Original Article

Assessment of nutritional anemia on the basis of dietary pattern estimation among the population of Garhwal Himalayan region

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ABSTRACT

Background: Nutritional anemia has its prevalence at a global level. Unfortunately, the developing countries are at more risk due to the unavailability of resources and poor socio-economic conditions. According to the WHO, India has >40% prevalence of anemia, which is a severe public health concern. **Materials and Methods:** The aim of this study was to assess the dietary pattern according to their haemoglobin levels. This cross-sectional study was designed to assess the prevalence of anemia in Garhwal population, which contained total 520 individuals (344 females and 176 males). For this a food frequency questionnaire is administered to elicit information on dietary consumption pattern. The frequency of consumption was divided into three levels: ≥ 3 days/wk., 1-2 days/wk. & no or rare consumption. Subjects were divided into 3 groups according to the level of haemoglobin. **Results:** In the present study, an overall prevalence of anemia was found 34.23% (38.06% in females and 27.61% in males). Results were expressed as Chi-square test and considered significant at 5% level of significance ($p < 0.05$). **Conclusion:** The overall status of anaemic individuals in the Garhwal region is of vital concern and should be paid due attention for the improvement of nutritional requirements to reduce the prevalence of anemia in this region. The effective measures include awareness about the essential nutrients to be included in diet along with the knowledge of anemia.

Keywords: Food frequency questionnaire, iron deficiency anemia, nutrition

Introduction

The anemia, which is caused due to the deficiency of essential nutrients in the diet of a person, can be termed as nutritional anemia. Lack of vitamins, dietary iron, and high-quality protein affect the stability of the membrane of red blood cells, thus causing various forms of anemia. So, nutritional anemia is a condition wherein the erythropoetic tissue is unable to maintain the normal hemoglobin concentration due to inadequate supply of nutrients. Iron is the most necessary micronutrient and a part of hemoglobin-moiety along with folate and vitamin B12.

Around the planet, iron deficiency anemia (IDA) is the most common disorder caused due to nutritional insufficiency, affecting almost over 30% of the world population. Developed nations like Japan, Sweden, and USA display a greater frequency of IDA in the affluent class people. The prevalence of anemia is high in developing countries in comparison to the developed ones.

Several studies conducted on anemia exhibit the fact that the rural population is more prone to be anemic in comparison

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to the urban population.[1,2] The women of reproductive age group, pregnant, and lactating along with the young children and adolescent girls are the most affected with IDA and the situation is more severe in developing countries like ours. More than half population in India has been found to be anemic.[3] Since, there are multifactorial causes of nutritional anemia therefore studies are carried out all over the nation and world to combat the disorder. In order to find the cause of nutritional anemia in any population various methods are adopted to come to a definite conclusion.

Confined data are available on the association of anemia and nutritional parameters in the region of Garhwal, Uttarakhand.[4,5] Thus, the current research was carried out in five major districts of Garhwal (Chamoli, Pauri, Rudraprayag, Tehri, and Uttarkashi) in order to determine the status of anemia in the given population.

Methodology

This cross-sectional study was carried out on total 520 individuals (344 females and 176 males) inhabiting the upper tracts of Garhwal Himalaya between January 2016 and September 2017. Individuals between 0 and 60 years of age and free from any chronic disease were included for the study. The participants visited the District hospitals (Chamoli, Pauri, Rudraprayag, Tehri, and Uttarkashi), Public Health Centers, local villages, and schools were considered for the present research. Sociodemographic data (i.e., age, ethnicity, marital status, occupation) were collected during their initial visit. The Institutional Ethical Committee of Hemwati Nandan Bahuguna Garhwal University approved the research protocol (Reference No: 975) and an informed written consent was taken from the participants.

To unravel the dietary pattern in relation to anemia, Food Frequency Questionnaire (FFQ) was considered a great tool for the assessment of dietary habits for this study. There are different types of FFQs, developed for a specific purpose for specific studies. Standard FFQs developed for one epidemiological study cannot be considered for intervention evaluation. Therefore, careful amendments were made after deciding on which FFQ is most suitable with our study subjects to minimize response burden and increase response rates. Therefore, for the present study, a predesigned FFQ[6] was standardized and modified according to the diet of local people with modifications of the local food stuffs. Especially, available grains, cereals, and fruits were included in order to record the intake of nutrients by the population of Garhwal.

