

## ORIGINAL ARTICLE

# Determination of Risk Factors for Night Eating Syndrome among Public University Students in Malaysia

Wan Ying Gan, Pei Qi Chin, Leh Shii Law

Department of Nutrition and Dietetics, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia.

## ABSTRACT

**Introduction:** Night eating syndrome (NES) has been progressively drawing attention and becoming a global concern due to its clinical implications. However, the study related to NES was found to be scarce in Malaysia. As such, this study aimed to determine the risk factors of NES among Malaysian public university students. **Methods:** This cross-sectional study involved 270 participants (mean age: 20.9±1.4 years), who were selected randomly from three different course disciplines at a public university in Selangor, Malaysia. The data were collected using a self-administered questionnaire on socio-demographic background, NES, depression, anxiety, stress, sleep quality, and disordered eating. Weight, height, and waist circumference of the participants were measured. **Results:** Results showed that 12.2% of the participants were engaged in NES. Binary logistic regression identified four significant risk factors of NES namely, being a male (AOR = 3.050, 95% CI = 1.129 – 8.238), persuading in a technical-stream course (AOR = 6.010, 95% CI = 2.057 – 17.555), being a stressful student (AOR = 3.580, 95% CI = 1.149 – 11.151), and having poor sleep quality (AOR = 4.664, 95% CI = 1.431 – 15.209). **Conclusion:** Early screening process should be conducted from time to time in which university students with potentially NES are able to receive necessary behavioural and cognitive therapy in order to recover.

**Keywords:** Night eating syndrome, Stress, Sleep quality, Risk factors, University students

## Corresponding Author:

Wan Ying Gan, PhD  
Email: wanying@upm.edu.my  
Tel: +603-89472469

## INTRODUCTION

In recent years, disordered eating behaviours have been drawing attention progressively and becoming a global concern due to their steady growing trends over the years (1). Tremendous efforts were carried out to define night eating syndrome (NES). In 1955, Stunkard et al. (2) were the first to describe NES as a serial of problematic behaviours such as morning anorexia, evening hyperphagia (25% of total energy intake after 7 pm) and insomnia. Later, in 2010, another definition of NES was proposed by Allison et al. (3), describing NES as a “*delay in the circadian pattern of food intake*”, in which reduction of energy intake happened in the first half of the day and followed by a great increment of energy intake in the second half of the day. Subsequently, in 2013, NES was categorized under “Other Specified Feeding or Eating Disorders” in the Diagnostic and Statistical Manual of Mental Disorders 5th edition (DSM-V). It was characterized as “*recurrent episodes of night eating, as*

*manifested by eating after awakening from sleep or by excessive food consumption after the evening meal*” (4).

Two core diagnostic criteria were proposed to facilitate the process of detecting NES (3), in which an individual was required to fulfil at least one of the criteria to be identified as having NES. One of the criteria is the flow of the food consumption in the evening and night, a condition at which 25% or more food intake occurs after the evening meals and from awakening nocturnal ingestions for at least twice a week. Besides, the individual is aware of the nocturnal ingestions and experiences distress or impairment in functioning for at least three months. Besides from the two core diagnostic criteria, another five descriptors were recommended to aid in the diagnosis of NES, in which three of the descriptors must be fulfilled. These descriptors include (i) a lack of desire to eat in the morning or breakfast is omitted on at least four mornings per week, (ii) a strong urge to eat between dinner and sleep onset and/or during the night, (iii) presence of sleep onset and/or sleep maintenance insomnia at least four nights per week, (iv) a belief that one must eat in order to initiate or return to sleep, and (v) frequent depressed mood or worsening of mood in the evening (3).

Nutritional development during early adulthood is an investment for future health (5). Presence of NES among university students (or to be known as young adults) has received great attention. The prevalence of NES among young adults (aged between 18 to 30 years) in the United States was the highest while it was the least common among adults aged 65 years and older (6). A study that has been conducted in three provinces of China showed that 2.8% Chinese university students were engaging in NES (7). Furthermore, 9.5% of the Turkish university students were reported having NES (8). Meanwhile, in Malaysia, the only published study on NES which was conducted by Sarina and Poh (9) showed that 9.5% of university students in a public university were found to have NES. Hence, more information is needed in order to understand the risk factors of NES and to reduce its prevalence, particularly among university students.

Disordered eating, depression, anxiety, stress, sleep disturbance, and overweight or obesity are commonly reported in university students (10-12), where these have been shown to be related to NES (8,13-17). NES is, therefore, a problem that warrants further investigation among university students as consuming most of the day's food at night will definitely put stress on digestive system at a time when a person should be resting. However, studies on NES in Malaysia are still scarce. Hence, this study was conducted to determine the risk factors of NES among university students in Malaysia. This study could provide insight for future intervention programs to prevent NES by promoting healthy eating behaviours and healthy lifestyles for better nutritional and health status of university students.

