Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/kq6hkf58

THE ROLE OF BODY MASS INDEX AND DIET IN ANEMIA SEVERITY: A STUDY ON MALNUTRITION AND NUTRITIONAL DEFICIENCIES

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Abstract
Anemia has been among the most prevalent health issues worldwide and has an excessive burden on the health of pregnant women, preschool children and more than half of women of reproductive age. The goal of the study was to estimate the severity, type, and clinical characteristics of the anemia in the population of 250 patients; the demographic variables and clinical symptoms were considered the priority. The results indicated that moderate anemia was the highest with 47.6 percent of all the participants in that category and severe anemia 32.8 percent, and mild anemia 19.6 percent. The most common form of anemia was microcytic hypochromic anemia accounting to 40 percent of all cases, followed by macrocytic (26 percent), normocytic normochromic (23 percent), and dimorphic (11 percent) anemia. Analysis of the demographic situation revealed that maximum level of anemia existed in the age group of 18-34 years (47%) with a significant difference based on gender, as females (55.4%) appeared to have higher levels of anemia than males (44.6). People living in rural areas as well as those who belong to lower socioeconomic classes, particularly those grouped as below the poverty line (BPL) were found to have prevalence of anemia higher with women in rural areas having more severe forms. Moreover, people with a low body mass index (BMI <18.5) were deprived of the most severe anemia (35.6%). The most frequent symptoms were weakness and fatigue (100%), decreased work capacity (80%), breathlessness (23.4%), and swelling (17.6 %). The clinical manifestation that was common included pallor (100%), splenomegaly (23.6%), and hepatomegaly (21%). The study highlights the much-felt effect of anemia in the high-risk groups, which include the young women, rural people, low-income, and vegetarians. It is important to identify these susceptible groups early and take early measures to help them to reduce physical effects of anemia, and to avoid other complications thus. Moreover, bigger population-based research is also necessary in order to find out more about the underlying causes and enhance prevention and treatment of anemia.

Key words: Anemia, Body Mass Index (BMI), Nutritional Deficiencies, Malnutrition, Dietary Habits

Introduction

Anemia is a world wide common health complication, and states, that it involves 1.62 billion individuals which are about a quarter of the world population or 24.8percent. It is a state characterized by lack of red blood cells or hemoglobin, which causes a decrease in the body transportation of oxygen. Certain populations of people are particularly susceptible to anemia and these include pregnant women, preschool children, and women of reproductive age. Anemia is known to affect more than half of the women in the reproductive age category, and South Asia has one of the greatest rates of prevalence in the world. In this region, anemia is related to high maternal mortality, since 20-40 cases of death among mothers are related to anemia. Magnitude of anemia ranges between mild, moderate and severe anemia, which is determined by use of hemoglobin (Hb) levels. Although the burden of anemia is disproportionately higher in disadvantaged segments of the population, e.g. in the rural inhabitants and in the individuals with lower socioeconomic status, little is known about the historical trends of anemia disparities. This is particularly worrying considering that anemia might cause serious health consequences in case of the failure to recognize and treat it on time. Since the nutritional and health requirements of women in childbearing age deserve to be attended to, it is also of high necessity that the trend and pattern of anemia amongst the various population be known. Anemia can be caused by a variety of factors, including nutritional deficiencies (e.g., iron, folate, vitamin B12), chronic diseases, genetic disorders like thalassemia, and blood loss. Microcytic hypochromic anemia, often associated with iron deficiency, is the most common type, followed by macrocytic anemia, typically related to vitamin B12 or folate deficiency. Normocytic normochromic anemia and dimorphic anemia are less frequently encountered. Given the diverse causes of anemia and its widespread impact, it is essential to identify at-risk populations for early screening and intervention. The aim of this study is to evaluate the severity, types, and demographic patterns of anemia in a cohort of 250 patients, focusing on the clinical manifestations, socioeconomic factors, and other potential determinants contributing to the disease's prevalence. Through this study, we hope to enhance the understanding of anemia's burden and propose targeted strategies for managing and preventing anemia, particularly in high-risk groups.

