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Nutrient Intake, Hemoglobin Level and Balance Beam Performance of Girls Engaged in Gymnastics

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ABSTRACT:

The current study was undertaken to find out nutrient intake, hemoglobin level &to assess performance of female gymnasts on balance beam. Total two hundred female gymnasts from age groups 10-12 years (n=100)& 13-15 years (n=100) were selected. Nutrient intake was calculated by taking 3 days dietary recall and then compared with the recommended dietary allowances (RDAs). Energy, macro-nutrients (carbohydrate, protein & fat)&iron were calculated.Mean daily energy intake of gymnasts from both age groups was found to be less than RDAs. Mean iron intake of the subjects exceeded RDAs for both the groupsof 10-12 & 13-15 years.Mean hemoglobin values of the female gymnasts aged 10- 12 years & 13-15 years were 11.92 g/dL& 12.11g/dL, respectively. Majority of gymnasts rated "excellent" for the performance of balance beam test. Results of the study tend to confirm the fact that there found impact of nutritional status on hemoglobin level & sports performance.
Keywords: energy, protein, iron, hemoglobin, balance beam.

INTRODUCTION:

Excellence in sports depends on physical fitness, state of training and diet of an athlete. Nutritional status and physical fitness of an athlete are directly related to each other. Good is the nutritional status, good is the physical fitness and thereby performance in the sport or competition. Nutritious meals at proper time helps in improving endurance of an athlete, adds strength to the muscles and aids in recovery as well. Nutritional requirements vary from person to person and from sports to sports.

Gymnastics is an "anaerobic" sport and it requires short, intense bursts of power. Generally gymnasts are in growing age so they require a nutritious meal plan that fulfils their requirements for both growth and development and to perform well in the sport. Ideally a high carbohydrate, moderate to high protein and normal fat diet is recommended for gymnasts.Small frequent meals which provide steady energy, enhance performance, maintain body weight and aid recovery are beneficial. Regular practice schedule and growing age are important factors in meal planning. **(Betancourt, L., 2011; Holt, B., 2011; Nall, J., 2011; Robertson, S., 2011; Binder, A. J., 2005, Pai Panandiker, D. H., et al,L.Kathleen Mahan et al, 2008)**

Like other athletes, meeting energy needs should be the priority of gymnasts. Maintaining a correct balance between power and weight is the challenge for gymnasts. Proper meals comprising of proteins and carbohydrates before and after practice should be included in routine. The diet should be planned from time to time by considering training frequency, intensity of

training, and duration to keep energy balance**. (Nutrition and athletic performance -- Position of the American Dietetic Association, Dietitians of Canada, and the American College of Sports Medicine 2000; Binder, A. J., 2005)**

Adequate carbohydrates should be included in the diet of gymnasts. 60% of total calories should come from carbohydrates. Complex carbohydrates with low to moderate glycemic index should be included in most of the meals. Carbohydrate consumption particularly before and after exercise is advised to maintain steady energy supply throughout the performance and replenish the energy stores after a practice schedule. **(Kamps, A., 2011)** In pre exercise meal low to moderate glycemic index foods are advisable. Simple carbohydrates are considered good to consume post exercise as they help in faster glycogen replenishment.

A diet which contains 1-2 grams of protein per kg of body weight is beneficial for gymnasts considering the sport requirements and growing age. Proteins should be included post exercise schedule as well to avoid negative nitrogen balance and muscle wasting. The best protein choices are low in saturated fat and cholesterol. **(Kamps A, 2011; Holt B, 2011; Pramukova, B. et al. 2011)**

Fat is a concentrated source of energy and has essential fatty acids in it so it should be included in gymnast's diet. Fat should provide about 15 % - 30% of a gymnast's diet. Quality fats should be included.**(Betancourt L, 2011)**

Micronutrient iron is essential for the formation of oxygen-carrying proteins, hemoglobin and myoglobin. Hemoglobin is essential for carrying oxygen to tissues in the blood. When the oxygen carrying capacity of the blood is lowered, anemia occurs. It may be because of low dietary intake of iron or altered absorption of dietary iron. Sports anemia is condition observed in athletes which is caused either by destruction of red blood cells or by dilution of red blood cells in plasma (plasma volume expands due to regular aerobic exercise). In athletes low hemoglobin level impairs muscle function and poor exercise performance. Hemoglobin appears to be a useful hematological monitoring parameter among sports persons **(Carter Eric, 2012; Sports Anemia, 2012; Rodriguez N R et al., 2010)**.

