4-30-2022

Investigating the Links Between Body Composition and Female University Students' Night Eating Habits and Sleep Quality

Hanisah Rosli
Faculty of Allied Health Sciences, University of Cyberjaya, Cyberjaya 63000, Malaysia,
hanisah@cyberjaya.edu.my

Arimi Fitri Mat Ludin
*Center for Healthy Ageing and Wellness, Faculty of Health Sciences, Universiti Kebangsaan Malaysia,
Kuala Lumpur 50300, Malaysia*, arimifitri@ukm.edu.my

Amanda Priscilla Lim
*Programme of Biomedical Science, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Kuala
Lumpur 50300, Malaysia*, amandalim07@hotmail.com

Vimalah Vallavan
*Programme of Biomedical Science, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Kuala
Lumpur 50300, Malaysia*, vimalah16@gmail.com

Lew Sze Yuen
*Programme of Biomedical Science, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Kuala
Lumpur 50300, Malaysia*, szeyuenlew@gmail.com

See next page for additional authors

Investigating the Links Between Body Composition and Female University Students' Night Eating Habits and Sleep Quality

Authors

Hanisah Rosli, Arimi Fitri Mat Ludin, Amanda Priscilla Lim, Vimalah Vallavan, Lew Sze Yuen, Norizatul Hidayah Yusop, Nur Athirah Razali, Amerull Daneal Amran, Nurfarahin Asmadi, and Mohd Sham Othman

Makara Journal of
Health Research

Investigating the Links Between Body Composition and Female University Students' Night Eating Habits and Sleep Quality

Hanisah Rosli[1] , Arimi Fitri Mat Ludin[2]* , Amanda Priscilla Lim[3] , Vimalah Vallavan[3] , Lew Sze Yuen[3] , Norizatul Hidayah Yusop[3], Nur Athirah Razali[3] , Amerull Daneal Amran[3], Nurfarahin Asmadi[3], Mohd Sham Othman[4]

[1]Faculty of Allied Health Sciences, University of Cyberjaya, Cyberjaya 63000, Malaysia

[2]Center for Healthy Ageing and Wellness, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Kuala Lumpur 50300, Malaysia

[3]Programme of Biomedical Science, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Kuala Lumpur 50300, Malaysia

[4]Center for Toxicology and Health Risk Studies, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Kuala Lumpur 50300, Malaysia

Abstract

Background: Malaysia has the highest prevalence of obesity among Southeast Asian countries, and the current number is expected to increase further. In particular, the rate of obesity is reportedly increasing among females and young adults in Malaysia. Modern lifestyle habits, which include night eating and poor sleep quality, have been shown to increase the risk of obesity and high body fat. This study aims to determine the link between female university students' body composition and their night eating habits and sleep quality.

Methods: Body composition was measured using a Bioelectrical Impedance Analysis (BIA) analyzer. Night eating syndrome and sleeping pattern and quality were determined using the Night Eating Questionnaire (NEQ) and the Pittsburgh Sleep Quality Index (PSQI), respectively.

Results: A total of 112 female students participated in this study, the majority (66.1%) of whom were categorized as having normal weight. Their body fat percentages (28.0 ± 6.1) were found to be lower than the standard value for Asian women. Most of the subjects were categorized as having normal night eating (93.8%) and poor sleep (76.8%) patterns. The correlation analysis results indicated significant relationships between sleep quality and night eating habit and body weight. Furthermore, analysis using binary logistic regression showed a protective relationship between muscle mass and sleeping habit.

Conclusions: This study showed that the majority of the university students had poor sleep quality. This is an alarming finding. Therefore, further investigations on factors related to poor sleep quality among young adults are required.

Keywords: body fat, night eating syndrome, obesity, sleeping habits, young adults

INTRODUCTION

Obesity can lead to multiple age-related non-communicable diseases and other health complications. The National Health and Morbidity Survey reported a steady increase in the prevalence of obesity among Malaysian adults: from 15.1% in 2011 to 17.7% in 2015 and 19.7% in 2019. With the current trend, the percentage is expected to increase in the future and further burden the healthcare system. The same report also revealed that more females (24.7%) were categorized as obese compared to males (15.3%).[1] This is an alarming figure indicating that a quarter of the female population in Malaysia are obese.