Methods

The present study was carried out to determine the severity, type and clinical profile of anemia, as well as the demographics and socio economic factors which were influencing the prevalence of anemia. Random sampling was done to choose 250 patients with anemia who were obtained as a sample of a healthcare institution. All inclusion criteria included all age groups of both the male and female and who fulfilled the clinical definition of anemia of varying degree of hemoglobin levels as noted in a clinical examination and was confirmed in the laboratory. They included patients whose diagnosis of anemia was ascribed to World Health Organization (WHO) criteria (Hb<12 g/dL in females, Hb<13 g/dL in males). The age groups that the patients were assigned included 18-34 years, 35-54 years, and 55 years or more. The paper was also done on both the rural and urban populations with an emphasis on the persons of different socioeconomic statuses. Patients with chronic systemic illnesses (including cancer or severe kidney disease), with conditions that accounted with expected re-classification of anemia (e.g. hemoglobinopathies, recent blood transfusions or pregnancy) were excluded. As well, comorbid patients who may have compromised hematological parameters (e.g., autoimmune pathologies or gastrointestinal diseases) have been excluded. Demographic variables such as age, sex, socioeconomic status (status below or above the poverty line), and diet (vegetarian or mixed), were taken. The patients were categorized into rural or urban living and Body Mass Index (BMI). The formula used in calculating BMI was: weight (kg) / height (m 2). History recorded included clinical history, symptoms that presented (e.g. weakness, tiredness, shortness of breath), plus findings on physical examination (e.g. pallor, spleen enlargement, liver enlargement). The classification of the severity of anemia was composed of three groups, including mild anemia (Hb 10-11 g/dL), moderate anemia (Hb 7-9.9 g/dL), and severe anemia (Hb <7 g/dL). Latent classification of types of anemia was according to the examination of peripheral blood smear which included microcytic hypochromic, macrocytic, normocytic

normochromic, and dimorphic anemia. Mean corpuscular volume (MCV) and mean corpuscular hemoglobin (MCH) were applied as the prognostic parameters of microcytic hypochromic and macrocytic anemia. The descriptive statistics were used to analyze the data with regard to anemia prevalence and its type among the various demographic groups. The Correlation between the intensity of the anemia and demographic factors, including age, gender, place of residence, and the BMI was and tested by the use of chi-square tests. There was also an analysis of the correlation between BMI and the severity of the anemia. This approach made it possible to establish the distribution of anemia and its severity, as well as to determine the causes of this disease, and to identify communities at high-risk to offer specific attention to them.

Result

The project goal was considered to be the evaluation of the severity and form of anemia along with clinical and demographic specifics of patients. The study allowed analyzing the data of 250 patients, and the main findings were as follows: As previously demonstrated in Table 1, the severity of anemia increased into three levels; mild, moderate, and severe. Among the 250 cases, a higher fraction (47.6 percent) was categorized to have moderate anemia whereas the number of severe cases came to 32.8 percent and 19.6 percent had mild anemia. This distribution means that there is more risk of moderate and severe anemia and this points to the early detection and proper management.

The cases were distributed by the type of anemia as provided in Table 2. In 40 per cent of patients, microcytic hypochromic anemia was prevalent. This was followed by macrocytic anemia which was 26 percent followed by normocytic normochromic and dimorphic anemia (23 percent and 11 percent respectively). This implies that microcytic hypochromic anemia which is usually related to iron deficiency is the most common cause of anemia in this group. The demographic data provided in Table 3 reveals that the prevalence of anemia applies to various age brackets and genders in diverse proportions. The most prevalent cases of anemia were identified in the age category 18-34 years especially in the mild and moderate cases. The ratio of severe anemia was sharply decreased in the 60 years old and less but remained in the 62.6 percent of the patients in the 60 or more years old group whose anemia was at the middle stage. The distribution of anemia between the sexes was also varying; different proportions of anemia classes were in females (moderate anemia-51.3 percent) as compared to males (moderate anemia-43.1 percent). Socioeconomic status was also able to depict that most of the anemic patients are in the below poverty line (BPL) category.

