

Severe maternal morbidity identified in the Hospital Information System of the Brazilian National Health System in Paraná State, Brazil, 2010*

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Abstract

Objective: to describe near miss maternal morbidity among women living in Paraná State, Brazil, in 2010. **Methods:** this was a descriptive study using Brazilian National Hospital Information System (SIH/SUS) data on all hospital admissions with primary diagnosis falling under Chapter XV of the International Statistical Classification of Diseases and Related Health Problems 10th Revision and/or with records of obstetric procedures indicative of near misses; three criteria were used to define severe maternal morbidity. **Results:** 4,890 admissions owing to near miss were identified, with a rate of 52.9 hospitalizations per 1,000 births, a rate of 69.8/1,000 among women aged 35-39 and a rate of 356.6/1,000 among women aged 44-49; the leading causes of hospitalization were preeclampsia (28.2%), haemorrhage (23.7%) and immune system dysfunction (14.0%). **Conclusion:** the results indicate the need to pay greater attention to women aged 35 and over since they had higher rates of near miss.

Keywords: Maternal Mortality; Morbidity; Pregnancy Complications; Hospital Records; Epidemiology, Descriptive.

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Introduction

Severe maternal morbidity, also known as near miss, is an event of near death caused by severe complications that occur with a woman during pregnancy, childbirth or puerperium.¹ The near miss rate is used as a development indicator in several countries,² so monitoring may be considered a tool for the prevention of maternal morbidity and mortality, and once those cases are identified, they can be an important alternative and complementary strategy to reduce the occurrence of maternal deaths.³

Monitoring near miss may be considered a tool for the prevention of maternal morbidity and mortality, and once those cases are identified, they can be an important alternative and complementary strategy to reduce the occurrence of maternal deaths.

Single women, with black skin color, who are less than 20 years old or more than 35, and who have a lower socio-economic status are among the population group that is more vulnerable to the occurrence of complication during pregnancy.⁴

Women mortality due to obstetric causes has declined all over the world, since the decade of 1990s.⁵ In Brazil, in spite of the 52% reduction in maternal mortality rates, from 120 maternal deaths per 100 thousand live births (LB) in 1990 to 58/100 thousand LB in 2008, the target set by the Millennium Development Goals – 35 deaths per 100 thousand LB for the year of 2015 has not been achieved yet.⁵ There are variations in the rates among the Brazilian regions, varying from 69.0 in the Northeast and 62.5 in the North, to 47.2 in the Southeast and 44.4 in the South, in 2011.⁶ In that same year, Paraná State presented the highest maternal mortality rate among the states of the Southern region of the country (51.7 per 100 thousand LB), whilst Santa Catarina presented 25.2 per 100 thousand LB, and Rio Grande do Sul, 48.7 per 100 thousand LB.⁶

In 2014, a population-based study conducted in Natal-RN found a near miss rate of 41.1/1,000 LB.⁷ Another research, conducted in Recife-PE, on the data of 225 medical records of hospital admissions in an intensive care unit (ICU) from 2007 to 2010, presented a rate of 12.8/1,000 LB.⁸

The monitoring and knowledge on the complications that may occur are essential to improve the quality

of women's life during pregnancy, childbirth and puerperium, and to reduce maternal morbidity and mortality until it reaches the target established by the Millennium Development Goals.⁹

The first studies on severe maternal morbidity or near miss began in the decade of 1990s and, after almost three decades, there is no clear and consensual theoretical and operational definition on this event.^{10,11} Some studies point out that the main causes of near miss are the hypertensive emergencies, followed by haemorrhage and sepsis.^{9,12}

In a search for a consensus over severe maternal morbidity, the Department of Reproductive Health and Research of the World Health Organization (WHO), in a joint work with other organizations and supported by the Bill & Melinda Gates Foundation, created the Maternal Morbidity Working Group (MMWG),¹³ which defined maternal morbidity as 'any health condition attributed to, and/or aggravated by, pregnancy and birth that has a negative impact on the woman's wellbeing'. This definition will be included in the Eleventh Revision of the International Statistical Classification of Diseases and Related Health Problems.¹³

Considering that women's death during pregnancy, childbirth and puerperium represent only the "tip of the iceberg" of women's health conditions, and that there are few studies on severe maternal morbidity that address all Brazilian regions, the identification of resulting severe complications can be a path to improve the quality of the care given to the health of Brazilian women in their reproductive period. In this sense, the Brazilian National Hospital Information System (SIH/SUS) can be an important source of information in the identification and surveillance of severe maternal morbidity cases.¹⁴

The objective of this study was to describe near miss maternal morbidity among women living in Paraná State, Brazil, in 2010.

Methods

This is a descriptive study, on the data of the Hospital Information System of the Brazilian National Health System – SIH/SUS. We considered here the hospital admission records of women aged 10 and 49 years, living in Paraná State, in 2010.

