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Original Article

Physiology Section

Poor Quality of Sleep and its Association with Increased Body Mass Index and Mood Disturbances in Young Adults

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ABSTRACT

Introduction: The ill-health effects of inadequate sleep and sleep-related disorders are usually underestimated by the general population. Recent studies have reported a declining trend in the quality of sleep among young adults due to the extensive use of electronic media. However, data regarding the quality of sleep and its association with Body Mass Index (BMI) and psychological status of young adults is very limited.

Aim: To assess the quality of sleep among young adults using simple self-reported pre-validated questionnaires and to measure the extent of its correlation with BMI and psychological status of the individuals.

Materials and Methods: This cross sectional study was conducted between August 2016 and December 2016 in the Department of Physiology, Indira Gandhi Medical College and Research Institute, Puducherry, India. Four hundred young adults (20-23 years, both genders) were recruited in the study and their BMI was calculated using the Quetelet's index. Quality of sleep, daytime sleepiness and symptoms pertaining to depression, anxiety and stress of the study participants were assessed using Pittsburgh Sleep Quality Index (PSQI) score, Epworth Sleepiness Scale score (ESS score) and Depression Anxiety Stress Scale Score (DASS score) respectively. The correlation between the study variables (PSQI scores, ESS scores, DASS scores, sleep hours and BMI) was determined using the Spearman correlation coefficient test.

Results: Statistically significant positive correlation was observed between: a) PSQI scores and BMI ($r=0.852$, $p<0.001$); b) ESS scores and BMI ($r=0.657$, $p<0.001$); c) DASS scores and BMI ($r=0.814$, 0.929, 0.946 for Depression, Anxiety and Stress scores respectively, $p<0.001$); and d) PSQI scores and DASS scores ($r=0.761$, 0.838, 0.836 for Depression, Anxiety and Stress scores respectively, $p<0.001$). Duration of sleep hours showed a significant negative correlation with BMI ($r=-0.533$, $p<0.001$), PSQI scores ($r=-0.714$, $p<0.001$), ESS scores ($r=-0.431$, $p<0.001$) and DASS scores ($r=-0.478$, -0.532, -0.522 for Depression, Anxiety and Stress scores respectively, $p<0.001$).

Conclusion: Poor quality of sleep predisposes to increased daytime sleepiness, increased BMIand mood changes in young adults.

Keywords: Depression anxiety stress scale, Epworth sleepiness scale, Pittsburgh sleep quality index, Sleep quality

INTRODUCTION

Sleep, defined as a reversible state of reduced consciousness is characterised by alterations in the electrical activity of the brain, muscle tone and autonomic status [1]. Good quality of sleep is considered to be very essential for the physical, cognitive and psychological well being of an individual. Recently, sleep-related research activities are gaining more importance due to the increasing incidence of sleep-related disorders and its associated co-morbidities in the general population [2].

The health consequences of inadequate sleep and sleep-related disorders are frequently overlooked and are mostly underestimated by the general population. Chronic sleep loss has varying effects on the cardiovascular, endocrine, immune and nervous system of the individuals resulting in various disorders such as Hypertension, Diabetes Mellitus, impaired cognition and mood disorders [3].

Insufficient sleep is also considered as one of the contributing factors to obesity. It has been reported that individuals with short duration of sleep have decreased levels of leptin and increased levels of ghrelin which in turn leads to increased appetite and therefore an increase in their BMI [4-6].

Chronic sleep loss results in excessive daytime sleepiness which predisposes to decreased attention span, impaired cognitive status and decreased performance. Inadequate sleep also has a significant negative impact on mood and behaviour. Depression, anxiety and excess mental distress have been observed in individuals with poor quality of sleep [7-10].

