Factors Associated with Inadequate Dietary Iron Intake among University Female Students in Makkah , Saudi Arabia

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Abstract: Iron deficiency is the most common nutritional problem among females. The aim of the current study was to evaluate the dietary iron intake and the factors influencing it among university female students in Makkah ,Saudi Arabia. A Cross sectional study was conducted on 240 students. Self -administered questionnaire was used to collect demographic, medical, and dietary histories. Weight, height, and Body Mass Index(BMI) were recorded**.** The Arab Food Analysis Program was used for energy and nutrient analysis**.** Results showed that (42.5%) of students had inadequate dietary iron intake. The inadequate group was consuming < 80% of the recommendation of almost all macro and micronutrients (P < 0.001). Regression analysis showed that skipping meals, taking phosphorus, and niacin below 80 % Recommended Daily Allowance (RDA)were independently related to inadequate iron intake (P < 0.05). It is advisable to design nutrition educational program to improve students' awareness of this problem.
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Keywords: iron intake, university females, dietary recommendations, eating habits, iron deficiency.

1. Introduction

Iron is an essential nutrient for humans, having a non replaceable position in a number of physiological processes. Deficient iron intake can in the long run lead to iron deficiency anemia, which is in turn potentially associated with adverse health outcomes.[1] Iron deficiency is the most common nutritional disorder worldwide, affecting people of all ages in both industrialized and developing countries. [2] Some subgroups of the population are more at risk than others; women of reproductive age have a higher risk of developing iron deficiency. [3]

In the Eastern Mediterranean Region (EMR), a total of 149 million people are iron deficient or anemic according to the World Health Organization (WHO) criteria. Eighty three million of them are women .In fact the prevalence of anemia in the Gulf Region ranged from 15 to 48% in women of childbearing age. In Saudi Arabia the overall country prevalence was 30 to 56%. [4]The major factor that cause anemia is insufficient intake of iron and/or factors that affect its absorption. However, no study until now evaluated iron intake of adult Saudi women, [5]so this study was designed to evaluate the dietary iron intake status and the dietary factors influencing it among a sample of Umm Al-Qura university female students in Makkah ,Saudi Arabia.

2. Materials and Methods

Study design and setting

This was a descriptive cross - sectional study conducted at Umm Al Qura University in Makkah Governorate, female students who agreed to participate were included. The study protocol, including data collection, was approved by the University Board.

Sample

This study was conducted from November 2010 to April 2011.The study included a convenient sample of 240 students (equal number were taken from medicine, nurse, pharmacy, health administration, laboratory medicine, and clinical nutrition departments) enrolled at Umm Al Qura University in Makkah Governorate. Pregnant and breast feeding females were excluded.

Data collection

A pretested, structured self -administered questionnaire was used. It consisted of 3 parts:

- Part 1: socio-demographic characteristics
- Part 2: present and past medical conditions including nutritional supplement and history of anemia
- Part 3: dietary history. This was further divided into 3 sections:

I- **Dietary habits:** Students were asked to report their dietary behaviors such as eating breakfast, skipping meals, number of meals per day, drinking of citrus juice, milk, coffee, and tea.

II- **Food frequency questionnaire (FFQ):** The students' food intake frequencies were classified into three categories: daily, weekly and monthly. In this questionnaire the food was divided into five major groups: Vegetables, Fruits, Grains, Dairy products, and Protein foods. [6]

III- **Food Record:** The participants recorded their food intakes in a diary during 3 consecutive days. Each diary consisted of five eating occasions: breakfast, lunch, dinner, morning and afternoon snacks. The students were asked to give a detailed description of the foods eaten, if possible to give a brand name and to estimate the amounts using natural measures (e.g. pieces, slices, etc.) or household measures (e.g. coffee spoon, cup, etc.). A standardized protocol was used, including a manual on household weights and measures, to convert the estimated amounts into weights. [3]The Arab Food Analysis Program version 10 was used for energy and nutrient analysis.