Studies estimate that young athletes may need up to 70% more iron everyday than their non-athlete peers **(Nutrition and athletic performance -- Position of the American Dietetic Association, Dietitians of Canada, and the American College of Sports Medicine, 2000, Benardot D., 2011, Maughan R. J., 1999, Heimo Mairbäurl, 2013)**

There are various measures to assess fitness performance of sports persons. For gymnasts, balance beam test is one of the important fitness evaluation tests which assesses active balance, through the ability to maintain balance while walking along an elevated beam. Only female gymnasts perform on the balance beam.

Present study deals with assessment of nutrient intake, estimation of hemoglobin level & evaluation of fitness of young female gymnasts.

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METHODOLOGY:

To assess nutrient intake of the gymnasts & their performance on balance beam was the aim of this research. For the present study, girls (10-12 and 13-15 years of age) engaged in gymnastics were purposively selected as sample population. 200 female gymnasts from various gymnastic clubs from Nagpur, Mumbai and Pune cities of Maharashtra were selected for the assessment. Injury free subjects who were practicing gymnastics regularly since 2 years and have participated in competitive events were chosen.

Nutrient Intake: Three (3) days' dietary recall method was used to know the daily dietary intake of gymnasts. Gymnasts were provided separate sheets of tables for each day to note their food intake. Gymnasts were told to mention every minute detail of the food they were consuming as per their meal pattern. Nutritive values of the diets of gymnasts were calculated based on the recall **(Gopalan et al., 2004)**. Nutrient intake was compared with Recommended Dietary Allowances for gender & age **(National Institute of Nutrition (NIN)/Indian Council of Medical Research (ICMR), 2009).**

Hemoglobin level: Considering importance of hemoglobin in athlete's performance, subjects were asked to check their hemoglobin levels at pathological laboratory. Gymnasts reported the hemoglobin values in the given questionnaire once the testing was done.

Balance Beam Test: Gymnastic balance beam and stopwatch was used to undertake the test. Gymnasts were told to walk the entire length of a standard balance beam steadily, without falling off, and within a six second time span. The participants started at one end, step up onto the beam and walked the length to other end. The time taken by the participant was noted using stopwatch**(Nande, P. J. & Vali, S. A., 2010).**

Statistical Analysis: Data was gathered, compiled and classified on the basis of age groups. Mean, standard deviation, range & percentage were calculated. Data was then compared with reference values of respective age groups using z test. Level of significance was tested at both 5% & 1% level.

RESULTS & DISCUSSION:

Data on daily intake of energy & energy giving nutrients by subjects is tabulated in Table 1.

Table 1:Data on Daily Intake of Energy & Energy Giving Nutrients By Subjects

Sr. No.	PARAMETERS	G I R L S (N=200)		
		10-12 Yrs (n=100)	13-15 Yrs (n=100)	z Values#
1	ENERGY (kcal)			
i	M±SD	**1932**±239.18	**2059**±213.54	**3.96***
ii	Range	1493-2435	1780-2630	
iii	Standard	2010	2330	
iv	z Values§	**3.26***	**12.69***	
v	%Deficit	-3.88	-1163	

