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Night Eating Syndrome, Ultra-processed Foods Consumption, and Physical Activity as Risk Factors for Overnutrition in Students of Faculty of Health Science UPN "Veteran" Jakarta

Sindrom Makan Malam, Konsumsi Ultra-processed Foods, dan Aktivitas Fisik sebagai Faktor Risiko Gizi Lebih pada Mahasiswa Fakultas Ilmu Kesehatan UPN "Veteran" Jakarta

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ABSTRACT

Background: Overnutrition among university students is a pressing concern, disrupting academic productivity and increasing the risk of metabolic diseases at a young age. According to RISKESDAS (2018), the prevalence of overweight/obesity among early adulthood populations reached 36%. Dietary patterns, unhealthy lifestyles, and night eating syndrome (NES) may contribute to overnutrition cases in university students.

Objectives: This study aimed to investigate the association between night eating syndrome, ultra-processed food consumption, physical activity, and overnutrition among students at the Faculty of Health Science, UPN "Veteran" Jakarta.

Methods: This analytical case-control study included 94 participants (47 case and 47 control), aged 19-24 years, from UPN "Veteran" Jakarta. Inclusion criteria comprised students with Body Mass Index (BMI) > 25 (case group) and BMI 18.5-25 (control group). Data collection employed anthropometric measurements, individual assessment using Night Eating Questionnaire (NEQ), Food Frequency Questionnaire (FFQ), and International Physical Activity Questionnaire (IPAQ). Bivariate analysis utilized Chi-square tests.

Results: Results indicated a significant association between night eating syndrome and overnutrition (p-value=0.004, OR=5.214). No significant associations were observed between ultra-processed food (UPF) consumption (p-value=0.409) or physical activity (p-value=0.149) and overnutrition.

Conclusions: This study concluded that night eating syndrome significantly predicts overnutrition incidence. Conversely, UPF consumption and physical activity demonstrated no significant associations with overnutrition.

INTRODUCTION

Overnutrition, marked by overweight and obesity, is a result from an energy balance disparity, where dietary energy intake exceeds physical energy expenditure. Excessive food intake is stored as fat in the body, leading to a body mass index (BMI) above the normal range. The global prevalence of overweight and obesity continues to rise, contributing to an increased burden of non-communicable diseases, such as cardiovascular disease, diabetes, and cancer[1]. According to the World Health Organization (WHO), at least 2.8 million people die annually due to overweight or obesity[2].

Overweight and obesity can affect individuals across all age groups, including those entering early adulthood. Early adulthood represents a critical developmental phase marked by heightened vulnerability to overweight and obesity. Rapid changes in behavior, lifestyle and environmental factors during this period contribute significantly to the rising prevalence[3]. According to the 2018 Basic Health Research (RISKESDAS), 15% of individuals entering early adulthood were classified as overweight, while 21% were obese[4]. Notably, these figures indicate a substantial increase from the 2013 data, which reported corresponding prevalence rates of 10.1% and 11.4%[5].

University students are vulnerable to nutritional problems, particularly overweight and obesity, during early adulthood. A growing body of research substantiates the alarming escalation of overweight/obesity prevalence within this cohort. A longitudinal study revealed that 30% of first-year students experienced significant weight gain (≥3%) within three-months, attributable to inadequate familiarity with healthy eating habits and lack of motivation for physical

activity[6]. Overnutrition among university students has detrimental consequences. Research indicates a negative correlation between obesity and academic achievement of the students[7,8]. Furthermore, Leksono's study among 19-24-year-old students in Semarang revealed that 48% of those with overweight/obesity exhibited comorbid metabolic disorders, including abdominal obesity, hypertension, insulin resistance, and low high-density lipoprotein (HDL) levels[9].

