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ORIGINAL RESEARCH

Determinants of Anaemia in Pregnancy in Indonesia: A Systematic Review

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Abstract

Background: Anaemia is a significant global health issue impacting pregnant women, potentially leading to adverse birth outcomes. To mitigate maternal and infant mortality complications, it is crucial to investigate the determinants contributing to maternal anaemia systematically.

Objectives: To identify the primary determinants of maternal anaemia in Indonesia.

Methods: A systematic review was conducted to examine the determinants of maternal anaemia in Indonesia, focusing on articles published between 01 January 2014 and 31 December 2023. Research databases, including Medline/PubMed, ProQuest, ScienceDirect, and additional manual searches, were used. Articles were selected using MeSH terms and relevant keywords, targeting a population of pregnant women within analytical observational studies.

Results: A total of 22 articles met the inclusion criteria. Bivariate and/or multivariate analyses identified 29 statistically significant variables ($p < 0.05$) associated with maternal anaemia. There were five major determinants significantly related to maternal anaemia in Indonesia.

Conclusion: The educational level of pregnant women, Body mass index (BMI) or nutritional status of pregnant women, parity, chronic energy deficiency (CED) status, and maternal age were the main determinants of maternal anaemia in Indonesia.

Keywords: Anaemia, BMI, Maternal age, Nutritional status, Pregnancy, Systematic review.

Introduction

Anaemia is a significant global health issue affecting various population groups, with pregnant women among the most vulnerable. It

is estimated to affect 37% of pregnant women worldwide. In Indonesia, the 2018 Basic Health Research reported anaemia in 48.9% of pregnant women, with the highest prevalence (84.6%) in the 15-24 age group. Severe anaemia

that happens during pregnancy can elevate the risks of premature births, as well as maternal and infant mortality. [1,2]

Factors associated with anaemia in pregnancy include inadequate nutrition, infections, chronic illnesses, pregnancy conditions, and hereditary haemoglobin disorders. A diet lacking essential micronutrients and unbalanced eating habits can cause iron-deficiency anaemia, which is the most common dietary deficiency among pregnant women. Deficiencies in other micronutrients, such as vitamin A, folate, vitamin B₁₂, and riboflavin, also contribute to anaemia because of their crucial roles in haemoglobin production and red blood cell formation. Infections such as malaria, tuberculosis, HIV, and various parasitic infections (schistosomiasis, hookworm infections) can disrupt nutrient absorption and metabolism and nutrient loss. Additionally, chronic diseases can worsen anaemia, and the blood volume increase during pregnancy can further contribute to its onset. [1,2]

Maternal anaemia significantly impacts birth outcomes and the long-term growth of infants. Studies in Iran reported that anaemia during pregnancy increased the risk of neonatal death (OR = 1.63; 95% CI, 1.25-2.13) and preterm births by 2.69 times (95% CI; 1.46-4.95). [2,3] Low birth weight is a frequent consequence of anaemia during pregnancy. Iron-deficiency anaemia can negatively affect the infants' physical, cognitive, and behavioural development, resulting in decreased productivity and quality of life over time and increasing socioeconomic burdens. Additionally, long-term malnutrition can cause stunting, wasting, and even childhood overweight or obesity because of decreased physical activity. [1]

Anaemia prevention depends on addressing its root causes. Dietary improvements, infection prevention (e.g., malaria, schistosomiasis), and managing chronic conditions like obesity and digestive issues in pregnant women are essential. [1] Pregnant women's attitudes and

behaviours are vital for preventing anaemia. However, limited access to iron supplements, side effects, and misconceptions about iron supplement use can hinder the effectiveness of prevention programs. Family support—physical, financial, spiritual, and informational—also plays a significant role. [4]

Although many studies have explored maternal anaemia in Indonesia, the results are scattered and of varying quality, highlighting the need for a comprehensive, evidence-based review to inform public health strategies. Since research on the factors causing maternal Anaemia in Indonesia is limited, a systematic review is necessary to thoroughly examine pregnancy and childbirth complications and help lower maternal and infant mortality rates in the country.

Methods

Eligibility criteria

The systematic review followed the guidelines outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA). This review was not registered in PROSPERO; however, the protocol had predefined inclusion and exclusion criteria.

Eligible articles for this review were original, full-text studies published in English or the Indonesian language. The publication period was restricted to January 2014 to December 2023 (10 years) to ensure the relevance and currency of the references, and a manual search was performed to access articles outside of the selected databases. The studies included focus on determinants of maternal anaemia in Indonesia (WHO's haemoglobin cut-off of <11 g/dL for anaemia) in any pregnancy trimester, and trimester-specific findings were described when available, employing an observational, analytical study design (prospective cohort, retrospective cohort, case-control, or cross-sectional) with pregnant women as participants. Articles were excluded if they did not examine maternal anaemia as an outcome

or if they utilised a descriptive or qualitative study design. Additionally, articles were excluded if they lacked precise methodological details or sufficient data for extraction and analysis. For duplicate publications, the latest and most comprehensive version was included.

Information sources

Articles were sourced from three databases – Medline/PubMed, ProQuest, and ScienceDirect – and supplemented with a manual search of Google Scholar for articles not indexed in these databases. When further clarification was required, the reviewer contacted the first author of a study. Article searches were conducted between February and March 2024.

Search strategy

The search strategy was based on PECO (Population - pregnant women; Exposure - Determinant Factor; Comparison - Non-Determinant Factors; Outcome - Maternal Anaemia). Searches in Medline/PubMed used Medical Subject Headings (MeSH), while Boolean operators (AND, OR, NOT) and synonyms were applied for other databases and manual searches. Key terms included "(risk factors OR determinants) (Pregnancy OR Maternal) AND (Anaemia) AND (Indonesia)" with the publication window set from January 2014 to December 2023.