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2	**CARBOHYDRATE(g)**			
i	**M±SD**	**328.97**±45.89	**350.23**±36.61	-
ii	**Range**	235.70-414.75	303.40-439.50	
3	**PROTEIN (g)**			
i	**M±SD**	**48.59**±6.44	**50.05**±5.83	**1.68**
ii	**Range**	35.78-75.00	42.99-65.00	
iii	**Standard**	40.4	51.9	
iv	**z Values§**	**12.72***	**3.17***	
v	**%Excess/Deficit**	+20.27	-3.56	
4	**FAT(g)**			
i	**M±SD**	**46.82**±8.65	**50.90**±9.45	-
ii	**Range**	29.90-65.00	38.22-68.00	

- z values are for between group comparison (i.e. comparison between age groups 10-12 yrs & 13-15 yrs); **§** - z values are for comparison between data of subjects & standards;* - Significant at both 5 % and 1% levels ($p<0.01$); ** - Significant at 5 % level but insignificant at 1 % level ($0.01<p<0.05$); Values without any mark indicate insignificant difference at both 5% & 1% levels ($p>0.05$).

Mean daily energy intake of girls aged 10-12 years and 13-15 years was 1932 kcal and 2059 kcal, respectively. Mean daily energy intake of gymnasts from both age groups was found to be less than RDAs ($z= 3.26$ & 12.69, respectively, $p<0.01$). % deficit was calculated as 3.88 &11.63, respectively. The observed range of total energy intake was 1493-2435 kcal (10-12 years, female gymnasts) & 1780-2630 kcal (13-15 years, female gymnasts) which depicted greater variations. Older girls consumed considerably higher energy than younger girls ($z=3.96$, $p<0.01$).

Mean daily intake of protein by gymnasts from both age groups was found to be good enough, however, older age group subjects showed significantly less protein intake in comparison to RDA for age ($z=3.17$, $p<0.01$). In contrast to this, younger girls from age group 10-12 years showed significantly higher intake of protein ($z=12.72$, $p<0.01$). Individual differences were observed among gymnasts for protein intake. A difference of 39.22 g & 22.01 g was derived between minimum & maximum intake of protein by subjects from age groups 10-12 & 13-15 years, respectively. This difference can be attributed to consumption of proteins from vegetarian &non-vegetarian food sources.

Girls from the age group 10-12 years consumed carbohydrates in the range of 235.70-414.75 g/day whereas it was noted to be 303.40-439.50 g/day for girls from age group 13-15 years. Higher carbohydrates are needed to fulfil the demands of exercise & sports. Similarly, mean fat intake was calculated as well. Mean values of fat intake of subjects from 10-12 years & 13-15 years were 46.82 g & 50.90 g/day, respectively. Wide range of fat consumption, 29.90-65.00 g for age group 10-12 years of girls & 38.22-68.00 g for age group 13-15 years was observed. This could be attributed to differences in day to day food choices & variations in the fat quantity.

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Percent energy derived from carbohydrates, protein & fats was also calculated. % energy derived from carbohydrate, protein & fat was found to be ranged between 68.04 to 68.08, 9.74 to 10.15 &21.81 to 22.18, respectively.

Iron intake of subjects was studied and mean values were compared with the RDAs for age (Table 2).

Table 2:Data on Daily Intake of Iron By Subjects

Sr. No.	PARAMETERS	G I R L S (N=200)		
		10-12 Yrs (n=100)	13-15 Yrs (n=100)	z Values#
3	**IRON (mg)**			
i	**M±SD**	**29.16**±6.37	**29.94**±6.31	**0.87**
ii	**Range**	19.00-46.00	20.00-40.00	
iii	**Standard**	27	27	
iv	**z Values§**	**3.39***	**4.66***	
v	**%Excess**	+8.00	+10.88	

- z values are for between group comparison (i.e. comparison between age groups 10-12 yrs & 13-15 yrs); **§** - z values are for comparison between data of subjects & standards;* - Significant at both 5 % and 1% levels ($p<0.01$); ** - Significant at 5 % level but insignificant at 1 % level ($0.01<p<0.05$); Values without any mark indicate insignificant difference at both 5% & 1% levels ($p>0.05$).