## **MATERIALS AND METHODS**

### **Study design and setting**

A cross-sectional study was conducted among university students in a public university from December 2017 to March 2018. The sample size for this study was calculated using two population proportion formula (18) and the sample required was 258 participants. The participants were selected through multi-stage random sampling. First, a list of all faculties in a public university in Selangor state, Malaysia was obtained. The faculties are divided into three fields of study (arts, science, and technical). Examples of the faculties under arts field are Economics and Management, Educational Studies, and Languages. Examples of the faculties under science field are Food Science and Technology, Medicine and Health Sciences, and Environmental Studies. Examples of technical field are Engineering and Architecture. One faculty was selected from each of the fields of the study. Then, a course from the selected faculty was randomly selected. All students in the selected course were invited to participate in the study. Out of 380 students who were eligible for this study, 270 of them agreed to participate in this study, with a response rate of 71.1%.

### **Ethical clearance and permission**

Ethical approval was granted from the Ethics Committee for Research Involving Human Subjects of Universiti Putra Malaysia [Reference No.: JKEUPM-2017-175]. Permission for conducting the study was obtained from the deans of the selected faculties. Prior to data collection, written informed consents were obtained from the participants.

### **Measures**

Data regarding demographic and socioeconomic characteristics, NES, depression, anxiety, stress, sleep quality and disordered eating behaviours of the participants were gathered through a self-administered questionnaire. Weight, height, and waist circumference of the participants were measured by following a standard procedure.

For demographic and socioeconomic characteristics, the interested information was age, date of birth, sex, ethnicity, course of study, current year of study, current living arrangement (in campus or out campus) and monthly pocket money.

The Night Eating Questionnaire (NEQ) was used to detect the presence of NES among the participants (19). The NEQ possesses 17 items that are able to capture the behavioural and psychological syndrome of NES, namely lack of morning appetite (two items), loss of control and degree of cravings overeating before bedtime and during the night (four items), initial and middle insomnia (three items), mood (two items), frequency of eating during the night (three items), believe that one needs to eat to sleep (one item), and level of awareness over these eating episodes (one item). Items were rated on a 4-point Likert scale rating from "not at all (0)", "a little (1)", "somewhat (2)", "moderately (3)" and "very (4)". Items 1, 4, and 14 were reversely scored. The scores of Items 1 to 12 and 14 were summed up in order to calculate the total score for NEQ. Total NEQ scores ranged from 0 to 52. Item 13 was used to rule out parasomnia, Nocturnal Sleep-Related Eating Disorder (NS-RED) but not included in the total score. Item 15 acted as a descriptor for the course of the symptoms (to reassure that the symptoms have been persisted for at least three months). Meanwhile, Items 16 and 17 were used to detect the presence of distress or impairment. A score of 25 or greater was suggestive of NES, while a score of 30 and above was a strong indicator of NES. This instrument had been validated among university students in the previous studies (20,21). The Cronbach's alpha for NEQ in this study was 0.70, indicating a good internal consistency.

Using Depression, Anxiety and Stress Scale – 21 (DASS-21) (22), the psychological states of the participants such as depression, anxiety, and stress were assessed. The scale consisted of 21 items and each emotional state had

seven items. Items were rated on a 4-point Likert scale rating from 0 (did not apply to me at all), 1 (applied to me to some degree, or some of the time), 2 (applied to me to a considerable degree, or a good part of time), and 3 (applied to me very much, or most of the time). No items were scored reversely. Depression, anxiety, and stress scores were calculated by summing up all the relevant items. The total score for each of the psychological statuses ranged from 0 to 21. Participants were classified in different rating categories of severity (normal, mild, moderate, severe and extremely severe). The DASS-21 was a valid instrument to measure depression, anxiety, and stress among university students (23). The internal consistency reliability of the three subscales in the present study was found to be acceptable, with the depression subscale 0.87, the anxiety subscale 0.78, and the stress subscale 0.81.

The Pittsburg Sleep Quality Index (PSQI) was used to assess the sleep quality of the university students over a month period (24). The instrument had 10 items. The seven sleep components under measurement included subjective sleep quality sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. The range of values for each item was 0 to 3. A global PSQI score ranging from 0 to 21 was calculated by summing up the seven components. The lower score indicated a healthier sleep quality. Then, the participants were divided into two groups, namely good sleep quality (PSQI score  $\leq 5$ ) and poor sleep quality (PSQI score  $> 5$ ). The PSQI showed good validity and reliability among university students (25,26). The Cronbach's alpha for this scale in the current study was 0.75, indicating good internal consistency reliability.

