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Prevalence of anemia in pregnant women in the Americas: a rapid review with meta-analysis

Prevalência de anemia em gestantes das Américas: uma revisão rápida com metanálise

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ABSTRACT

Anemia in pregnant women is a relevant problem of wide geographical expansion, typical of large urban centers and that affects several countries, such as America. Objective: To estimate the prevalence of maternal anemia and iron deficiency anemia in pregnant women in the Americas. Method: Rapid review with search in Medline, Pubmed, Scopus, Web of Science, SciELO, Lilacs and Open Grey databases. Cross-sectional studies that estimated the prevalence of maternal anemia and iron deficiency anemia were included. Random-effects meta-analyses were conducted. Results: 5148 articles were found, only 30 met the eligibility criteria. Meta-analyses showed a prevalence of 30% (95%CI: 28%; 32%. I^2: 99.4%) for maternal anemia and a frequency of 32% (95%CI: 25%; 40%. I^2: 96.6%) for iron deficiency anemia. Conclusion: Maternal anemia is a frequent event in the population of the Americas, with prevalence of 30% for maternal anemia and 32% for iron deficiency anemia, highlighting the need for more effective prevention and health promotion measures.

Keywords: Anemia. Pregnant women. Iron deficiency. Meta-Analysis..

RESUMO

A anemia em gestantes é um relevante problema de ampla expansão geográfica, típica de grandes centros urbanos que atinge diversos países, como os da América. Objetivo: Estimar a prevalência nas Américas de anemia materna e anemia ferropriva em gestantes. Método: Revisão rápida com busca no Medline, via PubMed, Scopus, Web of Science, SciELO, Lilacs e Open Grey. Incluíram-se estudos do tipo transversal, que estimassem a prevalência de anemia materna e anemia ferropriva. Foram realizadas metanálises com efeito randômico. Resultados: 5.148 artigos foram encontrados, apenas 39 atenderam aos critérios de elegibilidade. As metanálises apresentaram prevalência de 30% (IC95%: 28%; 32%. I2: 99,4%) para anemia materna e frequência de 32% (IC95%: 25%; 40%. I2: 96,6%) para anemia ferropriva. Conclusão: Anemia materna é um evento frequente na população das Américas, com 30% para anemia materna e 32% para anemia ferropriva, destacando a necessidade de medidas de prevenção e promoção à saúde mais eficazes.

Palavras-chave: Anemia. Gestantes. Deficiência de ferro. Metanálise.

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INTRODUCTION

Anemia is a condition related to the shortage of the number or capacity of red blood cells to transport oxygen[1]. Official estimates suggest that anemia affects around 800 million women and children, with various causes, with approximately half of the cases due to iron deficiency[2].

Iron deficiency anemia is recognized as a relevant factor impacting nutritional deficiency worldwide and despite affecting people of all ages and socioeconomic levels, pregnant women are characterized as one of the main risk groups[3]. During pregnancy, the daily need for iron may be increased by almost three times, due to the demands of the fetus for the formation of new hemoglobins that will be used up to the first three months of the child's life. Additionally, red blood cells are important for placental growth, increased blood volume and erythrocyte mass, and if combined with low intake or poor absorption of iron and social vulnerability, it presents a suitable and critical scenario for this condition[3,4].

It is worth noting that anemia during pregnancy brings several deleterious effects to both mother and baby, such as growth retardation, blindness, severe diseases, increased risk of miscarriage, low birth weight, and even increased risk of depression and maternal mortality[2].

Given the severity of the problem, it is important to mention that according to the World Health Organization (WHO), in developing countries, one in every two pregnant women has a positive diagnosis of anemia[5]. Due to the high prevalence, iron deficiency anemia has become a problem of epidemiological importance. Thus, the WHO has recommended prevention and reduction measures for this nutritional deficiency, through which women planning to conceive can be supplemented with iron and folic acid to improve mineral reserves, and upon confirming pregnancy, this supplementation becomes daily or intermittent depending on the severity of anemia[5,6].

For the development of erythrocyte mass, which helps in the growth of the fetus and placenta, there must be an adequate iron reserve; otherwise, there is a risk of developing iron deficiency anemia. In this context, iron supplementation is a preventive practice, included as routine in prenatal care[7].

Given the relevance of the topic in public health, coupled with the fact that no studies with the same approach on the topic have been found, either completed or ongoing, in the brief search conducted, studies are justified with the purpose of investigating the production of knowledge on iron deficiency anemia in pregnant women, through a rapid review.