Mean iron intake of the subjects exceeded RDAs for both the groups (z=3.39 & 4.66, respectively, $p<0.01$). Iron intake was 8.00% excess for subjects from 10-12 years age group & 10.88% excess for subjects from 13-15 years age group. Between age group comparison revealed very insignificant difference for iron intake (z=0.87, $p>0.05$).
Iron intake of subjects correlated positively with intake of energy, carbohydrate, protein & fat (r=0.0096 to 3930).

Iron intake was found to be correlated positively with hemoglobin level, hence indicating need of iron for maintenance of the hemoglobin concentration (r=0.0536 & 0.1553, respectively for 10-12 & 13-15 years).

Table 3 shows data on hemoglobin level of subjects.

Table 3: Data on Haemoglobin Level of Subjects (g/dL)

Sr. No.	SUBJECTS	PARAMETERS	AGE GROUPS		z Values#
			10-12 Yrs (n=100)	13-15 Yrs (n=100)	
1	**G I R L S**	**M±SD**	**11.92**±0.79	**12.11**±0.65	**1.86**
		Range	10.00-14.30	11.00-13.60	
		Standard↕	**≥11.5**	**≥12.0**	
		z Values§	**5.32***	**1.69**	

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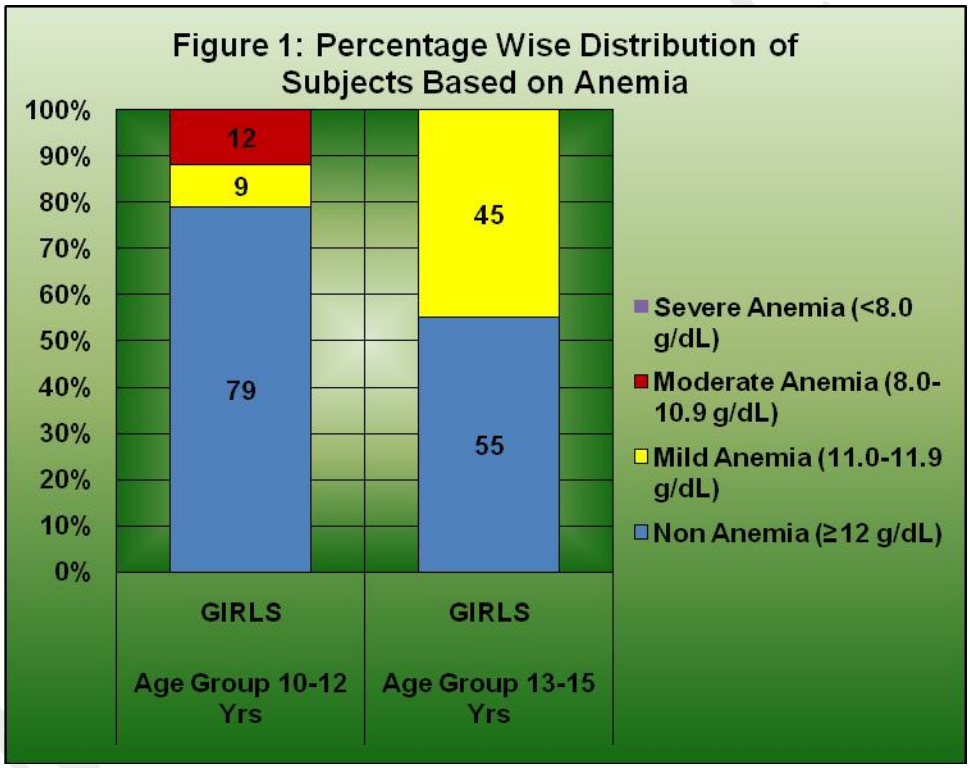
↕- WHO, UNICEF & UNU (2001); # - z values are for between group comparison (i.e. comparison between age groups 10-12 yrs & 13-15 yrs); **§** - z values are for comparison between data of subjects & standards;* - Significant at both 5 % and 1% levels ($p<0.01$); ** - Significant at 5 % level but insignificant at 1 % level ($0.01<p<0.05$); Values without any mark indicate insignificant difference at both 5% & 1% levels ($p>0.05$).

