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Original Research Article

Physical Activity, Sleep and Anthropometric Profile of Young Adult Females from Mumbai City

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ABSTRACT

Life style factors have been shown to influence physical health and risk of disease. We undertook a study of 768 young adult women and examined their physical activity patterns, and measured their heights, weights, waist and hip circumferences. Sleep patterns were assessed using the Pittsburgh Sleep Quality Index Questionnaire and excess day time sleepiness was assessed using the Cleveland Adolescents Sleepiness Questionnaire. Body mass index and waist-to-hip ratio were calculated. Almost one-fifth of the women (19.2%) overweight or obese but a much higher percentage (44.8%) exhibited abdominal obesity. Most of the women were sedentary. More than half (58.1%) slept for less than 7 hours/night and 35.8% reported that their sleep quality was not good. Duration of sleep was significantly and negatively correlated with the global score for sleep quality and sleepiness score), whereas global sleep score was positively correlated with sleepiness score. A higher percentage of women who slept less than 6 hours were overweight or obese compared to those who slept for a longer duration and mean daytime sleepiness score tended to increase with increasing BMI. Our study indicates that young adult women who are studying are likely to have sleep deficiency and this along with low physical activity levels, places them at risk of obesity and its adverse consequences.

Key Words: Sleep, physical activity, body mass index, waist to hip ratio

INTRODUCTION

Tremendous changes in lifestyle have occurred especially in the last two decades in India. These changes include relatively more sedentary lifestyles, altered sleep patterns and consumption of processed foods. These factors contribute to the rising prevalence of obesity and its undesirable, adverse consequences. [1] Physical activity is an important discretionary component of energy expenditure that influences body weight and adiposity. [2] Increasing reliance on different forms of transportation and changing lifestyles in urban areas have resulted in reduced physical activity especially among young girls and women. [3] Besides physical activity, less hours of sleep, more noticeably among adolescents and young adults has been observed. [4] In young adults, duration and quality of sleep can be influenced by academic schedules, internet access and electronics in the bedroom. [5,6] Sleep restriction or deprivation could impair glucose tolerance, [7] as well as alter leptin and ghrelin levels unfavorably. Nedeltcheva et al., [8] and Markwald et al., [9] observed that sleep curtailment was associated with higher energy intakes which can promote weight gain. [10] In this context, we undertook a study to determine whether physical activity and sleep patterns of young Indian college-going women were associated with their body mass index (BMI) and waist-to-hip ratio (WHR).

MATERIALS AND METHODS

Ethical Approval: The study was approved by the Inter System BioMedica Ethics Committee.

Selection of Subjects: Young women in the age group of 16-20 years who were students of seven colleges in Mumbai city were recruited after obtaining informed consent, from the college authorities and the students. Exclusion criteria included any chronic disease e.g. tuberculosis, diabetes, polycystic ovarian disease, dyslipidemia (self –reported). Those who were on hormone therapy or if they had suffered from any gastrointestinal or urinary tract infection or had either lost or gained weight in the two months prior to the study, were also excluded. A total of 800 women were recruited, but complete data was not available for 32 women, who were excluded at the time of data analysis. Hence the study sample consisted of 768 women.

Anthropometric measurements: A calibrated digital weighing scale (Equinox Model EB 6171), maximum capacity 150 kg±100 g was used. Height was measured using a calibrated, non-stretchable flexible tape, to the nearest 0.1 cm. Three measurements were taken and the average was calculated. Body mass index (BMI) was calculated and the women were classified into BMI categories based on the cut-offs given by the World Health Organization for Asians. [3] Waist and hip circumference were measured using a flexible, calibrated, non-stretchable tape to the nearest 0.1 cm. Waist circumference (WC) was measured mid way between the lowest rib and iliac crest in standing position. Hip circumference was measured at the maximal circumference over the buttocks. Waist to hip ratio (WHR) was calculated and a value >0.8 was considered as the cut off for abdominal obesity. [11]

Physical activity pattern: Physical activity pattern was assessed using a questionnaire consisting of questions from the "Global Physical Activity Questionnaire" of the Department of Chronic Diseases and Health Promotion, World Health Organization. [12,13] Information was collected about participation in activities in three domains – activity at work, travel to and from places and recreational activities. It also included questions about sedentary behavior. Each subject was required to keep a record of all physical activities for one 24-hour period. Habitual physical activity was calculated as metabolic equivalents (MET mins/day) for each activity in the three domains during the 24-hour period. MET value for each activity was multiplied by the total duration and frequency i.e. number of days per week for the activity. Subjects were classified as having high, moderate or low physical activity in terms of total MET minutes spent.