Selection process

During selection, the number of articles retrieved from each database and from the manual search was recorded. Two independent reviewers identified duplicate publications using the Mendeley application, retaining only the latest version with the most comprehensive data. Relevant articles were screened based on their titles and abstracts, and those that did not meet the inclusion criteria were excluded. Articles were first checked for full-text

availability and free access. They were then evaluated against inclusion and exclusion criteria, including relevance to maternal anaemia, an observational-analytical study design, and sufficient data extraction. Articles that met all criteria were included in the systematic review (see Figure 1). The chosen articles were sorted into folders by database source to facilitate access for independent reviewers.

Statistical analysis

Data Collection Process and Data Synthesis

Three reviewers subsequently reviewed the collected and organised data by database source, placing it in an automated folder. Each article was evaluated for quality using the Newcastle–Ottawa Quality Assessment Scale (NOS) in accordance with predefined inclusion and exclusion criteria. Two reviewers conducted the initial evaluation, with a third serving as a mediator to resolve any discrepancies in the quality assessments. An additional reviewer proofread to ensure clarity and accuracy in the final writing.

Data extraction was independently performed by the investigators using Microsoft Excel. Extracted data included the researcher's name, study year/publication date, location, study design, subject characteristics, sample size, determinant factors, outcome measures, and study findings (as shown in Table I). The study results included the proportion, p-value (significant if <0.05), and the strength of associations (odds ratio [OR] or relative risk [RR]) between the determinant factors and outcomes. For data synthesis, the strength of the association between each determinant factor and the outcome was identified. Determinant factors were organised in a table by subtheme, based on the number of articles examining each factor, enabling the quantification of the most frequently studied key determinants.

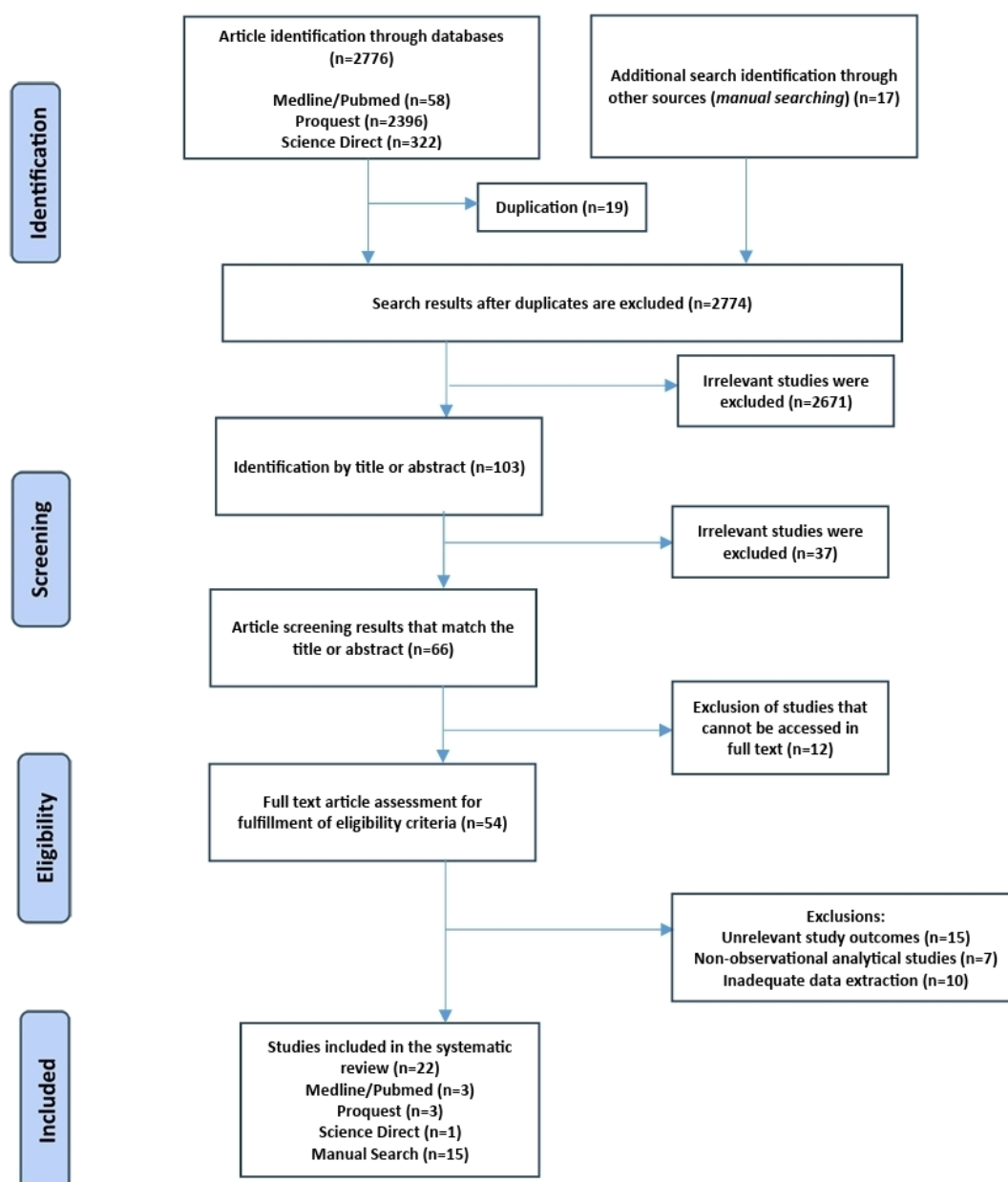


Figure 1. Study Selection Process

Results

Twenty-two studies met the eligibility criteria for inclusion in the systematic review, comprising four cohort studies, three case-control studies, and 15 cross-sectional studies (see Table I). The quality of each study was assessed using the Newcastle–Ottawa Quality Assessment Scale (NOS), focusing on selection, comparability, and outcome criteria. Results

showed that 20 studies were of moderate quality, while two studies were rated as low quality (see Table II).

