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REVIEW ARTICLE

RECENT TRENDS IN ANEMIA BIOLOGY

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ABSTRACT:

A decrease in the percentage of red blood cells is known as anemia. Anemia is a symptom of an underlying illness rather than a diagnosis. The sharpness of onset, the etiology of anemia, and the existence of additional comorbidities particularly cardiovascular disease all have an impact on a patient's prognosis. Reduced erythrocyte production or increased blood loss from hemolysis, hemorrhage, or both can cause anemia. Genetic, dietary, or viral variables influence them. Genetic factors cause hemoglobinopathies such as thalassemia and sickle cell anemia, while soil-transmitted infectious diseases like schistosomiasis, malaria, and helminths can also cause anemia. Anemia is still a serious health issue, particularly for women in developing nations. It is important to think about implementing preventive programs that improve access to iron supplements and address hemoglobinopathies early in diagnosis and treatment.

KEYWORDS: Anemia, Biology, Diseases.

INTRODUCTION:

About one-third of the world's population suffers from anemia, a condition in which the concentration of hemoglobin (Hb) and/or red blood cells (RBCs) is below normal and insufficient to support an individual's physiological needs. Poor birth outcomes, higher rates of morbidity and mortality in both women and children, lower adult productivity at work, and delayed cognitive and behavioral development in young children are all associated with anemia. Anemia disproportionately impacts women of reproductive age (WRA) and preschool-age children (PSC).

REVIEW OF LITERATURE:

Kebede, Regassa Alemu et al. (2024). Anemia is one of the main public health issues affecting children worldwide that significantly increases morbidity and mortality. Anemia in children aged six months to five years is a serious health issue in the majority of developing nations, with an estimated frequency of almost 43%. We aim to determine the extent, contributing factors, and morphological types of anemia in children aged 6 to 59 months who received admission to Jimma Medical Center in southwest Ethiopia between June 15 and October 15, 2022. We used a pre-structured questionnaire to gather information about the sociodemographic traits and other related criteria of the study participants. Medical interns and nurses gathered clinical data through physical examinations and client histories. Next, they drew 3 mL of venous blood and conducted a full blood count analysis. After the data were cleaned, coded, and imported into EpiData version 4.6, they were exported to SPSS version 25 for further examination. We employed binary logistic regression, both bivariate and multivariate, to find related factors. Anemia has been discovered to be a serious public health issue among research participants. This research suggests expanding health education regarding diet and child feeding. [1]

Bolun Sun et al. (2024). Due to its detrimental consequences for health, iron deficiency anemia (IDA), which is caused by micronutrient iron insufficiency, has garnered attention worldwide. Numerous hormones and transporters in the body work together to precisely regulate iron uptake and metabolism processes. Maintaining human health and iron requirements requires controlling dietary iron consumption. The review's purpose is to examine the literature on systemic regulation of dietary iron consumption. Additionally, dietary iron supplementation and the most modern IDA treatments are covered. This review also focuses on the relationship between bacteria and the

micronutrient iron in the gut, given the significance of the gut microbiome. The kind of iron and dietary variables have a significant impact on the efficiency of iron absorption. Although there are obstacles to the development of appropriate iron fortificants and food carriers with respect to bioavailability and acceptability, iron fortification is still the most economical approach. A lack of iron can change the composition of the gut microbiome and encourage the growth of harmful bacteria, which can impact immunological function and overall health. [2]

Habe, Sarasa et al. (2024). A major global health issue, gestational anemia (GA), is extremely common in Japan and is linked to a number of negative effects for both mothers and newborns. The purpose of this study was to investigate potential associations between maternal features, food consumption, low birth weight (LBW), preterm birth, GA, and non-anemic iron insufficiency (NAID) during the third trimester. We divided the participants into three groups based on their serum ferritin and hemoglobin levels: GA, NAID, and normal. We utilized the Brief Diet History Questionnaire to evaluate the intake of nutrients. Three hundred seventeen pregnant women's data were analyzed; among them were those from the GA, NAID, and normal groups (110 (34.7%), 151 (47.6%), and 56 (17.6%), respectively. GA was associated with being multipara ($p < 0.001$) and not taking any kind of iron supplement in the third trimester ($p = 0.043$). Compared to the GA and NAID groups, the normal group had a noticeably greater percentage of preterm births and low birth weights. Compared to the normal group, the GA group consumed considerably more energy ($p = 0.044$). Overall, the Japanese dietary recommended intakes for energy and micronutrients were far lower than the anticipated average requirement. Health care providers should take into account dietary recommendations that focus on total micronutrient consumption rather than just caloric intake as a way to prevent GA. [3]

