RESEARCH ARTICLE

EVALUATION OF NUTRITIONAL STATUS IN ADOLESCENTS IN RELATION TO THEIR DIETARY HABITS AND PHYSICAL ACTIVITY

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ABSTRACT

Aims: To determine the prevalence of underweight, overweight and obesity in healthy adolescents as well as to establish the relationship of nutritional status with dietary habits and physical activity.

Material & methods: Across sectional, observational study was conducted in a Tertiary Care Teaching Hospital for 12 months, which included 407 adolescent students of different socio economic group. Anthropometric measurements were taken and information regarding dietary habits, physical activity, TV watching habits and computer work were noted in a questionnaire. Statistical analysis of the data was done by SPSS v 17. Pearson's Chi- square test was used.

Results: Total 407 students of age group 11 to 16 years including 185 boys and 222 girls participated in the study.19.42% students were underweight, 64.61% were healthy weight, 12.29% were overweight and 3.68% were obese. A significant correlation was found between the different age groups and nutritional status. Mean caloric intake in underweight students was 1545.51 and2209.13 in obese students, with statistically significant relation between nutritional status and average diet. Statistically significant correlation found between decreased physical activity & overweight/obesity, as well as between increased duration of TV watching & computer work and overweight/obesity.

Conclusion: A baseline level of nutritional status of healthy adolescents is developed in the present study. Nutritional status of adolescent school going children is related with their dietary habits & physical activity.

INTRODUCTION

Adolescence is a significant period of human growth and maturation. In India adolescents (10-19 years) constitute 23% percent of the population. (Raina *et al.*, 2009) The health and nutritional status of the children is an index of the national investment in the development of its future manpower. (Physical status, 1995) Achievement of optimum growth during this period is of utmost importance in maintaining good health thereafter. India has achieved a substantial growth in human development index since independence. Although nutritional status has improved, "malnutrition" plagues a disproportionately large number of children in India as compared to other countries. Malnutrition denotes impairment of health, arising either from deficiency or excess or imbalance of nutrients in the body. Adolescence is an important period in the individual's life.

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Inadequate nutrition in adolescence can potentially retard growth and sexual maturation. A great health concern at national level is the decrease in the body weight associated with inadequate food and energy intake which causes under-nutrition and on the other hand as the result of westernization world is becoming a "global village", which also leads to increase in the prevalence of overweight and obesity. While India is in the midst of combating long standing problems of under-nutrition, a new situation has risen. The World Bank has predicted that coronary heart disease will become the leading cause of premature deaths in India by 2015 and the maximum number of diabetic patients in the world will be in India. (Bulatao and Stephens, 1992) Anthropometry is measurement of certain parameters of human body and is frequently used to assess nutritional status as well as growth and development of school aged children and adolescents. (Shetty and James, 1994) Body Mass Index (BMI) has been recommended by WHO to screen for overweight and obesity and under-nutrition among adults and adolescents. (Gorstein, 1989) Like many developing countries, India too faces an increasing dual burden of under-

nutrition and over-nutrition. (Popkin *et al.*, 2001) Anthropometry can thus be used to evaluate individuals in order to determine prevalence of over-nutrition and under-nutrition. As there are limited studies done about the nutritional status of adolescents and effect of diet and physical activity, our study was therefore planned to determine the prevalence of underweight, overweight and obesity in healthy adolescents as well as establish the relationship of nutritional status with dietary habits and physical activity.

MATERIALS AND METHODS

This was a cross sectional, observational, descriptive-analytic study which was conducted in a Tertiary Care Teaching Hospital, India. Duration of study was 12 months, in which total 407 students of different socio economic group were studied. The study was approved by the board of study of Department of Pediatrics and the Institutional Ethical Committee. We included three schools situated in the urban area of city. One school was exclusively for boys, one exclusively for girls and one was a co-education school. An effort was made to select students by stratified random sampling technique to ensure proportional representation of each age group and sex. A consent letter explaining the nature and the aims of the study was sent to the parents of students, after taking permission from the principal of school. A questionnaire was given to the students to ascertain information about their dietary intake and physical activity, TV watching habits and computer work (3 days including one weekend day).