The SIH/SUS is an information system coordinated by the Ministry of Health with the administrative goal

of paying for hospitalizations that occur in public or insured hospitals. The system has the Inpatient Hospital Authorization (IHA) as its primary document. This document is filled in with the information of other documents, such as the medical report and the patient's hospital medical record.^{14,15}

Paraná State, located in the Brazilian Southern region, covers a geographical area of 199,880 km² and has 339 municipalities. In 2014, Paraná State was the fourth biggest economy of the country, responsible for 6.3% of the national gross domestic product and with a human development index (HDI) of 0.749.¹⁶

The process of building the study's database was conducted, initially, with the selection of all hospital admissions of women living in Paraná that had occurred between January 1 and December 31, 2010. After that, we selected those women aged 10-49 years, with primary or secondary diagnosis falling under Chapter XV – Pregnancy, childbirth and puerperium (codes O00 to O99) – of the International Statistical Classification of Diseases and Related Health Problems – 10th Revision (ICD-10).¹⁷

The classification proposed by Sousa *et al.*,¹⁸ based on the criteria or markers established by Mantel *et al.*¹⁹ and Waterstone *et al.*,²⁰ was used for the selection of hospital admissions due to severe maternal morbidity and was complemented with the existing criteria/markers and procedures in the database of *SIH/SUS*. The criteria defined by Mantel *et al.*¹⁹ include the conditions related to organic dysfunction of the human body organs and systems, in addition to the procedures related to the assistance. The criteria defined by Waterstone *et al.*²⁰ include clinical diagnoses of the most frequent pathological conditions, such as severe preeclampsia, severe haemorrhage, severe sepsis and uterine rupture. In turn, Sousa *et al.*¹⁸ added other diagnoses, such as acute abdomen, the human immunodeficiency virus (HIV) and other conducted procedures – some of which were surgical (Figure 1).

For the selection of hospital admissions by codes of the procedures conducted during the woman's hospitalization period, the table of obstetric procedures in the classification of *SUS* Management System of the Table of Procedures, Medicines, Orthotics, Prosthetics and Special Materials (*SIGTAP*) was used,²¹ since it unifies and standardizes the procedure codes of *SIH/SUS* and the *SUS* Ambulatory Care Information System (*SIA/SUS*). For the present study, it was necessary to

update some procedures, altered by *SIGTAP*'s new classification criteria, as can be seen in the fourth and fifth columns of Figure 2.

The hospital admissions with procedures for severe haemorrhage (Waterstone *et al.* criterion²⁰) were excluded, since the updated code related to this procedure includes a set of admissions with procedures for the treatment of clinical problems in pregnancy, with no specification of the severity of these problems. If this procedure was considered, any irregularity could be included, even if it was not related to severe maternal morbidity. However, all the hospital admissions that had severe haemorrhage as primary diagnosis were selected.

It is important to highlight that the hospital admissions due to severe maternal morbidity were identified and selected from the group of admissions due to maternal morbidity as the criteria and markers were being applied, with no possibility of duplication.

The severe maternal morbidity rate – near miss – was calculated as the ratio between the number of hospital admissions due to severe maternal morbidity and the number of childbirths, multiplied by 1,000. In the denominator, the number of childbirths identified in the database was considered according to the primary diagnosis recorded on *SIH/SUS*, and not to the number of live births, since the Information System on Live Births (*Sinasc*) does not allow distinguishing between births that were and were not funded by the National Health System. For this study, only the hospital admissions funded by *SUS* were analyzed.

Absolute and relative frequencies of the admissions due to severe maternal morbidity were described according to the most frequent criteria or markers. The age was organized in 5-year intervals, and also in the following age groups, 10-19, 20-34 and 35-49, with the aim of estimating the frequency and rates of severe maternal morbidity, according to the most aggregated age groups.

The study project was approved by the Ethics Committee on Research of the State University of Maringá-PR (*UEM*): Resolution No. 093/2011.

Results

Out of the total 111,409 hospital admissions with primary diagnosis of pregnancy, childbirth or puerperium, we selected 141 admissions for childbirth mentioning admission to ICU and/or complications and/or death, and other 34,472 admissions due to various reasons.

