ANEMIA AND ITS EFFECT ON PHYSICAL PERFORMANCE OF SCHOOL GOING GIRLS IN JAIPUR CITY

Aditi Bhargava* and Anuradha Goyle**

***Research Scholar and ****Professor,**

Department of Home Science, University of Rajasthan, Jaipur

ABSTRACT

Introduction: Anemia is a major public health problem in India and its consequences lead to reduced physical performance.

Objectives: The objective of the study was to assess the effect of anemia on physical performance of school going girls.

Methodology: A study was conducted on school going girls (n=243; age= 10+-17+ years) studying in 2 private schools in Jaipur city. These girls belonged to low socio economic background and resided in slums of Jaipur city. The anemic status of the girls was determined by analyzing their haematological profile and the physical performance was assessed by Modified Harvard's Step test.

Results: The results revealed that 60.5% of the adolescent girls suffered from anemia (Hb= <12 g/dl), 42.0% of whom had mild deficiency (Hb=11-11.9 g/dl), 17.3% had moderate deficiency (Hb= 8-10.9 g/dl) and 1.2% had severe deficiency (Hb= <8 g/dl). It was observed that the Modified Harvard's Step test scores of the non -anemic girls were significantly higher than those of the anemic girls.

Conclusion: It was concluded that anemia had adverse effect on physical performance of school going girls from Jaipur city.

Keywords: Anemia, physical performance, school going girls.

INTRODUCTION

Anemia is a formidable public health problem among children and women worldwide, specially, among developing countries like India. According to WHO 'anemia is the decreased ability of the red blood cells to provide adequate oxygen to body tissues. It may be due to a decreased number of red blood cells, a decreased amount of a substance in red blood cells which transports oxygen (haemoglobin) or a decreased volume of red blood cells' (WHO, 2011). It has been reported in WHO fact sheets (2017) that anemia is a key nutritional problem among girls. It is very disheartening to know that in India the scenario of anemia among girls and women (15-49 years) is stagnant from past 10 years, 55.3% as stated in NFHS-3 (2005-2006) to 53% as given in NFHS-4 (2015-2016) reports.

There are many nutritional factors which lead to low haemoglobin levels in the body, but the most common among them is iron deficiency. School going age, particularly from 10-17^{+} years, demands for high nutritional requirement and during this age reserves are being laid for the subsequent rapid growth and development. After the pubertal growth spurt, mainly girls are more susceptible to anemia due to onset of mensuration cycle. Above that, those who belong to urban slums become more vulnerable to nutritional deficiencies because of poor access to basic amenities (Rawat et al., 2014; Srivastava et al., 2012).

One of the major consequences of anemia is reduced physical performance. Iron deficiency decreases iron containing enzymes of the mitochondrial respiratory chain in skeletal muscles with a concomitant decline in muscle respiratory capacity to utilize oxygen. This reduction in aerobic metabolism is associated with an increased susceptibility to early fatigue. As

a consequence, it impairs work performance both during intense short-lived exercise and longer intervals (Bhat et al., 2015; Sharma et al., 2015). However, very few studies have been conducted to study the effect of anemia on physical performance. Hence, the present research was planned with the objective of assessing the physical performance of anemic school.

METHODOLOGY

The present study was conducted on 260 school going girls who belonged to low socio economic background and resided in slums of Jaipur city. These girls were studying in 2 private schools, namely, Vimukti Girls School in Tilak Nagar and Dr. Ambedkar Public School in Jawahar Nagar of Jaipur city. The Principals of both the schools expressed willingness to participate in the study. A list of students studying from IInd to XIIth classes was obtained from the Vimkuti Girls School and Dr. Ambedkar Public School. All those students who were in the age group of 10 -17^{+} years and did not go through any iron supplementation in the past one year were selected for the study. A total of 260 students, 184 from Vimukti Girls School and 76 from Dr. Ambedkar Public School of Jaipur city were included in the study.

