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ORIGINAL ARTICLE

Incidence, trends and severity of primary postpartum haemorrhage in Australia: A population-based study using Victorian Perinatal Data Collection data for 764 244 births

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Background: Increasing incidence and severity of postpartum haemorrhage, together with postpartum haemorrhage-associated morbidities, have been reported in many high-resource countries. In-depth analysis of such factors in Victorian births since 2002 was lacking.

Aims: Our aim was to determine the incidence and trends for primary postpartum haemorrhage (World Health Organization and International Classification of Diseases 10th revision, Australian Modification definitions) for all confinements in Victoria, Australia, for the years 2003–2013 and the incidence and trends for severe postpartum haemorrhage (≥1500 mL) for 2009–2013.

Materials and methods: In this population-based cross-sectional study de-identified data from the Victorian Perinatal Data Collection were analysed for confinements (excluding terminations) from 2003 to 2013 (n = 764 244). Perinatal information for all births ≥20 weeks (or of at least 400 g birthweight if gestation was unknown) were prospectively collected.

Results: One in five women (21.8%) who gave birth between 2009 and 2013 experienced a primary postpartum haemorrhage and one in 71 women (1.4%) experienced a severe primary postpartum haemorrhage. The increasing trends in incidence of primary postpartum haemorrhage, severe primary postpartum haemorrhage, blood transfusion, admission to an intensive care or high dependency unit and peripartum hysterectomy were significant (P < 0.001). Women who had an unassisted vaginal birth had the lowest incidence of primary postpartum haemorrhage. The highest incidence was experienced by women who had an unplanned caesarean section birth. Women who had a forceps birth had the highest incidence of severe primary postpartum haemorrhage.

Conclusions: The incidence of primary postpartum haemorrhage, severe primary postpartum haemorrhage and associated maternal morbidities have increased significantly over time in Victoria.

KEYWORDS

incidence, maternal morbidity, perinatal data collection, postpartum haemorrhage, severe postpartum haemorrhage

INTRODUCTION

Postpartum haemorrhage (PPH) is a leading cause of maternal mortality[1–3] and morbidity[2–5] worldwide. The incidence of PPH is reported to have increased in recent decades, both in Australia[6,7] and other high-resource countries.[8–10] The incidence of severe PPH[10–13] and of morbidities associated with major blood loss are also rising.[4,7,9–11,14–16] Rates of peripartum hysterectomy associated with PPH rose in Victoria, Australia between 1999–2002.[17] The impact of PPH and resulting morbidities on women and their families can be substantial.[2,11,14,16]

As the last reported in-depth analysis of PPH in Victoria was for data up to 2002,[17] we undertook a descriptive analysis of PPH incidence for 2003–2013 and PPH severity for 2009–2013. Our aim was to determine the incidence of primary PPH and severe primary PPH and to investigate severe morbidity associated with PPH and trends using Victorian Perinatal Data Collection (VPDC) data.

MATERIALS AND METHODS

Study population

This population-based cross-sectional study included all women who gave birth in Victoria between January 2003 and December 2013 (n = 770 140). Women who had a multiple birth were included in the analysis once for a single birth episode. Women who had a termination of pregnancy or for whom estimated blood loss (EBL) data were missing (n = 5897) were excluded, leaving 764 244 confinements for analysis.

Data source

De-identified data were obtained from the VPDC, a recently validated[18] statutory collection of prospectively collected perinatal data for all births occurring in Victoria. A standardised set of information comprising demographic and clinical information on many aspects of prenatal, intrapartum and postpartum procedures and outcomes for the mother and baby is submitted at the completion of the birth event, usually by midwives. Information for each birth of ≥20 weeks (or of at least 400 g birth weight if gestation was not known) is submitted.[19]

Outcome

In this study, PPH refers to primary PPH only; secondary PPH was not examined. For 2003–2008, PPH was defined as blood loss of ≥500 mL following vaginal birth and ≥750 mL following caesarean section (CS), for the 24 h after birth according to the International Classification of Diseases 10th revision, Australian Modification (ICD-10-AM)[20] definition at the time.[21] Until 2008, PPH was reported by ticking a box to signify its occurrence, precluding analysis of severity of PPH. For 2009–2013, PPH was defined as blood loss of ≥500 mL in the first 24 h after birth, regardless of birth method (World Health Organization (WHO) definition)[22] and was reported as a continuous item, 'estimated blood loss mL'. Severe PPH was defined as EBL of ≥ 1500 mL.

