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Original Article

Anatomy Section

Correlation Between Body Mass Index and Sleep Quality among Indian Doctors: A Descriptive Study

HARPREET SINGH GULATI[1], KAMALJEET KAUR[2], JASVEEN KAUR[3], AMBICA WADHWA[4], MAMTA SHARMA[5]

ABSTRACT

Introduction: In the current scenario, clinicians are constantly subjected to high workload coupled with enormous amount of stress which can lead to both derangement of sleep and accumulation of body fat. Since they are the central pillar of healthcare industry, the health of doctors themselves is an extremely important factor in pursuit of a healthy and disease free society.

Aim: To determine the effect of Body Mass Index (BMI) on quality of sleep in clinicians and to establish a relation between obesity and sleep pattern of clinicians.

Materials and Methods: The present descriptive study was conducted on 400 doctors working in Outpatient Department (OPD) clinics of various departments at Punjab Institute of Medical Sciences, Jalandhar and OPDs of NIMS Hospital, Jaipur, India, from July 2019 to June 2021. BMI was calculated as ratio of weight (kg) to the square of height (m). Sleep quality was assessed by Pittsburgh Sleep Quality Index (PSQI) questionnaire as a Global Pittsburgh Sleep Quality Index. BMI and sleep quality were checked for inter-relationship using various statistical methods like Chi-square test, Analysis of Variance (ANOVA), student t-test and Pearson's correlation.

Results: In the present study, 200 were males and 200 were females. Most of the participants were in the age group of 41-50 years. A 51.4% of participants with BMI >25 kg/m^2 had poor sleep quality which was significantly higher when compared with participants with BMI <25 kg/m^2 (33.5%). Sleep quality had no significant bearing with gender. Further, it was found that surgical specialists had poorer sleep when compared with their medical counterparts. The results showed that with increase in age and BMI of clinician PSQI also increases, indicating decrease in quality of sleep.

Conclusion: The results of the present study showed a significant association and linear correlation between sleep quality and overweight/obesity status. This information serves as an awareness and warning signal for the clinicians to safeguard their own health.

Keywords: Clinicians, Medical, Obesity, Overweight, Surgical

INTRODUCTION

The practising doctors all over the world are the pillars of healthcare set-up, and are constantly making an effort to bridge the gap between disease and health by serving the ailing community. These clinicians are not only responsible for individual health of their patients, but on a broader spectrum, they are involved as mentors and motivators guiding the public health. In a healthcare set up, though the output is always a result of teamwork between medical, paramedical and other technical professionals, but the onus of leading the team with respect to care and treatment of patients always rests foremost with the doctors. Doctors are physically and mentally drained due to overtime working hours, and also due to night shifts. Excess of these can lead to inaccurate decision making which can hamper the health outcomes of their patients.

A good quality sleep is a must for good health. The quality of sleep at night forms the platform for a good day's work. In general, good sleep quality has been defined to have the following features- the person should fall asleep within 20-30 minutes of getting into bed, no more than waking up once throughout the whole night, and the total duration of sleep should be as recommended for the particular age group. In case of adults, the average duration of night sleep recommended is seven hours [1]. World Health Organisation (WHO) has certified many indicators which can be useful to aptly elucidate disturbances in sleep or sleep disorders, namely sleep latency, number of times there are awakenings at night, total sleep duration, Rapid Eye Movement sleep (REM sleep), along with variations in the autonomic activities like heart beat rate, blood pressure, vasoconstriction and respiratory rate; and recurring nights with sleep disturbance during the last one week or month [1].

There have been reports of concomitant increase in obesity percentage along with alterations in sleeping patterns [2-6]. Emerging evidence reveals that there is a definite relation between sleep parameters with respect to quality and duration, and body weight. Sleep disturbances have been reported as a more prominent factor for increased Body Mass Index (BMI) as compared to sleep duration [2]. Sleep efficiency is another attribute which basically means the percentage of time which the person has actually slept in relation to the total time spent in bed. It reflects both difficulty in falling asleep as well as difficulty in staying asleep. Normal sleep efficiency is considered to be anywhere above 80% [7]. Hasler G et al., also tested the hypothesis that diminished sleep duration is related to weight gain resulting in overweight and obesity during young adulthood with the results depicting a negative relation between decreased sleep and obesity at 27 years of age [3]. A study put forward a hypothesis that considerable weight loss can be appreciated in those obese women who have better quality and duration of sleep. An overall better quality of sleep promoted the chances of weight loss by 33%. The study concluded that both quality as well as quantity of sleep can have a significant contribution towards weight loss [4]. A study on Indian medical students explored the correlation between BMI and sleep deprivation as they suffer from loss of sleep owing to huge workload. Among obese subjects 61.5% reported sleep duration of less than six hours at night while those who sleep more than eight hours were not found to be obese. Thus, an inverse correlation between hours of sleep

per night and BMI in medical students was observed [5]. Wang J et al., in his cross-sectional study found that more percentage of female students had poor sleep quality and a significant correlation was also found between BMI and sleep quality in females [6].