The Macronutrient and micronutrient intakes were referenced against the Dietary Reference Intakes of the National Academies Press. [7]The Acceptable Macronutrient Distribution Range (AMDR) of fat, protein, and carbohydrates were established at 30 %, 15 % and 55% respectively. [8] In this study intake of less than 80% of RDA and AMDR was used to define a macro or micronutrient deficiency. [9]

The recommended daily energy intake was used to define the caloric needs of individuals based on resting energy expenditure and activity level for a given age. [9]Energy intake was calculated by using Harris Benedict equation.

Harris Benedict formula for Women:

Total daily calorie needs = {655.09 + (9.56× weight in kilograms) + (1.84× height in centimeters) – (4.67× age in years)} × activity factor (moderate activity 1.55)

In this equation the actual weight was used if the BMI was normal, but if the BMI was greater than 30 the adjusted body weight was used. [10]

Adjusted body weight = IBW (ideal body weight) + [(actual body weight – IBW) x 0.25]

IBW = 45.5 kg + 2.3 kg for each inch over 5 feet in height. [11]

Anthropometric measurements

- **Height :** was measured in centimeters to the nearest 0.5 cm using the ordinary tape measure. The student stood without shoes and stood straight with the head in the Frankfurt plane, feet together, knee straight, and heels, buttocks, and shoulder blades in contact with the wall. [8]
- **Weight:** was measured in kilograms to the nearest 0.1 kg using common health balance while the participant stood without shoes and lightly clothing. The balance was placed on a hard, flat surface (not carpet) and checked and adjusted for zero-balance before each measurement. The subject stood in the center of the flat form and looked straight ahead, standing unassisted and relaxed. [8]
- **Body Mass Index (BMI)**: was calculated as weight in kilograms divided by the square of height in meters. [12] BMI of students was categorized according to the WHO criteria (underweight: < 18.5, desirable weight: 18.5 to 24.9, overweight: 25 to 29.9, obese: ≥ 30). [13]

Statistical analysis

Statistical analysis was performed using the Statistical Package for Social Science (SPSS) version 16 (SPSS Inc., Chicago, IL, USA.). Students were classified based on their daily iron intake into: adequate iron intake (≥ 80 % RDA) and inadequate iron intake (< 80 % RDA). [9, 14]For the quantitative variables, compliance with the normal distribution was assessed using the Kolmogorov-Smirnoff test, as appropriate. In case of continuous variables, T test was chosen if the distribution was normal, otherwise a non-parametric test was used (Mann- Whitney test). Pearsons Chi square (x^2) test or Fisher's Exact test were used for categorical variables. Unconditional logistic regression was used to study the association of inadequate iron intake and varies variables investigated in this study. P value of less than (0.05) was considered to indicate statistical significance.

3. Results

From the 240 participants (57.50%) had adequate dietary iron intake (≥ 80 % RDA), while, (42.50%) had inadequate intake (< 80 % RDA) (figure1). An overview of their sociodemographic characteristics is given in Table 1. Students of both groups were comparable regarding their socio-demographic characteristics, 62.1% of students were more than 20 years of age. (53.3%) of their mothers were university graduated or had a high degree of education. In addition (66.7%) of students' mothers were unemployed, and (92.5%) of them reported that they had a family income of ≥ 5000 S.R/month.

The distribution of the studied students according to their medical history showed that headache, and dizziness were significantly associated with inadequate dietary iron intake (P< 0.05). In addition anthropometric assessment revealed that both groups were comparable, where (19.57%) of the adequate group compared to (16.67%) of inadequate group were under weight, also (58.59%) of adequate group compared to (57.80%) of inadequate group had normal BMI (Table 2)

Table 3 shows that (52.9%) of the adequate group compared to (29.4%) of the inadequate group were always or often having breakfast, (p<0.05).Moreover, high percentage of the inadequate group (71.5%) was always or often

skipping meals and (75.4%) ate less than three meals per day (p<0.01).

According to frequency of food consumption as shown in table 4, frequency of consumption of tomato, whole and skimmed milk, tea, and cola varied significantly between the studied groups (P < 0.0 5).