The anemic status of the girls was determined by analyzing their haematological profile. A one day blood withdrawal camp was organised in the Vimukti Girls School and another in Dr. Ambedkar Public School within school timings. Girls were informed about the camp earlier for maximum attendance. Out of 260 girls, blood sample for haematological profile was collected from 243 girls as few of them were absent on the day of the camp. The sample was withdrawn by a technician of KCJ Diagnostic and Research Centre, Jaipur and the analysis was also conducted at KCJ Diagnostic and Research Centre, Jaipur. The blood sample withdrawn for haemoglobin estimation was collected in a vial containing an anticoagulant Na_2 EDTA. Haemoglobin was estimated by an automated analyser namely, Mindray BC-5100 Auto

Hematology Analyzer. On the basis of the haemoglobin concentration, the girls were classified into anemic and non-anemic groups. According to WHO classification, the recommended haemoglobin levels to diagnose anemia in girls were <11.5g/dl for 10-11 years age group and <12g/dl for ≥ 12 years age group. Furthermore, the anemic girls were classified into different categories of anemia as given by WHO (WHO, 2011).

Physical performance of the girls was determined using Modified Harvard's Step test designed by Skubic and Hodgkins (1964). It is a very simple test concerned with the individual's dynamic physical fitness: her ability to perform and to recover from brief, strenuous work, as measured by the rate at which her heart decelerates after exercise. It was a simple 3 minute step test that used an 18" step bench. The girls were asked to follow the voice of a speaker to step up and down on the platform at the rate of 24 steps/min for 3 minutes. After 3 minutes, the girls were asked to sit down on the platform for 1 minute and then the pulse rate was counted for 30 seconds using heart rate monitor. The physical performance capacity was determined on the basis of the cardiovascular efficiency score. The cardiovascular efficiency score was determined by the following equation:

$$\text{Cardiovascular efficiency score} = \frac{\text{number of seconds completed} \times 100}{\text{recovery pulse} \times 5.6}$$

The following scoring form was used to score the girls:

Rating	Cardiovascular efficiency score	
	9-14 years aged girls	15-19 years aged girls
Excellent	72-100	71-100
Very good	62-71	60-70
Good	51-61	49-59
Fair	41-50	40-48
Poor	31-40	31-39
Very poor	0-30	0-30

Informed consent was obtained from the girls as well as from their parents. Ethical approval was also obtained from the Departmental Ethics Committee, Department of Home Science, University of Rajasthan, Jaipur, to carry out research among school going girls. All the data was consolidated on excel sheets. Means, standard deviations, independent't' test and ANOVA were calculated (Gupta, 2012).

RESULTS AND DISCUSSION

Haemoglobin

The mean haemoglobin level of all the girls (n=243) was 11.7±1.12 g/dl (Table 1). Out of 243 girls, it was found that 60.5% of the girls were anemic of whom 42.0% were mildly anemic, 17.3% were moderately and 1.2% were severely anemic. Considering the age-wise analysis of data, it was observed that the percentage of girls in the normal category decreased from 50.0% to 23.8% with the increase in age from 10.0-11.9 year to 16.0- 17.9 years. Similarly, the proportion of anemic girls increased with increase in age. However, in each age category, the mean haemoglobin level was at borderline or below the cut-off point.

Table 1 Mean haemoglobin (Hb) values of girls (n=243) agewise and their anemic status

Age (years)	Mean ±SD (g/dl)	Normal[a]	Anemic status (n=147)		
			Mild[b]	Moderate[c]	Severe[d]
10-11.9 (n=68)	11.5±1.04	34 (50.0)	23 (33.8)	10 (14.7)	1 (1.5)
12.0-13.9 (n=74)	11.9±1.15	33 (44.6)	33 (44.6)	06 (8.6)	2 (2.7)
14-15.9 (n=59)	11.6±1.13	19 (32.2)	25 (42.4)	15 (25.4)	-
16-17.9 (n=42)	11.5±1.17	10 (23.8)	21 (50.0)	11 (26.2)	-
Total (n=243)	11.7±1.12	96 (39.5)	102 (42.0)	42 (17.3)	3 (1.2)

Figures in the parentheses represent percentages.
[a] Hb ≥11.5 g/dl, age= 10-11 years; Hb ≥12 g/dl, age=12-17 years.
[b] Hb=11-11.4 g/dl, age= 10-11 years; Hb=11-11.9 g/dl, age=12-17 years.
[c] Hb = 8-10.9 g/dl.
[d] Hb= <8 g/dl.