With the increasing trends in obesity and keeping in mind the amount of workload on Indian clinicians and diminished sleep, it becomes imminent to venture into the possible relation between BMI and sleep quality. The objective of the study is to delineate the correlational effect of high BMI on quality of sleep among Indian doctors. The present study will not only enlighten us about the prevalence of obesity but also reflect on its relationship with sleep patterns among doctors.

MATERIALS AND METHODS

The current descriptive study was carried out on 400 clinicians working in Outpatient Departments (OPDs) of Punjab Institute of Medical Sciences, various private hospitals in Jalandhar, Punjab, India, and OPDs of National Institute of Medical Sciences, Jaipur, Rajasthan, India, from July 2019 onwards till June 2021. The study was undertaken with prior approval from Institutional Ethics Committee, NIMS University, Jaipur (vide Ref. no. NIMSUNI/IEC/2019/PhD/142 dated 30-07-2019).

Inclusion criteria: Subjects between ages from 25-60 years, of both genders, having a minimum clinical work experience of three years, doing clinical work of minimum duration of six hours per day and willing to participate in the study were included in the study by systematic random sampling method.

Exclusion criteria: Those doctors who are suffering from any chronic illness other than that related to job, doctors who underwent any major surgery in the preceding year, doctors having history of trauma or those having any congenital anomaly were excluded from the present study.

Sample size calculation: The sample size was calculated with the help of software G*Power version 3.1.9.2 to be 372. It was measured at 99% confidence, keeping margin of error at 5% from a total study population of 845 doctors in our list. They were selected by systematic random sampling method. For better interpretation, the total number of clinicians taken for the study was 400. For better generalisation among both genders and type of clinicians, sample size was divided into 200 males and 200 females, as well as 200 medical and 200 surgical clinicians.

Various clinical specialists were categorised into two broad groups namely, medical clinicians and surgical clinicians. The specialists of Medicine, Psychiatry, Pulmonary Medicine, Paediatrics, Dermatology, Emergency medicine, Radiodiagnosis, Rheumatology, Medical Oncology, Radiation Oncology, Anaesthesia, Cardiology, Neurology, Endocrinology, Gastroenterology, Neonatology, Nephrology and graduate general physicians were included as Medical Clinicians, whereas the specialists of General Surgery, Orthopaedics, Obstetrics and Gynaecology, Otorhinolaryngology, Ophthalmology, Neurosurgery, Urology, Surgical Gastroenterology, Paediatric surgery, Plastic surgery, Cardiac surgery and Surgical oncology were included as Surgical Clinicians for the study.

Study Procedure

For measuring the height, the subject was asked to remove his/her shoes, stand erect and look forwards with the face being in Frankfurt plane. Arms were placed by the side, and feet placed together. Height was calculated as the maximum distance from the floor to the vertex of the head. Weight was measured with the subject standing in anatomical position on an electronic weighing machine with minimal movement and without shoes. BMI was then calculated as the ratio of weight (kg) to the square of height (m) and expressed in kg/m^2. As per WHO norms, BMI has been divided into four categories: low BMI (<18.5 kg/m^2) or underweight; normal BMI (18.5-24.9 kg/m^2) or normal weight; high BMI (25-29.9 kg/m^2) or overweight; and very high BMI (>30 kg/m^2) or obese [8].

The quality of sleep was assessed by a widely accepted, reliable and valid tool PSQI [9,10]. The PSQI was developed by Buysse DJ et al., in 1989, in order to make a standardised measure which can collect consistent information about the subjective nature of sleep habits and provide a well-defined scoring index that can be useful to doctors, patients as well as researchers [11]. Pittsburgh Sleep Quality Index (PSQI) questionnaire makes an assessment of the quality of sleep in the past one month. The 19 self-rated questions are reflected as seven component scores, each of which can range from 0 to 3, where '0' indicates no difficulty, whereas a component score of '3' reflects severe difficulty. These components are basically individual mental definitions of sleep quality, sleep latency, total duration of night sleep, sleep efficiency (the proportion of actual sleep duration from the total time spent in bed), sleep disturbances (defined as night waking), use of medications and pills to induce or initiate sleep, and daytime dysfunction due to sleepiness. All the component scores are then added to get the Global PSQI score. A PSQI score of ≤5 reflects a good sleep quality whereas a PSQI score greater than five shows poor sleep quality.