Inclusion criteria

An apparently healthy adolescent aged 11-16 years studying in class 6th to 10th of the selected school, and who were free from any chronic illness were included in the study.

Exclusion criteria

Adolescents who were sufferings from any chronic illness at the time of examination were excluded from the study.

MATERIALS AND METHODS

The questionnaire was sent to the parents of selected students and was received back from the students. The details of information including dietary habits and physical activity, TV watching habits and computer work (3 days including one weekend day) were noted in the proforma. Each student then underwent a complete physical examination to rule out any chronic illness and anthropometric measurement.

Anthropometric measurement

The following measurements were carried out in a secluded room in the school.

Weight: Weight was measured with a standard floor weighting scale having an accuracy of 0.1 kilograms.

Height: Height was measured with the subject standing bare feet with back against a standard vertical sliding scale. The head was adjusted so that the Frankfurt plane was horizontal. The measurement was done to the nearest of 1 millimeter.

Calculation of Body Mass Index (BMI)

$$\text{BMI} = \frac{weight\ (kg)}{Height\ (mt)2}$$

The BMI number was plotted on CDC BMI for age growth charts (for boys or girls) and a percentile ranking was obtained according to which they were further classified as underweight, overweight and obese. The subjects with 'BMI for age' less than 5th percentile were categorized as underweight and those with BMI for age ≥95th were considered to be obese and 'BMI for age' 85th to <95th percentile considered as overweight while subjects having 'BMI for age' between 5th and 85th percentile were categorized as normal.

Dietary assessment: Dietary assessment of children was done by using 3 days diet recall questionnaire including a weekend day and two week days. Information from the 3 days recall included the name of food, the time of their consumption, and the portion sizes based on typical or natural portion consumed (e.g. slice, piece, cup, etc). The nutritive values (calories) of individual food were calculated using table of Nutritive value of Indian food. (Gopalan *et al.*, 1993)

Physical activity assessment: Information was collected on physical activity (3 days), which included the mode of transport used to go to school and physical activities such as participation in sports and games, aerobic physical exercises, and frequency and duration of participation in household activities. (Pate *et al.*, 2003) Time spent in watching television and playing computer and video games were also noted.

Statistical analysis

Statistical analysis of the data was done by SPSS v 17. Pearson's Chi- square test was used.

Table 1. Age and sex variation in anthropometric characteristics (n=407)

S. No.	Age	Sex	Mean Weight (kg)	Mean Height (cm)	Mean BMI (kg/m^2)
1.	11 years (27)	Female	32 (±5.28)	143 (±6.22)	16 (±2.01)
		Male	36 (±9.66)	145 (±5.34)	17 (±3.41)
2.	12 years (80)	Female	39 (±8.14)	148 (±5.75)	18 (±3.61)
		Male	37 (±5.72)	148 (±7.16)	17 (±2.35)
3.	13 years (132)	Female	43 (±6.79)	153 (±6.43)	18 (±2.85)
		Male	44 (±8.84)	154 (±9.03)	19 (±3.62)
4.	14 years (77)	Female	45 (±6.25)	155 (±5.61)	19(±2.42)
		Male	48 (±10.68)	156 (±7.80)	20 (±3.74)
5.	15 years (62)	Female	51 (±9.20)	156 (±6.29)	21 (±3.93)
		Male	52 (±12.09)	162 (±8.44)	20 (±4.75)
6.	16 years (29)	Female	50 (±9.44)	153 (±3.42)	21 (±4.14)
		Male	57 (±11.80)	164 (±5.69)	21 (±3.72)
7.	Total (407)		44 (±10.25)	154 (±8.50)	19 (±3.61)

