Review Article

Nutritional contributors to maternal anemia in Indonesia: Chronic energy deficiency and micronutrients

Nur Indrawaty Lipoeto MD, PhD[1], Masrul MD, PhD[1], Ricvan Dana Nindrea MPH, PhD[2]

[1]*Department of Nutrition, Faculty of Medicine, Universitas Andalas, Padang, Indonesia*
[2]*Department of Public Health and Community Medicine, Faculty of Medicine, Universitas Andalas, Padang, Indonesia*

Background and Objectives: Despite enduring efforts in Indonesia to eliminate anemia in pregnancy, it remains a major nutritional problem. Its nutritional contributors were reevaluated. **Methods:** A meta-analysis of reports on anemia during pregnancy in Indonesia from January 2001 to December 2019 in the PubMed and ProQuest databases was conducted. Pooled ORs were obtained in fixed- and random-effects models. Funnel plots and Egger's and Begg's tests were used to evaluate publication bias. Review Manager 5.3 and Stata version 14.2 were used for analysis. **Results:** A total of 2,474 articles were appraised. Systematic review and meta-analysis were performed on 10 studies including 4,077 participants. Chronic energy deficiency had the highest OR for the risk of anemia (3.81 [95% CI: 2.36–6.14]) followed by greater parity (OR=2.66 [95% CI: 1.20–5.89]), low education level (OR=2.56 [95% CI: 1.04–6.28]), and limited health knowledge (OR=1.70 [95% CI: 1.17–2.49]), whereas older age and inadequate iron supplementation were not apparently associated with maternal anemia ($p > 0.05$). **Conclusion:** Future policies and strategic action to reduce nutritional anemia during pregnancy in Indonesia should increase emphasis on local nutritional epidemiology to establish the pathogenesis of anemia and the validity of stand-alone single-nutrient interventions. Attention to chronic energy deficiency as a barrier to preventing anemia in pregnancy may be necessary to enable health workers and women at risk to be better informed in their efforts.

Key Words: anemia, pregnancy, risk factors, chronic energy deficiency, policies

INTRODUCTION
Anemia is a main cause of morbidity and mortality in pregnant women worldwide. Globally, 40% of pregnant women have anemia.[1] Studies have indicated that anemia is a serious health problem among pregnant women, with a prevalence of 66.2% in Sudan, 25.2% in Northwest Ethiopia, 90.5% in Pakistan, 84.5% in India, 40.4% in Southeastern Nigeria, and 22.0% in Uganda.[2–7] The Indonesia Basic Health Research 2018 survey reported that anemia occurred in 48.9% of pregnant women and was the most common among those aged 15–24 years.[8]

The mitigation of anemia during pregnancy in Indonesia and elsewhere may be limited by the widespread assumption that anemia is primarily caused by iron deficiency despite its likely multifactorial etiology; therefore, it is managed using a single-micronutrient approach with iron supplements, excluding other contributors. Risk factors might include age, a background dietary pattern with compromised nutrient bioavailability, chronic energy deficiency, parity, education level, iron supplementation, health knowledge, prenatal care, preconception and intercurrent health status and comorbidities such as menorrhagia, inflammatory and infectious diseases, and inherited hemolytic disorders such as glucose-6-phosphate dehydrogenase (G-6-PD) deficiency and hemoglobinopa-

thies.[9-11] Anemia in pregnant women in Indonesia has unique risk factors that might differ from that in pregnant women in other countries.

Despite efforts to prevent maternal anemia through maternal and child health programs and iron tablet supplementation, its incidence remains high. Other unaddressed factors may play a role. A meta-analysis of available reports in Indonesia might increase understanding on the putative multifactoriality of anemia in pregnancy and inform policies and strategic actions for its mitigation.

MATERIALS AND METHODS
Study design and research sample
This meta-analysis complied with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) Statement.[12] The samples in this study were

research articles published from January 2001 to December 2019 in the PubMed and ProQuest online databases. In each study, we identified risk factors for maternal anemia in Indonesia.

Operational definitions

Independent variables in this study were risk factors for maternal anemia, and the dependent variable was maternal anemia. Chronic energy deficiency was defined as a measured mid upper arm circumference of <23.5 cm.

Research procedure

First, data were collected from published research articles that identified the risk factors for maternal anemia in In-

donesia in the PubMed and ProQuest online databases (Figure 1).

The following keywords were used to search titles and abstracts in the literature: ("risk factors" OR "determinant factors") AND ("anemia") AND ("Indonesia"). A total of 2,474 articles were identified by searching the titles, abstracts, and full text of articles.

Articles were excluded if (a) maternal anemia was not an outcome, (b) they were not cross-sectional studies, or (c) they included insufficient data for extraction.

