

*Original Article****Body mass index and blood cell indices in students of Para-medical Faculty, Babol University of Medical Sciences***Farahnaz Sadighian¹ **Haydeh Alaoddolehei***¹ Parvin Sajjadi² Narges Kalantari³ Sorayya Khafri⁴

1. Department Of Laboratory Sciences, Faculty of Para- Medicine, Babol University of Medical Sciences

2. Department of Social Medicine, Faculty of Medical, Babol University of Medical Sciences, Babol, Iran.

3. Department of Laboratory sciences, Faculty of Para- Medicine, Cellular and Molecular Research Center, Health Research Institute, Babol University of Medical Sciences, Babol, Iran.

4. Department of Social Medicine, Faculty of Medical, Babol University of Medical Sciences, Babol, Iran.

*Correspondence to: Haydeh Alaoddolehei

alace.ha@gmail.com

Abstract

Background and purpose: Approximately one-third of the world's population suffers from anemia. Anemia in adults causes irritability, impaired mental focus, difficulty in daily activities, and sleep. Body mass index is an indicator of nutritional status in adults. The current study aimed to assess the body mass index and blood indices of students in local domain.

Materials and Methods: This cross-sectional study was performed on the students of Babol University of Medical Sciences. Body mass index value was obtained based on weight and height for each case. Cell blood count was also carried out for each participant. Hemoglobin of less than 12 g/dl and 13g/dl were considered as anemia in females and males, respectively.

Results: Of 312 sample students, 212 cases were female and 100 were male. The average Body mass index and hemoglobin were 22.8 kg/m² and 14 g/dl, respectively. Fifty-five (17.6%) students were anemic. Also, the analysis of distribution of Body mass index measurement by gender showed that being underweight was more prevalent in females (9.4%) in comparison with males (5%). The highest prevalence rate of anemia was observed in the cases that had Body mass index ≥ 25 . Overall, not any significant statistical difference was observed between Body mass index and anemia.

Conclusion: With regard to the results, overweight and obesity were associated with a lower probability of anemia in students. It was also revealed that anemia and emaciation, mainly observed in female students, should be considered as major issues for health care system. Furthermore, public health intervention to prevent combined micronutrient deficiencies and overweight/obesity was suggested. An investigation of the potential causes of this phenomenon was also recommended.

Key words: Anemia; BMI; Students; Obesity; Health

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1. Introduction

Anemia is a public health problem in both developed and developing countries especially in young people (1). It mainly affects adolescents' physical performance, growth, as well as school performance and attendance. It may also cause difficulty in their concentration and result in their impatience, which could then affect their health conditions and socio-economic development (2,3). Approximately, one-third of the world's population suffers from anemia. Prevalence of anemia in Iran has been reported from about 50% in Zanjan province (Iran) (4) and ranging between 7.9% to 25.1% in Tabriz and Gorgan (Iran) (5, 6). However, different risk factors have been considered for anemia such as nutrients uptake and body mass index (BMI). BMI as the ratio of weight and height is widely used to evaluate the nutritional and health status of an individual (7). Some studies have shown that a BMI of less than 20 or greater than 30 is a risk factor and may increase mortality rate (8). Furthermore, several studies have shown that obesity is a risk factor for anemia (3, 9). For instance, a study demonstrated that the risk of anemia increases to 1.6-fold with one unit increase of BMI (9). Another study reported a significant correlation between BMI and anemia in male students (10). The coexistence of obesity and anemia may be the result of the consumption of energy-dense foods that are poor sources of iron (11) or occur due to poor iron absorption and/or utilization due to obesity-related inflammation (12, 13). However, there is a limited understanding of the relationship between overweight and anemia in developing countries, where anemia is more prevalent, particularly among young

people (14). The main aim of the present study was to evaluate the body mass index and blood indices of students aged between 18-26 years.

