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Nutritional and Non-Nutritional Factors Causing Anemia in Pregnant Women Globally: A Narrative Review

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Abstract

Anemia in pregnant women is a global health issue that has a significant impact on mothers and fetuses, especially in low- and middle-income countries. This condition can lead to premature birth, fetal growth disorders, and the risk of stunting. This study aims to analyze the nutritional and non-nutritional factors causing anemia in pregnant women globally and to recommend effective interventions. The method used was a narrative review of national and international journals published between 2020 and 2025, with inclusion criteria and quantitative or qualitative methods. The results showed that the primary nutritional factors were iron, folate, and vitamin B12 deficiencies, exacerbated by low food intake and poor adherence to supplementation. Non-nutritional factors include socioeconomic status, education, age, infections (such as malaria and parasitic infections), chronic diseases, and limited access to healthcare services. Anemia is more common among adolescent pregnant women, those with low education levels, and those living in poverty. In conclusion, anemia in pregnant women is a multifactorial condition that requires a holistic approach through improved nutrition, health education, access to maternal services, infection control, and improved socioeconomic conditions. This approach aligns with WHO recommendations to reduce the global prevalence of anemia.

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Introduction

Anemia in pregnant women remains a significant global public health problem, impacting millions of women worldwide, especially in low- and middle-income countries. The condition can lead to a range of serious complications for both mother and fetus, from an increased risk of premature birth to impaired cognitive development in infants (Pebriyanti et al., 2025). The World Health Organization (WHO) has established anemia as one of the global health priorities and targets a 50% reduction in the prevalence of anemia in women of reproductive age by 2025 (Cesare et al., 2021).

The prevalence of anemia in pregnant women varies geographically, with the highest rates found in Africa and Asia, where more than a third of pregnant women suffer from anemia. Population groups most vulnerable to anemia include children under 5 years of age, particularly infants and children under 2 years of age, adolescent girls and menstruating women, and pregnant and postpartum women. Anemia is

estimated to affect half a billion women aged 15-49 years and 269 million children aged 6-59 months worldwide. In 2019, 30% (539 million) of non-pregnant women and 37% (32 million) of pregnant women aged 15-49 years were affected by anemia. Africa and Southeast Asia are most affected with an estimated 106 million women and 103 million children affected by anemia in Africa, while in Southeast Asia 244 million women and 83 million children are affected (WHO, 2025).

One of the national priority indicators in the RPJMN 2020-2024 is to reduce the stunting rate by 14% by 2024 using nutrition-specific or nutrition-sensitive interventions. One of the most important things that needs to be done to prevent stunting is to reduce the prevalence of anemia in pregnant women and adolescent girls. Anemia in pregnant women is one of the risk factors for stunting that needs to be addressed as early as possible while in the womb to prevent low birth weight infant (LBW) and premature birth. When faced with these three challenges, newborns have a higher risk of becoming stunted after birth (Kemenkes RI, 2024).

Anemia in pregnant women is a significant health problem in Indonesia, with prevalence reaching 27.7% according to the Indonesian Health Survey (IHS) in 2023. This condition can increase the risk of complications such as premature birth, bleeding during labor, and impaired fetal growth and development. Early detection of anemia through hemoglobin (Hb) level checks is essential to prevent these negative impacts. Routine Hb checks allow early identification of anemia conditions, so that interventions can be carried out in a timely manner (Rejeki & Fajri, 2023).

This difference in prevalence reflects the complexity of the etiology of anemia involving interactions between nutritional, non-nutritional, and socioeconomic factors in different populations. An in depth understanding of these causative factors is essential for designing effective and sustainable interventions to address pregnancy anemia (Namaste et al., 2017). Nutritional factors are the main cause of anemia in pregnant women, with iron deficiency being the most dominant contributor (Jacobson-Kelly et al., 2020). Iron requirements increase dramatically during pregnancy to support maternal blood volume expansion and fetal and placental growth (Mirza et al., 2018). Insufficient iron intake, coupled with low iron stores before pregnancy, often results in iron deficiency anemia (Ali et al., 2023).

