Factors associated with near miss and maternal mortality in Brazil: a systematic review

Fatores associados ao near miss e mortalidade materna no Brasil: uma revisão sistemática

Joana Karollyne de Siqueira Mendes[1], Vanessa de Oliveira e Silva[2], Idrys Henrique Leite Guedes[3], Vicente Castor Brito[4], Danusa Petra Barbosa Tomé[5], Katarina Venâncio Antunes Romeu Ramos[6], Klleydson Figueiredo da Silva[7], Vilessa Lilian de Araújo Gomes[8], Anna Luísa de Souza Holanda[9], Raimundo Antonio Batista de Araujo[10]

ABSTRACT: Introduction: Maternal Near Miss (NMM) events are important indicators of maternal health. In view of this, it is important to observe the main causes of gestational complications, Maternal Mortality (MM) and, mainly, NMM in Brazil, considering its relationship with sociodemographic and health care factors. **Objective:** To describe the factors associated with NMM and MM in Brazil. **Methods:** This is a systematic review with analysis of articles indexed in the PubMed, BVS, SciELO, ScienceDirect and Scopus databases. Data collection was carried out double-blind by two independent reviewers and I had the help of a third reviewer to analyze discrepancies. Initially, the articles were selected by titles and abstracts and, later, by the full text. **Results:** Analyzing the main conditions related to NMM and MM, it can be observed that the studies mainly listed: hemorrhage (10/17), hypertension (8/17), pre-eclampsia (7/17), sepsis (17/06), eclampsia (17/05) and infection (17/05). Furthermore, it is worth highlighting that other different variables such as skin color, income, presence of a partner also influenced the rates of NMM and MM, according to an analyzed article. **Conclusions:** The main clinical conditions associated with MM and NMM were: hemorrhage, hypertension and pre-eclampsia. The limitations of the study were: divergence between the assessment criteria for related conditions and some multicenter studies.

KEY WORDS: Near Miss; Maternal Mortality; Brazil; Comprehensive Health Care.

RESUMO: Introdução: Os eventos de *Near Miss* Materno (NMM) são importantes indicadores da saúde materna. Diante disso, é importante a observação das principais causas de complicações gestacionais, Mortalidade Materna (MM) e, principalmente, do NMM no Brasil, tendo em vista sua relação com fatores sociodemográficos e de assistência à saúde. **Objetivo:** Descrever os fatores associados ao NMM e a MM no Brasil. **Métodos:** Trata-se de uma revisão sistemática com análise de artigos indexados nas bases PubMed, BVS, SciELO, ScienceDirect e Scopus. A coleta de dados foi realizada em duplo cego por dois revisores independentes e contou com auxílio de um terceiro revisor para analisar as discrepâncias. Inicialmente, os artigos foram selecionados por títulos e resumos e, posteriormente, pelo texto na íntegra. **Resultados:** Analisando-se as principais condições relacionadas ao NMM e MM, pode-se observar que os estudos elencaram principalmente: hemorragia (10/17), hipertensão (8/17), pré-eclâmpsia (7/17), sepse (6/17), eclâmpsia (5/17) e infecção (5/17). Além disso, vale destacar que outras variáveis diferentes como cor da pele, renda, presença do companheiro também influenciaram nas taxas de NMM e MM, segundo um artigo analisado. **Conclusões:** As principais condições clínicas associadas a MM e NMM foram: hemorragia, hipertensão e pré-eclâmpsia. As limitações do estudo foram: divergência entre os critérios de avaliação das condições relacionadas e poucos estudos multicêntricos.

PALAVRAS-CHAVE: Near Miss; Mortalidade Materna; Brasil; Assistência Integral à Saúde.

1. Faculdade de Medicina, Universidade Federal de Campina Grande (UFCG). Campina Grande, Paraíba, Brasil. ORCID: https://orcid.org/0000-0002-7321-3539. E-mail: karollyne.siqueira.mendes@gmail.com
2. Faculdade de Medicina, Universidade Federal de Campina Grande (UFCG). Campina Grande, Paraíba, Brasil. ORCID: https://orcid.org/0000-0003-0417-9311. E-mail: van.oliveira.284@gmail.com
3. Faculdade de Medicina, Universidade Federal de Campina Grande (UFCG). Campina Grande, Paraíba, Brasil. ORCID: https://orcid.org/0000-0003-2693-1535. E-mail: idryshlg@gmail.com
4. Faculdade de Medicina, Universidade Federal de Campina Grande (UFCG). Campina Grande, Paraíba, Brasil. ORCID: https://orcid.org/0009-0003-2357-295X. E-mail: vcastorbrito@gmail.com
5. Faculdade de Medicina, Universidade Federal de Campina Grande (UFCG). Campina Grande, Paraíba, Brasil. ORCID: https://orcid.org/0000-0003-4443-7506. E-mail: danusapetra96@gmail.com
6. Faculdade de Medicina, Universidade Federal de Campina Grande (UFCG). Campina Grande, Paraíba, Brasil. ORCID: https://orcid.org/0000-0003-2758-6438. E-mail: katarinapicui@gmail.com
7. Faculdade de Medicina, Universidade Federal de Campina Grande (UFCG). Campina Grande, Paraíba, Brasil. ORCID: https://orcid.org/0000-0001-7730-6444. E-mail: kfffigueiredo@gmail.com
8. Faculdade de Medicina, Universidade Federal de Campina Grande (UFCG). Campina Grande, Paraíba, Brasil. ORCID: https://orcid.org/0000-0002-5772-7361. E-mail: vilessalilian@hotmail.com
9. Faculdade de Medicina, Centro Universitário UNIFACISA. Campina Grande, Paraíba, Brasil. ORCID: https://orcid.org/0009-0008-3284-6728. E-mail: anna.luisaholanda@gmail.com
10. Médico Especialista em Ginecologia e Obstetrícia. Faculdade de Medicina, Universidade Federal de Campina Grande (UFCG). Campina Grande, Paraíba, Brasil. ORCID: https://orcid.org/0000-0002-4734-2038. E-mail: raimundo.antonio@professor.ufcg.edu.br