Table I: Characteristics of Individual Study

No	Researcher	Publication Year	Location	Study Design	Subject Characteristic	Sample Size	Determinant Factor	Outcome Parameter	Result Study
1	Mocking <i>et al.</i> ^[12]	2018	Jakarta	Prospective Cohort	Early pregnancy	433	Weight, Height, BMI of mother	< 11 g/dL	Higher early pregnancy BMI was associated with lower odds for anaemia (adjusted OR 0.88; 95% CI 0.81, 0.97) (Mocking <i>et al.</i> , 2018)
2	Sumiyati <i>et al.</i> ^[5]	2021	Polewali Mandar, South Sulawesi	Cross-sectional	third-trimester pregnant mothers	80	Age, Education Level, Economic Status, Antenatal Care (ANC), nutritional status, parity, length of pregnancy, iron tablet consumption, parasitic infection (worms)	< 11 g/dL	A significantly related determinant in the study is the education (<i>P</i> -value = 0.003) and consumption of iron tablets (<i>P</i> -value = 0.036) (Sumiyati <i>et al.</i> , 2021)
3	Margawati <i>et al.</i> ^[24]	2023	Semarang, Central Java	Cross-sectional	Pregnant women who completed antenatal care (ANC) visits	238	age, total income, education, ANC, gestational age, nutrition knowledge, caloric intake, protein intake, fat intake, vitamin C intake, calcium intake, phosphorus intake, iron intake, zinc intake, manganese intake	< 11 g/dL	9 years of Education: OR 0,41 (95% CI 0,11-1,59). Iron tablet consumption < 90 tablets: OR 0,36 (0,07-1,75). Mother with low compliance ANC had a higher risk of Anaemia (OR = 4.991, 95% CI: 1.284-19.405, <i>p</i> = 0.020). Pregnant women with inadequate zinc intake higher risk of Anaemia during pregnancy (OR = 5.430, 95% CI: 1.671-17.647, <i>p</i> = 0.005). (Margawati <i>et al.</i> , 2023)

4	Aji <i>et al.</i> [6]	2020	West Sumatra	Cohort	Third-trimester pregnant women	176	Demographic, socioeconomic, anthropometry, and health history	< 11 g/dL	Anaemia status was associated with less minimum wage per month (Adjusted Odd Ratio (AOR): 5.15; 95%CI: 1.30–20.47), low-moderate maternal nutrition knowledge (Adjusted Odd Ratio (AOR): 15.88; 95%CI: 3.82–66.02), pre-pregnancy BMI <25 kg/m ² (Adjusted Odd Ratio (AOR): 11.82; 95%CI: 2.70–51.69), and no adherence iron supplement intake status (Adjusted Odd Ratio (AOR): 29.69; 95%CI: 6.58–133.91). A significantly related determinant is the education (<i>P</i> -value = 0.003) and consumption of iron tablets (<i>P</i> -value = 0.036) (Aji <i>et al.</i> , 2020)
5	Lestari <i>et al.</i> [13]	2018	North Sumatra	Cross-sectional	Pregnant women	140	Age, education, income, job, gestational age, ANC, parity, length of pregnancy, consumption of iron tablets, knowledge about anaemia, diet, risk of chronic energy deficiency	< 11 g/dL	Parity, knowledge of nutrition, diet, and the risk of chronic energy deficiency (<i>p</i> <0.05). Parity < 2 OR 0.43 (95% CI 0.19-1), knowledge Anaemia poor OR 1.48 (95% CI 0.79-2.75), diet less healthy OR 0.39 (0.14-1.06). CED OR 2.94 (95% CI 1.18-7.29). (Lestari <i>et al.</i> , 2018)
6	Mulyantoro <i>et al.</i> [25]	2021	Magelang, Central Java	Cross-sectional	Do not have a complication in pregnancy and have no infectious disease.	207	age, MUAC, body height	< 11 g/dL	After adjusting for gestational age and height factors, MUAC < 23.5 OR 2.42 (95% 1.13-5.18) (Mulyantoro & Kusriani, 2021)

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7	Pusporini <i>et al.</i> [17]	2021	Singgani and Tipo Primary Health Care, Central Sulawesi	Matched case-control	Pregnant women	138	Pregnancy spacing, miscarriage history, frequency of ANC, nutritional status	< 11 g/dL	The risk of pregnant women with chronic energy deficiency(CED) developing Anaemia (OR 13.14, CI 95% 4.75-36.06), nilai p 0.001 (Pusporini <i>et al.</i> , 2021)
8	Opitasari <i>et al.</i> [14]	2015	Government and Private Hospital, Jakarta	Cross-sectional	Pregnant women in the third trimester	1202	Education, marital status, occupation, funding sources, ANC, iron intake, gravidity, antepartum haemorrhage	< 11 g/dL	Pregnant women aged 16-20 years had 56% higher risk of being anaemic [RRa = 1.56; P = 0.014]. Multiparous women had a 58% higher risk of being anaemic (RRa = 1.58; P = 0.000) (Opitasari <i>et al.</i> , 2015)
9	Safrina <i>et al.</i> [15]	2020	Sidomulyo Health Care, Pekanbaru, Riau	Cross-sectional	Pregnant women in the second and third trimester	325	Mother's age, education, gestational age, parity, pregnancy duration, nutritional status, employment status, and compliance.	< 11 g/dL	Mothers age (POR = 1.993, 95% CI 1.017-3.908, nilai p 0.045), mothers' parity (POR = 3.473, 95% CI 1.753-6.878, nilai p 0.000), mother's nutritional status (POR = 40.647, 95% CI 19.507-84.695, nilai p 0.000) related association to anaemia ((Safrina <i>et al.</i> , 2020)