Data collection technique

Data were collected in an online search. The collected data were limited to articles published in English and In-
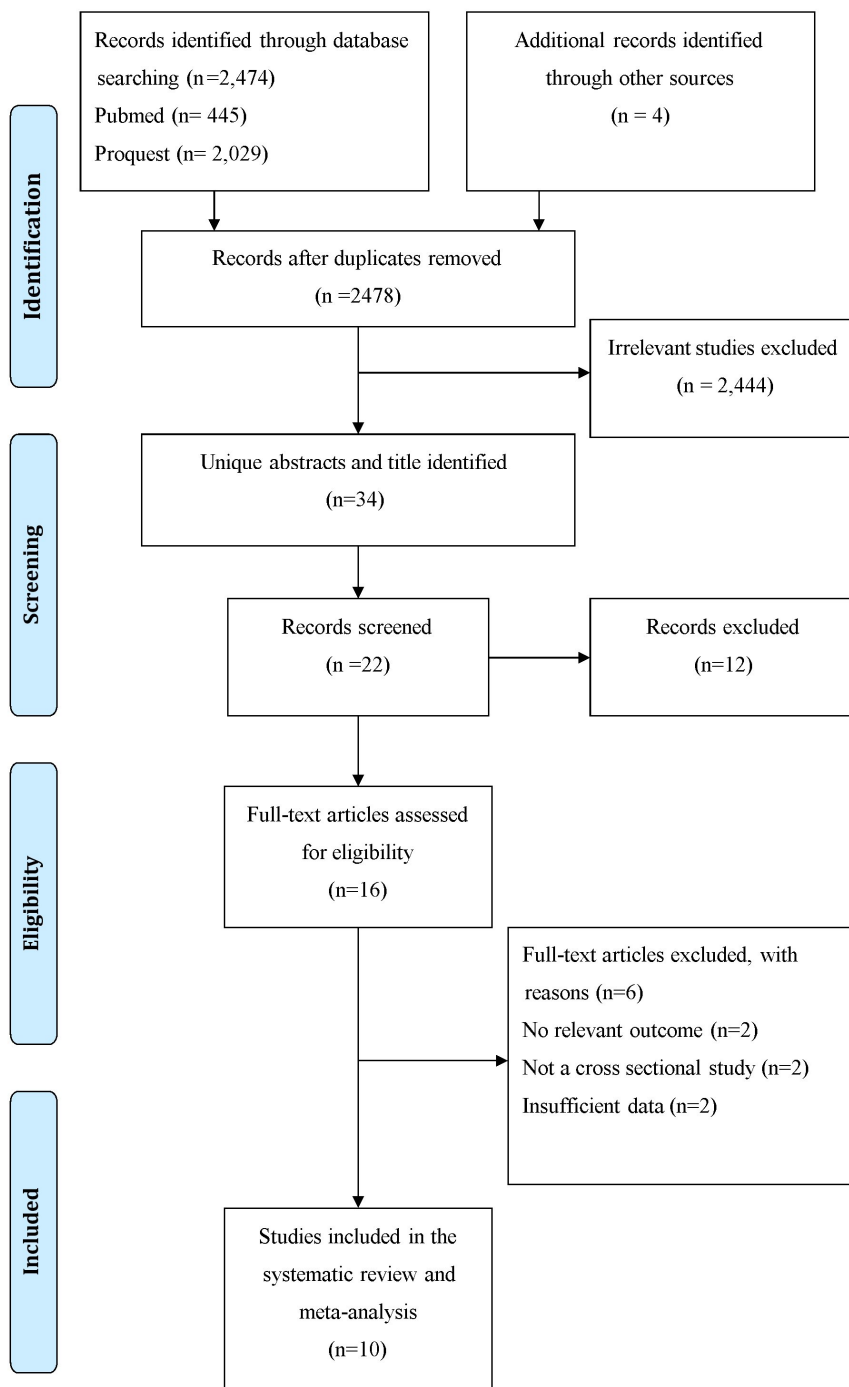

Figure 1. Publication selection protocol.

donesian that presented original research. The publication dates of articles were limited to January 2001–December 2019. Research participants were limited to humans only. Unique articles with conceivably significant titles were inspected, whereas insignificant articles were excluded. The full text of possibly significant unique articles was evaluated, after which nonessential articles were excluded. Inclusion criteria were research articles on risk factors for maternal anemia in Indonesia with a cross-sectional and observational analytical study design. Articles were excluded if (a) the inclusion criteria were non fulfilled, (b) their full text was unavailable, or (c) data provided in text were insufficient for extraction. The original author name, study location, study type, number of samples, and risk factors were also collected from the articles.

Information from all articles that fulfilled the inclusion criteria per a standardized protocol was carefully extracted by two investigators, and contradictions were settled by three different investigators. The Newcastle–Ottawa Quality Assessment Scale (NOS) was used to evaluate the quality of research articles. Articles were categorized as having poor (scores of 0–3), moderate (scores of 4–6), or high quality (scores of 7–9).[13]

Data analysis

Data analysis was conducted to obtain the pooled and combined ORs of collected articles. ORs with 95% CIs were utilized to pool results. These tests revealed articles with the minimum statistical power and small sample sizes that had significant heterogeneity ($I^2 > 50\%$). Articles with significant heterogeneity were assessed using a random-effects model, and those with homogeneity were assessed using a fixed-effects model. Review Manager 5.3 was used for data analysis. Publication bias was assessed using Egger's and Begg's tests and graphed on funnel plots. A two-tailed p value of <0.05 indicated significant publication bias. Stata version 14.2 was used to analyze publication bias.

RESULTS

Table 1 lists the results of the analysis of 10 studies including 4,077 pregnant Indonesian women evaluated for presumed maternal anemia and its potential risk factors. Covariates included older age, limited education, limited knowledge, inadequate iron supplementation, greater parity, and chronic energy deficiency.

