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Research Article

Assessment of the Role of Dietary Habits in Causing and Preventing Anemia among Adult Patients at Wad Medani Teaching Hospital, Gezira State, Sudan (2021-2022)

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Abstract

Anemia remains a significant public health concern, particularly in developing countries like Sudan. Dietary factors play a crucialrole in its etiology and prevention. This study aimed to investigate the association between dietary habits and anemia among adult patients admitted in medical wards at Wad Madani Teaching Hospital. A cross-sectional study was conducted among adult patients attending admitted in medical wards at Wad Madani Teaching Hospital during 2021-2022. Data on sociodemographic characteristics, dietary intake, and hematological parameters were collected using a structured questionnaire and laboratory investigations. The results showed that most of the respondents live in Gezira State (69.9%) and the rest, in descending order, were from Sennar (15.7%), Gadarif (11.4%), Damazin (1.4), and South Kordofan (1.4%), States. The results showed statistically significant differences when using chi-square ($p<0.05$) for satistical analysis of the relationship between blood test for anemia and consumption of proteins, fats, carbohydrates, minerals and vitamins 0.000, 0.000, 0.000, 0.258 and 0.258 respectively. The results showed no statistically significant relationship when using chi-square ($p<0.05$) for the relationship between income and consumption of proteins, fats, carbohydrates, minerals and vitamins 0.274, 0.230, 0.768, 0.729 and 0.238 respectively. It was concluded that, Individuals who consumed insufficient amounts of vitamins, proteins, minerals had a higher rate of anemia. Income does not play a major role in determining the consumption of these essential nutrients. The study recommended that well-planned diet with enough iron and vitamins can help to prevent and correct anemia.

Keywords: anemia; nutrition; dietary habits; iron deficiency; public health; sudan

Introduction

Anemia is a major public health problem, especially in developing countries including Sudan (Benoist *et al.*, 2008). It is common in adult and the prevalence of anemia is increasing with advancing age (Woodman *et al.*, 2005). There is a high prevalence of anemia among adults in different regions of Sudan, which hurts health. For instance, anemia prevalence was 35.6% in Sudanese women of reproductive age,23 (36.2%) in adults in Eastern Sudan,24 and (27.6%) in adults in Central Sudan (Elmardi *et al.*, 2020). Mohamed *et al.*, (2011) reported that 58.4% of pregnant women were affected by anemia in Sudan. Higher education is considered as the most important factor for accelerating economic, social, and cultural development in human communities. Responding to this vital role of higher education, the government of Sudan planned for a revolution in this sector, where the number of university students increased from 38,000 to 39,8733. Out of 39, 8733 students 26, 4752 (66.4%) were enrolled in universities of *Khartoum* state.

Anemia is a serious global public health problem that particularly affects young children, menstruating adolescent girls and women, and pregnant and postpartum women. WHO in 2023 estimates that 40% of children 6–59 months of age, 37% of pregnant women, and 30% of women 15–49 years of age worldwide are anemic.

Anemia may be caused by several factors: nutrient deficiencies through inadequate diets or inadequate absorption of nutrients, infections (e.g. malaria, parasitic infections, tuberculosis and HIV), inflammation, chronic diseases, gynecological and obstetric conditions, and inherited RBC disorders. The most common nutritional cause of anemia is iron deficiency, although deficiencies in folic acid, vitamins B12 and A are also important causes. The WHO regions of Africa and south-east Asia are most affected with an estimated 106 million women and 103 million children affected by anemia in Africa and 244 million women and 83 million children affected in south-east Asia (WHO, 2023).

Due to the increase in the prevalence of anemia among peoples in Sudan and the lack of studies in this field, this was an initial step to conduct this research that includes studying the nutritional causes of anemia, in order to follow a diet containing iron, vitamins, minerals, carbohydrates, and folic acid to find a way to reduce the prevalence of anemia. The general objective of this research is to study the role of diets in prevalence of anemia among Sudanese adults in *Wad-Medani*, *Gezira* state, Sudan.

Material And Methods

Site of study

This study was conducted at Wad Madani Teaching Hospital – in patients admitted to medical wards- in Wad-Medani city were targeted for the year (2021 - 2022), Gezira state, Sudan.