High physical activity: Vigorous/intensive activity on at least 3 days achieving a minimum of at least 1500 MET mins/week or 7 days of any combination of walking, moderate or vigorous activities achieving a minimum of at least 3000 MET mins/week.

Moderate physical activity: Moderately active person was considered as one who did not meet the criteria for the "high" category but who performed three or more days of vigorous intensive activity of at least 20 mins/day or 5 or more days of moderate intensity activity or walking of at least 30 minutes/day or 5 or more days of any combination of walking, moderate or vigorous intensity activities achieving at least 600 MET mins/week.

Low physical activity: A person not meeting any of the criteria for high or moderate physical activity.

Sleep pattern: This was assessed using a questionnaire adapted from the Pittsburgh Sleep Quality Index Questionnaire (PSQI) which measures sleep quality during the month prior to the survey. It consists of 19 self-rated questions and discriminates between good and poor sleepers. [14] The scale consists of 15 multiple-choice items about frequency of sleep disturbances and subjective sleep quality and four items that require the subject to write about typical bedtime, wake –up time, sleep latency and sleep duration. The global score was

calculated for seven domains. For each domain, the score ranges from 0 (no difficulty) to 3 (severe difficulty). A global score ≥5 is considered to be suggestive of significant sleep disturbance.

Besides this the Cleveland Adolescents Sleepiness Questionnaire which measures excess daytime sleepiness in adolescents was used. [15] This questionnaire consists of 16 items representing a range of situations in which the person may feel sleepy or fall asleep. A Likert-type format is used in which each item was given score values ranging from never=1, to almost every day=5. The minimum possible score is 16 and the maximum possible score is 60, with higher scores reflecting greater daytime sleepiness.

Statistical Analysis: SPSS version 17 was used for data analysis. Pearson's correlation coefficient was applied for analysis of data.

RESULTS

Profile of Subjects: Mean weight of the subjects was 47.6±9.7 kg (minimum 27.7 kg, maximum 103.5 kg). Mean height was 153.4±5.7 cm (minimum 126 cm, maximum 172 cm) and the mean BMI was 20.2 kg/m^2(minimum 20.2 kg/m^2, maximum 38.9 kg/m^2). Overall, 36.8% of the girls were underweight, 8.9% were overweight, 4.9% were pre - obese and 5.4% were in different grades of obesity. Mean waist circumference was 72.0±10.0 cm (minimum 51 cm, maximum 133 cm), with 56.1% having WC exceeding 80 cm. Mean WHR was 0.80±0.07, varying from 0.60 to 1.12. Two-fifths of the girls (44.8%) exhibited abdominal obesity i.e. WHR >0.8.

Physical Activity: Mean total habitual physical activity in terms of MET minutes /day was 1750±408 minutes. About one-fifth of the subjects' time was spent on taking notes in college or related activities followed by sleeping (Table 1). Watching television accounted for one-tenth of the total MET mins/day and only 5.5% of their total time spent was on activities of moderate intensity. Only 2.7% of the subjects had part-time jobs, among whom all except one were sedentary or had low physical activity levels. Mean MET minutes spent by them was 365±206 minutes/day, varying from 156 to 720 minutes /day. The mean time spent on this travel was 95.8±38.9 minutes/day Almost all (96.4%) subjects used public transport i.e. bus or train. The mean time spent on this travel was 95.8±38.9 mins/day. Three fourths of the subjects (76.5%) walked from their homes to the bus or train station and from the train/bus station to their colleges and back. Mean MET spent on walking was 53.0±39.8 mins/day.

Table 1: Mean MET minutes /day spent on Daily Physical Activities

Activity	MET minutes /day (mean ± sd)	Percent Contribution to total MET minutes/day
Self grooming	62.5±39.0	3.61
Eating	100.3±35.0	5.79
Cooking	25.9±64.2	1.50
Sweeping floor	1.2±6.1	0.07
Washing utensils	9.0±23.8	0.51
Reading newspaper	1.2±4.6	0.07
Walking to bus/train station	53.0±39.8	3.06
Travelling in bus/train	94.8±38.9	5.48
Taking notes in college	671.3±133.1	38.77
Sitting at the computer	9.1±33.2	0.53
Watching television	180.2±234.2	10.5
Exercising	39.1±84.0	2.26
Getting ready to leave	51.9±40.9	2.99
Time spent while on job	9.5±66.6	0.55
Praying	4.2±10.8	0.24
Meeting friends, talking, sitting	24.2±45.5	1.40
Lying/sitting quietly/listening to music	17.8±21.3	1.03
Making bed	8.3±47.9	0.48
Sleeping	376.1±212.7	21.72
Total MET minutes/day	1731.3±395.1	

