

## Original Research Article

# Role of sleep and stress in metabolic syndrome: a community based cross sectional study in Rishikesh, Uttarakhand

Senkadhirdasan Dakshinamurthy<sup>1\*</sup>, Vartika Saxena<sup>1</sup>, Ranjeeta Kumari<sup>1</sup>,  
Anissa Atif Mirza<sup>2</sup>, Minakshi Dhar<sup>3</sup>, Ashutosh Mishra<sup>1</sup>

<sup>1</sup>Department of Community and Family Medicine, <sup>2</sup>Department of Biochemistry, <sup>3</sup>Department of Medicine, AIIMS, Rishikesh, Uttarakhand, India

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### \*Correspondence:

Dr. Senkadhirdasan Dakshinamurthy,  
E-mail: [Senkadhirdasan85@gmail.com](mailto:Senkadhirdasan85@gmail.com)

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### ABSTRACT

**Background:** Sleep disturbances and stress may intervene with the physiological processes in human body and act as a modulator of metabolic homeostasis. The aim and objectives of the study were to estimate the person's average sleep propensity; to estimate the stress level in the study subjects; and to determine the association of sleep and stress with metabolic syndrome.

**Methods:** A community based cross sectional study was conducted in an urban area of Rishikesh. Sample size was calculated to be 478. Data was entered and analyzed using SPSS Version 20.0. Chi-square test was used to examine the association between categorical variables. A p value of <0.05 was considered significant.

**Results:** It was observed that different levels of stress did not have any significant association with metabolic syndrome (MetS) though the odds among individuals with moderate stress were 1.1 times (95% CI 0.6-2.2) higher than those with low stress. The overall sleepiness grading was not significantly associated with Metabolic Syndrome. However, people with mild excessive daytime sleepiness have 4.7 times (95% CI 1.2-18) higher odds of MetS as compared to those with low normal daytime sleepiness. Those with moderate excessive day sleepiness had 1.59 times (95% CI 0.3-8) higher odds of MetS, however it was not statistically significant.

**Conclusions:** Mild excessive daytime sleepiness was associated with an increased risk of metabolic syndrome. People with perceived stress are having higher chance of getting MetS.

**Keywords:** Cardiometabolic risk, Epworth sleepiness scale, MetS, NCEP ATP 3 criteria, Non-communicable diseases, Perceived stress scale, Uttarakhand

### INTRODUCTION

Metabolic syndrome is a cluster of risk factors like hypertension, high triglycerides, low HDL cholesterol, glucose intolerance and increased waist circumference.<sup>1</sup> According to the NCEP:ATP III panel, the main aim of evaluating the Metabolic Syndrome (MetS) was to identify individuals at higher risk of cardiovascular disease (CVD).<sup>2</sup> The prevalence of MetS in urban northern India was 18.4% in males and 30.9% in females and in southern India, it was 17.1% in males and 19.4% females respectively.<sup>3,4</sup> Studies demonstrated a clear

linkage between the non-behavioral variables (such as long work hours, exposure to stressors) and obesity risk which is a risk factor for CVD.<sup>5</sup> Chronic exposure to stress may affect the function of autonomic nervous system and neuroendocrine activity directly, that leads to the development of the MetS.<sup>6</sup> Excessive daytime sleepiness (EDS) is independently associated with Metabolic variables, and that the relationship is dependent on severity.<sup>7,8</sup> The mechanisms by which EDS act upon MetS are likely to be complex and involving variety of causes. Nocturnal hypoxemia and fragmented sleep are the characters of EDS that will impair the

autonomic nervous system, which alters hypothalamic-pituitary-adrenal (HPA) axis activity and causes systemic inflammation which leads to MetS.<sup>9</sup> Therefore, the current study was conducted in urban areas under Municipal Corporation of Dehradun district to determine the role of sleep and stress with MetS and its associated risk factors in people 19-60 years of age. Through this study, appropriate recommendations can be given for formulation of effective strategies to prevent and control MetS.

## METHODS

A community-based cross-sectional study was conducted in year 2018-19 for a duration of one year in the age group of 19 to 60 years residing in urban areas of Rishikesh. Assuming the proportion of MetS in young adults (34.3%), the sample size was calculated to be 227 by keeping relative precision of 18%.<sup>10</sup> Applying a design effect of 2.0, the sample size was calculated to be 454. Considering a dropout rate of 5%, the final sample size was calculated to be 478.