This phenomenon influences various levels of society, including young adults. One study reported overweight and obesity prevalence rates of 19.7% and 11.5%, respectively, among young adults aged 20–24 years—an age group that usually consists of college students.[1] The same study reported that around 22.1% and 13.6% of students aged more than 18 years are classified as overweight and obese, respectively.[1] This number is expected to increase in the future based on the increasing rate of overweight and obesity among the Malaysian population. If this situation is not given immediate attention by the responsible bodies, these young adults will grow older with various health issues, which, in turn, will impact their personal lives and their ability to contribute to the development of the nation.[2] Statistics has shown that Malaysia has the highest prevalence of obesity among Southeast Asian countries.[2–6]

As obesity is closely related to excessive body fat, which accumulates around important organs, it has been

Corresponding author:
Arimi Fitri Mat Ludin
Center for Healthy Ageing and Wellness, Faculty of Health Sciences,
Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia
Email: arimifitri@ukm.edu.my

shown to increase a person's risk for contracting various chronic diseases, including diabetes, cardiovascular diseases, and certain types of cancer.[2,7–10] In many cross-sectional studies, obesity and high body fat percentage are associated with higher mortality and poor quality of life. In addition, obesity is closely related to psychological issues, including anxiety, depression, and low self-esteem.[2,11–13]

There is no denying that obesity and high body fat are associated with various lifestyle factors, such as high consumption of fatty food and physical inactivity. Recent studies have reported other contributing factors to this unhealthy trend, one of which is night eating habit. A study by Okada *et al*. on overweight/obese women (body mass index, BMI>25 kg/m^2) aged 40–74 years in Japan indicated that the adjusted odds ratio (AOR) of skipping breakfast were 2.47 for having a late dinner (defined as two hours before bedtime) and 1.71 for having a bedtime snack.[14] These ratios were obtained after adjustments were made against age, exercise habit, smoking status, sleep duration, and employment status. Eating behaviors have also been shown to be associated with an increased risk of overweight/obesity. This study also found that these women had AORs of 1.46, 1.48, and 1.29 after having late dinner, having a bedtime snack, and skipping breakfast (at least three times per week), respectively, after the adjustments.[14] Therefore, the same study concluded that night eating behavior can be considered a strong contributing factor for the occurrence of obesity.

Additionally, a recent study has demonstrated the role of poor sleeping quality in inducing increased body weight. For example, Bonanno *et al*. reported negative correlations between sleeping hours and BMI in both male (r = −0.64; *p* < 0.001) and female (r = −0.78; *p* < 0.001) subjects.[15] Kristicevic *et al*. (2018) conducted a study involving 2100 university students, and found that both short (less than 6 hours per day) and long (more than 10 hours per day) times spent in bed, along with poor sleep quality, can be linked to a greater likelihood of being overweight and obese.[16]

The main aim of the current study is to determine the association of body composition on night eating habit and sleep quality among female university students. The prevalence of night eating habit and sleep quality among these students, together with their body composition, were also analyzed.

METHODS

This cross-sectional study was conducted among female students under the Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Kuala Lumpur. After obtaining a list of students' names from the administration office, stratified sampling was employed to include students from all undergraduate academic programs. All subjects were within the age group of 19–25 years. The identified students who met these criteria were invited through e-mail for further assessment. The study excluded students who were married, pregnant, with chronic disease, taking long-term medication, postgraduate, and having their clinical posting outside the campus. This study was conducted according to the Declaration of Helsinki and received ethical approval from the Universiti Kebangsaan Malaysia Human Research Ethics Committee (UKM PPI/111/8/JEP-2017-656). A detailed explanation on this study was provided by a group of researchers prior to securing informed consent from each participant.

The sample size (N = 122) for this study was calculated by using a formula by Krejcie and Morgan, with confidence interval (CI) of 95%, significance level of 0.05, and 0.05 margin of error.[17] The population size was based on the total number of female students (n = 225) enrolled at the Faculty of Health Sciences.