As illustrated in Figure 2, chronic energy deficiency had the highest OR (OR=3.81 [95% CI 2.36–6.14]), followed by greater parity (OR=2.66 [95% CI 1.20–5.89]), limited education (OR=2.56 [95% CI 1.04–6.28]), and limited knowledge (OR=1.70 [95% CI 1.17–2.49]). Older age and inadequate iron supplementation were not associated with maternal anemia ($p>0.05$). Older age, limited education, inadequate iron supplementation, and greater parity exhibited heterogeneity in terms of the risk of maternal anemia ($p_{heterogeneity} <0.05$; $I^2 >50\%$), indicating variation in research on maternal anemia. Limited knowledge and chronic energy deficiency exhibited homogeneity in research on anemia ($p_{heterogeneity} >0.05$; $I^2 <50\%$); therefore, in population-level analyses, the results regarding these risk factors were consistent despite differences in time, place, and conditions.

Figure 3 indicates the heterogeneity of older age, limited education, inadequate iron supplementation, and greater parity in research on maternal anemia because the plot is asymmetrical about the vertical line. However, the funnel plots confirmed that limited knowledge and chronic energy deficiency were homogeneous in research on maternal anemia because the plot was symmetrical about the vertical line.

Figure 4 presents publication bias among studies on risk factors for iron-deficiency maternal anemia in Indonesia. These funnel plots were then tested using Egger's and Begg's tests (Table 2).

Table 2 indicates that Egger's and Begg's tests revealed no significant publication bias in included studies ($p>0.05$).

DISCUSSION

Among the prospective determinants of anemia during pregnancy in Indonesia, chronic energy deficiency had the highest OR, followed by greater parity, limited education, and limited knowledge. The Indonesian Ministry of Health has supported iron tablet distribution to pregnant mothers for generations. Baseline Health Research[24,25] reports have considered these efforts to be successful when more than 80% of mothers receive 90 iron tablets in the final trimester, but some studies have indicated that compliance with tablet consumption is low.[26,27]

Current situation of maternal nutritional anemia in Indonesia

The results of this study demonstrated the situation of iron-deficiency anemia in pregnant women in Indonesia. Systematic reviews and meta-analyses have revealed problems of low knowledge among pregnant women on maternal anemia in terms of its impact and prevention as well as chronic energy deficiency.

Limited knowledge among pregnant women on anemia prevention is evident in Indonesian Basic Health Research reports, which have demonstrated that approximately 40% of pregnant women receive information on pregnancy complications and 60% receive iron tablets usage services. Nevertheless, not all pregnant women who receive iron tablets consume them correctly, and more than 90% of pregnant women are not reached.[24,25] Moreover, iron deficiency may or may not be a cause of their anemia. Women are held accountable for managing and preventing maternal anemia even though its epidemiology and pathogenesis are inadequately understood and presumptive. The extent to which a woman's diet is sufficient, whether her iron bioavailability is questionable, and whether nutrient loss or comorbidities are present remain largely unknown, if not ignored. In reality, women in the reproductive age group and preconceptionally are ill prepared in nutritional health. They also have compromised intrapartum support services because of the narrow assessment of nutritional and nonnutritional risks.

Chronic energy deficiency in pregnant women may result from low awareness of the importance of dietary quantity and quality during pregnancy.[27] In the first trimester, pregnant women often experience nausea or vomiting with decreased food consumption, meaning that the needs of the mother and fetus are not met.[29,30] A study

Table 1. Systematic review of risk factors for maternal anemia in Indonesia

First author	Region	Study type	Patients characteristic	Sample size	Risk factors	Anemia parameter	Iron deficiency	NOS
Aji et al[13]	Padang	Cross sectional study	Women in early pregnancy	176	Socioeconomic, knowledge, Pre-pregnancy BMI status, Fe tablets consumption	Hb <11 g/dL	N/A	7
Seu et al[14]	Kupang, West Timor	Cross sectional study	Pregnant women who visited antenatal care in PHC Facilities	102	Underweight/ chronic energy deficiency	Hb <10.5 g/dL	Shine and Lal index (SLI) ≥1,530	7
Diana et al[15]	Madura	Cross sectional study	Anemic pregnant women	252	Dietary diversity	Hb <10 g/dL	N/A	7
Lestari et al[16]	North Sumatera	Cross sectional study	Not available	140	Knowledge, parity and chronic energy deficiency	Hb <11 g/dL	N/A	7
Ani et al[17]	Bali	Cross sectional study	Women with a year postpartum period	163	Parity, chronic energy deficiency	Hb <11 g/dL	N/A	7
Lisfi et al[18]	Padang	Cross sectional study	Mother's third trimester of pregnancy	44	Fe tablets consumption	Hb <11 g/dL	N/A	6
Mariza[19]	Lampung	Cross sectional study	Pregnant women who visited independent Midwifery	102	Level of education, social and economic	Hb <11 g/dL	N/A	7
Opitasari et al[20]	Two hospitals in Jakarta	Cross sectional study	Mother's third trimester of pregnancy	1,202	Parity, age	Hb <11 g/dL	N/A	7
Ristica et al[21]	Pekanbaru	Cross sectional study	Pregnant women	212	Level of education, knowledge, Fe tablets consumption, chronic energy deficiency, age	Hb <11 g/dL	N/A	7
Suega et al[22]	Bali	Cross sectional study	Not available	1,684	Educational background, Fe tablets consumption	Hb <11 g/dL	Ferritin serum <20 μg/L	7
Total				4,077				