### *Inclusion criteria*

Individuals in the age group 19 years to 60 years on the day of data collection, and who consent to participate in the study and residing for more than 6 months in the area were eligible for inclusion in the study.

### *Exclusion criteria*

Diagnosed cases of cirrhosis of liver, chronic kidney disease, Cushing's syndrome, hypothyroidism, which cause increase in weight due to pathologic water retention and may lead to false readings of weight and anthropometric measurements were excluded from the study. Patients with type-1 diabetes mellitus, secondary hypertension and those on drugs causing overweight/obesity like steroids, oral contraceptives, antidepressants etc. were also excluded. Pregnant females were also excluded due to physiologic gain in abdominal circumference and alteration of various parameters during pregnancy.

Rishikesh Municipal Corporation present in district Dehradun, Uttarakhand. Urban Rishikesh is divided into 20 wards with population of 70,189 as per Census India, 2011.<sup>11</sup> Cluster sampling technique, which is a kind of two-stage sampling technique, was used to select the representative population of urban areas of Rishikesh. During first stage, a list of urban areas from the District Urban Development Authority office was taken and then, 10 clusters (wards) were selected. At second stage, 48 study participants from each of the selected clusters were randomly selected. If all the 48 study participants could not be found from a single cluster, then the contiguous cluster was taken until the desired number was completed. It was ensured to select only one study participant from each selected house. With a drop-out of 2, final analysis was done for 478 participants. Informed written consent

from the participants was obtained after informing them that the participation was voluntary, and there was no harm to the participant due to or during our study. A pre-tested interview schedule was used for data collection regarding sociodemographic characteristics. WHO steps instrument and protocol were used for assessment of risk factors and measurements, i.e. anthropometry and blood pressure.<sup>12</sup>

Study was started after getting approbation from the Ethics committee of the institution, AIIMS, Rishikesh (AIIMS/IEC/18/95). Confidentiality of the information obtained from the patient was maintained and the identity of the patient was not revealed. Descriptive statistics were used for getting percentages, proportion, mean (SD) and median (IQR). Chi-square test was used to examine the categorical variables association, whereas t-test was used for comparing the means. A significance level of 5% was used for all of the statistical tests. The data was analysed with SPSS Version 20.0.

### *Biochemical analysis*

Laboratory assessments included measurements of high density lipoproteins (HDL), triglycerides (TGL) and fasting blood sugar (FBS) obtained by venous blood samples in fasting state of 12 hours, measured by fully automated chemistry analyser. The blood samples were collected in a red vacutainer for measurement of fasting lipids (triglycerides, and high-density lipoprotein (HDL) cholesterol and grey vacutainer were used for estimating fasting blood sugar. A total 5 ml of blood sample was collected. All blood samples were properly labelled and transported to the laboratory at AIIMS, Rishikesh for analysis.

### *Stress assessment*

Assessed by perceived stress scale, range starting from zero 13 could be considered low stress, 14-26 could be considered moderate stress. And Scores ranging from 27-40 could be taken into consideration high perceived stress.<sup>13</sup>

### *Sleep assessment*

The Epworth Sleepiness Scale (ESS) score can range from 0 to 24. The higher the ESS score, the higher the 'daytime sleepiness'.<sup>14</sup>

## RESULTS

The number of subjects included in the study was 478 (men/women- 165/313). Females constituted 65.5% of the total sample.

Table 1 shows that more than half (58%) of study participant were able to handle stress due to something happening unexpectedly or from being unable to control things in their life. Only 9% of people reported feeling nervous/stressed fairly often or more.