Classification by Mantel <i>et al.</i> ¹⁹			
A.1 Conditions of the organic system			
Criteria/markers	Generic characterization of diagnoses [ICD-10 Codes]	Generic characterization of procedures	
		Procedure	Updated procedure ^a
1. Cardiac dysfunction 1.1 Pulmonary oedema 1.2 Cardiac arrest	Pulmonary oedema [J81] Cardiomyopathy; congestive heart failure [I11.0; I42.0; I42.1; I42.8; I42.9; I43.8; I46; I46.0; I46.9; I50.0; I50.1; I50.9; I75.4; I090.3; R57.0]	- Acute pulmonary oedema; embolism or pulmonary infarctions - Heart failure; hypertensive crisis; congenital heart defect, heart failure; shock by cardiac-vasculopathy; malignant hypertension	- Treatment of acute pulmonary edema; treatment of pulmonary embolism - Treatment of heart failure; treatment of hypertensive crisis; treatment of congenital anomalies of the circulatory system; treatment of arrhythmias; treatment of secondary hypertension 03.03.06.013-1 03.03.06.014-0 03.03.06.021-2 03.03.06.010-7 03.03.11.004-0 03.03.06.002-6 03.03.06.018-2
2. Vascular dysfunction 2.1 Hypovolemia with the necessity of 5 or + units of blood	Hypovolemic shock; volume depletion [E86; I75.1; R57.1; R57.9; T81.1]		
3. Immune disorder 3.1 Admission to intensive care due to sepsis	Infection; septicemia; abortion complicated by infection of the genital tract Peritonitis; salpingitis [A02.1; A22.7; A26.7; A32.7; A40; A40.0; A40.1; A40.2; A40.3; A40.8; A40.9; A41; A41.0; A41.1; A41.2; A41.3; A41.4; A41.5; A41.8; A41.9; A42.7; A54.8; B37.7; K35.0; K35.9; K65.0; K65.8; K65.9; M86.9; N70.0; N70.9; N71.0; N73.3; N73.5; N03.0; N03.5; N04.0; N04.5; N05.0; N05.5; N06.0; N06.5; N07.0; N07.5; N08.0; N08.2; N08.3; N08.4; N08.5; N08.8; N08.9; N08.0; N08.8; N08.3; T80.2]	- Infection of the abdominal wall post-caesarean section - Childbirth and puerperium infection - Septicemia (medical clinic) - Acute oophoritis - Post-caesarean section peritonitis; Peritonitis	Treatment of complications predominantly related to the puerperium; treatment of other bacterial diseases; treatment of inflammatory diseases of the female pelvic organs; treatment of peritoneal diseases 03.03.10.001-0 03.03.01.003-7 03.03.15.003-3 03.03.07.008-
4. Respiratory dysfunction 4.1 Intubation and ventilation for +60 min, except general anesthesia. 4.2 Saturation O ₂ <90% for +60 min. 4.3 Relation PaO ₂ /FiO ₂ <3	Respiratory insufficiency; respiratory arrest; pulmonary embolism Abortion complicated by embolism [I26.9; J80; J96; J96.0; J96.9; 003.7; 004.7; 005.2; 006.2; 006.7; 088.1; R09.2]	Acute respiratory insufficiency	Treatment of others diseases of the respiratory system 03.03.14.013-5
5. Renal dysfunction 5.1 Oliguria defined as <400 ml/24h	Renal insufficiency due to abortion [O08.4; R34]		
5.2 Acute deterioration of the urea to >15mmol/L or of the creatinine to >400 mmol/L	Acute renal insufficiency [E72.2; I12.0; I13.1; I13.2; N17; N17.0; N17.1; N17.2; N17.8; N17.9; N18.0; N08.4; O90.4]	Acute renal insufficiency	Treatment of acute renal insufficiency 03.05.02.004-8

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Figure 1 - Diagnoses of admission according to the International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10) and conducted procedures, used to select hospital admissions due to severe maternal morbidity (near miss)