Population of study

All patients at Wad-Medani admitted in medical wards during the study period were included in a cross-sectional study to investigate the association between dietary habits and anemia among adult males and females' patients over 18 years of age.

Inclusion and exclusion criteria

All cases that matched the study specifications and were confirmed to have anemia in medical wards at Wad-Medani Teaching Hospital during the year (2021-2022) were selected, and cases with any other type of diseases causing anemia and cases with hereditary anemia were excluded.

Questionnaire designing and applying

A questionnaire was administered about the potential risk factors for anemia, and the participants were interviewed at internal medicine wards at Wad-Medani Teaching Hospital after confirmation of diagnosis of anemia, and questions were asked in the local language. The questionnaire was designed and the interview was conducted within 20 minutes for each patient. The questionnaire consists of four parts, the first part is personal information, the second part is information about the disease, the third part is the diet before the disease, and the fourth part is the diet after the disease. This is in order to compare the diet before and after having anemia. The questionnaire also included other questions about nutritional habits, lifestyle, medical history, physical activity, dietary pattern, and family history of the disease. Food frequency questions were used to determine the amount and type of carbohydrates, proteins, fats, minerals, and different types of vitamins consumed for each food. A commonly used unit or volume is a specific size, slice, cup, or natural unit such as one apple. The total number of cases was 240 patients, and a sample of 150 was taken according to the formula for calculating the sample size. Due to the fact that some people left out and all the data was not available, there were missing values, so the sample size equals 140. Ethical approval was obtained from the Ministry of Health in Gezira State and Faculty of Agricultural Science ethical committee for the purpose of conducting the research as well as informed verbal consent from all participants. A group of (n = 140) agreed to participate in the questionnaire and provided nutritional information about their diet pattern before and after developing anemia. Laboratory chemical measurements were also performed for percentage of hemoglobin in the blood, iron and vitamin deficiency, and sickle cell anemia.

Statistical analysis

The amount of protein, fat, carbohydrates, minerals and vitamins was calculated individually and compared to the amounts consumed for each case. Differences between the means of individuals were determined through analysis of variance (ANOVA) and correlation. The relative risks of poverty were determined by comparison with these variables, measures of central tendency, standard deviation, percentage tables, F-test and Chi squarer were used in data analysis. Statistical analyzes were performed using the statistical software Statistical Package for the Social Sciences (SPSS) version 22.

Results and Discussion

Demographic characteristics of respondents

The study showed, as in Table (1), that more than half of the respondents (51.4%) were married and about a third (30%) of them were unmarried, while the percentage of widows and divorcees was (15.7%) and (2.9%) respectively. The study also showed that about two-thirds of the respondents were of average income, more than a quarter of them were of low income and (12.9%) were of sufficient income. The results of the study Table (1) showed that most of the respondents live in Gezira State (69.9%) and the rest, in descending order, are from Sennar (15.7%), Gadarif (11.4%), Damazin (1.4%), and Kordofan (1.4%), States. This is due to the presence of the hospital in Gezira State. The economic incomes also varied from middle income (61.4) to low income (25.7) and sufficient income (12.9), a natural reflection of their occupation of agriculture and marginal work, which may negatively affect their nutritional awareness and expose them to diet-related anemia. According to Silvia *et al.*, (2022) in Brazil, their results was similar to our current study, as they reported that poverty was a reality for 39.7% of individuals. A positive correlation between hemoglobin levels and per capita income was found. Nowaj *et al.*, in India (2023), their results were unlike this study. They found that among all variables, economic status dominantly controls the anemia level in all social groups. Anemia prevalence of the poor and poorest group of general women were much worse than the women of richer and richest groups.