Factors such as insufficient sleep duration, dietary patterns, poor diet quality, and academic stress contribute to overweight incidence among university students[10,11]. Research indicates that shortened sleep duration is associated with increased ghrelin secretion, leading to enhanced nighttime appetite[12]. Midnight meal and snacking is indicative of a deviant eating behavior known as Night Eating Syndrome (NES). NES is characterized by nighttime hyperphagia and/or waking up at least twice a week to eat[13]. Studies have reported that NES affects 15% of university students[14]. Consuming high-calorie foods at dinner time or during nighttime, compared to other meal times, results in a higher average body mass index (BMI) and increased risk of metabolic syndrome[15].

The prevalence of high-risk dietary habits among university students characterized by frequent consumption of sugary beverages, high-fat foods, and instant meals, has become a growing concern[16–18]. These high-calorie, nutrient-poor foods and beverages, including sugary drinks, high-fat foods, and instant products, are categorized as *ultra-processed foods* (UPFs)[19]. UPFs exhibit an unfavorable nutritional profile, characterized by high densities of energy, sugar, sodium, saturated fats and trans fats, while being deficient in fiber, polyunsaturated fatty acids and essential micronutrients (e.g., calcium, zinc, vitamins A, B12, C and E). This nutritional imbalance significantly contributes to excessive weight gain[20]. University students' frequent consumption of UPFs is facilitated by accessibility and peer influence, resulting in an average daily intake of four or more servings[21]. Consequently, deriving 75% of total daily energy intake from UPFs increases the likelihood of obesity by 32%[22]. High-calorie food consumption, combined with inadequate physical activity, exacerbates energy imbalance. Regular physical activity is essential for burning body fat. However, university students often spend their daily time studying in class, sitting for extended periods to complete assignments, and engaging in screen time, leading to sedentary behavior[23]. Previous research reported that a lack of regular physical activity increases the risk of overweight/obesity among university students by threefold[24]. A previous study conducted among students at the Faculty of Health Sciences, UPN "Veteran" Jakarta, revealed that 27.2% of students exhibited elevated BMI scores and high frequencies of consuming instant and sugary foods/beverages[25]. Therefore, this study aimed to investigate the association between night eating syndrome, ultra-processed food consumption, physical activity, and overnutrition among students at the Faculty of Health Science, UPN "Veteran" Jakarta.

METHODS

This analytical observational study with a case-control design was conducted from February to March 2024 at the Faculty of Health Sciences, Universitas Pembangunan Nasional (UPN) "Veteran" Jakarta. The study population included all active students enrolled in the Faculty of Health Sciences at UPN "Veteran" Jakarta during the 2023/2024 academic year. A purposive sampling technique was used to select the participants. The required sample size was calculated using the hypothesis testing formula for odds ratio (OR), yielding a minimum of 43 participants. To account for a 10% dropout rate, the final sample size was increased to 47 participants per group. The ratio between the case and control groups was 1:1, with matching based on age and gender, resulting in a total sample size of 94 participants. The case group consisted of participants with overweight/obesity, while the control group comprised participants with normal nutritional status. Inclusion criteria for the study were as follows: students aged 19–24 years, with a BMI >25.0 kg/m² for case group and a BMI between 18.5–24.9 kg/m² for control group, in a healthy condition, and agreed to participate as respondents. Exclusion criteria included students taking medications that could influence body weight, such as antidepressants, corticosteroids, diabetes medications, beta blockers, and antihistamines. Ethical approval for this study was granted by the Ethics Committee of UPN "Veteran" Jakarta under certificate number 101/III/2024/KEP, issued on March 27, 2024.

The dependent variable in this study was overweight/obesity. Independent variables included Night Eating Syndrome (NES), consumption of ultra-processed foods (UPFs), and physical activity. Data collection involved anthropometric measurements (weight and height) and structured questionnaires. Weight and height were measured using a digital scale and stadiometer, respectively. The questionnaire included respondent demographics, the Night Eating Questionnaire (NEQ) to identify NES, the Food Frequency Questionnaire (FFQ) to assess UPF consumption habits, and the International Physical Activity Questionnaire-Short Form (IPAQ) to evaluate physical activity levels.