Jyoti Sharma et al. (2024). Low blood hemoglobin (Hb) concentration, or anemia, is a major worldwide health issue that has been linked to unfavorable health outcomes. Anemia primarily affects children, women who are pregnant, and women of childbearing age. It is a symptom of inadequate nutrition. Data were gathered from Nagla Chandi Village, Uttar Pradesh, using a multilevel sampling methodology and a mixed-methods approach. Thirty mothers of children aged six to fifty-nine months and thirty-three women of reproductive age participated in the survey. One ASHA employee and two school teachers provided qualitative data for the study. The study community's anemia prevalence among women was found to be comparable to the NFHS statistics;

however, children's anemia prevalence was found to be lower. 64.7% of cases involving women had anemia, with mild and moderate anemia rates being 20.6% and 14.7%, respectively. 44% of female children and 36% of male children were anemic. Of the children, 79% of the females and 70% of the males were underweight. Of the adult female population, 26% were overweight, and 18% were underweight. In this community, the main causes of IDA are untreated water intake, poor hygiene practices, the absence of Anganwadi (a type of rural childcare center in India), inadequate education in society, unhealthy eating habits, and women's failure to take IFA supplements. To prevent anemia, the government should implement food fortification, nutritional education, and basic hygiene practices. [4]

Köseoğlu, Fatoş Dilan, and Bülent Özlek. (2024). This study aimed to evaluate the influence of iron deficiency and anemia on clinical outcomes in patients with heart failure with preserved ejection fraction (HFpEF). Anemia was defined as a serum hemoglobin level of less than 13 g/dL in men and less than 12 g/dL in women, based on a retrospective analysis of 212 patients with HFpEF. Moreover, we used a serum ferritin content of less than 100 ng/mL or a range of 100–299 ng/mL with transferrin saturation less than 20% to identify ID. The study's outcome was all-cause mortality among patients with HFpEF, both with and without anemia and iron deficiency. The patients were followed up for an average of 66.2 ± 12.1 months. We also looked into additional factors that predict mortality from all causes. The group as a whole was 70.6 ± 10.5 years old, and 55% of the patients were female. Of the patients, 108 (50.9%) had iron deficiency, while 81 (38.2%) had anemia. Sixty patients (28.3%) had died by the conclusion of the follow-up period. Compared to patients without anemia, those with anemia had inferior baseline functional capacity, greater NT-pro-BNP levels, diastolic dysfunction, and more symptoms of heart failure (HF). In a similar vein, individuals with iron deficiency had worse functional ability and more severe HF symptoms than those without. Researchers found that having a lower left ventricular ejection fraction, chronic kidney disease, paroxysmal nocturnal dyspnea, being older, not getting enough iron, and anemia were all independently linked to a higher risk of death from any cause (hazard ratio [HR]: 5.401, 95% confidence interval [CI]: 4.303–6.209, log-rank p = 0.001). We must consider anemia and iron deficiency as prevalent comorbidities when managing and prognosticating HFpEF, given their substantial increase in mortality risk. [5]

Dickson Kajoba et al. (2024). Because of their rapid development spurt that exceeds the supply of breastfeeding, children aged 6 to 23 months have the largest burden of iron deficiency anemia, which continues to be a global public health concern. Consequently, obtaining the necessary nutrients for improved growth and development requires a good supply of iron from the food chain. From April to July of 2022, Ishaka Adventist Hospital (IAH) and Kampala International University Teaching Hospital (KIUTH) hosted this cross-sectional descriptive study. We enrolled the study's participants sequentially. Data were collected using structured questionnaires, clinical examinations, and a 24-hour dietary recall. We used the statistical package for social scientists (SPSS) V22.0 for data analysis. Logistic regression was used for both bivariate and multivariate analyses, with significance defined at $p < 0.05$ for associations. There were 364 enrolled subjects in all, most of whom were male (198, 54.4%) and born at term (333, 91.5%). With a mean age of 14.1 months (SD 5.32), the modal age was 12–17 months [163 (44.8%)]. The overall IDA prevalence was 41.5%, or 151/364. Male sex (aOR 1.61), a recent episode of diarrhea (aOR 1.71), infrequent meal frequency (aOR 1.78), no vegetable consumption (aOR 2.47), and fruit consumption (aOR 1.97) in the seven days prior to the research were the factors linked to IDA. According to the study, four out of ten infants aged six to twenty-three months have at least one case of IDA. It is advisable to consider screening for IDA for male children who exhibit current diarrhea, low fruit and vegetable consumption, and irregular meal schedules. The Mentzer index is an alternative screening tool for IDA that is equally effective. [6]