Items	State	Town	Percent
Residence	*Gezira*	*Wad Medani*	35.7
		ELHasahiesa	17.1
		ALManagel	17.1
	Sinnar	*Sinnar*	15.7
	ALGadarif	*ALGadarif*	11.4
	South *Kordofan*	*Babanosa*	1.4
	ALDamazin	*ALDamazin*	1.4
	Total		**100.0**
	Categories		
Social status	Married		51.4
	Single		30.0
	Divorced		2.9

	Widow/er	15.7
	Total	**100.0**
Income	low	25.7
	Average	61.4
	Adequate	12.9
	Total	**100.0**

Table 1: Distribution of respondents according to their demographic characteristics: residence, social status and income. (n=140)

The association between income and nutrients intake

In Table (2), the results reported that none of the nutrients showed a significant association with income, as all of the significance ($p<0.05$). However, the results in Table (3) showed that there was no statistically significant when using chi-square ($p<0.05$) for statistical analysis, for relationship between income and consumption of proteins, fats, carbohydrates, minerals and vitamins 0.274, 0.230, 0.768, 0.729 and 0.238, respectively. Therefore, it is indicating that the differences in consumption between income groups are likely due to chance. Overall, this table suggests that income does not play a significant role in determining the consumption of these essential nutrients. Therefore, income is considered a non-essential factor in the occurrence of anemia compared to the effect of educational and cultural level, which affects nutritional awareness and consumption of food that raise the general percentage of hemoglobin level in the blood. Haegyu *et al.,* in South Korea (2021) their results support our current study, as they reported that in their study investigated the association between household income quintile and nutrient intake using data from KNHANES 2019. A total of 5088 South Korean adults were analyzed. Their results were on the contrary with or present study, reported that some nutrients are not consumed appropriately in the Korean population. Furthermore, they suggest that household income is significantly associated with the intake of overall minerals and several individual nutrients. These results suggest that nutritional assistance is required for certain vulnerable groups, and provide supplementary data for appropriate interventions or further research. According to Silvia *et al.,* (2022) in Brazil, revealed that poverty was a reality for 39.7% of individuals. A positive correlation between hemoglobin levels and per capita income was found as well as a negative correlation with EBIA scores and cardiovascular risk. Nowaj *et al.,* in India (2023), their results disagree with our current study, as they reported that in their study. They found that among all variables, economic status dominantly controls the anemia level in all social groups. Anemia prevalence of the poor and poorest group of general women were much worse than the women of richer and richest groups of SC and ST, OBC.

Source of Variation		**Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**
Protein	Between Groups	0.621	2	0.310	1.289	.279
	Within Groups	32.979	137	0.241		
	Total	33.600	139			
Fat	Between Groups	0.926	2	0.463	1.774	.174
	Within Groups	35.760	137	0.261		
	Total	36.686	139			
Carbo-hydrate	Between Groups	0.022	2	0.011	0.040	.961
	Within Groups	38.264	137	0.279		
	Total	38.286	139			
Mineral	Between Groups	0.071	2	0.035	0.310	.734
	Within Groups	15.615	137	0.114		
	Total	15.686	139			
Vitamin	Between Groups	0.290	2	0.145	1.433	.242
	Within Groups	13.881	137	0.101		
	Total	14.171	139			

Table 2: ANOVA table for association of proteins, fats, carbohydrates, minerals, vitamins, with income.

Items	**Scale**	**Low income**	**Median income**	**Adequate income**	**p- value, sig. Chi-square**
		%			
Protein	Weak	12.8	40	7.1	**.274**
	Adequate	12.8%	21.4%	9.6%	
	Total	**25.7%**	**61.4%**	**12.8%**	
Fat	Weak	18.5%	40%	9.6%	**.230**
	Adequate	7.1%	20%	7.1%	
	More	0.0%	1.4%	1.2%	
	Total	**25.7%**	**4.3%**	**12.8%**	
Carbohydrate	Weak	14.2%	37.1%	7.1%	**.768**
	Adequate	11.4%	22.8%	9.6%	
	More	0.0%	1.4%	0.0%	

	Total		**25.7%**		**61.4%**	**12.8%**	
Mineral	Weak		21.4%		54.2%	11.4%	**.729**
	Adequate		4.3%		7.1%	1.2%	
	Total		25.7%		61.4%	20%	
Vitamin	Weak		22.8%		52.8%	12.8%	**.238**
	Adequate		4.8%		8.6%	0.0%	
	Total		**25.7%**		**61.4%**	**12.8%**	
*P-value considered significant at equal or less than 0.05							

Table 3: Association of Proteins, Fats, carbohydrates, Minerals and Vitamins with income. (n=140)