Goyle and Prakash (2009) found that 96.3% of the school going girls (n=109; age=10-15 years) belonging to low socioecomic group in Jaipur city were anemic. In rural parts of Sirohi district, Rajasthan, the prevalence of anemia as judged by WHO recommended cutoff values of haemoglobin (<12g/dl) was found to be 83.6% among 1462 school children aged 5-15 years (Mandot and Bhanawat, 2015). In another study at Banasthali Vidyapeeth, Rajasthan, 77.5% of the school going girls (n=111; age=8-11 years) were found to be anemic (Jain and Chandra, 2012). In the present study too, 60.5% of the girls were anemic, which indicated the high prevalence of anemia among school going girls in Rajasthan.

Physical performance

The mean cardiovascular efficiency score of the girls was 43.4±8.67 which according to the rating scale could be rated in the fair category (Table 2). The mean cardiovascular efficiency scores depicting the physical performance of the girls decreased slightly with the increase in age from 10.0-11.9 years to 16.0-17.9 years. Similarly, the percentage of girls having very good, good and fair ratings decreased with age and percentage of girls having poor and very poor ratings increased with age. As seen earlier, with increase in girls' age, their haemoglobin levels declined, which might be the cause of their reduced physical performance.

It is evident from Table 3 that the mean cardiovascular efficiency score of the anemic girls was significantly lower than that of the non-anemic girls (37.84±3.86 vs 51.97±7.07). Thereby, projecting the poor physical performance of the anemic girls. Moreover, the mean cardiovascular efficiency score of the anemic girls had fallen in the poor rating while that of the non-anemic girls had fallen in good rating. On distribution of girls into different ratings as per the scale, it was observed that all the girls having very good rating belonged to non-anemic

category. The percentages of non-anemic girls with good (39.6% vs 2.0%) and fair (42.7% vs 7.5%) ratings were higher as compared to anemic girls. On the other hand, the percentage of anemic girls was higher in poor (87.1% vs 6.3%) and very poor (3.4% vs 0.0%) ratings as in comparison to non-anemic girls. Here too, it became clear that the ratings obtained by the anemic girls for physical performance were inferior as compared to non-anemic girls.

Table 2 Mean cardiovascular efficiency scores and frequency distribution of the girls (n=260) agewise in different ratings

Age (years)		Excellent	Very good	Good	Fair	Poor	Very poor
	Rating scale for cardiovascular scores						
10-14 years		72-100	62-71	51-61	41-50	31-40	0-30
15-17 years		71-100	60-70	49-59	40-48	31-39	0-30
Age (years)	Mean cardiovascular efficiency score	Frequency distribution of subjects (n=260)					
10-11.9 (n=72)	46.4±8.59	-	4 (5.6)	15 (20.8)	21 (29.2)	31 (43.1)	1(1.3)
12.0-13.9 (n=80)	43.4±8.50	-	4 (5.0)	13 (16.3)	20 (25.0)	41 (51.3)	2 (2.5)
14-15.9 (n=64)	42.4±9.34	-	3 (4.6)	9 (14.1)	15 (23.4)	37 (57.8)	-
16-17.9 (n=44)	40.1±6.41	-	-	5 (11.4)	9 (20.5)	28 (63.6)	2 (4.5)
Total (n=260)	43.4±8.67	-	11 (4.2)	42 (16.2)	65 (25.0)	137 (52.7)	5 (1.9)

Mean±SD.
Figures in the parentheses represent percentages.

The severity of anemia also seemed to have an adverse effect on the physical performance of the girls. It is apparent from Table 4 that the mean cardiovascular efficiency score had decreased from mildly anemic girls to moderately anemic girls to severely anemic girls (39.3±3.44 vs 34.7±2.12 vs 30.41±0.17). The comparison of the means of cardiovascular

efficiency scores of mildly, moderately and severely anemic groups by ANOVA revealed a significant difference between the groups. Intergroup comparison showed significant difference only between mildly vs moderately anemic girls and mildly vs severely anemic girls.