Rapid reviews constitute a form of knowledge synthesis in which the elements of the systematic review process are simplified or even omitted to generate information quickly, so that decision-makers have the possibility to interpret primary studies inserted in the broad panorama of evidence, providing clinical practice guidelines or public policy development[8].

Thus, the objective of this work is to estimate the prevalence of maternal anemia and iron deficiency anemia in pregnant women in the Americas through a rapid review with meta-analysis.

METHODOLOGY

STUDY DESIGN

This is a rapid prevalence review with meta-analysis. In this design, some of the steps are optimized to provide speed to the evidence synthesis process[9]. Therefore, no protocol was submitted, as the PROSPERO platform does not recommend the registration of rapid reviews.

RESEARCH QUESTION

The research question that guided the work was: What is the prevalence of maternal anemia and iron-deficiency anemia in pregnant women in the Americas? Thus, the population was configured as "pregnant women in the Americas"; and the outcome was represented by the "prevalence of maternal and iron-deficiency anemia" from cross-sectional studies.

INFORMATION SOURCE

Article searches were conducted in Medline via PubMed, Lílacs, Scielo, Scopus, Web of Science, and Open Grey. The search for information was performed on March 14, 2021.

ELIGIBILITY CRITERIA

Studies conducted in the Americas with pregnant women who had maternal anemia or iron-deficiency anemia and who provided measures for evaluating hemoglobin, iron, and/or ferritin levels with no restriction on the year of publication, in English or Portuguese, were included. Prevalence and cross-sectional studies were used.

REVIEWER TRAINING

A previous training was conducted for the reviewers (E.S.S and A.O.L) for article selection. At this stage, preliminary article search strategies were applied, adjusting them to each database, and the eligibility criteria of the studies were refined.

SEARCH STRATEGIES

For data collection, tests of search strategies were performed with the indexed terms Health Science Descriptors (DECS) and Medical Subject Headings (MESH), Anemia, Iron-Deficiency, Pregnancy, Prevalence, Cross-Sectional Studies, and their synonyms, adapted for each information source, using them alone or in combined form, employing NOT, AND, and OR operators for search refinement, choosing those with better results for each information source. The EndNote software (Boston, Massachusetts, United States) was used for duplicate removal and reference management.

Below is the Medline strategy, via PubMed, used in this study. The strategies for other sources of information are available in the supplementary material

Table 1. Medline search strategy via PubMed used in this study.

Medline strateg y, via Pubmed
((Cros-s-Sectional Studies[MeSH Terms]) OR (Cross-Sectional Studies[Title/Abstract])) OR (Analyses, Cross-Sectional[-Title/Abstract])) OR (Analyses, Cross-Sectional[Title/Abstract])) OR (Analysis, Cross-Sectional[Title/Abstract])) OR (Analysis, Cross-Sectional[Title/Abstract])) OR (Cross Sectional Analyses[Title/Abstract])) OR (Cross Sectional Analysis[Title/Abstract])) OR (Cross Sectional Studies[Tit-le/Abstract])) OR (Cross Sectional Survey[Title/Abstract])) OR (Cross-Sectional Analyses[Title/Abstract])) OR (Cros-s-Sectional Analysis[Title/Abstract])) OR (Cross-Sectional Study[Title/Abstract])) OR (Cross-Sectional Survey[Title/Abstract])) OR (Cross-Sectional Surveys[Title/Abstract])) OR (Disease Frequency Survey[Title/Abstract])) OR (Di-sease Frequency Surveys[Title/Abstract])) OR (Prevalence Studies[Title/Abstract])) OR (Prevalence Study[Title/Abstract])) OR (Studies, Cross-Sectional[Title/Abstract])) OR (Studies, Prevalence[Title/Abstract])) OR (Study, Cros-s-Sectional[Title/Abstract])) OR (Study, Prevalence[Title/Abstract])) OR (Survey, Cross-Sectional[Title/Abstract])) OR (Survey, Disease Frequency[Title/Abstract])) OR (Sur-veys, Cross-Sectional[Title/Abstract])) OR (Surveys, Disea-se Frequency[Title/Abstract])) OR (Cohort Studies[MeSH Terms])) OR (Cohort Studies[Title/Abstract])) OR (Analy-ses, Cohort[Title/Abstract])) OR (Analysis, Cohort[Title/Abstract])) OR (Closed Cohort Studies[Title/Abstract])) OR (Closed Cohort Study[Title/Abstract])) OR (Cohort Analyses[Title/Abstract])) OR (Cohort Analysis[Title/Abs-tract])) OR (Cohort Studies, Closed[Title/Abstract])) OR (Cohort Studies, Historical[Title/Abstract])) OR (Cohort Study[Title/Abstract])) OR (Cohort Study, Closed[Title/Abstract])) OR (Cohort Study, Historical[Title/Abstract])) OR (Concurrent Studies[Title/Abstract])) OR (Concur-rent Study[Title/Abstract])) OR (Historical Cohort Stu-dies[Title/Abstract])) OR (Historical Cohort Study[Title/Abstract])) OR (Incidence Studies[Title/Abstract])) OR (Incidence Study[Title/Abstract])) OR (Studies, Closed Cohort[Title/Abstract])) OR (Studies, Cohort[Title/Abstract])) OR (Studies, Concurrent[Title/Abstract])) OR (Studies, Historical Cohort[Title/Abstract])) OR (Studies, Incidence[Title/Abstract])) OR (Study, Closed Cohort[-Title/Abstract])) OR (Study, Cohort[Title/Abstract])) OR (Study, Concurrent[Title/Abstract])) OR (Study, Historical Cohort[Title/Abstract])) OR (Study, Incidence[Title/Abstract])) OR (Prospective Studies[MeSH Terms])) OR