Table 5 represents the mean macro and micro-nutrients intake and their Reference Intake among female students. The relative energy contribution of carbohydrate in diets was less than the recommended, while the relative energy contribution of protein and fat were more than the recommended. However, the students received lower than the recommended intake of fiber, cholesterol, and almost all minerals and vitamins.

Comparison of the mean intake of macro and micro-nutrients among both groups is shown in table 6. Apart from the contribution of fat to the total daily energy consumption, there was significant difference between the adequate and inadequate groups regarding the intake of macronutrient elements. In addition, among the enhancers of iron absorption, vitamin A, vitamin C, and riboflavin varied significantly between both groups (P < 0.001).

Figure 2 shows that the inadequate group were consuming less than 80% of the recommended intake of all macro and micro-nutrient elements except fiber, zinc, Vitamin C, D, and B12 (P < 0.0 5).

Regression analysis of the variables associated with inadequate dietary iron intake is shown in table 7, skipping meal, taking phosphorus, and niacin below 80 % RDA were the independent variables related to inadequate dietary iron intake (P < 0.05).

Table 1:Socio-demographic characteristics of the studied students.

Variables	Iron intake						P*
	Adequate (n=138)		Inadequate (n=102)		% of total students		
	n	%	n	%	n	%	
Age groups in years							
≤ 20	55	39.9	36	35.3	91	37.9	0.472
>20	83	60.1	66	64.7	149	62.1	
Marital intake							
Married	12	8.7	6	5.9	18	7.5	0.413
Single	126	91.3	96	94.1	222	92.5	
Education of father							
Illiterate /Can read and write.	3	2.2	2	2.0	5	2.1	
Primary/intermediate school.	16	11.6	12	11.8	28	11.7	0.998
Secondary school.	34	24.6	26	25.5	60	25.0	
University graduate/postgraduate.	85	61.6	62	60.7	147	61.2	
Education of mother							
Illiterate / can read and write.	10	7.2	4	3.9	14	5.8	
Primary/intermediate school.	15	10.9	18	17.6	33	13.8	0.264
Secondary school.	41	29.7	24	23.5	65	27.1	
University graduate /postgraduate.	72	52.2	56	54.9	128	53.3	
Occupation of father							
Professional/managerial	39	28.3	21	20.6	60	25.0	
Technical/clerical	14	10.1	9	8.8	23	9.6	0.682
Skilled worker	11	8.0	10	9.8	21	8.8	
Partly skilled	4	2.9	3	2.9	7	2.9	
Unskilled	42	30.4	40	39.3	82	34.1	
Unemployed	28	20.3	19	18.6	47	19.6	
Occupation of mother							
Professional/managerial	14	10.1	5	4.9	19	7.9	
Technical/clerical	25	18.1	24	23.5	49	20.4	
Skilled worker	1	0.7	0	0.0	1	0.4	
Partly skilled	0	0.0	1	1.0	1	0.4	0.050
Unskilled	2	1.5	8	7.9	10	4.2	
Unemployed	96	69.6	64	62.7	160	66.7	
Income (SR/month)							
< 5000	8	5.8	10	9.8	18	7.5	0.331
≥ 5000	130	94.2	92	90.2	222	92.5	

SR, Saudi Riyal, *:Chi -Square test.

