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RESEARCH ARTICLE

ASSOCIATION BETWEEN DIETARY PATTERNS AND HB CONCENTRATION AMONG YOUNG ADULT FEMALES

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ABSTRACT

Anemia is a widespread public health problem associated with an increased risk of morbidity and mortality, especially in pregnant women and young children. It is a disease with multiple causes, both nutritional (vitamin and mineral deficiencies) and non-nutritional (infection) that frequently co-occur. Nutritional anemia refers to a reduced red blood cell count due to a poor diet which is deficient in iron, folate and/or Vitamin B12. This is a cross sectional study conducted in two administrative units in Southern province of Sri Lanka. Females between 20-50 years of age (n=152 from each administrative unit) were selected. Therefore, this study was conducted to assess the association between anaemia and the dietary habits in a female study population. Anemic status was assessed based on Haemoglobin (Hb) concentration where anemia is defined as Hb concentration <12 g/dl in females. When considering the relationship between Hb concentration and dietary habits in the study population, consumption of fish, white meat, green leafy vegetables and egg shows a significant positive relationship with Hb concentration.

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INTRODUCTION

Anemia remains a public health problem affecting 818 million women and young children worldwide (McLean *et al*., 2007). Anemia is primarily defined in terms of the level of oxygen carrying pigment haemoglobin in the blood. In adults cut-off Hb level for anemia is Hb <13 g/dl in males and Hb <12 g/dl in females (Kankanamge *et al*., 2016). A number of studies among children, aged 1–13 years, showed significant improvement in mean haemoglobin (Hb) concentrations and a decrease in anemia prevalence after supplementation with different diets with vitamin supplements (Zimmermann *et al*., 2006). It is assumed that one of the most common contributing factors is iron deficiency, and anemia resulting from iron deficiency is considered to be one of the top ten contributors to the global burden of disease. In iron deficiency anemia, the red cells appear abnormal and are unusually small (microcytic) and pale (hypochromic). The pallor of the red cells reflects their low hemoglobin content. Nutritional anemia refers to a reduced red blood cell count due to a poor diet which is deficient in iron, folate and/or Vitamin B12 (Badham *et al*., 2007). Global prevalence of anemia in preschool aged children is 47.4%, global prevalence of anemia in pregnant women is 41.8%, global prevalence of anemia in non-pregnant women is 30.2%, 818 million women worldwide (both pregnant and non-pregnant) and young children suffer from anemia and over half of these, approximately 520 million, live in Asia (De Benoist *et al*., 2008). Based on these estimates, the magnitude of nutritional anemia or of iron deficiency anemia is difficult to assess since most of the surveys used do not address the causes of anemia and are solely restricted to the measurement of hemoglobin. Anemia remains a significant public health concern. Nutrition has an important role in anemia and of all the nutrients involved, iron is the most crucial. Although most anemia in developing countries is due to iron deficiency, a proportion may be due to deficiency of vitamins of B complex, principally folate and vitamin B12. A diet that meets the dietary guidelines will ordinarily have enough iron, folate, and vitamin B 12 to prevent anemia. Exceptions include women of

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childbearing age who are well advised to take supplemental iron and folic acid, and preterm infants who are often prescribed iron supplements (Badham *et al*., 2007). These new estimates are likely to reflect the current situation and are a good starting point for tracking global progress. Future surveys need to include data on the causes of anemia, as lack of this data impairs our ability to correct this significant public health problem.

MATERIALS AND METHODS

304 Healthy females in the age group 20-50 years were randomly selected to the study as the study population. All healthy females who gave consent were taken into the study and pregnant women, females who have chronic diseases and females who were suffering from acute infections were excluded. The anaemic status was determined using Hb concentration. Haemoglobin concentration was assessed by the Cyanmethaemoglobin method. Prior to the study, informed consent was obtained from each participant after a detailed explanation of the experimental procedures. Interviewer administered questionnaires were used to obtain data to ascertain dietary habits. Two milliliters (2ml) of venous blood was withdrawn from each subject by a qualified nurse, under aseptic conditions using disposable syringes. Blood was collected into vacutainer tubes and transported within 24 hours of collection in a cold box at about 4 centigrade for laboratory analysis of haemoglobin. The protocol of this study was approved by the Ethical Review Committee of Faculty of Medical Sciences, University of Sri Jayewardenepura, Sri Lanka.

Hb analysis by Cyanmethaemoglobin method

Blood was diluted in the ICSH (International Council for Standardization Haematology) reagent based on Drabkin's reagent. This contains potassium ferricyanide, potassium cyanide and a non-ionic detergent. Red cells are lysed and the released haemoglobin is reduced to methaemoglobin by potassium ferricyanide and then methaemoglobin reacts with potassium cyanide to form cyanmethaemoglobin complex. Formation of cyanmethaemoglobin complex is directly proportional to the haemoglobin content of whole blood, when measured at 540nm. Calibration curve was plotted using series of haemoglobin standard with Drabkin's reagent. Absorbance was read using UV spectrophotometer at 540nm wave length. After preparing calibration curve, all test specimen of blood were analyzed. Haemoglobin concentration was measured using the calibration curve. Data analysis was done using a computer based statistical package, SPSS (version 15). Descriptive statistical methods were used to describe and summarize the sample characteristics. Pearson correlation test and chi-square test were used as significant tests as when required. A p-value of <0.05 was taken as the significant probability level.

