

Incidence of maternal near miss in hospital childbirth and postpartum: data from the *Birth in Brazil* study

Incidência do *near miss* materno no parto e pós-parto hospitalar: dados da pesquisa *Nascer no Brasil*

Incidencia del *near miss* materno en el parto y posparto durante la hospitalización: datos de la investigación *Nacer en Brasil*

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Abstract

This study evaluated data on the incidence of maternal near miss identified on World Health Organization (WHO) criteria from the Birth in Brazil survey. The study was conducted between February 2011 and October 2012. The results presented are estimates for the study population (2,337,476 births), based on a sample of 23,894 women interviewed. The results showed an incidence of maternal near miss of 10.21 per 1,000 live births and a near-miss-to-mortality ratio of 30.8 maternal near miss to every maternal death. Maternal near miss was identified most prevalently by clinical criteria, at incidence of 5.2 per 1,000 live births. Maternal near miss was associated with maternal age 35 or more years (RR = 1.6; 95%CI: 1.1-2.5), a history of previous cesarean delivery (RR = 1.9; 95%CI: 1.1-3.4) and high-risk pregnancy (RR = 4.5; 95%CI: 2.8-7.0). incidence of maternal near miss was also higher at hospitals in capital cities (RR = 2.2; 95%CI: 1.3-3.8) and those belonging to Brazil's national health service, the Brazilian Unified National Health System (SUS) (RR = 3.2; 95%CI: 1.6-6.6). Improved quality of childbirth care services can help reduce maternal mortality in Brazil.

Maternal Mortality; Cesarean Section; Maternal and Child Health; Perinatal Mortality; Parturition

Resumo

Este estudo avaliou os dados sobre a incidência do near miss materno, identificados segundo os critérios da Organização Mundial da Saúde, na pesquisa Nascer no Brasil. O estudo foi realizado entre fevereiro/2011 e outubro/2012 e os resultados apresentados são estimativas para a população estudada (2.337.476 partos), baseados na amostra de 23.894 puérperas entrevistadas. Os resultados mostraram uma incidência de near miss materno de 10,21 por mil nascidos vivos e uma razão de mortalidade do near miss materno de 30,8 casos para cada morte materna. Os critérios clínicos para identificação do near miss materno foram os mais prevalentes e tiveram incidência de 5,2 por mil nascidos vivos. O near miss materno esteve associado com a idade materna de 35 anos ou mais (RR = 1,6; IC95%: 1,1-2,5), com história de cesariana anterior (RR = 1,9; IC95%: 1,1-3,4) e gestação de risco (RR = 4,5; IC95%: 2,8-7,0). Os hospitais localizados nas capitais (RR = 2,2; IC95%: 1,3-3,8) e os pertencentes ao SUS (RR = 3,2; IC95%: 1,6-6,6) também apresentaram maior incidência de casos de near miss materno. A qualificação dos serviços de assistência ao parto pode ajudar a reduzir a mortalidade materna no Brasil.

Mortalidade Materna; Cesárea; Saúde Materno-Infantil; Mortalidade Perinatal; Parto

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Introduction

The World Health Organization (WHO) estimates that, in 2010, some 287,000 women died worldwide during pregnancy and childbirth. That figure represents a 47% decline from 1990 levels, but is still a long way short of the 5th *Millennium Development Goal* of a 75% reduction in maternal deaths by 2015. Most of those deaths are concentrated in developing countries and result from lack of access to proper routine care and emergency care when necessary¹.

Analyzing the deaths that have occurred is a fundamental step towards understanding the process of obstetric care offered to women, identifying the problems in the health system and taking measures to improve the quality of care. Confidential studies of maternal deaths are one strategy that has been used worldwide to understand the flaws in health systems and services and, using the lessons learned from such review, to foster improvements in the quality of care². However, in developed countries, maternal deaths have declined to the point where they are rare events, meaning that information from studies of deaths are insufficient to evaluate the care provided. Pattinson³ adds that, even in countries where maternal deaths are relatively frequent, although maternal mortality studies at the national level can be important, these are less significant when conducted in small local regions or in institutions.

Women who survive severe complications in pregnancy, childbirth and postpartum share much in common with those who die from the same complications. This similarity has led to the development of the concept of maternal near miss^{4,5}, defined by the WHO as “*a woman who nearly died, but survived a complication that occurred during pregnancy, childbirth or within 42 days of termination of pregnancy*”⁴ (p. 289).

Maternal near-miss audits have been considered a useful approach to improving maternal care^{3,6}. Cases of maternal near miss are more frequent than maternal deaths, making for more robust analyses of the problems and obstacles in care provided to women during the cycle of pregnancy, childbirth and postpartum^{7,8}. Accordingly, identification of cases of maternal near miss is emerging as a promising alternative, complementary strategy for reducing mortality^{9,10}.

For several years, the main impediment to using maternal near miss as a reliable tool for evaluating maternal health conditions was that it was being defined on differing criteria, which led to heterogeneous estimates of its incidence^{4,11}. In 2009, with a view to standardizing the criteria on which maternal near miss is defined, the WHO

proposed a new classification using 25 criteria based on the presence of organ and system (cardiovascular, respiratory, renal, hepatic, neurologic, coagulation and uterine) dysfunction⁴. Since then, several studies from various different countries and institutions have been published taking these criteria into account^{7,11,12,13,14,15,16,17,18}.