Leisure time was spent largely watching television or using the computer (90.2%) or going shopping (39.2%). Mean MET minutes spent on television viewing or working at the computer was 98.8±51.1 minutes, with 31.6 percent spending 120 MET mins/day and 29.6% spending 150 MET mins/day.

Only 17.7% girls exercised or played sports, with mean time spent on these activities being 241.1±472.3 MET mins/week. Among these, 11.4% walked, 1.3% went jogging, 1.1% did floor exercises and 1.1% did yoga. A very small percentage (0.8%) attended dance classes.

Sleep patterns: Time for going to bed varied from 9 pm to 3 am and wake up time was from 4 am to 12 noon. Almost half the participants (45.9%) went to bed between 11 pm and 12 am and 27.7% between 12 and 1 am. One-tenth (10.2%) of the participants went to bed between 1 and 3 am. Mean duration of sleep was 6.6±1.3 hours ranging from 3 to 11 hours. One-fifth (21.6%) slept for 5 to 6 hours, 36.5% between 6 and 7 hours, 16.9% between 7 and 8 hours and 19.6% slept for more than 8 hours per day. A considerable percentage of the subjects reported that they experienced disturbed sleep (Table 2). Only one-third (35.8%) of the women reported that their sleep quality was very good, 55% opined that it was fairly good but 9.0% felt that it was bad.

Table 2: Sleep Quality of Subjects

Components of Sleep Quality	Percent subjects
Cannot fall asleep within 30 minutes of going to bed	75.9
Wake up in the middle of the night or early morning	57.4
Have to go to use the bathroom	54.6
Cannot breathe comfortably	14.1
Cough or snore loudly	11.3
Feel too hot	19.4
Feel too cold	17.7
Have bad dreams	50.5
Have pain	31.2
Take medication to help to go sleep	5.2
Have trouble staying awake	6.6
Problem to keep enthusiasm	22.3

Mean global score for sleep quality was 4.3±1.9 with a score ≥5 indicative of poor sleep. Almost two-fifths (38.3%) had a global score ≥5. A slightly higher percentage of the older girls aged 18 to 20 years (40.1) had scores in this range compared to 33.6% of the 16-17 years old girls (Figure 1) with sleep latency being an important contributor to the global scores.

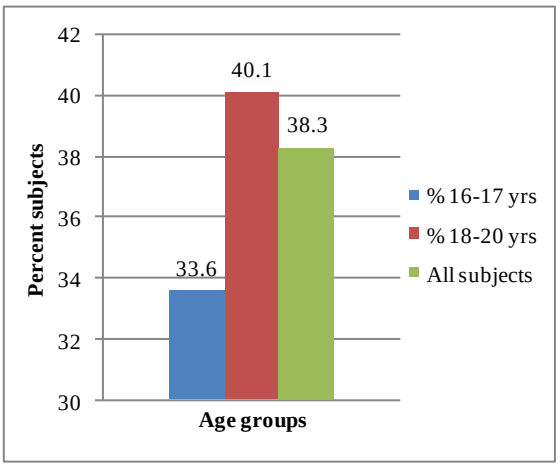

Figure 1: Percent Subjects having Global Sleep Score above 5

For daytime sleepiness, the mean score was 30.5±6.7, with 22.3% women having scores between 16 to 25, 54.2% between 26 and 35. One-fifth of the women (21.7%) had scores between 36 and 45, with only 1.5% having scores above 45.

Duration of sleep was negatively correlated with the global score for sleep quality (r=-0.454, p=0.000) and sleepiness score (r=-0.368, p=0.000), whereas global sleep score was positively correlated with sleepiness score (r=+0.780, p=0.000).

Almost three-fourths of the subjects reported that they could not fall asleep within 30 minutes of going to bed. A little more than half had had trouble in the month prior to the study, with 40 of the 768 subjects reporting that they needed medication to help them sleep.