Table 2: Medical history and BMI of the studied students

Variables	Iron intake				% of total students	P*
	Adequate (n=138)		Inadequate (n=102)			
	n	%	n	%		
Headache						
Yes	119	86.23	96	94.12	89.58	0.048
No	19	13.77	6	5.88	10.42	
Fatigue						
Yes	133	96.38	98	96.09	96.25	0.904
No	5	3.62	4	3.91	3.75	
Dizziness						
Yes	101	73.19	86	84.31	77.92	0.040
No	37	26.81	16	15.69	22.08	
Blurred vision						
Yes	70	50.72	56	54.90	52.50	0.522
No	68	49.28	46	45.10	47.50	
Difficult to concentrate						
Yes	108	78.26	80	78.43	78.33	0.975
No	30	21.74	22	21.57	21.67	
Lack of appetite						
Yes	107	77.54	82	80.39	78.75	0.593
No	31	22.46	20	19.61	21.25	
Bleeding gum						
Yes	74	53.62	47	46.08	50.42	0.248
No	64	46.38	55	53.92	49.38	
Hair Loss						
Yes	112	81.16	89	87.25	83.75	0.206
No	26	18.74	13	12.75	16.25	
Pale skin						
Yes	54	39.13	49	48.04	42.92	0.168
No	84	60.87	53	51.96	57.08	
Menstrual cycle irregularly						
Yes	102	73.91	86	84.31	78.33	0.053
No	36	26.09	16	15.69	1.67	
Past history of anemia						
Yes	45	32.61	18	17.65	26.25	0.009
No	93	67.39	84	82.35	73.75	
Iron supplementation						
Yes	35	25.36	20	19.61	22.92	0.294
No	103	74.64	82	80.39	77.08	
BMI categories						
Underweight	27	19.57	17	16.67	18.34	0.880
Normal	81	58.69	59	57.84	58.33	
Overweight	20	14.49	18	17.65	15.83	
Obese	10	7.25	8	7.84	7.50	

*:Chi - Square test.

Table 3: Some dietary habits as stated by the studied students

Variables	Iron intake				% of total students	P*
	Adequate (n=138)		Inadequate(n=102)			
	n	%	n	%		
Eating breakfast						
Always	33	23.9	17	16.7	20.8	0.002
Often	40	29.0	13	12.7	22.1	
Sometime	63	45.7	67	65.7	54.2	
Never	2	1.4	5	4.9	2.9	
Skipping meal						
Always	14	10.1	24	23.5	15.8	< 0.001
Often	53	38.4	49	48.0	42.5	
Sometime	60	43.5	25	24.6	35.4	
Never	11	8.0	4	3.9	6.2	
Number of meals/ day						
One meal	2	1.4	8	7.8	4.2	< 0.001
Two meals	72	52.2	69	67.6	58.8	
Three meals	55	39.9	20	19.6	31.2	
> 3 meals	9	6.5	5	4.9	5.8	
Drink citrus juice with a meal						
Yes	54	39.1	24	23.5	32.5	0.011
No	84	60.9	78	76.5	67.5	
Take milk or milk product with a meal						

Yes	53	38.4	25	24.5	32.5	0.023
No	85	61.6	77	75.5	67.5	
Drink tea/coffee directly after a meal						
Yes	38	27.5	31	30.4	28.8	0.629
No	100	72.5	71	69.6	71.2	

***:** Chi- Square test.

Table 4: Distribution of the studied students according to frequency of consumption of selected types of food

Food	Never					Daily					Weekly					P *
	Adequate		Inadequate		Total †	Adequate		Inadequate		Total †	Adequate		Inadequate		Total †	
	n	%	n	%		n	%	n	%		n	%	n	%		
Brown bread	52	37.7	47	46.1	41.2	49	35.5	37	36.3	35.5	37	26.8	18	17.6	26.8	0.206
White bread	28	20.3	19	18.6	19.6	74	53.6	60	58.8	55.8	36	26.1	23	22.5	24.6	0.717
White rice	15	10.9	15	14.7	12.5	52	37.7	35	34.3	36.2	71	51.4	52	51.0	51.2	0.645
Pasta	56	40.6	47	46.1	42.9	12	8.7	7	6.9	7.9	70	50.7	48	47.1	49.2	0.663
Citrus fruit	29	21.0	21	20.6	20.8	63	45.7	40	39.2	42.9	46	33.3	41	40.2	36.2	0.513
Dates	46	33.3	32	31.4	32.5	38	27.5	32	31.4	29.2	54	39.1	38	37.3	38.3	0.811
Spinach	116	84.1	88	86.3	85.0	2	1.4	1	1.0	1.2	20	14.5	13	12.7	13.8	0.875
Tomato	20	14.5	22	21.6	17.5	66	47.8	33	32.4	41.2	52	37.7	47	46.1	41.2	0.048
Potato	34	24.6	24	23.5	24.2	19	13.8	18	17.6	15.4	85	61.6	60	58.8	60.4	0.713
Full fat milk	74	53.6	72	70.6	60.8	24	17.4	12	11.8	15.0	40	29.0	18	17.6	24.2	0.028
Skimmed milk	125	90.6	81	79.4	85.8	10	7.2	13	12.7	9.6	3	2.2	8	7.8	4.6	0. 033
Meat	60	43.5	38	37.3	40.8	6	4.30	7	6.9	5.4	72	52.2	57	55.9	53.8	0.499
Chicken	7	5.1	9	8.8	6.7	51	37.0	29	28.4	33.3	80	58.0	64	62.7	60.0	0.254
Egg	29	21.0	27	26.5	23.3	19	13.8	19	18.6	15.8	90	65.2	56	54.9	60.8	0.266
Tea	43	31.2	34	33.4	32.1	55	39.9	52	51.0	44.6	40	29.0	16	15.7	23.3	0.046
Coffe	29	21.0	30	29.4	24.6	66	47.8	42	41.2	45.0	43	31.2	30	29.4	30.4	0.314
Cola	73	52.9	31	30.4	43.3	25	18.1	37	36.3	25.8	40	29.0	34	33.3	30.8	<0.001