The WHO¹ ranks Brazil among countries that achieved considerable reductions in maternal mortality between 1990 and 2010, although this downward trend has slowed since 2001¹⁹. As there are no population-based studies of incidence of maternal near miss in Brazil, knowing maternal near miss figures and the characteristics of the women who experienced these disorders can help improve the quality of maternal care, especially urgent obstetric care, and reduce maternal deaths¹². Quicker access to information from the study of cases of maternal near miss will permit both quicker intervention³ and evaluation of service performance in providing care for such cases⁷.

This study aims to estimate the incidence of maternal near miss in hospital childbirth and postpartum by maternal characteristics and to describe the occurrence of maternal near miss by reason for hospitalization, sector to which admitted and perinatal outcomes.

Methods

Birth in Brazil is a Brazilian national, hospital-based study of women who have recently given birth and their newborns, conducted from February 2011 to October 2012. The sample was selected in three stages. The first comprised hospitals with 500 or more deliveries per year, stratified by Brazil's five macro-regions, location (state capital or elsewhere) and type of hospital (private, public or mixed). The second comprised days (a minimum of seven days in each hospital) and the third, the women who had just given birth. At each of the 266 hospitals sampled, 90 women who had just given birth were interviewed, totaling 23,940 women. More information on the sample design is detailed in Vasconcellos et al.²⁰.

The main aim of the study was to evaluate the mode of delivery and its perinatal outcomes. All women who had recently given birth in hospital, where the outcome was a live birth, regardless of weight or gestational age, or a stillbirth weighing more than 500g or with gestational age greater than 22 weeks, were eligible.

Sample size was calculated considering the outcome caesarean section, estimated at 46.6% (2007 figure), with 5% significance to detect differences of 14% among types of service, statisti-

cal power of 95% and design effect of 1.3, resulting in a minimum sample of 440 to 450 women per stratum.

At the first study stage, the women were interviewed in person during their hospital stay, data were drawn from their clinical records and those of the newborns, and the women's antenatal cards were photographed. Telephone interviews were conducted before six months and at twelve months after childbirth to collect data on maternal and neonatal outcomes. This study used only the information from the first interview conducted during the hospital stay, plus the data from the hospital clinical records and antenatal cards, when available. The clinical record data were collected at hospital discharge or, for women who continued in hospital, on the 42nd day of their stay. Women transferred to another hospital facility were also followed up by the research team, even when that facility was not part of the study.

The field work was conducted by students and health personnel, after a minimum of three days' training given in each state by members of the study's central and state coordinating teams. Throughout the whole data collection period these professionals were accompanied by supervisors and by the state study coordinator. At none of the maternity hospitals included in the study was data collection performed by personnel from that same health facility. Detailed information on the data collection is reported in do Carmo Leal et al.²¹

Cases of maternal near miss were identified on criteria defined by the WHO, as already published by other authors⁵, using information contained in hospital patient records. All the cases identified were reviewed by two specialists independently, with a view to detecting possible inconsistencies in record data extraction or record completion. Disagreements were resolved by consensus.

Incidence was estimated for maternal near miss, cases of severe maternal outcomes (the number of women with maternal near miss plus the number of maternal deaths), the maternal mortality ratio (MMR) (maternal deaths per 100,000 live births), fatality rate among cases of maternal near miss (the proportion of maternal deaths among cases of maternal near miss), and the mortality ratio for cases of maternal near miss (number of maternal near miss for each maternal death).

This study was not designed to analyze maternal mortality, which may have resulted in underestimation of this outcome. Accordingly, it was decided to calculate the MMR using the cases of maternal deaths recorded in Brazil's Mor-

tality Information System (SIM). This calculation included maternal deaths occurring during childbirth or in the 42 days following childbirth at hospitals with more than 500 deliveries per year, and thus excluding maternal deaths occurring during pregnancy, from complications of abortion, occurring at home or at hospitals with less than 500 deliveries per year. As the study sample was calculated to be representative of births in 2011, it used only maternal deaths identified in the SIM for that year.

Incidence of maternal near miss was calculated by the demographic, socioeconomic and reproductive characteristics of the woman giving birth, as well as by geographical location, type of service and source of payment for care in childbirth. Women who delivered in public health care facilities and women who delivered in mixed health care facilities that were not paid by health insurance plans were classified as "public source of payment". Women whose delivery was paid by source of payment, and the delivery occurred in mixed or private hospitals, and women who delivered in private facilities, regardless if the delivery had been paid or not by the health insurance plan, were classified as "private source of payment".

Proportional distribution of maternal near miss was also ascertained by reason for hospital admission and sector to which admitted, occurrence of adverse perinatal outcomes (fetal and neonatal death), and admission of the newborn to an intensive care unit (ICU). The Chi-square test was used to examine differences among the proportions.

The study examined social and demographic variables, as well as variables relating to prior obstetric history and the history of the current pregnancy, hospital location, form of financing, type of delivery and perinatal outcomes.

Fetal deaths were identified from the maternal record. Neonatal deaths and data on admission to a neonatal ICU were obtained from the baby's record. Demographic and socioeconomic information were obtained by interviewing the woman giving birth. Obstetric background and data on the current pregnancy were obtained at interview, from antenatal cards (when available) and the mothers' hospital record. Information on high-risk pregnancy and hospital admission during pregnancy were obtained at interview of the woman giving birth.