Correspondence: Joana Karollyne de Siqueira Mendes. E-mail: karollyne.siqueira.mendes@gmail.com. Avenida Almirante Barroso, 284, Liberdade, Campina Grande, Paraíba, Brasil. CEP: 58414-200.

INTRODUCTION

The pregnancy-puerperium cycle can be associated with various conditions that represent complications in the natural process of pregnancy and conception, the main ones being hypertension, resulting in pre-eclampsia, eclampsia and HELLP syndrome, hemorrhages and infections. The prevalence of these causes of Maternal Mortality (MM), as well as the indicator itself, vary between the different geographical regions of the world depending on the quality of their respective health care for pregnant and postpartum women[1], with hemorrhages being the main cause of MM when the MM rate is between 89 and 359 cases per 100.000 live births in countries on the American continent such as Bolivia and Haiti[2], pre-eclampsia and eclampsia when this rate is between 50-100, as in Brazil[3,4], while indirect causes, aggravation of the pregnant woman's pre-existing comorbidities, predominate in countries such as the USA, with a MM rate of less than 18[5].

Until the 1980s, MM figures were considered to be the main indicators of the quality of obstetric care, and from that decade onwards a succession of targets were set to reduce this rate. Initially with the Safe Motherhood Initiative in 1987, which aimed to reduce MM by 50%, then in 1990 with the Millennium Development Goals proposed by the UN to achieve 75% fewer deaths by 2015, and finally with the 17 Sustainable Development Goals in 2015 included in the 2030 Agenda, which set the goal of reducing the rate to 70 cases per 100,000 live births by the year 2030. Although none of the stipulated targets have been fully achieved, considerable reductions in MM rates have been achieved so far, but with intense disparities between countries[6].

In addition to the MM rate, *Near Miss* Maternal (NMM) events are important indicators of maternal health and are defined by the World Health Organization (WHO) as the occurrence of serious complications during pregnancy that lead to near death during pregnancy, childbirth or up to 42 days after conception, characterizing a set of organic dysfunctions with a high potential to culminate in the death of the pregnant woman[7].

As these events are more numerous than deaths, occurring in 0.14 to 0.92% of pregnant women, depending on the criteria used to diagnose *Near Miss*, compared to approximately 210 maternal deaths per 100,000 live births[8], they allow for quicker and more effective interventions, making it possible to better assess the performance of health care services[8,9]. Consequently, there are several obstetric care markers that use the number of NMM cases in their calculations, such as the "Severe Maternal Outcome Ratio" used to estimate the complexity of care, the "Mortality Index" useful for estimating the performance of care for severe cases, as well as the "Maternal Severity Score", which evaluates care for women with complications[10].

Thus, in addition to the NMM and MM itself, there are also potentially life-threatening complications that can also be useful as indicators of the quality of health care, such as the occurrence of severe postpartum hemorrhage, pre-eclampsia and eclampsia, severe systemic infection, uterine rupture, admission to the Intensive Care Unit, among other events. Added to these elements are the NMM criteria recently standardized by the WHO, which stipulate objective conditions relating to the dysfunctions of each organ system for the respective diagnosis[11].

In view of this, it is important to look at the main factors listed by previous studies as causes of gestational complications, MM and, above all, NMM, in view of the multiplicity of previous scientific studies dealing with the subject, as well as its importance for more targeted health measures that enable more positive results in reducing MM. With this in mind, this study aims to describe the factors associated with MM and MM in Brazil, with the aim of improving scientific knowledge on the subject and stimulating actions aimed at reducing maternal mortality and the occurrence of severe maternal morbidity.

METHODS

This study is a Systematic Review, which is based on a research method based on the systematized synthesis of various studies and allows specific conclusions to be drawn about a given topic. In view of this, the eight essential stages for its preparation were followed: (1) drafting the research question; (2) searching the literature; (3) selecting articles; (4) extracting data; (5) assessing methodological quality; (6) synthesizing data (meta-analysis); (7) assessing the quality of the evidence; and (8) writing up and publishing the results.

To develop the research, the following guiding question was established based on the PICO method for non-clinical research questions: "What are the Factors Associated with *Near Miss* and Maternal Mortality in Brazil?".