NES was determined based on two primary criteria: consuming ≥25% of daily caloric intake between dinner and bedtime or waking up at night to eat at least twice per week. Respondents exhibiting either behavior were considered indicative of NES[26]. These behaviors were assessed using NEQ responses to specific questions: B3 ("How much food do you consume between dinner and bedtime?"), D2 ("How often do you wake up in the middle of the night [after having already fallen asleep] and find it difficult to fall back asleep?"), and D5 ("How often do you eat [meals or snacks] when having difficulty falling asleep or waking up in the middle of the night?"). UPF consumption was categorized as frequent (total FFQ score ≥ median score) or infrequent (total FFQ score < median score)[27]. Physical activity levels were classified as light (<600 MET-minutes/week) or moderate (≥600 MET-minutes/week)[28]. The collected data were analyzed using univariate and bivariate analyses. Bivariate analysis employed the Chi-square test with a significance level of 0.05.

RESULTS AND DISCUSSIONS

Respondent Characteristics

This study involved 94 students from the Faculty of Health Sciences at Universitas Pembangunan Nasional (UPN) "Veteran" Jakarta. Participants were divided into two groups: 47 students with overweight/obesity (case group) and 47 students with normal nutritional status (control group). Table 1 outlines the characteristics of the respondents, including gender and age. The respondents were predominantly female (91.5%), with ages ranging from 19-23 years (mean age: 20 years, 40.4%). This age distribution is due to the majority of participants being students from the 2021 and 2022 cohorts.

Table 1. Respondent characteristics

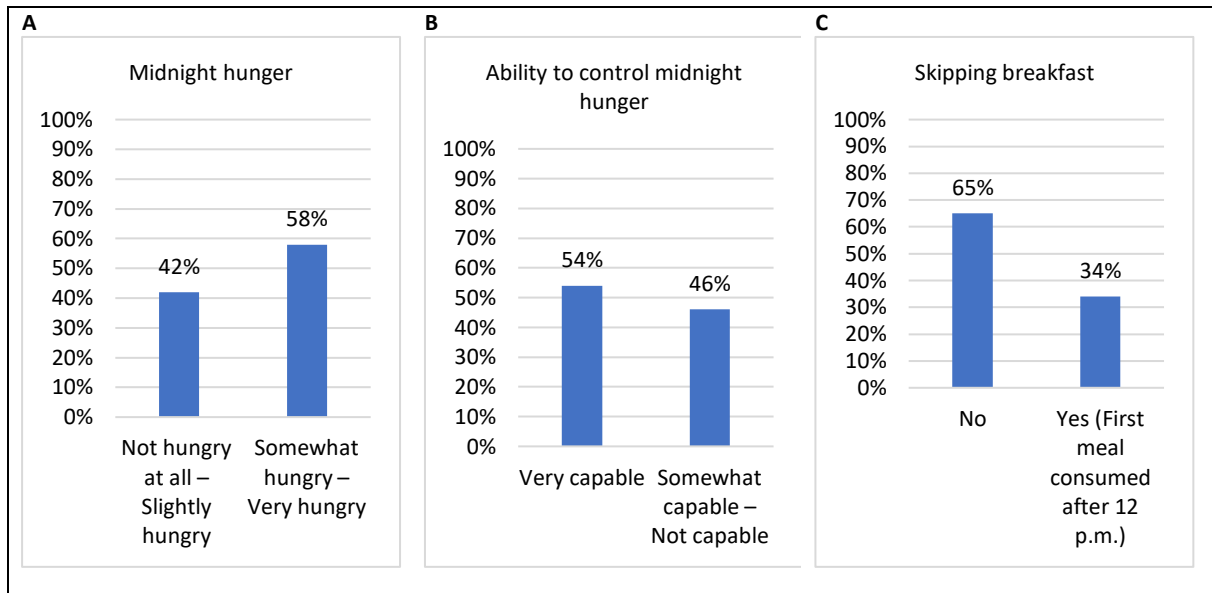| Characteristics	Case		Control	
	n	%	n	%
Sex				
Male	4	8.5	4	8.5
Female	43	91.5	43	91.5
Age (Years)				
19	13	27.7	13	27.7
20	19	40.4	19	40.4
21	11	23.4	11	23.4
22	3	6.4	4	8.5
23	1	1.1	0	0.0