Adequate (n=138), Inadequate (n=102). †: % of total students, *: Chi- Square test.

Table 5: The macro and micro-nutrients intake (Mean & SD) and their Reference Intake of female students

Nutrients	Actual intake (A)		Reference	% of + or – of A over R	
	Mean	SD	Intake (R)	Mean	SD
Macronutrients					
Energy (kJ/day)	5338.59	2303.91			
% energy from protein	17.97	6.00	15	+19.78	39.97
% energy from fat	31.58	7.79	30	+5.27	25.95
% energy from carbohydrates	50.45	9.97	55	-8.27	18.13
Fiber (g/day)	6.93	3.82	25	-72.26	15.29
Cholesterol (mg/day)	161.30	138.79	300	-46.23	46.26
Minerals					
Phosphorus (mg/day)	909.39	584.07	700	+29.91	83.43
Calcium (mg/day)	460.14	305.21	1000	-53.99	30.52
Potassium (mg/day)	1507.49	1525.82	4700	-67.93	32.46
Zinc (mg/day)	0.70	1.12	8	-91.26	14.05
Iron (mg/day)	18.37	13.47	18	+2.04	74.82
Vitamins					
Vitamin A (µg/day)	282.60	262.22	700	-59.63	15.29
Vitamin C (mg/day)	29.06	37.79	75	-61.25	50.38
Thiamin (mg/day)	0.37	0.30	1.1	-66.31	27.13
Riboflavin (mg/day)	1.06	1.16	1.1	-4.08	105.63
Vitamin D (µg/day)	2.06	2.71	15	-86.25	18.06
Vitamin B12 (µg/day)	0.19	0.34	2.4	-91.98	14.11
Niacin (mg/day)	14.91	18.62	14	+6.48	132.99

