

# Discriminant Function Analysis of Sleep Quality and its Determinants among General Adult Population of Ahmedabad City, Gujarat

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## Abstract

**Background:** Poor sleep quality harms the ability to think, lowers stress, and sustains a healthy immune system. The present study assessed sleep quality and its determinants in adult population using discriminant function analysis (DFA) in Ahmedabad city, Gujarat. **Objectives:** The objective of the study was (1) to assess the quality of sleep using the Pittsburgh Sleep Quality Index (PSQI) and (2) to determine various parameters affecting sleep quality using DFA. **Materials and Methods:** A cross-sectional study was conducted among the general adult population (18–60 years) residing at Ahmedabad city during July–December 2019. The interviewers conducted house-to-house visit among selected households for filling up the pre-designed and pretested questionnaire. **Results:** Out of 600 participants, the mean age of participants was  $37.8 \pm 18.3$  years. As per PSQI, overall sleep quality was poor among 31% of participants. Sleep quality was significantly associated with gender, education, occupation, social class, body mass index, Internet addiction, depression, and spirituality. **Conclusion:** Overall sleep quality was poor among the study participants. This article considered analysis of determinants of sleep quality among the urban adult population.

**Keywords:** Determinants, discriminant function analysis, general adult population, sleep quality

## INTRODUCTION

Quality as well as quantity both matters as far as sleep is concerned. According to the National Sleep Foundation (NSF, USA), in young adults (18–25 years) and adults (26–64 years), the daily sleep requirement is between 7 and 9 h, but for older adults (65 years and older), it decreases to 7–8 h.<sup>[1]</sup> Having sufficient sleep is essential for human health. The National Blood, Lung, and Heart Institutes have stated that people who have an insufficient sleep are at greater risk of developing heart and kidney diseases, high blood pressure, stroke, diabetes, and obesity. Patients with physical disorders, psychiatric depression, anxiety and stress, insomnia, schizophrenia, or side effects of medications, and those who consume psychoactive substances may present with poor sleep quality.<sup>[2]</sup> Sleep disorders result in a less pleasurable experience of social activities and reduce efficiency at the workplace. Sleep duration can be directly related to mortality, as one of the components of sleep quality.

Most of the sleep analytical studies are conducted previously among specific groups or regions.<sup>[3,4]</sup> Research related to sleep

quality of productive age group is meager as far as India is concerned. The present study focused on sleep quality and its determinants among the representative adult population (>18–60 years of age) of Ahmedabad City. Sleep quality appraisal relies mostly on individual perception. An objective parameter used in the present study for measuring the actual sleep quality was – Pittsburgh Sleep Quality Index (PSQI).<sup>[5]</sup>

## Objectives

1. To assess the quality of sleep using the PSQI
2. To determine various parameters affecting sleep quality using discriminant function analysis (DFA).

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## MATERIALS AND METHODS

A cross-sectional study was conducted among the general adult population (18–60 years) residing at Ahmedabad city from July to December 2019. The researcher sought permission from the institutional ethics committee before conducting the study.

### Sample size

Based on a previous study, showing a prevalence of poor sleep quality of 42.58%, a sample size of 542 was required to obtain a 95% level of confidence.<sup>[6]</sup> Considering nonresponse 10%, the researcher rounded up the sample size to 600.

### Sampling method

As per the official website of Ahmedabad Municipal Corporation, Ahmedabad city has been divided into total six Zones.<sup>[7]</sup> Each zone is further divided into wards. One ward was selected randomly from each zone. Furthermore, one urban area was randomly selected from each ward. Total of 100 houses were selected using systematic random sampling method from each urban area. From each home, one participant (18–60 years) was selected randomly using the lottery method. Trained nursing students interviewed selected individuals through a validated questionnaire. The investigators sought participants informed consent before the interview.