**Table 1: Distribution of study participants according to stress assessment.**

Variable	Never N (%)	Almost never N (%)	Sometimes N (%)	Fairly often N (%)	Very often N (%)
<b>Upset because of something that happened unexpectedly</b>	49 (10.3)	228 (47.7)	173 (36.2)	26 (5.4)	2 (0.4)
<b>Unable to control the important things in your life</b>	38 (7.9)	236 (49.4)	189 (39.5)	15 (3.1)	0
<b>Felt nervous and stressed</b>	28 (5.9)	226 (47.2)	181 (37.9)	41 (8.6)	2 (0.4)
<b>Felt confident about ability to handle personal problems</b>	1 (0.2)	10 (2.1)	92 (19.2)	279 (58.2)	96 (20.1)
<b>Felt things were going their way</b>	4 (0.8)	19 (4.0)	111 (23.2)	273 (57.1)	71 (14.9)
<b>Felt could not cope up with the things</b>	80 (16.7)	186 (38.9)	192 (40.2)	19 (4.0)	1 (0.2)
<b>Able to control irritations in life</b>	0 (0)	7 (1.5)	151 (31.6)	246 (51.5)	74 (15.5)
<b>Felt that you were on top of things</b>	2 (0.4)	28 (5.9)	156 (32.6)	232 (48.5)	60 (12.6)
<b>Felt angered because of things that were outside of your control</b>	38 (7.9)	259 (54.2)	159 (33.3)	20 (4.2)	2 (0.4)
<b>Felt difficulties piling up so high that you could not overcome</b>	26 (5.4)	274 (57.3)	161 (33.7)	15 (3.1)	2 (0.4)

Most of them (78.5%) reported feeling confident about ability to handle personal problems and another 72% felt things were going their way, fairly often or better. Very few people (4%) reported that they felt that they could not cope up with the things.

Most of the people (67%) reported that they were able to control irritations in life fairly often. Only 6% of people felt that they were never or almost never on top of things. Another 4.2% reported feeling angered fairly often because of things that were outside of their control.

Analysis of the scores of stress assessment questionnaire showed that more than half of the study participants were

having low stress (56.1%) and remaining 43.9% were found to have moderate stress. None of the study participants was found to have high stress based on assessment through the perceived stress scale (Table 2)

**Table 2: Distribution of study participants according to stress assessment grading.**

Stress score grading	Number (n=478)	Percentage
<b>Low stress (0-13)</b>	268	56.1
<b>Moderate stress (14-26)</b>	210	43.9
<b>High stress (27-40)</b>	0	0

**Table 3: Distribution of study participants according to sleep level.**

Variable	Would never doze off N (%)	Slight chance of dozing off N (%)	Moderate chance of dozing off N (%)	High chance of dozing off N (%)
<b>Sitting and reading</b>	164 (34.3)	294 (61.5)	20 (4.2)	0
<b>Watching television</b>	147 (30.8)	308 (64.4)	23 (4.8)	0
<b>Sitting inactive in public place</b>	214 (44.8)	236 (49.4)	27 (5.6)	1 (0.2)
<b>Passenger in a car for an hour without a break</b>	190 (39.7)	270 (56.5)	17 (3.6)	1 (0.2)
<b>Lying down to rest in the afternoon</b>	96 (20.1)	345 (72.2)	34 (7.1)	3 (0.6)
<b>Sitting and talking to someone</b>	261 (54.6)	192 (40.2)	25 (5.2)	0
<b>Sitting quietly after lunch</b>	223 (46.7)	213 (44.6)	41 (8.6)	1 (0.2)
<b>In a car, while stuck in traffic</b>	307 (64.2)	151 (31.6)	20 (4.2)	0

Table 3 shows the description of scores obtained by study participants based on ESS. The most common response obtained regarding the frequency of dozing off while performing activities, such as sitting and reading, watching television, sitting inactive in a place, sitting as a passenger in a car for an hour without a break and lying down to rest in the afternoon was “slight chance of

dozing off” and it was reported to be 61.5%, 64.4%, 49.4%, 56.5% and 72.2%, respectively. However, most of the study participants would never doze off while sitting or talking to someone (54.6%), sitting quietly after lunch (46.7%) or while they were in a car stuck in traffic (64.2%).

**Table 4: Distribution of study participants according to sleep level grading.**

Sleep level grading	Number (n=478)	Percentage
Low normal daytime sleepiness	314	65.6%
High normal daytime sleepiness	145	30.3%
Mild excessive daytime sleepiness	12	2.5%
Moderate excessive daytime sleepiness	6	1.2%
Severe excessive daytime sleepiness	1	0.2%

**Table 5: Association of stress based on perceived stress scale with metabolic syndrome.**

Stress level	MetS Present	MetS Absent	OR (95% CI)	Chi-square value, P value
	N (%)	N (%)		
Moderate stress (n=210)	83 (39.5)	127 (60.4)	1.1 (0.6-2.2)	0.24,0.62
Low stress (n=268)	100 (37.3)	168 (62.6)		