STUDY SELECTION

Two reviewers (E.S.S and A.O.L) independently selected the titles and abstracts. After this phase, the researchers read the full text. The articles that met the eligibility criteria were included in the rapid review. In cases where there was disagreement between the reviewers' decisions, the inclusion or exclusion of the articles was made by consensus, and if necessary, the decision was made by a third reviewer (S.S.C).

DATA EXTRACTION

Data extraction from the included articles was performed by two independent researchers, and the information was subsequently compared. If necessary, a third reviewer was consulted. The data were filled in an electronic form that contained the following fields: authors' names, year of publication, study location and year, sample size, maternal anemia frequency, percentage of iron-deficiency anemia occurrence, and maternal age average.

DATA ANALYSIS PROCEDURES

First, a description of studies and results related to maternal anemia and iron-deficiency anemia was performed. Statistical heterogeneity was measured using the chi-squared test ($p<0.10$) and the I-squared (I2) statistic. I2 values greater than 50% were considered high, 25% to 50% moderate, and less than 25% low[10].

Simultaneously, the prevalence and respective 95% confidence interval were calculated using random-effects meta-analysis through the Freeman-Tukey technique. Publication bias was analyzed by inspecting the Begg's funnel plot. The data analysis and computation of the summary measure using meta-analysis were performed using the STATA® statistical package version 15.

Ethical Aspects

The study complies with the guidelines and criteria established in Resolution 466/12 of the National Health Council (CNS). Even though it is a rapid review, the ethical precepts established with regard to ensuring the legitimacy of information, privacy, and confidentiality of information when necessary, making the results of this research public, were considered throughout the entire process of constructing this work

RESULTS

SELECTED STUDIES

A total of 5,148 articles were identified in the search. After removing duplicates and screening titles and abstracts, 80 articles were selected for full-text review (Figure 1), and only 39 met the eligibility criteria.

