

## RELATION BETWEEN SLEEP-WAKE CYCLE AND BODY MASS INDEX: A PRELIMINARY STUDY

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### ABSTRACT

Present investigation was focused to examine the relation between sleep/wake pattern and body mass index (BMI) in human female volunteers of different age groups. The data collection was made through the Munich Chronotype Questionnaire (MCTQ) and General Questionnaire (GQ). Results of ANOVA revealed a statistically significant effect of age on BMI. In general, it has been noticed that BMI increased with age. Further, results of ANOVA indicated no significant effect of duration and time of sleep on BMI. However, BMI increased and decreased with increased duration of time and late night sleep time, respectively.

On the basis of the results of the present preliminary study, it may be concluded that time and duration of sleep may have important role in the maintenance of BMI. However, validation of this statement solicits intensive study based on large sample.

**KEYWORDS:** Sleep, BMI, Obesity, Human Female Volunteers

Obesity has become one of the major health problems in humans (Obesity foundation India, 2015). Recently, it has been linked to multiple medical consequences, such as increased risk for diabetes, heart disease, arthritis, thyroid disorders and cancer (Centres for Disease Control and Prevention, 2009 ). It is unequivocally accepted that body mass index (BMI) is a simple, inexpensive and noninvasive measure to estimate the body fat (Centres for Disease Control and Prevention (2009). Further, sleep has evolved as a significant determinant of body composition and reported that lack of adequate sleep lead to overweight and obesity (Story *et al.*, 2002, Hasler *et al.*, 2004). Sleep is vital for both mental and physical health of an individual. Duration of sleep influences the metabolism, regulates body weight and linked to obesity (Obesity foundation India, 2015, Seicean *et al.*, 2007). Increased BMI has been reported to be one of the most consistently documented correlates of short sleep duration<sup>3</sup>. It has become common practice for young adults to go to bed late and get up late during the morning. Therefore, present investigation was focused to examine the relation between sleep/wake pattern and body mass index (BMI) in human female volunteers of different age groups.