Sleep, BMI and WHR: Duration of sleep did not differ much among the different BMI categories (F=0.72, p=0.64). However, a higher percentage, almost one-fourth of women who slept less than 6 hours were overweight or obese compared to those who slept for a longer duration (Table 3). Mean daytime sleepiness score increased with increasing BMI, although there was no significant difference between BMI

categories (F=0.59, p=0.79).

Table 3: Distribution of Women according to Hours of Sleep and BMI Categories

Hours of Sleep	Percent subjects		
	18.5-22.9	23.0-24.99	≥25.0
< 5.00	40.0	37.5	22.5
5.01-5.99	34.3	40.9	24.6
6.00-6.99	37.7	46.2	6.2
7.00-7.99	40.7	36.9	23.0
≥8.00	33.7	51.6	14.5

MET mins/day, BMI and WHR: Overweight and obese girls spent less time on habitual physical activity (1692±416 MET minutes/day) compared to women with normal BMI (1763±406 MET minutes/day) and underweight women (1776±434 MET minutes/day). BMI was negatively and significantly correlated with MET minutes /day (r=-0.077, p=0.016). Women with WHR <0.8 spent 1747±399 MET minutes/day compared to 1753±420 MET minutes/day, spent by those with WHR >0.8.

Mean MET minutes spent on watching television or working on computer was lowest for those with normal BMI (102±143mins/day) and highest for those who were underweight (156±303mins/day) whereas values for those who were overweight/obese were between the normal and underweight girls (136±246mins/day). Among the subjects who undertook sports activities or exercised, a higher percentage had normal BMI (Table 4). Percentage of time spent sitting and lying down while awake was significantly higher (F=2.7, p=0.008) for the overweight/obese category (66.0±11.7mins/day) followed by those who were underweight (60.6±15.7mins/day) and the least for women in the normal BMI category (57.5±14.6mins/day).

Table 4: Distribution of Women According to Leisure Time Activities

Leisure Time Activity	Percent subjects		
	18.5-22.9	23.0-24.99	≥25.0
Play sports	33.3	66.7	0
Exercise	35.2	49.5	15.4
Watch television	37.8	43.1	19.0
Dance	20.8	75.0	4.2
Read books	48.5	30.3	21.3
Do household work	50.0	33.3	16.7
Chat on phone with friends	40.6	43.8	15.6

Amount of time spent on exercise in MET minutes/day was lowest for those who were overweight/obese (96±309) followed by those who were underweight (168±379mins/day) and highest for those with normal BMI (367±562mins/day). Women with normal WHR spent significantly more MET mins/day (255±494mins/day) than those with WHR above 0.8 (224±445mins/day).

DISCUSSION

Most of the women in the present study had low physical activity levels. Overweight subjects tended to spend less MET minutes per day as compared to normal and underweight females. Women with normal BMI spent less MET minutes on sedentary leisure time activities i.e. watching television or lying down. Also, obese women spent significantly more time either sitting or lying down. In the US National Health and Examination Survey, Mendoza et al., [16] observed a significant association between obesity and the amount of time spent watching television among 12 to 17 year olds. For each additional hour of television viewing, prevalence of obesity increased by 2%. Television viewing or working at a computer displaces physical activity as there is less time for exercise, sports or other activities that will result in greater energy expenditure. Our findings conform with earlier reports in the literature. The World Health Survey in 2003 by the International Institute for Population Sciences and the Indian Global School-based health survey [17] indicated that majority of girls aged 16 to 18 years were physically active for less than 60 minutes, less than five days in a week.

Fagard [18] conducted a meta analysis of 72 randomized trials on endurance training involving 105 study groups. Endurance training was found to significantly reduce resting blood pressure, systemic vascular resistance, plasma nor-adrenaline and rennin as well as body weight, waist circumference and body fat.

Physical activity has beneficial effects on adiposity for youth who are overweight or obese as well as being beneficial for normotensive youth, especially because adolescents and young adults who have elevated blood pressure are more likely to have hypertension in adulthood. [19] Janssen and leBlanc [20] reported that participants who were least fit were more likely to have hypertension compared to those who were physically fit.

Further, in the present study, women with normal WHR spent significantly more MET minutes per day than whose WHR exceeded 0.8. Daniels et al [21] reported from observational studies of children and adolescents that increased amount of time was spent on sedentary activities while levels of physical activity decreased. This was associated with increased levels of obesity, adverse lipid profiles and related cardiovascular risk factors including hypertension and insulin resistance.

