International Journal of Advanced Multidisciplinary Research
ISSN: 2393-8870
www.ijarm.com
DOI: 10.22192/ijamr Volume 5, Issue 4 -2018

Review Article

DOI: http://dx.doi.org/10.22192/ijamr.2018.05.04.003

A Review on Nutritional Anaemia

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Keywords

Nutritional anaemia, haemoglobin concentration, folate deficiency.

Abstract

Nutritional anaemia may be defined as a reduction in haemoglobin concentration below that which is normal for the individual, due to an inadequate supply of haernopoietic nutrients. In a given healthy individual who ingests and absorbs adequate amounts of haernopoietic nutrients, the haemoglobin concentration will be at a level optimal for that individual and further ingestion of haemopoietic nutrients will not increase the haemoglobin concentration. Anemia of nutritional origin is acquired problem caused by diets that lack sufficient quantity of bioavailable essential hematopoietic nutrients to meet the need for hemoglobin and red blood cell synthesis. Although many nutrients are involved in the production of red cells and haemoglobin, iron deficiency is by far the commonest cause of nutritional anaemia all over the world. In certain sections of the population, especially pregnant women, folate deficiency is also an important cause. In some individuals, vitamin B12 deficiency may produce severe anaemia. Environmental factors that expose humans to infections, such as hookworm, schistosomiasis, and other parasites that can lead to excessive loss or competition for hematopoietic nutrients, are also of concern, particularly among populations exposed to poverty and deprived living conditions.

Introduction

Nutritional anaemia may be defined as a reduction in haemoglobin concentration below that which is normal for the individual, due to an inadequate supply of haernopoietic nutrients [1]. However, problems arise when an attempt is made to define a "normal" concentration [2]. In a given healthy individual who ingests and absorbs adequate amounts of haernopoietic nutrients, the haemoglobin concentration will be at a level optimal for that individual and further ingestion of haemopoietic nutrients will not increase the haemoglobin concentration [3]. However, Anemia of nutritional origin is acquired problem caused by diets that lack sufficient quantity of bioavailable essential hematopoietic nutrients to meet the need for hemoglobin and red blood cell synthesis [4]. Need is influenced by environmental factors that cause excessive blood loss or haemolysis. Nutritional anemia are unlikely to be inherent to man's existence, but evolved as ancient man's lifestyle turned from hunting animals and foraging for wild berries fruits and green leaves, to growing cereal crops and cultivating vegetables to provide energy and nutrient needs [5]. This caused primary menu to shift toward foods containing less bioavailable hematopoietic nutrients (iron and vitamin 612) or those that enhance their utilization (vitamins C and A), and a shift of his culinary practices to those that exposed food to longer heat exposure that was potentially destructive for certain nutrients (folates) [6]. Not all nutritional anemia are attributable to diet and changing lifestyles. Physiological factors may contribute to a decline in normal functions associated with aging, such as low stomach acidity which decreases the bioavailability of vitamin Bisfrom food [7].

Etiology of anaemia associated with nutrition

Although many nutrients are involved in the production of red cells and haemoglobin, iron deficiency is by far the commonest cause of nutritional anaemia all over the world [8].

In certain sections of the population, especially pregnant women, folate deficiency is also an important cause. In some individuals, vitamin B12 deficiency may produce severe anaemia, as in classical pernicious anaemia; however, this is relatively rare and even in countries such as India, where the population subsists on a largely vegetarian diet with a marginally adequate vitamin B12 intake, there is little evidence from the public health point of view that vitamin B12 deficiency is a significant cause of anaemia [9]. In children with severe protein energy malnutrition, protein deficiency may play a role in the accompanying anaemia; however, less marked degrees of protein deprivation have not been shown to cause anaemia [3].