Classification by Mantel et al. ¹⁹			
A.1 Conditions of the organic system			
Criteria/markers	Generic characterization of diagnoses [ICD-10 Codes]	Generic characterization of procedures	
		Procedure	Updated procedure ^a
Code			
6. Liver dysfunction 6.1 Jaundice in the presence of pre-eclampsia	Liver disorders. Complication of pregnancy, birth and puerperium by viral hepatitis [K72; K72.0; K72.9; O26.6; O98.4]	No procedure was found	
7. Metabolic dysfunction 7.1 Diabetic ketoacidosis	Diabetes mellitus with coma or ketoacidosis [E10.0; E10.1; E11.0; E11.1; E12.0; E12.1; E13.0; E13.1; E14.0; E14.1]		
7.2 Thyroid crisis	Thyrototoxicosis. Metabolic dysfunction due to abortion [E05; E05.0; E05.1; E05.2; E05.3; E05.4; E05.5; E05.8; E05.9; E06.0; E07; E07.8; E07.9; O08.5]	Thyroid dysfunction. Thyrototoxicosis	Treatment of disorders in the thyroid gland 03.03.03.005-4
8. Coagulation dysfunction 8.1 Acute thrombocytopenia requiring a platelet transfusion	Disseminated intravascular coagulation; blood clotting deficiency [D65; D68; D68.9; D69.4; D69.5; D69.6; D82.0; O45.0; O72.3]	Thrombocytopenic purpura	Treatment of defects of purpura clotting and other hemorrhagic disorders 03.03.02.006-7
9. Cerebral dysfunction 9.1 Coma in a patient lasting > 12 h			
9.2 Subarachnoid or intracerebral haemorrhage	Intracerebral haemorrhage. CVA. Cerebral venous thrombosis in pregnancy. [G93.6; I60; I60.0; I60.1; I60.2; I60.3; I60.4; I60.5; I60.6; I60.7; I60.9; I61; I61.0; I61.1; I61.2; I61.3; I61.4; I61.5; I61.6; I61.8; I61.9; I64; I69.1; O22.5]	Conservative treatment of intracerebral haemorrhage	Conservative treatment of severe head injury 03.03.04.010-6
A.2 Items based in management			
10. Intensive care admission 10.1 For any reason	Total of days in the ICU (field 'uti_mes31')		
11. Emergency hysterectomy 11.1 For any reason		Total or subtotal hysterectomy. Hysterectomy with unilateral or bilateral adnexectomy. Puerperal hysterectomy.	Total hysterectomy. Subtotal hysterectomy. Hysterectomy with unilateral or bilateral adnexectomy. Puerperal hysterectomy 04.09.06.013-5 04.09.06.012-7 04.09.09.011-9
12. Anesthetic accidents 12.1 Severe hypotension associated with epidural or spinal anesthesia 12.2 Failure to perform tracheal intubation, requiring anaesthetic reversal	Pulmonary complications resulting from anesthesia administered during pregnancy, birth or puerperium [O29; O29.0; O29.1; O29.2; O29.3; O29.5; O29.8; O29.9; O74; O74.0; O74.1; O74.2; O74.3; O74.4; O74.6; O74.8; O74.9; O89; O89.0; O89.1; O89.2; O89.3; O89.5; O89.8; O89.9; T88.2; T88.3; T88.5]		

Continue on next page

Figure 1 – Continued

Classification by Waterstone et al. ²⁰			
Criteria/markers	Generic characterization of diagnoses [ICD-10 Codes]	Generic characterization of procedures	
		Outdated procedure	Up-to-date procedure
1. Severe preeclampsia	Moderate, severe or unspecified preeclampsia. Preexisting hypertensive disorder with overlapped proteinuria [O11; O14.0; O14.1; O14.9]	Severe preeclampsia	Treatment of edema, proteinuria and hypertensive disorders during pregnancy, birth and puerperium 03.03.10.003-6
2. Eclampsia	Eclampsia during pregnancy, labor or puerperium [O15; O15.0; O15.1; O15.2; O15.9]	Birth with eclampsia Eclampsia	Treatment of edema, proteinuria and hypertensive disorders during pregnancy, birth and puerperium 03.03.10.002-8
3. HELLP syndrome ^c	Abortion complicated by excessive or delayed haemorrhage. Placenta previa with haemorrhage. Premature dislocation of the placenta. [D62; O03.1; O03.6; O04.1; O04.6; O05.1; O05.6; O06.1; O06.6; O07.1; O07.6; O08.1; O44.1; O45.0; O45.8; O45.9; O46; O46.0; O46.8; O46.9; O67.0; O67.8; O67.9; O69.4; O72; O72.0; O72.1; O72.2]	Pregnancy haemorrhage	Treatment of clinical complications in pregnancy 03.03.30.004-4 CODE DELETED ^b
4. Severe haemorrhage	Infection. Septicemia. Abortion complicated by infection of the genital tract. Peritonitis. Salpingitis [A02.1; A22.7; A26.7; A32.7; A40.0; A40.1; A40.2; A40.3; A40.8; A40.9; A41; A41.0; A41.1; A41.2; A41.3; A41.4; A41.5; A41.8; A41.9; A42.7; A54.8; B37.7; K35.0; K35.9; K65.0; K65.8; K65.9; M86.9; N70.0; N70.9; N71.0; N73.3; N73.5; O03.0; O03.5; O04.0; O04.5; O05.0; O05.5; O06.0; O06.5; O07.0; O07.5; O08.0; O08.2; O08.3; O41.1; O75.3; O85; O86; O86.0; O86.8; O88.3; T80.2]	Infection of the abdominal wall post-caesarian section. Infection in birth and puerperium. Septicemia (medical clinic). Acute oophoritis. Post-caesarean peritonitis. Peritonitis	Treatment of complications predominantly related to the puerperium. Treatment of other bacterial diseases. Treatment of inflammatory diseases of the female pelvic organs. Treatment of peritonitis' diseases 03.03.10.001-0 03.03.01.003-7 03.03.15.003-3 03.03.07.008-0
6. Uterine rupture	Rupture of the uterus before or during labor. Rupture of the cesarean's incision [O71.0; O71.1; O90.0]		
Classification by Sousa et al. ¹⁸			
Criteria/markers	Generic characterization of diagnoses [ICD-10 Codes]	Generic characterization of found procedures	
		Outdated procedure	Up-to-date procedure
1. Acute abdomen	Acute abdomen [R10.0]		
2. Disease by HIV ^d	Disease by HIV resulting in infectious diseases [B20; B20.0; B20.1; B20.4; B20.8; B20.9]		
3. Other surgical procedures		Multiple surgery. Exploratory laparotomy. Laparotomy with hysterography. Surgical treatment of post-birth acute uterine inversion	Treatment by multiple surgeries. Exploratory laparotomy. Hysterography. Surgical treatment of post-birth acute uterine inversion 04.15.01.001-2 04.07.04.016-1 04.11.01.008-5 04.09.06.016-0