The data were subjected to weighting and calibration procedures; the results presented, estimates for the study population (2,337,476 deliveries), are based on the sample of 23,894 expectant mothers interviewed²⁰. Complex sample analysis was used with a view to incorporating

the study design effect and data weighting to adjust for the sampling design. All analysis was performed using the software IBM SPSS version 19.0 (IBM Corp., Armonk, United States).

The study followed all the recommendations of *Resolution n. 196/96* by Brazil's National Health Council (CNS) and was approved by the Ethics Research Committee of the National School of Public Health, Oswaldo Cruz Foundation (ENSP/Fiocruz), report n. 92/2010. Digital consent was obtained from each expectant mother before interview, after reading the Declaration of Free and Informed Consent, which in the case of expectant minors, was given by their guardians.

Results

A total of 243 cases of maternal near miss were identified as occurring in the study period, with an estimated 23,747 cases of maternal near miss occurring nationwide in a total of 2,325,394 live births recorded in Brazil, resulting in incidence of 10.2 per 1,000 live births (95% confidence interval – 95%CI: 7.5%-13.7% per 1,000). A total of 684 maternal deaths were identified in the SIM, giving a MMR of 29.41 per 100,000 live births. The number of women with severe maternal outcomes was estimated at 24,431 cases, with a mortality ratio among cases of maternal near miss of 34.71:1 and a mortality rate of 2.79% among women with severe maternal outcomes.

Among the women identified as maternal near miss, most met only one (67%) or two (20%) of the WHO diagnostic criteria. Most prevalent in identifying cases of maternal near miss were clinical criteria (50%) and management criteria (42%). The clinical criteria most recorded were alterations in respiratory rate (16.8%), coagulation disorders (15%), acute cyanosis (9.8%) and shock (9.6%). The most prevalent management criteria were transfusion of five or more units of red blood cells (24%), infection or hemorrhage leading to hysterectomy (18%) and indication of use of continuous vasoactive drugs (9.3%). The clinical criteria with greatest incidence was respiratory rate greater than the 40 or less than 6 breaths per minute (1.7 per 1,000 live births); the laboratory criterion with greatest incidence was acute thrombocytopenia (< 50,000 platelets) (1.2 per 1,000 live births); and the most incident management criterion was blood transfusion of 5 or more units of red cells (2.4 per 1,000 live births) (Table 1).

When incidence of maternal near miss was analyzed by demographic and socioeconomic characteristics, it was found to be greater at the limits of reproductive age, with the highest rates

observed among adolescents from 10 to 14 years old and among women over 35 years old, the latter being statistically significant (RR = 1.6; 95%CI: 1.1%-2.5%). No significant differences were observed by skin color, marital status or schooling, although maternal near miss was far lower among women with higher education than in the other education brackets (Table 2).

In terms of obstetric background and characteristics of the current pregnancy, maternal near miss was found to be more incident in women with prior caesarean sections, incidence of maternal near miss increasing with the increase in prior caesarean sections. Pregnant women who described themselves as at risk and those admitted to hospital during pregnancy displayed higher incidences of maternal near miss than those who presented no complications in the current pregnancy. Primiparas, women with multiple gestations and those who had not received antenatal care displayed higher incidences of maternal near miss, but these differences were not statistically significant (Table 2).

Higher incidence of maternal near miss was found in hospitals in the capital cities, in hospitals belonging to the Brazilian Unified National Health System (SUS) and in women whose delivery was publicly funded (Table 3).

A rising gradient was observed in incidence of maternal near miss by the number of maternity facilities approached for admission to give birth. Incidence was significantly (four times) greater in those who had approached three or more services, as compared with those admitted to the first service approached (Table 3).

Incidence of maternal near miss was greater among women with forceps delivery and those subjected to cesarean section without labor, while the lowest value was observed among women with vaginal delivery. Higher incidence of maternal near miss was also found among women with induced labor. Although the distribution of cases of maternal near miss by macro-region of Brazil revealed highest incidence in the Central region and lowest in the Southeast, these differences were not statistically significant (Table 3).

Higher proportions of maternal near miss were found among women admitted for clinical obstetric complications (4.8%) and those admitted to induce labor (1.8%) than among those admitted in labor (0.5%) or for cesarean section without labor (0.6%) ($p < 0.001$) (Table 4).

The highest rate of maternal near miss was observed among women who, on admission, were taken to the ICU (14.3%). A higher rate was observed among those hospitalized in prepartum/partum/postpartum beds (2.4%), as compared with pregnant mothers admitted to other

Table 1

Incidence and proportional distribution of cases of maternal near-miss by World Health Organization (WHO) criteria *.
Brazil, 2011-2012.

	Incidence per 1,000 live births	%
Number of criteria		
1	6.8	67.0
2	2.0	20.0
3	0.4	4.3
≥ 4	1.0	9.5
Clinical criteria	5.2	51.0
Respiratory frequency greater than 40 or less than six breaths per minute	1.7	16.8
Coagulation disorder	1.5	15.0
Acute cyanosis	1.0	9.8
Shock	1.0	9.6
Oliguria non-responsive to fluids or drugs	0.9	8.5
Repeated seizures/total paralysis	0.8	7.8
Jaundice in the presence of pre-eclampsia	0.6	6.0
Prolonged unconsciousness lasting ≥12 hours	0.5	4.7
Gasping	0.5	4.6
Loss of consciousness + absence of pulse	0.3	3.2
Stroke	0.1	1.1
Laboratory criteria	3.1	30.0
Acute Thrombocytopenia (< 50,000 platelets)	1.2	12.0
pH < 7.1	0.6	5.5
Creatinine ≥ 3.5mg/dl	0.5	5.3
Hyperbilirubinemia (> 6mg/dl)	0.5	5.2
PaO ₂ /FIO ₂ < 200mmHg	0.5	5.0
Loss of consciousness and presence of glucose plus ketoacids in urine	0.5	4.7
O ₂ saturation < 90% for ≥ 60 minutes	0.4	3.5
Lactate > 5	0.1	0.8
Management criteria	4.2	42.0
Transfusion of ≥ 5 units of red blood cells	2.4	24.0
Uterine hemorrhage or infection leading to hysterectomy	1.8	18.0
Continuous vasoactive drug support	0.9	9.3
Mechanical intubation and ventilation for ≥ 60 minutes and unrelated to anesthesia	0.6	6.1
Dialysis for acute renal failure	0.3	3.2
Cardiopulmonary resuscitation	0.1	1.2