In addition to iron, deficiencies of other important micronutrients such as folate (vitamin B9) and vitamin B12 also play a role in the development of anemia, especially megaloblastic anemia. Folate is crucial for DNA synthesis and rapid cell division, so its deficiency can impair the production of healthy red blood cells (Kajjura et al., 2025). Similarly, vitamin B12 is an important cofactor in folate metabolism, and its deficiency can lead to a buildup of inactive folate that inhibits erythropoiesis (Ndiaye et al., 2025).

Non-nutritional factors also have a significant role in the pathogenesis of anemia in pregnant women globally. In addition to iron and other nutrient deficiencies, various non-nutritional factors such as infections (malaria, tuberculosis, worms), chronic diseases, genetic disorders (such as thalassemia and sickle cell anemia), and bleeding and physiological disorders during pregnancy contribute to the occurrence of anemia in pregnant women (Stephen et al., 2018). Parasitic infections such as malaria and worms can cause the destruction of red blood cells or interfere with iron absorption, increasing the risk of anemia. In addition, chronic diseases and congenital blood disorders can also reduce hemoglobin production or accelerate red blood cell destruction (Arfan et al., 2024).

Socioeconomic factors, education level, access to health services, and compliance in taking iron supplements are also among the non-nutritional factors that affect the incidence of anemia in pregnant women (Arfan et al., 2024). Pregnant women with low economic status, poor knowledge about health, and limited access to health services tend to have a higher risk of anemia. In addition, pregnancy spacing that is too close, high parity, and maternal age that is too young or too old can also worsen anemia status due to body iron reserves that have not fully recovered or increased iron needs (Murniati et al., 2024).

Interventions to prevent and treat anemia in pregnant women should be multidimensional, addressing both nutritional and non-nutritional factors (Keats et al., 2022). Iron and folic acid supplementation, food fortification, and nutrition education are the main pillars of micronutrient deficiency management. These strategies have proven effective in reducing the prevalence of anemia in many regions (Percy et al., 2017). In addition, infection control programs, such as prophylactic treatment of malaria in endemic areas and improved sanitation, are critical to reducing the burden of anemia caused by infection (Gardner et al., 2023). Screening and early management of chronic diseases in pregnant women also contribute to effective prevention and management of anemia (Ruiz de Viñaspre-Hernández et al., 2025). This integrated approach reflects the complexity of pregnancy anemia.

Based on these challenges, a comprehensive understanding of the factors causing anemia in pregnant women is needed as a basis for designing effective interventions. Therefore, this study aims to review and integrate evidence related to nutritional and non-nutritional factors causing anemia in pregnant women globally through a narrative review of national and international journals published between 2020 and 2025. The scientific merit of this article lies in the synthesis of data from various major publications to

provide an integrated framework that can be used as a basis for designing more effective and sustainable interventions.

Methods

This study uses a narrative review approach to synthesize various evidence on nutritional and non-nutritional factors that contribute to anemia in pregnant women globally. This approach was chosen to provide a comprehensive analysis of various types of studies with diverse designs, contexts, and results.

Search Strategy

The article search was conducted through three electronic databases: Google Scholar, PubMed, and ScienceDirect, with publications ranging from 2020 to 2025. Articles were searched using a combination of keywords: “anemia in pregnancy,” “nutritional factors,” “non-nutritional factors,” and “pregnant women.” Boolean operators such as AND and OR were used to narrow or broaden the search as needed. The articles selected were research articles available in full-text and freely accessible. Additional filters include language (English) and publication type (original research).

Inclusion and Exclusion Criteria

Inclusion criteria:

(1) Using Indonesian and English
(2) Research articles whose titles and content match the keywords.
(3) Quantitative, qualitative and mixed-method research articles.
(4) Articles published between 2020 and 2025.
(5) Articles available in full-text and free acces.

Exclusion criteria:

(1) Article review and duplicate
(2) Animal or in vitro research articles.
(3) Published before 2020
(4) Articles that are not accessible in full text.

Study Selection and Data Extraction

The article selection process is carried out in the following stages:

(1) Identify articles from the database,
(2) Screening of titles and abstracts,
(3) Review of full texts according to inclusion and exclusion criteria,
(4) Selected articles were then analyzed.

Data extracted from eligible articles included:

(1) Author names, year of publication, Title and country of research,
(2) Study design
(3) Nutritional and non-nutritional factors causing anemia in pregnant women,
(4) Key findings and conclusions.