Among the general population, the young adults are more vulnerable to sleep loss and sleep-related disorders. The usage of modern electronic gadgets such as mobile phones, computers and television for long hours before sleep, usage of various stimulants, and varying academic schedules and social activities have been identified as major causes for sleep-related disorders among young adults [11]. Over the past few decades, there are increasing reports on insufficient and poor quality of sleep among adolescents and young adults [12-14]. However, data regarding the quality of sleep and its association with BMI among young adults is limited, especially with respect to Indian scenario. Hence, in this study, authors primary aim was to assess the quality of sleep of young adults using simple self-reported pre-validated questionnaires and to correlate it with BMI. In addition to it, authors also aimed at assessing the emotional status of the individuals using pre-validated questionnaires and to assess its correlation with the quality of sleep and BMI.

MATERIALS AND METHODS

This cross-sectional study was conducted between August 2016 and December 2016 in the Department of Physiology, Indira Gandhi Medical College and Research Institute, Puducherry, India. The study was prior reviewed and approved by the Institute Research and Ethical Committee (ECR/677/Inst/PY/2014).

Inclusion criteria: Young adults aged 20-23 years studying in engineering colleges in Puducherry who were willing to participate and who had given informed consent were included in the study.

Exclusion criteria: Individuals with known history of acute or chronic medical illnesses and those who refused to give informed consent were excluded from the study.

Sample size: Considering the prevalence of sleep disorder as 10% [14] among the sample, sample size was calculated using the formula, $n=4*p*q/L^2$ and the calculated sample size was 400. Two hundred males and 200 females who fulfilled the inclusion and exclusion criteria were included in the study.

BRIEF PROCEDURE

Four hundred young adults were included in the study. Their socio-demographic details were collected and entered in a data sheet.

Assessment of Height and Weight

Following standardised procedures, height (nearest 0.1 cm) of the subjects was measured using a stadiometer and the weight (nearest 0.5 kg) using a weighing scale. BMI was calculated using the formula, weight in kg divided by the square of the height in meters. Classification of BMI was done as per the Consensus Statement for Diagnosis of Obesity, Abdominal Obesity and the Metabolic Syndrome for Asian Indians [15]. Participants were categorised as undernourished, normal, overweight and obese when their BMI (kg/m^2) was <18.5, 18.5-22.9, 23-24.9 and ≥25 respectively.

Assessment of Quality of Sleep

The quality of sleep of the study participants was assessed using the PSQI [16], and daytime sleepiness was assessed using the ESS [17]. These questionnaires have been validated for their contents and format in various research projects conducted in India [14,18].

A detailed explanation of the questionnaires was given to all the participants and then they were asked to complete the questionnaires under the supervision of the investigator.

Pittsburgh Sleep Quality Index (PSQI): PSQI, a simple self-rating questionnaire was used to assess the subject's quality of sleep over the past one month in the following domains: 1) subjective sleep quality; 2) sleep latency; 3) sleep duration; 4) sleep efficiency; 5) sleep disturbance; 6) use of sleep medications; and 7) daytime dysfunction. A global score was calculated by adding all the seven component scores. Except for the first four open questions, the rest was assessed on a 4-point scale. Each component score had a value of '0' (no difficulty) to '3' (severe difficulty) and a value >0 was considered as abnormal. Subjects with global PSQI score <5 were considered as "good" sleepers while those with PSQI score ≥5 were considered as poor sleepers.

Epworth Sleepiness Scale (ESS): ESS was used to assess excessive daytime sleepiness. It consisted of eight questions for which the subject had to respond based on a 4-point Likert scale ranging from 0 (not at all likely to fall asleep) to 3 (very likely to fall asleep). Total ESS score of <10 was considered normal and total scores between 11-14 were considered as mild, 15-18 as moderate and 19-24 as severe daytime sleepiness [17]. A few terms in the questionnaire were slightly modified to suit the Indian context and were used after pretesting to assess the level of daytime sleepiness among the study participants.

Assessment of Depression/Anxiety/Stress Levels

Depression, anxiety and stress levels perceived by the subjects over the past week were assessed using the self-reported DASS questionnaire. Each item in this questionnaire was rated by the subject on a 4-point severity scale. The final scores of depression, anxiety and stress were obtained by adding the individual scores of the relevant items. Depression, anxiety and stress were classified as mild, moderate, severe or extremely severe as per the standard DASS guidelines [19-21].