Night Eating Syndrome and Overnutrition

Table 2 indicates a 38.3% incidence of night eating syndrome within the case group. Conversely, 89.4% (n=42) of control groups did not exhibit NES syndrome. Chi-square analysis revealed a significant association between night eating syndrome and overweight/obesity (p-value=0.004). The statistical analysis yielded an odds ratio (OR) of 5.214, indicating that students experiencing night eating syndrome are 5.2 times more likely to have overweight/obesity compared to those without night eating syndrome. This finding aligns with similar research conducted among students in Jember[29]. Furthermore, prior studies suggest that night eating syndrome increases the risk of overweight/obesity by 6.5-fold[30]. Night eating syndrome is positively correlated with higher BMI among university students in Lebanon[31]. Night eating syndrome is significantly associated with disruptions in the circadian rhythm, affecting physiological processes, including leptin and ghrelin hormone regulation, energy metabolism, and nutrient utilization, ultimately affecting energy balance[32]. Consistent with prior research, night eating syndrome disrupts circadian rhythms, yielding energy imbalance due to irregular eating patterns. This disruption impacts metabolic processes, increasing susceptibility to metabolic disorders (e.g., obesity, diabetes)[33]. Night eating syndrome is more prevalent among obese individuals with comorbid metabolic conditions (e.g., insulin resistance, dyslipidemia)[9].
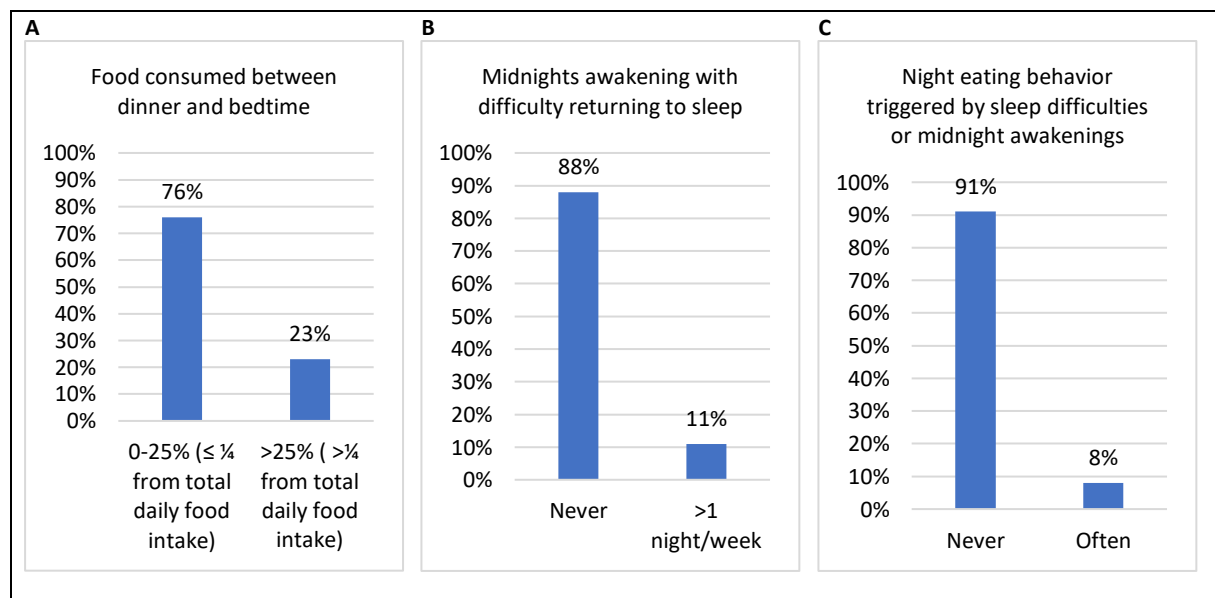
Images 1. Main characteristics distributions of night eating syndrome