NOS: Newcastle–Ottawa Quality Assessment Scale; articles were classified as having poor (scores of 0–3); moderate (scores of 4–6); and high quality (scores of 7–9).[12]
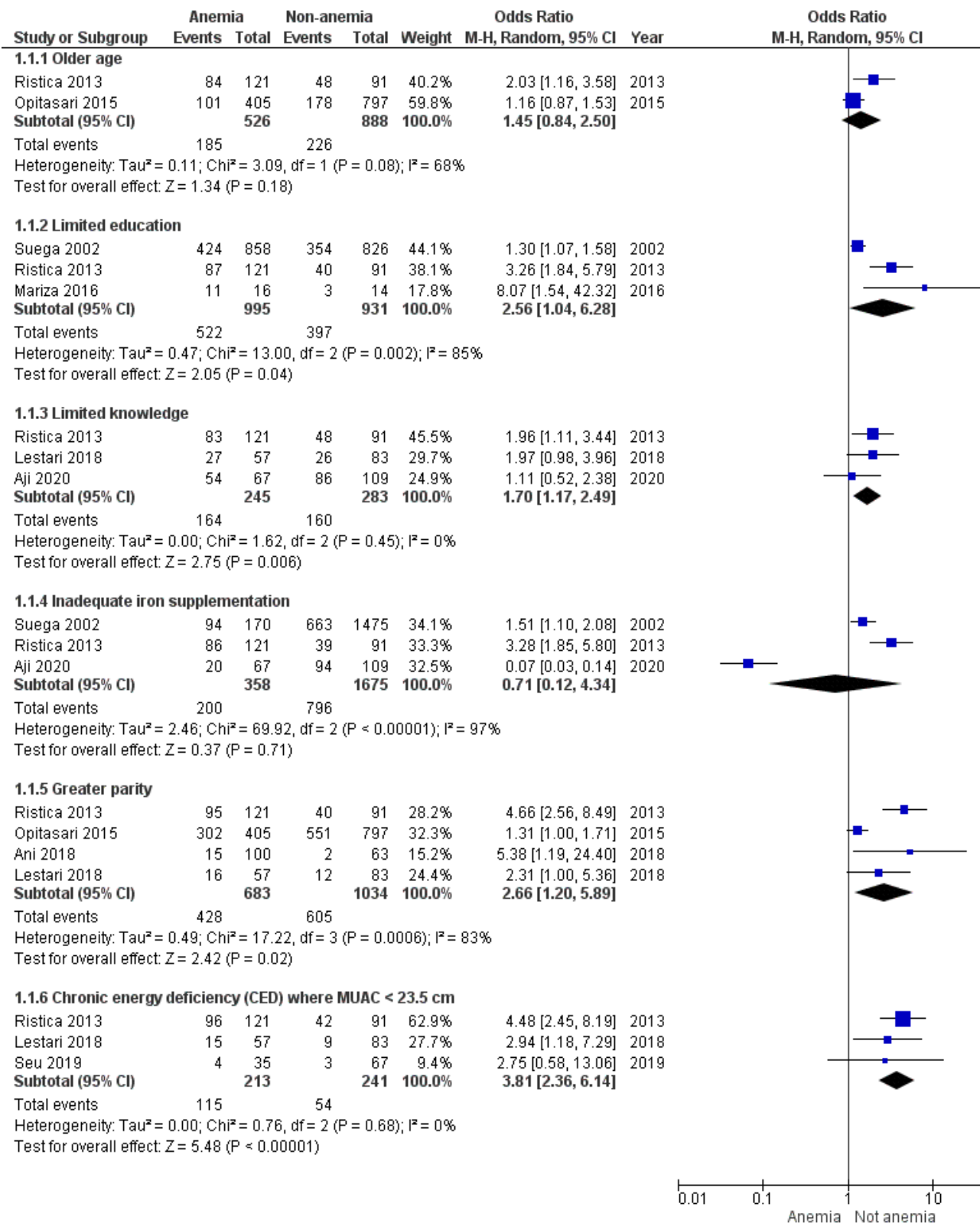
Figure 2. Meta-analysis of the likelihood of anemia in pregnancy by maternal and child clinical metrics.

conducted in West Sumatra, Indonesia,[30] reported the nutrient intake of 360 pregnant mothers, indicating that their energy intake reached only two-thirds of the RDA; their iron intake was approximately half of the RDA for Indonesian people. Although their protein intake exceeded the RDA, their intake of folic acid and fiber was more than a third of the RDA. The study also reported that the median food intake of pregnant women with chronic energy deficiency was lower than normal nutritional status

for local dietary patterns. Pregnant women with normal nutritional status consumed more plant-based foods, meat, fish coconut milk, and dairy products.[31]