The 26-item Eating Attitudes Test-26 (EAT-26) was used to detect the presence of disordered eating behaviours (27). The instrument had three subscales, namely dieting, bulimia and food preoccupation, and oral control. All items were rated on a 6-point Likert scale rating from "always (3)", "usually (2)", "often (1)", "sometimes (0)", "rarely (0)", and "never (0)" except for item 26. The item 26 was scored reversely. The total score for EAT-26 ranged from 0 to 78. A score equal to or greater than 20 was considered to have a high level of concern in dieting, body weight or problematic eating behaviours. The EAT-26 was commonly used among Malaysian university students and showed good validity and reliability (16,28). Cronbach's alpha for the EAT-26 in this study was 0.91 indicated that the instrument was reliable.

The weight of the participants was measured by using the TANITA Digital Weight Scale HD306 (TANITA Corporation, Arlington Heights, IL, USA) while height was measured by using the SECA Body Tape Measure SE206 (SECA, Hamburg, Germany). Two measurements for weight and height were taken in order to determine

mean weight and height for each of the participants. With the available information, body mass index (BMI) was calculated using the formula  $BMI = \text{weight (kg)} / \text{height (m)}^2$ . A BMI less than 18.5 kg/m<sup>2</sup> was classified as underweight, BMI at or greater than 18.5 kg/m<sup>2</sup> and less than 25.0 kg/m<sup>2</sup> was normal weight, overweight had a BMI at or greater than 25.0 kg/m<sup>2</sup> and less than 30.0 kg/m<sup>2</sup>, and a BMI at or over 30.0 kg/m<sup>2</sup> was considered as obesity (29). Furthermore, the Lufkin Executive Diameter Tree Tape C606PM (Cooper Hand Tools, Raleigh, North Carolina, USA) was used to measure waist circumference of the participants. The waist circumference cut-off points specifically to Asians were used, in which a waist circumference  $\geq 90$  cm for men and  $\geq 80$  cm for women were considered as at increased risk for abdominal obesity (30).

### Statistical Analysis

Statistical analysis of this study was conducted by using the IBM SPSS Statistics version 24 (IBM Corp., Armonk, NY, USA). The findings of univariate analysis were presented in means and standard deviations for continuous variables and in frequencies and percentages for categorical variables. The associations between categorical variables with NES have been evaluated through the chi-square test. All the variables that had  $p < 0.25$  during the chi-square test were selected and binary logistic regression (enter method) was carried out. The significant level of the statistical test was set at  $p < 0.05$ .

## RESULTS

### Characteristics of the Participants

As shown in Table I, a total of 270 participants (mean age: 20.9 $\pm$ 1.4 years) were recruited from three faculties. Among them, 26.7% were males while 73.3% were females. Majority of them were Malays (82.2%), followed by Chinese (12.6%), Indians (2.6%), and others (2.6%). Almost all the participants lived in university dormitory (92.2%). With regards to their economic status, around four-fifths of the participants (78.1%) had less than MYR 500 per month for pocket money.

In addition, around one-tenth of the participants (12.2%) were found to engage in NES. Besides, the prevalence of depression, anxiety, stress, poor sleep quality and disordered eating behaviours were 55.6%, 45.9%, 47.8%, 55.1% and 20.4%, respectively. Furthermore, one-fourth of the participants (25.0%) were overweight and obese while another 14.5% were underweight. One-fifth of the participants (20.1%) were grouped as having abdominal obesity.

### Associations between personal and psychological factors with Night Eating Syndrome

As shown in Table II, sex ( $\chi^2 = 4.774$ ,  $p = 0.029$ ), field of study ( $\chi^2 = 14.157$ ,  $p = 0.001$ ), monthly pocket money ( $\chi^2 = 4.636$ ,  $p = 0.031$ ), stress ( $\chi^2 = 9.700$ ,  $p = 0.021$ ) and sleep quality ( $\chi^2 = 16.394$ ,  $p < 0.001$ ) were found to be