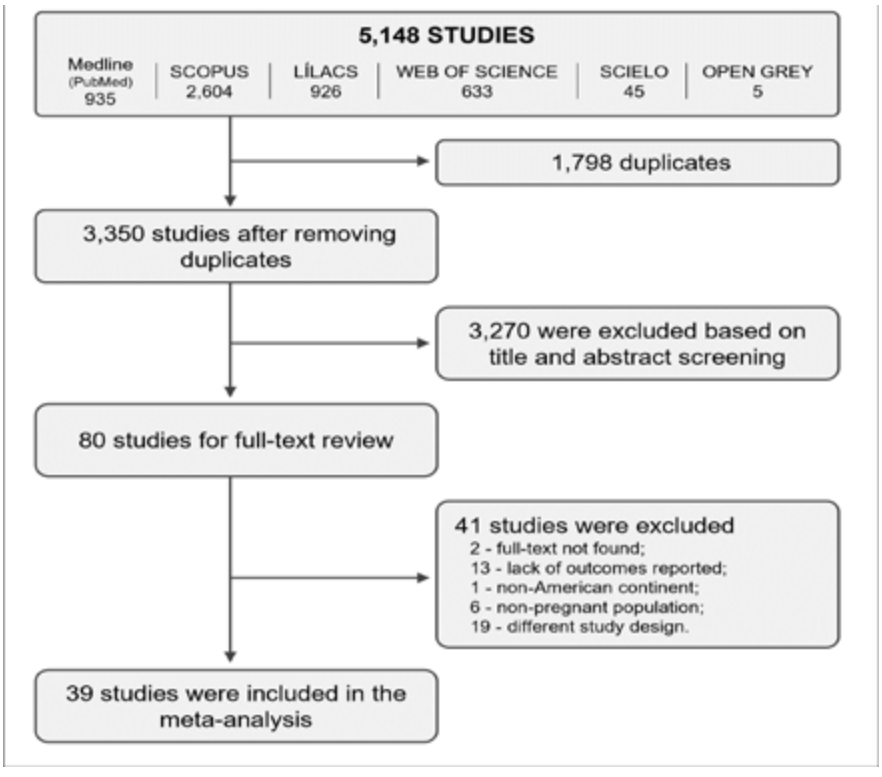

Figure 1. Flowchart of the search, selection, and inclusion of studies.

GENERAL CHARACTERISTICS OF THE STUDIES

In this review, 39 articles were included, however, the study by Fujimori et al.[11] presented results from both Cuiabá and Maringá separately for analysis, totaling 40 studies. Of these studies, 23 were conducted between 2011 and 2020, with 77.5% of studies conducted in South America, 15.0% in North America, and 7.5% in Central America. The total population of the studies was composed of 605,812 pregnant women, with more than half of the studies having a sample size greater than 325 participants (Table 1).

Table 1. Characteristics of the selected studies.

(Continua)

CHARACTERISTICS	N	%
Transversal	40	100.0
PREVALENCE OF ANEMIA		
HEMOGLOBIN		
Normal 0-4.9%.	-	-
Light 5-19.9%	9	23.1
Moderate 20-39.9%	20	51.3
Severe ≥40%	10	25.6
HEMOGLOBIN + FERRITIN		
0-4.9%	-	-
5-19.9%	3	27.3

(Conclusão)

20-39.9%	6	54.5
≥40%	2	18.2
AMERICAN CONTINENT		
Central America	3	7.5
North America	6	15.0
South America	31	77.5
SAMPLE SIZE *		
≤325	20	50.0
>325	20	50.0
YEAR OF PUBLICATION		
≤2000	3	7.5
2001-2010	14	35.0
2011-2020	23	57.5

*Threshold according to the distribution of the sample size of the studies.

The mean age of the participants was 24.0 (±3.9), and the findings showed that 25.6% of these studies were classified as having a high prevalence of anemia, i.e., a prevalence greater than 40%, followed by the group of moderate prevalence, which totaled 51.3% of the studies. It is worth noting that only 11 studies provided ferritin levels, and of these, 54.5% had a prevalence between 20-39.9%. None of the studies on iron-deficiency anemia were conducted in North America, with 3 studies conducted in Brazil, 3 in Venezuela, 3 in Colombia, 1 in Cuba, and another in Mexico (Table 2).

MATERNAL ANEMIA AND IRON-DEFICIENCY ANEMIA

The results of the meta-analysis in this review showed a prevalence of 30% (95% CI: 28%; 32%) for maternal anemia with an I2 of 99.4% (Figure 2) and a frequency of 32% (95% CI: 25%; 40%. I2: 96.6%) for iron-deficiency anemia, as presented in Figure 3. The funnel plots showed publication bias for the outcome of maternal anemia and iron-deficiency anemia (Figures 4 and 5), respectively.

Table 2. Description of the studies included in the qualitative synthesis of the rapid review.