The association between social status and nutrients intake

Table (4) showed the statistical analysis of the F test by using analysis of variance (ANOVA) showed that the results for proteins; fats; carbohydrate and minerals the sum of squares of differences between and groups were (2.351; 0.846; 1.934 and 0.280), respectively, resulting in an average difference between their squares of (0.784; 0.282; 0.645 and .093). The calculated F value was recorded as (3.41; 1.070; 2.412 and 0.825) at a probability level ($P < 0.05$) compared to the tabular F value of (0.019). Thus indicates a significant difference in protein; fats; carbohydrate and minerals consumption among different social levels of the respondents. As for vitamins on the other hand, the sum of squares of differences between and groups was (0.123), resulting in an average difference between their squares (0.041). The calculated F value was recorded as (0.397) at a probability level ($P < 0.05$) compared to the tabular F value of (0.755). Thus suggests that there is no significant difference in vitamin consumption among different social levels of the respondents. In summary, the results indicate that there is a significant difference in protein; fats; carbohydrate and minerals consumption among different social statuses, while there is no significant difference in vitamin consumption. Therefore, social level is considered a non-essential factor in the occurrence of anemia compared to the effect of educational and cultural level, which affects nutritional awareness and consumption of food that raise the general percentage of hemoglobin level in the blood. Nowaj *et al.,* in India (2023), their results agree with our current study, as they reported that in their study. They found that among all variables, economic status dominantly controls the anemia level in all social groups. Anemia prevalence of the poor and poorest group of general women were much worse than the women of richer and richest groups of SC&ST, OBC. The odds of women having anemia were lower among higher educated and urban women as compared to the non-educated and rural women, irrespective of social group. The prevalence of anemia decreases with increased age of women and increases with the number of child bearing. All differences were statistically significant. In a study similar to our current study in Sudan, Mohammed *et al.,* (2011) reported that the incidence of anemia among pregnant women was 58.4%. Higher education is considered the most important factor compared to other factors such as economic, social and cultural factors in human societies. Sadiq *et al.,* in Iraq (2023) Children of married mothers are more affected by anemia. Families with high overcrowding showed the lowest rate of HB. They experienced low socioeconomic status as a result. The degree of anemia was significantly correlated with the child's age, residence, mother's educational level, father's job, and socioeconomic position. Their results are consistent with the current findings. In his study in (2011) Milliman, indicated that despite all the recent social and economic developments and health-related improvements, anemia remains a widespread global public health problem affecting individuals at any stage of life in both developing and developed countries, causing serious effects on quality of life, morbidity and mortality. His results are consistent with the current findings.

ANOVA						
		Sum of Squares	Df	Mean Square	F	Sig.
Protein	Between Groups	2.351	3	.784	3.411	.019
	Within Groups	31.249	136	.230		
	Total	33.600	139			
Fat	Between Groups	.846	3	.282	1.070	.364
	Within Groups	35.840	136	.264		
	Total	36.686	139			
Carbo-hydrate	Between Groups	1.934	3	.645	2.412	.069
	Within Groups	36.351	136	.267		
	Total	38.286	139			
Mineral	Between Groups	.280	3	.093	.825	.482
	Within Groups	15.405	136	.113		
	Total	15.686	139			
Vitamin	Between Groups	.123	3	.041	.397	.755
	Within Groups	14.048	136	.103		
	Total	14.171	139			
*If Fcal. is equal or greater than Ftab., the differences consider significant at P<0.05.						

Table 4: Association of Proteins, Fats, carbohydrates, Minerals, Vitamins, with social status. (n=140)

The association between nutrients intake with blood test before and after test of anemia.