Iron deficiency anaemia

The nature of these nutrient deficiencies, especially iron, and their role in the etiology of nutritional anemias is described in this section. Iron deficiency anemia, as a term, is almost interchangeable with nutritional anemia and represents the most prevalent deficiency of early childhood in the United States. Its frequency has even prompted the suggestion that it is the most frequent disorder seen in clinical medicine. Although usually considered benign, iron deficiency anemia may have serious debilitating effects. These include: a decreased resistance to infection, an impaired immune response, symptoms of irritability and fatigue, a diminished capacity for work and activity, and lowered intellectual motivation and performance. While its frequency of occurrence has been well documented in infants and preschool age groups of children, there has been relatively little study of this condition among older adolescents and young adults. Undoubtedly, the most reliable population data are those collected in the Health and Nutrition Examination Survey (HANES) of the National Center for Health Statistics [9]. These data, based on blood specimens collected primarily by venipuncture from a national probability sample, indicate that in the age groups 12-17 and 18-19, mean hemoglobin levels of males are consistently higher than females. A thorough examination of the mean differences among females of reproductive age found that they could not have been due to differences in iron nutrition, as measured by transferrin saturation values [10].

Folic Acid Deficiency

Folic acid deficiency can produce a megaloblastic, macrocytic anemia because this nutrient is required for the synthesis of erythrocytes [2]. Changes in red blood cell morphology and the number of cells occur later than the drop in serum and red blood cell folate concentrations. New data are needed on the global prevalence of folate deficiency. In the U.S., prior to folic acid supplementation of flour, about 15% of women had suboptimal folate status assessed by low serum and erythrocyte folate concentrations [11]. The prevalence has been reported to be higher in Africa and Asia [12], but few data are available. No abnormal values for folic acid in serum or red blood cells were observed in studies in Thailand, Guatemala, or Mexico [13]. The folate content of foods such as legumes, leafy greens, and fruits is considerable and in some poor regions these may be consumed in larger amounts than in industrialized countries. Clearly the prevalence of folic acid deficiency is uncertain [14].
The most significant effects are seen in Africa, where folic acid deficiency and megaloblastosis may have been caused by malaria. A WHO collaborative study in Burma and Thailand found no incremental benefit of folate on the Hb concentrations of pregnant women or non pregnant women [15]. But these countries are not known to have a high prevalence of deficiency. In south Benin, folate deficiency was associated with (but was not necessarily the cause of) anemia in 20% of adults [16]. A significant increase in Hb was found only in South Africa. Increasingly, the main rationale for including folate in iron supplements for anemic women is reduction of risk of neural tube defects [14].

Vitamin B12 Deficiency

There are few data on the global prevalence of vitamin B12 deficiency, which can result in megaloblastic anemia. Even less is known about its global contribution to anemia. Because this vitamin is found only in animal products, and it is actively reabsorbed from bile, deficiency has been traditionally associated with long term consumption of strict vegetarian diet[17]. Pernicious anemia, an autoimmune disorder involving a defect in the synthesis of gastric intrinsic factor needed for vitamin B12 absorption, only explains about 2% of the prevalence of deficiency in U.S. adults. In an international survey of anemia conducted between 1973 and 1982, the prevalence of serum vitamin B12 concentrations indicating deficiency was low in the 21 countries that made this assessment. However, the methods used may have overestimated serum concentrations of the vitamin by 40 to 50%.69 More recent studies in rural Mexico, for example, indicate that between one fifth and one third of individuals ranging from preschoolers to adult men and women have some degree of vitamin B12 deficiency [18]. Almost half of lactating women in peri-urban Guatemala City had marginal or deficient plasma vitamin B12 concentrations; their infants were at risk of deficiency of the vitamin as early as 3 months of age; and there were low concentrations of the vitamin in breast milk. The elderly have an especially high prevalence of this vitamin deficiency. For example, we have reported that about 7% of elderly (age >65 years) Hispanics in northern California have deficient (<200 μg per liter) concentrations of the vitamin in plasma and an additional 16% have marginal concentrations (200 to 220 μg per liter) [19].

In developing countries, the prevalence of vitamin B12 deficiency at all ages is expected to be substantially higher than in developed countries. The risk of vitamin B12 deficiency is likely to be highest when impaired absorption and low intakes co-exist. Even though vitamin B12 deficiency may emerge as a relatively common problem on a global scale, its contribution to anemia is uncertain.

Anemia does not usually appear until an individual has a relatively severe state of depletion of the vitamin. Infants born to and breastfed by strict vegetarian mothers develop anemia and hematological abnormalities that are reversible by vitamin B12. A few studies of pregnant women tested the benefit of adding vitamin B12 to folate and iron supplements. The additional B12 failed to improve Hb further in two Indian studies, one of which was of very short duration. Premature, low birth weight infants treated with iron, vitamin E, and folic acid showed an improvement in Hb concentrations when they were also given parenteral vitamin B12.66 Additional studies are needed to examine the prevalence, causes, and consequences of vitamin B12 deficiency — including anemia — in other regions of the world.