Author	Year of publication	Research period	Study site	American Continent	Sample Size	Prevalence of maternal anemia	Prevalence of iron deficiency anemia	Average maternal age
Becerra et al.	1998	1993-1995	Peru	South America	1,015	70.3%	-	-
Labrada et al.	2000	1998	Cuba	Central America	209	64.6%	-	-
Rodríguez et al.	2000	1999	Peru	South America	84	33.3%	-	-
Martí-Carvaja et al.	2002	1996	Venezuela	South America	630	34.4%	39.2%	24.0
Baron et al.	2003	1997	Venezuela	South America	122	13.1%	7.4%	16.5
Casanueva et al.	2003	-	Mexico	North America	163	77.9%	68.1%	15.0
Núñez et al.	2003	1996-2000	Mexico	North America	35	25.7%	-	24.5
Baron et al.	2005	1997-2001	Venezuela	South America	419	14.4%	16.2%	-
Gonzales et al.	2006	2001-2005	Peru	South America	10,354	7.2%	-	25.8
Bresani et al.	2007	2000-2001	Brazil (Pernambuco)	South America	318	56.6%	17.6%	-
Paiva et al.	2007	2000	Brazil (São Paulo)	South America	95	19.0%	30.5%	-
Veloz Martínez et al	2008	-	Mexico	North America	290	22.4%	-	28.5
Sato et al.	2008	2006	Brazil (São Paulo)	South America	360	8.6%	-	25.0
Fujimori et al.	2009	2006-2007	Brazil (Cuiabá)	South America	954	25.5%	-	-
Fujimori et al.	2009	2006-2007	Brazil (Maringá)	South America	780	10.6%	-	-
Charles et al.	2010	2008	Jamaica	North America	204	34.8%	-	-
Einloft et al.	2010	2004-2005	Brazil (Minas Gerais)	South America	246	28.9%	-	24.5
FujimoriI et al.	2011	2006 e 2008	Brazil	South America	12,114	20.2%	-	-
Murillo et al.	2011	2007-2008	Colombia	South America	513	21.8%	-	25.2
Naples Garcia et al.	2012	2009-2010	Cuba	Central America	97	36.1%	-	-
Munares-García et al.	2012	2011	Peru	South America	287,691	28.0%	-	25.5

(Conclusão)

Sarmiento et al.	2012	2005	Colombia	South America	1,620	44.7%	38.8%	-
Camargo et al.	2013	2008-2009	Brazil (Mato Grosso)	South America	146	5.0%	39.0%	-
Rodríguez-García et al.	2013	2005-2006	Mexico	North America	321	55.1%	-	25.1
Munares-García et al.	2014	2009-2012	Peru	South America	265,788	25.7%	-	-
Escudero et al.	2014	-	Colombia	South America	276	20.7%	44.4%	-
De Sá et al.	2015	-	Brazil (Rio de Janeiro)	South America	54	53.7%	-	24.0
Oliveira et al.	2015	2014	Brazil (Alagoas)	South America	428	28.3%	-	23.9
Ramírez-Vélez et al.	2015	2010	Colombia	South America	1,386	-	37.2%	23.9
Restrepo-Mesa et al.	2015	2011	Colombia	South America	294	44.4%	-	17.3
Oliveira et al.	2016	2013	Brazil (Alagoas)	South America	129	49.6%	-	-
Pinho-Pompeu et al.	2016	2005-2013	Brazil (São Paulo)	South America	458	41.3%	-	-
Wright et al.	2017	-	Jamaica	North America	197	37.6%	-	-
Miranda et al.	2018	2015	Brazil (Rio Grande do Sul)	South America	3,419	35.9%	-	27.0
Ferreira et al.	2018	2009-2012	Brazil (Minas Gerais)	South America	12,283	29.2%	-	-
Magalhães et al.	2018	2010-2011	Brazil (Bahia)	South America	328	18.9%	-	24.0
Díaz-Granda and Díaz-Granda	2019	2016-2017	Ecuador	South America	428	31.8%	-	25.0
Rincón-Pabón et al	2019	2008-2010	Colombia	South America	1,385	11.0%	-	24.3
Santiesteban et al.	2019	2017-2018	Cuba	Central America	135	30.4%	25.9%	-
Orsolin et al.	2020	2015	Brazil (Rio Grande do Sul)	South America	44	25.0%	-	31.8

