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Research Article

A Cross Sectional Study of Association between Hemoglobin Levels and the BMI Indices among the Adolescents Sunni Muslim Population in Lucknow City, India

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Abstract

Anemia is a nutritional problem worldwide and its prevalence is higher in developing countries when it compared to the developed countries. The prevalence of anemia in the developing countries tends to be three or four times higher than in the developed countries. Nutritional anemia affects all age and sex group in India. Adolescents or early childhood is one of the most vulnerable periods to anemia in human life when nutritional requirements are high due to growth spurt. With this back ground, the objective of the present study was to assess the correlation of low BMI with the hemoglobin level among the adolescent Sunni Muslims of Lucknow city, Uttar Pradesh, India. This cross-sectional study was conducted among the 159 school going Sunni Muslims adolescents aged between 12 to 18 years. There was no significant sex differences on BMI. Whereas, in case of hemoglobin levels the differences based on sex was statistically significant ($t=2.786$; $p < 0.05$). There was a strong positive correlation between BMI and Hb in overall studied population ($r=0.236$; $p<0.005$). Considering the various categories of BMI, there were statistically significant correlation between severely thinness and thin individuals with hemoglobin levels but not in case of overweight and normal adolescent participants.

Keywords: *Adolescents; BMI Levels; Hemoglobin; India; Lucknow; Sunni Muslim*

Introduction

Nutritional anemia refers to the condition in which the hemoglobin content of the blood is lower than the normal level as a result of a deficiency of one or more essential nutrients, regardless of the cause of such deficiency [1]. In present day, anemia is one of the nutritional problems universally and in developing countries its prevalence is higher when it compared to the developed countries [2, 3]. Young children and pregnant women are mostly affected with an estimated global prevalence of 43% and 51% respectively [4].

The prevalence of anemia in the developing countries tends to be three or four times higher than in the developed countries [5]. Definition of adolescents by WHO is as the period of life span between the ages of 10-19 years [6]. It is the growing period of life when most of the physical, psychological and behavioral changes occur. It is the most vulnerable period in the life cycles of human being for developing nutritional anemia [7]. It not only affects one's growth and development and resistance to infections and is associated with mortality among children younger than two years old. And it also affects the mental and motor development of one, leading to decrease one's working capacity, impaired cognitive performance and lower IQ level which in turn affect the development of a country.

Anemia not only affects the cognitive and scholastic performance of adolescents but it also affects to high maternal morbidity and mortality [8]. The most affected population groups are infants aged between four to twenty four months old, school going children, female adolescents, pregnant women and nursing mothers [9].

Nutritional anemia affects all age and sex group in India. According to a survey conducted by NFHS, the prevalence of anemia in young girls between 15-22 years is 56% with higher rates in rural than in urban area [10]. Report published by UNICEF very recently that an estimated 56% of adolescents' girls in India are anemic and this amount on an average of 64 million girls at any point of time [11]. Nutritional anemia is prevalent all over the world with an estimated two billion people being iron deficient and is one of the most common nutritional disorders in developing countries. With an average prevalence of 40% among general population which is affect nearly about two third of the pregnant and one third of non-pregnant women which is three to four times higher in developing countries, where the prevalence of anemia is 4% to 12% women of childbearing age [4]. Habitual diets contain adequate amounts of iron only a small amount is absorbed(less than 5%). This poor bioavailability is considered to be a major reason for the widespread iron deficiency. Women lose a considerable amount of iron during their menstruation. Anemia in adolescents' girls will highly attribute to the incidence of babies with low birth weight with increased prenatal mortality and fetal wastage. Most commonly, people with anemia report feelings of weakness or fatigue or sometimes poor concentration [12].

Various socio-demographic characteristics like age, sex, social class, dietary habits, and infections are the etiological factors for nutritional anemia. Adolescents or early childhood is one of the most vulnerable periods to anemia in human life when nutritional requirements are high due to growth spurt. In India recent data from district nutrition project in 16 districts and 11 states on prevalence of anemia in non-pregnant adolescents showed rate at as high as 90.1% with severe anemia in 7.1 % [13].

Lucknow is being called sister city of Delhi NCR. It is the second largest city after Kanpur in Uttar Pradesh. Lucknow is ranked 6th among all the cities in India for faster job creation because of large number of industries and an emerging hub for goods and services. Many people from different parts of the country come to seek employment and for business purpose also. These have led to formation of slums in many out layer parts of the city.