### Exclusion criteria

Person who did not give consent, suffering from a major illness such as cancer, cardiovascular diseases, trauma, underwent any surgery, or admission in hospital in the past 1 month or reported any mortality or any unfortunate event in his or her family were excluded from the interview.

The study pro forma included questions regarding sociodemographic profile, biometric parameters, physical health, personality and behavior, and sleep quality. PSQI was used to assess sleep quality. It can assess sleep quality during the previous month and has 19 items.<sup>[5]</sup> Sleep quality was correlated with depression, internet addiction, body mass index (BMI) status, and spirituality. The Patient Health Questionnaire (PHQ)-9 was used to measure the level of severity of depression among the study group.<sup>[8]</sup> Internet addiction test (IAT)<sup>[9]</sup> was used, which is a reliable and valid measure of addictive use of the Internet, developed by Dr. Kimberly Young. It consists of twenty items that measure the mild, moderate, and severe level of Internet addiction. Spiritual quiz adapted from a personality inventory devised by Washington University psychiatrist Robert Cloninger was used to assess the spirituality status of participants.<sup>[10]</sup>

### Data analysis

Data were entered into MS Excel and analyzed using IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp. Proportion and mean were calculated for descriptive data. Stepwise discriminant function analysis (DFA) was used to determine which factors could best differentiate good sleepers and poor sleepers. Many assumptions and restrictions could be studied using discriminant analysis as compared to logistic regression.<sup>[11]</sup>

## RESULTS

The study enrolled a total of 600 respondents. Among those enrolled, 65.5% were males, and 34.5% were female. The mean age of participants was  $37.8 \pm 18.3$  years. Majority study subjects were graduates and above (77.5%), working (64.5%), and belonged to the nuclear family (50.2%). Around 61.0% were from Social Class I as per modified Prasad's classification.<sup>[12]</sup>

It was found that overall sleep quality (based on seven components) was poor among 31% of participants having global PSQI score ">5." The majority (89.8%) had good subjective sleep quality. The mean scores of subjective sleep quality, sleep disturbances, and daytime dysfunction were  $1.5 \pm 0.9$ ,  $1.2 \pm 0.7$ , and  $0.7 \pm 0.6$  h, respectively. The study participant's average night sleep duration was  $7.2 \pm 2.1$  h. Average sleep latency was 35 min. Out of 600, 392 study participants (65.3%) reported that they had <7 h of sleep per night, 76 (12.7%) had a diminished habitual sleep efficiency (<75%), and 150 (25%) used sleep medication within the past 1 month at the time of the interview, 270 (45%) had day time dysfunction once or twice in a week [Table 1].

Out of total study participants, 346 (57.7%) had normal BMI, whereas 15.7% and 3.2% were overweight and obese,

**Table 1: Percent distribution as per Pittsburgh sleep quality index variables (PSQI) among study population (n=600)**

PSQI Variables	Percentage
Subjective sleep quality	
Very good	89.8
Fairly good	10.2
Sleep latency (h)	
<1	54.5
1-2	40.7
3-4	4.8
Sleep duration (h)	
>7	34.7
6-7	54.8
5-6	9.2
<5	1.3
Sleep efficiency (%)	
>85	28.0
75-84	59.3
<75	12.7
Sleep disturbance	
1-9	73.8
10-18	24.8
19-27	1.3
Use of Sleep medication	
Not needed in the past week	75.0
Less than once a week	17.0
Once or twice a week	6.0
Three or more times a week	2.0
Daytime dysfunction	
Less than once a week	47.8
Once or twice a week	45.0
Three or more times a week	7.2