Data collection was conducted at the students' hostel common area to facilitate their participation. First, anthropometric measurements were obtained using standard methods, which included weight and body fat percentage using a TANITA body analyzer (Tanita Corporation, Tokyo, Japan). Their standing height was measured using a stadiometer. Once their BMIs were calculated, the subjects were categorized as underweight (<19.9 kg/m^2), normal weight (20.0–24.9 kg/m^2), overweight (25.0–29.9 kg/m^2), and obese (>30.0 kg/m^2).[18] Subsequently, the students were interviewed to obtain information on their sociodemographic profiles.

The Night Eating Questionnaire (NEQ) is used to measure a person's eating behaviours and to determine the severity of one's night eating syndrome (NES).[19] There are 14 items in the questionnaire, which uses a Likert scale (0–4 scoring) to assess the behavioral and physiological symptoms of NES. A score of 25 or greater is suggestive of NES, while a score of 30 and above is a strong indicator of NES. The items in this questionnaire included, among others, the lack of morning appetite, loss of control and degree of cravings/overeating before bedtime and during the night, initial and middle insomnia, mood, frequency of eating during the night, belief that one needs to eat to sleep, and level of awareness over these eating episodes. The NEQ has been validated in previous studies involving university students. For example, a study by Meule *et al*. showed internal consistency of α = 0.71 and three-week retest reliability of r = 0.77.[20] Furthermore, a reliability assessment in a study involving Malaysian university students conducted by Gan *et al*. showed the Cronbach's alpha value of 0.70.[21]

To measure the subjects' sleeping pattern and quality, the Pittsburgh Sleep Quality Index (PSQI) was used in the current study.[22] The PSQI is a self-rated questionnaire that assesses sleep quality and disturbances over a time interval of one month. Nineteen individual items generate seven "component" scores: 1) subjective sleep quality, 2) sleep latency, 3) sleep duration, 4) habitual sleep efficiency, 5) sleep disturbances, 6) use of sleeping medication, and 7) daytime dysfunction. The higher the global score, the worse the sleep quality, where a score of 5 or more indicated poor sleep quality. In a study conducted among Malaysian adults by Farah *et al.*, internal consistency for the Malay-version PSQI, as measured by Cronbach's alpha, was 0.74.[23] Additionally, test–retest reliability (intra-class correlations coefficient) was 0.58, and standard error of mean was 1.34. The PSQI test–retest scores indicated that most of the respondents (90%) were within the 95% limit of agreement.[23]

RESULTS

The response rate for this study was 92.0% with a total of 112 female subjects agreeing to participate in this study. The mean age of the participants was 21.5 ± 0.6 years, and the majority of these students were recruited from the Biomedical Sciences (26.0%) and Optometry (14.4%) programs. (Table 1).

In terms of body composition, most of the subjects were categorized as having normal body weight (66.1%) with mean BMI of 21.3 ± 3.6 kg/m^2 (Table 1). Among the participants, 12.5% and 2.6% of the subjects were categorized as overweight and obese, respectively. These values are lower than the national statistical data for overweight (22.1%) and obesity (13.6%) among college students. Their mean body fat percentage was 8.0 ± 6.1%. This value is lower than the standard fat percentage among Asian women.[24]

In terms of night eating behavior, most subjects were categorized as having normal night eating patterns (93.8%) (Table 1). Among the participants, 5.4% and 0.8% showed signs of suggestive night eating syndrome and NES, respectively. In contrast, the majority of the subjects (76.8%) were categorized as having poor sleeping pattern and quality (Table 1).

Correlation analysis was conducted to determine the effects of sleep quality and NES with other parameters. Table 2 shows significant relationships between the PSQI and NEQ scores (r = 0.167, *p* < 0.001), indicating that there is a link between poor sleep quality and night eating habits. Furthermore, the binary logistic regression results demonstrated a protective relationship between muscle mass and sleeping habit (AOR = 0.872 (0.770–0.989); *p* < 0.05) (Table 3). At the same time, Table 4

shows no significant relationship between body composition and NES.