**Table I:** Characteristics of the participants (n=270)

Characteristics	Mean ± SD	n (%)
<b>Sex</b>		
Male		72 (26.7)
Female		198 (73.3)
<b>Age (years)</b>	20.9 ± 1.4	
19-21		193 (71.5)
22-25		77 (28.5)
<b>Ethnicity</b>		
Malay		222 (82.2)
Chinese		34 (12.6)
Indian		7 (2.6)
Others		7 (2.6)
<b>Field of study</b>		
Sciences		131 (48.5)
Technical		80 (29.6)
Arts		59 (21.9)
<b>Current year of study</b>		
First year		92 (34.1)
Second year		77 (28.5)
Third year		55 (20.4)
Fourth year		46 (17.0)
<b>Current living arrangement</b>		
College dormitory		249 (92.2)
Rented room		11 (4.1)
Own house		10 (3.7)
<b>Monthly pocket money</b>		
<MYR 500		211 (78.1)
MYR 500-999		52 (19.3)
MYR 1000-1499		5 (1.9)
MYR 2000-2499		2 (0.7)
<b>Night Eating Syndrome</b>	17.18 ± 6.44	
Presence of night eating syndrome		33 (12.2)
Without night eating syndrome		237 (87.8)
<b>Depression</b>	6.28 ± 4.6	150 (55.6)
Mild		40 (14.8)
Moderate		61 (22.6)
Severe		21 (7.8)
Extremely severe		28 (10.4)
<b>Anxiety</b>	7.49 ± 4.17	124 (45.9)
Mild		49 (18.1)
Moderate		57 (21.1)
Severe		15 (5.6)
Extremely severe		3 (1.1)
<b>Stress</b>	7.57 ± 4.06	129 (47.8)
Mild		59 (21.9)
Moderate		34 (12.6)
Severe		29 (10.7)
Extremely severe		7 (2.6)
<b>Sleep quality</b>	6.37 ± 2.92	
Good sleep quality		120 (44.9)
Poor sleep quality		147 (55.1)
<b>Disordered eating behaviors</b>	13.39 ± 13.34	
At risk		55 (20.4)
Normal		214 (79.6)
<b>Anthropometric measurements</b>		
Weight (kg)	58.9 ± 14.8	
Height (cm)	159.6 ± 7.7	
BMI (kg/m <sup>2</sup> )	23.06 ± 5.09	
Underweight		39 (14.5)
Normal		163 (60.6)
Overweight		37 (13.8)
Obesity		30 (11.2)
<b>Waist circumference (cm)</b>	75.2 ± 11.0	
Normal		215 (79.9)
Abdominal obesity		54 (20.1)

MYR=Malaysian Ringgit (USD 1 = MYR 4.1405 as at 28 September 2018)

associated significantly with NES.

As shown in Table III, binary logistic regression results showed that male participants were more likely than

**Table II:** Results of chi-square test of independence of association between personal factors and NES groups (n=270)

Characteristics	n (%)			χ <sup>2</sup>	p
	Non-NES (n=237)	NES (n=33)	Total (n=270)		
<b>Sex</b>				4.774	0.029
Male	58 (80.6)	14 (19.4)	198 (73.3)		
Female	179 (90.4)	19 (9.6)	72 (26.7)		
<b>Age (years)</b>				0.20	0.654
19-21	171 (88.6)	22 (11.4)	193 (71.5)		
22-25	66 (85.7)	11 (14.3)	77 (28.5)		
<b>Ethnicity</b>				1.32	0.250
Malay	192 (86.5)	30 (13.5)	222 (82.2)		
Non-Malay	45 (93.8)	3 (6.3)	48 (17.8)		
<b>Field of study</b>				14.157	0.001
Sciences	104 (79.4)	27 (20.6)	131 (48.5)		
Technical	42 (52.5)	38 (47.5)	80 (29.6)		
Arts	52 (88.1)	7 (11.9)	59 (21.9)		
<b>Current year of study</b>				0.58	0.901
First year	82 (89.1)	10 (10.9)	92 (34.1)		
Second year	66 (85.7)	11 (14.3)	77 (28.5)		
Third year	49 (89.1)	6 (10.9)	55 (20.4)		
Fourth year	40 (87.0)	6 (13.0)	46 (17.0)		
<b>Current living arrangement</b>				0.155	0.694
College dormitory	218 (87.6)	31 (12.4)	249 (92.2)		
Out campus	19 (90.5)	2 (9.5)	21 (7.8)		
<b>Monthly pocket money</b>				4.636	0.031
<MYR 500	190 (90.0)	21 (10.0)	211 (78.1)		
≥MYR 500	47 (79.7)	12 (29.3)	59 (21.9)		
<b>BMI (n = 269)</b>				1.403	0.496
Underweight	32 (82.1)	7 (17.9)	39 (14.5)		
Normal	145 (89.0)	18 (11.0)	163 (60.6)		
Overweight/Obesity	59 (88.1)	8 (11.9)	67 (24.9)		
<b>Waist circumference (n = 269)</b>				0.568	0.451
Normal	187 (87.0)	28 (13.0)	215 (79.9)		
Abdominal obesity	49 (90.7)	5 (9.3)	54 (21.1)		
<b>Depression</b>				4.509	0.204
Normal	109 (90.8)	11 (9.2)	120 (44.4)		
Mild	37 (92.5)	3 (7.5)	40 (14.8)		
Moderate	51 (81.6)	10 (18.4)	61 (22.6)		
Severe	40 (81.4)	9 (18.6)	49 (18.1)		
<b>Anxiety</b>				4.451	0.217
Normal	131 (89.7)	15 (10.3)	146 (54.1)		
Mild	45 (91.8)	4 (8.2)	49 (18.1)		
Moderate	47 (82.5)	10 (17.5)	57 (21.1)		
Severe	14 (77.8)	4 (22.2)	18 (6.7)		
<b>Stress</b>				9.700	0.021
Normal	132 (93.6)	9 (6.4)	141 (52.2)		
Mild	47 (79.7)	12 (20.3)	59 (21.9)		
Moderate	28 (82.4)	6 (17.6)	34 (12.6)		
Severe	30 (83.3)	6 (16.7)	36 (13.3)		
<b>Sleep Quality (n = 267)</b>				16.394	< 0.001
Normal	116 (96.7)	4 (3.3)	120 (44.9)		
Poor sleep quality	118 (80.3)	29 (19.7)	147 (55.1)		
<b>Disordered eating behavior (n = 269)</b>				0.119	0.731
Normal	187 (87.4)	27 (12.6)	214 (79.6)		
At risk	49 (89.1)	6 (10.9)	55 (20.4)		