To measure a large group through dietary intake, 24-hour recall method[7] is well-established and efficient way. Thus, this method was adopted in filling the questionnaire for our evaluation, wherein the respondent recalls as to when and how much food was consumed. Participants were asked to fill the FFQ based on the consumption pattern of their diets, frequency of consumption of various food items which included: Cereals, pulses, vegetables, fruits, milk and milk products, meat, fish and poultry, cooking oil, ghee, sweets, nuts, and dry fruits, fruit juice, and junk food stuffs. Participating individuals were asked how often they consumed the food items and beverages during the past month. The frequency of intake included daily, 1–2 times a week, 3–5 times a week, once in a fortnight (1/15 days), once in a month (1/30 days), occasionally (festivals, special functions, etc.), rarely or never. In order to estimate the portion size of food consumed, different types of serving vessels (Katoris) were shown and the volume of the food consumed was obtained by this method. They were also asked for the preference of consumption of spicy and fried foods along with the use of mustard oil or refined oil. Miscellaneous foods/drinks, alcoholic, and non-alcoholic beverages were also considered for the proposed research.

The estimation of hemoglobin was also done. For which, 20 µL of whole blood were collected using vacutainer and transferred to Ethylenediaminetetraacetic acid (EDTA) vials. The entire 20 µl blood was utilized for hemoglobin analysis. Sahli's hemoglobinometer,[8] CBC counter,[9] photometric method,[10] and Visual Card Reader (as per the manufacturer's detail) method were used for measurement of hemoglobin. Analysis of data was done with statistical software SPSS version 16. Results were expressed as Chi-square test and considered significant at 5% level of significance ($P < 0.05$).

Results

An overall prevalence of anemia was recorded 34.23% (38.06% in females and 27.61% in males) for the present study. On the basis of the WHO guidelines (2011), the hemoglobin levels were measured accordingly and divided into four groups. Group 1 consisted of 37.71% males and 62.28% females with non-anemic diagnosis. Individuals with mild anemia were (29.66% males and 70.33% females) classified in group-2. Group 3 individuals had moderate anemia with 20% males along with 80% females. Very few of the cases were found to be severe anemic consisting 20% males and 80% females. The Chi-square value ($P < 0.05$) suggests that females were comparatively more anemic than males being statistically in all the groups.

The age-wise distribution according to hemoglobin level revealed that only 13.34% individuals with age range 0–19 years showed severe anemic condition [Figure 1]. Our finding revealed that age range of 20–39 years was primarily susceptible to anemic condition as compared to the other two age groups. In mild-anemic categories, majority of subjects (51.69%) belonged to 20–39 yrs. age group followed by elderly group (40-60 yrs.) having 33.89%, whereas of individual between 0 and 19 yrs. showed least prevalence (14.42%). Individuals of 20–39 yrs. age group also showed higher prevalence (53.33%) in moderately anemic categories by leaving behind other age groups. Same trend also continued in severe-anemic group, majority of individuals (46.66%) belong to age range 20–39 years followed by age range 40–60 years with 40% suggesting that the elderly people are prone to be anemic.
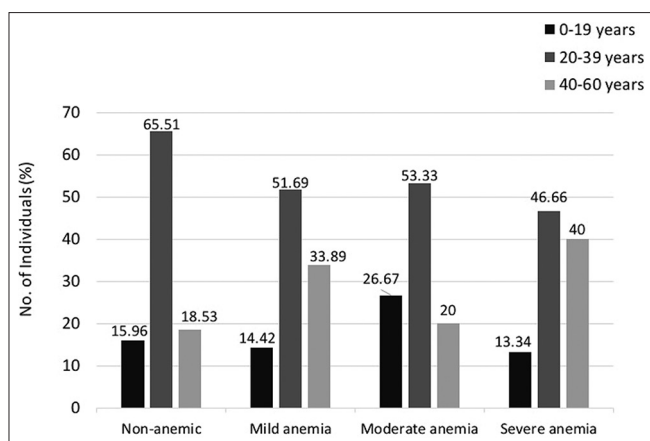
Figure 1: Age-wise distribution across various anemia morphologies among the studied individuals

Consumption pattern of rice, wheat, other cereals, and pulses was almost same in all the groups and thus the results were insignificant. The locally available grains in Garhwal region have potential nutritional effects on the health of an individual but to our surprise it was found that staple food like mandua, jhangora, etc., were less consumed by the people residing in Garhwal region. Regardless of anaemic and non-anemic category majority of individuals consumed cereals, wheat, rice, staple food, and pulses daily. Therefore, the results were non-significant as the protein and carbohydrate requirement was fulfilled.