2. Materials and Methods

The participants of the current study were selected from among the university students of Para-medical Faculty, Babol university of Medical Sciences, Babol, northern Iran. They participated in the study from September 23rd, 2012 to January 21st, 2013. The main objective of the study was explained in detail for all participants, and then a written formal consent was obtained. The demographic (age, gender, educational level, and current residence) and occupational information was collected through filling out questionnaire. All participants with any internal diseases were excluded from the study. Two milliliters of blood was taken from each participant, and then collected in a tube containing anti-coagulant (EDTA) in order to be transported to the designated lab. Cell blood count was performed by Sysmex (XS-1000i). Hemoglobin of less than 12 g / dl and 13g / dl were considered anemia in women and men, respectively. Also, HCT, RDW, MCV and Mentzer indices were evaluated in anemic persons. The Mentzer index is defined as mean corpuscular volume per red cell count. An index of less than 13 suggests that the patient has the thalassemia trait, and an index of more than 13 suggests that the patient has iron deficiency ([http:// emedicine.medscape.com/](http://emedicine.medscape.com/)). The following formula was used to assess the students' body mass index: $BMI (kg/m^2) = Weight(kg) / Height (m^2)$. The height of participants was measured by a ruler with 0.5 cm accuracy without shoes and leaning against wall in a standing position. The

weight of participants was also measured by a scale (Armin Rudd) with an accuracy of 0.5 kg in weight with minimal cloth and without shoes. The subjects were then divided to four groups according to the WHO criteria (Table1) (15).

Table 1. BMI standard levels by WHO criteria

Category	BMI (kg/m ²)
Underweight	<18.4
Normal	18.5-24.9
Overweight	25-29.9
Obese	>30

The collected data were analyzed by SPSS Software version18 using Chi-Square and

descriptive statistics. A P value of less than 0.05 and 95% confidence level was considered statistically significant. It should be mentioned that the current study was approved by the Ethical Committee of the Research Council of Babol University of Medical Sciences, Babol, Iran.

3. Results

In total, from 342 university students who participated in the present study 30 cases were excluded because of exclusion criteria or incomplete information. Also, 212 (67.9%) cases were female and 100 participants were male (32.1%) with a mean of 20.6 years, ranging from 18-26 years (Table 2).

Table 2. Distributions of BMI, Blood indices and age among students in Babol University of Medical Sciences by gender

	Age(year)			Height(cm)			Weight(kg)			BMI*				Hemoglobin(g%)			Hematocrit(%)			RBC(mil/mm ³)			MCV(fl)		
	<20	20-22	>22	<160	160-180	>180	<50	50-90	>90	1	2	3	4	<12	12-15	>15	<36	36-45	>45	<4	4-5.5	>5.5	<80	80-96	>96
Female N	87	57	68	96	115	1	36	172	4	19	151	35	7	25	180	7	9	195	8	4	186	22	33	167	12
%	41	26.9	32.1	45.3	54.2	0.5	17	81.1	1.9	9	71	16.6	3.4	11.8	84.9	3.3	4.2	92	3.8	2	87.7	10.3	15.6	78.7	5.7
Male N	48	23	29	2	72	26	0	86	14	5	63	18	14	0	29	71	0	29	71	0	52	48	14	86	0
%	48	23	29	2	72	26	0	86	14	5	63	18	14	0	29	71	0	29	71	0	52	48	14	86	0
P-value	0.175			0.000			0.000			0.000				0.000			0.000			0.000			0.198		

*1- Underweight 2-Normal weight 3- Overweight 4- Obese

Overall, 68.5% of the students were in the normal weight range. 19 out of 212 (9%) of female students were also underweight and 16.5% were overweight. At the same time, 5 out of 100 (5%) of male students were underweight and 18% were overweight. The amount of obesity was higher in male cases

(14%) compared with female participants (3.3%) (Table 2). It was finally found that there was a significant statistical difference between BMI and gender (P=0.001) of the participants in the present study. Fifty-five (17.6%) students were anemic (with regard to the Hb concentration and Mentzer

indices). It was documented that the prevalence of anemia among female and male cases were 19.8 % (42/212) and 13% (13/100), respectively. There was also a statistically significant difference between anemia and gender ($P=0.039$).

Totally, the prevalence rate of anemia observed in cases that had BMI ≥ 25 (including overweight and obesity) (18.1%) was higher than under and normal weight cases (18.1 vs. 14.8%) (Table 3). This difference was not statistically significant.