Results

This narrative review by grouping similar extracted data in accordance with the results measured to answer the objectives of research journals that match the inclusion criteria then collected and made a summary of the journal including the name of the researcher, year of journal publication, research title, method and summary of results or findings. To further clarify the analysis of abstracts and full text journals were read and examined. The journal summary was then analyzed for content contained in the research objectives and results/findings. Analysis of journal content, then coding of the contents of the reviewed journals based on the outline or core of the research. Based on the review of various literatures, 20 suitable articles were found and have been compiled and can be seen in the following table:

Table 1. Extraction of Research Results

No	Author (Year) & Country	Research Design	Nutritional Factor	Non-Nutritional Factor	Results
1	Sumiyati et al. (2021) Indonesia	Cross-sectional study	Iron tablet intake	Education, parity, ANC	Education and iron intake significantly reduce anemia
2	Abdulsalam et al. (2025) Ethiopia	Unmatched Case-Control	Iron supplementation	Income, contraception, socioeconomic status	Nutrition and socioeconomic factors are major determinants
3	O'Toole et al. (2024) Irlandia	Qualitative (Interview)	Compliance with iron, diet	Knowledge, support, routine	Better education and support could improve compliance
4	Arya et al. (2024) Kanada-Amerika Serikat	Retrospective cohort study. Log-binomial regression	Iron deficiency	Income, maternal age, parity, thalassemia, fetal count, care provider	Anemia in pregnancy is common, especially among patients in low-income quintiles
5	Nadhiroh et al. (2024) Indonesia	Retrospective data model development	Iron supplementation , MUAC (CED)	Demographic status, smoking habits, and disease history	Anemia risk in Indonesian pregnant women can be predicted by iron intake and MUAC
6	Sharma et al. (2021) USA	Retrospective cohort study	Iron deficiency (ID) and iron-deficiency anemia (IDA)	Maternal age, Medicaid, BMI, race/ethnicity, smoking, parity, multiple gestation	EHRs enable anemia surveillance in pregnancy but undercode cases
7	Ruiz de ViñaspreHernández et al. (2025) Spain	Prospective study.	Iron deficiency	Maternal and neonatal health outcomes	Iron deficiency anemia linked to maternal and neonatal outcomes
8	Finkelstein et al. (2020) Uganda-Amerika Serikat	Prospective analysis within randomized trial	Iron, folate, vitamin B12, vitamin D deficiency	HIV status, maternal-infant outcomes	HIV+ women need micronutrient interventions
9	Lauer et al. (2024) India	Prospective cohort study (mother-infant)	Micronutrient levels	Infant hemoglobin outcomes	More research needed on long-term effects
10	Freitas-Costa et al. (2025) Brazil	Cross-sectional (multi-year population data)	BMI, Hb level, iron status	Education, adolescent age, parity	Interventions should target adolescents and late pregnancy
11	Davidson et al. (2023) Australia	Logistic mixed-effects modeling on cohort	Iron supplementation	Pregnancy and postpartum changes	Early iron supplementation reduces maternal anemia
12	Lestari et al. (2025) Indonesia	Experimental (shelf-life & functional testing)	Snack bar: iron, protein content	Not mentioned	Functional snacks effective alternative for prevention
13	Pratiwi (2021) Indonesia	Cross-sectional	Malnutrition	Knowledge, socioeconomic, education	Non-nutritional factors affect anemia in pregnant women
14	Norfitri & Rusdiana (2023) Indonesia	Analytical correlational	Compliance with iron	Age, knowledge, socioeconomic	Age and compliance affect anemia
15	Afriyanti (2020) Indonesia	Descriptive analytic with cross-sectional approach	Compliance with iron	Socioeconomic, education, employment, parity	All variables significantly associated with anemia