Data analysis

From 2009, the new data item, 'estimated blood loss mL' permitted calculation of PPH and severe PPH. We recoded three data items into categories for analysis: 'parity' into 'primiparous' and 'multiparous' and 'birth method' by CS into 'planned CS' and 'unplanned CS', each of which could occur with or without labour. Data for severe PPH were analysed for primiparae and multiparae for each birth method for the period 2009–2013. Additionally, to enable analysis of PPH trends from 2003 to 2013 and comparison with other Australian research, we created a variable to match the ICD-10-AM definition for births in 2009–2013. However, the focus of the paper is on PPH according to the WHO definition and severe PPH.

Data were analysed using the statistical software Stata version 14.2 (StataCorp, College Station, TX, USA). Cross-tabulations and stratified cross-tabulations are presented and χ^2 analysis was performed to determine the statistical significance of differences found. Trends over time were analysed using χ^2 for linear trend. Ethics approval for the study was obtained from La Trobe University Human Research Ethics Committee (FHEC 12/025), and the Victorian Consultative Council on Obstetric and Paediatric Mortality and Morbidity approved the use of de-identified VPDC data for this project.

RESULTS

Annual confinements in Victoria increased from 62 186 in 2003 to 76 744 in 2013.

PPH trend for 2003–2013 (ICD-10-AM definition)

Using the ICD-10-AM definition, the overall incidence of PPH rose from 9.0% in 2003 to 13.5% in 2013, a relative increase of 50% (P = 0.014 for linear trend). The incidence rose across this period from 9.7% to 15.3% for vaginal births but for CS births remained static at around 9.0% (Fig. 1a).

PPH trend for 2009–2013 (WHO definition)

Using the WHO definition, the overall incidence of PPH was seen to rise between 2009 and 2013 from 20.9% to 23.0% (Fig. 1b). Women who had an unassisted vaginal birth had the lowest PPH incidence (11.3%) while women who had any CS birth had the highest (39.2%). There was no evidence of an increase in the incidence of PPH for CS (P = 0.062), in comparison to the incidence of PPH for all methods of vaginal births. An increasing trend in