TABLE 1. Subjects' personal profiles

Categories	n (%)
Age (years)	21.5 ± 0.6
BMI (kg/m^2)	21.3 ± 3.6
BMI categories	
Underweight	21 (18.8)
Normal weight	74 (66.1)
Overweight	14 (12.5)
Obese	3 (2.6)
Body composition	
Body fat (%)	28.0 ± 6.1
Body fat (kg)	15.2 ± 5.9
Muscle mass (kg)	35.7 ± 3.7
Total body weight (kg)	49.8 ± 3.1
Sleeping quality	
Pittsburgh Sleep Quality Index (PSQI) (mean ± SD)	6.3 ± 2.8
PSQI (normal)	26 (23.2)
PSQI (poor sleep quality)	86 (76.8)
Night eating behavior	
Night Eating Questionnaire (NEQ) (mean ± SD)	13.5 ± 5.6
NEQ (normal)	105 (93.8)
NEQ (suggestive NES)	6 (5.4)
NEQ (night eating syndrome)	1 (0.8)
Academic program	
Audiology	9 (8.0)
Biomedical Science	29 (26.0)
Dietetics	9 (8.0)
Environmental Health	10 (8.9)
Nutrition	9 (8.0)
Optometry	16 (14.4)
Occupational Therapy	9 (8.0)
Physiotherapy	10 (8.9)
Speech Science	11 (9.8)

TABLE 2. The association between sleep quality and selected variables

Variables	r	*p*
Eating habit	0.167	<0.01**
BMI	0.015	0.207
Body fat (%)	0.020	0.141
Body fat (kg)	0.026	0.088
Muscle mass (kg)	0.004	0.498
Body weight (kg)	0.042	0.043*

*Significant association at *p* < 0.05
** Significant association at *p* < 0.01

TABLE 3. The relationship between body composition and sleep quality

Body composition	Sleep quality categories	Mean ± SD	AOR	p
BMI	Normal	21.79 ± 3.30	0.954 (0.848–1.073)	0.431
	Poor sleep quality	21.15 ± 3.72		
Body fat (%)	Normal	28.50 ± 6.06	0.981 (0.914–1.054)	0.606
	Poor sleep quality	27.80 ± 6.14		
Body fat (kg)	Normal	15.89 ± 5.05	0.977 (0.910–1.049)	0.523
	Poor sleep quality	15.05 ± 6.17		
Muscle mass (kg)	Normal	37.11 ± 3.98	0.872 (0.770–0.989)	0.032*
	Poor sleep quality	35.32 ± 3.46		

*Significant association at $p < 0.05$ using binary logistic regression
Abbreviations: AOR = adjusted odds ratio; SD = standard deviation; BMI = body mass index

TABLE 4. The relationship between body composition and night eating syndrome

Body composition	Night eating syndrome categories	Mean ± SD	AOR	p
BMI	Normal	21.24 ± 0.67	1.071 (0.889–1.290)	0.469
	Suggestive of NES	22.26 ± 0.90		
Body fat (%)	Normal	27.86 ± 6.14	1.040 (0.920–1.170)	0.522
	Suggestive of NES	29.39 ± 5.80		
Body fat (kg)	Normal	15.19 ± 6.01	1.022 (0.907–1.151)	0.725
	Suggestive of NEs	16.00 ± 4.54		
Muscle mass (kg)	Normal	35.75 ± 3.77	0.983 (0.795–1.216)	0.875
	Suggestive of NES	35.53 ± 0.60		

No significant association using binary logistic regression
Abbreviations: AOR = adjusted odds ratio; NES = night eating syndrome; SD = standard deviation; BMI = body mass index

DISCUSSION

This study was conducted to determine the relationship between the occurrence of obesity, on the one hand, and night eating habits and poor sleep quality, on the other hand. One of the possible explanations for the association between obesity and night eating habit is related to the concept of energy balance, which refers to the relationship between energy intake and energy expenditure. In particular, as a result of lower diet-induced thermogenesis and a lower resting metabolic rate after meals, eating at night appears to have a lower energy expenditure than eating in the morning. In terms of the association between sleep quality and BMI, short sleep duration is associated with many hormonal changes, especially with decreased levels of leptin (hormone that suppresses appetite) and increased levels of ghrelin (hormone that increases appetite), which potentially mediates the association between short sleep and BMI.[16]