Weckmann, G. et al. (2023). Dyspnea, lethargy, and diminished energy and focus are frequently considered signs of symptomatic anemia and could therefore influence the choice of diagnosis and course of treatment. to look at the relationship between symptoms that are typically associated with anemia and the presence of anemia itself. The Study of Health in Pomerania (SHIP) involved two distinct cohorts whose data were evaluated. Data from physical examinations, lab tests, and interviews were all individually connected to claims information from the Association of Statutory Health Insurance Physicians. A comprehensive case analysis utilizing logistic regression models was conducted to assess the correlation between anemia and symptoms that are typically associated with anemia. Confounding variables, including depression, medicine, sleeplessness, and other illnesses, were taken into account while adjusting the models. The analysis comprised 5979 participants, with a median age of 55 and 53% of them being female. Of them, 29% expressed

weakness and/or dyspnea, 30% claimed exhaustion, 16% reported low energy, and 16% reported difficulty concentrating. About 6% of the population had anemia (379). Those who had anemia were more likely to experience the symptoms. On the other hand, anemic participants were older and in worse condition. Multivariate logistic regression models did not show any correlation between anemia and the symptoms of weakness, dyspnea, exhaustion, or loss of concentration. In the multivariate analysis, anemia was related (OR: 1.45; 95% CI: 1.13–1.86) to fatigue. The symptoms were more closely linked to other variables like medicine, depression, and sleeplessness. The clinical signs and symptoms that are frequently linked to anemia are vague and extremely common in both anemic and non-anemic individuals. Certain diseases, such as depression, heart failure, asthma, and COPD, which are more intimately linked to the symptoms, should be taken into consideration as causes even in the presence of anemia. More diagnostic research is necessary to investigate the relationship between symptoms in various situations and subgroups to support clinical decision-making. [7]

Kumar A, Sharma E, Marley A, et al. (2022). Iron deficiency anemia (IDA), which affects 30% of the world's population, has been recognized by the WHO as the most prevalent nutritional deficit worldwide. Reduced dietary iron and impaired iron absorption are also contributing factors to iron deficiency anemia (IDA), even though gastrointestinal bleeding and menstruation in women are the most common causes. The goal of treating IDA patients should be to restore their iron stores and get their hemoglobin back to normal. This has been demonstrated to enhance morbidity, prognosis in chronic illness, quality of life, and pregnancy outcomes. Many chronic inflammatory diseases, such as inflammatory bowel disease, chronic kidney disease, and congestive heart failure, are accompanied by iron deficiency. An updated summary of IDA diagnosis and treatment for patients with chronic illnesses, both preoperatively and throughout pregnancy, will be given in this article. We will go over the advantages and disadvantages of oral vs. intravenous iron replacement for each group, as well as a summary of the cost comparisons between the various iron formulations that are currently available. [8]

Aliyo A, Jibril A (2022). Children's mental, physical, and social development is negatively impacted by anemia, especially in Africa. It has serious detrimental effects on children's cognitive development, growth, and maturation in the early years of life. From October to November 2020, this study sought to evaluate anemia and related risk factors in children under five in the West Guji

Zone, southern Ethiopia. At the Bule Hora General facility in southern Ethiopia, a quantitative cross-sectional study was carried out within the facility. 375 children under the age of five who were enrolled in the study were chosen by a convenience sample procedure. Following proper written informed consent, study participants' socioeconomic and demographic data were gathered using the pretested framework questionnaire. After that, a Midray BC 3000 Plus machine was used to determine each child's hemoglobin level from a venous blood sample. The related determinants of anemia were identified through the use of binary logistic regression models. P-values less than 0.05 were regarded as statistically significant. Although the majority of anemic children in the research area were in a severe stage, the frequency of anemia among children under five was found to be low. It could be controlled by avoiding intestinal protozoa, soil-transmitted helminthic infections, and malaria infections. [9]