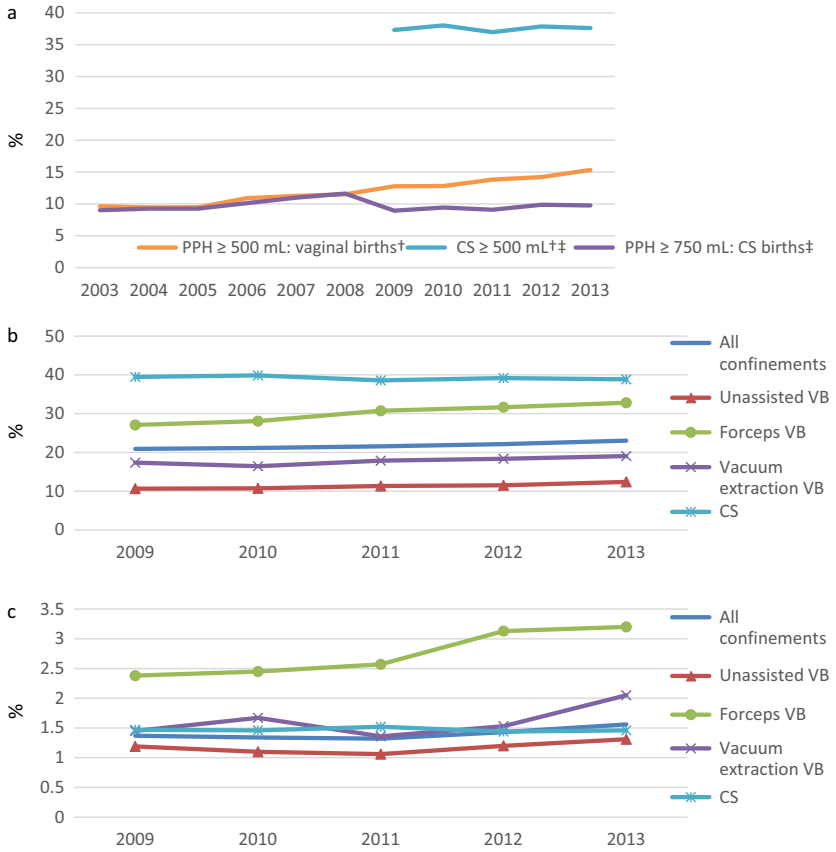

FIGURE 1 Estimated blood loss in mL for confinements by method of birth and year in the Victorian Perinatal Data Collection: (a) ≥500 mL for vaginal births and caesarean section (CS) births and ≥750 mL for CS births (*n* = 762 806)[§]; (b) primary postpartum haemorrhage ≥500 mL[†] and (c) severe primary postpartum haemorrhage ≥1500 mL by method of birth for 2009–2013[¶] (*n* = 364 574). [†]World Health Organization definition of primary postpartum haemorrhage: all methods of birth. [‡]International Classification of Diseases 10th revision definition of postpartum haemorrhage: ≥500 mL for vaginal births and ≥750 mL for CS births. §Excludes vaginal breech for 2003–2008 only (*n* = 1435). [¶]Estimated blood loss data not available 2003–2008.

TABLE 1 Proportional contribution of postpartum haemorrhage and severe postpartum haemorrhage by birth category for confinements† in Victoria, 2009–2013

	EBL ≥ 500 mL		EBL ≥ 1500 mL		All confinements	
	n	%	*n*	%	*n*	%
Vaginal births:						
Unassisted	22 346	28.1	2314	45.2	197 179	54.1
Forceps	7003	8.8	644	12.9	23 111	6.3
Vacuum extraction	5358	6.7	484	9.5	30 069	8.2
Caesarean section births	44 730	56.3	1678	32.8	114 215	31.3
Total	79 437	100.0	5120	100.0	364 574	100.0

†Missing cases excluded: estimated blood loss: *n* = 5897; method of birth: *n* = 132.
EBL, estimated blood loss.

incidence was seen for unassisted vaginal births ($P < 0.001$), forceps births ($P = 0.001$) and vacuum extractions ($P < 0.001$).

The risk of PPH was greater for women having CS births than for those having vaginal births. Thirty-one percent of women gave birth by CS but 56.3% of all PPH occurred in women who had a CS, while the higher number of unassisted vaginal births (54.1%) accounted for 28.1% of PPH (Table 1).

Severe PPH ≥ 1500 mL (2009–2013)

The overall incidence of severe PPH increased from 1.4% in 2009 to 1.6% in 2013 ($P < 0.001$). The annual incidence of severe PPH by vaginal birth methods and CS birth is shown in Figure 1c. Women who had a forceps birth or a vacuum extraction had the highest incidence of severe PPH. The incidence of severe PPH