The results of this study indicated that majority of the subjects were categorized as having normal body weight. In fact, the mean value of body fat percentage among the subjects was lower than the standard fat percentage among Asian women.[24] This phenomenon could be due to the fact that the subjects have better

level of health knowledge, as they are students from programs under the Faculty of Health Sciences, whose curricula focus on human biology and health. Juvinya–Canal *et al*. measured the level of health literacy among students of nursing, social work, primary education, and social education and found that nursing students scored the highest compared to students from other healthcare-related programs, which was the highest rated subdormain.[25] In that study, more than 90% of the subjects were categorized as having normal night eating patterns. A study by Gan *et al*. showed that 12.2% of Malaysian university students were categorized as having NES.[21] However, instead of health sciences students, their study involved students from various faculties, including Arts, Science, and Technical. Okada et. al. studied Japanese women aged 40–74 years and found that 11% and 22% of the subjects regularly had late dinner and bedtime snacks, respectively, while 8% consistently skipped breakfast.[14] The result from the current study showed a lower prevalence of NES than in both studies.

Furthermore, in this study, the majority of the subjects (76.8%) were categorized as having poor sleeping pattern and quality. Li *et al*. conducted a study among college students and reported that 31.0% of the subjects were classified as having poor sleep quality, as assessed

by the PSQI.[26] Furthermore, the males had significantly higher scores on sleep duration and usage of sleep medication compared to their female counterparts. In contrast, females experienced significantly greater sleep disturbances. An analysis of multivariate logistic regression showed some significant predictors of poor sleep quality: being a freshman, alcohol use, gambling, exercised for more than 30 min a week on less than one day, the feeling of being satisfied with parental love, and harmonious/neutral relationship with classmates.[26] In a study by Farah *et al*. involving working adults, 45% of the total sample were categorized as having poor sleep quality, with average night sleep duration of 5.95 ± 1.05 hours.[23] Additionally, Schlarb *et al*. conducted a study among university students and found that 74% of the study subjects reported symptoms of insomnia disorder, while 51.9% met all the criteria of insomnia disorder according to the Diagnostic and Statistical Manual of Mental Disorders (Fifth Edition).[27] Moreover, about 56% of the subjects reported severely impaired sleep quality according to the PSQI. In a study involving a large population of college students, Lund *et al*. reported that 60% of the college students they studied suffered from poor sleep quality according to the PSQI.[28]

The high number of students in the category of having poor sleep quality in the current study is worrying, as the disorder has been shown to severely impair university students' academic success.[28] Moreover, students with poor sleep quality have been found to have reduced daytime functioning.[29] A study by Curcio *et al*. correlated sleep quality with impeded learning, especially poorer declarative and procedural learning, neurocognitive performance, and academic success.[30] Okano *et al*. concluded that better quality, longer duration, and greater consistency of sleep correlated with better grades among students in an introductory college.[31] The results indicated that sleep measures accounted for nearly 25% of the variance in academic performance.[31] Thus, the factors causing these students to have poor sleep quality should be further investigated.

The results of the current study showed a significant relationship between poor sleep quality and night eating habit. A study by Gan *et al*. revealed that university students with poor sleep quality had AOR of 4.664 (1.431–15.209) to develop night eating symptoms.[21] Additionally, the current study also found a significant relationship between sleeping quality and body weight. Bonanno *et al*. found a negative significant correlation between sleep hours and BMI for both male and female subjects.[15] This is an interesting finding given that sleeping pattern and quality have been found to be significantly associated with both night eating habit and body weight and should thus be studied further in future studies. Both night eating habit and body weight are strong factors for many health issues and contribute

significantly to an individual's well-being. Therefore, sleeping habit and quality should be improved throughout one's life, as it is associated with various health parameters.

Meanwhile, the binary logistic regression analysis performed in the current study revealed a protective relationship between muscle mass and sleeping habit. Chen *et al*. conducted a study among university students and found a positive association between sleep quality and muscle strength, which they observed in both male and female students after adjusting for other confounding factors.[32] In terms of sleep duration, they found that male students with shorter sleep duration (<6 hours) had poorer muscle strength than their counterparts who slept for 7–8 hours and over 8 hours in the final adjusted model. In contrast, no significant association was observed between sleep duration and muscle strength among female students. The same study also suggested that muscle strength was associated with both sleep quality and duration.[32] One of the explanations for this phenomenon is the role of IGF-1 in sleep quality.[30] IGF-1 is an anabolic hormone that is responsible for protein synthesis and the maintenance of muscle mass.[33–35] Previous studies have found that IGF-1 is rapidly reduced under conditions of sleep deprivation.[32] In a study by Luboshitzky *et al*., sleep deprivation is associated with changes in the pattern of the rhythmic section of anabolic hormones.[36]