Chronic energy deficiency and anemia appear to be concurrent in pregnancy. A reduction in chronic energy deficiency may also reduce anemia. However, a study conducted in India[32] revealed no significant association of iron deficiency and energy intake with the risk of anemia and chronic energy deficiency. The study suggested that
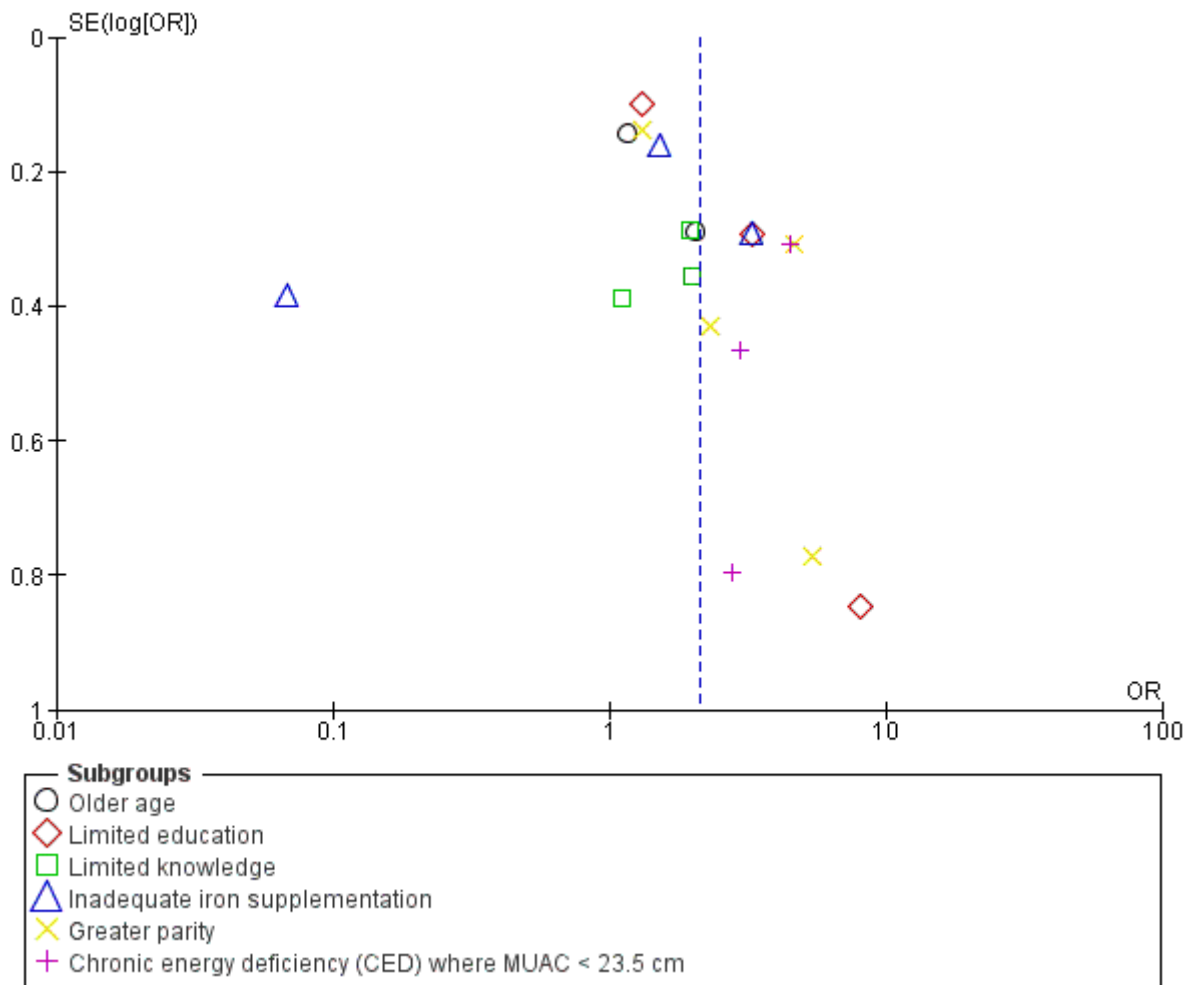
Figure 3. Funnel plots of risk factors for iron-deficiency anemia in pregnant women in Indonesia.

although diet optimization is obviously crucial for overall health, interventions that focus solely on diet may have limited efficacy in reducing the prevalence of anemia.

Prenatal care should be personalized to account for ethnicity, culture, education level, knowledge level on pregnancy, and diet. Educational efforts through increasing communication, information, and education can be used as a health promotion strategy in primary, secondary and tertiary education.[32] Information media widely used by health facilities in Indonesia tend to be conventional, namely involving counseling, brochures, and leaflets. The current rapid growth of the Internet and social media use presents an opportunity to disseminate information, increase literacy, and provide education.[33] As a result, educational content can become more engaging by utilizing interactive media; information can also be more widely shared and accessible than information shared using conventional methods.