This review was selected by double-blind peer review, following the recommendations of the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA) protocol for literature reviews[12]. The descriptors used for the search were: "*near miss*", "*maternal mortality*" and "Brazil". The descriptors were searched in the DeCS (Health Sciences Descriptors) and MeSH (*Medical Subject Headings*) databases. The Boolean operator used was AND. In all the databases, the following combination was applied: "*near miss* AND *maternal mortality* and *Brazil*"

In order to make a more rigorous selection of studies possible, the inclusion criteria and filters used were: appropriateness to the topic; article available (complete and free); work from the last 5 years; human studies; clinical screening, cohort and case-control studies and articles in English, Portuguese and Spanish. The exclusion criteria were: duplicate articles; unavailability of the text (not free and/or only summarized); review articles; departure from the proposed theme (articles that did not mention factors associated with *near miss* or maternal mortality).

The five databases used in the search were *PubMed* (*National Library of Medicine and National Institute of Health*), BVS (Virtual Health Library), *SciELO (Scientific Electronic Library Online)*, *ScienceDirect* and *Scopus*. At the end of the double-blind selection process, the *Kappa* coefficient was calculated using the Biostatistics V.1.1.0 application, with the aim of assessing the level of agreement of the pairwise selection that was carried out, so that the agreement value was calculated according to a categorical method[13]. The value found was: K = 0.820 (almost perfect agreement). In addition, the protocol for this review was published on the *International Prospective Register of Systematic Reviews* (PROSPERO) website under the

registration number: CRD42022326725.

The articles were critically analyzed by three people, two double-blind observers and a reviewer, in order to assess their individual quality, based on two studies[14]. Twelve items were considered when assessing the quality of the articles, expressed in Roman numerals (I to XII) in Table 1. Each item was given a score based on the qualitative analysis of the article evaluated, where 0 = absent; 1 = incomplete; and 2 = complete. The quality (Q) of each article was obtained from the sum of the points achieved in each criterion divided by the maximum expected in each item, and expressed as a percentage[15]. The evaluation results for the 17 articles selected, according to the 12 criteria, are shown in Table 1.

Table 1 - Quality analysis of the articles selected to make up the qualitative analysis of this review on the factors associated with maternal *near miss* and mortality

Studies	Evaluation Criteria												
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Q (%)
LIMA et al. (2016)	2	2	1	2	2	1	2	2	2	2	1	2	91,6%
FERNANDES et al. (2017)	2	2	1	2	2	1	2	2	1	2	2	2	87,5%
FERNANDES, SOUSA, CECATTI (2017)	2	1	1	2	2	1	2	2	1	2	2	2	83,3%
RUDEY; CORTEZ; YAMAGUCHI (2017)	2	2	2	1	2	1	2	2	1	2	2	2	87,5%
CIRELLI et al. (2018)	2	2	1	1	2	1	2	2	1	2	2	2	83,3%
MONTE et al. (2018)	2	1	2	2	2	1	2	2	2	2	2	2	91,6%
CARVALHO et al. (2019)	2	1	1	2	1	1	2	2	1	2	2	2	79,16%
LIMA et al. (2019)	2	2	2	2	2	1	2	2	2	2	2	2	95,8%
SOARES et al. (2019)	2	2	1	2	2	1	2	2	1	2	2	2	87,5%
ANDRADE et al. (2020)	2	1	1	1	2	1	2	2	1	2	2	2	79,16%
CANTALICE; CARVALHO; OLIVEIRA (2020)	2	2	2	2	1	1	2	1	1	2	2	2	91,6%
MORAIS et al. (2020)	2	2	2	2	2	1	2	2	2	2	2	2	95,8%
BARROS et al. (2021)	2	2	1	2	2	1	2	2	1	2	2	2	87,5%
HERDT et al. (2021)	2	2	1	2	2	1	2	2	1	2	2	2	87,5%
MAGALHÃES et al. (2021)	2	2	1	2	2	1	2	2	1	2	2	2	87,5%
ANDRADE et al. (2022)	2	2	1	2	2	1	2	2	1	2	2	2	87,5%
SILVA et al. (2022)	2	2	2	2	2	1	2	2	2	2	2	2	95,8%

Key: I - Review and detail of studies in the literature to define the research question; II - Specific inclusion and exclusion criteria; III - Specific objectives; IV - Appropriate scope of psychometric properties; V - Justification and presentation of sample size; VI - Patient follow-up; VII - Specific procedures for administration, execution and interpretation of results; VIII - Appropriate medication/evaluation techniques; IX - Detailed data for each hypothesis; X - Appropriate statistics; XII - Estimates of statistical errors; XII - Valid conclusions and clinical recommendations. Score - 0 = absent; 1 = incomplete; 2 = complete. Q (%) - Quality of the article expressed as a percentage.
Source: Authors.

The majority of the studies had a quality score of over 80%, with only two showing a score of 79.16%.

