RESEARCH ARTICLE

Effects of dietary factors on iron status and body mass index in students

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Abstract

Objective: To analyse the correlation of dietary factors with haemoglobin concentration and body mass index.

Methods: This cross-sectional study was conducted in Shaheed Benazirabad district of the Sindh province in Pakistan from September 2015 to April 2016, and comprised students randomly selected from government schools. Data concerning dietary intake, such as meat, milk, egg and fruits, was noted. Baseline data was compared with haemoglobin and serum ferritin levels. Data was analysed using SPSS 20.

Results: There were 1686 subjects aged 11-18 years; 946(56%) boys and 740(44%) girls. Dietary factors, such as meat, egg and fruits, showed significant association with haemoglobin, serum ferritin levels as well as with Body Mass Index and monthly household income ($p<0.05$). However, milk consumption had non-significant association with haemoglobin ($9p>0.05$).

Conclusion: Iron status in blood was found to be significantly affected by dietary intake, such as meat, milk, fruits and eggs.

Keywords: Diet, Body mass index, Haemoglobin, Serum ferritin, School students. (JPMA 71: 2135; 2021)

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Introduction

Deficiency of micronutrients has markedly raised many health issues worldwide.[1] Iron is commonly deficient in diet, especially in industrial areas, increasing the risk of anaemia. High rate of morbidity and mortality is linked with severe anaemia in children in Africa.[2] Cognitive impairment, decreased productivity and even death can be a result of severe iron deficiency in developed countries.[3] The link between reduced levels of haemoglobin (Hb) and nutrient deficiency was strongly acknowledged amongst college students in Ludhiana, India.[4] Increased iron deficiency anaemia (IDA) and low Hb in children can be because of several factors, such as poor financial position, reduced intake of iron-rich food and inheritance.

In developing countries, like Pakistan, iron deficiency is the most common of all nutritional deficiencies. Children consuming junk food have low Hb, serum ferritin (SF) and body weight.[5]

Poor crop development also limits access to sources of iron intake in Pakistan. Low heme proteins in diet and high phytate content of wheat flour are two of the dietary factors accountable for IDA in our country.[6] The current study was planned to analyse the correlation of dietary factors with Hb concentration and body mass index (BMI) in school-going children.

Subjects and Methods

This cross-sectional study was conducted in Shaheed Benazirabad district of the Sindh province in Pakistan from September 2015 to April 2016. After approval from the ethics review committee of the Peoples University of Medical and Health Sciences, Nawabshah, Pakistan, the sample size was calculated using Raosoft at 95% confidence level and with 2.385% margin of error which was reduced to increase validity of the findings.[7] The sample was selected randomly from among students of government institutions belonging to either gender aged 11-18 years from the rural and urban areas of Sakrand, Nawabshah, Kazi Ahmed and Daur talukas. Those with history of blood disorders, other clinical manifestations and any extensive surgery were excluded, and so were those who were dumb or deaf or unable to communicate properly.

After taking consent, data was collected using a questionnaire exploring education, social class, age, gender and dietary habits.

Students were divided into three groups using the World Health Organisation (WHO) criterion; from 11 years to 13 years and 9 months, from 14 years to 16 years and 9 months, and from 17 years to 18 years.[8] The monthly income of parents were divided into three categories using the Water/Sanitation, Assets, Maternal Education

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and Income (WAMI) index, as: income <Rs: 20,000/m = lower class, income Rs21-27,000 = middle class, and income >Rs28,000 = middle upper class.[9]

BMI was calculated using the standard formula. Blood samples 5cm were collected from all the subjects in tubes containing ethylene diaminetetraacetic acid (EDTA). The evaluation of Hb and SF was done at the Liaquat University of Medical and Health Sciences, Hyderabad. To evaluate SF, 3cc blood was added into the test tube at room temperature for 30 minutes, followed by centrifugation for 15 minutes at 3500rpm. Sysmex Kx-21N Haemoglobin Auto analyser and enzyme-linked immunosorbent assay (ELISA) method were used to evaluate Haemoglobin and Serum Ferritin concentration respectively. WHO cut-off diagnostic values were use for Haemoglobin and Serum Ferritin evaluation for males and females.[10]

Data was analysed using SPSS 20 version which was used to compare mean and standard values, and bivariate correlation test was performed for correlation coefficient. P<0.05 was considered significant.

Results

There were 1686 subjects aged 11-18 years; 946(56%) boys and 740(44%) girls (Figure).

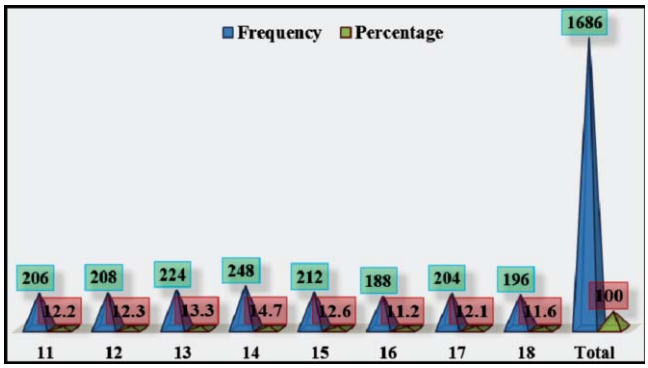

Figure: Age-wise distribution of study subjects (N=1686).

Hb, SF and BMI were higher in subjects consuming meat, eggs and fruits more often (Table-1).

Hb, SF and BMI values were higher in subjects aged 17-19 years compared to the other groups (Table-2).