In the present study among the 768 young women, only 136 met the WHO criteria for moderate level of physical activity. Among those subjects, 71.3% had normal BMI compared to nearly two-fifths of those who were inactive but had normal BMI. Subjects with normal blood pressure spent less time watching television and more time exercising compared to those with higher blood pressure.

Nguyen et al [22] observed that adolescents in the lowest activity group were five times more likely to have metabolic syndrome and the odds increased from the second to the fourth quartile of time spent on moderate to vigorous physical activity compared with the most active quartile. Zuo et al., [23] observed in a cross-sectional study that occupational activity was inversely associated with fasting insulin and insulin resistance. Gong et al., [24] stated that different types of physical activity can differently influence the risk for cardiovascular disease. They reported that intensive domestic physical activity may not afford as much protection as leisure time activities which involve moderate or higher levels of physical activity.

Besides low physical activity, short sleep duration and poor sleep quality was also reported by the subjects in the present study. The negative correlation between duration of sleep and global sleep scores indicated that inadequate sleep was responsible for daytime sleepiness. Spilsbury et al., [15] reported similar trends on adolescents aged 11-17 years. Excessive day time sleepiness is associated with poor work performance, and possibly adverse consequences on quality of life. [25] Short sleep duration has also been found to contribute to insulin resistance. Casas et al., [26] observed in postmenopausal women that those who had good sleep quality were more physically active and that sleep quality was associated with lower BMI, waist circumference and total body fat. Multivariate analysis indicated that physical activity was significantly associated with high density lipoprotein levels, trunk fat and total body fat after controlling for sleep quality, sleep duration, age and BMI.

Earlier in 2010, Hairston et al., [27] studied changes in abdominal adiposity and subcutaneous adipose tissue among African American and Hispanic men and women followed up over a five-year period. In younger individuals below 40 years of age, short sleep duration less than five hours per night was associated with the greatest accumulation of fat. However, this was not observed among participants above 40 years of age. The authors noted that short sleep had a greater impact on adiposity than did long sleep. They proposed that the role of short sleep may be two-fold: increased energy intakes due to feeling hungry as a result of increase in leptin and ghrelin and less energy expenditure through changes in thermoregulation and increased fatigue. In their participants, the investigators also noted that among participants with short sleep duration, vigorous activity was decreased.

Similarly, Silva et al., [28] noted that children who slept less than 7.5 hours at

night had higher BMI and they had higher odds of developing obesity during adolescence. These data indicate that young women in the present study are likely to have similar risk. This is reinforced by the findings of the present study that BMI increased with daytime sleepiness and that a higher percentage of women were obese among those who slept for a shorter duration.

Yu et al., [29] reported that higher adiposity in terms of total and truncal body fat was associated sleep duration of < 8 hours and ≥9 hours per night as compared to a medium duration of 8 to 9 hours. The shorter sleep duration was attributed to the possibility of delayed bed time combined with the need to rise early at a fixed time, due to school schedules. Delayed bedtime was attributed to psychosocial factors like autonomy and participating in social interactions during the evening. Hall et al., [30] reported that duration of sleep was independently associated with abdominal obesity and elevated blood glucose and total cholesterol. Adults subjects who slept for less than 7 hours in a night were almost two times more likely to have abdominal obesity compared to those who slept for 7-8 hours at night.

Short term loss of sleep has been found to alter blood pressure as well as metabolic and immune functions. In experimental models, sleep restriction was associated with an increase in the orexigenic hormone ghrelin and an increase in leptin than has an orexigenic effects. Such changes could well lead to increased food intake. Combined with increased cortisol levels caused by sleep loss. There may be alterations in the central and peripheral systems that are involved in energy homeostasis, which in turn could lead to weight gain and obesity.

Adipose tissue is a source of inflammatory molecules including TNF-α and IL-6, which have been found to have a negative effect on nocturnal sleep as well as increase fatigue. Short sleep duration may be linked with physiologic pathways as well as eating behavior alterations that are associated with increased food intake. [30]

In the light of these reports in the literature, the findings of the present study are of concern that less than optimal duration of sleep and compromised sleep quality combined with physical inactivity could well increase their risk of non-communicable diseases. It is well documented that the prevalence of obesity, diabetes mellitus is high in India. [1]

CONCLUSION

Based on the observations of this study it appears that lifestyle of young women are of concern as it increases the risk of obesity and its adverse consequences. This calls for a larger epidemiological study among young Indian adults who may be apparently healthy and to sensitize the young adult population about the ill effects of their life style patterns.

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