Safiri, S. et al. (2021). About 30% of women of reproductive age and 40% of children suffer from anemia, a prevalent illness that can have serious health effects. According to age, sex, and sociodemographic index (SDI), the current study presents the burden of anemia on a global, regional, and national scale, as well as its underlying causes between 1990 and 2019. The global burden of disease (GBD) 2019 study provided publicly available data on the point prevalence and years lived with disability (YLDs) for 204 nations and territories between 1990 and 2019. The study provided the 95% confidence intervals for the point prevalence, YLD numbers, and rates per 100,000 population. [10]

Yan Deivita et al. (2021). Through a search and evaluation of the literature, the study seeks to define the picture of anemia connected to risk factors and the recommended course of action. We searched articles from 2019 to 2021 using online databases such as Science Direct, PubMed, and Google Scholar. Taking into account relevancy and inclusion criteria, they have acquired up to 20 articles. Young women's anemia remains a serious issue in the community. Early detection methods are required to swiftly ascertain the prevalence of anemia and characterize it as one of the facts for young women in all circles. Anemia is more prevalent in women, particularly younger women. This is because people who follow rigorous diet plans to avoid gaining weight end up malnourished since their bodies aren't getting enough of the nutrients they need. On the other hand, because of growth and menstruation, there is an increase in iron needs during adolescence. As a result, offering clever methods to reduce the incidence of anemia is critical. Early detection is

suggested so that preventative measures can be taken. Due to its widespread use in the community, particularly among teenagers, information technology can be used to perform an early diagnosis of anemia in adolescents. According to the comprehensive research evaluation, young women appear to benefit most from interventions that address their nutritional state, which has a significant impact on the occurrence of anemia. The use of technology and early detection are two of the creative methods provided. [11]

Shaban, L., Al-Taiar, A., Rahman, A. et al. (2020). We calculated the prevalence of anemia in school-age children and looked at the contributing factors in Kuwait. We conducted a cross-sectional study on 1415 randomly selected teenagers from Kuwaiti middle schools. We tested a venous blood sample for hemoglobin, iron, ferritin, folate, and vitamin B12, among many other laboratory markers. We gathered information about anemia risk factors from parents and teenagers. The study used multiple logistic regression to investigate the factors associated with anemia. 8.06% (95% CI: 6.69–9.60%) was the prevalence of anemia, and it was substantially greater in females than in males (10.96% vs. 5.04%; $p < 0.001$). The mean (standard deviation) hemoglobin level for males and females was 133.7 (9.89) g/L and 130.00 (10.48) g/L, respectively ($p < 0.001$). 5.94%, 1.91%, and 0.21% of people had mild, moderate, or severe anemia, respectively. The multivariable analysis showed a relationship between anemia and ferritin, age, gender, and iron concentration. According to these findings, anemia among Kuwaiti schoolchildren has a minimal impact on public health. Correcting iron deficiency should be the main goal of any further anemia reduction for schoolgirls. Anthropogenic surveillance systems may think about implementing a cut-off point that is unique to the techniques used for Hb monitoring and blood samples. [12]

Chaparro, Camila M, and Parminder S Suchdev. (2019). A third of the world's population suffers from anemia, which impairs brain development, increases illness and mortality, and reduces productivity at work. Understanding the multifaceted and intricate etiology of anemia is imperative in order to devise efficacious interventions targeting the context-specific origins of anemia and to oversee anemia control initiatives. We provide definitions and categorizations of anemia, explain the biological processes that lead to its development, and go over the range of circumstances that may cause it. We highlight the risk factors—nutritional inadequacies, infection/inflammatory conditions, and genetic hemoglobin disorders—that are particularly common in low- and middle-

income nations. Recently, we have improved our understanding of the intricate etiology of anemia, including the percentage of iron deficiency (ID)-induced anemia and the significance of infection and inflammation. The amount of ID-related anemia varies according to the population type, geographic location, incidence of other anemia causes, and burden of infectious diseases, according to mounting data. The significance of hereditary hemoglobin problems in particular groups, the impact of acute and chronic diseases, and the effect of other dietary deficits all require more investigation. [13]