Future policies and strategic actions

Many factors can affect the occurrence of maternal anemia, including chronic energy deficiency, iron deficiency in the diet, iron malabsorption, and the level of compliance with iron tablet consumption.[9,10] These factors are related to the knowledge of pregnant women regarding anemia and its effects and prevention methods. Knowledge is a factor that stimulates health behavior. If pregnant women understand the consequences of anemia

and how to prevent it, they will exhibit favorable health behavior.[18,23] For example, the problem of nutritional anemia among pregnant women in Indonesia is related to chronic energy deficiency during pregnancy, which is caused by imbalanced nutrition of both macronutrients and micronutrients. Consequently, pregnant women are at risk of nutritional disorders. This condition occurs because pregnant women have insufficient knowledge on anemia.[14,17]

Lack of knowledge regarding anemia affects health behavior, especially during pregnancy. Consequently, pregnant women may have suboptimal health behavior to prevent anemia in pregnancy. Pregnant women who have little knowledge on anemia may not have a balanced diet of macronutrients, micronutrients, and foods containing iron because of their ignorance both before and during pregnancy.[16,21]

Knowledge regarding anemia can be increased through counseling based on the characteristics of target groups to ensure that informational materials can be accepted by all pregnant women even though their characteristics are different. For example, providing education to pregnant women with a low education level requires a different method from that used to counsel highly educated pregnant women.[34,35]

Policies that can be enacted by the government include campaigns, advocacy, education, and behavioral change communications for the prevention of anemia in pregnant
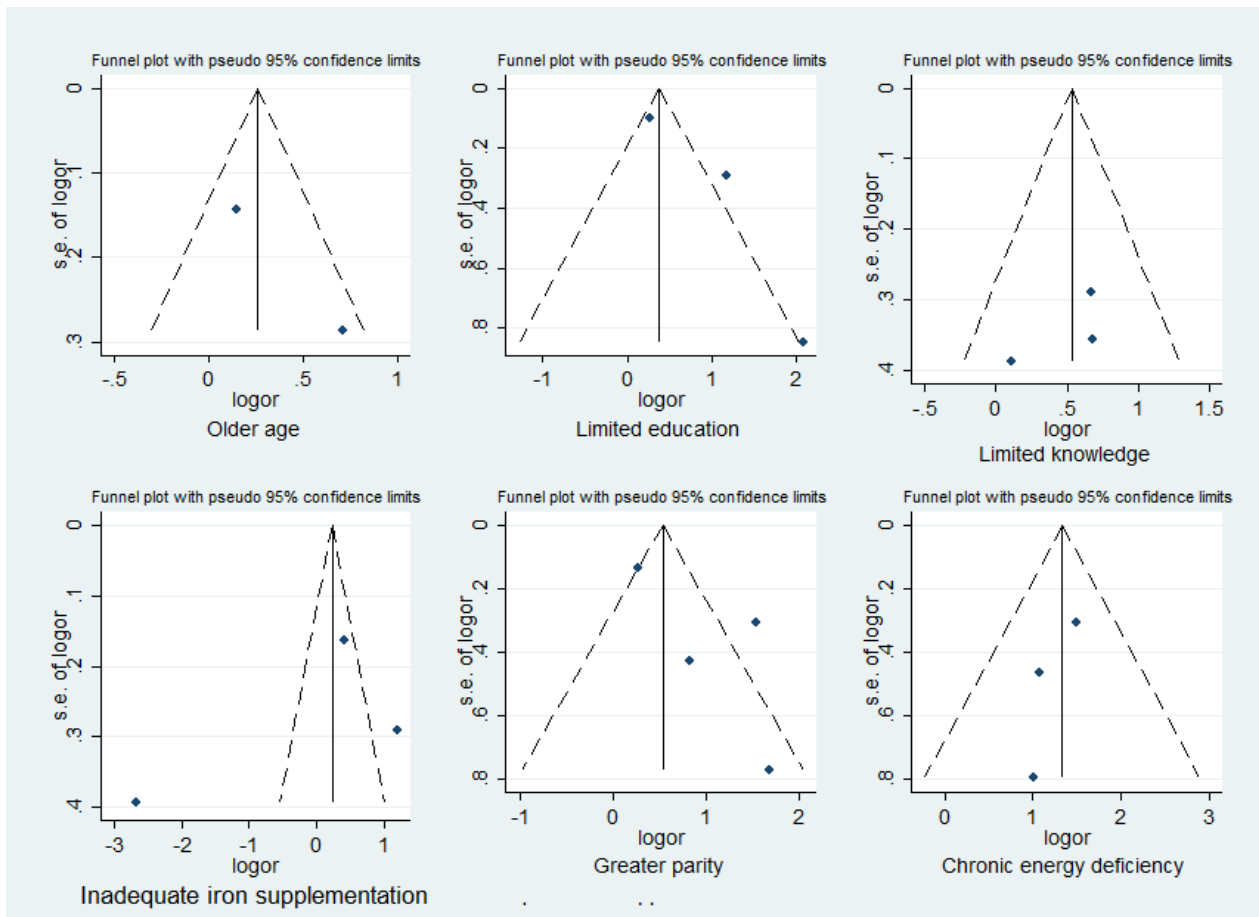
Figure 4. Publication bias for studies on the risk factors for iron-deficiency anemia in pregnant women in Indonesia

Table 2. Publication bias among studies based on Egger's and Begg's tests

Risk factors	Publication bias	
	Begg's test	Egger's test
Older age	0.317	0.310
Limited education	0.602	0.216
Limited knowledge	0.316	0.290
Inadequate iron supplementation	0.317	0.312
Greater parity	0.497	0.217
Chronic energy deficiency	0.602	0.358

$p>0.05$, no publication bias.

women by using innovative methods and various communication channels. These policies should be aimed at the systematic and innovative dissemination of iron anemia prevention information to pregnant women to increase awareness and community commitment. This policy strategy includes (a) involving the community, mothers, and first-level health service facilities in increasing awareness of iron-deficiency anemia prevention in pregnant women and the health benefits for both pregnant women and babies as well as pregnancy outcomes and (b) developing nutritional advocacy, communication, and mass mobilization by using clear and attractive messages tailored to specific age groups and enacting strategies that can be used by all stakeholders from the central level, namely that of the Ministry of Health of the Republic of Indonesia, to the community health level, namely first-level health facilities and independent midwives; support

from organizations and all related parties can be disseminated through innovative communication channels, such as nonelectronic media and electronic social media.