10	Iswardani <i>et al.</i> [20]	2019	Indonesia	Cross-sectional	Mothers with a pregnancy period ending at the age of 9 months or more (respondent IFLS 5 study)	722	Iron pills consumption, maternal age, maternal education, living place, ANC visit, total pregnancies (gravida), bleeding	< 12 g/dL	Mother's residence and history of bleeding at delivery were significantly associated with the incidence of maternal anaemia, with OR (95% CI) sequentially 0.64 (0.46-0.88), p value 0.007, and 1.74 (0.97-3.10), p value 0.042. (Iswardani <i>et al.</i> , 2019)
11	Nadiyah <i>et al.</i> [9]	2021	Kebun Jeruk Primary Health Care, West Jakarta	Cross-sectional	Pregnant women	60	Age, trimester of pregnancy, total pregnancy, working status, education, husband's income, UAC, height, energy, and nutrition intake	< 11 g/dL	Gestational age (trimester), Mother's education, husband's income, and UAC were significantly related to anaemia (p value < 0.05). Trimester 3 OR 7.11 (95% CI 2.22-23.76), Low education OR 10.39 (95% CI 2.47-43.68), husband income OR 11.81 (95% CI 3.4-41.06), UAC < 23.5 cm OR 0.09 (0.001-0.79) (Nadiyah <i>et al.</i> , 2021)
12	Ridwan <i>et al.</i> [16]	2023	Indonesia (Basic Health Research Data 2018)	Cross-sectional	All pregnant women aged 10–54 years.	538	Mother's age, gestational age, education status, employment status, residence, blood supplement tablets (BST), parity, ANC, and chronic energy deficiency (CED).	< 11 g/dL	Factors associated with gestational anaemia in Indonesia were: maternal age, gestational age, and CED ($p \leq 0.05$). Mothers aged 20-35 years OR 0.48 (95% CI 0.234-0.994, p value 0.048), gestational age trimester 3OR 2.57 (95% CI 1.552-4.350), and CED OR 1.68 (95% CI 1.025-2.760, p value 0.04) (Ridwan <i>et al.</i> , 2023)

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13	Dewi <i>et al.</i> ^[19]	2022	Puskesmas Batunadua, Padasidim puan, Sumatra Barat	Cross-sectional	Pregnant women	229	Eating patterns, physical activity	< 11 g/dL	Relationship between diet ($p=0.000$), physical activity ($p=0.000$), and the incidence of anaemia in pregnant women. Perhitungan manual not enough dietary habit OR 28.8 (95% CI 7.91-104.9) (Dewi <i>et al.</i> , 2022)
14	Kusrini <i>et al.</i> ^[26]	2021	Indonesia (Basic Health Research Data 2018)	Cross-sectional	Mothers with a pregnancy at the time of the basic health research survey	484	Height, type of residence, education, occupation, and undernutrition status	< 11 g/dL	CEM is associated with anaemia ($p < 0.05$) and AOR 2.25 (CI: 1.38–3.66), adjusted to height and type of residence, education, and occupation (Kusrini <i>et al.</i> , 2021)
15	Arnianti <i>et al.</i> ^[27]	2022	Palopo, South Sulawesi	Case-control	Pregnant women	99	Age, parity, distance of pregnancy, education, adherence to Fe intake, and upper arm circumference (UAC) status	< 11 g/dL	Age of pregnant mother (OR=7.368, 95% CI 2.486-21.843; sig (0.000 < 0.05), parity (OR=2.754, 95% CI 0.991-7.655; sig=0.047 < 0.05), pregnancy interval (OR=2.925, 95% CI 1.145-7.469<; Sig-p=0.022), education (OR=3.750, 95% CI 1.545-9.103; sig-p=0.003), adherence to consuming Fe tablets (OR=4.214, 1.450-12.245; Sig-p=0.006, and LiLA status (OR=27.125, 95% CI 7.888-93.272; Sig-p=0.000) were related to anaemia in pregnant women (Arnianti <i>et al.</i> , 2022)
16	Jasmi <i>et al.</i> ^[28]	2022	Rumbai Primary Health Care, South Sulawesi	Cross-sectional	Pregnant women in the third trimester	67	Husband support	< 11 g/dL	There was a relationship between the husband's support and the incidence of anaemia in pregnancy, with a value ($p = 0.032$). No husband's support OR

									0.99, 95%CI 0.42-2.34) (Jasmi <i>et al.</i> , 2022)
17	Sari <i>et al.</i> [29]	2021	Pisangan Primary Health Care, South Tangerang, Banten	Cross-sectional	Pregnant women	265	Age, gestational age, parity, CED nutritional status	< 11 g/dL	There was a statistically significant association between gestation age factor (second and third trimester) (OR 2.938, 95% CI: 1.26-6.87; p value 0.016) with the incidence of anaemia in pregnant women (Sari <i>et al.</i> , 2021)
18	Fitriahadi <i>et al.</i> [30]	2021	Mantrijeron Primary Health Care, Jogjakarta	Retrospective Cohort	Pregnant women in the third trimester	84	Level of education, parity, maternal age, nutritional status, frequency of ANC	< 11 g/dL	Correlations between education level, parity, maternal age, and the frequency of ANC visits (<i>p-value</i> <0.05) to the incidence of anaemia. Perhitungan manual: ANC < 4 kali OR 6.38 (95%CI 1.26-32.18) (Fitriahadi <i>et al.</i> , 2021)
19	Mahmudian <i>et al.</i> [31]	2021	Sukowono Primary Health Care, East Java	Case-control	Pregnant woman with a history of LBW	68	CED (chronic energy deficiency)	< 11 g/dL	Pregnant women with poor nutritional needs have a greater risk of developing anaemia during pregnancy (OR 6.97; 95% CI 2.08-23.37, p=0.001) (Mahmudian <i>et al.</i> , 2021)
20	Hellyyana <i>et al.</i> [32]	2019	Muara I Primary Health Care, Lhokseumawe, Aceh	Cross-sectional	Pregnant women	90	Education, CED	< 11 g/dL	CED has a significant effect on anaemia in pregnant women (OR = 64.34; 95% CI = 15.10 to 274.10; p <0.001). (Hellyyana <i>et al.</i> , 2019)