\*Perceived stress scale

**Table 6: Association of study participants sleep level with metabolic syndrome.**

Sleepiness Level	MetS Present	MetS Absent	OR (95% CI)	Chi-square value, P value
	No. (%)	No. (%)		
Low normal daytime sleepiness* (n=314)	121 (38.5)	193 (61.4)	1	-
High normal daytime sleepiness (n=145)	50 (34.4)	95 (65.5)	0.8 (0.5-1.2)	0.69, 0.40
Mild excessive daytime sleepiness (n=12)	9 (75)	3 (0.25)	4.7 (1.2-18)	6.41, 0.01
Moderate excessive daytime sleepiness (n=6)	3 (50)	3 (50)	1.5 (0.3-8)	0.32, 0.56
Severe excessive daytime sleepiness (n=1)	0	1 (100)	-	-

\*Reference category for OR.

Analysis of composite scores of ESS showed that most of the study participants were having low normal daytime sleepiness (65.6%), while 30.3% had high normal daytime sleepiness and only 0.2% of people were found to have severe excessive daytime sleepiness. Remaining 3.7% participants were found to have mild to moderate excessive daytime sleepiness (Table 4).

From the Table 5, it was observed that different levels of stress did not have any significant association with MetS. Although the odds among individuals with moderate stress were 1.1 times higher than those with low stress, it's not significant statistically (Table 5).

From the Table 6, it was observed that overall sleepiness grading was not significantly associated with metabolic syndrome. However, people with mild excessive daytime sleepiness have 4.7 times higher odds of MetS as compared to those with low normal daytime sleepiness. Those with moderate excessive day sleepiness had 1.59 times higher odds of MetS, however it was not statistically significant.

## DISCUSSION

### Stress and metabolic syndrome

Janczura et al noted that the mean score of perceived stress was 16.66 (scores range: 0-40; 41.65%) among the study participants.<sup>15</sup> It was significantly higher in the participants with MetS subjects [17.55 (43.87%) versus 15.78 (39.45%); p=0.03]. Univariate analysis showed that perceived stress increased the chance of MetS (OR=1.07, 95% CI: 1.03-1.13).

In our study the mean stress scale was 15±5 in both the groups and people with moderate stress are 1.1 odds of getting MetS, but was not statistically significant (p=0.62).

In some studies, stress at work place proved to be a possible factor for heart diseases, especially among the working-age younger population and was associated with a higher risk of MetS and obesity.<sup>16-18</sup>

Chandola et al, reported that about 16% of the effect of work stress on coronary artery disease may well be attributed to its effect on MetS.<sup>19</sup>

Studies done by Borráz-León et al, Dickerson et al, Kurina et al, confirmed that perceived stress shows a strong correlation with blood cortisol. This leads to rise in blood glucose level and promote insulin resistance, which is a major agent in metabolic syndrome.<sup>20-22</sup>

### Sleep and metabolic syndrome

Patients with metabolic syndrome had scored more on the ESS, it shows the higher prevalence of excessive daytime sleepiness (EDS). Excessive daytime sleepiness was

independently associated with an increased risk of metabolic syndrome (odds ratio=1.24,95% CI: 1.0-1.5).<sup>7</sup> Subjects with metabolic syndrome have more excessive daytime sleepiness (EDS) than the general population.<sup>23</sup> EDS is independently associated with metabolic variables, and the relationship is dependent on severity.<sup>24,25</sup>

It was observed from our study that the overall sleepiness grading was not significantly associated with metabolic syndrome. However, people with Mild excessive daytime sleepiness have 4.7 times higher odds of MetS as compared to those with low normal daytime sleepiness. Those with moderate excessive day sleepiness had 1.59 times higher odds of MetS, however it was not statistically significant.

This study had a limitation. Among the study participants, the females (65.5%) were higher than the males (34.5%). It is because of higher proportion of males in the study population were working class and so they were not available during the time of data collection. However, each selected participant was approached 3 times for inclusion within study as 3 separate days.

## CONCLUSION

Mild excessive daytime sleepiness was associated with an increased risk of metabolic syndrome. People with perceived stress are having higher chance of getting MetS. Further research is needed to determine whether a causal relationship exists between EDS and MetS. Stress and loss of sleep not only affecting the mental health but also affects the physical health by causing MetS.

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*Ethical approval: The study was approved by the Institutional Ethics Committee AIIMS, Rishikesh (AIIMS/IEC/18/95)*

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