A high significant difference ($P < 0.05$) was observed in the frequencies of consumption of Green vegetables among non-anaemic (67.54%) and anemic groups (49.43%). While 28.65% and 21.92% consumed vegetables ≥3 days/wk or rarely were found in anemic condition. Consumption pattern of green leafy vegetables also showed the same pattern exhibiting 54.67% of the population been non-anaemic due to daily consumption of green leafy vegetables, but 44.38% of the cases having anemia even on consumption of green leafy vegetables daily. Individuals who never or rarely having green leafy vegetables in their diet and found to be more anemic (23.04%) were approximately two-fold in comparison to non-anaemic (15.22%) individuals. The same risk pattern was also observed for rare or never consumption of fruits. A highly significant difference was also observed for the consumption pattern of fruit intake ($P < 0.01$).

There was no significant difference observed for consumption pattern of milk and milk products (i.e., curd, paneer, lassi, butter milk, etc.) as consumption of these products was found in majority of individual for both anemic and non-anemic categories. The consumption pattern of sweets included in the diet of individuals also displayed almost the same pattern for both groups. On the contrary, results obtained on the basis of non-vegetarian diet consumption on daily basis revealed that 63.58% were non-anemic while 36.42% being anemic thus depicting the protective nature of non-vegetarian diet and thus the results were statistically significant at $P < 0.05$.

The population under study consumed tea in a great proportion in comparison with other beverages like coffee and fruit juice. Among non-anemic population, 68.63% had tea daily in comparison with the anemic individuals (31.37%) and the differences were found to be statistically significant ($P < 0.05$). Consumption of fruit juice was also uncommon in the studied population whether they belong to non-anemic or anemic group. Though, consumption of fruit juice in non-anemic groups was higher than anemic group, but there was no significant difference observed.

Overall, more than 60% of individuals residing in Garhwal consume fast food. There is no statistical significant difference found for the consumption pattern of fast food between non-anemic and anemic group. Consumption pattern of other food stuff like biscuits, rusk, and bakery products etc., was almost same in both the groups and statistically insignificant.

Discussion

Worldwide, anemia is the most prevalent nutritional deficiency and 25% of the world's population suffers from some form of anemia.[11] In developing countries, it is increasing at an alarming rate. The most common nutrient deficiency, which gives rise to nutritional anemia is iron deficiency due to its inadequate intake in the diet.

Publicly, available data for 187 countries were categorized into 20 different age groups for estimation of anemia between 1990 and 2010 and it was found that the prevalence of anemia was higher in females for most regions.[12] Different studies carried out in India, also point toward females being more vulnerable to anemia, as this gender biases are found among all castes, religion across all regions.[13,14] Our study was also not an exception as the number of anemic females (38.08%) was found more as compared to males (26.70%).

The ubiquitous persistence of anemia and IDA along with the etiology are complex and multifactorial and in concordance with this fact our study also suggested that there are other multiple reasons for a person being anemic apart from nutrition.[15,16] The overall proportion of anemia for this study was 34.22%, which is almost similar to the report of Global Data,[17] wherein the population having anemia is 39.86%.

The results of the study carried out by Kotecha *et al.* indicated that age and educational status were not significantly associated with anemia,[18] which is in accordance with our study. This inquest explored that the most susceptible population of anaemic age group was 20–39 years, wherein the prevalence rate for mild anemia was found to be 51.69% followed by 53.33% for moderate anemia. The vulnerability for being anemic during this span of life (20–39 years) may be attributed to blood loss during menstruation and child-birth in pre-menopausal females. As gender biases are very common in our country, females are not accessible to proper balanced diet. As a result, the deficiency of

nutrients can never be replenished during later stages of life. On the contrary, cohort studies of Guralnik *et al.* and Stuetz *et al.* among the post-menopausal women of USA depicted higher prevalence rate of unexplained anemia in older age (>60 years of age) along with the suggestion that in older women inadequacy of several nutrients is responsible for anemia persistence.[13,19,20]

The association of diet and anemia is not uncommon and many studies have been conducted to reveal the role of diet in the person being anaemic. Fortification can also reduce the burden of IDA.[21] Females residing in rural areas were found more prone to nutritional anemia than urban ones due to, education, and economic constraints.

The consumption pattern of vegetables and fruits among the studied population was statistically significant. In spite of consuming green leafy vegetables, the prevalence of anemia in this region is still 49.43%. A study conducted on Tanzanian female farmers reported that the females consuming more green leafy vegetables had higher hemoglobin level in comparison to the individuals not consuming green leafy vegetables.[20] Another study pertaining to green leafy vegetable powder was carried out by Egbi *et al.*[22] on Ghanian School suggested that the consumption of it increased the mean hemoglobin concentration thus reducing the risk of anemia.