RESULTS

Before applying the filters, the following results were obtained: 967 in *ScienceDirect;* 110 articles in BVS; 93 articles in *PubMed*; 24 articles in *SciELO* and 88 articles in *Scopus*. Thus, before the filters were applied, the total number of articles was 1282. After applying the filters, the total number of articles in the databases was 369, of which 345 were excluded after analyzing the titles. Of the remaining 24, 4 were excluded after reading the

abstracts, making a total of 20 articles read in full, and 3 were subsequently excluded for not meeting the established criteria. In the end, 17 papers met all the inclusion criteria and were selected for the qualitative analysis (Figure 1).
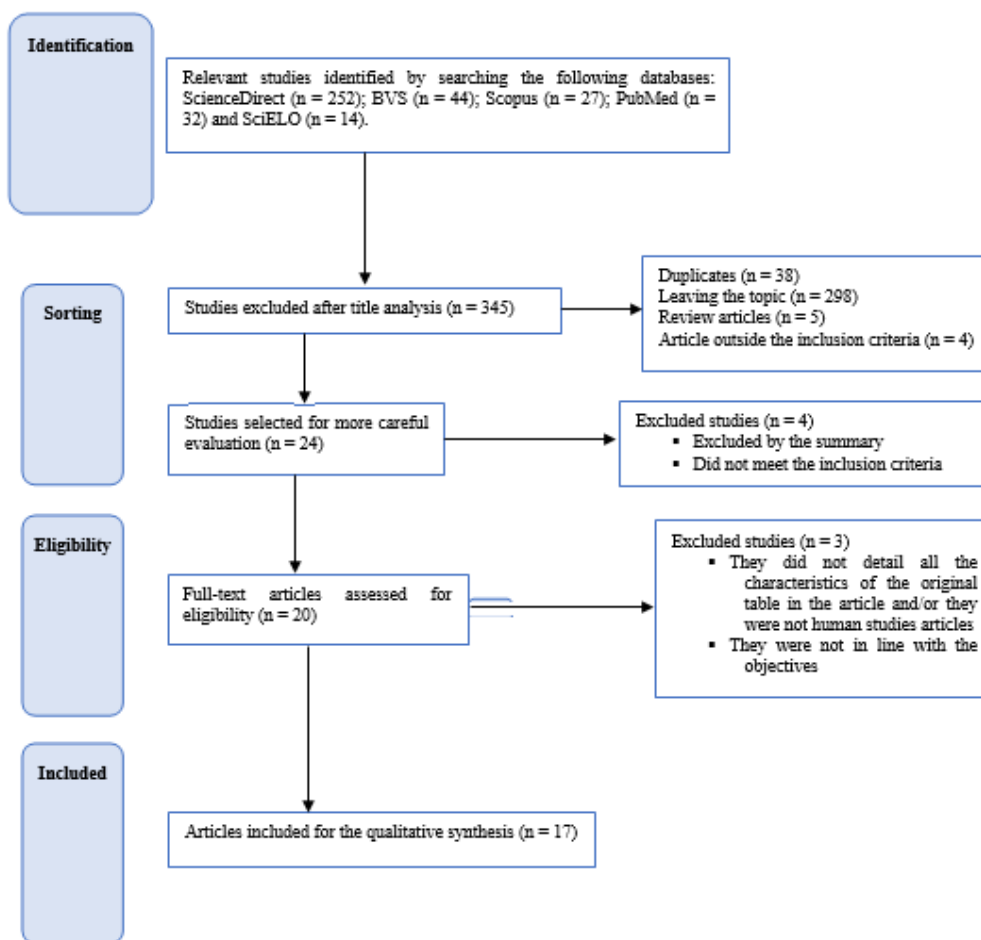

Figure 1 - Flowchart of the critical selection of articles carried out according to the recommendations of the PRISMA protocol
Source: Authors

Of the 17 articles selected for the qualitative synthesis, 10 are *cross-sectional* studies, 2 are ecological studies, 2 are retrospective cohorts, 1 is a prospective cohort, 1 included a retrospective and prospective cohort and 1 is a case-control study. Table 2 shows the main results of the studies found for discussion. It is separated by authors and year of publication, number of patients studied, type of study carried out and main evidence.

Table 2 - Qualitative analysis of the data from the 17 articles selected, showing the main evidence from the studies analyzed regarding factors associated with maternal *near miss* and mortality

Author	N	Type of Study	Main Conditions Associated with *Near Miss* and Maternal Mortality
LIMA et al. (2016)	941	Transversal	Hypertension, diabetes mellitus, severe pre-eclampsia, eclampsia, HELLP syndrome and severe sepsis.
FERNANDES et al. (2017)	5.025	Transversal	Bleeding, infection, eclampsia and pre-eclampsia.
FERNANDES, SOUSA, CECATTI (2017)	16.783	Transversal	Bleeding and infection
RUDEY; CORTEZ; YAMAGUCHI (2017)	37	Transversal	Hypertensive disease, pulmonary complications, hemorrhage and infection.
CIRELLI et al. (2018)	9.555	Transversal	H1N1 influenza, sepsis, cancer and cardiovascular diseases.
MONTE et al. (2018)	560	Transversal	Cardiovascular, coagulation and hematological dysfunctions respiratory.