STATISTICAL ANALYSIS

The data were entered into an Excel datasheet and statistical analysis was done using SPSS Version 16.0. Categorical variables are expressed as frequency and percentage. Spearman correlation coefficient test was done to assess the extent of correlation between the following: (a) PSQI and BMI; (b) ESS and BMI; (c) sleep hours and BMI; (d) DASS and BMI; (e) DASS and PSQI; (f) DASS and ESS; (g) PSQI and sleep hours; (h) ESS and sleep hours; (i) DASS and sleep hours; and (j) PSQI and ESS. The p-values <0.05 was considered significant.

RESULTS

A total of 400 young adults in the age group of 20-23 years were included in the study. It was observed that 43.5% of the study participants had a normal BMI, while 15.5% were overweight and 23.8% of participants were obese [Table/Fig-1]. The average sleep hours of the participants were 6.76 hours per night. The quality of sleep as assessed by PSQI scores was poor among 25.8% of the study participants. Mild and moderate daytime sleepiness as assessed by ESS was noted in 12.8% and 2.2% of the participants respectively. Self-reported symptoms of mild to extremely severe depression, anxiety and stress as assessed by DASS scores were noted in 24.5%, 26.8% and 20.2% of the participants respectively [Table/Fig-1]. Statistically significant positive correlation was observed between PSQI scores and BMI (r=0.852, p<0.001) and between

Parameters	No of participants	% of participants
BMI (kg/m^2)		
<18.5 (Undernourished)	69	17.2
18.5-22.9 (Normal)	174	43.5
23-24.9 (Overweight)	62	15.5
≥25 (Obese)	95	23.8
PSQI Scores		
<5 (Good sleepers)	297	74.2
≥5 (Poor sleepers)	103	25.8
ESS Scores (daytime sleepiness)		
0-10 (normal)	340	85.0
11-14 (mild)	51	12.8
15-18 (moderate)	9	2.2
19-24 (severe)	-	-
D (Depression) Scores		
0-9 (Normal)	302	75.5
10-13 (Mild)	48	12.0
14-20 (Moderate)	40	10.0
21-27 (Severe)	7	1.7
28+ (Extremely Severe)	3	0.8
A (Anxiety) Scores		
0-7 (Normal)	293	73.2
8-9 (Mild)	30	7.5
10-14 (Moderate)	40	10.0
15-19 (Severe)	26	6.5
20+ (Extremely Severe)	11	2.8
S (Stress) Scores		
0-14 (Normal)	319	79.8
15-18 (Mild)	31	7.7
19-25 (Moderate)	23	5.7
26-33 (Severe)	24	6.0
34+ (Extremely Severe)	3	0.8

[Table/Fig-1]: Characteristics of study participants.
BMI: Body mass index; PSQI scores: Pittsburgh sleep quality index scores; ESS scores: Epworth sleepiness scale scores; D (Depression) scores: Depression scores; A (Anxiety) scores: Anxiety scores; S (Stress) scores: Stress scores

DASS scores and BMI (r=0.814, 0.929, 0.946 for Depression, Anxiety and Stress scores respectively, p<0.001) [Table/Fig-2]. A significant positive correlation was also observed between PSQI and DASS scores (r=0.761, 0.838, 0.836 for Depression, Anxiety and Stress scores respectively, p<0.001) [Table/Fig-3]. On the other hand, significant negative correlation was observed between sleep hours and BMI (r=-0.533, p<0.001) [Table/Fig-2].