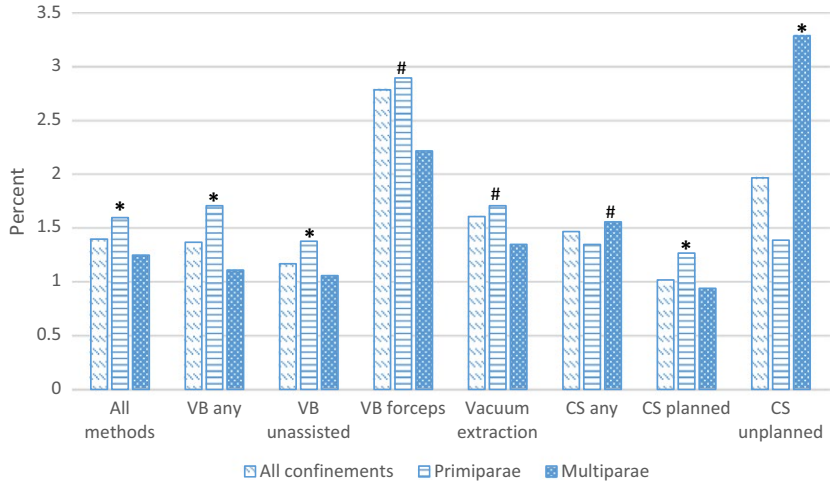

FIGURE 2 Incidence of severe postpartum haemorrhage ≥1500 mL by method of birth and parity for confinements† in Victoria for 2009–2013 (n = 364 574). †Denominator excludes cases with missing values for estimated blood loss (n = 5897) and method of birth (n = 132). CS, caesarean section birth; VB, vaginal birth; *P < 0.001; #P < 0.05

associated with forceps births increased annually between 2009 and 2013 (P < 0.045). An upward trend in the incidence of severe PPH was also seen for vacuum extractions (P = 0.004); however, there was no evidence of an increase for either unassisted vaginal births (P = 0.055) or CS (P = 0.875). During the same period, the percentage of forceps births increased from 5.8% to 7.3% of all births (P < 0.001) while vacuum extractions decreased from 8.2% to 7.7%.

Severe PPH occurred significantly more often to primiparae than multiparae who had a vaginal birth or planned CS, whereas multiparae who had an unplanned CS had a significantly higher incidence of severe PPH than primiparae with the same type of CS (Fig. 2). One-third (32.8%) of severe PPH were associated with CS births. In contrast to the situation with PPH, almost half of severe PPH occurred following unassisted vaginal births (45.2%) despite its lower incidence in that group, related to the higher number of women having an unassisted vaginal birth (Table 1, Fig. 1c).

The upward trend in incidence for both PPH (WHO definition) and severe PPH was significant (P < 0.001).

Other markers of severity (2009–2013)

All other markers of severity (blood transfusion, admission to high-dependency unit / intensive care unit (HDU/ICU) and peripartum hysterectomy) increased significantly over the five years. Blood transfusion administration rose from 1.2% in 2009 to 1.6% of women giving birth in 2013 (P < 0.001). The incidence of blood transfusion for women who experienced a PPH was 5.6%, increasing to 45.1% of women who had a severe PPH. Blood transfusion was received by 3.9% of women who had a PPH following a CS birth compared with 7.5% of those with a PPH following unassisted vaginal births and 10.1% of those following instrumental births (Table 2). In contrast, 48% of women who had either a severe PPH following a CS or instrumental vaginal birth were transfused, compared with 41.5% of women with a PPH following an unassisted vaginal birth. Nine out of ten women (88.8%) who received a blood transfusion had a PPH.

Almost a fifth of women (17.9%) who had a severe PPH were admitted to HDU/ICU. Women who had a severe PPH following a CS were more than twice as likely to be admitted to HDU/ICU as women having a severe PPH following a vaginal birth (P < 0.001). The incidence of PPH-associated HDU/ICU admission increased from 2.9% to 3.2% for 2009–2013. Of all women admitted to HDU/ICU, 51% had experienced a PPH. Of all women giving birth, 0.01% had a peripartum hysterectomy; however, the incidence of PPH-associated peripartum hysterectomy was 0.06% (P < 0.001) and for severe PPH the incidence was 0.8% (P < 0.001).

DISCUSSION

One in five women who gave birth in Victoria in 2009–2013 experienced a primary PPH (WHO definition) and 1.4% experienced a severe PPH.