* Pattinson et al. 6.

sectors of the hospital. The lowest value was observed among those taken to the delivery room (0.1%) (Table 4).

Maternal near miss was found to occur more often in pregnancies that resulted in adverse perinatal outcomes (fetal or neonatal deaths), and when newborns were admitted to the neonatal ICU (Table 4). The rate of fetal and neonatal deaths was eight times higher among cases of maternal near miss, and newborn admission to the neonatal ICU, three times more frequent ($p < 0.001$).

Discussion

Interest in using the concept of maternal near miss as an adjunct in reducing maternal mortality is growing worldwide. However, incidence of maternal near miss varies widely because different diagnostic criteria are used^{9,22}. In 2009, the WHO proposed a set of criteria for identifying cases of maternal near miss, but as yet only a few studies use them^{18,23}. Even when using the criteria proposed by the WHO, studies published to date report considerable differences in incidence

Table 2

Incidence of maternal near-miss in hospital childbirth and postpartum and relative hazard by demographic, socioeconomic, obstetric and current pregnancy characteristics. Brazil, 2011-2012.

Women's characteristics	Incidence of maternal near miss/1,000 live births.	Relative hazard	95%CI
Mother's age (years)			
10-14	15.7	1.7	0.4-6.7
15-19	9.8	1.0	0.7-1.6
20-34	9.4	1.0	-
≥ 35	15.4	1.6	1.1-2.5
Skin color			
White	9.3	1.0	-
Non-white	10.6	1.1	0.8-1.7
Marital status			
No partner	10.8	1.1	0.8-1.5
With partner	10.0	1.0	-
Schooling			
Incomplete Primary School	10.8	1.7	0.7-4.2
Complete Primary School	11.2	1.8	0.8-3.9
Complete Secondary School	10.0	1.6	0.8-3.4
University and more	6.2	1.0	-
Parity			
≥ 1 births	8.8	1.0	-
Primipara	11.7	1.3	0.9-1.8
Pregnancy type			
Single	10.0	1.0	-
≥ Twin	22.0	2.2	0.8-6.4
Prior cesarian *			
No	6.5	1.0	-
1 prior caesarian	12.5	1.9	1.1-3.4
≥ 2 prior caesarians	16.4	2.5	1.5-4.2
High-risk pregnancy			
Yes	31.4	4.5	2.8-7.0
No	7.0	1.0	-
Antenatal care			
Yes	9.9	1.0	-
No	25.2	2.5	0.8-7.6
Admission during pregnancy			
Yes	20.5	2.4	1.8-3.3
No	8.4	1.0	-

* Dados refer only to women with prior birth.

95%CI: 95% confidence interval.

of maternal near miss, ranging from 5.0 to 33.2 per 1,000 live births ^{7,11,12,14,15,16,18,24}.

The incidence of maternal near miss found in this study was 10.2 per 1,000 live births, with a further 23,000 cases estimated in the sample expanded to national level. These numbers are conservative, however, as the study did not in-

clude cases resulting from abortion, complications postpartum after hospital discharge, nor childbirth at home, on a public thoroughfare or in small hospitals with fewer than 500 deliveries per year. Santana et al. ²⁵ state that ectopic pregnancy may account for approximately 8% of cases of maternal near miss.

Table 3

Incidence of maternal near-miss childbirth and postpartum and relative hazard by characteristics of delivery and service providing care. Brazil, 2011-2012.

Women's characteristics	Incidence of maternal near miss/1,000 live births.	Relative hazard	95%CI
Region			
North	9.9	1.1	0.4-2.8
Northeast	10.6	1.2	0.5-2.7
Southeast	9.2	1.0	-
South	10.4	1.1	0.7-1.9
Central	14.5	1.6	0.6-4.0
Hospital location			
Non-capital	7.0	1.0	-
Capital	15.4	2.2	1.3-3.8
Hospital type			
SUS	13.9	3.2	1.6-6.6
Mixed	8.5	2.0	1.0-4.1
Private	4.3	1.0	-
Delivery payment source			
Health plan/Private	6.0	1.0	-
SUS	11.2	1.9	1.1-3.2
Number of hospitals to admission			
Admitted to 1 st hospital	8.8	1.0	-
Admitted to 2 nd hospital	14.0	1.6	0.9-2.8
Admitted to ≥ 3 rd hospital	35.2	4.0	2.0-8.1
Labor			
Spontaneous	5.1	1.0	-
Induced	8.6	1.7	1.0-2.7
Without labor	18.0	3.5	2.3-5.4
Delivery type			
Vaginal	4.4	1.0	-
Cesarian section with labor	7.7	1.8	1.0-3.1
Cesarian section without labor	18.0	4.1	2.7-6.3
Forceps	40.7	9.3	4.2-20.4

95%CI: 95% confidence interval; SUS: Brazilian Unified National Health System.