**Table 2: Percent distributions of determinants of sleep quality among good and poor sleepers**

Determinants of sleep quality	PSQI		Total	Cramer's V (P)
	Good sleepers (n=414), n (%)	Poor sleepers (n=186), n (%)		
Age (years)				
18-29	106 (65.4)	56 (34.6)	162	0.074 (0.349)
30-39	129 (74.1)	45 (25.9)	174	
40-49	103 (67.3)	49 (32.2)	152	
50-59	76 (67.9)	36 (32.1)	112	
Gender				
Female	162 (78.3)	45 (21.7)	207	0.1453 (0.0004)*
Male	252 (64.1)	141 (35.9)	393	
Education				
Primary	10 (100.0)	0	10	0.2060 (<0.0001)*
Secondary	10 (100.0)	0	10	
Higher secondary	59 (52.2)	56 (47.8)	115	
Graduate and above	335 (71.7)	130 (28.3)	463	
Marital status				
Married	283 (68.9)	128 (31.1)	411	0.0041 (1)
Unmarried	131 (69.3)	58 (30.7)	189	
Type of family				
Joint	163 (70.6)	68 (29.4)	197	0.034 (0.717)
Nuclear	203 (67.4)	98 (32.6)	301	
Three generation	48 (70.6)	20 (29.4)	102	
Occupation				
Working	231 (59.7)	156 (40.3)	387	0.2714 (<0.0001)*
Nonworking	183 (85.9)	30 (14.1)	213	
Socio economic class				
I	259 (70.8)	107 (29.2)	366	0.1297 (0.0177)*
II	119 (63.0)	70 (37)	189	
III	14 (100.0)	0	14	
IV	22 (71.0)	9 (29.0)	31	
BMI				
Underweight	88 (62.4)	53 (37.6)	141	0.1632 (0.0011)*
Normal	231 (66.8)	115 (33.2)	346	
Overweight	78 (83.0)	16 (17)	94	
Obese	17 (89.5)	2 (10.5)	19	
Internet addiction				
Yes	345 (67.1)	169 (32.9)	514	0.0993 (0.0211)*
No	69 (80.2)	17 (19.8)	86	
Depression				
None	5 (100.0)	0	5	0.3533 (<0.0001)*
Mild	156 (69.6)	68 (30.4)	224	
Moderate	128 (54.5)	107 (45.5)	235	
Moderately severe	108 (100.0)	0	108	
Severe	17 (60.7)	11 (39.3)	28	
Spirituality				
A practical empiricist lacking self-transcendence	25 (32.89)	51 (67.10)	76	0.3184 (<0.0001)*
Highly skeptical, resistant to developing spiritual awareness	12 (52.17)	11 (47.82)	23	
Highly spiritual, a real mystic	74 (81.31)	17 (18.68)	91	
Spiritually average, could develop more spiritual life if desired	181 (75.10)	60 (24.89)	241	
Spiritually aware, easily lost in the moment	122 (72.18)	47 (27.81)	169	

\*Significant result. Figures in the parenthesis are row-wise percentages. PSQI: Pittsburgh sleep quality index, BMI: Body mass index

respectively. As per the IAT, 514 (85.7%) had Internet addiction. The PHQ-9 was used to measure the level of

severity of depression among the study group. It was found that 224 (37.3%) were having mild and 235 (39.2%) had moderate

levels of depression. Around 40.2% of total participants were belonged to the spiritually average group as per the spirituality quiz.

Association between various determinants of sleep quality was tested using Cramer's V test. It was found that sleep quality was significantly associated with gender, education, occupation, social class, BMI, Internet addiction, depression, and spirituality [Table 2].

DFA was carried out, in which the cutoff score for defining poor sleep quality comes out  $-0.617$  that means a score less than or equal to the cutoff score indicate poor sleep quality. For the model regarding sleep quality, all these explanatory variables jointly affect, but among them, gender, occupation, BMI, internet addiction, depression, and spirituality have a significant effect on sleep quality. Based on DFA, the prediction of bifurcation of sleep quality can be measured 94.7% accurately [Table 3].