As Table 4 shows, the prevalence of anemia in the rural population was higher than on the urban population and such indicators were found on all the levels of its severity. Also, it was revealed that the BMI plays an important role in the level of anemia. It is possible that there is a relationship between malnutrition and anemia since the results indicate that patients with a low BMI (less than 18.5) had the highest prevalence of severe anemia (35.6 percent). Table 5 has shown that weakness and fatigue were the most frequently reported personal symptom with all the 250 patients reporting the symptom. There was pallor as the most indicated clinical symptom as all the patients had it. The other symptoms like poor work performance (80%), breathlessness (23.4%) and body swelling (17.6%) were also observed frequently. Clinical manifestations were observed in 23.6 and 21 percent of patients having splenomegaly and hepatomegaly respectively. Some signs of severe forms of anemia were also detected in the form of hemic murmurs (15%) and koilonychia (9%). To conclude, the research found that anemia associated with a considerable number of the population, especially the people living in rural areas, the group of people with low BMI, and the low socioeconomic status. The clinical manifestations and symptoms observed point out the extent and complications of anemia and hence the need to focus on intervention in high-risk populations.

Table 1: Classification of cases based on the severity of anemia

S. No.	Severity of anemia (Hb in gm/dl)	No. of cases	Percentage
1.	Mild	49	19.6
2.	Moderate	119	47.6
3.	Severe	82	32.8
Total		**250**	**100.0**

Table 2: Classification of cases based on the type of anemia

S. No.	Type of Anemia	Mean MCV (fl.)	Mean MCH (pg.)	No. of Patients
1.	Microcytic hypochromic	73.1	24.5	100
2.	Macrocytic	104.9	29.0	65
3.	Normocytic normochromic	85.64	29.3	58
4.	Dimorphic	100.5	24.6	27
Total				**250**

Table 3: Demographic profile

Age (years)	Mild (%)	Moderate (%)	Severe (%)	Total	MH	MA	NN	DA
18-34	45 (19.1%)	101 (43%)	89 (37.9%)	235 (47%)	125	70	15	25
35-54	29 (19.3%)	65 (43.3%)	56 (37.4%)	150 (30%)	50	40	40	20
≥ 55	23 (20%)	72 (62.6%)	20 (17.4%)	115 (23%)	25	20	60	10
Sex								
Male	55 (24.6%)	96 (43.1%)	72 (32.3%)	223 (44.6%)	80	58	65	20
Female	42 (15.2%)	142 (51.3%)	93 (33.5%)	277 (55.4%)	120	72	50	35
APL	19	68	43	130	40	33	37	20
BPL	78	170	122	370	160	97	78	35

Table 4: Categorization of cases based on residence and body mass index

Residence	Mild	Moderate	Severe	Total
Rural	80 (21.2%)	166 (43.9%)	132 (34.9%)	378
Urban	17 (13.9%)	72 (59%)	33 (27.1%)	122
< 18.5	45 (15.8%)	138 (48.6%)	101 (35.6%)	284
18.5 - 24.9	36 (20%)	85 (47.2%)	59 (32.8%)	180
≥ 25	16 (44.4%)	15 (41.7%)	5 (13.9%)	36

Table 5: Classification of cases based on observed symptoms and clinical signs

S. No.	Symptoms	No. of Patients	Clinical Signs	No. of Patients
1.	Weakness & fatigue	250	Pallor	250
2.	Decreased work performance	200	Splenomegaly	59
3.	Breathlessness	59	Hepatomegaly	53
4.	Swelling over body	44	Pedal Edema	44
5.	Anorexia	35	Hemic Murmur	38
6.	Palpitation	25	Koilonychia	23
7.	Pica	8	Glossitis	10
8.	-	-	Stomatitis	8
9.	-	-	Icterus	7
10.	-	-	Lymphadenopathy	2

