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PHYSICAL INACTIVITY AS A DETERMINANT OF OBESITY IN ADOLESCENTS OF JAIPUR CITY

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ABSTRACT :

India is fighting the dual burden of malnutrition, on one hand it tops the list of maximum number of children dying of under-nutrition and on the other hand the middle and upper middle class are suffering from overweight and obesity. Consumption of calorie dense food and physical inactivity are the main determinants of overweight and obesity in children. This study examines the role of physical inactivity and subsequent increase in screen time and decreasing physical inactivity in overweight and obese adolescents from affluent class schools of Jaipur city. Two thousand four hundred and forty nine children in the age group of 10-14 years were screened for overweight and obesity on the basis of BMI, out of which, 652 were found to be overweight and obese. A two-day 24 hour record of physical activity was done and daily activities including- screen time, sleep time, playing indoor and outdoor games, time spent in commuting from home-school-home, home-tuition-home were recorded. The mean anthropometric measurements like height, weight, BMI, WHR were recorded and it was found that these were comparatively higher in boys than in girls. The mean TEE (Total Energy Expenditure) increased with age and boys had a higher TEE as compared to girls. The difference in the mean TEE was also found to be significantly higher in all the ages (P value< 0. 001). The mean PAL (Physical Activity Level) was found to be more in boys as compared to girls (P value< 0.05). Positive correlation was found between BMI and TEE, BMR had a negative correlation with PAL.

INTRODUCTION

Obesity was earlier known as global epidemic and it is now a pandemic[1,2]. Obesity is partly an environmentally influenced disorder, and many factors contribute for the same. Firstly, there is a small but positive association between socioeconomic status and obesity among children living in industrialized societies. Secondly, there is evidence that family discord is associated with increased BMI among children and adolescents. Thirdly, there is strong evidence that television viewing is associated with obesity among children. Increased viewing hours may lead to obesity by displacing energy

expenditure of physical activity, although other factors related to dietary intake also are likely. Lastly, larger portion sizes of food may promote increased body weight in children. Obesity generally arises from a mismatch between energy intake and energy expenditure. The imbalance results from both a progressive reduction in physical activity, mainly in adolescents and an increase in energy intake[3].

Physical activity is one of the modifiable risk factors for obesity[4,5] and it has been observed that physical activity declines dramatically as children becomes adolescents [6,7]. Since the roots of adult obesity and its subsequent effects on morbidity are laid down in childhood, early identification of risk factors pertinent and bears important public health implications[8]. With this background in mind, obese and overweight children from affluent class schools were selected and data regarding energy balance, total energy expenditure, basal metabolic rate and physical activity level was collected.

METHODS :

Purposive sampling technique was used for the selection of five schools with highest fee structure and that were willing to participate in the study from Jaipur city. For screening all children present in the age group of 10- 14 years were selected and for detailed study co-operative and willing students were selected. A written consent was taken from schools, parents and students. The total number of sample comprised of 2499 students (1209 girls and 1290 boys). Anthropometric measurements included height, weight, BMI and WHR. Height was measured to the nearest 0.1 cm with a standard wall mounted height-o-meter and weight measured on an electronic weighing scale to the nearest 100 g. BMI was calculated by dividing body weight in kilograms by height in meters squared. Waist and hip circumference were also measured by non-flexible, non-stretchable measuring tape and WHR (Waist Hip Ratio) was calculated. Children with BMI more than the standards (IOTF) [9], were selected for the detailed study.

Physical activity:

A set of pre-coded questions were prepared and the children were interviewed in the presence of their family members /warden (in case of hostellers), whom so ever they were comfortable with. Detailed questionnaire was used to study the physical activity pattern of the school going children. The type of activity of the subject was judged by asking the subject to report the time spent in various activities. The subjects were asked to record a minute by minute details of their activities for 2 days one of which being a holiday. On the basis of this information their average energy expenditure was determined. Besides this, information about their usual duration of sleep (day and night), time spent playing games (both indoor and outdoor), screen timings (both computer and television), studying time (at school, home and tuition) was also obtained. Once the data was collected, the time units were converted into minutes. PAL (physical activity level) was calculated for sleep, personal care, eating, sitting, walking, and light leisure activities based on the Factorial calculations of TEE for a population group. TEE calculated with the help of given equations based on Joint report of FAO/WHO/UNU (2004). Basal metabolic rate was estimated with predictive equation on body weight.

Statistical analysis:

The statistical analysis was done using SPSS 19.0 version. Association between BMI, age, and physical activity was studied using Spearman's rho correlation test and Multiple Regression Analysis.