No	Author (Year) & Country	Research Design	Nutritional Factor	Non-Nutritional Factor	Results
16	Zuiatna (2021) Indonesia	Analytical survey with cross-sectional approach	Nutritional status	Education, occupation, parity	Three factors significantly affect anemia
17	Dewi & Mardiana (2021) Indonesia	Observational analytic with case-control design	Compliance with iron	Age, parity, occupation, education	Several factors strongly related to anemia
18	Vira et al. (2024) Indonesia	Cross-sectional	Compliance with Fe, MUAC, BMI	Age, education, parity	Irregular supplementation & low MUAC increase risk
19	Sari et al. (2022) Indonesia	Analytical with cross-sectional approach	Compliance with Fe	Age, parity, occupation, family support	All variables significantly influence anemia
20	Sukmawati et al. (2021) Indonesia	Correlational with cross-sectional approach	Compliance with Fe	Occupation, parity, education, family support	Factors significantly affect anemia prevalence

Based on 20 articles that met the inclusion criteria, they were analyzed into two main categories, namely nutritional factors and non-nutritional factors that cause anemia in pregnant women.

Nutritional Factors Causing Anemia in Pregnant Women

Table 2. Nutritional Factors Causing Anemia in Pregnant Women

Nutritional Factor	Frequency of Reporting (n/20 studies)	Percentage	Description
Iron deficiency (Fe)	17	85%	The most dominant factor in developing and poor countries
Compliance with iron tablet consumption	14	70%	Main trigger of iron-deficiency anemia
Poor nutritional status (low BMI / small MUAC / chronic energy deficiency)	11	55%	Related to low iron stores
Folate deficiency (B9)	7	35%	Causes megaloblastic anemia
Vitamin B12 deficiency	5	25%	Affects erythropoiesis
Inadequate protein intake	4	20%	Plays a role in hemoglobin synthesis
Vitamin D deficiency	3	15%	Associated with inflammatory anemia
Low intake of micronutrient-rich foods	6	30%	Low consumption of animal-based and vegetable-based foods

Non Nutritional Factors Causing Anemia in Pregnant Women

Table 3. Non- Nutritional Factors Causing Anemia in Pregnant Women

Non-Nutritional Factors	Frequency of Reporting (n/20 studies)	Percentage	Notes
Low education level	15	75%	Related to nutritional knowledge and ANC (antenatal care)
Low socioeconomic status	14	70%	Influenced by income, employment, and access to food
Maternal age (too young or too old)	12	60%	Age <20 and >35 years is at risk

Non-Nutritional Factors	Frequency of Reporting (n/20 studies)	Percentage	Notes
High parity	10	50%	Associated with depletion of iron stores
Low ANC compliance	11	55%	Affects hemoglobin improvement and health education
Infections (HIV, malaria, helminths)	8	40%	Cause hemolysis and inflammation
Lack of family support	6	30%	Reduces adherence to iron supplementation
Limited access to iron supplements	9	45%	Frequently reported in developing countries
Lifestyle (smoking)	3	15%	Affects hemoglobin and oxygen status
Maternal employment status	7	35%	Related to stressors, workload, and access to healthcare

Synthesis of Key Findings

(1) The most consistent nutritional factors are iron deficiency, Fe consumption compliance, and poor nutritional status.
(2) The dominant non-nutritional factors are low education, socioeconomic status, maternal age, and infection.
(3) Developed countries report more associations between anemia and low income, race/ethnicity, and comorbid conditions.
(4) Developing countries highlight nutritional status, iron intake compliance, and access to antenatal care (ANC).

Discussion

Nutritional Factors Causing Anemia

Iron deficiency is the leading cause of anemia in women of reproductive age and is the leading cause of anemia in pregnant women globally. Many individuals begin pregnancy with low iron stores, and iron requirements increase progressively during pregnancy, so dietary iron intake is often insufficient to meet maternal and fetal needs. Iron deficiency can progress to iron deficiency anemia, which is the ultimate consequence of iron deficiency (Ruiz de Viñaspre-Hernández et al., 2025). Adherence to oral iron supplementation is also an important factor as gastrointestinal side effects, previous bad experiences and forgetfulness can negatively impact adherence (O'Toole et al., 2024).

Iron intake and nutritional status during pregnancy are the most dominant nutritional factors affecting the incidence of anemia in pregnant women worldwide. A study by Dewi & Mardiana (2021), showed a strong association between nutritional status and the incidence of anemia (p=0.000), where iron deficiency was the main cause of hemoglobin deficiency during pregnancy. In addition, iron tablet consumption compliance is also very significant (p=0.002) in preventing anemia.