Objectives

Correlation between hemoglobin and BMI has not been ascertained by no scholars previously, among Sunni Muslims of Lucknow city. With this back ground, the objective of the present study was to assess the correlation of low BMI with the hemoglobin level among the adolescent Sunni Muslims of Lucknow city, Uttar Pradesh, India.

Materials and Methods

Study area: This cross-sectional study was conducted in the two sub urbans areas of Lucknow city named Aurangabad Jagir and Chillawava. The samples were taken from the two schools named SuryabalaVidyalaya and M.C.D Public School, located 10 km. away from the Lucknow City.

Sample Size: This cross-sectional study was conducted among the 159 school going Sunni Muslims adolescents aged between 12 to 18 years residing at Aurangabad Jagir and chillawava(sub urban areas), adjacent to the Lucknow City.

Selection Criteria

➢ **Inclusion criteria**

- The samples were drawn with the help of school register copy.
- Muslims adolescents subjects were chosen aged between 12 to 18 years.

➢ **Exclusion criteria**

- To maintain the ethnicity, no Hindu subjects were taken as samples (Table 1).

Age	Male (%)	Female (%)	Total (%)
12	20 (12.6)	18 (11.3)	38 (23.9)
13	14 (8.8)	10 (6.3)	24 (15.1)
14	14 (8.8)	5 (3.1)	19 (11.9)
15	12 (7.5)	4 (2.5)	16 (10.1)
16	10 (6.3)	5 (3.1)	15 (9.4)
17	9 (5.7)	7 (4.4)	16 (10.1)
18	24 (15.1)	7 (4.4)	31 (19.5)
Total	103 (64.8)	56 (35.2)	159 (100.0)

Table 1: Age and Sex wise Distribution of participants.

Variables: Anthropometric variables like Height, weight were measured following standard method [14] and hemoglobin level was measured from the students by using Sahil's hemoglobin meter.

Ethical consideration: Before taking the measurements consent was taken from the school authorities and also from the parents of the students.

Age groups	Haemoglobin Concentration(g/dL)
12-14years	<12.0
>15 years males	<13.0
>15 years females	<12.0

Adopted from FAO, WHO, World Declaration and Plan of Action for Nutrition, International Conference on Nutrition, Rome, Food and Agriculture Organization of the United Nations, December1992 and WHO, UNICEF, UNU, Iron deficiency anemia: assessment, prevention and control, a guide for programme managers, Geneva, World Health Organization, 2001 [15,4].

Statistical Analysis: The data analysis was carried out using Statistical Package for Social Science. Data was expressed as

mean, standard deviation, standard error and percentage also. Differences between groups were evaluated using independent sample t-test; the relationship between Hemoglobin (Hb) concentration and BMI was examined by calculating the Pearson's correlation coefficient (r) at the 95% CI. To test the Statistical significance of the difference in mean values between two sex groups, here we applied independent t – test.

Table 2 shows that 59.1% of the total data set, were suffering from anemia while 40.9% participants were non-anemic. Within 59.1% anemic people, 37.1% boys and 22.01% girls were anemic. 34.6% were individuals were anemic and at the same time they were severely thin. 31.4% individuals of the total data set were thin, within that 15.1% were anemic and 16.4% were non anemic. 11.9% individuals were normal, 3.8% were anemic and 8.2% were non anemic. 6.9% individuals were overweight and among them 5.0% were anemic. And we found, very less number of individuals, who were obese.

BMI Grades	Anemia present (%)	Anemia absent (%)	Total (%)
SEVERE THINNESS	55 (34.6)	21(13.2)	47.8
THINNESS	24 (15.1)	26(16.4)	31.4
NORMAL	6 (3.8)	13(8.2)	11.9
OVER WEIGHT	8 (5.0)	3(1.9)	6.9
OBESE	1 (0.6)	2(1.2)	1.9
Total (%)	94 (59.1)	65 (40.9)	100

Table 2: Distribution of Anemic and Non-anemic Individuals in Different BMI Grades.

Table 3 shows the mean and standard deviation of hemoglobin level in different BMI grades. This study showed mean hemoglobin concentration was increasing as BMI indices increases except overweight.