RESULTS and DISCUSSION

Anthropometry:

From all the 2499 children in the age group 10-14 years, 652 children were classified as overweight and obese. Based on IOTF classification for the grades of obesity, 15.97 % children were categorized as underweight, 57.94 % were normal weight, 20.89 % children were overweight and 5.20 % were obese. From the children selected for detailed study - the mean height of girls was found to be 148.49 ± 10.97 cm as compared to 150.32 ± 10.80 cm that of the boys. The mean height and weight of boys was more than the girls (Table 1). The mean waist circumference of boys (80.91 ± 10.42 cm) was more than the girls (80.86 ± 9.00 cm). The mean hip circumference of all the children was 86.52 ± 6.96 cm; 86.30 ± 6.54 cm for girls and 86.71 ± 7.28 cm for boys. The WHR of overweight and obese children were found to be high in case of 85.77 % girls and 27.27 % boys. Girls were more at-risk than boys. WHR among girls indicates a strong positive correlation with BMI which was highly significant (*P* value 0.01).

Physical Activity:

Figure 1 indicates that maximum amount of the child's energy expenditure was from sedentary and light activities. It was observed that there was a positive correlation between age, BMI, light and moderate activities and energy expenditure in growth. Negative correlation was observed between energy expenditure in sedentary activities and age. There was a negative correlation of sleep with BMI, whereas significant positive correlation was observed between BMI and energy expenditure from moderate activities and growth.

The mean sleeping time was 504.02±15.58

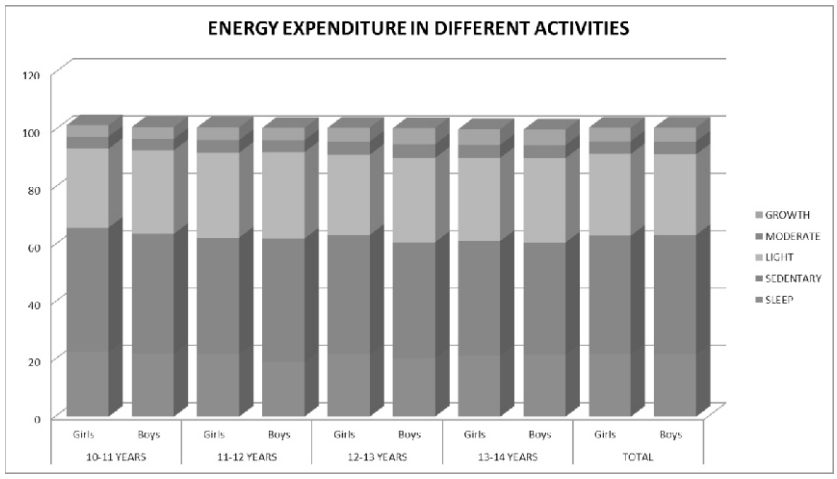


Figure 1
Age and Gender wise Mean Energy Expenditure in Different Activities of Children

minutes in case of girls and 502.63±15.91 minutes for boys. The mean time spent in sedentary activities was 631.98±37.65. minutes in girls and in boys it was 631.98±36.24 minutes and this differences was found to be non-significant. The time spent in sedentary activities were more than 10 hours and the difference between the time spent in sedentary activities among the genders was not found to be significant at any age group. Studies have shown that sedentary behaviour like watching television and playing computer games are associated with increased prevalence of obesity[10].

The time spent in light activities was found to be low i.e., 272.89±36.80 minutes for girls and 272.89±35.90 minutes for boys i.e., 4.5 hours. However the 't' test applied for measuring the significance statistically, among gender was found to be non-significant in all age groups. Similar results were found in a study where the overweight group spent more energy than normal weight group and less energy than obese group on all the activities, although these differences were not statistically significant[11].

The mean time spent in performing moderate activities by girls was 31.09±6.64 minutes and by boys was 31.31± 7.57 minutes. The test of significance ('t' test) was applied for measuring the significance statistically, among gender it was found to be non-significant in all age groups. The children were not spending any time in vigorous and strenuous activities. In a similar study the obese children have been found to be significantly less active than normal weight children, spending less time in moderate or greater intensity activity rather than normal weight counterparts [12]. Riddoch[13] also reported that there has been a marked decline in time spent in moderate and vigorous activities from pre-puberty through adolescence. According to Lobstein [14], there are certain social trends that have encouraged overweight and obesity in children: increased in use of motorized transport, increase in traffic hazards for walkers and cyclists, fall in opportunities for recreational physical activity, increased sedentary recreation, and multiple TV channels round the clock. All these factors were highlighted in our outcome of physical activity pattern.