The population that consumed fruits daily was found generally non-anemic and their percentage was 63.58. The rate of prevalence of anemia even after consumption of fruits was found to be 36.42% in the studied population. A recent health survey of Ghana also reported that individuals consuming fruits more often were non-anemic than those not including fruits in their diet.[23]

Casein and calcium, present in high amounts in milk, inhibits the non-heme iron absorption. In the light of the aforesaid fact Zeigler suggested that the consumption of milk has adverse effects at the status of iron stores in the blood on their iron stores.[24] Fortification of milk with iron protects the infants and toddlers against the negative effects of iron stores. In contrast, our study showed that majority of individuals consume milk daily or >3 days/week and are of non-anemic category. Thus, the results did not show any significant difference between milk consumers and non-consumers irrespective of anemia.

Non-vegetarian diet plays a significant role in the non-occurrence of anemia as the rate of its prevalence is higher among the individuals who consume vegetarian diet.[25] In comparison to vegetarian diet the non-veg diet is better due to the bioavailability of heme iron which gets easily absorbed. Majority of our study subjects consuming non-veg daily (63.58%) or more than three days/week (61.71%) were recorded as non-anemics. In accordance with the present research, a comparative study on prevalence of anemia in non-vegetarians and vegetarians was also done by Mahajani and Bhatnagar[25] where the results indicated

that mean hemoglobin levels of non-vegetarians was higher than the vegetarians. It proves the fact about the presence of more haeme in non-vegeterian diet.

The link between tea consumption and anemia has not been established yet, but in our study the prevalence of anemia was recorded at 68.63% in individuals drinking tea daily and at 58.73% in individuals consuming tea more than 3 days/week with the results been statistically significant at *P* < 0.05. It strikes an unusual fact in our minds as to what can be the role of tea in an individual being anaemic which is still unexplained.

According to the WHO-VMNIS,[26] industrial trans fats are considered an unhealthy diet. The consumption of fast food was very prevalent in the individuals residing in Garhwal. Population under anemic category was 37.64% for fast food consumption, though the results were statistically insignificant.

The exploration of anemia prevalence in low- and middle-income countries[14] showed that economic well-being is the strongest factor for anemia because the affluent class (developed countries) can afford healthy and balanced diet in comparison to the weaker sections of the society (developing one's). Thus, it can be stated that anemia is mostly related to an individual's socioeconomic condition more than his caste and education. Our research findings also point out on the fact that the population residing in the upper Himalayan region is devoid of iron supplements due to the remoteness of place and poor socio-economic conditions prevailing in this region resulting in more number of anemic individuals.

The major shocking concern for Indian infants is that they are born anemic which although is unacceptable but a sorrowful fact.[27] Anemia and malnutrition have been clearly linked with each other and the association with other factors is plausible, still the fact remains that diet plays an important role in an individual being anaemic or not.[12] The recently published WHO guidelines also suggests that nutrition should be optimized including daily iron supplementation for high-risk anemia prevalence groups, as the first-line intervention. Pullan *et al.*[28] also suggested that anemia surveillance and intervention should be a priority in young children and females who are actually the high-risk population.

Conclusion

Majority of the people in Garhwal reside in mountainous villages but are aware about the basic dietary requirement. The majority of the population is educated, but unaware about many factors regarding anemia, dietary sources of iron, folic acid and vitamins, knowledge about hemoglobin levels, etc., As studied by different researcher's evidence suggested that only hemoglobin value alone may not serve the purpose of evaluating anemia in multiethnic population. At National level, many programs have been launched to control anemia. In spite of so many programs implemented to give awareness regarding nutrition and hygiene, anemia is still found and persisting among the population of

Garhwal. Adequate intake of iron and folic acid rich food, change in dietary habits is necessary and should be promoted through education and primary care physicians.

There are multifactorial causes of anemia including infections, menstrual bleeding, loss of blood due to injury or operation, lack of knowledge about proper nutrition and supplementation of diet with multivitamins and minerals apart from the genetic factors and disorders.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Ethics declaration

The research and study procedures were approved by the Institutional Ethical Committee of Hemvati Nandan Bahuguna Garhwal University and informed written consent was obtained from all participants.

Conflicts of interest

There are no conflicts of interest.

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