BMI Indices	Hemoglobin
	Mean (SD)
Severely Thin	11.59 (1.28)
Thinness	12.05 (1.60)
Normal	12.07 (1.49)
Overweight	11.47 (1.58)
Obese	13.50 (1.57)

Table 3: Mean and standard deviation of Hemoglobin level in Different BMI Grades.

Table 4 shows the mean and standard deviation of age, height, weight, BMI and hemoglobin among boys and girls. Mean age for boys and girls were 14.9 (2.2) yrs and 14.3 (2.2) yrs respectively. Mean height in boys was 157.8 (12.1) cm and in girls was 148.3 (7.2) cm. Mean weight in boys were high, 43.9 (11.3) kg than girls was 38.3 (7.7) kg. Mean BMI in boys was 17.4 (3.1) and in case of girls it was 17.7 (3.2). In boys the mean Hb level was 12.2 (1.6) g/dl and in girls it was 11.4(1.1) g/dl.

		Age (yrs)	Height (cm)	Weight (kg)	BMI	Hb (g/dL)
Boys	Mean	14.9	157.8	43.9	17.4	12.2
	N	103	103	103	103	103
	Std. Deviation	2.24	12.06	11.28	3.1	1.6
Girls	Mean	14.3	148.3	38.3	17.7	11.4
	N	56	56	56	56	56
	Std. Deviation	2.23	7.2	7.72	3.2	1.1
Overall	Mean	14.7	154.5	42.2	17.5	11.8
	N	159	159	159	159	159
	Std. Deviation	2.25	11.52	10.42	3.13	1.46

Table 4: Mean and Standard Deviation of Different Variables among Boys and Girls.

Table 5 shows the sexual dimorphism for BMI and Hb levels. The Mean (SD) of BMI among boys was 17.4 (3.1) and among girls it was 17.7 (3.2). There was no significant sex difference on BMI. On the other hand, the Mean (SD) of hemoglobin levels among boys was 12.1 (1.6) and among girls it was 11.4 (1.1). Here, the differences based on sex was statistically significant ($t=2.786$; $p < 0.05$).

Variables	Gender	N	Mean (SD)	t
BMI	Boys	103	17.4	
			-3.1	0.494
	Girls	56	17.7	
			-3.2	
Hemoglobin	Boys	103	12.2	
			-1.6	2.786*
	Girls	56	11.4	
			-1.1	
* P < 0.05				

Table 5: Sexual dimorphism for BMI and Hemoglobin levels.

From the Table 6, it is evident that, there was a strong positive correlation between BMI and Hb in overall samples (r=0.236, p<0.005) at 99% CI. We also found statistically significant correlation between hemoglobin and BMI amongst boys but not in girls.

Gender	BMI Mean (SD)	Hb Mean (SD)	r
Boys	17.4	12.2	0.277**
	-3.1	-1.6	
Girls	17.7	11.4	0.199
	-3.2	-1.1	
Overall samples	17.52	11.8	0.236**
	-3.13	-1.5	
** p < 0.005)			

Table 6: Correlation coefficient between BMI Mean and Hb Mean levels.

From Table 7: Considering the BMI categories, there were positive significant correlation between the severely thin (r=0.258; p < 0.05) and thin (r=0.457; p < 0.01) individuals with hemoglobin levels. But the overweight was inversely correlated with hemoglobin. We didn't found any significant correlation between BMI and hemoglobin, in case of normal individuals also (Figure 1).

BMI Categories	r
Severe thinness	0.258*
Thinness	0.457**
Normal	0.101
Overweight	-0.095
***= p < 0.05; ** = p < 0.01**	

Table 7: Correlation coefficient (r) between BMI categories and Hemoglobin levels.

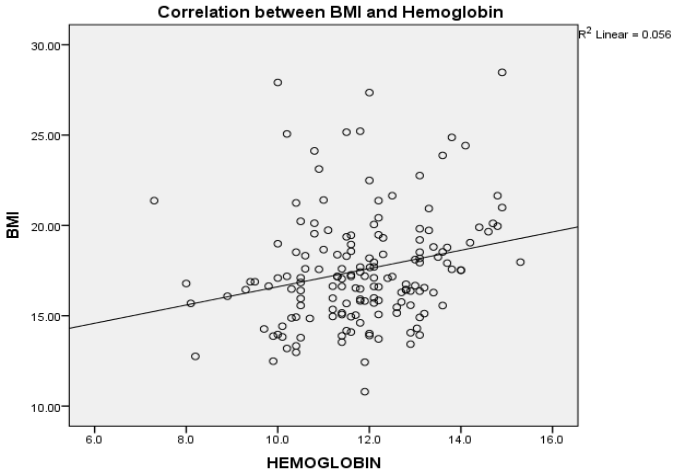

Figure 1: Showing correlation between BMI and Hemoglobin.