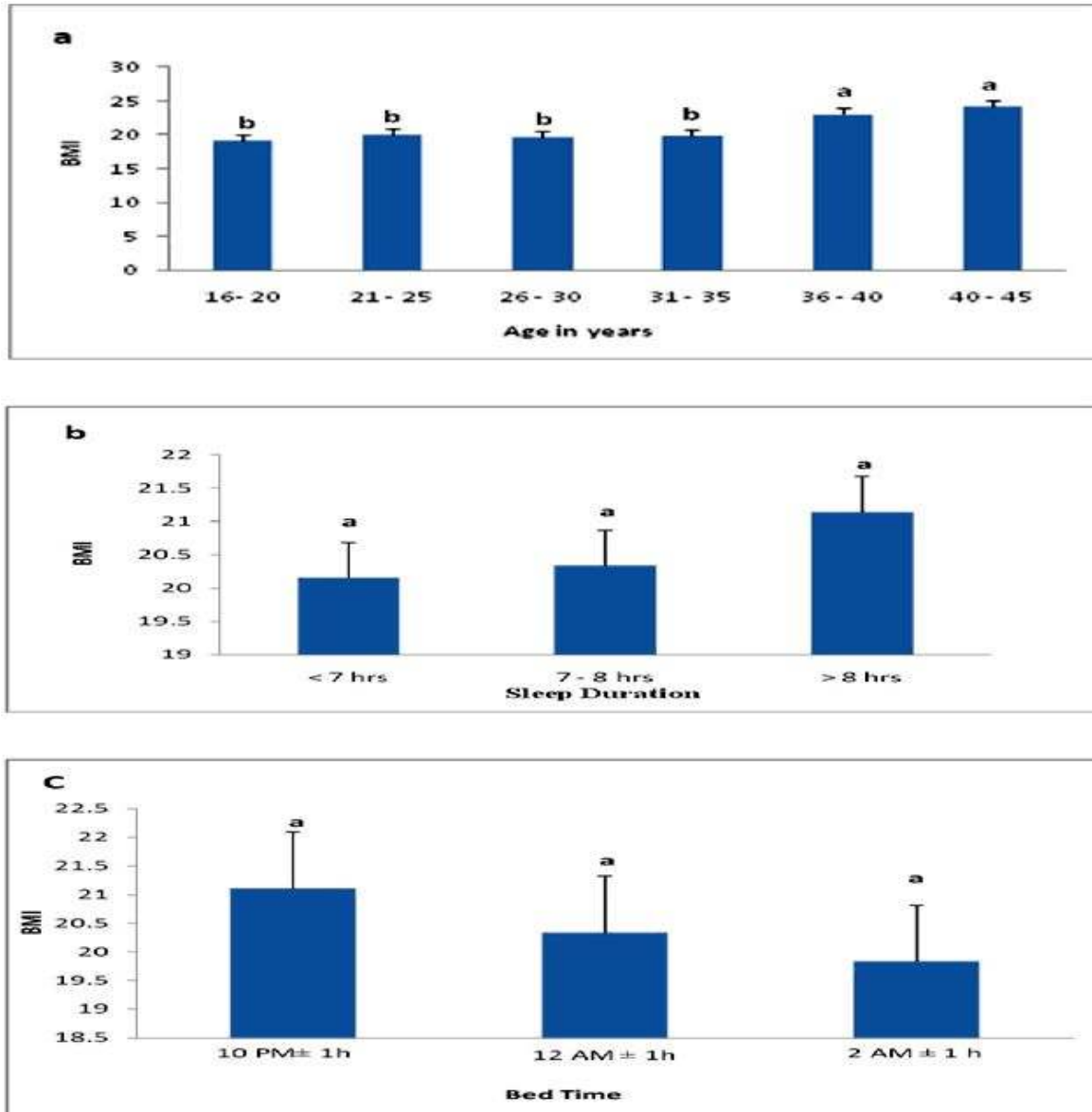
### Research design and methods

Three hundred four apparently healthy female volunteers (alcohol consumers, smokers, shift workers, diabetic, thyroid and migraine patients excluded) inhabitant of Raipur (19° 50' to 21 °53' N & 81°25' to 83°38' E), India, randomly selected for this study. Subjects were following their normal routine, no restriction was imposed their sleep/wake pattern.

**Table 1: Effect of various factors on Body Mass Index in human female volunteers (Results of ANOVA)**

Source	Degree of freedom	F- value	P
Age	5	12.91	0.0000
Sleep duration	2	1.190	0.306
Bed time	2	1.447	0.237

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**Figure 1: Effect of (a) age, (b) sleep duration and (c) bed time on body mass index (BMI) in human female volunteers. Bars with similar alphabets do not have statistical validation (Results based on Duncan's Multiple Range Test)**

The data such as age (y), height (m), weight (kg), breakfast, lunch and dinner time (hrs and min.) recorded through General Questionnaire (GQ). Munich Chronotype Questionnaire (MCTQ)<sup>9</sup> (*et al.*, was used to record the time of bed, time to fall asleep, time of awaking and getting up. BMI calculated through self reported weight (kg) and height (m) using the formula weight in (kilogram) divided by height in meter square (m<sup>2</sup>). Further, it is categorized as underweight (less than 18.5 kg/m<sup>2</sup>), normal weight (18.5 to 24.9 kg/m<sup>2</sup>) and over weight

(greater than 24.9 kg/m<sup>2</sup>). On the basis of sleep duration individuals were also categorized as short sleeper (less than 7 hrs), normal sleeper (7 – 8 hrs) and long sleeper (greater than 8 hrs).

This study was approved by the institutional ethical committee of Pt. Ravishankar Shukla University, Raipur (C. G.), India. All participants gave written informed consent prior to enrollment for study. One way ANOVA and Duncan's Multiple Range test were applied on data using COSTAT and SPSS 16.0. A p-value of < 0.05 was considered to be

statistically significant.

## RESULTS AND DISCUSSION

Results of ANOVA depicted statistically significant effect of age on body mass index (Table 1). A statistically significant increase in BMI was observed in the individuals aged above 35 years as compared to individuals aged below 35 years (Figure 1). Further, results of ANOVA indicated no significant effect of duration and time of sleep on BMI. In addition, an increase and decrease in BMI was observed in the individuals having long sleep duration and late bed time, respectively (Figure 2, 3). However, statistical validation could not be obtained.

Sleep timing has been reported as a behavior that exhibit significant variation within the population (Baron *et al.*, 2011). It is influenced by both biological and social factors. The timing and duration of sleep is regulated by an interaction between biological clock and homeostatic sleep pressure (Borbely *et al.*, 1982). It has been suggested that sleep duration is associated with obesity (Baron,*et al.*, 2011).

It has been observed that BMI is increased with increase in duration of sleep in the present study. No association between sleep duration and BMI in Malaysian adults has been documented by Lai *et al.*, 2013 and Kamath *et al.*, 2014. Similarly, Bajorkelund *et al.*, 2005 and Stranges *et al.*, 2008 reported that weight gain is not significantly associated with sleep duration. However, an earlier study Baron *et al.*, 2011, Patel *et al.*, 2008) suggested that association of higher BMI with shorter sleep duration and late sleep time. It has also been suggested that there is negative association between sleep duration and BMI (Gangwisch *et al.*, 2005).

Excess body weight is one of the most important factors contributing to the risk of diabetes, hypertension and dyslipidemia and thereby reducing life expectancy and greatly increasing health and social burden (James *et al.*, 2004). In human BMI has been suggested to be age and sex dependent (Yu *et al.*,2007, Shaikh *et al.*,2009). A statistically significant effect of age was observed on 4 BMI in the present study. It has been noticed that BMI is increased in the human female volunteers aged 35 year and above. Present results corroborate with other

reports (Yu *et al.*, 2007, Shaikh *et al.*,2009), who also documented increased body fat in old persons. Similarly, BMI has been shown to increase from 30 to 74 years of age in women (Steven, *et al.*, 1998).

Further, being awake late at night may lead to greater risk for obesity Baron *et al.*,2011) Stewart *et al.*, 1985, Waterhouse *et al.*, 2003). However, present result depicted that BMI is decreased in the studied human female volunteers who go to bed late. This may be due to time gap between dinner and sleep time is more than 5 hrs without any food intake.

Recently, it has been documented that meal timing significantly contribute weight regulation (Kamath *et al.*,2014). Similarly Golley *et al.*, 2014, shows that late bed and wakeup time are associated with diet quality. On the basis of the results of the present preliminary study, it may be concluded that time and duration of sleep may have important role in the maintenance of BMI. However, validation of this statement solicits intensive study based on large sample.

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