CONCLUSIONS

The study results revealed that the majority of the university students recruited were categorized as having poor sleep quality. This is an alarming finding, as previous studies have indicated that poor sleep quality is negatively associated with daytime functioning, academic performance, and general health, among others. This study also found a significant relationship between sleep quality and eating habit and body weight. Interestingly, this study also found a protective effect of sleeping habit on muscle mass. It is suggested that future studies be conducted in other populations, such as middle-aged and elderly adults, to further determine the effects of healthy sleeping patterns and night eating habits with health parameters in these specific age groups.

ACKNOWLEDGMENT

CONFLICT OF INTEREST

The authors reported no competing interests.

REFERENCES

1. Institute for Public Health. *The National Health and Morbidity Survey 2019*. Kuala Lumpur: Institute for Public Health, National Institutes of Health, Ministry of Health Malaysia, 2019.
2. Mohd Sidik S, Lekhraj R, Foo CN. Prevalence, Associated Factors and Psychological Determinants of Obesity among Adults in Selangor, Malaysia. *Int J Environ Res*. 2021;18:1–17.
3. Harbuwono DS, Pramono LA, Yunir E, Subekti I. Obesity and central obesity in Indonesia: Evidence from a national health survey. *Med J Indones*. 2018;27:114–20.
4. Chen KK, Wee SL, Pang BWJ, Lau LK, Jabbar KA, Seah WT, *et al*. Relationship between BMI with percentage body fat and obesity in Singaporean adults–The Yishun Study. *BMC Public Health*. 2021;21:1–9.
5. Pengpid S, Peltzer K. Overweight or obesity and related lifestyle and psychosocial factors among adolescents in Brunei Darussalam. *Int J Adol Med Health*. 2018;14;32.
6. Phan HD, Nguyen TNP, Bui PL, Pham TT, Doan TV, Nguyen DT, *et al*. Overweight and obesity among Vietnamese school-aged children: National prevalence estimates based on the World Health Organization and International Obesity Task Force definition. *PLoS One*. 2020;15:e0240459.
7. Kjellberg J, Larsen AT, Ibsen R, Hojgaard B. The socioeconomic burden of obesity. *Obes Facts*. 2017;10:493–502.
8. Powell-Wiley TM, Poirier P, Burke LE, Despres JP, Gordon-Larsen P, Lavie CJ, *et al*. Obesity and cardiovascular disease: A scientific statement from the American Heart Association. *Circ*. 2021;143:e984–1010.
9. Avgerinos KI, Spyrou N, Mantzoros CS, Dalamaga M. Obesity and cancer risk: Emerging biological mechanisms and perspectives. *Metab*. 2019;92:121–35.
10. Petrelli F, Cortellini A, Indini A, Tomasello G, Ghidini M, Nigro O, *et al*. Association of obesity with survival outcomes in patients with cancer a systematic review and meta-analysis. *JAMA Netw Open*. 2021;4:1–30.
11. Wimmelmann CL, Lund R, Christensen U, Osler M, Mortensen EL. Associations between obesity and mental distress in late midlife: results from a large Danish community sample. *BMC Obes*. 2016;3:1–11.
12. Aldossari KK, Shubair MM, Al-Ghamdi S, Al-Zahrani J, AlAjmi M, Alshahrani SM, *et al*. The association between overweight/obesity and psychological distress: A population based cross-sectional study in Saudi Arabia. *Saudi J Biol Sci*. 2021;28:2783–8.
13. Raza I, Qayyum N, Chaudhry AR, Sami RA, Khan M. Obesity, anxiety and psychological distress: A case study. *Int J Acad Res Psycho*. 2016;2:58–78.
14. Okada C, Imano H, Muraki I, Yamada K, Iso H. The association of having a late dinner or bedtime snack and skipping breakfast with overweight in Japanese women. *J Obes*. 2019;2019:2439571.
15. Bonanno L, Metro D, Papa M, Finzi G, Maviglia A, Sottile F, *et al*. Assessment of sleep and obesity in adults and children: Observational study. *Med*. 2019;98:1–6.
16. Kristicevic T, Stefan L, Sporis G. The associations between sleep duration and sleep quality with body-mass index in a large sample of young adults. *Int J Environ Res Public Health*. 2018;15:1–10.
17. Krejcie RV, Morgan DW. Determining sample size for research activities. *Educ Psychol Meas*. 1970;30:607–10.
18. World Health Organization expert consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet*. 2004:363:157–63.
19. Allison KC, Lundgren JD, O'Reardon JP, Martino NS, Sarwer DB, Wadden TA, *et al*. The night eating questionnaire (NEQ): Psychometric properties of a measure of severity of the night eating syndrome. *Eat Behav*. 2008;9:62–72.
20. Meule A, Allison KC, Platte P. A German version of the night eating questionnaire (NEQ): Psychometric properties and correlates in a student sample. *Eat Behav*. 2014;15:523–7.
21. Gan WY, Chin PQ, Law LS. Determination of risk factors for night eating syndrome among public university students in Malaysia. *Malaysian J Med Health Sci*. 2019;15:25–32.
22. Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh leep quality index: A new instrument for psychiatric practice and research. *Psychiat Res*. 1989;28:193–213.
23. Farah NMF, Teh SY, Mohd Rasdi, HF. Self-reported sleep quality using the Malay version of the Pittsburgh sleep quality index (PSQI-M) in Malaysian adults. *Int J Environ Res*. 2019;16:1–10.
24. Gallagher D, Heymsfield SB, Heo M, Jebb SA, Murgatroyd PR, Sakamato Y. Healthy percentage body fat ranges: An approach for developing guidelines based on body mass index. *Am J Clin Nutr*.2000;72:694–701.
25. Juvinya-Canal D, Suner-Soler R, Porquet AB, Vernay M, Blanchard H, Bertran-Noguer C. Health literacy among health and social care university students. *Int J Environ Res Public Health*. 2020;17:1–10.
26. Li Y, Bai W, Zhu B, Duan R, Yu X, Xu W, *et al*. Prevalence and correlates of poor sleep quality among college students: A cross-sectional survey. *Health Qual Life Outcomes*. 2020;18:1–11.
27. Sclarb AA, Friedrich A, Claben M. Sleep problems in university students–An intervention. *Neuropsychiatr Dis Treat*. 2017;13:1989–2001.
28. Lund HG, Reider BD, Whiting AB, Prichard JR. Sleep patterns and predictors of disturbed sleep in a large population of college students. *J Adolesc Health*. 2010;46:124–32.
29. Alapin I, Fichten CS, Libman E, Creti L, Bailes S, Wright J. How is good and poor sleep in older adults and college