Lotufo et al.²⁶, in a cross-sectional study conducted at a university referral hospital in Sao Paulo State and including only women admitted to the ICU, found a lower incidence, of 4.4 cases of maternal near miss per 1,000 live births. This low incidence may be explained by the definition of maternal near miss used in the study and also by the fact that the hospital in question is not a major referral center for high-risk pregnancies.

In a one-year cross-sectional study to develop a tool based on the WHO recommendations and intended for prospective identification of cases of maternal near miss at an Australian hospital, Jayaratnam et al.¹⁷ found incidence of 6 per 1,000

live births. Jabir et al.¹⁴, in a cross-sectional study at six hospitals in Baghdad, Iraq, found incidence of 5.06 cases per 1,000 live births. In these three studies, experts from the hospitals themselves were responsible for extracting and analyzing data from hospital records in order to identify cases. The hospitals involved had the necessary structure to follow up cases of maternal near miss and the data collection periods were longer, making it possible to consult the health personnel who had cared for the women in order to clarify doubts about the records, which may explain the lower incidence encountered. In the *Birth in Brazil* study, the field period was shorter and access

Table 4

Reason for pregnant woman's hospital admission and department admitted to and perinatal outcomes by diagnosis of maternal near-miss. Brazil, 2011-2012.

	With maternal near miss %	Without maternal near miss %	p-value *
Reason for admission			
Admission in labor	0.5	99.5	
Admission to induce delivery	1.8	98.2	
Admission for elective caesarian section	0.6	99.4	< 0.001
Admission for clinical obstetric complication	4.8	95.2	
Other reason	1.0	99.0	
Admitted to			
Ward/Room	1.0	99.0	
Prepartum	1.0	99.0	
prepartum/partum/postpartum bed	2.4	97.6	
Delivery room	0.1	99.9	< 0.001
Surgical center	1.1	98.9	
ICU	14.3	86.0	
Admission of at least one newborn to neonatal ICU			
Yes	3.1	96.9	< 0.001
No	0.9	99.1	
Fetal or neonatal death			
Yes	8.3	91.7	< 0.001
No	1.0	99.0	

ICU: intensive care unit.

* Chi-square statistic test.

to health service personnel for clarifications was more difficult, which may have led to overestimation of severity from the data in patient records.

The WHO recommendations for characterization of cases of maternal near miss propose diagnosis by organ dysfunction, which can be identified on clinical, laboratory and treatment criteria. The use of all the clinical, laboratory and treatment criteria in isolation is another factor that may have contributed to more cases being identified as maternal near miss. Cecatti et al.¹⁶, in a paper on pre-validation of organ dysfunction-based criteria for identification of maternal near miss, write that, as regards the management criteria, the facility where the study was conducted and the treatment resources available should be considered, because when management criteria are used in isolation there is a tendency to include less severe cases.

The incidence of maternal near miss found in this present study agrees with those found in another major Brazilian national study⁷, comprising 82,388 women at 27 institutions, and in the WHO survey¹² of 314,623 women in 29 countries

(9.4 and 8.3 per 1,000 live births, respectively). Similar incidences were also found by Morse et al.¹⁸ at a referral hospital in Rio de Janeiro, also using the WHO criteria, which reported an incidence rate of 9.35 per 1,000 live births.

Higher rates were found in two studies with characteristics different from *Birth in Brazil*. Cecatti et al.¹⁶, in a retrospective study of a five-year period, to pre-validate the organ dysfunction criteria in an obstetric intensive care unit at a local-region university referral hospital, found an incidence rate of 13.46 per 1,000 live births. In India, Roopa et al.²⁴ found a rate of 17.8 at a local-region tertiary referral hospital with ICU in a study with characteristics similar to that of Cecatti et al.¹⁶.

Souza et al.²⁷, in a WHO survey of maternal and perinatal health at 120 hospitals in eight different Latin American countries, using pragmatic criteria such as admission to ICU, puerperal hysterectomy, blood transfusion, cardiac and renal complications and eclampsia to identify cases of maternal near miss, found a rate for Brazil of more than 40 per 1,000 live births, four times

greater than found in this study. Enlargement of the criteria used to diagnose cases of maternal near miss is one possible explanation for the higher incidence encountered.

In this study, the highest incidences of maternal near miss were observed in women 35 or more years old, women with more prior caesarean sections, reporting high-risk pregnancy and hospital admission during pregnancy, whose delivery was financed from public funds, who were treated at hospitals of the SUS, at hospitals in the state capitals and who underwent forceps or caesarean section deliveries. Differences in the incidence of maternal near miss by other demographic and socioeconomic variables were not observed, but may act as distal determinants of cases by their association with risk situations in gestation and difficulties in service access.

Previous studies have identified greater incidence of maternal near miss in women 35 or more years old^{27,28}, in primiparas²⁷, in women with prior caesarean sections²⁷ and in women with less schooling²⁸.

Greater incidence of maternal near miss in hospitals in state capitals may reflect the profile of those hospitals, where conditions are more appropriate to treating high-risk pregnancies and which are referral centers for expectant women who present complications during pregnancy and reside outside the capital. The greater incidence of maternal near miss in expectant women treated at SUS hospitals and those with publicly-funded deliveries probably results from the greater reproductive risk of women treated at public sector facilities.