In the present study, association was checked between different BMI categories of clinicians and other demographic variables such as age, gender, type of clinician with sleep quality.

STATISTICAL ANALYSIS

The independent variables included in this study were age, gender, BMI and type of clinician. These were associated with sleep quality which is a dependent variable. The data was given statistical treatment with the software IBM Statistical Package for the Social Sciences (SPSS) software version 21.0. Chi-square test of association was checked between different categories of BMI and sleep quality. Analysis of Variance (ANOVA) and student t-test were employed to reflect the association between mean PSQI score with different levels of BMI and gender, respectively. Pearson's correlation coefficient was also established to determine linear correlation between BMI and sleep quality in doctors.

RESULTS

Reflecting upon the overall distribution of BMI in doctors, it is evident from [Table/Fig-1] below, that majority of the clinicians reported with high BMI (n=199, 49.8%), thus falling in the overweight category, while 11.5% (n=46) of the clinicians were having BMI >30 kg/m^2,

BMI category	Total n (%)	Gender		Age groups				Type of clinician	
		Male (n=200) n (%)	Female (n=200) n (%)	≤30 years n (%)	31-40 years n (%)	41-50 years n (%)	>50 years n (%)	Medical (n=200) n (%)	Surgical (n=200) n (%)
Low	12 (3)	4 (2)	8 (4)	2 (5.3)	3 (2.5)	7 (4.8)	0	10 (5)	2 (1)
Normal	143 (35.8)	83 (41.5)	60 (30)	17 (44.7)	47 (38.5)	46 (31.3)	33 (35.5)	77 (38.5)	66 (33)
High	199 (49.8)	95 (47.5)	104 (52)	14 (36.8)	57 (46.7)	71 (48.3)	57 (61.3)	88 (44)	111 (55.5)
Very high	46 (11.5)	18 (9)	28 (14)	5 (13.2)	15 (12.3)	23 (15.6)	3 (3.2)	25 (12.5)	21 (10.5)
Chi-square test		χ^2=7.614, p-value=0.055		χ^2=18.960, p-value=**0.026**				χ^2=9.186, p-value=**0.027**	

[Table/Fig-1]: Body Mass Index (BMI) distribution with gender, age, type of clinician.
p-value in bold font indicates statistically significant values

thereby falling in the obese category. Thus, a cumulative 61.3% of clinicians were having more weight than recommended for their height.

Prevalence of high BMI was analysed with respect to age, gender and type of clinician. It was found that BMI was significantly associated (p-value=0.026) with different age groups [Table/Fig-1]. Maximum percentage of obese doctors was found in age groups 41-50 years while 51-60 years group had maximum overweight clinicians. Thus, BMI was found to increase after the fourth decade of life in majority of the clinicians. Relating BMI with gender yielded insignificant association (p-value>0.05) via Chi-square test, but females in general reported slightly higher number of overweight and obese clinicians. But there was found significant association (p-value=0.027) of BMI with type of clinician, as it was seen that more percentage of high to very high BMI clinicians were surgical specialists (66%) as compared to medical doctors (56.5%).

Sleep quality which was assessed as a Global PSQI score was statistically analysed for its relation with different age groups, gender and type of clinicians via Chi-square test of association. [Table/Fig-2] depicts that sleep quality does not bear a significant association with gender as both males and females were similarly affected with sleep disturbances. But there was found a highly significant statistical relationship with age groups. The general pattern observed was that prevalence of poor sleep increased manifold with advancing age groups, with the exception being the youngest age group of less than 30 years. Clinicians aged above 50 years reported the maximum prevalence of poor sleep (71%) while those aged between 31-40 years had highest incidence of good sleep quality (70.5%).

For deriving meaningful inference, analysis with respect to mean PSQI score was done by way of Analysis of Variance (ANOVA) with age as well as BMI categories as shown below in [Table/Fig-4]. Mean PSQI was found to increase beyond the age of 30 years with 51-60 years age group doctors reporting a far higher mean as compared to the preceding age group. Pronounced effect of increase in BMI can be observed, as PSQI was found to increase consistently with increase in BMI. This signifies that with increase in body weight, the sleep quality takes a downward trend. Student t-test applied to infer relationship of mean PSQI with gender and type of clinician yielded that surgical specialists were having markedly higher mean PSQI denoting poor sleep, while no such association was found statistically with regards to the gender.