Table 6: The macro and micro-nutrients intake (Mean ± SD) of female students

Nutrients	Iron intake				P * value	95% CI
	Adequate n=138		Inadequate n=102			
	Mean	SD	Mean	SD		
Macronutrients						
Energy (kJ/day)	6179.30	2315.72	1003.50	448.86	<0.000	597.49-347.20
Protein (g/day)	73.40	38.02	38.38	19.96	<0.000	42.49-27.55
Fat (g/day)	53.57	25.21	35.23	20.42	<0.000	24.15-12.54
Carbohydrate (g/day)	175.04	62.48	133.25	64.80	<0.000	58.22-25.36
% energy from protein	19.64	5.84	15.71	5.46	<0.000	5.37-2.48
% energy from fat	31.87	7.14	31.19	8.60	0.518	2.74-1.39
% energy from carbohydrate	48.50	8.73	53.10	10.95	0.001	2.00-7.19
Fiber (g/day)	8.20	3.87	5.22	3.02	<0.000	3.86-2.11
Cholesterol (mg/day)	199.48	155.16	109.65	90.77	<0.000	121.31-58.3
Minerals						
Phosphorus (mg/day)	1217.50	557.72	492.44	282.57	<0.000	833.81-616.49
Calcium (mg/day)	552.13	269.15	335.69	308.17	8.650	291.69-141.20
Potassium (mg/day)	2266.90	1594.90	480.11	452.70	<0.000	2069.03-1504.47
Zinc (mg/day)	0.89	1.32	0.45	0.73	0.003	0.70-0.17
Iron (mg/day)	26.09	12.93	7.92	3.29	<0.000	20.44-15.90
Vitamins						
Vitamin A (µg/day)	356.80	286.45	182.26	183.63	<0.000	234.47-114.61
Vitamin C (mg/day)	34.27	40.83	22.01	3.21	<0.000	21.53-2.98
Thiamin (mg/day)	0.47	0.34	0.42	0.17	<0.000	0.29-0.16
Riboflavin (mg/day)	1.35	1.42	0.66	0.42	<0.000	0.93-0.43
Vitamin D (µg/day)	1.91	2.12	2.26	3.35	0.471	0.40-1.09
Vitamin B12 (µg/day)	0.26	0.40	0.11	0.19	0.002	0.23-0.07
Niacin (mg/day)	21.86	21.30	5.50	7.04	<0.000	20.19-12.52

*: Mann-Whitney test

Table 7: Regression analysis of the variables associated with dietary iron intake

Variables		P value	Odds ratio	95% CI
Eating breakfast (yes)		0. 890	0.968	0.62-1.53
Skipping meal (yes)		0. 032	1.675	1.04-2.69
Drink citrus juice with a meal (yes)		0. 451	0.728	0.32-1.66
Take milk or milk product with a meal (Yes)		0. 124	0.515	0.22-1.20
Drink tea/coffee directly after a meal (yes)		0. 437	1.778	0.65-,4.88
Energy	(< 80 % RDA)	0. 330	1.660	0.60-4.60
Cholesterol	(< 80 % RDA)	0. 998	2.00	0.00-0.00
Phosphorus	(< 80 % RDA)	<0.001	6.547	2.54-16.91
Calcium	(< 80 % RDA)	0.161	2.786	0.67-11.68
Potassium	(< 80 % RDA)	0.998	5.00	0.00-0.00
Zinc	(< 80 % RDA)	1.000	1.00	0.00-0.00
Vitamin A	(< 80 % RDA)	0.809	0.867	0.27-2.75
Vitamin C	(< 80 % RDA)	0.602	1.313	0.47-3.65
Thiamin	(< 80 % RDA)	0.998	9.00	0.00-0.00
Riboflavin	(< 80 % RDA)	0.275	1.553	0.71-3.42
VitaminB12	(< 80 % RDA)	1.000	0.000	0.00-0.00
Niacin	(< 80 % RDA)	0.025	2.579	1.13-5.91

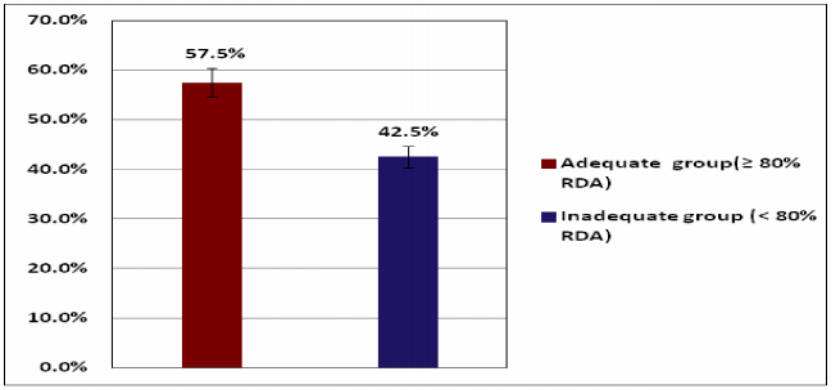

Figure 1: Distribution of the studied students according to their dietary iron intake