Iron deficiency

Iron is essential for metabolic processes that are concerned with oxygen transport, oxidative metabolism, and cellular growth [17]. Most functional iron is present in the form of heme in hemoglobin, myoglobin, cytochromes, catalase, and peroxidase. Non-heme iron compounds include the metallo flavoproteins, the iron sulfur protein s, and ribonucleotide reductase. Anemia is the most easily identifiable manifestation of functional iron deficiency although it is important to note that the suboptimal iron supply affects all tissues. Functional consequences are the result of inadequate oxygen delivery because of the reduced circulating hemoglobin level and diminished functional activity of iron containing tissue enzymes.

The most important are impaired mental development and physical coordination in infants, poor school achievement in later childhood, and a limited ability to perform tasks requiring physical activity at all ages. The neurological and cognitive abnormalities are thought to result from, the effect of iron deficiency on brain neurotransmitters. The precise biochemical basis is poorly understood. The limitation in the ability to perform prolonged physical activity is due primarily to compromised oxidative metabolism in skeletal muscles. There are many other consequences of iron deficiency including impaired immunity, abnormalities of the mucosa of the mouth and esophagus, koilonychia (spoon nail), impaired temperature regulation, and perversions of taste leading to the consumption of nonfood items (pica) or a craving for ice (pagophagia).

Other causes of anaemia associated with nutrition

Environmental factors that expose humans to infections, such as hookworm, schistosomiasis, and other parasites that can lead to excessive loss or competition for hematopoietic nutrients, are also of concern, particularly among populations exposed to poverty and deprived living conditions. Obviously, the acquired nature of nutritional anemias is complex and requires multiple considerations in finding the appropriate mix of remedial measures. From a global public health perspective, however, iron is by far the most significant hematopoietic nutrient lacking in quantity or availability from diets [20]. Nevertheless, to restrict the consequences to those from anemia far understates the health impact of iron deficiency that occur, before hematopoiesis is affected, e.g., compromised immunity, cognitive functions, and work performance [21].

Prevalence of anaemia associated with nutrition

The importance of the problem was recognized by WHO and FAO at the first meeting of the Joint Advisory Committee in 1949, and at each subsequent meeting through the late 1950s.

Between 1955 and 1958, WHO sponsored a national survey of anemia in Mauritius, identifying a prevalence of 15 to 64% for anemia, with a hypochromic microcytic variety prevailing and associated with hookworm infection. The anemia subsequently was shown to respond to bread enrichment with iron. WHO followed up with investigations of nutritional anemia among pregnant women in India, 38% of whom were anemic; half of those who were severely anemic showed megaloblastic changes in their bone marrow, which were responsive to combined iron and folic acid prophylaxis.

These studies prompted WHO to establish internationally acceptable standards for the study of anemia based on hemoglobin levels, but the standards set were general for age and sex categories [22].

Consequently, hemoglobin has emerged as the fair weather surrogate in most national and regional surveys of nutritional anemia, particularly in developing countries, because of ease of measurement in comparison with other specific causative nutrients. The databank available at the WHO which estimates the global and regional prevalence of anemia, therefore, does not allow differentiation of nutritional etiology or that caused by non nutritional factors.

Conclusion

Nutritional anaemia may be defined as a reduction in haemoglobin concentration below that which is normal for the individual, due to an inadequate supply of haernopoietic nutrients. Anemia of nutritional origin is acquired problem caused by diets that lack sufficient quantity of bioavailable essential hematopoietic nutrients to meet the need for hemoglobin and red blood cell synthesis. Environmental factors that expose humans to infections, such as hookworm, schistosomiasis, and other parasites that can lead to excessive loss or competition for hematopoietic nutrients, are also of concern, particularly among populations exposed to poverty and deprived living conditions.

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Quick Response Code	Subject: Health Sciences
DOI:10.22192/ijamr.2018.05.04.003	

How to cite this article:
Obeagu Emmanuel Ifeanyi. (2018). A Review on Nutritional Anaemia. Int. J. Adv. Multidiscip. Res. 5(4): 11-15.
DOI: http://dx.doi.org/10.22192/ijamr.2018.05.04.003