The incidence of PPH and severe PPH increased during 2009–2013 (a relative increase of 10.1% for PPH and 13.8% for severe PPH). This overall increase in PPH is concerning, but particularly worrying is the increase in severe PPH. Trends reported elsewhere in Australia[6] and in other high-resource countries[3,8–10,13,16] exceed our findings, although definitions, data sources and methods of reporting differ. The incidence of PPH (21.8%) in this study lies between widely differing results reported by others using matching/similar definitions: 2.6–4.5%[10,23] and 33.7%.[24] Other Australian jurisdictions reported PPH rates of 7.7% (Queensland) up to 25.4% (Australian Capital Territory) and 38.0% (Northern Territory) for 2015.[25]

For 2009–2013 data in this study, the highest incidences of PPH and severe PPH were found following CS births and

TABLE 2 Postpartum haemorrhage† and severe postpartum haemorrhage (estimated blood loss in mL) and associated morbidity for all confinements‡ in Victoria, 2009–2013§ (n = 364 706)

		Maternal blood transfusion§				HDU/ICU admission¶				Peripartum hysterectomy
		††All confinements	††VB non-instrumental	††VB instrumental	††CS (any)	††All confinements	††VB non-instrumental	††VB instrumental	††CS (any)	††All confinements
EBL < 500 mL	n	561	229	139	193	2301	981	311	1007	0
	%	0.2	0.1	0.3	0.9	0.8	0.6	0.8	1.5	0
EBL¶ ≥ 500 mL	n	4468	1670	1244	1553	2378	532	334	1512	46
	%	5.6	7.5	10.1	3.9	3.0	2.9	2.7	3.4	0.06
EBL¶ ≥ 500–<1500 mL	n	2171	712	705	754	1464	236	185	1043	5
	%	2.9	3.6	6.3	1.8	2.0	1.9	1.7	2.4	0.1
EBL¶ ≥ 1500 mL	n	2297	958	539	799	914	296	149	469	41
	%	45.1	41.5	48.0	48.2	17.9	12.8	13.2	28.1	0.8
Total number‡‡	n	5028	1899	1383	1,746	4677	1513	645	2519	46
Total percent	%	1.4	1.0	2.6	1.5	1.3	0.8	1.2	2.2	0.01

†Postpartum haemorrhage ≥500 mL (all modes of birth).
‡Denominator excludes cases with missing values for estimated blood loss (n = 5897) except for ‡‡Total number of confinements.
Denominators exclude cases with missing values for: §Maternal blood transfusion (n = 376); ¶HDU/ICU admission (n = 515) and ††Birth method (n = 182). CS, caesarean section; EBL, estimated blood loss; HDU/ICU, high dependency unit/intensive care unit; VB, vaginal birth.

forceps births. The finding that severe PPH is more common following forceps births may be partly due to a de-skilling of the workforce in forceps births and associated trauma to the genital tract.

A higher incidence of severe PPH, for multiparae compared with primiparae, was seen following unplanned CS births. This result reflects the unusual circumstance of a multipara having an unplanned CS and is likely to be related to the complication for which CS was indicated.

Severity (2009–2013)

The relative increase in the incidence of severe PPH in this study was 14%.

Although women who had unassisted vaginal births were less likely than women who had CS births to experience a severe PPH, nearly half of all severe PPH occurred following unassisted vaginal birth. This has implications for midwives and obstetricians caring for women who have unassisted vaginal births which are likely to take place in birth suites and low-level facilities such as birth centres.

One in 18 women who experienced a PPH in this study required a blood transfusion. Large increases in blood transfusion administration for PPH have been reported elsewhere in Australia[5,7] and overseas[10,16,26] in contrast to reported decreasing rates over a 14-year period in a study from The Netherlands.[8] We found an increase in the incidence of peripartum hysterectomy associated with PPH, consistent with other reports.[9,26,27] In Victoria, the incidence increased from 0.05% reported in 2004[17] to 0.06% for 2009–2013.