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21	Rahardjo <i>et al.</i> ^[33]	2022	Baturaden and Purwokerto Primary Health Care, Central Java	Cross-sectional	Pregnant women	135	Maternal age, adherence to the consumption of iron tablets, and the duration of pregnancy. Gestational age, adherence to vitamin C intake, consumption pattern, and the level of protein intake	< 11 g/dL	The causes of anaemia in rural areas are maternal age (OR 21.6; p=0.03). The causes of anaemia in urban areas are gestational age (OR 5.06; p=0.022). (Rahardjo <i>et al.</i> , 2022)
22	Andriani <i>et al.</i> ^[11]	2016	Benculuk Primary Health Care, Banyuwangi, East Java	Retrospective Cohort	Pregnant woman	100	Pregnant woman class, maternal education, family income, myth in pregnant mother, visit to an obstetric gynaecology specialist.	< 11 g/dL	Participation in pregnant woman class (OR=0.18; 95%CI= 0.03 to 1.21; p=0.078), maternal education ≥ senior high school (OR=0.07; 95%CI= 0.01 to 0.92; p= 0.043), and high family income (≥ Rp 1,599,000) (OR=0.18; 95%CI= 0.31 to 1.03; p= 0.054) decreased the risk of pregnancy anaemia. (Andriani, <i>et al.</i> , 2016)
Total						5880			

Table II: Summary of Quality Assessment of Individual Studies based on NOS

Study	Selection	Comparability	Outcome	Quality
Mocking <i>et al.</i> ¹²	**	**	**	Moderate (6)
Sumiyati <i>et al.</i> ⁵	***	-	*	Moderate (4)
Margawati <i>et al.</i> ²⁴	***	*	**	Moderate (6)
Aji <i>et al.</i> ⁶	***	**	*	Moderate (6)
Lestari <i>et al.</i> ¹³	***	-	**	Moderate (5)
Mulyantoro <i>et al.</i> ²⁵	**	**	*	Moderate (5)
Pusporini <i>et al.</i> ¹⁷	*	-	**	Moderate (3)
Opitasari <i>et al.</i> ¹⁴	***	**	*	Moderate (6)
Safrina <i>et al.</i> ¹⁵	**	**	*	Moderate (5)
Iwardani <i>et al.</i> ²⁰	**	**	-	Moderate (4)
Nadiyah <i>et al.</i> ⁹	**	-	**	Moderate (4)
Ridwan <i>et al.</i> ¹⁶	***	**	*	Moderate (6)
Dewi <i>et al.</i> ¹⁹	**	-	-	Poor (2)
Kusrini <i>et al.</i> ²⁶	***	**	*	Moderate (6)
Arnianti <i>et al.</i> ²⁷	-	-	**	Moderate (2)
Jasmi <i>et al.</i> ²⁸	***	-	*	Moderate (4)
Sari <i>et al.</i> ²⁹	***	-	*	Moderate (3)
Fitriahadi <i>et al.</i> ³⁰	***	-	-	Moderate (3)
Mahmudian <i>et al.</i> ³¹	-	-	*	Poor (1)
Helliyana <i>et al.</i> ³²	**	*	*	Moderate (4)
Rahardjo <i>et al.</i> ³³	***	**	*	Moderate (6)
Andriani <i>et al.</i> ¹¹	***	*	-	Moderate (4)

Outcome: The Newcastle-Ottawa Scale uses up to nine stars:

- 7-9 stars = high quality
- 4-6 stars = moderate quality
- <4 stars = low quality

Two low-quality studies were retained due to unique variables relevant to the Indonesian context and discussed with limitations noted.

The 22 studies meeting the eligibility criteria involved a total of 5,880 pregnant women, with analyses based on multiple potential determinant factors. In a systematic review, 29 statistically significant ($p < 0.05$) determinants were identified through bivariate and multivariate analyses. These factors included maternal age, body mass index (BMI) or nutritional status, maternal weight, height, mid-upper arm circumference (MUAC), educational level, living environment, occupation, diet, iron tablet consumption and adherence, micronutrient intake (such as vitamins A, B, C, D, calcium, zinc), protein intake, antenatal care (ANC), family income, maternal nutrition knowledge and attitudes, ferritin levels, gestational age, parity, pregnancy spacing, chronic energy deficiency

(CED), protein-energy deficiency (PED), husband's support, history of bleeding during pregnancy or childbirth, and physical health activity.

Five key determinants with the greatest impact were identified: BMI or nutritional status, education level, parity, chronic energy deficiency (CED), and maternal age (see Table III). As this was a qualitative synthesis due to heterogeneity and inconsistent effect sizes across the studies, pooled effect sizes were not computed, and no meta-analysis was performed. Most studies did not report effect sizes uniformly. Nonetheless, specific ORs and CIs for the five main determinants are provided in the discussion for each determinant.