Hora²⁹ suggests that, as public maternal and neonatal referral services also offer care to a portion of high-risk pregnancies from the (private) Supplementary Health System when such coverage does not extend to the care necessary in situations of risk, this contributes to the higher incidence of maternal near miss among women treated by the public health service.

Higher incidence was also found in the group of women who reported difficulties in access on seeking admission for childbirth, which characterizes delayed care. Several authors have documented the adverse effects of delays in care for women at childbirth³⁰.

Forceps delivery was associated with the highest incidence of maternal near miss, but its low prevalence, of about 1.5% among the women in the study, hinders any better analysis of this association. Higher incidence of maternal near miss among women with a prior history of caesarean section and those undergoing such surgery in the present gestation indicates the need for further analysis of the association between

this type of delivery and maternal near miss and maternal mortality. Caesarean section is known to be indicated in maternal complications occurring during gestation and/or at childbirth; such complications are indeed the cause of maternal near miss. Nonetheless, national studies show that caesarean sections are increasingly being performed in Brazil, and now account for more than half of all deliveries per year. Rates are even higher in services of the Supplementary Health System, frequently motivated by non-clinical factors^{31,32,33,34}.

Differences were observed in rates of maternal near miss by why the expectant mother was admitted to hospital and to which sector. Maternal near miss was more frequent among those admitted for complications in pregnancy or for induced delivery, and in those admitted to the ICU or to prepartum/partum/postpartum beds. The clinical or obstetric pathologies which occasioned these expectant mothers' hospital admission and induced delivery during gestation are the probable risk factors for maternal near miss, demonstrating the importance of proper care for women about to give birth in such situations. The higher rate of maternal near miss among women about to give birth who are referred to ICU on admission to hospital attests to the severity of these women's clinical conditions. However, it is not so clear why a higher rate was observed among expectant mothers admitted to prepartum/partum/postpartum beds (rooms where women are admitted for monitoring during labor, care at childbirth and immediate postpartum care) (Table 4). One possible explanation is that, as these beds are in individual rooms, they are being used for observation of women with more complicated conditions. The limited number of cases observed in this study are insufficient for any conclusive analysis.

Adverse perinatal outcomes and transfer to neonatal ICU were common among women classified as maternal near miss. Souza et al.²⁷ also found associations between maternal near miss and adverse perinatal outcomes, such as transfer to neonatal ICU, low birth weight, stillbirth and neonatal mortality.

These results indicate that maternal near miss is related both to complications occurring during gestation (pregnancies classified as high-risk, hospitalizations during gestation, hospital admission to ICU) and to difficulties in accessing care for gestation and childbirth, which also resulted in adverse perinatal outcomes (deaths and ICU admissions).

The main limitations on this study to evaluate the incidence of maternal near miss in Brazil are that it did not include cases of abortion,

complications occurring postpartum after hospital discharge, or childbirth at home, on a public thoroughfare or in hospitals with fewer than 500 deliveries per year. According to data from the SIM, some 58% of maternal deaths in 2011 occurred at hospitals with fewer than 500 deliveries per year, which may explain in part the high ratio of maternal near miss to maternal death (34.71:1) found in the study, which is far higher than found in the studies by Morse et al.¹⁸ (3.3:1), Cecatti et al.¹⁶ (10.7:1) and Amaral et al.³⁰ (23.7:1). Only the study by Souza et al.²⁷, which used broader criteria to identify the cases of maternal near miss, found a higher ratio of maternal near miss to maternal mortality (185:1) than this study. Meanwhile, the study design (by health personnel unconnected with the institution studied, based on hospital patient records, and with no clarification of doubts about cases identified) may have led to overestimation of cases, as suggested by the high ratio of maternal near miss to mortality encountered.

As the instrument used did not allow the identification of women who gave birth paid by direct disbursement, it is possible that some women had their delivery assisted in mixed health care facilities and were classified as having public source of payment, having paid for their delivery care. However, as these women had very similar socioeconomic characteristics of women attending public hospitals, it is likely that misclassification occurred in a few cases. As it is a non-differential misclassification with respect to the outcomes studied, it is expected that there

has been attenuation of the magnitude of the observed associations.

Another limitation is the size of the sample, which was not planned specifically to examine the outcome maternal near miss, and may have been insufficient to detect significant differences for some variables, such as parity, multiple gestation, antenatal care, and delivery financing type. Note that other studies have identified an association between maternal near miss and an absence or smaller number of antenatal care appointments^{35,36,37}.

The higher incidence of maternal near miss in expectant women with complications in pregnancy and those with difficulties in gaining admission, and the higher incidence of case management-related criteria (predominantly blood transfusion and hysterectomy), indicate the need for improvements in the quality of services providing care in pregnancy and childbirth, including strengthening referral and counter referral networks for high-risk pregnancies, thus assuring timely access to specialized services whenever necessary, given that such women display higher incidences of maternal near miss.

The diversity of results from Brazilian national studies of incidence of maternal near miss may be related to, among other things, the facilities available at the hospitals studied, the duration of the fieldwork, the training of health personnel to provide urgent and emergency obstetric care and organization of the health care network, and suggests a need for further studies on this subject.