Clara Camaschella (2019). Over 1.2 billion people worldwide suffer from iron deficiency anemia, and iron deficiency without anemia is significantly more common. The causes of total-body (absolute) iron insufficiency include decreased iron intake, pathologically faulty absorption, chronic blood loss, and physiologically increased iron requirements in children, adolescents, young adults, and pregnant women. Iron regulatory proteins regulate the body's response to iron deficiency, enhancing iron uptake and retention at the tissue level. Hepcidin, the iron hormone, is suppressed at the systemic level, causing absorptive enterocytes and recycling macrophages to release more iron into the plasma. Absolute iron deficiency is a simple diagnosis unless it is confounded by an inflammatory illness. Every case of iron deficiency has to have its underlying cause and course of treatment evaluated. To prevent iron treatment from making the infection worse, extra care must be taken in places where malaria and other infections are widespread. Ongoing initiatives seek to minimize the typical side effects of oral iron and optimize iron salt-based therapy through administration methods based on the physiology of hepcidin regulation. A growing number of disorders are finding that IV iron, particularly last-generation compounds given at large doses in single infusions, is a useful option because of its acceptable safety profile and faster and more sustained hematological response. The pros and cons of the various treatments for iron deficiency should be considered while developing a specific treatment plan. [14]

Awidi M et al. (2018). The aim of this study was to understand the effects of iron deficiency anemia on female hematological service customers in a developing nation. Study of adult and teenage women with iron deficiency anemia who visited a hospital's hematology department in the past, using a retrospective cross-sectional design. A tertiary university hospital offering hematological services as an outpatient or inpatient. All female patients receiving hospital hematology treatments who had iron deficiency anemia and were younger than 13 years old.

Several factors contribute to iron deficiency-induced anemia. We have observed a correlation between the severity of anemia and heavy menstruation or poor red meat consumption. Healthcare planners and policymakers may find our findings helpful in stepping up efforts to lower the severity and prevalence of iron deficiency anemia among women in Jordan. [15]

Allali, Slimane et al. (2017). Worldwide, childhood anemia is a serious public health issue. Iron deficiency is the most common etiology, but it is frequently complex. There are many different consequences, most of which are underappreciated. Never minimize the significance of anemia in youngsters. Despite the common implication of iron deficiency, it is crucial to exclude other potentially fatal causes. Because of overlapping comorbidities, it is challenging to determine the precise role that anemia plays in child mortality and morbidity. Infants with chronic anemia may have problems with growth, heart function, and cognitive development, but there are other effects that are not well understood and need more research. [16]

Zegeye Getaneh et al. (2017). Anemia is a worldwide public health issue that impacts 305 million school-age children (SC). It has detrimental impacts in SC, including decreased school accomplishment owing to stunted physical and cognitive growth, weariness and a short attention span, and higher morbidity due to weakened immunity to infection. Therefore, the purpose of this study was to evaluate the incidence of anemia and its contributing factors among SC students enrolled in public primary schools in Gondar, Northwest Ethiopia. It was discovered that anemia in South Carolina was a minor public health issue. We closely linked it to intestinal helminth infection, food insecurity, stunting, and low maternal education. To lower anemia among SCs, targeted policies and initiatives should be developed with an emphasis on the aforementioned criteria. [17]

Antwi-Bafour, S., Hammond, S., Adjei, J.K. et al. (2016). Reduced hemoglobin content in the blood results in a decrease in the ability of red blood cells to carry oxygen, making them insufficient to meet the body's physiological requirements. This condition is known as anemia. While a small number of studies have examined the occurrence of anemia in individuals with diabetes before signs of renal impairment, numerous publications have suggested that anemia mostly affects patients with diabetes who have renal insufficiency. Other research has also linked anemia to the need for renal replacement treatment in patients with diabetes. Understanding the etiology of anemia associated with diabetes mellitus could aid in developing strategies to improve

outcomes for these individuals. Therefore, the purpose of this study was to ascertain the anemia prevalence among type 2 diabetic patients. According to the data, people with poorly controlled diabetes and those who have both diabetes and renal insufficiency are likely to have a significant incidence of anemia. [18]