Analysing the correlational effect of sleep quality with different variables, PSQI score was subjected to Pearson's correlation and its coefficient was determined as shown in [Table/Fig-5] below. The results showed that with increase in age and BMI of clinicians, PSQI score also increases, denoting the decrease in quality of sleep, thereby establishing linear correlation between BMI and sleep quality.

DISCUSSION

The health of doctors in our society is one aspect that has been neglected in general, but rather needs to be extensively taken care of. Doctors need to be reminded and alarmed regarding the effects of negligence of their own health, especially concerning excessive weight gain owing to sedentary and stressful professional life. The present study has shown prevalence of

Sleep quality	Total n (%)	Gender		Age groups				Type of clinician	
		Male (n=200) n (%)	Female (n=200) n (%)	≤30 years n (%)	31-40 years n (%)	41-50 years n (%)	>50 years n (%)	Medical (n=200) n (%)	Surgical (n=200) n (%)
Good sleep (PSQI ≤5)	222 (55.5)	116 (58)	106 (53)	22 (57.9)	86 (70.5)	87 (59.2)	27 (29)	128 (64)	94 (47)
Poor sleep (PSQI >5)	178 (44.5)	84 (42)	94 (47)	16 (42.1)	36 (29.5)	60 (40.8)	66 (71)	72 (36)	106 (53)
Chi-square test		χ^2=1.012, p-value=0.314		χ^2=38.378, p-value <**0.001**				χ^2=11.702, p-value=**0.001**	

[Table/Fig-2]: Association of sleep quality with gender, age, type of clinician.
p-value in bold font indicates statistically significant values

Quality of sleep was also analysed for its relationship with different categories of BMI and it was inferred that there exists a highly significant relationship between BMI and sleep quality in doctors (χ^2=19.998, p-value <0.001). The prevalence of poor sleep quality increased consistently with increase in BMI, as from only 35.7% normal weight doctors being affected by poor sleep quality, the figure rocketed to nearly double (65.2%) prevalence in obese doctors. A 51.4% of participants with BMI more than 25 kg/m^2 had poor sleep quality which was significantly higher when compared with participants with BMI <25 kg/m^2 (33.5%) as shown in [Table/Fig-3].

BMI category	Sleep quality (PSQI score)	
	Good sleep (PSQI ≤5)	Poor sleep (PSQI >5)
Underweight (n=12)	11	1
	91.7%	8.3%
Normal weight (n=143)	92	51
	64.3%	35.7%
Overweight (n=199)	103	96
	51.8%	48.2%
Obese (n=46)	16	30
	34.8%	65.2%

[Table/Fig-3]: Association of sleep quality with BMI in clinicians.
Chi-square value=19.998, df=3, p-value <0.001

Parameters		PSQI score			p-value
		Mean	SD	SEm	
Age# (years)	≤30 (n=38)	5.237	2.3531	0.3817	**<0.001**
	31-40 (n=122)	4.459	2.3325	0.2112	
	41-50 (n=147)	5.095	2.3124	0.1907	
	≥50 (n=93)	6.548	2.2092	0.2291	
BMI#	Low (n=12)	3.833	2.3677	0.6835	**0.001**
	Normal (n=143)	4.853	2.4146	0.2019	
	High (n=199)	5.412	2.3227	0.1647	
	Very high (n=46)	6.174	2.4971	0.3682	
Gender$	Male (n=200)	5.145	2.4152	0.1708	0.374
	Female (n=200)	5.360	2.4186	0.1710	
Type of clinician$	Medical (n=200)	4.800	2.4861	0.1758	**<0.001**
	Surgical (n=200)	5.705	2.2613	0.1599	

[Table/Fig-4]: Association of mean PSQI score with age, BMI, gender, type of clinician.
#ANOVA; $Student 't' test; SD: Standard deviation; SEm: Standard error mean

Parameters	PSQI score	
	r-value	p-value
Age	0.246	**<0.001**
BMI	0.191	**<0.001**

[Table/Fig-5]: Pearson correlation of sleep quality with other variables.
r-value: Pearson correlation coefficient

high BMI in majority of the doctors in the study population. The prevalence of overweight and obese clinicians is much higher (61.3%) than the national rate (42.01%) of overweight and obese people having BMI >25 kg/m^2. However, in terms of obese individuals with BMI >30 kg/m^2, the percentage of clinicians in this category (11.5%) stood very close to the obesity rate (10.03%) in a study by Hadaye RS et al., [12].