**Table III:** Odds ratios for demographic and socioeconomic and psychological characteristics towards night eating syndrome

Variables	Adjusted Odds Ratio (95% CI)	<i>p</i>
Sex		
Female	1	
Male	3.050 (1.129 – 8.238)	0.028
Ethnicity		
Malay	1	
Non-Malay	0.390 (0.092 – 1.657)	0.202
Field of study		
Sciences	1	
Arts	1.745 (0.529 – 5.749)	0.360
Technical	6.010 (2.057 – 17.555)	0.001
Monthly pocket money		
Less than MYR 500	1	
MYR 500 and more	2.500 (0.979 – 6.386)	0.056
Depression		
Normal	1	
Mild	1.018 (0.223 – 4.638)	0.982
Moderate	1.342 (0.377 – 4.778)	0.650
Severe	1.239 (0.246 – 6.422)	0.795
Anxiety		
Normal	1	
Mild	0.608 (0.156 – 2.363)	0.472
Moderate	1.288 (0.366 – 4.536)	0.694
Severe	2.194 (0.236 – 20.400)	0.490
Stress		
Normal	1	
Mild	3.580 (1.149 – 11.151)	0.028
Moderate	1.511 (0.320 – 7.126)	0.602
Severe	1.151 (0.147 – 8.990)	0.893
Sleep quality		
Normal	1	
Poor sleep quality	4.664 (1.431 – 15.209)	0.011

female to engage in NES (AOR = 3.050, 95% CI = 1.129 – 8.238). Besides, participants from a technical field were 6.010 (95% CI = 2.057 – 17.555) times more likely than participants from a science field to develop NES. Moreover, from psychological perspective, students with mild stress level were also possessed a higher likelihood (AOR = 3.580, 95% CI = 1.149 – 11.151) than their normal counterparts to engage in NES. Moreover, students with poor sleep quality were 4.664 (95% CI = 1.431 – 15.209) times more likely than students with good sleep to develop NES. The Nagelkerke R-square for the model was 0.321, indicating that 32.1% of the variance in NES of university students in this study was explained by sex, technical field, stress level, and poor sleep quality.

## DISCUSSION

The prevalence of NES found in this study was alarming. The prevalence was almost similar among university students at the Central Michigan University (mean age = 20.6 ± 1.7 years), at 12.3% (31). Another study found that 15.0% of the Brazilian university students reported to have NES (32). However, the prevalence of NES was found to be 9.5% among Turkish university students (8). The findings from the foreign studies

should be interpreted cautiously due to diversity and distinctiveness in their socio-demographic, culture, and degree of urbanization and industrialization that have influences on the behaviours of the university students (33). Local food environment plays an important role in eating behaviours of university students. The availability of 24 hours restaurants or late hour restaurants in Malaysia allows students to dine out conveniently at night to chat together or watch sports games together in a group while ordering food to eat (34), especially among males.

Being a male was 3 times more likely to develop NES than females. This was consistent with several previous studies in which males were more vulnerable to NES (9,35). For example, findings from the 2005 Korean National Health and Nutrition Examination Survey showed that males presented 1.9 times higher odds of being night eaters than females (35). On the other hand, females were protected from night eating because they were more concerned about overeating, weight, and shape (9,33).