Resumen

Este estudio evaluó los datos sobre la incidencia del near miss materno, identificado conforme los criterios de la Organización Mundial de la Salud, en la investigación Nacer en Brasil. El estudio se realizó entre febrero/2011 y octubre/2012 y los resultados presentados son estimaciones de población (2.337.476 nacimientos), en base a una muestra de 23.894 mujeres entrevistadas. Los resultados mostraron una incidencia de near miss materno de 10,21 por cada 1.000 nacidos vivos y una tasa de mortalidad del near miss materno de 30,8 casos por cada muerte materna. Los criterios clínicos para la identificación del near miss materno fueron los más frecuentes y tenían una incidencia de 5,2 por cada 1.000 nacidos vivos. El near miss materno se asoció

con una edad materna de 35 años o mayores (RR = 1,6; IC95%: 1,1-2,5), con antecedentes de parto por cesárea (RR = 1,9; IC95%: 1,01-3,04) y embarazo de riesgo (RR = 4,5; IC95%: 2,8-7,0). Los hospitales ubicados en las ciudades de capitales (RR = 2,2; IC95%: 1,3-3,8) y los que pertenecen al Sistema Único de Salud (RR = 3,2; IC95%: 1,6-6,6) también tuvieron una mayor incidencia de near miss materno. La cualificación de la atención en la prestación de servicios puede ayudar a reducir la mortalidad materna en Brasil.

Mortalidad Materna; Cesárea; Salud Materno-Infantil; Mortalidad Perinatal; Parto

Contributors

M. A. B. Dias, R. M. S. M. Dominguez, A. O. C. Schilithz, M. Nakamura-Pereira and C. S. G. Diniz collaborated in data analysis and interpretation, and in drafting the paper. I. R. Brum, A. L. Martins, M. M. Theme Filha, S. G. N. Gama and M. C. Leal contributed to critical review of content, and to drafting the paper.

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References

1. World Health Organization. MDG 5: improve maternal health. http://www.who.int/topics/millennium_development_goals/maternal_health/en/ (accessed on 17/Aug/2013).
2. Lewis G. The Confidential Enquiry into Maternal and Child Health (CEMACH). Saving Mothers' Lives: reviewing maternal deaths to make motherhood safer – 2003-2005. The Seventh Report on Confidential Enquiries into Maternal Deaths in the United Kingdom. London: Confidential Enquiry into Maternal and Child Health; 2007.
3. Pattinson R. Near miss audit in obstetrics. *Best Pract Res Clin Obstet Gynaecol* 2009; 23:285-6.
4. Say L, Souza JP, Pattinson RC. Maternal near miss – towards a standard tool for monitoring quality of maternal health care. *Best Pract Res Clin Obstet Gynaecol* 2009; 23:287-96.
5. Souza JP, Gülmezoglu AM, Carroli G, Lumbiganon P, Qureshi Z; WHOMCS Research Group. The world health organization multicountry survey on maternal and newborn health: study protocol. *BMC Health Serv Res* 2011; 11:286.
6. Pattinson R, Say L, Souza JP, Broek Nv, Rooney C, et al. WHO maternal death and near-miss classifications. *Bull World Health Organ* 2009; 87:734.
7. Souza JP, Cecatti JG, Haddad SM, Parpinelli MA, Costa ML, Katz L, et al. The WHO maternal near-miss approach and the maternal severity index model (MSI): tools for assessing the management of severe maternal morbidity. *PLoS One* 2012; 7:e44129.
8. Pattinson RC, Hall M. Near misses: a useful adjunct to maternal death enquiries. *Br Med Bull* 2003; 67:231-43.
9. Tunçalp O, Hindin MJ, Souza JP, Chou D, Say L. The prevalence of maternal near miss: a systematic review. *BJOG* 2012; 119:653-61.
10. World Health Organization. Evaluating the quality of care for severe pregnancy complications: The WHO near-miss approach for maternal health. Geneva: World Health Organization; 2011.
11. Lobato G, Nakamura-Pereira M, Mendes-Silva W, Dias MA, Reichenheim ME. Comparing different diagnostic approaches to severe maternal morbidity and near-miss: a pilot study in a Brazilian tertiary hospital. *Eur J Obstet Gynecol Reprod Biol* 2013; 167:24-8.
12. Souza JP, Gülmezoglu AM, Vogel J, Carroli G, Lumbiganon P, Qureshi Z, et al. Moving beyond essential interventions for reduction of maternal mortality (the WHO Multicountry Survey on Maternal and Newborn Health): a cross-sectional study. *Lancet* 2013; 381:1747-55.
13. van den Akker T, Beltman J, Leyten J, Mwagomba B, Meguid T, Stekelenburg J, et al. The WHO maternal near miss approach: consequences at Malawian District level. *PLoS One* 2013; 8:e54805.
14. Jabir M, Abdul-Salam I, Suheil DM, Al-Hilli W, Abul-Hassan S, Al-Zuheiri A, et al. Maternal near miss and quality of maternal health care in Baghdad, Iraq. *BMC Pregnancy Childbirth* 2013; 13:11.