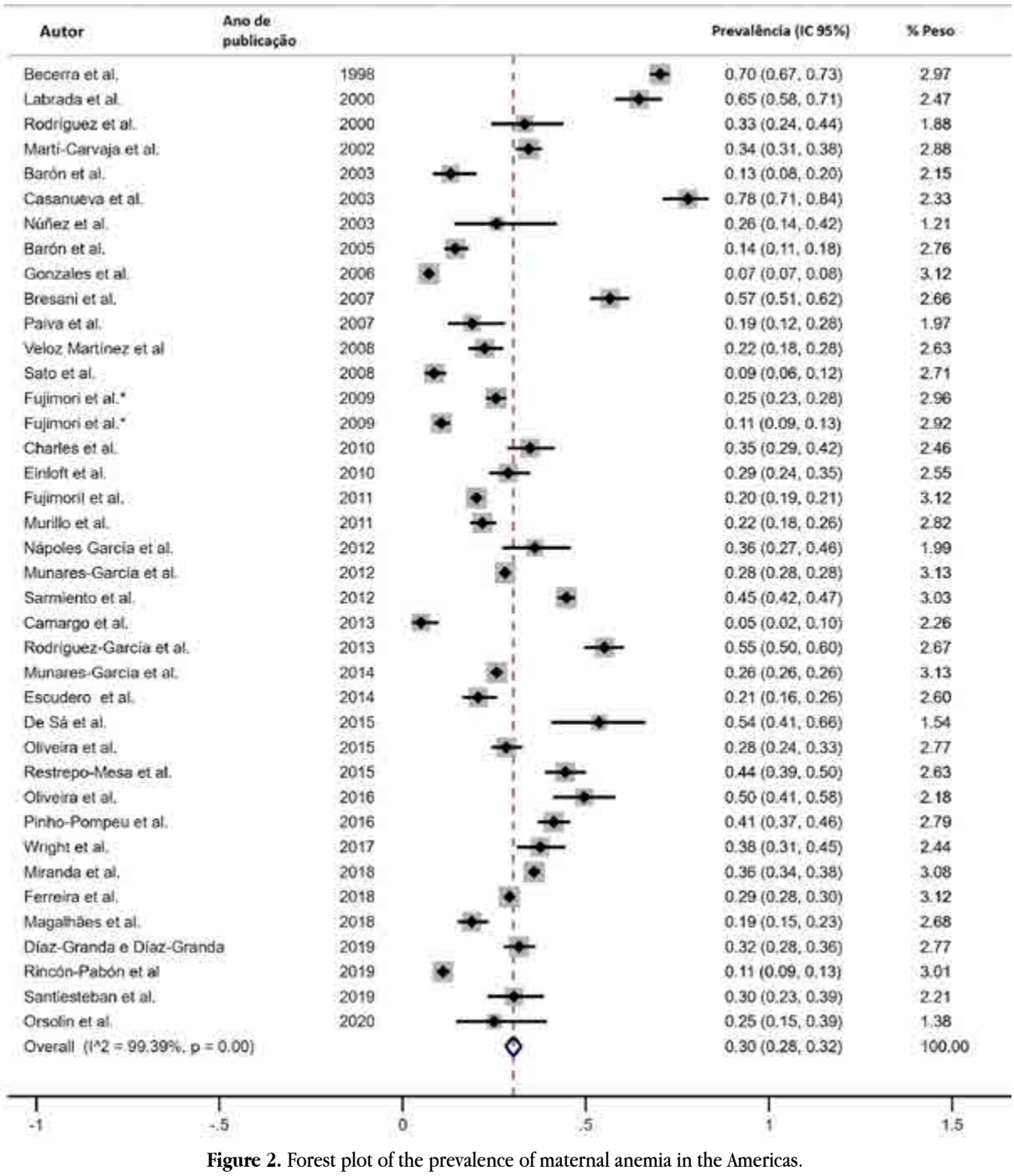

Figure 2. Forest plot of the prevalence of maternal anemia in the Americas.