Furthermore, the findings of this study showed that students from technical background possessed a higher risk of developing NES than students with science background. This was probably due to students from science backgrounds had more access to nutritional knowledge that prevented them from engaging in unhealthy eating behaviours such as NES (36). Specifically, the students studying science course in this study had a higher chance to meet with friends from other science-related courses such as nutrition and dietetic students, who were under the same faculty. The social interaction among students indirectly helped to disseminate the nutritional knowledge. Nutritional knowledge has led people to make better nutritional choices and to prevent unhealthy eating behaviours (36).

Besides, students with mild stress level possessed high tendency (3.580 times) in practicing NES when compared to students with no stress. The finding was consistent with Wichianson et al. (37), in which perceived stress was strongly and positively associated with NES among California undergraduates. Similarly, Person (38) presented significant differences in the mean scores of perceived stress among NES groups (full-syndrome NES, moderate NES, mild NES, and non-NES). The group means in perceived stress was found to be in the increasing trend with the increasing NES severity. Nolan and Geliebter (13) explained that stress is a common trigger for NES and emotional eating, in which a stressed student who was prone to emotional eating was more likely to wake up at night and eat in order to reduce the undesired effects of their negative feelings. Individuals with NES may experience disturbances in the hypothalamic-pituitary-adrenal (HPA) axis, which is responsible for regulating the cortisol stress response

(39). Cortisol, a stress hormone, was found to be higher in NES group than control group, which may lead to hunger in individuals with NES (39).

Another identified risk factor for NES was poor sleep quality. Students with poor sleep quality were more vulnerable (4.664 times) to NES compared to students with good sleep quality. Consistent findings were reported in several studies (13,14,31,38). Possible explanation of poor sleep quality among NES students was sleep disruption as a result in delaying eating rhythms (40). Individuals with NES may experience frequent sleep awakening at night for food intake due to low levels of melatonin in night eaters (41). Sleep disturbances may precede NES while NES may cause sleep disturbances (41,42). Hence, cohort studies should be conducted to confirm the findings.

Several limitations were found in this study. First, this study applied cross-sectional study design. As such, causal inferences could not be drawn from significant associations between socio-demographic and psychological characteristics of NES participants. Cohort studies should be applied in the future. Since this study involved only university students at a public university in Selangor, the effect of generalizing the findings from this study is limited to all university students. A larger study scale involving private and public universities in Malaysia is recommended. Lastly, the data collection of this study was conducted by using self-administered questionnaire. This method relied heavily on the willingness and sincerity of the participants to answer the questions honestly. At the same time, the questionnaire consisted of several retrospective questions that depended on the memory of the participants to recall their behaviours over the previous one month. These procedures introduced biases that arise from memory lapse. In spite of these limitations, however, this study improves on previous research in several ways. First, the possible risk factors of NES were studied in a complex context in this study but not only as an individual risk factor. Second, multistage random sampling but not convenience sampling was used in this study. Third, the findings of this study add to the body of knowledge of NES in the local context.

## CONCLUSION

This study showed that university students were at risk of NES especially being a male, studying in technical field, being stressed and having poor sleep quality. Government agencies and university authorities should take the problem seriously. Early screening process should be carried out periodically to allow university students with potentially NES to receive necessary treatment. Nutritionists and dietitians play a crucial role in providing nutritional counselling to the affected students by targeting behavioural strategies (monitoring food consumption together with regulating meals and

snacks consumption) and cognitive therapy components (identifying, evaluating and restructuring maladaptive thought) are recommended (42).

## ACKNOWLEDGEMENTS

We would like to thank Deans of the faculties that permitted the data collection to be conducted at the respective faculty. Besides that, the cooperation of the participants during data collection is highly appreciated. Furthermore, the authors would like to thank Dr. Thavamaran Kanesan's group for proofreading this manuscript.