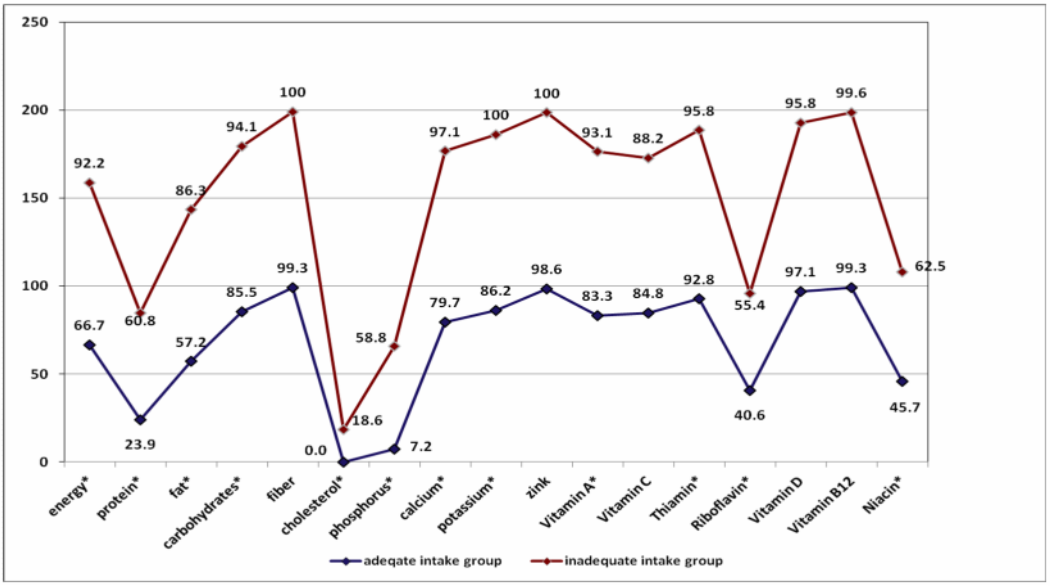

Figure 2: Percentage of students whose nutrients intake was below 80% RDA (macro and micro-nutrients)
***Significant difference between the two groups by chi- square test (p<0.05)**

4.Discussion

Iron deficiency is the most common micronutrient deficiency in the world. It affects all age groups in both developing and developed countries. Dietary iron intake is one of the regularity factors of iron status and therefore important in the prevention of iron deficiency. [15]

In the present study the intake of dietary iron was adequate for (57.50%) and inadequate for (42.50%) of students when compared to (80%) of RDA, this result agrees with **Story and Stang (2005).** [14] However, **Abdeen et al. (2002)** reported that the prevalence of inadequate iron intake among Palestinian females of the same age group in West Bank and Gaza Strip was (72.70%, 73.50%) respectively, when using (80%) of RDA as a cutoff point . [9] This study was also, inconsistent with **Al-Rewashedh and Al-Dmoor (2010), Sato et al. (2010), and Pynaert et al. (2005),** who found that iron intake was inadequate among (22.20% , 31.00%, 99.40%) of the studied students respectively. [8, 15, 16] However, a comparison of the results of the present study with other studies needs to be interpreted carefully because of differences in the study population, study design and cutoff points used to identify inadequate iron intake.

A past medical history of iron deficiency anemia had been reported to be a risk factor for a subsequent recurrence. [4] In this study the results show that significantly (32.60%) of adequate group versus (17.60%) of the inadequate one had a past history of anemia, this result agrees with **Al-Sayes et al. (2011), and Al-Quaiz (2001).** [4, 17]