There was a strong correlation of Hb, SF and BMI values with the consumption of egg, meat, fruit and household income, while daily milk consumption had a negative

Table-1: Asscoiation of weekly diet consumption with haemoglobin (Hb), serum ferritin (SF) and body mass index (BMI) among study subjects (N=1686).

Diets	Diet Intake Weekly	Frequency of Volunteers N	%	Hb gram/dL Mean±S.D	S.F µg/L Mean±S.D	BMI kg/m^2 Mean±S.D	P-Value
Meat consumers	0	14	0.83	12.28±0.77	34.00±10.49	18.42±0.67	P=0.001
	1	878	52.07	11.93±1.05	70.77±46.09	18.68±1.33	
	2	680	40.33	12.61±1.63	113.08±64.07	19.01±1.52	
	3	14	0.83	14.68±1.30	190.0±69.94	21.50±1.15	
	Rarely	100	5.93	11.65±0.98	62.20±31.20	18.51±1.15	
Milk consumers	0	118	7.60	11.82±0.72	108.44±55.18	18.15±0.88	P=0.001
	1	66	3.92	12.02±1.13	78.42±42.06	18.77±1.21	
	2	310	18.38	12.43±1.04	74.31±49.73	19.02±1.16	
	3	228	13.53	12.30±1.57	83.43±60.60	18.87±1.19	
	5	160	9.48	12.14±1.19	91.38±61.86	18.50±1.63	
	7	702	41.64	11.51±1.20	107.67±64.20	18.44±1.51	
	Rarely	102	6.04	11.95±2.88	68.29±34.44	19.28±1.50	
Egg Consumers	0	150	8.89	10.80±0.00	66.73±30.64	17.50±1.00	P=0.001
	1	486	28.82	12.24±0.94	69.79±45.54	18.74±1.13	
	2	348	20.64	12.26±2.0	101.2±61.91	18.93±1.59	
	3	212	12.58	12.25±1.20	96.44±66.31	19.05±1.56	
	4	4	0.23	11.49±0.95	118.0±0.00	17.80±0.00	
	5	108	6.40	12.69±0.97	100.0±70.58	19.18±1.29	
	7	74	4.38	13.22±1.39	134.94±76.80	19.07±1.73	
	Rarely	304	18.03	11.86±1.18	90.53±54.44	18.42±1.59	
Fruit consumers	1	874	51.82	11.92±0.93	73.86±47.67	18.34±1.22	P=0.001
	2	726	43.06	12.35±1.63	95.06±59.75	18.94±1.39	
	3	78	4.62	14.25±1.00	178.28±62.89	20.94±1.84	
	Rarely	8	0.5	11.75±1.01	112.5±61.47	20.1±1.38	
All Diets consumers	Total	1686	100.0	12.21±1.37	88.0±58.44	18.73±1.45	P=0.001

Rarely= Children who did not take food components daily or weekly but consumed once or more after a week. SD: Standard Deviaition, SF=Serum Ferritin

Table-2: Age-wise mean values of Haemoglobin (Hb), Serum ferritin (SF) and body mass index (BMI) of the study subjects (N =1686).

Age group (years)	Frequency of variable N	%	Hb gram/dL Mean±S.D	S.F µg/L Mean±S.D	BMI kg/m^2 Mean±S.D
11 years-13 years and 9 months	638	37.84	12.09±1.16	83.63±57.90	18.20±1.59
14 years-16 years and 9 months	648	38.43	12.13±1.61	84.03±59.29	18.63±1.35
17 years-18 years	400	23.74	12.22±1.25	85.21±57.19	18.79±1.37
Total	1686	100	12.21±1.37	88.0±58.44	18.73±1.45

SD: Standard deviation.

Table-3: Correlation co-efficient of dietary factors with monthly income, haemoglobin (Hb), serum ferritin (SF) and body mass index (BMI) of the study subjects (N=1686).

Variable	Hb	BMI	S.F	M.Income
Meat	0.365**	0.250**	0.390**	0.470**
Egg	0.396**	0.177*	0.213**	0.374**
Milk	-0.13*	0.092*	0.076*	0.104*
Fruit	0.391**	0.337**	0.325**	0.467**

**Correlation is significant at the P< 0.01 level.

correlation with Hb (Table-3).

Discussion

The current study is the first such survey done among the students of Shaheed Benazirabad in the Sindh province of Pakistan.

Earlier studies showed relationship between Hb deficiency and low intake of meat per week.[11] Since meat is invariably cooked before it is eaten, little nutritional significance can be attached to the inhibition of Hb absorption. A study done in Gaza showed 12% students aged 12-18 years had meat on a daily basis.[12] Some studies showed SF having a weak positive correlation with meat intake. The data for positive correlation between meat and vegetable with health status is complex to figure out.[13] The current study found a significant positive correlation of Hb, SF and BMI with meat intake.

In the current study, a regular habit of taking cow's milk on a daily basis was found to be prevalent in the rural population. A relation was found between weekly intake of milk with Hb and BMI. Also, milk intake was associated with iron status, Hb, SF and BMI.

An earlier study showed a negative relation between SF and intake of eggs, while other studies found no relationship between iron statuses and egg intake.[9,14,15] In the current study, egg was significantly associated with Hb, SF BMI and household income.

The current study also found that iron absorption was highly affected by fruit and vegetable consumption. Other studies, however, reported no relation between fruit intake and SF level.[16-18]

In view of the findings, it is suggested that the doctors should take into account the need for protein-rich and balanced diet for subjects of all age groups. Also, Hb and SF should be considered vital diagnostic tools in anaemic patients.

Further large-scale studies are needed to support the findings of the present study.

Conclusion

Iron status in blood was found to be significantly affected by dietary intake, such as meat, milk, fruits and eggs.

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Conflict of Interest: None.

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