Table III: Determinants of Anaemia in Pregnancy

No	Determining Factors	Significant Number of Articles ($p < 0.05$)
1	Body Mass Index (BMI) of Pregnant Women	5
2	Weight of Pregnant Women	1
3	Educational Level of Pregnant Women	5
4	Consumption of Iron Tablets & Level of Compliance	3
5	Antenatal care (ANC)	3
6	Zinc Intake	1
7	Family Income Level	3
8	Mother's Knowledge about Nutrition	3
9	Ferritin Status	1
10	Gestational Age	2
11	Protein Intake	1
12	Vitamin A Intake	1
13	Vitamin C Intake	1
14	Vitamin D Intake	1
15	Parity	5
16	Dietary Habit	2
17	Chronic energy deficiency (CED)	4
18	Pregnant Woman's Age	4
19	Husband's Support	1
20	Residential Environment	2
21	History of Bleeding (Pregnancy and Delivery)	1
22	Vitamin B Intake	1
23	Calcium Intake	1
24	Physical Activity	1
25	Mother's Height	1
26	Work Status	1
27	Pregnancy Spacing	1
28	Upper Arm Circumference Status	1
29	Mother's Attitude to Nutrition	1

Discussion

Most studies did not report strong Odds Ratios (ORs) or Relative Risks (RRs) for the determinant factors or maternal anaemia. Instead, proportions and p-values were reported without further analysis, necessitating manual calculations to determine OR or RR associations. Re-evaluation of each study's findings is essential to enable a

comprehensive quantitative assessment for heterogeneity and potential publication bias. This study analysed various research findings to provide a qualitative and descriptive overview of the five primary determinants of maternal anaemia in Indonesia: maternal education level, body mass index (BMI) or nutritional status, parity, chronic energy deficiency (CED), and maternal age.

Maternal Education Level

Seven studies highlighted a statistically significant association between maternal education level and anaemia risk. Studies in South Sulawesi, West Sumatra, and Yogyakarta found statistical significance for associations with maternal anaemia in third-trimester pregnancies. [5-11] In West Jakarta and Central Java, education levels were associated with anaemia incidence. [8,9] Lower education levels increased anaemia risk by an OR of 3.75 ($p = 0.022$), [10] while higher education levels (above high school) reduced anaemia risk by 93% (95% CI 0.01-0.92). [11] Higher education level influenced health awareness, shaping knowledge on nutrition and health management during pregnancy, thereby impacting dietary choices and nutritional intake. [5, 7]

Body Mass Index (BMI) or Nutritional Status

Five studies identified a significant link between BMI or maternal nutritional status and anaemia risk. A survey in Jakarta found that a sufficient BMI in early pregnancy reduced the risk of anaemia (OR 0.88, 95% CI 0.81-0.97). [12] Another study reported that a BMI $<25 \text{ kg/m}^2$ before pregnancy raised anaemia risk by 11.82 times (95% CI 2.70-51.69). [6] BMI affects haemoglobin levels, with low BMI often indicating inadequate nutrient intake or chronic illness, thereby increasing anaemia risk. [12]

Parity

Parity emerged as a crucial factor, with five studies indicating a significant correlation with anaemia. Research conducted in North Sumatra and Yogyakarta revealed that higher parity was associated with anaemia. [7,13] Multiparity was found to significantly increase the risk of anaemia by 58%. [14] Additionally, similar findings were observed in Pekanbaru and South Sulawesi. [10,15] Frequent pregnancies deplete iron reserves and haemoglobin levels, thereby elevating the risk of anaemia in subsequent pregnancies. [13]

Chronic Energy Deficiency (CED)

Chronic energy deficiency (CED) plays a crucial role in maternal anaemia, and four studies showed significant associations. Studies in North Sumatra and Indonesia's Basic Health Research 2018 data analyses indicated that CED significantly increases anaemia risk. [13,16] A case-control study reported an OR of 24 (95% CI 2.769-207.987) for CED as a risk factor for anaemia. CED, marked by low macronutrient intake, limits micronutrient availability, contributing to anaemia. [17-22]

Maternal age

Maternal age also played a significant role in the risk of anaemia, as indicated by four studies. A Jakarta study found that ages 16-20 increased anaemia risk by 1.56 times. [14] Analyses of the 2018 Basic Health Survey and research conducted in Yogyakarta and South Sulawesi corroborated similar findings, notably indicating elevated risks among women under 20 and over 35 years of age. [7,10,16,23] A comparison with prior regional systematic reviews from Southeast Asia and South Asia revealed consistent findings concerning the principal determinants of maternal anaemia. Studies originating from South Asia have likewise highlighted maternal education, nutritional status (notably iron and protein intake), parity, and maternal age as significant factors contributing to anaemia during pregnancy. For example, a systematic review by Balarajan *et al.* highlighted low maternal education and poor nutritional intake as key risk factors for anaemia among South Asian women. Similar biological and social vulnerabilities were seen across India, Bangladesh, and Nepal. [34] Similarly, Kavle and Landry, in their 2018 review of anaemia interventions in Southeast Asia, emphasised that early antenatal care, food-based strategies, and adolescent nutrition are crucial for lowering anaemia rates. [35] These findings aligned with current research, emphasising the importance of

an integrated approach that combines health education, targeted supplementation, and community-based interventions. However, this review offered new insights by focusing specifically on Indonesia, highlighting country-specific evidence that can guide more localised health policy creation.

Policy initiatives should prioritise improving nutrition education and supplementation during early antenatal care (ANC) visits. Additionally, implementing community-based programs for adolescents and young mothers, who are at increased risk of anaemia, is essential. Strengthening ANC services by incorporating routine nutritional screening for BMI and CED can help identify at-risk individuals. Moreover, providing targeted support and close monitoring for multiparous and undernourished women is crucial for mothers. These measures could be incorporated into existing national programs, such as the National Strategy to Accelerate Stunting Reduction and maternal nutrition initiatives, thereby enhancing pregnancy outcomes and reducing maternal morbidity and mortality rates in Indonesia.