continuation

Author	N	Type of Study	Main Conditions Associated with *Near Miss* and Maternal Mortality
CARVALHO et al. (2019)	1.059.988	Ecological	Severe pre-eclampsia, eclampsia, severe bleeding, severe sepsis, uterine rupture.
LIMA et al. (2019)	1094	Prospective cohort	Hypertension in pregnancy, hemorrhage, eclampsia, severe pre-eclampsia, antepartum hemorrhage, postpartum hemorrhage, placental abruption, ectopic pregnancy and sepsis.
SOARES et al. (2019)	24.396	Transversal	Bleeding, hypertension and infection.
ANDRADE et al. (2020)	3.497	Transversal	Severe pre-eclampsia, severe hypertension, endometriosis, placental abruption, ectopic pregnancy, sepsis and post-partum hemorrhage.
CANTALICE; CARVALHO; OLIVEIRA (2020)	118	Retrospective cohort	Cardiovascular diseases, gestational diabetes mellitus and incomplete prenatal care.
MORAIS et al. (2020)	137	Transversal	Renal failure, pre-eclampsia and severe acute azotemia
BARROS et al. (2021)	284	Retrospective cohort	Chronic hypertension, acute kidney injury, HELLP syndrome, puerperal hemorrhage, acute pulmonary edema, postpartum hemorrhage and inadequate MgSO4 regimen.
HERDT et al. (2021)	766.249	Ecological	Pre-eclampsia, severe bleeding, sepsis, eclampsia and uterine rupture.
MAGALHÃES et al. (2021)	532	Case-control	Non-white women, family income of less than 2 minimum wages, absence of a partner, obesity, no prenatal care or < 6 visits, inter-hospital transfer and absence of labor on admission,
ANDRADE et al. (2022)	1.098	Transversal	Hemorrhagic diseases and hypertensive syndromes.
SILVA et al. (2022)	590	Retrospective and prospective cohort	Bleeding, hypertension and infection resulting from obstetric complications during pregnancy, childbirth and the puerperium. Also omissions and incorrect treatment.

Abbreviations: N - Number of patients studied in the article
Source: Authors

Analyzing the main conditions related to *near miss* and maternal mortality, shown in the table above, it can be seen that the studies mainly listed: hemorrhage (10/17), hypertension (8/17), pre-eclampsia (7/17), sepsis (6/17), eclampsia (5/17) and infection (5/17). Other conditions mentioned in fewer articles included kidney problems, diabetes and HELLP syndrome, among others. It is worth highlighting the study by Guimarães et al. (2021) which analyzed different variables such as skin color, income, presence of a partner, among others.

DISCUSSION

Maternal mortality (MM) represents a challenge for public and private health systems, since many of the causes of mortality related to pregnancy, childbirth and the puerperium are preventable (Sá, de Marcos). In this context, maternal morbidity rates take into account potentially fatal clinical situations for women during pregnancy and the puerperium. The frequency of these events characterized as Maternal *Near Miss* (MNM) are robust indicators for evaluating the provision of obstetric care and services[16,17]. The data associated with *Near Miss* and maternal mortality found in this selection were hemorrhagic conditions, systemic arterial hypertension, pre-eclampsia, sepsis, eclampsia and infections.

Postpartum haemorrhage (PPH) is the leading cause of maternal mortality and near death, postpartum complications and maternal death, especially in low-income countries[18,19]. It is characterized as the loss of 500 ml of blood in normal childbirth and 100 ml in postpartum caesarean section within 24 hours of delivery[18,19] PPH still represents a challenge for women's health services, since the lack of standardized measures to measure blood loss does not allow for the primary identification of PPH, the quantitative assessment of blood loss by traditional methods, such as visual estimation, can acquire subjective bias associated with the experience of the health professional, delaying timely medical intervention. Despite the recommendation for active management of the third stage of labor using uterotonic agents such as oxytocin, Misoprostol, prostaglandins, ergometrine or methylergometrine[18,19,20], during the third stage of labor, the amount of blood lost after normal delivery or caesarean section is often underestimated and treatment is not carried out in a timely manner. Therefore, other second-line therapies are used to treat hemorrhage[21].

The identification of risk factors for PPH during pregnancy can serve as predictive factors to measure possible hemorrhage after delivery[18]. Labor processes such as induction of labor, instrumental delivery, premature delivery and placental retention, as well as sociodemographic factors, are significant predictors of PPH[19]. When early prophylaxis or secondary prevention prove ineffective, surgical interventions are essential to prevent maternal death[19].

Hypertensive disorders during pregnancy, chronic hypertension, gestational hypertension, pre-eclampsia and chronic hypertension with superimposed pre-eclampsia, are the second cause of maternal morbidity and mortality, being categorized as *Near Miss* Maternal (NMM)[22,23] and long-term complications for the mother, such as chronic hypertension, real and cardiovascular disease, cognitive impairment for the

offspring[24]. Gestational Hypertension, where Systolic Blood Pressure is $\geq$ 160 mmHg and Diastolic $\geq$ 110 mmHg 2 times with a minimum interval of 4 hours, develops from the 20th gestational week onwards and is associated with the worst prognosis for mother and fetus, including prematurity and maternal mortality[23].

In preeclampsia, gestational hypertension is associated with dysfunction of target organs such as the kidneys, liver, lungs and nervous system, and is one of the main causes of maternal and perinatal morbidity and mortality[23,25]. A history of previous pre-eclampsia contributes to worse maternal-fetal outcomes in subsequent pregnancies[23].