Adequate nutrition is critically important for the achievement of the young women optimal performance. [18] The proportion of energy derived from macronutrients has been used to assess the quality of diet and distribution of macronutrient intake of individuals. [19]According to the results of this study, the relative contribution of macronutrients to the total energy intake of students was well within dietary guidelines for a healthy diet and met the population nutrient goals recommended. [6, 7] The distribution of energy from macronutrients in the diets of Saudi students as found in this study was also comparable to that of Singaporeans and the Hong Kong Chinese but proportionately less carbohydrate and more fat than the Japanese. [20] However, in comparison to their Western counterparts, Saudi students consumed proportionately more carbohydrate but less fat compared to the British (carbohydrate: 45.00%, protein: 16.00%, fat: 39.00%), Australians (carbohydrate: 45.00%, protein: 17.00%, fat: 32.00%), [19] and Belgium (carbohydrate: 47.00%, protein: 16.00%, fat: 36.00%). [3] On the other hand, consumed proportionately less carbohydrate but more fat compared to Poland (carbohydrate: 58.00%, protein: 16.00%, fat: 26.00%).[21]

The frequency of meals should provide a relatively even distribution of nutrient intake. It would be optimal to have four-five meals daily and, if possible, always have them at the same time during the day. [22] This objective was not achieved by the students at all, their tight curricular timetable being one of the major impediments.

Vitamin C (Ascorbic acid) is known as a powerful enhancer of iron absorption from non-meat foods

when consumed within a meal. [23]In the present study (42.90 %) of students reported that they were consuming vitamin C containing fruits (citrus fruits) daily and (32.50%) of them were drinking vitamin C containing juice with meals. This is in accordance with other studies. [17, 23]

Vitamin A may help improve iron status, and perhaps because of their relationship to stomach acidity levels. [24] In this research, it was found that (87.50%) of total students consuming less than the recommended intake of vitamin A, and the mean intake of vitamin A was higher in the adequate group than the inadequate one. This result was compatible with **Abdeen et al. (2002),**[9] but it was conflicting with **Story and Stang (2005).** [14]

Vitamin B_2, also commonly called riboflavin, plays an important role in other nutrients, especially iron, zinc, folate, vitamin B3 and vitamin B12 which are not fully available in the body without adequate supplies of riboflavin**.** [25] According to this study, (75.50%) of the inadequate group had a lower intake of riboflavin than the recommended compared to (40.60%) of the adequate group. Moreover, there was an association between lower daily dietary iron intake, and lower daily intake of riboflavin, this result agrees with **Biro et al. (2005), and Jaworowska and Bazylak (2007) ,**[26, 20] but it disagrees with **Al-Rewashedh and Al-Dmoor (2010).** [8]

Important iron absorption inhibitors are polyphenols (gallolyl groups), present in tea, coffee and cocoa. Many studies have reported such an inhibitory effect**.** [27] According to FFQ, the present study revealed significant association between the daily consumption of cola and dietary iron intake, where higher percent of the inadequate group consumed cola daily. This result was compatible with **Pynaert et al. (2005),** [15]and inconsistent with **Al-Sayes et al. (2011), Sato et al. (2010), and Al-Quaiz (2001).** [4, 16, 17]On the other hand no association was found between iron intake and drinking tea and coffee directly after meal, this is possibly because drinking tea and coffee after a meal is a common dietary habit in Saudi Arabia and to detect a significant difference between adequate and inadequate group a bigger sample size is .

It should be noted that results of this preliminary study may not be amenable for generalization because of restricting participants to student females from one university only. Over- and underestimation of intakes are a notable limitation of all self-reported dietary assessment data. Under -reporting of intakes cannot be ruled out and may have been a factor in the unusually low nutrients intakes reported here.

5. Conclusion

The study revealed that high percentage of students had inadequate dietary iron intake. Dietary habits played an important role in this study, high percentage (more than half) of the inadequate group didn't take breakfast, and always or often skipped meals. According to the FFQ, the inadequate group consumed more tea and cola daily which have negative influence on iron absorption. Daily intake of micronutrients fell short of the recommended intake in both groups. However, it was lower in the inadequate group.

Recommendation

Nutrition educational programs to improve public awareness of this problem, causes and advocate healthy dietary habits, are needed. Further extension of the present study is needed to verify and validate findings presented here and correlate the presence of dietary iron deficiency with biochemical analysis of iron deficiency, and iron deficiency anemia science diagnosis of iron deficiency cannot be based on inadequate dietary intake alone.

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