Action programs to increase knowledge among pregnant women, namely in the form of campaigns, advertisements in various media, and collaboration with influential figures to promote prevention to the target audience and the wider community, can facilitate the prevention of maternal anemia. Radio and bus advertisements as well as leaflets, posters, and idol artists promoting anemia prevention in pregnant women improved anemia prevention in Ethiopia.[35] The use of posters, leaflets, and idol advertisements was effective in reducing the prevalence of maternal anemia in the Philippines.[37,38]

Apart from advertising, activities that empower communities are necessary to enable health cadres to recognize, prevent, and manage anemia in pregnant women,

thereby increasing community-based social support. Through community involvement and empowerment efforts with health cadres, support for the prevention and management of maternal anemia can increase. Community empowerment activities to prevent maternal anemia include increasing the capacity of health cadres and pregnant women in first-level health facilities through efforts to increase knowledge.

Conclusion

In Indonesia, as expected, education level, health knowledge, parity, and iron supplementation (typically with folic acid) are associated with maternal anemia. The strong association of chronic energy deficiency with maternal anemia compared with any of the other factors indicate the need for more widespread of health and food system considerations. Future strategies should engage women in the reproductive age group by using programs that optimize general health and nutrition to ensure health at conception and uncompromised fetal development throughout pregnancy.

ACKNOWLEDGMENT

AUTHOR DISCLOSURES

The authors declare no conflicts of interest.

REFERENCES

1. World Health Organization. Anaemia. 2020 [cited 2020/08/27]; Available from: https://www.who.int/health-topics/anaemia#tab=tab_1.
2. Adam I, Khamis AH, Elbashir MI. Prevalence and risk factors for anaemia in pregnant women of eastern Sudan. Trans R Soc Trop Med Hyg. 2005;99:739-43. doi: 10.1016/j.trstmh.2005.02.008
3. Asrie F. Prevalence of anemia and its associated factors among pregnant women receiving antenatal care at Aymiba Health Center, northwest Ethiopia. J Blood Med. 2017;8:35-40.
4. Baig-Ansari N, Badruddin SH, Karmaliani R, Harris H, Jehan I, Pasha O et al. Anemia prevalence and risk factors in pregnant women in an urban area of Pakistan. Food Nutr Bull. 2008;29:132-9.
5. Toteja GS, Singh P, Dhillon BS, Saxena BN, Ahmed FU, Singh RP et al. Prevalence of anemia among pregnant women and adolescent girls in 16 districts of India. Food Nutr Bull. 2006;27:311-5.
6. Dim CC, Onah HE. The prevalence of anemia among pregnant women at booking in Enugu, South Eastern Nigeria. Medscape Gen Med. 2007;9:11.
7. Namusoke F, Rasti N, Kironde F, Wahlgren M, Mirembe F. Malaria burden in pregnancy at Mulago National Referral Hospital in Kampala, Uganda. Malar Res Treat. 2010;2010: 1-10.
8. Ministry of Health Republic of Indonesia. Jakarta: Indonesia Basic Health Research; 2018.
9. Balarajan Y, Ramakrishnan U, Özaltin E, Shankar AH, Subramanian SV. Anaemia in low-income and middle-income countries. Lancet. 2011;378(9809):2123-35.
10. Salhan S, Tripathi V, Singh R, Gaikwad HS. Evaluation of hematological parameters in partial exchange and packed cell transfusion in treatment of severe anemia in pregnancy. Anemia. 2012;2012:608658.
11. Lukito W, Wahlqvist ML. Intersectoral and eco-nutritional approaches to resolve persistent anemia in Indonesia. Asia Pac J Clin Nutr. 2020;29(Suppl 1):S1-S8. doi: 10.6133/apjcn.202012_29(S1).01.
12. Liberati A, Altman DG, Tetzlaff J, Mulrow C, Gøtzsche PC, Ioannidis JP et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: explanation and elaboration. BMJ. 2009;339:b2700.
13. Wells GA, Shea B, O'Connell D, Peterson J, Welch V, Losos M et al. The Newcastle-Ottawa Scale (NOS) for assessing the quality of nonrandomised studies in meta-analyses. 2009 [cited 2020/07/05]. Available from: http://www.ohri.ca/programs/clinical_epidemiology/oxford.asp
14. Aji AS, Yusrawati Y, Malik SG, Lipoeto NI. Prevalence of anemia and factors associated with pregnant women in West Sumatra, Indonesia: Findings from VDPM Cohort Study. Indonesian Journal of Nutrition and Dietetics. 2020;7:1-12. (In Indonesian)
15. Seu MMV, Mose JC, Panigoro R, Sahiratmadja E. Anemia prevalence after iron supplementation among pregnant women in midwifes practice of primary health care facilities in Eastern Indonesia. Anemia. 2019;2019:1413906.
16. Diana R, Khomsan A, Anwar F, Christianti DF, Kusuma R, Rachmayanti RD. Dietary quantity and diversity among anemic pregnant women in Madura Island, Indonesia. J Nutr Metab. 2019;2019:2647230.
17. Lestari S, Fujiati II, Keumalasari D, Daulay M, Martina SJ, Syarifah S. The prevalence of anemia in pregnant women and its associated risk factors in North Sumatera, Indonesia. IOP Conference Series: Earth and Environmental Science. 2018;125:012195.
18. Ani LS, Utami NWA, Weta IW, Darmayani IGAS, Suwiyoga K. Anemia in preconception women in Sideman Sub District Karangasem Regency, Bali-Indonesia. Gineco eu. 2018; 14:131-4.
19. Lisfi I, Serudji J, Kadri H. Relationship between iron tablet consumption and anemia among third trimester pregnant mothers of Air Dingin Public Health Centre in Padang. Jurnal Kesehatan Andalas. 2017;6:191-5. doi: 10.25077/jka.v6i1.669. (In Indonesian)
20. Mariza A. Relationship between level of education and socioeconomic status with anemia among pregnant mothers in Primary Health Care of Yohan Way Halim Bandar Lampung 2015. Jurnal Kesehatan Holistik. 2016;10:5-8. doi: 10.33024/hjk.v10i1.114. (In Indonesian)
21. Opitasari C, Andayasari L. Young mothers, parity and the risks of anemia in the third trimester of pregnancy. Health Science Journal of Indonesia. 2015;6:7-11. (In Indonesian)
22. Ristica OD. Risk factors related to anemia in pregnant women. Jurnal Kesehatan Komunitas. 2013;2:78-82. (In Indonesian)
23. Suega K, Dharmayuda TG, Sutarga IM, Bakta IM. Iron-deficiency anemia in pregnant women in Bali, Indonesia: a profile of risk factors and epidemiology. Southeast Asian J Trop Med Public Health. 2002;3:604-7.
24. Ministry of Health of Indonesia. Basic Health Research. Jakarta: Ministry of Health of Indonesia; 2013.
25. Ministry of Health of Indonesia. Basic Health Research. Jakarta: Ministry of Health of Indonesia; 2018.
26. Schultink W. Iron-supplementation programmes: Compliance of target groups and frequency of tablet intake. 1996. [cited 2020/11/15]; Available from: http://www.unu.edu/unupress/food/8F171e/8F171E06.htm.
27. Seck BC, Jackson RT. Determinants of compliance with iron supplementation among pregnant women in Senegal. Public Health Nutr. 2008;11:596-605.
28. Shaheen R, Lindholm L. Quality of life among pregnant women with chronic energy deficiency in rural Bangladesh. Health Policy. 2006;78:128-34.