Its evolution into episodes of generalized convulsions, whether in the antepartum, during or postpartum period, characterizes one of the rarest and most serious preeclamptic complications, Eclampsia[26]. The postpartum period is the most critical time for the worst prognosis of the condition, mainly because in many women, previous symptoms (premonitory signs) of worsening are not observed in good time. This makes it difficult to identify risk factors associated with severe forms, prevent them early on and reduce their progression to epilepsy, organ dysfunction or death[23,26]. In addition, the lack of correlation between gestational age and the onset of hypertensive disorders leads to a worse prognosis of the clinical picture[26].

In maternal sepsis, the various physiological changes that occur during pregnancy complicate the assessment of the infection and subsequent management, aggravating maternal and fetal morbidity and mortality, which are intrinsically associated with the lack of early and adequate treatment, present in up to 28% of maternal deaths in the postpartum period[27].

Infection by *S. pneumoniae* and *H. influenzae* are the main causes of pneumonia in pregnant women, responsible for up to 30% of cases of severe sepsis in pregnancy, leading to significant morbidity for the mother, such as empyema and respiratory failure, further aggravated by reduced clearance of secretions and worsening airway obstruction. During labor, aspiration is a significant source of infection, the risk of which is increased by the inhibition of the cough reflex due to epidural blocks, further increasing the risk of aspiration pneumonitis and cough[27].

Women with pre-existing chronic comorbidities, such as diabetes, chronic kidney disease, chronic hypertension, cardiovascular disease and systemic lupus erythematosus, are 3 times more likely to have hypertensive disorders during pregnancy, with an emphasis on severe pre-eclampsia, than women without comorbidities[23,25,26]. In addition, diseases linked to the gestational period, such as gestational diabetes and fetal congenital anomalies were also associated with a worse outcome for hypertensive disorders[26]. Nulliparous women are more likely to have pre-term and term hypertensive complications during pregnancy. Including HELLP Syndrome, as a consequence of worsening pre-eclampsia, characterized by liver dysfunction, thrombocytopenia and microangiopathic anaemia caused by the destruction of maternal erythrocytes[26].

Diabetes Mellitus (DM) is associated with 3 times more chances of cardiac arrest and maternal death compared to women without pre-pregnancy or gestational diabetes. And maternal morbidity such as coronary artery disease and heart disease later[28]. Proper diagnosis of gestational diabetes reduces maternal death rates when compared to diabetic pregnant women who were not diagnosed at the right time. This shows that women with hyperglycemic disorders who receive the correct diagnosis are monitored more closely, reducing the rates of complications and death[29].

In turn, renal dysfunctions during pregnancy, whether acute or chronic, which are being managed through hemodialysis, are considered potential variables for unfavorable maternal outcomes, including maternal and fetal death[29]. The incidence of acute kidney injury occurs in the third trimester of pregnancy and in the postpartum period, with pre-eclampsia and eclampsia followed by maternal sepsis and postpartum hemorrhage being the most common, treatable and preventable causes of kidney injury in this period[30, 31].

The increased risk of severe maternal morbidity in non-white ethnic groups compared to whites is a frequent and studied phenomenon in different countries, which stands out in the face of the growing migratory process and consequent population increase of ethnic minority groups in European countries and regional differences in countries of great extension and ethnic diversity, such as Brazil. Compared to white European women, the chances of severe maternal morbidity were 83% higher among black African women, 80% higher among black Caribbean women and 43% higher among Pakistani women, with a substantial relationship to factors such as anemia in the current pregnancy, problems in a previous pregnancy, absence or inadequate use of prenatal care and age[32]. The occurrence of maternal *near miss* due to ethnic influences has also been reported in Brazil among populations of white, black and indigenous women in the North and Northeast regions, with an emphasis on the evaluation of care for pregnancy, childbirth and babies under 1 year old. Among indigenous women, there was a 25% higher risk of maternal *near miss* compared to white women[33].

This review has limitations when analyzing the current evidence on the factors associated with maternal *near miss* due to the lack of adequate clinical and laboratory monitoring for the evaluation of severe morbidity criteria, such as organ failure, which makes it possible to under-report cases. It should also be noted that different studies may differ in their criteria for assessing and reporting *near miss* and severe morbidity from those currently used by the WHO. This makes it impossible to standardize the identification of NMM and leads to differences between the results obtained from the care offered to pregnant women, highlighting the complexity of the issue when comparing the occurrence of NMM in different societies. In this context, the existence of a maternal *near miss* surveillance system would make it possible to analyze the efficacy and effectiveness of the interventions put in place by the health care team, guiding the measures with the greatest impact on preventing maternal death[34].

Early identification of potential conditions for worse maternal and fetal outcomes is associated with maternal morbidity and mortality rates. In Brazil, between 1996 and 2018, 38,919 maternal deaths were recorded, of which approximately 67% originated directly from obstetric complications during

pregnancy, childbirth or the puerperium, due to interventions, omissions, incorrect treatment or a chain of events resulting from any of these causes[35]. It is clear, therefore, that a wait-and-see approach to the non-identification of maternal *Near Miss* can underestimate obstetric and fetal complications, increasing the time it takes to diagnose maternal complications and making clinical management late or neglected. Another worrying factor is the follow-up of NMM women in the period following childbirth until the end of the puerperium, thus preventing the long-term measurement of risk factors and future complications for the woman and her offspring. This is confirmed by the scarcity of prospective observational studies on the subject.

