



EVALUATION AND CORRELATION OF SLEEP PATTERNS WITH BODY MASS INDEX AND CARDIORESPIRATORY FITNESS

Physiology

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ABSTRACT

AIM: Evaluation and correlation of sleep patterns with body mass index and cardiorespiratory fitness.

Material and Method: A total of 300 participants, which includes 150 male and 150 female participants of age group 18-25 years were recruited for this study from Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana [Ambala]. The participants were examined thoroughly so as to exclude those with the history of any acute or chronic illness or on long term medication or with a history of Traumatic injuries. Sleep patterns were determined using PSQI scale. A standardized and validated questionnaire in a form of proforma was given to each participant. BMI was calculated by using Quetelet index and Cardiorespiratory fitness was evaluated by using VO₂max. VO₂max was estimated indirectly by following the protocol of Queen's College Step Test [QCT] method.

Result: The result suggests highly positive significant association and correlation between Sleep patterns (PSQI) and BMI and highly negative significant correlation between BMI and VO₂max in both male and female participants.

KEYWORDS

INTRODUCTION

Obesity, a sedentary lifestyle disease has been a topic of concern from past several years as the prevalence has been increasing at epidemic rate. With the rise in weight there has been a simultaneous epidemic of chronic sleep deprivation.^[1] Short sleep duration is a major risk factor for weight gain and obesity. In addition to this fatigue caused by chronic partial sleep deprivation leads to decreased physical activity and also increases the risk for weight gain.^[2,3] VO₂max is a parameter to measure cardiorespiratory fitness. It has a direct relation to cardiorespiratory fitness, more is the fitness higher is the value of VO₂max, predicting the intensity and duration of exercising in person's who are well conditioned as compared to person who are not well conditioned.^[4] So, this study was planned to find a correlation between sleep pattern, BMI and cardiorespiratory fitness. The data was collected and then analyzed to find any correlation between these parameters.

MATERIAL AND METHOD

This study was conducted in the Department of Physiology, Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana [Ambala]. Institutional ethical committee approval was taken. The study comprised of 300 healthy participants which includes 150 male participants and 150 female participants.

Including criteria:

The study included apparently healthy, non-smoker, non-alcoholic male and female participants in the age group of 18-25 years were included.

Excluding criteria:

Participants on a long term medication, with the history of any acute or chronic illness or with a history of Traumatic injuries were excluded.

Experimental Design

Sleep patterns and duration determination

Sleep patterns and duration was determined using PSQI scale. A standardized and validated questionnaire in a form of proforma was given to each participant. Grading and scoring of the PSQI was done according to the performed scoring instructions of the Pittsburgh sleep quality index.^[5]

Body Mass Index

BMI was calculated by using Quetelet index i.e. Body weight in kilograms divided by square root of Body height in meter. Normal weight is defined as BMI 18.5 to \leq 22.9, Underweight as BMI $<$ 18.5, Overweight as BMI 23 to \leq 24.9 and Obesity as BMI \geq 25 kg/m², as per revised body type classification for Health ministry and Diabetes Foundation of India in 2008.^[6]

Cardiorespiratory fitness (Vo₂max)

Cardiorespiratory fitness was evaluated by using VO₂max. VO₂max or maximal oxygen uptake was estimated indirectly by following the protocol of Queen's College Step Test [QCT] method [7][8]. For the test a stepper of 16.25 inches height was used. Exercise was done for a total duration of 3 minutes at a rate of 24 steps per minute for males and 22 steps per minute for females a the pace was set by a metronome. After completion of exercise, pulse rate was noted from the fifth to the twentieth second of recovery period which was converted into beats per minute. VO₂max was calculated separately for both males and females using respective equations. [9][10]

For males:

$$VO_{2max} = 111.33 - [0.42 \times \text{pulse rate beats/min}]$$

For females:

$$VO_{2max} = 65.81 - [0.1847 \times \text{pulse rate beats/min}] \text{ [ml/kg/min]}$$

Statistical Analysis:

Statistical analysis was done by using SPSS software. Pearson correlation was used to correlate Sleep patterns (PSQI), BMI and VO₂max (ml/kg/min)

Results and Analysis:

In present study it was found that among 150 male participants, the male participants with PSQI score 0-3 were having BMI 18.5 \leq 22.9kg/m² and cardiorespiratory fitness 50.33. Those with PSQI score of 4- 6 were having BMI 23 \leq 24.9kg/m² and cardiorespiratory fitness 43.92. The participants with PSQI score of 7-9 had BMI \geq 25kg/m² and cardiorespiratory fitness 40.84. The participants with PSQI score 10-12 had BMI \geq 25kg/m² and cardiorespiratory fitness 36.29. Increasing PSQI score shows increase in the difficulty in sleep patterns and sleep related problems.