29. Desyibelew HD, Dadi AF. Burden and determinants of malnutrition among pregnant women in Africa: A systematic review and meta-analysis. PLoS One. 2019;14:e0221712.

30. Alemayehu MS, Tesema EM. Dietary practice and associated factors among pregnant women in Gondar town north west, Ethiopia, 2014. Int J Nutr Food Sci. 2015;4:707-12.

31. Widyawati W, Jans S, Utomo S, van Dillen J, Janssen ALML. A qualitative study on barriers in the prevention of anaemia during pregnancy in public health centres: perceptions of Indonesian nurse-midwives. BMC Pregnancy Childbirth. 2015;15:47.

32. Subasinghe AK, Walker KZ, Evans RG, Srikanth V, Arabshahi S, Kartik K, Kalyanram K, Thrift AG. Association between Farming and Chronic Energy Deficiency in Rural South India. PLoS One. 2014;9:e87423.

33. Purnakarya I. Relationship of local-based dietary intake, patterns and quality with zinc status among Minangkabau pregnant women in West Sumatra, Indonesia. Thesis, Universitas Indonesia; 2017.

34. Souganidis ES, Sun K, de Pee S, Kraemer K, Rah JH, Moench-Pfanner R et al. Relationship of maternal knowledge of anemia with maternal and child anemia and health-related behaviors targeted at anemia among families in Indonesia. Matern Child Health J. 2012;16:1913-25.

35. Sunuwar DR, Sangroula RJ, Shakya NS, Yadav R, Chaudhary NK, Pradhan PMS. Effect of nutrition education on hemoglobin level in pregnant women: A quasi-experimental study. PLoS One. 2019;14:e0213982.

36. Shah S, Sharma G, Shris L, Shah SK, Sharma M, Sapkota NK. Knowledge on dietary patterns among pregnant women attending antenatal care check-up in Narayani hospital, Nepal. Int J Community Med Public Health. 2017;4:1466-72.

37. Karim AM, Betemariam W, Yalew S, Alemu H. Programmatic correlates of maternal healthcare seeking behaviors in Ethiopia. Ethiop J Health Dev. 2010;24:92-9.

38. Sanghvi TG, Harvey PWJ, Wainwright E. Maternal iron-folic acid supplementation programs: evidence of impact and implementation. Food Nutr Bull. 2010;31:S100-7.