## DISCUSSION

The present community-based study was carried out using validated PSQI among 600 urban adult population of Ahmedabad city. The mean age of participants was 37.8 years. PSQI global score recognized 31% of participants as having poor sleep quality in preceding 1 month. The proportion showed consistent result with the results of other studies.<sup>[13-15]</sup> Prevalence of poor sleep quality was 38.2% in a study carried out by Madrid-Valero *et al.*<sup>[13]</sup> In a study by Hinz *et al.*,<sup>[14]</sup> it was found that 36% of the general population slept poorly. Prevalence of general sleep disturbance was 32.1% in one of the studies conducted at the Netherlands by Kerkhof.<sup>[15]</sup> A study conducted at Ethiopia<sup>[16]</sup> revealed relatively high prevalence of poor sleep (64.5%). This may be due to variation in the socioeconomic status as well as a cultural difference. Minimal research of similar kind is found to be conducted in the Indian context. In a study carried out by Mondal *et al.*<sup>[6]</sup> the prevalence

of poor sleep quality was 42.58% in the urban population of West Bengal, India.

In the present study, sleep quality was not showing a significant alteration with the age of the people. Madrid-Valero *et al.* mentioned in their research that age was directly and significantly associated with a low quality of sleep.<sup>[13]</sup> In the present study, females were having better sleep quality as compared to males. A similar finding was there in a study of Berhanuat Ethiopia.<sup>[16]</sup> Study conducted in Spain<sup>[13]</sup> and Germany<sup>[14]</sup> revealed contrasting result in this regard. This might be due to the nature of the study participants in their area. Furthermore, males bear more responsibility to lead the family and substance users as far as India is concerned. In the present study, variables found to be significantly associated with poor sleep quality were gender, working status, BMI, internet addiction, depression and spirituality of individuals. In the study conducted at Ethiopia,<sup>[16]</sup> age, monthly income, and BMI were demonstrated to have a statistically significant association with sleep quality. A study by Nikfar *et al.*<sup>[17]</sup> revealed that individuals with higher BMI had worse sleep quality.

Average night sleep duration was 7.2 h in the present study, while average sleep latency was 35 min. Around 65.3% reported having  $<7$  h of sleep per night, and 25% of individuals used sleep medication within the past month at the time of interview. Similar results were seen in Ethiopia base study.<sup>[16]</sup> Wu *et al.* mentioned in their study that 12.4% have used sleeping medication at least once in the previous month, and average sleeping time was 6.6 h.<sup>[18]</sup> A survey in a representative sample of the Swiss population mentioned an average sleep duration of 7.5 h.<sup>[19]</sup>

## CONCLUSION

Overall sleep quality was poor among the participants. Usage of sleeping medication was also higher in the study group. This article considered analysis of determinants of sleep quality

**Table 3: Discriminant function analysis for the sleep quality determination**

Discriminant Function Coefficient	Explanatory Variables	P	Score	Accuracy (%)
-0.0440	Age	0.758	-0.617	94.7
+2.2260	Gender*	0.000		
-0.2600	Education	0.595		
+0.8380	Marital status	0.948		
-0.2290	Type of family	0.456		
-2.2850	Occupation*	0.000		
+0.0940	BMI*	0.000		
+0.0050	Internet addiction*	0.017		
+0.0050	Depression*	0.002		
+0.2010	Spiritual*	0.000		
+0.0000	Per capita income	0.221		
+1.3600	Number of children*	0.000		
-3.2250	Constant			

\*Significant explanatory variables

among urban adult population using DFA which predicts sleep quality with 94.7% accuracy. Based on the present study, it is concluded that gender, working status of an individual, BMI, Internet addiction, depression, and spirituality have a significant effect on the quality of sleep.

### Limitation of the study

A cross-sectional study design does not allow cause and effect inference. Perceived sleep quality assessed using the PSQI questionnaire bound to have some recall bias.

### Implication of the study

The present study is first of its kind, which has analyzed the sleep quality of general adult population of Ahmedabad city. Findings of the study have identified the population with poor quality of sleep that deserves greater attention.

### Financial support and sponsorship

Nil.

### Conflicts of interest

There are no conflicts of interest.

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