## REFERENCES

1. Ortega-Luyando M, Alvarez-Rayyn G, Garner DM, Amaya-Hernández A, Bautista-Dhaz ML, Mancilla-Dhaz JM. Systematic review of disordered eating behaviors: Methodological considerations for epidemiological research. *Revista Mexicana de Trastornos Alimentarios*. 2015;6(1):51-63. doi:10.1016/j.rmta.2015.06.001.
2. Stunkard AJ, Grace WJ, Wolff HG. The night-eating syndrome: A pattern of food intake among certain obese patients. *Am J Med*. 1955;19(1):78-86. doi:10.1016/0002-9343(55)90276-X.
3. Allison KC, Lundgren JD, O'Reardon JP, et al. Proposed diagnostic criteria for night eating syndrome. *Int J Eat Disord*. 2010;43(3):241-7. doi:10.1002/eat.20693.
4. American Psychiatric Association. *Diagnostic and statistical manual of mental disorders*. 5th ed. Washington DC: American Psychiatric Association; 2013. doi: 10.1176/appi.books.9780890425596.744053.
5. Brown JE, Isaacs JS, Krinke UB, et al. *Nutrition through the life cycle*. Belmont CA: Thomson Wadsworth; 2005.
6. Striegel-Moore RH, Franko DL, Thompson D, Affenito S, Kraemer HC. Night eating: Prevalence and demographic correlates. *Obesity*. 2006;14(1):139-47. doi:10.1038/oby.2006.17.
7. He J, Huang F, Yan J, Wu W, Cai Z, Fan X. Prevalence, demographic correlates, and association with psychological distress of night eating syndrome among Chinese college students. *Psychol Health Med*. 2018(5);23:578-84. doi:10.1080/13548506.2017.1400669.
8. Sevincer GM, Ince E, Taymur I, Konuk N. Night eating syndrome frequency in university students: Association with impulsivity, depression, and anxiety. *Bulletin of Clinical Psychopharmacology*. 2016;26(3):238-47. doi:10.5455/bcp.20160322093750.
9. Sarina S, Poh LK. Association between socio-demographic status and body mass index with night eating syndrome among university students in Shah Alam, Selangor. 9th Asian Pacific Conference on

- Clinical Nutrition, Kuala Lumpur. *Malays J Nutr.* 2015;21.
10. Gan WY, Mohd Nasir MT, Zalilah MS, Hazizi AS. Differences in eating behaviours, dietary intake and body weight status between male and female Malaysian university students. *Malays J Nutr.* 2011;17(2):213-28.
  11. Gan WY, Mohd Nasir MT, Zalilah MS, Hazizi AS. Psychological distress as a mediator in the relationships between biopsychosocial factors and disordered eating among Malaysian university students. *Appetite.* 2012;59(3):679-87. doi:10.1016/j.appet.2012.08.002.
  12. Lemma S, Gelaye B, Berhane Y, Worku A, Williams MA. Sleep quality and its psychological correlates among university students in Ethiopia: A cross-sectional study. *BMC Psychiatry.* 2012;12:237. doi: 10.1186/1471-244X-12-237.
  13. Nolan LJ, Geliebter A. Night eating is associated with emotional and external eating in college students. *Eat Behav.* 2012;13(3):202-6. doi:10.1016/j.eatbeh.2012.02.002.
  14. Cleator J, Abbott J, Judd P, Wilding JPH, Sutton CJ. Correlations between night eating, sleep quality, and excessive daytime sleepiness in a severely obese UK population. *Sleep Med.* 2013;14(11):1151-6. doi:10.1016/j.sleep.2013.04.026.
  15. Haraguchi A, Fukuzawa M, Iwami S, et al. Night eating model shows time-specific depression-like behavior in the forced swimming test. *Sci Rep.* 2018;8(1):1081. doi:10.1038/s41598-018-19433.
  16. Cleator J, Abbott J, Judd P, Sutton C, Wilding JPH. Night eating syndrome: Implications for severe obesity. *Nutrition & Diabetes.* 2012;2(9):e44. doi:10.1038/nutd.2012.16.
  17. McCuen-Wurst C, Ruggieri M, Allison KC. Disordered eating and obesity: associations between binge-eating disorder, night-eating syndrome, and weight-related comorbidities. *Ann NY Acad Sci.* 2018;1411(1):96-105. doi:10.1111/nyas.13467.
  18. Lemeshow S, Hosmer DW, Klar J, Lwanga SK. Adequacy of sample size in health studies. Chichester: Wiley; 1990. doi:10.1186/1472-6963-14-335
  19. Allison KC, Lundgren JD, O'Reardon JP, et al. Eating Questionnaire (NEQ): psychometric properties of a measure of severity of the Night Eating Syndrome. *Eat Behav.* 2008;9(1):62-72. doi:10.1016/j.eatbeh.2007.03.007
  20. Meule A, Allison KC, Platte P. A German version of the Night Eating Questionnaire (NEQ): Psychometric properties and correlates in student sample. *Eat Behav.* 2014;15:523-7. doi: 10.1016/j.eatbeh.2014.07.002
  21. Elsadek AM, Hamid MS, Allison KC. Psychometric characteristics of the Night Eating Questionnaire in a Middle East population. *Int J Eat Disord.* 2014;47(6):660-5. doi:10.1002/eat.22285
  22. Lovibond SH, Lovibond PF. Manual for the Depression Anxiety Stress Scales. 2nd ed. Sydney: Psychology Foundation of Australia. Psychology Foundation of Australia; 1995. doi:10.1016/0005-7967(94)00075-U.
  23. Teo YC, Asnah HY, Alice Lim WP, et al. Validation of DASS-21 among nursing and midwifery students in Brunei. *J Public Health.* 2018. doi:10.1007/s10389-018-0947-z
  24. Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh sleep quality index: A new instrument for psychiatric practice and research. *Psychiatry Res.* 1989;28(2):193-213. doi:10.1016/0165-1781(89)90047-4.
  25. Manzar MD, Moiz JA, Zannat W, et al. Validity of the Pittsburgh Sleep Quality Index in Indian Students. *Oman Med J.* 2015;30(3): 193-202. doi:10.5001/omj.2015.41
  26. Dietch JR, Taylor DJ, Sethi K, et al. Psychometric evaluation of the PSQI in U.S. college students. *J Clin Sleep Med.* 2016;12(8):1121-9. doi:10.5664/jcsm.6050
  27. Garner DM, Olmstead MP, Bohr Y, Garfinkel P. The eating attitudes test: Psychometric features and clinical correlates. *Psychol Med.* 1982;12(4):871-8. doi:10.1017/S0033291700049163.
  28. Edman JL, Yates A. Eating attitudes among college students in Malaysia: An ethnic and gender comparison. *Eur Eat Disord Rev.* 2004;12(3): 190-6. doi:10.1002/erv.567
  29. World Health Organisation. Obesity: Preventing and managing the global epidemic. WHO Technical Report Series 894. Geneva: World Health Organization; 2000.
  30. WHO/IASO/IOTF. The Asia-Pacific perspective: redefining obesity and its treatment. Geneva: World Health Organization; 2000. doi:0-9577082-1-1.
  31. Yahia N, Brown C, Potter S, et al. Night eating syndrome and its association with weight status, physical activity, eating habits, smoking status, and sleep patterns among college students. *Eat Weight Disord.* 2017;22(3):421-33. doi:10.1007/s40519-017-0403-z.
  32. Borges KM, dos Santos Figueiredo FW, do Souto, RP. Night eating syndrome and emotional states in university students. *J Hum Growth Dev.* 2017;27(3): 332-41. doi:10.7322/jhgd.141277
  33. Pike KM, Dunne PE. The rise of eating disorders in Asia: a review. *J Eat Disord.* 2015;3:33. doi:10.1186/s40337-015-0070-2
  34. Ali N, Abdullah MA. The food consumption and eating behaviour of Malaysian urbanites: Issues and concerns. *Malaysian Journal of Society and Space.* 2012;8(6):157-165.
  35. Suh Y, Lee EK, Chung YJ. Comparison of nutritional status by energy level of night snack in Korean adults: using the data from 2005 Korean National Health and Nutrition Examination Survey. *K J Nutr.* 2012;45(5):479-88.