Basal Metabolic Rate :

Table 2 depicts the mean BMR (basal metabolic rate), in girls it was found to be 1414.25±132.6 kcal/day which was less than boys 1634.84±186.26 kcal/day and this differences was found to be highly significant(t =16.645). The 't' test applied to test the difference in BMR between the genders and it was found to be highly significant in all age groups.

Physical Activity Level (PAL):

The PAL was calculated taking into consideration two criteria firstly, the energy cost (PAR) of daily activities and secondly, by the formula TEE/BMR. Table 2 depicts the mean PAL considering PAR, it was found that there was a difference observed in both the outcomes of PAL as one in based on the daily activities performed and another is based on the weight based formula. The mean PAL calculated on the energy expenditure on daily activities for girls was found to be 1.51±0.08 which was less than boys 1.53±0.08. The mean PAL calculated by the formula TEE/BMR is depicted in table 2, for girls and boys it was calculated to be 1.71±0.06 and 1.81±0.02 respectively with a 't' value = 28.581 and the difference was found to be highly significant statistically. Difference between genders was found to be highly significant in all age groups.

Association of age and BMI with TEE, BMR and

PAL in girls showed that there was a significant correlation of age with BMI, TEE, BMR and negative correlation with PAL. BMI had a positive correlation with TEE, BMR, and negative correlation with PAL. BMR had a negative correlation with PAL. This signifies that with increase in age, BMI and TEE, BMR increased, and with increase in age PAL decreased. In boys the association of age with BMI, TEE, BMR and PAL, and BMI was correlated to TEE, BMR and PAL and TEE to BMR and PAL and BMR to PAL were associated.

Time spent in different activities

The lack of appropriate play area and limited open space around homes makes it difficult for children to stay physically active[15]. Time spend in playing games have a major role in determining the activity levels of the children. It was observed that girls spent more time playing indoor games as well as outdoor games as compared to boys. The difference in time spent on various activities by girls and boys was found to be statistically significant for outdoor games, time spent on computer and day time rest at 5% significance level.

In a study at Wardha city it was found that, grade 5-10th children playing outdoor games for less than 30 min were significantly associated with overweight/obesity[16].

Overweight and obese children's screen time (time spent in front of computer, playing games or doing homework and watching television or playing games through play stations) was more than 1.5 hours/day. There was a significant difference in mean time spent in front of computer between total girls and boys (t-2.166; $p<0.01$). It was noticed that screen time spent in front of television was more than computer, television been watched more by girls (110.11±36.46 minutes) than boys (108.47±33.15minutes), and computer was used more by boys (96.55±39.73 minutes) than girls (89.55±41.70 minutes). Furthermore, parents report that they prefer their children watching TV inside home rather than playing outside unsafely as then they are then able to do their household works keeping an eye on their children. Some studies concluded that sedentary behaviour such as TV viewing may be more important predictors of obesity indices in children than are physical activity behaviours[17]. Dietz[18] emphasized that fact as early as 1985 that each additional hour of TV viewing per week increased the risk of obesity by 2%. In a study on 425 adolescents, it was found that on an average children spent 5 hours/ day in sedentary time and 1.5 hours/day in screen time (computer + TV)[19]. Another study reported that more than half of the adolescents (57.2 % boys and 52.8% girls) spent 1-4 hours/day watching TV or sitting at the computer[20]. Based on a survey of 855children in Finland, it was found that the risk of being overweight/obese increases as the number of hours spent watching TV increases. Watching television for more than 1 hour per day tripled the risk of being overweight compared to children who watched TV for less than one and half hour per day[21]. Also, due to unsafe roads, lack of free space for playing and increased television viewing and computer use has made life sedentary[22].

Average night sleeping time for girls and boys was calculated as 433.02±34.78 minutes and 428.10±32.25 minutes, respectively. On an average, the children slept for less than 8 hour per night. In a study by Goyal[23], on children between 12 and 18 years, emphasized that physical activity in childhood attenuated BMI and body mass in children is influenced by the

sleeping habit in the afternoon, lack of physical exercise, and sports habits as sleeping habit in afternoon influenced BMI through displacing the time that could be spent playing sports in engaging in other forms of physical activity[23].