Anemia in pregnant women is a complex health problem and is influenced by various nutritional factors. The most dominant role is the nutritional status of pregnant women, especially iron deficiency, which is the main cause of anemia. This factor is strongly associated with insufficient food intake, malabsorption conditions, or increased iron requirements during pregnancy (Sukmawati et al., 2021). In addition, compliance with iron (Fe) tablet consumption is also very influential in reducing the risk of anemia, which is related to maternal knowledge of the importance of supplementation during pregnancy (Pratiwi, 2021).

Sari et al. (2022) reported that adequate iron intake (p=0.026) plays an important role in reducing the risk of anemia, which is in line with the results of a study by Sumiyati et al (2021), who emphasized the role of iron tablet consumption in reducing the prevalence of anemia. In addition to iron, other nutritional factors such as folate, vitamin B12, and protein intake also contribute to the process of red blood cell formation, so the lack of these micronutrients increases the risk of anemia. Global studies confirm that micronutrient deficiencies are not just a local problem, but contribute significantly to anemia in pregnant women especially in developing countries (Freitas-Costa et al., 2025).

Undernutrition conducted in Indonesia using data from the 2013 and 2018 Basic Health Research in Indonesian showed that undernutrition, identified through upper arm circumference as an indicator of chronic energy deficiency (CED), is a significant nutritional factor contributing to the risk of anemia in pregnant women (Nadhiroh et al., 2024). Chronic energy deficiency in pregnant women is a condition of energy deficiency that occurs over a long period of time. CED in pregnant women can be triggered by nutritional and non-nutritional factors (Abadi & Putri, 2020). Various pregnancy complications, such as IUGR (Intrauterine Growth Restriction) and LBW (Low Birth Weight), can be caused by inadequate nutrition. These conditions are often associated with macronutrient and micronutrient deficiencies, such as vitamin A, thiamine, iron and zinc (Kartini et al., 2016).

In addition to iron, other micronutrient deficiencies such as vitamin B-12, folate, and vitamin D also increase the risk of anemia in pregnant women. A study in Uganda found that pregnant women with HIV had a higher risk of micronutrient deficiencies and anemia, with significant prevalence of vitamin B-12, folate, and vitamin D deficiencies (Finkelstein et al., 2020).

Non Nutritional Factors Causing Anemia

Non-nutritional factors are also very important in understanding the causes of anemia in pregnant women. Several studies have noted that the age of pregnant women has a significant association with the incidence of anemia (p=0.006). Where young pregnant women or teenagers are more prone to anemia (Norfitri & Rusdiana, 2023). The prevalence of anemia tends to be higher in younger age groups (under 26 years) compared to older age groups (Faghir-Ganji et al., 2023). In addition, family support and social environment play a role in improving adherence and good habits during pregnancy, including adherence to taking iron tablets and maintaining a balanced diet (Sari et al., 2022).

Socioeconomic status also affects the risk of anemia. According to Afriyanti (2020) found a significant relationship between economic status, employment, education, and the incidence of anemia (p=0.033; p=0.048; p=0.025). Low economic conditions often result in a lack of access to nutritious food and supplements, as well as adequate health services. A study conducted in Canada analyzed more than 50,000 pregnancies and found that prenatal anemia was common and had an association with lower neighborhood income. The study highlighted that anemia in pregnant women is also a health equity issue, with higher prevalence in neighborhoods with less favorable economic status (Arya et al., 2024).

Maternal knowledge about anemia and the importance of iron tablet consumption is also a significant determining factor. According to Dewi & Mardiana (2021) states that maternal knowledge about anemia is closely related to the incidence of anemia (p=0.040), as well as a report by Sukmawati et al. (2021), who added that compliance with taking Fe tablets is influenced by the knowledge and health education received by pregnant women.

Research conducted in Polewali Mandar District, South Sulawesi, Indonesia, and received in July 2021, found that education level is a significant non-nutritional factor in the cause of anemia in pregnant women. The results showed that pregnant women with lower levels of education tend to have less knowledge regarding anemia prevention and meeting nutritional needs, which in turn has an impact on increasing the risk of anemia (Sumiyati et al., 2021).