36. Korinth A, Schiess S, Westenhoefer J. Eating behaviour and eating disorders in students of nutrition sciences. *Public Health Nutr.* 2010;13(1):32–7. doi:10.1017/S1368980009005709.
37. Wichianson JR, Bughi SA, Unger JB, Spruijt-Metz D, Nguyen-Rodriguez ST. Perceived stress, coping and night-eating in college students. *Stress Health.* 2009;25(3):235–40. doi:10.1002/smi.1242.
38. Person SM. Perceived stress, psychological functioning and sleep in night eating syndrome. Master's thesis. Ontario: Lakehead University; 2014. [cited 2018 September 29]. Available from: <http://knowledgecommons.lakeheadu.ca/handle/2453/574>.
39. Morrow J, Gluck M, Lorence M, Flancbaum L, Geliebter A. Night eating status and influence on body weight, body image, hunger, and cortisol pre- and post- Roux-en-Y Gastric Bypass (RYGB) surgery. *Eat Weight Disord.* 2008;13(4):e96–e99.
40. Stunkard AJ, Allison KC, O'Reardon JP. The night eating syndrome: A progress report. *Appetite.* 2005;45(2):182–6. doi:10.1016/j.appet.2005.01.013.
41. O'Reardon JP, Ringel BL, Dinges DF, et al. Circadian eating and sleeping patterns in the night eating syndrome. *Obes Res.* 2004;12(11):1789–96. doi:10.1038/oby.2004.222.
42. Allison KC, Tarves EP. Treatment of night eating syndrome. *Psychiatr Clin North Am.* 2011;34(4):785–96. doi:10.1016/j.psc.2011.08.002.