Images 2. Other characteristics distributions of night eating syndrome

Table 2. Bivariate analysis

Variable	Case		Control		p-value	OR
	n	%	n	%		
Night Eating Syndrome						
Yes	18	38.3	5	10.6	0.004*	5.214
No	29	61.7	42	89.2		
Ultra-processed Foods Consumption						
Often	25	53.2	20	42.6	0.409	1.534
Seldom	22	46.2	27	57.4		
Physical Activity						
Mild	28	59.6	20	42.6	0.149	1.989
Moderate	19	40.4	27	57.4		

*) Chi-square test, p-value<0.05 indicating statistically significant association

Night eating syndrome is associated with the habit of staying up late and excessive nighttime food consumption[13]. The majority of respondents in this study reported being accustomed to staying up late. The urge to eat at midnight is triggered by an increase in ghrelin secretion, a hormone that stimulates appetite, which is partly due to insufficient sleep duration[12]. Short nighttime sleep increases ghrelin levels and decreases leptin levels, hormones that regulate hunger and appetite as orexigenic and anorexigenic agents, respectively. In line with this finding, a study reported that staying up late with only 4 hours of sleep was associated with increased ghrelin levels and worsened the hunger feeling[34]. In this study, students with late-night habits were found to experience significant hunger (58%) and reported difficulty controlling their midnight eating urges (46%) (Image 2).

Another criterion of night eating syndrome is reduced morning appetite and a tendency to skip breakfast[13]. Current study revealed that 34% of students experiencing night eating syndrome were accustomed to skipping breakfast. These respondents often consumed their first meal after 12 p.m. Skipping breakfast is a risk factor for overweight and obesity among students, as it leads to increased appetite throughout the day[35].

Ultra-processed Foods Consumption and Overnutrition

Results indicated that a significantly higher proportion of case group respondents (53.2%) frequently consumed UPF, whereas 57.4% of control group participants reported infrequent UPF consumption (Table 2). Based on the Chi-square test analysis, there was no significant association between UPF consumption and overweight/obesity (p-value>0.05). These results align with previous studies conducted in Malaysia and Surabaya[36,37]. This is likely because UPF is not a primary source of daily food intake, as approximately 75% of daily energy intake comes from minimally processed foods, and the average energy intake from UPF is only 370 kcal. Although this study did not quantify UPF consumption, the findings suggest that most respondents consumed UPF infrequently.

UPF consumption in Indonesia is relatively lower than in Western countries, such as the United States and the United Kingdom[38]. According to an individual food consumption survey in Jakarta, UPF contributes the least to daily energy intake across all age groups, indicating that non-processed or minimally processed foods remain the primary dietary sources[39]. The survey highlighted that staple macronutrient sources among Indonesians mainly

Amerta Nutrition

e-ISSN: 2580-1163 (Online)
p-ISSN: 2580-9776 (Print)
Hanifa et al. | Amerta Nutrition Vol. 8 Issue 3SP (December 2024). 43-50

47

include non-processed foods such as rice and chicken. On the other hand, the most consumed UPF products are sweetened beverages. At the household level, UPF products such as instant noodles and frozen foods are typically stored as emergency supplies. These products are consumed only in specific situations, such as when there is no desire to cook, a lack of fresh ingredients, or requests from family members due to their convenience. However, the frequency of UPF consumption is limited to about twice a week to once a month[40].