A cross sectional study done on South Indian children in the age group 6-16 years showed that children who slept less than eight and half hours/day had significantly higher odds of being overweight when compared to children who slept more than9and half hours/day[24].

CONCLUSIONS :

Adolescence is a transitional period that involves physiological, psychological and social changes that may contribute towards the development of overweight and obesity (Wan *et.al.,* 2004). Overweight children and adolescents have been found to have a relative low level of aerobic power and fitness. Studies have shown that individuals with low physical activity have a greater body weight and body fat as compared to their active counterparts 12 and similarly gender differences have also been observed.

In conclusion, preventive strategies and interventions programs for overweight and obese adolescents are the key to prevention. Adolescents needs to be aware about the healthy weight, educated about the importance of regular physical activity. We should focus attention on a strategy that uses media, sometimes in sophisticated ways, to help young people avoid behaviours that reduce their wellbeing and increase behaviours that promote it. Parents may play a vital role on impact of children's television viewing. Parents need to be educated about the negative effects of media, but it is not clear how to target messages in such a way that parents will feel that they have the power to make changes within the home. The main goal of treatment of childhood obesity should be to encourage the child and his family to have a healthy lifestyle. A moderate dietary restriction in combination with physical activity and psychological support in severely obese children and adolescents is effective in decreasing body fat and improving physical performance taking into account family and social environmental conditions, through multidisciplinary team approach.

Table 1 Mean Anthropometric Measurements of Overweight and Obese Children

AGE GROUP	Girls (n=267)Mean±SD	Boys (n=385)Mean±SD	"t" value
Height (cms)	148.49 ±10.97	150.32±10.80	2.108**
Weight (kgs)	53.91 ±9.90	55.22 ±10.53	1.591^{NS}
BMI	24.31 ±2.59	24.29±2.97	0.068^{NS}
Waist Circumference (cms)	80.86 ±9.00	80.91 ±10.42	0.058^{NS}
Hip Circumference (cms)	86.00 ±6.97	85.76±7.82	0.410^{NS}
Waist Hip Ratio	0.93±0.07	0.94±0.08	0.433^{NS}

** Highly significant P value< 0.001, * Significant P value < 0.05, NS: Non -significant

Table 2: Age and gender wise total energy expenditure, basal metabolic rate and physical activity level of children

	Girls (n=267) Mean±SD	Boys (n=385) Mean±SD	"t" value
TEE[a] (kcal/day)	2420.01±15 6.22	2974.61±348.70	24.345**
BMR [b] (kcal/day)	1414.25±132.60	1634.84±186.26	16.645**
PAL[c]	1.51±0.08	1.53±0.08	2.175*
PAL[d] (TEE/BMR)	1.71±0.06	1.81±0.02	28.581**
Energy Intake (kcal/d)	3501.24±1068.00	3821.22±1384.77	3.177**
Energy Expenditure (kcal/d)	2420.01±156.22	2974.62±348.70	24.345**
Energy Balance (kcal/d)	1081.22±1066.95	846.60±1416.22	2.293**

** Highly significant- P value< 0. 001; * Significant P value< 0.05; NS: Non-significant

a: TEE (girls) =263.4 + 65.3kg - 0.454kg^2
TEE (boys) =310.2 + 63.3kg 0.263kg^2

b: basal metabolic rate estimated with predictive equations on body weight

c: Mean PAL multiple of 24-hour

d: physical activity level= TEE/ BMR_{est}

[a, b] Source - Joint FAO/WHO/UNU[25]. Human Energy Requirements. Report of Joint FAO/WHO/UNU Expert Consultation, Rome, 17-24 Oct. 2001. Rome FAO/WHO/UNU, 2004

Table 3 Age and Gender Wise Time Spent in Different Activities by children

	Girls (n=267)	Boys (n=385)	TOTAL 652
INDOOR GAMES(in minutes)	81.24±34.86	79.64±32.09	0.604[NS]
OUT DOOR GAMES (in minutes)	79.44±31.58	73.17±24.53	2.848**
ON COMPUTER (in minutes)	89.55±41.70	96.55±39.73	2.166**
WATCHING TV (in minutes)	110.11±36.46	108.47±33.15	0.598[NS]
DAY TIME REST(in minutes)	68.27±36.68	77.84±37.87	1.982*
NIGHT TIME SLEEP (in minutes)	433.02±34.78	428.10±32.25	1.858[NS]

** Highly significant P value< 0. 001; * Significant P value< 0.05; NS: Non- significant

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Reviewer comments :

Please do the numbering of references in sequence of the text rather than writing the author and year.