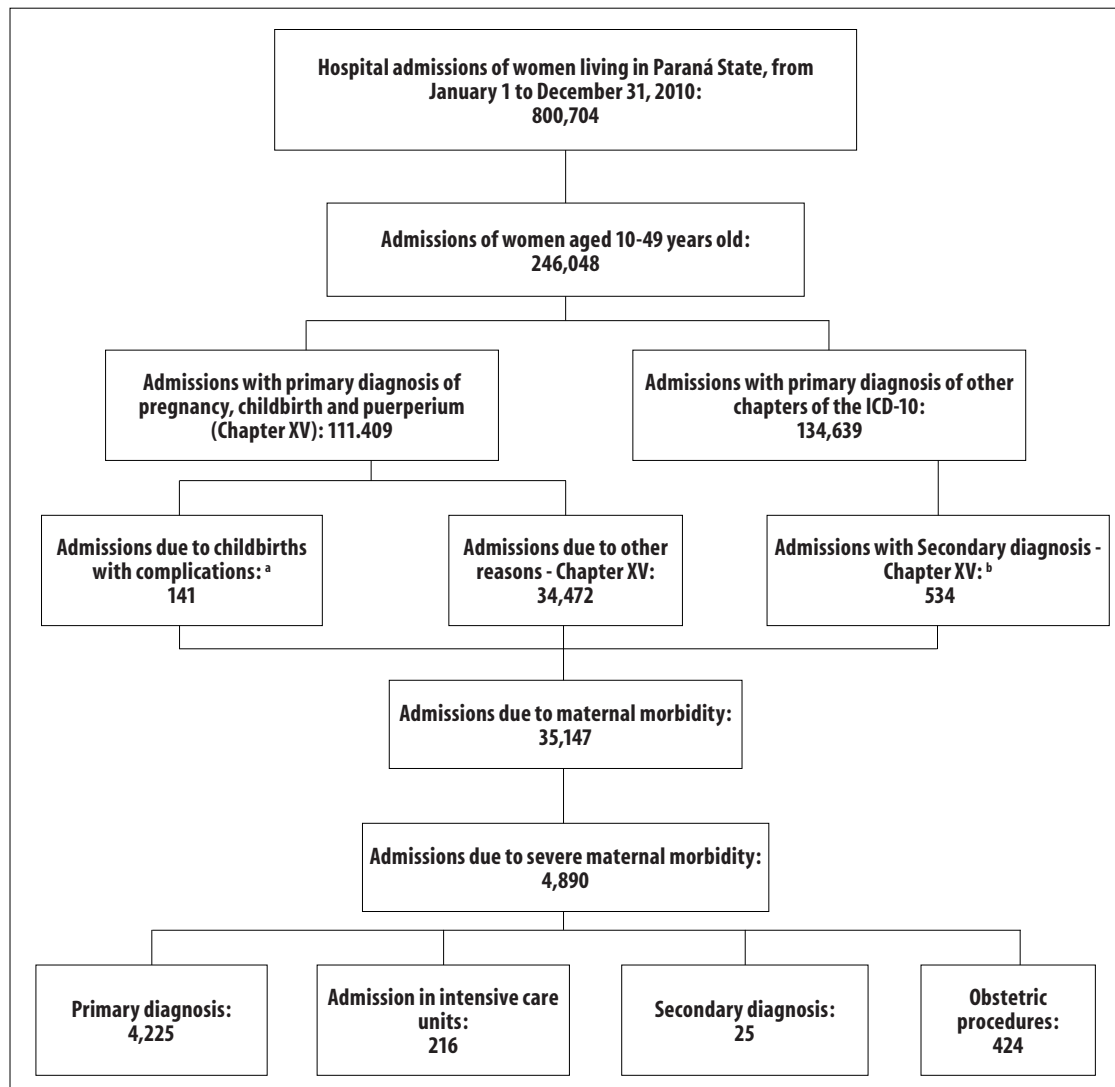
a) Table of obstetric procedures of the SUS Management System of the Table of Procedures, Medicines, Orthotics, Prosthetics and Special Materials – SIGTAP classification¹¹

b) According to the criteria of Mantel et al.,¹⁹ Waterstone et al.²⁰ and Sousa et al.¹⁸

c) Hemolysis, elevated liver enzyme levels and low platelet levels.