When evaluating the studies, it was concluded that the main conditions associated with maternal *near miss* and mortality were hemorrhage, hypertension, pre-eclampsia, sepsis, eclampsia, infection, diabetes and HELLP syndrome. In addition, socioeconomic variables such as race, income, partner and access to health services were intrinsically related to *near miss* and maternal mortality in Brazil. Another important analysis refers to the lack of health professionals trained to identify and manage NMM women at the time of delivery and postpartum, in order to measure future complications and risk factors.

Thus, the main limitations of this review were the scarcity of articles to discuss all the main conditions related to *Near Miss* and Maternal Mortality, as well as divergence between the criteria of the studies for evaluating the conditions reported and the lack of multicenter studies that follow up women after childbirth in an attempt to identify complications. Another limiting factor was the lack of adequate clinical and laboratory monitoring to assess severe morbidity criteria, which makes it possible to under-report cases.

Therefore, future prospects include new studies with standardized methods for analyzing these NMM women and a longer follow-up period, as well as adequate clinical and laboratory monitoring and a system that allows for optimal reporting of cases.

REFERENCES

1. Heitkamp A, Meulenbroek A, van Roosmalen J, Gebhardt S, Vollmer L, I de Vries J, et al. Maternal mortality: near-miss events in middle-income countries, a systematic review. Bulletin of the World Health Organization. 2021;1;99(10):693-707F. Doi: 10.2471/blt.21.285945.

2. Overview of the Situation of Maternal Morbidity and Mortality: Latin America and the Caribbean. 2017. https://lac.unfpa.org/sites/default/files/pub-pdf/MSH-GTR-Report-Eng.pdf.

3. Dias MAB, Domingues RMSM, Schilithz AOC, Nakamura-Pereira M, Diniz CSG, Brum IR, et al. Incidência do near miss materno no parto e pós-parto hospitalar: dados da pesquisa Nascer no Brasil. Cad Saúde Pública. 2014;30(suppl 1):S169–81. Doi: 10.1590/0102-311X00154213.

4. Pinto KB, Chagas LTPC, Alexandra L, Dos Santos D, Dantas MKL, Figueiredo MS. Panorama de Mortalidade Materna no Brasil por Causas Obstétricas Diretas. Res Socie Develop. 2022;11(6):e17111628753. Doi: 10.33448/rsd-v11i6.28753.

5. Douthard RA, Martin IK, Chapple-McGruder T, Langer A, Chang S. U.S. Maternal Mortality Within a Global Context: Historical Trends, Current State, and Future Directions. J Women's Health. 2020;30(2). Doi: 10.1089/jwh.2020.8863.

6. Kassebaum NJ, Barber RM, Bhutta ZA, Dandona L, Gething PW, Hay SI, et al. Global, regional, and national levels of maternal mortality, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. The Lancet [Internet]. 2016;388(10053):1775-812. Doi: 10.1016/S0140-6736(16)31470-2.

7. Avaliação da qualidade do cuidado nas complicações graves da gestação: A abordagem do near miss da OMS para a saúde materna. 2011. https://ensino.ensp.fiocruz.br/perfil_de_mortalidade/documents/Avaliacao-da-qualidade-do-cuidado.pdf.

8. Chhabra P. Maternal near miss: An indicator for maternal health and maternal care. Ind J Commun Med. 2014;39(3):132. Doi: 10.4103/0970-0218.137145.

9. Dias MAB, Domingues RMSM, Schilithz AOC, Nakamura-Pereira M, Diniz CSG, Brum IR, et al. Incidência do near miss materno no parto e pós-parto hospitalar: dados da pesquisa Nascer no Brasil. Cad Saúde Pública. 2014;30(suppl 1):S169-81. Doi: 10.1590/0102-311X00154213.

10. 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(3):287-96. Doi: 10.1016/j.bpobgyn.2009.01.007.

11. Galvão TF, Pansani TSA, Harrad D. Principais itens para relatar Revisões sistemáticas e Meta-análises: A recomendação PRISMA. Epidemiol Serv Saúde. 2015;24(2):335-42. Doi: 10.5123/S1679-49742015000200017.

12. Richard LJ, Koch GG. The Measurement of Observer Agreement

for Categorical Data. Biometrics. 1977;33(1):159-74. Doi: 10.2307/2529310.

13. MacDermid JC, Walton DM, Avery S, Blanchard A, Etruw E, McAlpine C, et al. Measurement Properties of the Neck Disability Index: A Systematic Review. J Orthop Sports Phys Ther. 2009;39(5):400-C12. Doi: 10.2519/jospt.2009.2930.

14. Greenhalgh T. How to read a paper: Assessing the methodological quality of published papers. BMJ. 1997;315(7103):305-8. Doi: 10.1136/bmj.315.7103.305.

15. Small MJ, Allen TK, Brown HL. Global disparities in maternal morbidity and mortality. Seminars in Perinatology. 2017;41(5):318-22. Doi: 10.1053/j.semperi.2017.04.009.