One in five women were found to have experienced a PPH; one in 70 had a severe PPH. The increased incidence of severe PPH is accompanied by an increased incidence of interventions such as blood transfusion. Only one-tenth of women who received a blood transfusion did not have an associated PPH. Californian researchers recently reported a substantial reduction in the incidence of severe maternal morbidity, including PPH and blood transfusion, with the introduction of quality improvement toolkits. Toolkits comprise educational tools, protocols and policies, regular drills and a PPH trolley.[28] The reduction in morbidity was greatest in hospitals that have used the toolkit longest.[28] Training has been recommended to identify repeated mistakes in PPH management.[10] As managing severe PPH requires a greater share of scarce clinical and economic resources, for example, the need for blood transfusion, ICU admission and increased length of stay,[15] and in light of our findings of increasing trends for severe PPH, it may be beneficial to explore the potential of introducing a similar toolkit into Victoria's hospitals.

The reported incidence of PPH rose markedly in 2009 as simultaneous changes were made to both the definition and format for data collection; however, the incidence of PPH has continued to rise. One explanation for this increased incidence is that the change to the WHO PPH definition resulted in the inclusion since 2009 of 33 497 more cases of PPH following CS birth (ie those

with an EBL of 500–749 mL). The immediate, pronounced rise in PPH incidence for CS births supports this, although we note that the incidence has remained relatively constant since 2009. The incidence of PPH following vaginal births, unaffected by a definition change, rose more gradually, chiefly associated with forceps births which increased as a proportion of all births. The change of format, from tick-box to estimated volume, may also have had an effect on the increase. The three Australian jurisdictions that have adopted the format of EBL volume have each reported sharp increases in the incidence of PPH.[25]

We postulate that the tick-box format had obscured the true occurrence of PPH prior to 2009, when clinicians had to decide if a PPH had occurred — a decision obviated by the subsequent change of format to EBL volume. However, it is possible that, consistent with other studies,[2,12] changes to characteristics of the maternal population such as increasing age, CS rates and obstetric interventions, contributed to the increased PPH incidence.

Strengths and limitations

The major strength of this study is the population-based design using data from a validated collection[18] recorded prospectively by caregivers. The inclusion of all births in the state ensures that it is representative, eliminating the possibility of sampling bias. The long period of data collection provides sufficient numbers to facilitate accurate calculation of the burden of PPH and trend analysis. Because we defined PPH for 2009–2013 based on reported EBL, not hospital diagnostic codes, misclassification is minimised.

A potential limitation of studies such as this one arises regarding measurement of blood loss which, because of the nature of childbirth, is usually subjective and therefore inaccurate, particularly for larger volumes[29] which are more likely to be underestimated. The change of data collection format for PPH from a tick-box to EBL volume may have contributed to an increase in reported incidence and/or indicates under-reporting prior to 2009. A recent validation study of VPDC birth data found that, while accuracy of reporting of the new EBL volume data item was high, there was evidence of under-reporting, particularly for severe PPH.[30] The incidence of severe PPH therefore may be higher than is indicated by information reported to the VPDC.

Another potential limitation of 2003–2008 data is the uncertainty about which definition of PPH was used by individual midwives and maternity services during this period. Also, reporting trends for PPH or severe PPH before 2009 were precluded by those data not being available.

RECOMMENDATIONS

Our findings support the need for vigilance in the early postpartum period to enable clinicians to promptly detect and initiate treatment for excessive blood loss. Although some PPH will occur despite best practice, skill development may prevent further escalation in the severity of PPH and consequent morbidities to women. Measures such as conducting drills, establishing a PPH response team and reviewing PPH management protocols and documentation may be beneficial. The increasing trend in incidence of severe PPH highlights the need for research into causes and risk factors.

CONCLUSION

Maternity care providers should be informed by this study that both the incidence and severity of PPH are increasing in Victoria. It is likely that these data are generalisable to other jurisdictions. Based on current trends, the increase in forceps births and continuing high level of CS births will maintain or further increase the incidence of severe PPH and the corresponding burden and costs to women and health services can be expected to rise.[26] Implications for women exist in the form of associated morbidities. Implications for clinicians and health services potentially include the need to promote best practice and to manage unanticipated or unexpectedly severe PPH, remembering that nearly half of severe PPH follows an unassisted vaginal birth. There may be particular implications for smaller hospitals with fewer resources.

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