Discussion

In this study different classes and forms of anemia were categorized. There was moderate anemia in 47.6 percent of the patients and severe anemia in 32.8 percent patients and mild anemia in 19.6 percent patients \[Table 1]. Such results can be correlated with other studies that have brought forward moderate anemia as the most prevalent one. The elevated levels of moderate and severe anemia in this article might be as a result of late diagnosis, lack of health insurance and awareness

of people on the same. Regarding the type of anemia, 40 percent of the patients showed microcytic hypochromic anemia, 26 percent were with macrocytic anemia, 23 percent were with the normocytic normochromic anemia and 11 percent with dimorphic anemia \[Table 2]. Such findings prove that the most apparent one is microcytic hypochromic anemia, usually associated with iron deficiency, followed by the normocytic and macrocytic anemia. Morphological diagnosis of anemia aids in come up with plausible causes which may be ascertained based on special tests like iron studies, vitamin B12/folate level or electrophoresis and is done to distinguish between iron deficiency anemia, thalassemia, anemia of chronic diseases and megaloblastic anemia. The mean MCV (73.1 fl) and MCH (24.5 pg) of microcytic hypochromic anemia of this work are in line with results of iron deficiency anemia. The mean MCV of macrocytic anemia was 104.9 f l and the mean MCH was 29.0 pg which is consistent with findings in elderly patients who experience megaloblastic anemia. Such measurements are important in the diagnosis of certain types of anemia and its mechanisms. Most of the anemic patients were in the age category between 18-34 years (47%) followed by the age category of 35-54 years (30%) and 23 percent of patients were in the age category of more than 55 years \[Table 3]. The trend is in line with other sources that have demonstrated a greater occurrence of anemia among younger groups because of various factors such as menstruation, childbirth and food insufficiency. Screening especially among women at an early age is essential in order to avert any complication arising because of anemia. In gender terms, it was discovered that more people were female as the study reflects that 55.4% of the total cases involved females whilst males were 44.6% \[Table 3]. Females had higher evidential rates of severe anemia, as expected with other studies. Such increase in women prevalence can be connected with menstruation, pregnancy, and other reproductive health aspects. This sexual inequality explains why women should be intervened more especially during menstruation and pregnancy. Concerning the residence, 75.6 percent of the patients were referred to as rural and 24.4 percent referred to as urban [Table 4]. The prevalence of anemia is higher in the rural setting and similar patterns have been observed when describing the prevalence of anemia among the rural population which has been reported to have higher prevalence rate since they are more susceptible because of poor living conditions, limited healthcare access, poor nutrition, and low awareness. Also, in this study, severe anemia was more frequent in rural patients, and this aspect requires medical education and services improvement in rural communities. The other factor was socioeconomic status and 74 percent of patients came under below the poverty line (BPL) backgrounds \[Table 3]. This observation concurs with earlier findings depicting the increased chance of anemia on persons of low financial segmentation who have little access to healthcare services, nutritional deficit and the availability of poor diets which are contributing factors to anemia. The BPL group was characterized with higher rates of severe cases of anemia indicating that poverty related problems should be addressed when dealing with anemia.

Concerning the clinical manifestation, the most frequently observed symptoms were the weakness and fatigue with all the patients reporting them. Aggravated work performance (80%), the shortness of breath (23.4%), and body swelling (17.6%) are other symptoms \[Table 5]. The results are comparable to what has been recorded in literature wherein fatigue is the most frequently reported symptom of anemia. Pica as a less frequent symptom presented itself in only 3 percent of the patients and it adds to the significance of early detection and screening of anemia. The presence of pallor (100%), splenomegaly (23.6%), hepatomegaly (21%), and edema (17.6%) were present as clinical manifestation \[Table 5]. Additional indications that included hemic murmurs, koilonychia, glossitis, and stomatitis were also found. All these clinical manifestations especially in cases of severity point out to the fact that anemia is a chronic condition and affects the overall health of the body. There existed a significant correlation between BMI and the severity of anemia. Of patients, 56.8 percent had a low BMI (<18.5), 36 percent had a normal BMI (18.5-25) and 7.2 percent had a high BMI (>25) \[Table 4]. This justifies earlier researches that a low BMI could cause great prevalence of severe anemia and purporting to the fact that malnutrition and nutritional deficiency are key factors in the development of the anemia issues. Another important cause of anemia severity was diet. Sixty five percent patients were total vegetarians whereas 35 percent adhered to mixed