Mean hemoglobin values of the female gymnasts aged 10- 12 years & 13-15 years were 11.92 g/dL& 12.11g/dL, respectively. Based on mean values, these subjects were surpassing the standard values of hemoglobin ($z=5.32$, $p<0.01$ for 10-12 years & $z=1.69$, $p>0.05$ for 13-15 years). Even though, mean hemoglobin levels of subjects were highly satisfactory, individual variations were found to be higher. Minimum hemoglobin value was recorded as 10 g/dL whereas maximum value was recorded as 14.30 g/dL. Fig. 1 shows percentage wise distribution of subjects based on anemia.



79 % girls from the age group 10-12 years & 55 % girls from the age group 13- 15 years were non anemic (hemoglobin level: ≥12g/dL). The difference between two groups may be because iron intake of girls from 10-12 years age was comparatively more than the girls from the age group 13-15 years. 9 % girls from the age group 10-12 years & 45% girls from the age group 13-15 years were categorised under mild anemia (hemoglobin level:11.0-11.9g/dL).12% girls from age group 10-12 years were categorized as moderatel yanemic (hemoglobin level: 8.0-10.9 g/dL). None of the subjects were found to be severely anemic with hemoglobin level <8.0 g/dL. (Fig. 1).

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Data on the results of balance beam test is demonstrated in Table 4.

Table 4: Data for Balance Beam Test for Subjects

Sr. No.	Study Periods	Time Taken (Seconds) M±SD (Range)	z Values #	Performance Assessment of Subjects Based on Time Taken in Seconds to Maintain Balance while Walking along an Elevated Beam						
				Excellent No. & %	Above Average No. & %	Average No. & %	Below Average No. & %	Poor No. & %	Very Poor No. & %	Total
1	**G I R L S (N=200)**									
i	**Age Group 10-12 Yrs** (n=100)	**4.44**±0.78 (3.00-5.00) ***Above Average***	**2.81***	**62**	20	18	0	0	0	**100**
ii	**Age Group 13-15 Yrs** (n=100)	**4.72**±0.62 (3.00-5.00) ***Excellent***		**81**	10	9	0	0	0	**100**

- z values are for between group comparison (i.e. comparison between age groups 10-12 yrs & 13-15 yrs); **§** - z values are for comparison between data of subjects & standards;* - Significant at both 5 % and 1% levels ($p<0.01$); ** - Significant at 5 % level but insignificant at 1 % level ($0.01<p<0.05$); Values without any mark indicate insignificant difference at both 5% & 1% levels ($p>0.05$).

Subjects from age group 13-15 years showed higher mean value for the time taken to maintain balance while walking on an elevated beam than subjects from age group 10-12 years ($z=2.81$, $p<0.01$). This showed greater impact of age on the results of the balance beam test which could be because of effect of longer training. 81% subjects from age group 13-15 years were rated "excellent" for the performance of this test whereas 62% from age group 10-12 years were rated "excellent" for the test.

It is well said that nutritional status has positive impact on sports performance. For this study, for the performance results of balance beam test, it was seen that for gymnasts from both age groups 10-12 & 13- 15 years, the results correlated positively with intake of energy ($r=0.0486$ & 0.3950), carbohydrates ($r= 0.1255$ & 0.3741), protein ($r=0.0146$ & 0.0433), fat ($r=0.2840$ & 0.3357) & iron ($r=0.2555$ & 0.2288). It also reflected positive correlation with hemoglobin level ($r=0.0292$ & 0.1664, respectively for 10-12 & 13-15 years).

Results of the study tend to confirm the fact that there found impact of nutritional status on hemoglobin level & sports performance.

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