Among the respondents of this study, the most frequently consumed UPF products in the past month were instant noodles and chili sauce, with an average frequency of once per week. Similarly, a study by Vashtianada involving university students in Depok reported that the most consumed UPF products were instant noodles, flavored milk, ice cream, and commercially produced bread[21]. These findings indicate that most UPF products consumed by students are primarily snacks rather than main meals. Daily, students continue to consume rice as their staple food, accompanied by eggs, chicken, or legumes as the most frequently consumed protein sources over the past month[41].

Despite not being a primary daily food source, UPF consumption still needs to be limited. UPF typically contains unbalanced nutrients and tends to be high in calories, sugar, and fat. Additionally, UPF products often include various food additives such as preservatives, antioxidants, stabilizers, colorants, flavorings, flavor enhancers, sweeteners, emulsifiers, carbonating agents, antifoaming agents, anti-caking agents, foaming agents, humectants, coatings, and other additives. Artificial sweeteners can increase insulin concentration and affect glycemic responses, potentially leading to insulin resistance[42].

Physical Activity and Overnutrition

Based on Table 2, a total of 28 respondents (59.6%) in the case group engaged in mild physical activity, whereas more respondents in the control group engaged in moderate physical activity (57.4%). The average minutesMET/week spent on physical activity between the case and control groups were relatively similar, at 787.404 minutesMET/week and 883.404 minutesMET/week, respectively. Bivariate analysis showed no significant association between physical activity and overweight/obesity (p-value>0.05). These findings are consistent with previous studies conducted among students at Tarumanegara University and Jember State Polytechnic, which also reported no significant association between physical activity and nutritional status[43,44]. In general, physical activity influences the balance between energy expenditure and food intake, thereby affecting body weight. However, physical activity is not the primary determinant of body weight; other factors, such as food intake, play a more direct role. High consumption of snacks and the habit of skipping breakfast are considered significant contributors to obesity among university students[35].

In this study, more than 50% of students with overweight/obesity reported engaging in mild level of physical activity levels. Students often spent a considerable amount of time in sedentary activities, with the average respondent sitting for more than six hours per day. Other research found that 70.7% of students do not engage in adequate physical activity[45]. Low physical activity level adversely impacts overall metabolic function. Further, inadequate physical activity disrupts metabolic homeostasis, reducing basal metabolic rate and impairing energy expenditure, thereby contributing to metabolic dysregulation.

A study among university students in Bangladesh found that respondents with no physical activity habits were three times more likely to be overweight or obese compared to those who regularly engaged in at least 30 minutes of physical activity[24]. Physical activity is a key component of energy expenditure, alongside basal metabolic rate (BMR) and specific dynamic action (SDA)[46]. When individuals are less physically active on a daily basis, their energy expenditure decreases, disrupting the balance between energy intake and expenditure. This imbalance fosters a positive energy balance, where caloric consumption surpasses expenditure, leading to excessive weight gain.

This study has several limitations, particularly in the data collection process. For the variable of night-eating syndrome, the energy intake of students during nighttime relied solely on respondents' self-reported estimates. Additionally, UPF consumption could not be quantified due to the use of the Food Frequency Questionnaire (FFQ) method. Despite these limitations, the study's strength lies in its ability to identify the extent to which exposure to various risk factors contributes to overnutrition, particularly overweight and obesity. Future studies are recommended to provide more accurate estimates of calorie intake using a 24-hour dietary recall method and include additional risk factor variables for overweight/obesity.

CONCLUSIONS

This study reveals a significant correlation between night-eating syndrome and overnutrition. Individuals with night eating syndrome exhibited a 5.2-fold increased risk of overweight/obesity. Ultra-processed food consumption and physical activity showed no significant association with overweight/obesity. Our findings emphasize the importance of optimizing sleep duration/quality and mindful nighttime eating habits, especially for university students to prevent overnutrition.

conceptualization, writing-review, and editing; UW: supervision, draft review.

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49

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