Correlation	PSQI scores	ESS scores	D scores	A scores	S scores	Sleep hours
BMI (Kg/m^2)	0.852**	0.657**	0.814**	0.929**	0.946**	-0.533**

[Table/Fig-2]: Spearman correlation between BMI, PSQI scores, ESS scores, DASS scores and sleep hours.
Values are Spearman correlation coefficient-** p<0.001
BMI: Body mass index; PSQI scores: Pittsburgh sleep quality index scores; ESS scores: Epworth sleepiness scale scores; D scores: Depression scores; A scores: Anxiety scores; S scores: Stress scores

Correlation	ESS scores	D scores	A scores	S scores	Sleep hours
PSQI scores	0.691**	0.761**	0.838**	0.836**	-0.714**
ESS scores		0.692**	0.662**	0.637**	-0.431**
Sleep hours		-0.478**	-0.532**	-0.522**	

[Table/Fig-3]: Spearman correlation between PSQI scores, ESS scores, DASS scores and sleep hours.
Values are Spearman correlation coefficient-** p<0.001
PSQI scores: Pittsburgh sleep quality index scores; ESS scores: Epworth sleepiness scale scores; D scores: Depression scores; A scores: Anxiety scores; S scores: Stress scores

DISCUSSION

This study was primarily conducted to assess the extent of correlation between the quality of sleep and BMI of young adults. It also aimed to assess their psychological status and correlate it with their quality of sleep and BMI.

Chronic sleep deprivation is a known risk factor for obesity and various health disorders. The present study included 400 young adults (200 males and 200 females), 62 individuals were overweight and 95 individuals were obese. Sleep restriction is known to result in an increase in BMI [4,22-24]. The average duration of actual sleep hours of present study participants was 6.76 hours per night which was marginally less than the recommended 7-9 hours of sleep for adults aged 18-25 years [25]. A systematic review by Patel SR and Hu FP, documented a strong positive association between short sleep duration and obesity, both in children and in adults [22]. Gangwisch JE et al., have also reported that inadequate sleep is associated with increased BMI [23]. Similarly, in a study by Singh M et al., the prevalence of obesity was seen to be high in individuals with less total sleep time [24]. In agreement with the results of the above-mentioned studies, authors observed a highly significant negative correlation between the sleep hours and BMI and a highly significant positive correlation between PSQI scores and BMI indicating that restriction in sleep hours and a poor quality of sleep would lead to increase in BMI.

Excessive daytime sleepiness, an outcome of decreased sleep quality and quantity is also known to be associated with BMI, mood and cognition of the individual. In this study, highly significant negative correlation was observed between sleep hours and PSQI scores and sleep hours and ESS scores indicating that reduced sleep hours will result in poor sleep quality and excessive daytime sleepiness. Similarly, a highly significant positive correlation was observed between ESS scores and PSQI scores and between ESS scores and BMI indicating that poor quality of sleep would predispose to increased daytime sleepiness and increase in BMI. These findings are in agreement with the reports of previous studies by Hasler G et al., Bixler EO et al., and Martikainen K et al., [8,26,27]. Epidemiological studies have suggested that poor sleep quality and excessive daytime sleepiness is associated with depression and anxiety [8,14,26,28,29]. In support to these evidences, a significant positive correlation between PSQI scores and DASS scores and ESS scores and DASS scores and a significant negative correlation between sleep hours and DASS scores was observed in this study. Thus, individuals with less total sleep time and poor quality of sleep are susceptible to increased risk of depression, anxiety and stress. In addition, a significant positive correlation was also observed between BMI and DASS scores thus supporting the fact that chronic sleep loss may act as a stressor thereby predisposing the individuals to increased risk of obesity, depression, anxiety and stress [30,31].

LIMITATION

Assessment of quality of sleep by self-reported sleep questionnaires as opposed to the objective measures of sleep quality such as actigraphy and polysomnography could be a limitation of the study. Factors such as diet, physical activity patterns and academic schedules which may influence the BMI, sleep and levels of perceived stress of the study participants were not included in the study, and this could be another limitation of the study. Considering the age of the study participants, the findings of the study cannot be generalised to individuals of other age groups. Hence, similar studies on individuals of different age groups are required to substantiate the results of the study.

CONCLUSION

Poor quality of sleep predisposes to increased BMI and increased risk of depression, anxiety and stress among young adults. Hence, regular health education programmes need to be initiated to educate young adults regarding the ill-health effects of poor sleep and to stress the importance of good quality of sleep.

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