Discussion

Nutritional anemia through worldwide, is more concerned in the developing countries due to its high rate of prevalence. In the present study, we found that 59.1% adolescents were anemic within the total data set. Out of 59.1% total anemic people, 37.1% boys and 22.0% girls were anemic. The increased prevalence of anemia amongst boys and/or males could be the decreased level of testosterone which is associated with decrease synthesis of hemoglobin.

Anemia indicates both poor health and nutrition. There are varieties of causes responsible for anemia. One of the most common causes is iron deficiency. There are various risk factors related to iron deficiency anemia include inadequate intake of iron, poor absorption etc. Mehta found prevalence of anemia among students was 70.83% more prevalent among females (74.47%) than males (35.71%) [9]. In another study, the observation of premalatha; Pattanaik; Rati and Jawadagi, where they found the prevalence at 78.75%, 78.8% and 80% respectively [16-18]. Study by ICMR in sixteen districts of eleven states reported a prevalence rate of 90.1% among the adolescent girls of 11-18 years age groups [13]. A very high prevalence of anemia (90.1%) was noted by Kulkarni in adolescent girls of an urban slum in Nagpur [19].

A study done by Tazeen Khan, and others found that males had also higher mean hemoglobin concentration as compared to females, the same result have found in our study that the mean hemoglobin concentration is higher in boys 12.2 (1.6) compared

to the girls 11.4 (1.1) [20]. The study done by Khan et al. also shows statistically highly significant positive correlation of BMI with hemoglobin [21].

In a study we found that the higher prevalence of anemia among the severely thin people 34.59% followed by thin people 15.09% in overweight 5.03% in normal 3.77% while least among obese 0.62%. While Metha found anemia more among prevalent among underweight students (63.33%) and overweight (0.83%) students had less prevalence of anemia while in normal weight student's prevalence of anemia was 6.67 % [9]. Pandey found prevalence of anemia among underweight (60%), normal weight (27.5%), and overweight (12.5%) [22]. Gupta found higher prevalence of anemia among underweight (91.4%), in normal weight (83.6%), and in overweight (73.3%) [23].

Our study showed in table 5, mean hemoglobin concentration was gradually increasing as the BMI increases, except overweight. The same result shown in the previous study. This may be attributed to the fact that underweight predisposes to iron depletion and increases the risk of anemia [21,24]. Another study from Ethiopia, reported that underweight was a significant predictor of anemia in adolescents [25].

Our study also showed BMI is positively correlated with hemoglobin (r=0.236) at the significance level of 0.05, and which is similar to the findings of the previous studies [16,26,27]. These previous studies also showed very similar result with present study that only male students depicted a significant positive correlation but no significant correlation was observed among females [26-28]. Another study done by Bagni and others [29] contradicts with the result of our study where it was shown that, BMI is negatively correlated with Hb.

In our study we found that the BMI of severely thin and thin individuals were positively correlated and statistically significant at 0.05 and 0.01 levels respectively, with hemoglobin. But the BMI of overweight individuals were negatively correlated with hemoglobin and statistically not significant. Our study is very close to the study previously done by Hemamalini, who did work amongst the women of Andhra Pradesh and found that there was a inverse association between obesity and anemia. The women with overweight and obesity are less likely to be anemic compared with the normal weight women [30]. In another study conducted by Qin, resembles the similar results with the present study, the hemoglobin concentration was highest amongst the obese group compared to all other BMI group [31].

Conclusion

From the present study it can be concluded that the more adolescent boys were affected than girls and Hb levels were increases as the BMI increases. There were not significant correlation between BMI and hemoglobin levels among girls but among boys it was were statistically significant at higher level.

Furthermore, Hb levels and BMI were significantly associated and within the all BMI indices only severely thin and thin individuals were significantly correlated with Hb and individuals with overweight were negatively associated with the levels of hemoglobin but not statistically significant.

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Conflict of interest

There is no conflict of interest what so ever.

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