RESULTS

More than 90% of population consumes red raw rice in both administrative areas. More than 80% of population consumes fish in both areas and more than 90% of population doesn't consume red meat in both areas. Percentage of the population who never consume potato, green leaves and fruits is zero in

Table 1. Comparing anemia with dietary habits in the total population

	Non Anemic/Anemic (Frequency, n=304)						
Food	Non Anemic			Anemic			P - value
	0	1	2	0	1	2	
Red raw rice	5	55	230	0	0	14	0.165
White raw rice	27	205	58	1	13	0	0.151
Fish	6	42	242	4	5	5	0.000
Red meat	281	9	0	14	0	0	0.503
White meat	34	252	4	8	6	0	0.003
Potato	0	83	207	0	4	10	0.997
Grain	5	267	18	0	13	1	0.878
Grean leafy vegetables	0	28	262	0	7	7	0.000
(Consumption: 0 = never 1 = 3 days or less than 3 days/week 2= more than 3 days/week)							
Non anemic/anemic (frequency, n=304)							
Food	Non Anemic			Anemic			P-value
	0	1	2	0	1	2	
Milk	275	12	3	14	0	0	0.683
Tea	14	260	16	0	12	2	0.296
Plain tea	8	168	114	0	8	6	0.806
Coffee	288	2	0	14	0	0	0.755
Yoghurt	121	165	4	6	8	0	0.906
Egg	19	196	75	4	6	4	0.007
(consumption: 0 = never 1 = once/day 2= more than once/day)							
	Non Anemic/Anemic (Frequency, n=304)						
Food	Non Anemic			Anemic			P-value
	0	1	2	0	1	2	
Vegetable	0	144	146	0	6	8	0.619
Fried food	18	144	128	1	8	5	0.825
Coconut oil	6	119	165	0	6	8	0.860
Vegetable oil	283	6	1	14	0	0	0.841
Fast food	40	250	0	1	13	0	0.477
(Consumption: 0 = never 1 = 3 days or less than 3 days/week 2= more than 3 days/week)							

both areas. More than 80% of population consumes fast food 3 days or less than 3 days per week in both areas. Regarding dietary habits, there is a significant difference in daily consumption of various food types between each area. Consumption of red raw rice, fish, red meat, white meat, coffee, vegetable oil and fast food does not show a significant difference among the participants in both areas, according to Pearson Chi-Square test. But, consumption of white raw rice, potato, grain, green leaves, milk, tea, plain tea, yogurt, egg, coconut oil and fried food shows a significant difference in both areas. Prevalence of consuming green leaves more than 3 days per week is considerably lower in the anemic population where it is high in non-anemic population. More than 85% of non anaemic population consumes green leaves 3 days or more 3 days per week in both areas. Percentage of anaemic population who doesn't consume green leaves is zero in both administrative areas. Concerning the association between dietary habits and Hb level (anemia) in the total population, consumption of fish (p=0.000), white meat (p=0.003), egg (p=0.007) and green leafy vegetables (p=0.000) shows a statistically significant difference with Hb level.

DISCUSSION

The study was conducted to assess the dietary habits of each individual, for the purpose of assessing the impact of different types of food intake on anemia. These findings are significant as it provides evidence for a simple food-based intervention that may contribute to the reduction of anaemia in developing countries. Regarding dietary habits, there is a significant difference in daily consumption of various food types between each area. Consumption of white raw rice, potato, grain, green leaves, milk, tea, plain tea, yogurt, egg, vegetable oil and fried food shows a significant difference between both administrative areas. When considering the relationship between Hb concentration and dietary habits, consumption of fish, white meat, egg and green leaves shows a significant positive relationship with Hb concentration in the study population, but no relationship with consumption of red and white raw rice, red meat, potato, grain, milk, tea, plain tea, coffee, yogurt, egg, coconut oil, vegetable oil, fast food and fried food. The relationships observed are not compatible with a study undertaken in Ahmedabad, India, in which a higher prevalence of anaemia (81.8%) among girls was reported. According to that Anaemia was significantly higher among girls who were having the post meal habit of consuming tea/coffee (94.4%). It can be due to the interference of the dietary bioavailability of iron by the tannin contents of tea/coffee. On the other hand, the prevalence of anaemia was significantly lower in girls consuming green leafy vegetables, which is similar to what we observed in our study where less than 3% of anemic population consumes green leaves less than 3days per week. Anaemia in girls, who do not consume green leafy vegetables regularly, can be due to the lower availability of dietary iron (Verma *et al*., 2004). Because green leaves contain some percentage of recommended daily intake of iron (Eg; 34% of recommended dietary allowance of iron in 100g of Spinach), habit of consuming green leaves regularly would be helpful in maintaining normal Hb levels (United States Department of Agriculture (USDA), 2005). Above mentioned study included the girls of school age (Verma *et al*., 2004). Similarly our study also shows a significant positive relationship between Hb and dietary intake of leaves when considering the whole study population. Additionally, it shows that dietary intake of fish, white meat and egg is also having a positive relationship with Hb concentration. But, it doesn't show any relation between intake of tea, coffee or plain tea with Hb concentration. The present study doesn't show a relation in consuming meats and dairy products with Hb concentrations though the consumption frequency of red meat, white meat and milk is less in anemic population. But, the prevalence of low haemoglobin levels was higher in young children who consumed no meat or poultry (28.8% *vs* 19.0% overall, *P*=0.044) according to a study conducted in Britain (Cowin *et al*., 2001).

Conclusion

Some food types with their frequency in consuming show a relationship with Hb concentration. Higher frequency in consuming some food types improve Hb concentration and decrease the prevalence of anemia. Nutritional status, quantity of foods they intake and intake of high iron foods by persons should be considered in the future studies since the present study only concern on the frequency in consuming various foods per week. Our data confirm that parents should encourage green leafy vegetables consumption and include at least a little meat or fish and egg in their diet. We recommend the promotion of vegetables in a well-varied diet, including haem or non-haem sources of iron, to improve dietary nutrient absorption.

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