Table 3 Comparison of mean cardiovascular efficiency scores and frequency distribution of anemic and non- anemic girls (n=243) in different ratings

Age (years)	Rating scale for cardiovascular scores												
	Excellent	Very good	Good	Fair	Poor	Very poor		Excellent	Very good	Good	Fair	Poor	
10-14 years	72-100	62-71	51-61	41-50	31-40	0-30	10-14 years	72-100	62-71	51-61	41-50	31-40	
15-17 years	71-100	60-70	49-59	40-48	31-39	0-30	15-17 years	71-100	60-70	49-59	40-48	31-39	
Mean cardiovascular efficiency score	Frequency distribution of anemic subjects (n=147) in different ratings						Mean cardiovascular efficiency score	Frequency distribution of non-anemic subjects (n=96) in different ratings					Independent 't' test value between mean scores
37.84±3.86	-	-	3 (2.0)	11 (7.5)	128 (87.1)	5 (3.4)	51.97±7.07	-	11 (11.5)	38 (39.6)	41 (42.7)	6 (6.3)	20.12*

Mean±SD.
Figures in the parentheses represent percentages.
*Significant at 5% level.

Table 4 Comparison of mean cardiovascular efficiency score of mild, moderate and severe anemic girls using ANOVA

	[a]Mildly anemic (n=102)	[b]Moderately anemic (n=42)	[c]Severely anemic (n=3)	F value	Comparison
Cardiovascular efficiency score	39.3± 3.44	34.7± 2.12	30.4± 0.17	41.6*	Mild vs Moderate (0.001)*
					Severe vs Mild (0.000)*
					Severe vs Moderate (0.06) NS

Mean±SD.
[a]Hb=11-11.4 g/dl, age= 10-11 years; Hb=11-11.9 g/dl, age=12-17 years; [b] Hb = 8-10.9 g/dl; [c] Hb= <8 g/dl.
NS= Non Significant
*Significant at 5% level.

Though, no difference was found between moderately vs severely anemic girls. Furthermore, frequency distribution of anemic girls into different rating scale also exhibits the fact that mildly anemic girls had better physical performance as compared to moderately anemic girls and moderately anemic girls fared better than the severely anemic girls (Table 5). All the girls who had good (n=3) and fair (n=11) cardiovascular scores belonged to the mildly anemic category. However, 69% of the mildly anemic girls (n=88) had poor cardiovascular scores. Moderately anemic girls (n=42) had either poor (95.2%) or very poor (4.8%) cardiovascular efficiency scores and all the severely anemic girls (n=3) had very poor cardiovascular efficiency scores.

Table 5 Frequency distribution of mild, moderate and severe girls (n=243) into different ratings of physical performance

	Rating scale for cardiovascular scores					
	Excellent	Very good	Good	Fair	Poor	Very poor
[a]Mildly anemic (n=102)			3 (2.9)	11 (10.8)	88 (86.3)	0 (0.0)
[b]Moderately anemic (n=42)					40 (95.2)	2 (4.8)
[c]Severely anemic (n=3)						3 (100.0)

Figures in the parentheses represent percentages.
[a]Hb=11-11.4 g/dl, age= 10-11 years; Hb=11-11.9 g/dl, age=12-17 years.
[b] Hb = 8-10.9 g/dl.
[c] Hb= <8 g/dl.

A study assessing the physical performance of 210 anemic and non-anemic girls (age=10-19 years) of Jammu city noted that there was a significant difference between the scores of Harvard's step test of anemic and non-anemic girls. It was also observed that among anemic girls, mildly anemic girls scored significantly better scores than moderately anemic girls, hence, reflecting effect of severity of anemia on physical performance of girls (Bhat et al., 2015). Singh et al. (2013) also demonstrated that the physical performance of 13-17 years aged anemic girls (n=25) was significantly poorer than that of the non-anemic girls (n=59) from Rajasthan. It was

found that anemic girls climbed lesser steps in 3 minutes of test and that the recovery time to return to basal pulse rate was also prolonged as compared to non-anemic girls. In a similar study conducted earlier among school going girls (n=230, age=9-14 years) of Vadodara, Gujarat, the time taken to revert back to basal pulse rate after finishing the physical performance test was significantly longer among anemic girls than those of non-anemic girls. On the basis of severity of anemia, longer recovery time was noticed in those who were moderately anemic as compared to mildly anemic (Sen and Kanani, 2006). Panjikkaran and Usha (2010) reported that rural girls of Kerela had average endurance capacity and none of the girls had excellent or even good endurance capacity. It was also found out that the girls with acceptable levels of haemoglobin (≥12g/dl) obtained significantly better endurance capacity scores against those with low haemoglobin levels. These findings of the above studies support the results of the present study, that is, physical performance of the anemic girls was significantly poorer than that of the non-anemic girls and it decreased with severity of anemia.