Good quality of night sleep is an essential physiological function that prepares the body for performing optimum physical activity at workplace. Sleep quality and duration of sleep per night has seen a downward trend all over the globe in the last three decades [13]. Insufficient body rest disrupts the ability to think wisely, to manage mental stress, to sustain a good immune strength and also to moderate social and emotional behaviour [14].

Analysing sleep quality with different age groups, the current study results yielded a specific pattern in which quality of sleep improved from <30 years category (42.1% poor sleepers) to 31-40 years category (29.5% poor sleepers) but declined heavily in 41-50 years (40.8% poor sleepers) and further in 51-60 years age groups (71% poor sleepers). Attal BA et al., reported a high mean global PSQI of 6.85 among medical students, and found 68% of them to be poor sleepers. They also estimated that poor sleep was more prevalent in males as compared to females [15]. Berhanu H et al., found a significantly higher prevalence of poor sleep quality in age group 40-49 years [16]. Wang P et al., reported that poor sleep quality was found in 33.8% in the total sample, 39.2% in females and 26.3% in males [17].

Regarding the relation between body weight and sleep quality, the results of the present study support the findings of Vargas PA et al., in which they found that sleep disturbances were related significantly (p-value=0.006) to being overweight. They concluded that disturbances in sleep are exaggerated with age with an increase of 3% per year of age [2]. Wang J et al., also reported a close association between sleep quality determined by PSQI and BMI in females [6]. Peltzer K and Pengpid S, explored the relationship between BMI, waist circumference and quality of sleep and found that decreased duration of sleep was strongly associated with high BMI in both genders [18]. Mirdha M et al., investigated the relation between sleep quality and BMI among college students in India, and reported that there is a significant relationship between sleep latency and sleep disturbances with increase in BMI [19].

Thus, it is very conclusive that the quality of sleep is markedly influenced by high BMI. According to National Sleep Foundation, poor sleep quality and overweight have bidirectional cause-effect relationship. The physiological basis is that poor sleep patterns induce decreased levels of appetite suppressant hormone 'leptin', along with increased levels of appetite stimulant hormone 'ghrelin' which underline the theory behind association of sleep quality with weight gain. These hormonal imbalances make an individual to eat more, thereby causing high BMI [20]. Excessive accumulation of body fat around the respiratory passage can obstruct it and lead to further sleep disturbances. It has already been highlighted that sleep disordered breathing is closely associated with weight gain, especially in males [21]. It would be apt to say that high BMI and poor sleep quality are inter-related physiologically and each factor must be cordoned off by clinicians for their health improvement.

Limitation(s)

The current study is confined to doctors in two cities of India, namely, Jalandhar and Jaipur, thus limiting the geographical generalisation. Another limitation is that the general health status of the clinician was not evaluated in the current study. The present study also does not prove or reaffirm the cause effect bidirectional relationship between poor sleep quality and obesity.

CONCLUSION(S)

The study draws certain lucid and succinct conclusions in terms of effects of BMI on sleep quality of clinicians. The striking result of the study is the huge percentage (61.3%) of overweight and obese clinicians. The sleep quality declined very significantly with increase in BMI with obese doctors suffering maximum from poor sleep. For doctors to advocate good health practices, and counsel their patients productively, they must in some way act as role models of better health.

Authors' contribution: HSG- Study design, data collection, manuscript drafting; KK- Data collection and interpretation; JK- Data collection and analysis; AW- Study design, Research question conception; MS- Data interpretation, critical revision of manuscript.

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PARTICULARS OF CONTRIBUTORS:
1. Assistant Professor, Department of Anatomy, Punjab Institute of Medical Sciences, Jalandhar, Punjab, India.
2. Associate Professor, Department of Anatomy, Punjab Institute of Medical Sciences, Jalandhar, Punjab, India.
3. Associate Professor, Department of Anatomy, Punjab Institute of Medical Sciences, Jalandhar, Punjab, India.
4. Professor and Head, Department of Anatomy, Punjab Institute of Medical Sciences, Jalandhar, Punjab, India.
5. Professor, Department of Anatomy, Punjab Institute of Medical Sciences, Jalandhar, Punjab, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Harpreet Singh Gulati,
Assistant Professor, Department of Anatomy, Punjab Institute of Medical Sciences, Garha Road, Jalandhar, Punjab, India.
E-mail: drharpreetonline@gmail.com

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