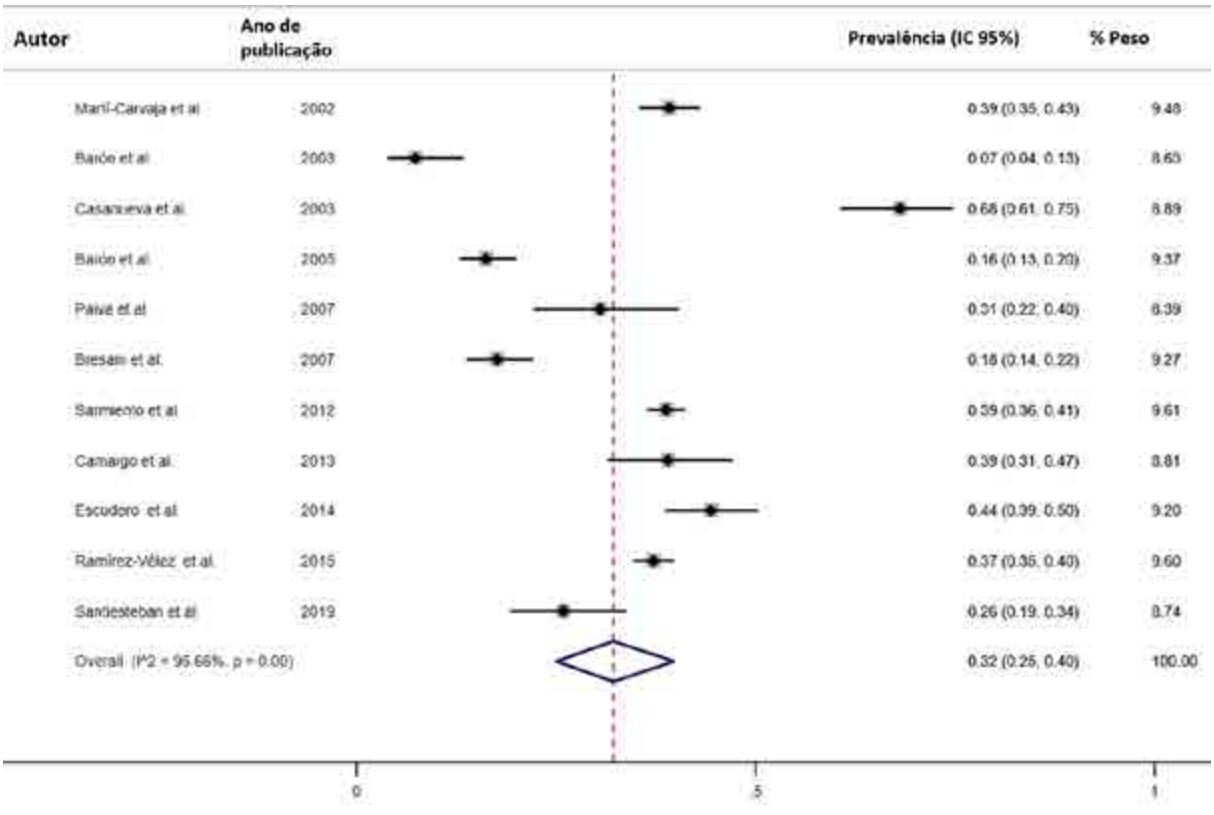

Figure 3. Forest plot of the prevalence of iron deficiency anemia in the Americas.

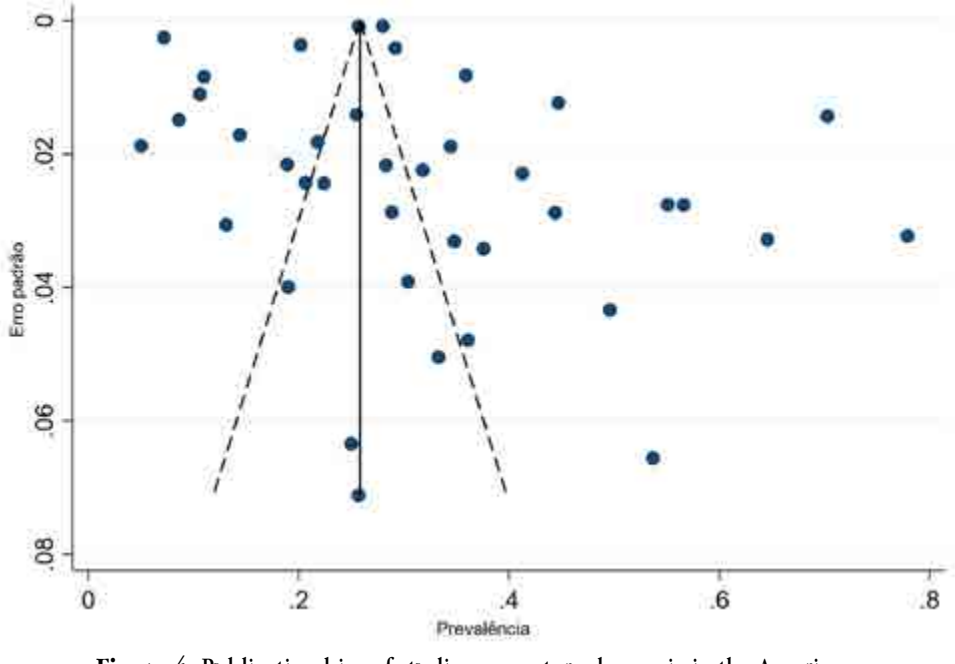

Figure 4. Publication bias of studies on maternal anemia in the Americas.

DISCUSSION

The main findings of this rapid review showed moderate prevalences of maternal anemia and iron-deficiency anemia in the countries of the Americas. There was significant regional variation in the occurrence of maternal anemia among the North, Central, and South areas.