d) Human Immunodeficiency Virus

Figure 1 – Conclusion



a) Childbirths with admission in intensive care units (ICU) and/or conducted procedures indicative of complications and/or hospital death.

b) Admissions with secondary diagnosis in Chapter XV of the International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10) – Pregnancy, childbirth and puerperium – and with conducted procedures indicative of complications.

Figure 2 – Process of identification and selection of hospital admissions due to severe maternal morbidity in the Hospital Information System of the Brazilian National Health System (SIH/SUS) in Paraná State, 2010

From the admissions with primary diagnosis belonging to other chapters of the ICD-10, 534 with secondary diagnosis of pregnancy, childbirth and puerperium were selected, totalizing 35,147 admissions due to maternal morbidity. From them, 4,890 were selected, of which 4,225 were by primary diagnosis, 216 by admission in ICU, 25 by secondary diagnosis and 424 by obstetric procedures conducted during admission. Figure 2 presents the study's flowchart.

For the calculation of the severe maternal morbidity rate, 92,397 childbirths were accounted in the denominator,

being 76,936 of them admitted due to childbirth and 15,461 with the reference of childbirth among the conducted procedures. In 2010, the severe maternal morbidity rate in Paraná State was of 52.9 admissions per 1,000 childbirths. In that year, the highest severe maternal morbidity rates observed occurred in the highest age groups, reaching 356.6 admissions per 1,000 childbirths in women aged 45-49 years, whilst for women aged 20-24 years, this rate was of 41.2; and for those aged 15-19 years, of the rate was of 37.7 admissions per 1,000 births (Figure 3).

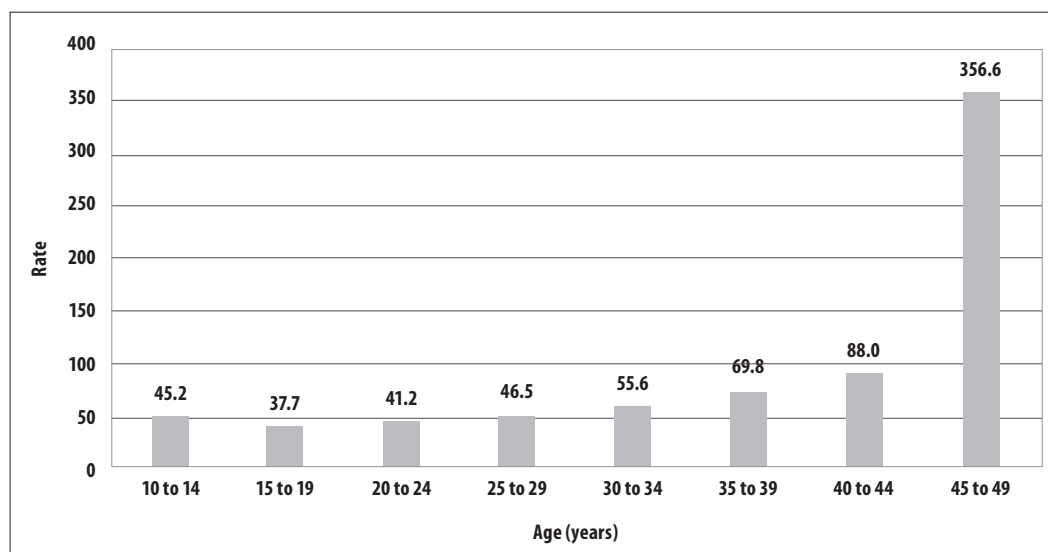


Figure 3 – Rate of severe maternal morbidity – near miss – per 1,000 births, according to age group, in Paraná State, 2010

The leading causes of severe maternal morbidity were preeclampsia, with 14.9 admissions per 1,000 births, followed by severe haemorrhage (12.5/1,000 births), immune system dysfunction (7.4/1,000 births), severe sepsis (5.5/1,000 births) and eclampsia (5.1/1,000 births). Concerning the main causes of severe maternal morbidity by age group, severe haemorrhage was found in the age group 10-19 years, with 11.1 admissions per 1,000 births, and preeclampsia in the age group 20-34 years (15.9/1,000 births) and 35-49 years (23.4/1,000 births). Considering all the age groups that were analyzed, women aged 35-49 years presented the highest severe maternal morbidity rate: 88.6 admissions per 1,000 births (Table 1).