Conclusion

This systematic review found five key factors strongly linked to maternal anaemia in Indonesia: low maternal education, poor nutritional status (reflected by low BMI), high parity, chronic energy deficiency (CED), and very young or older maternal age (<20 or >35 years). These findings highlighted the complex causes of anaemia during pregnancy and emphasised the importance of comprehensive and tailored interventions. They aligned with Indonesia's national goals to lower maternal mortality and combat anaemia, as outlined in the National Strategy for Accelerating Stunting Reduction and the National Action Plan for Accelerating

Maternal Mortality Reduction. These findings endorsed practical strategies, including early antenatal nutritional screening, improved maternal education initiatives, targeted supplementation for high-risk populations, and community outreach programs for adolescents and multiparous women. Integrating these evidence-based methods into national and subnational health planning will be essential for reducing the burden of maternal anaemia and achieving Indonesia's maternal health objectives.

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References

1. World Health Organisation (WHO). Anaemia 1. May 2023;1-5. https://www.who.int/health-topics/anaemia#tab=tab_1.
2. Khezri R, Salarilak S, Jahanian S. The association between maternal anaemia during pregnancy and preterm birth. Clin Nutr ESPEN. 2023;56:13-17. <https://doi.org/10.1016/j.clnesp.2023.05.003>.
3. Heydarpour F, Soltani M, Najafi F, Tabatabaee HR, Etemad K, Hajipour M, *et al.* Maternal anaemia in various trimesters and related pregnancy outcomes: Results from a large cohort study in Iran. Iran J Pediatr 2019;29:1-7. <https://doi.org/10.5812/ijp.69741>.
4. Triharini M, Nursalam, Sulistyono A, Adriani M, Armini NKA, Nastiti AA. Adherence to iron supplementation amongst pregnant mothers in Surabaya, Indonesia: Perceived benefits, barriers and family support. Int J Nurs Sci 2018;5:243-248. <https://doi.org/10.1016/j.ijnss.2018.07.002>.

5. Sumiyati, Jusuf EC, Aminuddin, Rachmat M. Determinant of Anaemia in pregnancy at Polewali Mandar District, South Sulawesi, Indonesia. *Gac Sanit* 2021;35:319-321. <https://doi.org/10.1016/j.gaceta.2021.10.044>
6. Aji AS, Yusrawati Y, Malik SG, Lipoeto NI. Anaemia prevalence and its associated risk factors among Minangkabau pregnant women in West Sumatra, Indonesia: Findings from VDPM cohort study. *Proc Nutr Soc* 2020;79:E780. <https://doi.org/10.1017/S0029665120007661>.
7. Fitriahadi E, Ayuningtyas D. The Identification of Maternal Characteristics and The Incidence of Anaemia in Pregnant Women. *Pak J Med Health Sci* 2021;15:1516-1520. <https://doi.org/10.53350/pjmhs211561516>.
8. Kurniati A, Astirin OP, Suryani N. Effect of Maternal Education, Family Income, Mother-Midwife Interface, and the Incidence of Iron Deficiency Anaemia in Pemalang, Central Java. *J Matern Child Health* 2016;1:220-229. <https://doi.org/10.26911/thejmch.2016.01.04.03>.
9. Nadiyah, Meilinda E, Simanjuntak AC. Relationship between Characteristics and Nutrient Intake with Anaemia among Pregnant Women at Kebon Jeruk Public Health Center, Jakarta. *Int J Nurs Health Serv* 2021;4:303-312. <https://doi.org/10.35654/ijnhs.v4i3.454>.
10. Arnianti A, Adeliana A, Hasnitang H. Analisis Faktor Risiko Anaemia dalam Kehamilan pada Masa Pandemi COVID-19. *Jurnal Ilmiah Kesehatan Sandi Husada* 2022;11:437-444. <https://doi.org/10.35816/jiskh.v11i2.807>.
11. Andriani Y, Respati SH, Astirin OP. Effectiveness of Pregnant Woman Class in The Prevention of Pregnancy Anaemia in Banyuwangi, East Java. *J Matern Child Health* 2016;1:230-241. <https://doi.org/10.26911/thejmch.2016.01.04.04>.
12. Mocking M, Savitri AI, Uiterwaal CS, Amelia D, Antwi E, Baharuddin M, *et al.* Does body mass index early in pregnancy influence the risk of maternal anaemia? An observational study in Indonesian and Ghanaian women. *BMC Public Health* 2018;18:1-9. <https://doi.org/10.1186/s12889-018-5704-2>.
13. Lestari S, Fujiati II, Keumalasari D, Daulay M, Martina SJ, Syarifah S, *et al.* The prevalence of anaemia in pregnant women and its associated risk factors in North Sumatera, Indonesia. *IOP Conf Ser Earth Environ Sci* 2018;125:012195. <https://doi.org/10.1088/1755-1315/125/1/012195>.
14. Opitasari C, Andayasari L. Young mothers, parity and the risks of anaemia in the third trimester of pregnancy. *Health Sci J Indones* 2015;6:7-11.
15. Safrina D, Dewi O, Damayanti IP. Analysis of Factors that Correlated with Anaemia Incidence in Pregnant Women at Working Area of the Sidomulyo Health Center Outpatient UPTD Pekanbaru City. *BioHS J* 2020;3:105-114.
16. Ridwan DA, Nurjannah N, Yeni CM, Suhanda R. Determinant Analysis of Gestational Anaemia in Indonesia. *Int Res J Pharm Med Sci* 2023;6:15-23. <https://irjpms.com/wp-content/uploads/2023/03/IRJPMS-V6N2P202Y23.pdf>.
17. Pusporini AD, Salmah AU, Wahyu A, Seweng A, Indarty A, Suriah, *et al.* Risk factors of anaemia among pregnant women in community health center (Puskesmas) Singgani and Puskesmas Tipo Palu. *Gac Sanit* 2021;35:S123-S126. <https://doi.org/10.1016/j.gaceta.2021.10.010>.
18. Azmi U, Puspitasari Y. Literature Review: Risk Factors of Anaemia in Pregnant Women. *J Qual Public Health* 2022;6:244-256. <https://doi.org/10.30994/jqph.v6i1.428>.
19. Dewi SSS, Hasibuan A, Aswan Y, Harahap M, Anggraini W. Relationship Between Diet and Physical Activity with the Event of Anaemia in Pregnant Women. *Int J Public Health Excellence* 2022;1:87-92.
20. Iswardani O, Hakimi M, Kurnia AR, Information A. Association of Iron Pills Consumption during Pregnancy with Incidence of Maternal Anaemia in Indonesia (IFLS 5 Advanced Analysis Study). *J Health Educ* 2019;4:29-36. <https://doi.org/10.15294/jhe.v4i1.27756>.
21. Judistiani RTD, Gumilang L, Nirmala SA, Irianti S, Wirhana D, Permana I, *et al.* Association of cholecalciferol, ferritin, and Anaemia among pregnant women: Results from a cohort study on Vitamin D status and its impact during pregnancy and childhood in Indonesia. *Hindawi*. 2018;2018. <https://doi.org/10.1155/2018/2047981>.
22. Triharini M, Rahmawati A, Nastiti AA, Dewi YS, Mani SK, *et al.* Factors Affecting Anaemia

