–1.36	<0.001
2005–2007	3765 (17.1	1.29	1.23–1.37	<0.001
Labour onset				
Spontaneous	2242 (7.7)	Ref	–	–
Induced	4168 (26.9)	3.01	2.83–3.20	<0.001
Augmented	4766 (19.5)	1.87	1.76–1.98	<0.001
Epidural analgesia				
No epidural	3901 (9.0)	Ref	–	–
Epidural	7236 (28.7)	3.28	3.12–3.44	<0.001

OES-country = overseas English speaking country; NES-country = non-English speaking country; Ref = reference group.

[a] Includes only primiparous women aged 20–34 years without medical or obstetric complications with a singleton pregnancy at term (37–41 weeks), a non-small for gestational age baby and cephalic presentation.

[b] 95% confidence intervals and probability values based on Huber/White robust variance estimates.

4. Discussion

To our knowledge, the population-based study reported here is the first to describe caesarean births to Vietnamese-born women in Australia in comparison with their Australian-born counterparts over more than a twenty-year period, and also to investigate risk of unplanned caesarean birth with adjustment for available confounders. The findings are illuminating, if somewhat unexpected, as Vietnamese women are not a group perceived to be at increased risk for caesarean section.

The proportion of Vietnamese women having caesarean births rose over the twenty-four years from 1984 to 2007, with unplanned caesareans slightly higher initially, but then similar overall to Australian-born women. Planned caesarean sections remained lower among Vietnamese-born women throughout the twenty years studied, a factor likely to be influenced by the much smaller number of Vietnamese-born women having private obstetric care, where planned caesarean rates are known to be higher than in public care.[21]

The only other recent Australian population-based study to examine caesarean births to low risk primiparous Vietnamese women is that of Dahlen et al.[3] who found in another Australian state (New South Wales) that 10.9% of Vietnamese-born women compared with 16.0% of Australian-born women had an unplanned caesarean section. Without adjustment for other factors that may be associated with caesarean section and which appear to differ significantly for Vietnamese and Australian-born women, (such as women's admission status (public/private), socio-economic status, use of induction and augmentation and use of epidural analgesia), it is unknown whether or not increased adjusted odds of unplanned caesarean section would also have been found in low risk primiparous Vietnamese-born women in the New South Wales data set.

Our analyses of nested multivariable models where socio-demographic factors, hospital admission status (public/private), obstetric and labour factors were sequentially adjusted, have demonstrated the extent to which estimates of the odds of unplanned caesarean birth to Vietnamese women are masked in unadjusted analyses. In understanding how the odds of unplanned caesarean birth for Vietnamese-born women may be underestimated using an unadjusted approach, interventions in labour are important to consider. Compared to Australian women, Vietnamese-born women had lower rates of induction of labour and epidural analgesia use (Table 2) and given the positive association (relative to spontaneous labour in the case of induction) between these labour factors and unplanned caesarean birth (adjOR = 1.35, 95%CI = 1.31–1.38 for induction and adjOR = 2.85, 95%CI = 2.79–2.91 for epidural analgesia), it follows that their relative lower rates of labour intervention mask a more complete estimate of the odds of unplanned caesarean birth. This is a strength of the current study. As noted above, increased risk of unplanned caesarean section in

Vietnamese women has not been found in previous Australian studies and the lack of inclusion of induction of labour and epidural analgesia in adjusted analyses seems likely to be the reason for this. Indeed, unadjusted analyses are a common limitation of research on perinatal outcomes in immigrant women, as has been noted in systematic reviews of the literature, both in general,[22] and in relation to studies of caesarean section.[10]

What might be the explanation for this increased risk of unplanned caesarean birth in Vietnamese-born women after adjustment for clinical risk factors and other factors known to be associated with caesarean birth, such as private vs. public admission status? A limitation of this study is our lack of capacity to adjust for other potential confounders, including migration-related factors such as length of residence since migration, fluency in English and migration history (refugee vs. skilled migrant, for example). Although these factors have been implicated as being important in adverse birth outcomes, including caesarean section[8] – particularly communication difficulties/lack of host country language fluency and recent arrivals' lack of familiarity with care systems – no data for these factors are available in routinely collected perinatal data in Victoria or any other Australian state. Nor were data available regarding reasons for the unplanned caesarean section, and this may have also been informative. Explanations of our findings must therefore remain speculative. Another limitation of this research is the lack of more recent VPDC data; however this was not possible due to permission for access to the data not being available to us for this study beyond 2007. While this would have provided a more contemporaneous context for the findings, we feel these results are important nonetheless, identifying how critical it is to investigate specific country of birth groups and to undertake analyses exploring maternal country of birth effects on adverse birth outcomes which condition on relevant confounding factors. Also, when interpreting the statistical significance of differences in estimates reported in this paper, the reader should note the relatively large size of the study sample and the effect this may have on tests of statistical inference in some analyses. Given the sample size, generally analyses reported in this paper are well powered to detect small differences between groups, and this should be considered when interpreting the clinical significance of findings.[23]

There is increasing concern about high rates of caesarean section in developed countries such as the United States of America and Australia, with attention now turning to safe ways of reducing caesarean birth.[24,25] A focus on models of care which provide continuous support in labour and promote normal birth in low risk women, especially in groups known to have higher rates of caesarean section is a potentially important strategy.[25,26] To provide the best chance of achieving a normal birth for women from non-English speaking countries, such as the Vietnamese women studied here, such models of care should incorporate appropriate language support in labour for women not fluent in English. While not well evaluated to date, bilingual labour companion or 'doula' programs show some promise for reducing unplanned caesarean section in immigrant populations.[27,28] These programs combine communication assistance with continuous physical and emotional support for women during labour and birth. To confirm the potential of such models for reducing elevated risk of unplanned caesarean section in low risk immigrant women, such as Vietnamese-born women in Australia, randomised trials are clearly needed.

5. Conclusion

It is important that studies of caesarean section in immigrant compared with non-immigrant women adjust for available confounding factors, especially as they may affect these groups differentially. Our study shows that factors other than clinical risk appear to predispose Vietnamese-born women to unplanned caesarean birth. Potentially contributing factors not available in the available routine data warrant further investigation. These include intrapartum communication difficulties, length of residence since migration, familiarity with care systems and variations in care practices for Vietnamese women. Where an elevated risk of caesarean section is found in low risk immigrant women, strategies for safely reducing caesarean section should be explored.

Contribution to authorship

RS conceived the research, with input from PA and MD. PA developed and undertook statistical analyses with input from RS and MD. PA, RS and MD drafted the manuscript.

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Disclosures

In addition to their university appointment, MD has a part-time appointment at the Victorian Department of Health and Human Services. Part of their role there is to prepare data for research projects such as this. None of the authors have any other potential conflict of interest to declare.

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