In table (5) the results showed that there were statistically significant differences when using chi-square ($p<0.05$) for statistical analysis, for relationship between blood test for anemia and consumption of proteins, fats, carbohydrates, minerals and vitamins 0.000, 0.000, 0.000, 0.258 and 0.258, respectively. In the same manner the analysis was done for minerals (0.258) and vitamins (0.258), with blood test but the result was not significant for both. Also, the table showed that before the test, 60% of respondents had weak protein intake, while none had adequate protein intake. After the test, there was a significant improvement, with 58.6% having adequate protein intake and 41.4% having more protein intake. The association between protein intake and anemia was highly significant ($p<0.001$). The respondents had a weak fat intake, before the test it was (64.3%), while only (1.4%) had fatter intake. After the test, there was a significant improvement, with (87.2%) having adequate fat intake and (2.8%) having fatter intake. The association between fat intake and anemia was highly significant ($p<0.001$). Before the test, (87.2%) of respondents had a weak mineral intake, while only (12.8%) had adequate mineral intake. After the test, there was a significant improvement, with 54.3% having adequate mineral intake. The association between mineral intake and anemia was highly significant ($p<0.001$). It is clear from the results obtained that the dietary pattern of the respondents changed positively after they were diagnosed with anemia, which led to an improvement in the level of hemoglobin in the blood, especially at the level of foods rich in protein, fats and carbohydrates, but it was not reflected in minerals and vitamins intake.

The findings are in concordance with the previous studies. According to Rathi *et al.*, (2021), inadequate dietary intake, poor nutritional status, heavy smoking, and alcohol consumption are associated with the risk of anemia. Dietary patterns with high intakes of eggs, meat, organ meats, rice or flour products, fried foods, sugary beverages, and processed foods significantly increased the risk of anemia, and was associated with decreased hemoglobin, hematocrit, and red blood cells, but increased white blood cells and C-reactive protein levels. Moreover, current alcohol drinkers, as well as people who were underweight, overweight, obese, and central obese, were more likely to increase their risk of anemia by 46%, 20%, 23%, 34%, and 28%, respectively. Fishman, (2014) reported that vitamin A can improve haematological indicators and enhance the efficacy of iron supplementation. Both folate and vitamin B12 can prevent and correct megaloblastic anemia, this is consistent with our present study which found that there was significant association between carbohydrate and vitamin intake and anemia. Before the test, 54.3% of respondents had very low blood tests results, 32.9% had weak results, and 12.8% had normal results. After the test, there was a significant improvement, with only 12.8% having very weak results, 72.9% having weak results, and 14.3% having normal results. The association between blood test results for vitamins and anemia was highly significant ($p<0.001$).

Items	Scale	Before Anemia		After Anemia	p- value, sig Chi-square
		%		%	
Protein	Weak	60		0.0	.000
	Adequate	40		58.6	
	More	0		41.4	
	Total	**100**		**100**	
Fat	Weak	64.3		10	.000
	Adequate	34.3		87.2	
	More	1.4		2.8	
	Total	**100**		**100**	
Mineral	Weak	87.2		45.7	.000
	Adequate	12.8		54.3	
	Total	**100**		**100**	
Carbo-hydrate	Weak	58.6		61.4	.258
	Adequate	40		34.3	
	More	1.4		4.2	
	Total	**100**		**100**	
Vitamin	Weak	88.6		52.9	.258
	Adequate	11.4		47.1	
	Total	**100**		**100**	
*P-value considered significant at equal or less than 0.05					

Table 5: Association of Proteins, Fats, carbohydrates, Minerals, Vitamins and blood test before and after test of anemia.

Conclusion

Based on the results, the study concluded that, individuals who consumed insufficient amounts of vitamins had a higher rate of anemia due to chronic diseases compared to those who consumed adequate amounts of vitamins. Income does not play a major role in determining the consumption of these essential nutrients.

Recommendations

Based on the study and the obtained results, the followings are recommended:

1. Consuming iron-rich food such as red meat, poultry, fish, fortified cereals, legumes, beans, and lentils are also good sources of iron.
2. Intake Vitamin C-rich food like citrus fruits and leafy greens can enhance iron absorption. Additionally, vitamin B12 supplements or fortified foods can help maintain healthy RBCs.
3. Whole grains, such as brown rice and whole wheat bread, can also help due to their mineral and vitamin content.
4. A well-planned diet with enough iron and vitamins can help to prevent and treat anemia.

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Disclosure of conflict of interest

All authors have no conflict of interest

Ethical approval

Ethical approval was obtained from the Ministry of Health in Gezira State and the Faculty of Agricultural sciences, University of Gezira ethical committee for the purpose of implementing the study as well as informed verbal consent from all participants

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