There was a difference in the identification of severe maternal morbidity cases, depending on the criteria used. Waterstone's criteria allowed identifying more severe maternal morbidity cases – 3,539 admissions – when comparing with Mantel's criteria, which showed 1,265 admissions, and with Sousa's criteria, with 86 admissions. Among the criteria used, in relation to the codes, there was no equality in the evaluated items (Table 1).

Discussion

This study showed that the rate of hospital admissions due to severe maternal morbidity in Paraná State was

higher in women aged 35 years and over, and the main causes of hospital admission were preeclampsia, severe haemorrhage and immune system dysfunction.

The severe maternal morbidity rate in Paraná State was higher than the estimates of the rates presented by a systematic review of researches conducted in the period 2004-2010, directed to countries in Africa, Asia and Latin America.²² In the municipality of Juiz de Fora-MG, a research based on *SIH/SUS* data in 2006-2007 identified 326 women with admissions due to severe maternal morbidity, with a rate of 37.8/1,000 childbirths.²³

In this study, the highest rate of admissions due to severe maternal morbidity found among older women corroborates a study conducted in Rio de Janeiro-RJ, in 2009, which showed higher frequency of near miss in the age group of over 30 years (34.8).⁹

With regard to the criteria of Mantel *et al.*¹⁹ and Waterstone *et al.*,²⁰ the most frequent causes of admissions that indicate severe maternal morbidity were preeclampsia (28.2%), followed by severe haemorrhage (23.7%) and immune system dysfunction (14.0%). In Sousa *et al.*'s study,¹⁸ conducted with 2002 *SIH/SUS* data, when including all Brazilian capitals with Waterstone and Mantel's criteria, in addition to adding three more criteria (acute abdomen, HIV disease and surgical procedures), the results were different, with a higher incidence of immune system dysfunction comparing to severe haemorrhage.¹⁸ In 2014, a population based

Table 1 – Hospital admissions due to severe maternal morbidity – near miss –, according to criteria/markers and age, in Paraná State, 2010

Criteria/markers	Age (in years)									Total		
	10-19			20-34			35-49					
	N	%	Rate ^a	N	%	Rate ^a	N	%	Rate ^a	N	%	Rate ^a
Mantel et al.¹⁹												
Cardiac disorder	73	7.1	3.1	156	5.0	2.6	25	3.3	3.0	254	5.2	2.7
Vascular disorder	1	0.1	–	–	–	–	–	–	–	1	–	–
Immunological disorder	170	16.6	7.2	422	13.6	7.0	93	12.4	11.0	685	14.0	7.4
Respiratory disorder	3	0.3	0.1	4	0.1	0.1	–	–	–	7	0.1	0.1
Liver disorder	–	–	–	–	–	–	1	0.1	0.1	1	–	–
Coagulation disorder	10	1.0	0.4	25	0.8	0.4	4	0.5	0.5	39	0.8	0.4
Cerebral disorder	–	–	–	2	0.1	–	–	–	–	2	–	–
Admission to ICU ^b	51	5.0	2.2	131	4.2	2.2	34	4.5	4.0	216	4.4	2.3
Emergency hysterectomy	1	0.1	–	9	0.3	0.1	47	6.3	5.5	57	1.2	0.6
Anesthesia accident	2	0.2	0.1	1	–	–	–	–	–	3	0.1	–
Waterstone et al.²⁰												
Severe preeclampsia	221	21.5	9.4	958	30.8	15.9	198	26.4	23.4	1,377	28.2	14.9
Eclampsia	103	10.0	4.4	303	9.7	5.0	65	8.7	7.7	471	9.6	5.1
Severe haemorrhage	262	25.5	11.1	729	23.4	12.1	167	22.3	19.7	1,158	23.7	12.5
Severe sepsis	118	11.5	5.0	311	10.0	5.2	81	10.8	9.6	510	10.4	5.5
Uterine rupture	6	0.6	0.3	8	0.3	0.1	9	1.2	1.1	23	0.5	0.2
Sousa et al.^{18,c}												
Other surgical procedures	5	0.5	0.2	55	1.8	0.9	26	3.5	3.1	86	1.8	0.9
Total	1,026	100.0	43.5	3,114	100.0	51.6	750	100.0	88.6	4,890	100.0	52.9

a) Severe maternal morbidity rate, calculated by the ratio between the number of indicative admissions due to severe maternal morbidity by 1,000 births.

b) ICU: intensive care unit

c) Sousa et al.¹⁸ – acute abdomen, disease by the HIV and some surgical procedures

survey was conducted in Natal-RN and identified, as markers for severe maternal morbidity, admission in ICU (19.1/1,000 births), eclampsia (13.5/1,000 births), blood transfusion (11.3/1,000 births) and hysterectomy (2.3/1,000 births).⁷