The result regarding the global frequency of maternal anemia, originated from the meta-analysis, corroborates official data. In 2011, the global frequency of iron-deficiency anemia in pregnant women in the Americas was about 15.2% (95%CI 11.7%; 18.6%), approximately 50% lower than that estimated in this review[12].

Some investigations carried out in the American continent depict the profile of maternal anemia in this region. In 2012, it was estimated that 21% of pregnant women in Mexico were diagnosed with anemia, and half of this event's frequency was caused by iron deficiency[13]. In Venezuela, this indicator corresponded to 34.4% in 2002, and almost 50% of these women were diagnosed with iron-deficiency anemia[14].

In Cuba and Peru, in 2011, the prevalence of maternal anemia was 29.7% and 28.0%, respectively[15,16], with data reported on iron deficiency. A study conducted in Brazil between 2000 and 2001[17] pointed out that 56% of the investigated pregnant women had maternal anemia, and only approximately 11% of them had iron-deficiency anemia. There is a discrepancy regarding the frequency of iron-deficiency anemia in different countries of the Americas.

Several studies consider iron deficiency as an essential condition for the occurrence of maternal anemia, since most women are affected by iron deficiency during pregnancy. It is estimated that iron depletion is 2.5 times more frequent than anemia in pregnant women. Therefore, when the pregnant woman has low hemoglobin levels, maternal anemia is characterized as iron-deficiency anemia[18].

However, currently, there are few studies that evaluate the differential diagnosis of maternal anemia[14,17,19-23]. It is worth noting that the use of hemoglobin levels alone to define anemia in pregnant women is an indicator with low diagnostic accuracy, in relation to the types of anemia, due to its low sensitivity. The use of at least two criteria to define the etiology of maternal anemia can improve the specificity of the test and reduce the possibility of false positives, i.e., the possibility of diagnosing iron-deficiency anemia in women who do not have iron deficiency[17].

Additionally, the proper use of hematological markers can lead to a better investigation of the type of anemia. For example, the number of red blood cells can help in the classification of anemia and guide the healthcare professional to request complementary exams, such as ferritin dosage. Red blood cell values greater than 4 million and hemoglobin less than 11g/dl are suggestive of iron-deficiency anemia[24], and confirmation of the diagnosis is necessary through ferritin dosage (<15 femtoliters)[25,26].

Regarding the limitations of this study, despite the extensive search conducted in various databases that were not previously investigated in other systematic reviews, the findings showed publication bias for the estimated prevalences. Another limitation is the inability to evaluate the impact of maternal anemia on adverse maternal and child health events, due to the temporality of the methodological design employed in the studies used in this review.

The design of this synthesis study is also a probable limitation, as rapid reviews, although very useful as an approach that allows timely information for decision-makers, on the other hand, also have the disadvantage of not being as precise as traditional systematic reviews[8].

Regarding the strengths of this rapid review, robust investigation techniques were used. Subgroup analysis was performed to measure the prevalences by region of the Americas. Another positive aspect was the selection of original

research that obtained secure outcome records (laboratory tests and medical records). No study reported self-reported data sources for maternal anemia and iron deficiency anemia, minimizing the possibility of information bias in the studies.

In this rapid review, although uncommon, meta-analysis was presented, even in the face of high heterogeneity, considering that this finding was presented only as a preliminary result and the estimated global measures need confirmation through traditional systematic reviews.

Some studies had representative samples for the investigated countries, however, others presented only for the study site. This review included research on the topic conducted on the American continent, with a high number of cross-sectional studies. The high prevalence of maternal anemia and iron deficiency anemia shows that the measures currently adopted for prevention and promotion of health for the maternal-child group are still not very effective.

In summary, the study findings show that it is necessary to expand the measures adopted for the prevention and promotion of the health of pregnant women, as maternal anemia and iron deficiency anemia still have a high prevalence in the population. Public policies that include specific actions to combat these conditions are essential to reduce maternal and infant morbidity and mortality, improving the quality of life of women and their children

CONCLUSION

The high prevalence of maternal and iron-deficiency anemia in the Americas highlights the need for public policies that include specific actions for the prevention and treatment of these conditions, aiming to reduce maternal and infant morbidity and mortality caused by these conditions. In addition to this contribution, this study provides differentiation between scenarios of maternal anemia and iron-deficiency anemia, supporting decision-making and targeted policies, which can result in long-term improvements in the health of pregnant women and their children. Therefore, this study is relevant not only for the scientific community, but also for healthcare professionals, as it provides important evidence for health promotion and disease prevention.

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