RESULTS

The study included 407 students from three schools. There were 185 boys and 222 girls, of age group 11 years to 16 years. There were 27 (7%) student of age 11 years, 80 (20%) students of age 12 years, 132 (32%) students of age 13 years, 77 (19%) students of age 14 years, 62 (15%) students of age 15 years and 29 (7%) student of age 16 years. Total 407 students were included in the study out of this 79 (19.42%) were underweight, 263 (64.61%) were healthy weight, 50 (12.29%) were overweight and 15 (3.68%) students were obese. Pearson's Chi- square test was applied & a significant correlation was found between the different age groups and nutritional status (p value =.010). Out of total 79 (19.4%) underweight students, 41 (51.9%) were female and 38 (48.1%) were male. 50 (12.3%) students were overweight, out of which 21 (42%) were female and 29 (58%) were male. Total obese student were 15 (3.7%), out of which 7 (46.7%) were female and 8 (53.3%) were male. The prevalence of underweight in boys was 20.5% and in girls it was 18.5%. The prevalence of overweight in boys was 15.67% & in girls was 9.45%, and the prevalence of obesity in boys was 4.32% while in girls was 3.15%. Mean caloric intake in underweight students was 1545.51 and minimum caloric intake was 962 and maximum caloric intake was 2080. Mean caloric intake in healthy weight was 1868.41, minimum caloric intake was 1106 and maximum caloric intake was 2744. Mean caloric intake in overweight was 2107.6, minimum caloric intake was 1651 and maximum caloric intake was 2707. Mean caloric intake in obese was 2209.13, minimum caloric intake was 1840 and maximum caloric intake was 2702. Pearson's Chi- square test was applied and statistically significant relation was found between the nutritional status and average diet (p = 0.000).

Among the total 65 overweight and obese adolescents, 51(78.5%) were involved in <60 minutes physical activity (moderate to vigorous) however 14 (21.5%) were involved in ≥60 minutes physical activity (moderate to vigorous). There was a significant correlation between decreased physical activity and overweight/obesity (Pearson's coefficient = -0.269 and p =0.000). Among the total 65 overweight and obese adolescents, 39(60%) were involved in ≥120 minutes of TV watching and computer work per day, however 26 (40%) were involved in <120minutes minutes of TV watching and computer work per day. There was a significant correlation between increased duration of TV watching and computer work and overweight/obesity (Pearson correlation =0.235 and p =0.000).

DISCUSSION

India faces a dual burden of under nutrition and over nutrition due to lifestyle transition and economic improvement. Malnutrition, either under nutrition or over nutrition is of public health significance among all over world as both causes lasting effects on the growth, development and physical fitness of a person. Present study was done to assess the nutritional status of school going adolescents and to establish the relationship between nutritional status and their dietary habits and physical activity. The mean weight of girls in present study showed an increasing trend till 15 years of age (mean weight

51kg) after which it decreased in 16 year old girls, who had mean weight of 50kg. This decrease in weight could be due to the increasing consciousness of teenage girls toward their weight and physical appearance. Girls in present study had an increasing height as they grew older. The mean height at 11 years was 143 cm and at 16 years was 153 cm. A similar trend was observed by Chaturvedi S *et al* in rural Rajasthan, & also by Mukhopadhyay *et al.* (Chaturvedi *et al.*, 1996; Mukhopadhyay *et al.*, 2005) an increasing trend in weight was observed in boys; mean weight of 11 years old was 36 kg which increased to 57 kg in 16 years old. Similar trend was observed by Mukhopadhyay A *et al.* (Mukhopadhyay *et al.*, 2005) Boys also showed a consistent rise in height from 145 cm at 11years of age to 164 cm at 16 years of age. In present study boys had BMI slightly higher than girls. Similar relationship was also noted in the study conducted by Deshmukh *et al.* (Deshmukh *et al.*, 2006) an inverse relationship was noted in Mukhopadhyay *et al.* and Agrawal *et al.* with the girls having higher BMI then boys. (Mukhopadhyay *et al.*, 2005; Agrawal *et al.*, 2001)