Therefore, it can be concluded that anemia and severity of anemia had resulted in lowered physical performance.

CONCLUSIONS

Out of 243 school going girls, 60.5% were found to be anemic. The mean cardiovascular efficiency score of all the girls was in the fair rating, about 55% of the girls had poor and very poor ratings. There was a significant decrease in cardiovascular efficiency scores in anemic girls as compared to non-anemic girls. Among anemic girls, moderately anemic girls had poorer scores than mildly anemic girls. Hence, it was concluded that anemia had adverse effect on physical performance of school going girls in Jaipur city.

ACKNOWLEDGEMENT

The first author is thankful to the UGC-SAP, New Delhi for their financial support through the BSR-Scholarship for the study.

REFERENCES

Bhat AN, Yograj S, Sahi M. Presence of iron deficiency anemia in adolescent girls of Jammu District and its effect in their physical performance. Ind J Clin Anat Physio, 2015; 2(4): 164-168.

Goyle A, Prakash S. Iron status of adolescent girls (10-15 years) attending a government school in Jaipur city, Rajasthan, India. Mal J Nutr, 2009; 15(1): 205 – 211.

Gupta SP. Statistical methods. Ed. 42nd. Sultan Chand and Sons. Educational Publishers. New Delhi, 2012: 911-1038.

Jain M, Chandra S. Correlation between haematological and cognitive profile of anemic and non- anemic school age girls. Curr Pediatr Res, 2012; 16 (2): 145-149.

Mandot S, Bamnawat S. Prevalence of anemia among rural school children of Rajasthan. Int J Cur Res Rev, 2015; 7(15): 40-45.

NFHS-3 (2005-2006). National Family Health Survey-3 2005-2006, India. International Institute for Population Sciences, 2008: 309-310.

NFHS-4 (2015-2016). National Family Health Survey-4 2015-2016, India. International Institute for Population Sciences, 2016: 299-300.

Panjikkaran ST, Usha V. A path analysis on the nourishment directed haemoglobin status and resulting endurance capacity of adolescent Indian rural girls. J Dairy Foods Home Sci, 2010; 29(1): 1-11.

Rawat R, Kumar S, Manju L, Jose R. Prevalence and determinants of under-nutrition among school-aged children in an urban slum in India. Academic Med J India, 2014; 20; 2(3): 102–105.

Sen A, Kanani SJ. Deleterious functional impact of anemia on young adolescent school girls. Indian Pediatrics, 2006; 219(43): 219-226.

Sharma V, Shazia, Padha L. A study of iron status and its effects on physical performance in young adult females. Int J Health Sci Res, 2015; 5(10):118-123.

Singh E, Jain PP, Sharma S. Effect of food-based iron supplementation on the physical work performance of adolescent girls in Banasthali campus: A case study. Int J Green Pharm, 2013; 7: 167-72.

Skubic, V, Hodgkins, V. Cardiovascular efficiency test scores for junior and senior high school girls in the United State. Research Quarterly, 1964; 35: 184-192.

Srivastava A, Mahmood SE, Srivastava PM, Shrotriya VP, Kumar B. Nutritional status of school-age children - A scenario of urban slums in India. Archives of Public Health, 2012; 70:8.

WHO. Adolescents Factsheet, 2017.

http://www.who.int/mediacentre/news/releases/2017/yearly-adolescent-deaths/en/

Accessed on 23rd September, 2017. 1:00 pm.

WHO. Hemoglobin concentration for the diagnosis of anemia and assessment of severity. Vitamin Mineral Nutrition Information System, World Health Organisation, Geneva, 2011.

*****