15. Nelissen E, Mduma E, Broerse J, Ersdal H, Evjen-Olsen B, van Roosmalen J, et al. Applicability of the WHO maternal near miss criteria in a low-resource setting. *PLoS One* 2013; 8:e61248.
16. Cecatti JG, Souza JP, Oliveira Neto AF, Parpinelli MA, Sousa MH, Say L, et al. Pre-validation of the WHO organ dysfunction based criteria for identification of maternal near miss. *Reprod Health* 2011; 8:22.
17. Jayaratnam S, De Costa C, Howat P. Developing an assessment tool for maternal morbidity “near-miss” – a prospective study in a large Australian regional hospital. *Aust N Z J Obstet Gynaecol* 2011; 51:421-5.
18. Morse ML, Fonseca SC, Gottgroy CL, Waldmann CS, Gueller E. Severe maternal morbidity and near misses in a regional reference hospital. *Rev Bras Epidemiol* 2011; 14:310-22.
19. Secretaria de Vigilância em Saúde, Ministério da Saúde. Boletim Epidemiológico 43(1). http://portalsaude.saude.gov.br/portalsaude/arquivos/bolepi_vol_43_n1.pdf (accessed on 17/Aug/2013).
20. Vasconcellos MTL, Silva PLN, Pereira APE, Schilithz AOC, Souza Junior PRB, Szwarcwald CL. Desenho da amostra *Nascer no Brasil*: Pesquisa Nacional sobre Parto e Nascimento. *Cad Saúde Pública* 2014; 30 Suppl:S49-58.
21. do Carmo Leal M, da Silva AA, Dias MA, da Gama SG, Rattner D, Moreira ME, et al. Birth in Brazil: national survey into labour and birth. *Reprod Health* 2012; 9:15.
22. Say L, Pattinson RC, Gulmezoglu AM. WHO systematic review of maternal morbidity and mortality; the prevalence of severe acute maternal morbidity (near miss). *Reprod Health* 2004; 1:3.
23. Pattinson R, Say L, Souza JP, Broek N, Rooney C; WHO Working Group on Maternal Mortality and Morbidity Classifications. WHO maternal death and near-miss classifications. *Bull World Health Organ* 2009; 87:734.
24. Roopa PS, Verma S, Rai L, Kumar P, Pai MV, Shetty J. “Near miss” obstetric events and maternal deaths in a tertiary care hospital: an audit. *J Pregnancy* 2013; 2013:393758.
25. Santana DS, Cecatti JG, Parpinelli MA, Haddad SM, Costa ML, Sousa MH, et al. Severe maternal morbidity due to abortion prospectively identified in a surveillance network in Brazil. *Int J Gynaecol Obstet* 2012; 119:44-8.
26. Lotufo FA, Parpinelli MA, Haddad SM, Surita FG, Cecatti JG. Applying the new concept of maternal near-miss in an intensive care unit. *Clinics* 2012; 67:225-30.
27. Souza JP, Cecatti JG, Faúndes A, Morais SS, Villar J, Carroli G, et al. Maternal near miss and maternal death in the World Health Organization’s 2005 global survey on maternal and perinatal health. *Bull World Health Organ* 2010; 88:113-9.
28. Souza JP, Cecatti JG, Parpinelli MA, Sousa MH, Lago TG, Pacagnella RC, et al. Maternal morbidity and near miss in the community: findings from the 2006 Brazilian demographic health survey. *BJOG* 2010; 117:1586-92.
29. Hora TB. Análise das características das beneficiárias de planos privados de saúde atendidas no SUS para assistência ao parto no ano de 2005 [Monografia de Graduação]. Rio de Janeiro: Escola Nacional de Saúde Pública Sérgio Arouca, Fundação Oswaldo Cruz; 2009.
30. Amaral E, Souza JP, Surita F, Luz AG, Sousa MH, Cecatti JG, et al. A population-based surveillance study on severe acute maternal morbidity (near-miss) and adverse perinatal outcomes in Campinas, Brazil: the Vigimoma Project. *BMC Pregnancy Childbirth* 2011; 11:9.
31. Domingues RMSM, Dias MAB, Nakamura-Pereira M, Torres JA, d’Orsi E, Pereira APE, et al. Processo de decisão pelo tipo de parto no Brasil: da preferência inicial das mulheres à via de parto final. *Cad Saúde Pública* 2014; 30 Suppl:S101-16.
32. Barros AJD, Santos IS, Matijasevicha A, Domingues MR, Silveira M, Barros FC, et al. Patterns of deliveries in a Brazilian birth cohort: almost universal cesarean sections for the better-off. *Rev Saúde Pública* 2011; 45:635-43.
33. Potter JE, Hopkings K, Faúndes A. Women’s autonomy and scheduled cesarean sections in Brazil: a cautionary tale. *Birth* 2008; 35:33-40.
34. Dias MAB, Domingues RMSM, Pereira APE, Fonseca SC, Gama SGN, Theme-Filha MM, et al. Trajetória das mulheres na definição pelo parto cesáreo: estudo de caso em duas unidades do sistema de saúde suplementar do Estado do Rio de Janeiro. *Ciênc Saúde Coletiva* 2008; 13:1521-34.
35. Shen FR, Liu M, Zhang X, Yang W, Chen YG. Factors associated with maternal near-miss morbidity and mortality in Kowloon Hospital, Suzhou, China. *Int J Gynaecol Obstet* 2013; 123:64-7.
36. Rööst M, Altamirano VC, Liljestrand J, Essén B. Does antenatal care facilitate utilization of emergency obstetric care? A case-referent study of near-miss morbidity in Bolivia. *Acta Obstet Gynecol Scand* 2010; 89:335-42.
37. Amorim MM, Katz L, Valença M, Araújo DE. Morbidade materna grave em UTI obstétrica no Recife, Região Nordeste do Brasil. *Rev Assoc Med Bras* 2008; 54:261-6.

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