Table 3. Distribution of BMI among the anemic students in Babol University of Medical Sciences

	Underweight				Normal weight				Overweight				Obese			
	Female		Male		Female		Male		Female		Male		Female		Male	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Anemic	1	5	1	20	30	20	9	14.3	9	25.7	2	11.1	2	28.6	1	7.1
Non-anemic	19	95	4	80	20	80	54	85.7	26	74.3	16	88.9	5	71.4	13	92.9
P-value	0.37				0.18				0.19				0.25			
Total	20	100	5	100	50	100	63	100	35	100	18	100	7	100	14	100

4. Discussion

In the current study, a combination of BMI and anemia was evaluated in young population. The findings showed that the prevalence of anemia in overweight cases was not statistically higher than underweight or normal weight people. Therefore, overweight and obesity were associated with a lower possibility of anemia. The association between anemia and being overweight has been well documented in developed countries; however, there are limited reports from developing countries (14). Hence, the results obtained from the present study were found to be in agreement with the findings of other studies performed in Egypt, Peru, and Colombia which all demonstrated an overlap between overweight and anemia (11, 13, 16, 17). However, the findings of the current research were in contrast with the previous studies which claimed that being overweight is associated with poorer iron status in adults and

children in some developed countries such as USA and Israel and developing countries like Mexico, Egypt and Peru (12, 16, 18-20). The different obtained results could be due to the hereditary condition of anemia in the studied area, such as thalassemia. Indeed, a high prevalence rate of thalassemia had been reported in the region where the present study was conducted (2, 21). Other key factors influencing the results were economic variety, geographical variations, and nutrient habitant variety. However, several studies have shown that anemia, particularly iron deficiency anemia, could be due to a decrease in physical endurance and maximal exercise capacity (22) or impaired adaptation to aerobic exercise (23). Hence, poor exercise capacity of anemic cases can be considered as a risk factor for being overweight and obese. The evaluation rate of acceptable regular exercise and physical activity in adolescents in Iran has also been

reported insufficient, which supports our justifications (24). The findings of the present study revealed that the prevalence of overweight and obesity is relatively high (21.6%). The findings were also supported by other studies which demonstrated high prevalence of overweight in medical students (25-26). In the present study, a statistically significant relationship was observed between gender and BMI, and it was found that underweight cases were more prevalent among female students (9.4% vs. 5%) and the prevalence of obesity in male cases were significantly higher than female cases (14% to 3.3%). Many other studies have also shown that BMI is associated with gender. Saxena, for instance, showed that 15.5% of Indian medical students and 25.7% of girls have BMI \leq 18.5 (27). Also, Moafi found 18.2% of males and 20% of females were underweight (10). The possible explanation could be that female cases are typically more sensitive to their body shape than males (28). Differences in life style, feeding habits, race, economic status and geographical location of studied populations could be a possible explanation. In the current study, it was observed that anemia was more prevalent in female students in comparison with male cases (19.8% vs. 13%). This finding is supported by several previous studies indicating a significant association between anemia and gender. For example, in a study conducted at Isfahan University of Iran on the students, it was observed that the prevalence of anemia in female and male students were 7.8% and 5.4%, respectively (10). Another study on students in India showed that the prevalence of anemia in females was 17% while none of the male

students were anemic (27). A possible reason was a higher prevalence of iron deficiency anemia in females than males (29). The current study had a limitation with regard to the assessment of the link between anemia and BMI without considering the different types of anemia. In conclusion, our findings showed that overweight and obesity were associated with a lower probability of anemia in students. It was also revealed that anemia and emaciation in female student should be considered as a major issue for the health care system. Thus, public health intervention to prevent combined micronutrient deficiencies and overweight/obesity as well as more investigation on the potential causes of this phenomenon is recommended. Further research is also suggested regarding the association between the different types of anemia particularly iron deficiencies and BMI with a larger sample size.

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Conflict of Interest

There were no conflicts of interest.

Authors' contributions

FS designed the study, performed the experiments and interpreted the results. HA designed the study, interviewed with participants and interpreted the results. PS designed the study and interpreted the results. NK interpreted the results and wrote the manuscript. SK performed statistical analysis.

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