Le CHH (2016). The prevalence of anemia is an important public health indicator since it is linked to poor health outcomes. Although iron deficiency is the main cause of anemia, other disorders, such as chronic diseases, can also produce inadequate oxygen-carrying capacity, which is a significant health concern in the United States. There is, however, little research looking at the prevalence of anemia in the US population as a whole and in more focused subgroups. Serum hemoglobin levels (Hb) according to World Health Organization (WHO) criteria were used to evaluate two outcomes: anemia and moderate-severe anemia, based on data from five National Health and Nutrition Examination Surveys (NHANES) conducted between 2003 and 2012. SAS statistical analysis looked at age groupings, racial/ethnic groups, and sexes for anemia prevalence and temporal patterns. According to the study, throughout this ten-year period, an average of 5.6% of Americans fulfilled the criteria for anemia, and 1.5% of them had moderate-to-severe anemia. High-risk populations were identified, and the connections between several risk variables were looked at. These groups included pregnant women, the elderly, and women of reproductive age, non-Hispanic blacks, and Hispanics. Men's anemia rates rose monotonically with age, but women's rates rose bimodally, peaking in the 40–49 and 80–85 age groups. It has been noted that risk variables compound their effects. For example, the prevalence of anemia in 80–85-year-old black women was 35.6%, which is 6.4 times greater than the average for the population. Furthermore, the prevalence of moderate-severe anemia (1.0% to 1.9%) and anemia (4.0% to 7.1%) has nearly doubled from 2003–2004 to 2011–2012, making anemia a major concern. As a result, these findings add to our understanding of the frequency, severity, and distribution of anemia in the US among various categories and highlight the need for immediate public health intervention. [19]

Shuchismita Behera and Gandham Bulliyya (2016). In India, anemia is a common public health issue that primarily affects youngsters. In the current study, children in the Odisha district of Khurda district are assessed for the incidence of anemia and the state of several hematological parameters. The study included preschool (0–5 years old) and school-aged (6–12 years old) groups, totaling 313 children ages 0–12 years. Hematological markers, such as plasma ferritin, white blood

cell (WBC), and red blood cell (RBC) indicators, were measured using conventional protocols. Sixty-two percent of people had anemia. Boys in this population had a mean Hb value that was lower than girls'. Compared to preschoolers, school-age children had greater rates of anemia across all grades. It was discovered that school-age boys had mean plasma ferritin levels higher than those of girls. Boys in preschool age groups had a higher mean WBC count than boys in school age groups. Of concern is the greater prevalence of anemia among the study population with concurrent acute infections. In order to eradicate anemia, public health nutrition programs must include appropriate intervention strategies and ongoing monitoring, as the hematological parameters are associated with age, gender, and each other. [20]

M. Domenica Cappellini, Irene Motta (2015). Anemia is a worldwide public health issue that affects people of all ages in both industrialized and developing nations. The World Health Organization (WHO) defines anemia as having hemoglobin (Hb) levels that are less than 12.1 g/dL in men and less than 12.0 g/dL in women. However, ethnicity, physiological state, and sex all affect the typical distribution of hemoglobin. It has been suggested to set new lower limits for normal Hb readings based on age, gender, and ethnicity. Anemia is not a singular, autonomous phenomenon; rather, it is frequently complex. The patient's medical history, the underlying pathogenic cause, and the hematologic characteristics should all be considered when classifying and diagnosing the condition. Anemia among the elderly is on the rise due to population aging, particularly in Western nations. The majority of anemia in this group is mild, with Hb <12 g/dL in both sexes as of late. (10–12 g/dL). Since anemia in this population increases morbidity and mortality, it is crucial to comprehend its pathogenesis. An iron, folate, or vitamin B12 deficiency is the cause of anemia in one-third of the patients; anemia resulting from chronic illness accounts for around another third of cases. However, anemia is referred to as "unexplained anemia" when it cannot be attributed to a particular pathological process or underlying disease in one-third of the patients. A prolonged subclinical pro-inflammatory state and the growing resistance of bone marrow erythroid progenitors to erythropoietin may be the cause of unexplained anemia. [21]

CONCLUSION:

Anemia is still a serious and pervasive global health issue that has to be properly addressed, especially in LMICs, where development has been uneven and sluggish. Even though ID is still the predominant cause of anemia in most areas, new research indicates that the etiology of anemia

is context-specific and complex. In order to apply the right remedies in the right situations, further research is required to determine how the main causes of anemia—such as ID and other nutritional deficiencies, illness, and Hb disorders—contribute to anemia. When evaluating anemia clinically and in communities, this work will necessitate incorporating biochemical indicators of micronutrient status (mainly iron and VA) and markers of inflammation, in addition to hematological indices. Clinical symptoms that are frequently linked to anemia are vague and extremely widespread in both anemic and non-anemic individuals. Anemia should not be the main focus of a patient's diagnostic work-up if they exhibit symptoms like fatigue, dyspnea, lack of energy, or difficulty concentrating. Particularly in outpatient settings, other reasons such as depression, heart failure, asthma, and COPD should be taken into account, as they are more likely to occur.

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