Among 150 female participants, the female participants with PSQI 0-3 were having BMI 18.5 \leq 22.9kg/m² and cardiorespiratory fitness 39.65. Those participants with PSQI 4- 6 were having BMI 23 \leq 24.9kg/m² and cardiorespiratory fitness 36.56. The participants with PSQI 7-9 were having BMI \geq 25kg/m² and cardiorespiratory fitness 35.43. The female participants with PSQI 10-12 were having BMI \geq 25kg/m² and cardiorespiratory fitness 32.69.

The result suggests highly positive significant association and correlation between Sleep patterns and BMI and highly significant negative correlation between BMI and VO₂max in both male participants (table1) and female participants (table 2).

Table 1. Correlations between Sleep Patterns (PSQI) and BMI in male participants

Variable		BMI
PSQI	r	.763
	p	<0.001

Correlations between BMI and VO2max in male participants

Variable		Vo2max
BMI	r	-.579
	p	<0.001

Bar diagram showing correlation between PSQI, BMI and VO2 max in male participants

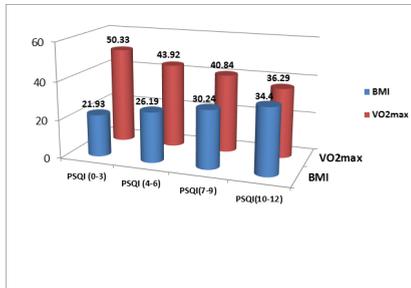


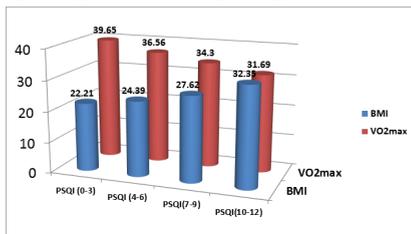
Table 2. Correlations between Sleep Patterns (PSQI) and BMI in female participants

Variable		BMI
PSQI	r	.609
	p	<0.001

Correlations between BMI and VO2max in female participants

Variable		Vo2max
BMI	r	-.648
	p	<0.001

Bar diagram showing correlation between PSQI, BMI and VO2 max in male participants in female participants



DISCUSSION:

This study showed that there is a considerable overall irregularity in sleep patterns along with a poor sleep quality among both male and female participants. Increasing PSQI score shows increase in the difficulty in sleep patterns and sleep related problems. The maximum numbers of participants were having a global PSQI score of 7-9 and 10-12. The group which showed greater irregularity in sleep patterns with poor sleep quality was either overweight or obese. The increased BMI may be due to poor sleep quality that reduces the amount of physical activity as disturbed or decreased sleep makes an individual lethargic. Thus the results support a positive relationship between poor sleep quality and irregular sleep with the development of obesity. Our result correlates with Kripke et al [11]; Cunnings et al [12] all have centered on the relationship between sleep duration and weight gain in adults. Patel SR et al [13], Gangwisch JE et al [14], found a direct association between short sleep duration and weight increase.

The results of the study also showed that the participants male or female who were having higher BMI value had lower value of VO2max or decreased cardiorespiratory fitness. VO2max is an internationally accepted parameter to evaluate the cardiorespiratory fitness. It is a measure of functional limit of cardio-respiratory system and also maximal exercise capacity. Type II muscles increases and type I muscle fibers decreases in obese participants which leads to reduced O2 uptake. Bandyopadhyay studied cardiorespiratory fitness in obese girls and found that VO2max was less which was due to excess fat deposition (15). P Setty et al 2012 in their study found negative correlation between obesity and cardiorespiratory fitness (16). Our

findings lines with the earlier studies done by Welch et al (17), Ozcelick et al (18) & Rowland et al (19) in which a highly significant negative correlation between BMI and VO2max is seen which shows the effect of increasing BMI on cardiorespiratory fitness.

Conclusion:

The participants involved in this study shows highly significant positive correlation between Sleep patterns (PSQI) and BMI, thus increasing PSQI score shows increase in the difficulty in sleep patterns and sleep related problems. A highly significant negative correlation between BMI and VO2max (ml/kg/min) which suggests that an individual with a disturbed sleep patterns (PSQI) has a tendency towards more BMI and decreased cardiorespiratory fitness (VO2max). A healthy body is a necessity for an individual so that daily tasks can be performed vigorously and alertly. For this increased working capacity a maintained physical fitness is required and with the energy that is left over the person is able to enjoy leisure time activities. It helps to withstand stress and carry on, in circumstances where a physically unfit person could not continue. For a country to have a full potential it requires its citizens to be healthy and have a good cardiovascular fitness. In both men and women a low physical and cardiovascular fitness attributes to the risk factors for all cause mortality. So, proper awareness and education at early stage is extremely important to impress the consequences of low sleep duration and in prevention of development of obesity and improvement in the cardiorespiratory fitness.

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