diet. Macrocytic and dimorphic anemia were more common among vegetarians, which is logical as they lack important nutrients, including iron and vitamin B12. These results concur with the existing reports indicating that vegetarians have a higher risk of developing anemia which in most cases is macrocytic anemia. The rate of microcytic anemia was related to the tobacco use whereas the rate of macrocytic anemia was related to the alcohol use in those patients with the addiction with tobacco or alcohol. The observation of the findings is related to research findings that indicate that tobacco and alcohol use might cause the kind of anemia. Due to this study, it has been indicated that anemia is prevalent in high-risk groups, such as those below 35 years, females, rural, low-income, vegetarians, and people with low BMI. Basing screening to a population that has a high risk group would be a more affordable alternative since it is impossible to screen a whole population. Anemia can be categorised according to the clinical history, physical examination, peripheral blood smear as well as hematological parameters such as MCV and MCH. When etiology is difficult to be determined, extra tests also can contribute to the identification of the diagnosis. Since the symptoms of anemia are not specific, any person who has such symptoms as weakness and fatigue should be taken to the doctor to be checked because only in this way, they can be early diagnosed and treated. The study will play a critical role in determining those at risk of the condition as well as educating how to conduct early screening, prevention, and intervention. There is need to carry out larger-scale studies to collect more information and come out with effective policies in treating anemia across the globe.

Conclusion

The evidence of this research summarizes the extensive and variant tendency of anemia, especially its distribution in high-risk groups including women of reproductive age, rural communities, people with low income and low BMI. The findings indicate that most common types of anemia are moderate, severe and mild levels respectively. Another important aspect of the study regards the significance of early diagnosis and selective measures especially among the high-risk groups. Since moderate cases of anemia are present in 47.6 percent of patients in the studied group, and the rates of moderate and severe cases are higher, it is necessary to propose raising the awareness and early diagnosis, effective ways to deal with this condition. The study found that 40% of the patients had microcytic hypochromic anemia, which is commonly associated with iron deficiency, indicating that iron deficiency is the primary cause of anemia in this cohort. Additionally, macrocytic anemia, typically linked to vitamin B12 or folate deficiencies, was observed in 26% of cases, underscoring the need for comprehensive nutritional screening. The demographic factors, including age, gender, residence, and socioeconomic status, were found to significantly influence both the prevalence and severity of anemia. The young adult age groups of 18-34 years showed the highest prevalence of anemia and this is more common in mild and moderate types. Inequalities between men and women were also noted, whereby females showed more instances of anemia probably caused by menstruation, pregnancy, or other reproductive causes. Anemia was much more common in the rural population and in socioeconomically deprived people, especially those in the below the poverty line (BPL) category. It emphasizes why specific interventions should be designed to draw more attention to nutrition, healthcare access, and education of the individuals within such groups. Furthermore, the research revealed a close connection between low BMI and the anomalous degree of anemia. The greatest frequencies of severe anemia levels belonged to the patients with low BMI (<18.5) which is an indication that malnutrition is a major determinant. The prevalence of anemia among vegetarians is also quite high and in countries where many people are vegetarians they should take into consideration their dietary habits as a prevention and treatment approach to anemia. Non-specificity of anemia symptoms was underlined by the fact that weakness, fatigue and pallor were the clinical manifestations shared by the majority of the patients. It is vital to screen patients at risk of anemia at an early stage in order to ensure that the disease and subsequent causes of complications do not get out of control. They also indicated serious clinical manifestations including splenomegaly, hepatomegaly and pedal edema which are also known to contribute to the seriousness and risks associated with anemia when not addressed. This research paper highlights the

significance of the entire screening programs aimed at risk groups such as women of reproductive age, people living in the countryside and those living in low-income groups. To solve the root causes of anemia, it may be recommended that the public health strategies would emphasize on enhancing awareness, healthcare accessibility, and good nutrition. Also, it needs extensive research to examine the causal agents of anemia further and to establish effective prevention and management of the ailment to fight this rampant health hazard.

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