In present study 50 (12.29%) students were overweight and 15 (3.68%) were obese. A similar incidence was seen by Khadilkar *et al* in Pune who reported prevalence of overweight and obesity as 19.9% and 5.7% respectively. (Khadilkar and Khadilkar, 2004) Similar incidence was also reported by Ramachandran A *et al.* (Ramachandran *et al.*, 2002) in south India (16.8% overweight and 3.1% obese) and by Mohan *et al* (Mohan *et al.*, 2004) (11.6% overweight and 2.6% obese). A higher incidence of obesity with rate of 7.5% was reported by Gupta AK *et al* (Ramachandran *et al.*, 2002) and 7.4% in affluent school children in Delhi by Kapil *et al.* (Sidhu *et al.*, 2005) In present study girls were less overweight and obese then boys. The prevalence of overweight in boys was 15.67% and in girls was 9.45% while the prevalence of obesity in boys was 4.32% and in girls was 3.15%. Aggrawal T *et al.* (Aggarwal *et al.*, 2008) also found that boys (15%) were more overweight then girls (10.2%). Chhatwal *et al* also had similar results of boys (15.7%) being more overweight then girls (12.9%) and also obesity being more in boys (12.4%) than in girls (9.9%). (Chhatwal *et al.*, 2004) Malik M *et al* observed children in United Arab Emirates & found an overall prevalence of overweight (21.5%) and obesity (13.7%) higher than in the above mentioned studies, with girls (22.9%) more overweight then boys (20.2%). (Malik and Bakir, 2007)

In present study the prevalence of overweight in adolescents showed a rise from 11 years (7.4%) to 13 years (10.6%) and a decrease at 14 years (7.8%) and again increased at 15years and 16 years (27.6%) of ages. A similar trend was seen in the prevalence of obesity with maximum prevalence at 15 years of age. Chhatwal *et al* found that the prevalence of obesity decreases till 14 years of age and then increases at 15 years. [18] Kapil *et al* found that maximum prevalence of obesity was during the pubertal period, between 10-12 years. (Kapil *et al.*, 2001) In present study 20.5% of boys and 18.5% of girls were underweight, higher percentage of underweight in boys than in girls. Similar trend was noted by Koushik Bose *et al* where 41.8% boys and 25.2% of girls were underweight. (Bose and Bisai, 2008) In present study the mean caloric intake of the overweight adolescents was 2107 kcal/day with the maximum

intake being 2707 kcal/day. Similarly the mean caloric intake in obese adolescent was 2209 kcal/day with the maximum intake being 2702 kcal/day. There was a significant correlation between BMI status and caloric intake. This association of increased incidence of overweight and obesity is a cumulative effect of increased energy intake and physical inactivity. The mean caloric intake in underweight adolescents was 1545 kcal/day which was lower than recommended dietary allowances (RDA) for adolescents for age and sex. Under nutrition is a serious problem in developing countries like India. The extent of under nutrition in our study was similar to that found by Kruz *et al.* (Woodruff *et al.*, 1998) but was lower than that found in rural Nepalese children by Cookson *et al.* (Cookson *et al.*, 1998) and 57% Woodruff *et al.* (Woodruff *et al.*, 1998) Statistically significant relation was found between BMI status and physical activity. Sedentary behavior and physical activity in children may be predictive of body mass in late adolescence. Numerous studies have shown that sedentary behaviors like watching television and playing computer games are associated with increased prevalence of obesity (Swinburn and Egger, 2002; Tremblay and Willms) There were few shortcomings in the study like the socioeconomic status of participants was not assessed as students were not able to tell the income of their family. Similar studies need to be done with larger sample size and in different regions of the country which will be helpful in policy making process in this age group.

Conclusion

A baseline level of nutritional status of healthy adolescents is developed in the present study. Prevalence of underweight was 19.42% while 12.29% of participants were overweight and 3.68% adolescents were obese. Prevalence of underweight as well as overweight & obesity was more in boys than girls. A statistically significant relation was observed between the nutritional status and average diet, between decreased physical activity & overweight/obesity, as well as between increased duration of TV watching & computer work and overweight/obesity.

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