In a systematic review on the prevalence of severe maternal morbidity, 33 studies were found. They were conducted in the period 1999-2010, pointing the emergency hysterectomy as a criterion for near miss diagnosis. The same review showed that countries with low and medium income, most of them located in Asia and Africa, have higher severe maternal morbidity rates,²² corroborating the data from the World Health Organization: according to the institution, about 536 thousand women die every year due to complications during pregnancy, and 99% of these deaths occur in low and medium income countries.²⁴

From the detailed analysis of each criterion adopted in the diagnoses for severe maternal morbidity, using the total amount of each criterion, we can notice that the criteria of organic dysfunction (dysfunctions of the many systems of the human body [Mantel]) are more restrict in identifying near miss cases: they showed only 26% of the cases of this study. The criteria of clinical conditions (Waterstone) identified 72% of the cases.

This inequality in the severe maternal morbidity rates pointed out in the literature through the use of different criteria brings up the discussion on the possibility to adopt a single and standardized classification, capable of providing, as routine procedures, the surveillance and analysis of these conditions by hospitals' health care teams that assist women during pregnancy, childbirth and puerperium.

WHO, in an attempt to standardize these criteria, formulated a classification based on three principles of severe maternal morbidity: clinical markers; laboratory markers; and management markers.²⁵ However, a study, conducted in 2009, used this classification for the selection of severe maternal morbidity cases in a public hospital of Niterói-RJ, and concluded that, in addition to these principles, it would also be necessary to use the criteria proposed by Mantel *et al.*¹⁹ and by Waterstone *et al.*²⁰ for identifying the cases, since they are based on different approaches, with different characteristics.⁹ The classification adopted by WHO allows the identification of more severe cases, with higher risk of death. On the other hand, Waterstone's criteria broaden the cases detection.

Despite the lack of an operational classification of severe maternal morbidity events, the method used in this study showed that is possible to detect cases by analyzing the information from *SIH/SUS*.

The *SIH/SUS* can be used as a tool to analyze hospital morbidity. The system represents an important option for the planning of preventive measures.¹² Identifying admissions of women with obstetric complications is essential for planning the care during pregnancy, childbirth and puerperium. This identification brings information so that health professionals may avoid death or severe complications in women.²⁶

The use of this method can be a way to study severe maternal morbidity cases in Brazil, its regions and municipalities, considering that the admissions supported by *SUS* are still a majority in the country, which will allow an evaluation of the care provided by the Brazilian Public Health.

The use of secondary data has increased in Brazilian studies. They generate epidemiological information on the populations' health as a whole, in addition to the possibility of revealing the profile of obstetric complications and death of women in reproductive age.²⁷

In 2008, a study conducted in the municipality of Rio de Janeiro-RJ sought to identify cases of severe maternal morbidity by comparing data resulting from the revision of hospital admissions with those available at *SIH/SUS* database. The authors did not recommend the use of *SIH/SUS* as a source for identifying severe maternal morbidity and the possible prevention of these complications.¹⁰ However, another study, which was conducted in Paraná State

in 2010, and thus, using most recent records of *SIH/SUS*, found that the system can be a valuable tool for identifying obstetric complications.²⁸ It is important to highlight that few countries have well-structured hospital admission information systems, and Brazil is one of them.²⁹

However, there are some limits imposed in working with secondary data, in which information generated by the system depends on the (i) quality and coverage of the data filled in hospital medical records and the (ii) qualification of professionals that encode the diagnoses of hospital admissions. These conditions are added to the fact that *SIH/SUS* main objective is to transfer financial resources to hospitals, reason why we could not use the haemorrhage criterion as secondary diagnosis in this study, due to the changes promoted in the procedures' codes, which began to include all hospital admissions with procedures per treatment of clinical irregularities of pregnancy, with no specification of the severity of these diseases.

Regardless of these limitations, studies on severe maternal morbidity that use *SIH/SUS* can be a promising path for the surveillance of these complications, since the results that were found in this study are similar to other studies on this topic.

The severe maternal morbidity events – near miss – are not rare in the country's health clinics and hospitals. For health services, this study presents *SIH/SUS* as a tool for identifying these cases, with the objective of improving the quality of assistance and, consequently, the reduction of maternal mortality. The results presented also show the need to pay particular attention to women aged 35 years and over, which are exactly the group who presented the highest rates of severe maternal morbidity.

Authors' contributions

Silva TC contributed to the conception and design of the study, data analysis and drafting of the intellectual content of the manuscript.

Valera PRL, Oliveira RR and Mathias TAF contributed to study design, data analysis and to the critical revision of the intellectual content of the manuscript.

All the authors contributed to the interpretation of data and approved the final version of the manuscript, and declared to be responsible for all the aspects of the work, ensuring its accuracy and integrity.

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