16. Rajbanshi S, Norhayati MN, Nik Hazlina NH. Severe maternal morbidity and its associated factors: A cross-sectional study in Morang district, Nepal. Kabir R, editor. PLOS ONE. 2021;16(12):e0261033. Doi: 10.1371/journal.pone.0261033.

17. Andrikopoulou M, D'Alton ME. Postpartum hemorrhage: early identification challenges. Seminars in Perinatology. 2019;43(1):11-7. Doi: 10.1053/j.semperi.2018.11.003.

18. Feduniw S, Warzecha D, Szymusik I, Wielgos M. Epidemiology, prevention and management of early postpartum hemorrhage — a systematic review. Ginek Polska. 2020;91(1):38-44. Doi: 10.5603/GP.2020.0009.

19. Pacheco LD, Saade GR, Hankins GDV. Medical management of postpartum hemorrhage: An update. Semin Perinatol. 2019;43(1):22-6. Doi: 10.1053/j.semperi.2018.11.005.

20. Recomendações da OMS para a prevenção e tratamento da hemorragia pós-parto. 2014. Disponível em: https://iris.who.int/bitstream/10665/75411/12/9789248548505.

21. Manyahi JR, Mgaya H, Said A. Maternal near miss and mortality attributable to hypertensive disorders in a tertiary hospital, Tanzania; a cross-sectional study. BMC Preg Childbirth. 2020;20(1). Doi: 10.1186/s12884-020-02930-y.

22. Wilkerson RG, Ogunbodede AC. Hypertensive Disorders of Pregnancy. Emerg Med Clinics North Am. 2019;37(2):301-16. Doi: 10.1016/j.emc.2019.01.008.

23. Turbeville HR, Sasser JM. Preeclampsia beyond pregnancy: long-term consequences for mother and child. Am J Physiology-Renal Physiol. 2020;318(6):F1315-26. Doi: 10.1152/ajprenal.00071.2020.

24. Ives CW, Sinkey R, Rajapreyar I, Tita ATN, Oparil S. Preeclampsia - Pathophysiology and Clinical Presentations: JACC State-of-the-Art Review. J Am College Cardiol. 2020;76(14):1690-702. Doi: 10.1016/j.jacc.2020.08.014.

25. Lisonkova S, Bone JN, Muraca GM, Razaz N, Wang LQ, Sabr Y, et al. Incidence and risk factors for severe preeclampsia, hemolysis, elevated liver enzymes, and low platelet count syndrome, and eclampsia at preterm and term gestation: a population-based study. Am J Obstet Gynecol. 2021;225(5):538.e1-19. Doi: 10.1016/j.ajog.2021.04.261.

26. Burlinson CEG, Sirounis D, Walley KR, Chau A. Sepsis in pregnancy and the puerperium. Int J Obst Anest. 2018;36:96–107. Doi: 10.1016/j.ijoa.2018.04.010.

27. Tavera G, Dongarwar D, Salemi JL, Akindela O, Osazuwa I, Akpan EB, et al. Diabetes in pregnancy and risk of near-miss, maternal mortality and foetal outcomes in the USA: a retrospective cross-sectional analysis. J Public Health [Internet]. 2021;44(3):549-57. Doi: 10.1093/pubmed/fdab117.

28. Awowole IO, Omitinde OS, Arogundade FA, Bola-Oyebamiji SB, Adeniyi OA. Pregnancy-related acute kidney injury requiring dialysis as an indicator of severe adverse maternal morbidity at a tertiary center in Southwest Nigeria. Europ J Obstet Gynecol Reproduc Biol. 2018;225:205-9. Doi: 10.1016/j.ejogrb.2018.04.041.

29. Chaudhury A, Saini S, Divyaveer S, Maurya P, Sircar D, Dasgupta S, et al. The changing face of pregnancy-related acute kidney injury from eastern part of India: A hospital-based, prospective, observational study. Saudi J Kidney Dis Transplant. 2020;31(2):493. Doi: 10.4103/1319-2442.284025.

30. Prakash J, Prakash S, Ganiger V. Changing epidemiology of acute kidney injury in pregnancy: A journey of four decades from a developing country. Saudi J Kid Dis Transplant. 2019;30(5):1118. Doi: 10.4103/1319-2442.270268.

31. Nair M, Kurinczuk JJ, Knight M. Ethnic Variations in Severe Maternal Morbidity in the UK – A Case Control Study. Vitzthum VJ, editor. PLoS ONE. 2014;9(4):e95086. Doi: 10.1371/journal.pone.0095086.

32. Fernandes KG, Souza RT, Leal MC, Moura EC, Santos LM, Cecatti JG. Ethnic differences in maternal near miss. Arch Gynecol Obstet. 2017;296(6):1063-70. Doi: 10.1007/s00404-017-4530-6.

33. Ferreira MES, Coutinho RZ, Queiroz BL. [Maternal morbidity and mortality in Brazil and the urgency of a national surveillance system for maternal near miss]. Cad Saude Publica. 2023;39(8):e00013923. Doi: 10.1590/0102-311XPT013923.

34. Sá MFS de. Maternal Mortality and the Public Health Service in Brazil. Rev Bras Ginecol Obstet / RBGO Gynecol Obstet. 2021;43(09):645-7. Doi: 10.1055/s-0041-1736537.