- Prevention Behavior in Pregnant Women based on Lawrence Green's Theory. *J Int Dent Med Res* 2021;14:1705–1708.
23. Yuniati T, Judistiani RTD, Natalia YA, Irianti S, Madjid TH, Ghozali M, *et al.* First trimester maternal Vitamin D, ferritin, hemoglobin level and their associations with neonatal birthweight: Results from a cohort study on Vitamin D status and its impact during pregnancy and childhood in Indonesia. *J Neonatal-Perinatal Med* 2020;13:91–96. <https://doi.org/10.3233/NPM-180043>.
 24. Margawati A, Syauby A, Utami A, Adespin D. A. Prevalence of Anaemia and Associated Risk Factors among Pregnant Women in Semarang, Indonesia, during the COVID-19 Pandemic. *Ethiop J Health Sci* 2023;33:451–462. <https://doi.org/10.4314/ejhs.v33i3.8>
 25. Mulyantoro DK, Kusriani I. Protein Energy Deficiency Increases the Risk of Anaemia in Pregnant Women. *IOP Conference Series: Earth Environ Sci* 2021;810:1–6. <https://doi.org/10.1088/1755-1315/810/1/012043>
 26. Kusriani I, Mulyantoro DK, Tjandrarini DH, Ashar H. Profile of Double of Undernutrition Problem, Coexistence with Anaemia among Pregnant Women in Indonesia 2018: A Cross-Sectional Survey. *Macedonian J Med Sci* 2021;9:1250–1255.
 27. Arnianti A, Adeliana A, Hasnitang H. Analysis of Risk Factors for Anaemia in Pregnancy During the Covid-19 Pandemic. *Jurnal Ilmiah Kesehatan Sandi Husada* 2022;11:437–444. <https://doi.org/10.35816/jiskh.v11i2.807>.
 28. Jasmi J, Rahmi J, Noviyanti A, Franciska Y. (2022). Relationship Between Husband's Support And The Incidence Of Anaemia In Pregnancy In The Working Area Of The Rumbai Health Center. *J Matern Child Health Sci* 2022;2:193–198. <https://doi.org/10.36086/maternalandchild.v2i2.1473>.
 29. Sari NAN, Fauziah M. The Factors Associated with the Incidence of Anaemia in Pregnant Women in Pisangan Public Health Center Visitors in 2020. *Muhammadiyah Jurnal of Epidemiologi* 2021;1(1):16–23.
 30. Fitriahadi E, Ayuningtyas D. The Identification of Maternal Characteristics and The Incidence of Anaemia in Pregnant Women. *Pak J Med Health Sci* 2021;15:1516–1520. <https://doi.org/10.53350/pjmhs211561516>.
 31. Mahmudian AA, Dian Aby R, Sugijati S. Hubungan KEK dengan Anaemia Gravidarum pada Ibu Riwayat BBLR. *ARTERI: Jurnal Ilmu Kesehatan* 2021;2:80–85. <https://doi.org/10.37148/arteri.v2i3.165>.
 32. Hellyana H, Aritonang EY, Sanusi SR. The Associations between Maternal Education, Chronic Energy Deficit, and Anaemia in Pregnant Women: An Evidence from Lhokseumawe, Indonesia. *J Matern Child Health* 2019;4:302–306. <https://doi.org/10.26911/thejmch.2019.04.05.02>.
 33. Rahardjo S, Wati EK. Differences in Factors Causing Anaemia in Pregnant Women in Rural and Urban Areas. *Prosiding TIN PERSAGI* 2022;4:349–351.
 34. Balarajan Y, Ramakrishnan U, Özaltın E, Shankar AH, Subramanian SV. Anaemia in low-income and middle-income countries. *The Lancet* 2011;378:2123–2135. [https://doi.org/10.1016/S0140-6736\(10\)62304-5](https://doi.org/10.1016/S0140-6736(10)62304-5).
 35. Kavle JA, Landr M. Addressing barriers to maternal nutrition in low- and middle-income countries: A review of the evidence and programme implications. *Maternal Child Nutr* 2018;14(1):e12508. <https://doi.org/10.1111/mcn.12508>.



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