students related to daytime sleepiness, fatigue, and ability to concentrate? *J Psychosom Res*. 2000;49:381–90.

30. Curcio G, Ferrara M, De Gennaro L. Sleep loss, learning capacity and academic performance. *Sleep Med Rev*. 2006;10:323–37.

31. Okano K, Kaczmarzyk JR, Dave N, Gabrieli JDE, Grossman JC. Sleep quality, duration, and consistency are associated with better academic performance in college students. *Npj Sci Learn*. 2019;4:1–5.

32. Chen Y, Cui Y, Chen S, Wu Z. Relationship between sleep and muscle strength among Chinese university students: A cross-sectional study. *J Musculoskelet Neuronal Interac*. 2017;17:327–33.

33. Rusch HL, Guardado P, Baxter T, Mysliwiec V, Gill JM. Improved sleep quality is associated with reductions in depression and PTSD arousal symptoms and increases in IGF-1 concentrations. *J Clin Sleep Med*. 2015;11:615–23.

34. Dattilo M, Antunes HK, Medeiros A, Monico Neto M, Souza HS, Tufik S, de Mello MT, *et al*. Sleep and muscle recovery: Endocrinological and molecular basis for a new and promising hypothesis. *Med Hypotheses*. 2011;77:220–2.

35. Everson CA, Crowley WR. Reductions in circulating anabolic hormones induced by sustained sleep deprivation in rats. *Am J Physiol End Metab*. 2004;286:E1060–70.

36. Luboshitzky R, Zabari Z, Shen-Orr Z, Herer P, Lavie P. Disruption of the nocturnal testosterone rhythm by sleep fragmentation in normal men. *J Clin End Metab*. 2001;86:1134–9.