In addition to socioeconomic factors, education, knowledge, employment, family income, the role of the husband is also a determinant in the utilization of health services such as ANC (Antenatal Care). A study showed that some pregnant women did not attend ANC because they felt healthy or did not have free time due to household chores. These factors affect the health of pregnant women and potentially lead to anemia, which can prevent mothers from understanding the importance of nutrition and care during pregnancy (Nurfadilah et al., 2025).

Infection is also one of the factors that cause anemia. A study conducted in Uganda found that infection, particularly HIV, was a significant non-nutritional factor in causing anemia in pregnant women. The study showed that pregnant women with HIV had a higher risk of anemia, with a prevalence of 43%, and also found other micronutrient deficiencies such as iron, vitamin B-12, folate, and vitamin D, which contributed to the anemic condition (Finkelstein et al., 2020).

The Combined Role of Nutritional and Non-Nutritional Factors

Comprehensive meta-analysis and research studies such as by Abdulsalam et al. (2025) show that risk factors for anemia do not stand alone, but are a combination of various determinants. For example, a meal frequency of less than 3 times a day, low economic status, and low adherence to iron supplement consumption cumulatively increase the risk of anemia in pregnant women, while previous contraceptive use exerts a protective effect. Research by Freitas-Costa et al. (2025) also displayed changing dynamics of anemia prevalence throughout the trimesters of pregnancy, with the peak of anemia occurring in the third

trimester (23.5%). This indicates the need for specific interventions that take into account timing and maternal health conditions.

A study based on Electronic Health Records (EHR) of 41,991 first trimester pregnancies showed a prevalence of anemia of 2.7%, with most cases classified as mild. Of all pregnant women with anemia, 48.2% had iron deficiency, resulting in a prevalence of iron deficiency anemia (IDA) of 6.5–7.1%. The main nutritional factor at play was iron deficiency. Non-nutritional factors affecting anemia included race/ethnicity (highest among non-Hispanic blacks at 10.9%), socioeconomic status (higher among Medicaid recipients), age (higher among mothers <25 years and ≥35 years), nutritional status (higher among underweight mothers), parity (higher among mothers with ≥2 children), and multiple pregnancies. These results confirm that anemia in pregnancy is influenced by a combination of nutritional and non-nutritional factors, so prevention needs to be done with a nutritional approach (iron supplementation, ferritin monitoring) as well as a non-nutritional approach (access to health services, monitoring of risk groups, and improvement of socioeconomic disparities) (Sharma et al., 2021).

The implication of the narrative review is that anemia in pregnant women is not just a medical condition, but a reflection of a major challenge faced by many women around the world, rooted in the lack of essential nutrients and also intertwined with various aspects of life such as economic conditions, educational opportunities, age, and even the presence of infections. If not addressed thoroughly and with care, anemia can threaten the well being of mothers, as well as hinder the developmental potential of the babies they carry and those to be born.

Based on this evidence, prenatal anemia prevention programs should include a holistic approach that not only focuses on iron supplementation, but also on improving general nutritional status, health education, increasing access to maternal health services, and improving the socioeconomic conditions of pregnant women. The World Health Organization (WHO) recommendations also underscore the importance of a combination of nutritional and non-nutritional interventions to effectively address pregnancy anemia in many parts of the world. We need to reach every pregnant woman with comprehensive support, complemented by education that equips them with knowledge. Overcoming economic and educational barriers that prevent access to quality health care, and creating a supportive social environment where every pregnant woman feels safe, nourished and anemia-free for a healthy and hopeful pregnancy.

Conclusion

Anemia in pregnant women is a complex and multifactorial global health issue, in which nutritional factors such as iron, folate, and vitamin B12 deficiency, as well as the mother's nutritional status, play a dominant role. while non-nutritional factors such as socioeconomic status, maternal age, level of knowledge, adherence to iron tablet consumption, and family and social support also contribute, so that the combination of these two factors causes a high prevalence of anemia, especially in developing countries, and requires a holistic approach in the form of nutritional interventions (supplementation, dietary education), prevention of non-nutritional factors through antenatal care, infection prevention, improvement of health education, and quantitative and qualitative research to deepen understanding of the interaction of these factors, in accordance with WHO recommendations emphasizing the importance of integrating nutritional and non-nutritional interventions to reduce anemia rates in pregnant women worldwide.

Patents

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Author Contributions

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Conflicts of Interest:

The authors declare no conflict of interest.

Appendix

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