THE EFFECT OF CHRONONUTRITION ON MENTAL WELL-BEING AMONG IIUM STUDENTS

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ABSTRACT

Introduction: Chrononutrition, also referred to as the circadian timing of meals, has been found to have an impact on health outcomes, particularly on metabolic health. However, limited evidence exists regarding the influence of chrononutrition on mental well-being. Given the increasing concern about the mental well-being of university students due to various factors affecting their overall health, this study aimed to explore the association between chrononutrition behavior and mental well-being among students. **Method:** An online questionnaire was administered to 336 IIUM students from the Gombak, Kuantan, and Pagoh campuses. The participants completed the Depression, Anxiety and Stress Scale-21 (DASS21) questionnaire and the Chrononutrition Profile Questionnaire (CP-Q). The CP-Q assessed six components of chrononutrition that are likely to influence health, namely breakfast skipping, largest meal, evening eating, evening latency, night eating, and eating window. This is a cross sectional study and the source of the population was selected through convenient sampling. A chi-square test of independence was conducted to study the association between chrononutrition behavior and mental well-being among IIUM students. **Results:** The findings revealed a significant correlation between specific chrononutrition behaviors, particularly evening latency, and evening eating on all states of mental well-being, namely stress, anxiety, and depression. The results suggest that engaging in poor evening latency and evening eating behaviors are associated with increased levels of stress, anxiety, and depression. There is a significant association between the eating window and skipping breakfast with stress although there are no significant associations found with anxiety or depression. No significant associations were found between night eating and stress or anxiety, whilst a significant association was identified between night eating and depression. The largest meal shows a significant association with stress and depression with no significant association found with anxiety. **Conclusion:** These findings emphasize that chrononutrition behaviors impact not only physical health but also mental health and overall well-being. It also highlights the significance of considering chrononutrition in interventions aimed at promoting better mental health outcomes.

KEYWORDS: chrononutrition, mental well-being, circadian rhythm

INTRODUCTION

University students exhibit bad eating habits and receive insufficient amounts of nutrients, according to research by Wy et al. (2011). According to Chin & Nasir (2009), Malaysian female students exhibited unhealthy eating behaviours including meal skipping and frequent snacking.

Nutrition and eating behaviours have a significant impact on mood, mental health, and sleep (Godos et al., 2021). Meal timing is no less important than the type and amount of food taken. Meal timing or known as chrononutrition is the understanding that the timing of food consumption interacts with internal circadian rhythms to impact health outcomes. Meal timing needs to be taken care of, especially among students who usually skip their meals when they are occupied with classes and work (Wehrens et al., 2017).

According to the World Health Organization (WHO, 2020), health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. Often, individuals who experience poor physical health receive treatment to alleviate their symptoms and ailments. While it may be relatively easy to identify the cause of the illness through physical and medical assessments and address it accordingly, it is essential to recognize that health encompasses not only physical well-being but also mental well-being.

Factors that lead to mental disorders and disruption in emotional well-being may come from internal and external factors. Poor dietary habits and eating behaviour are examples of external factors. Students who undergo the transition to university life often exhibit unhealthy eating habits. While these behaviors are commonly perceived as temporary and associated with university life, they often persist into adulthood, carrying potential long-term consequences (Ganasegeran et al., 2012).

A study by Murca et al. (2020) showed that university students who exhibit unhealthy eating habits have shown a strong correlation with increased prevalence of anxiety, stress, and depression scores. Among the unhealthy eating habit, chrononutrition and its effect on mental health and emotional well-being among students need attention. Chrononutrition is an emerging field in nutritional psychiatry based on the relationship between temporal eating patterns, circadian rhythms, and health. In addition to dietary composition, the food intake window and the daily distribution of food intake are also critical factors for mental health (Gombert & Cenit, 2023).

The data on the effect of irregular meal timing on mental health remains elusive and thus needs further research and studies (Tahara et al., 2021). Therefore, this study will investigate the effect of chrononutrition on the mental well-being of the students.

MATERIALS AND METHODS

Study Design and Population

This study was conducted towards International Islamic University Malaysia (IIUM) students from three campuses; Gombak, Kuantan, and Pagoh. This study was conducted via a cross-sectional study whereby data collections were conducted from February until May 2023.

Determination of sample size was calculated using a single proportion formula adopted from the previous study by Tahara et al (2021), where 24% of the participants aged 20-69 years practiced irregular meal timing. A total of 308 participants were required for the sample size. The inclusion criteria for the respondents were undergraduate IIUM students who are free from mental health disorders.

The study protocol was approved by the Kulliyyah of Allied Health Sciences Postgraduate and Research Committee (Reference No: IIUM/310/14/11/2). A written consent for the respondents to participate in this study was attached to the online questionnaire. All information was treated as strictly confidential.

A total of 336 students participated in this study via convenient sampling. The finalized set of online questionnaires was distributed through social media applications, such as WhatsApp and Instagram. The participants were well informed of the inclusion and exclusion criteria to ensure those who participated fit in the inclusion criteria.

Questionnaire

The questionnaire comprises of 3 sections. The first section is about the demographic details of the participants such as gender, year of study, kulliyyah, and anthropometry measurement. The next section consists of questions on mental health assessment in which the DASS21 questionnaire was used. The third section is on the chrononutrition whereby chrononutrition Profile – Questionnaire (CP-Q) was used. The CP-Q assessed 6 components of chrononutrition that are likely to influence health (breakfast skipping, largest meal, evening eating, evening latency, night eating, and eating window). This questionnaire is designed to assess general chrononutrition behaviours and preferred timing of food intake (Engwall, 2018).

a) Demographic Data

The information that was collected consists of the students' gender, year of study, campus, kulliyyah, weight, height and BMI. The BMI was calculated by the students themselves using an online BMI calculator that was included in the questionnaire. The BMI is subsequently classified into categories such as underweight, normal weight, overweight, or obesity based on specific BMI ranges.

b) DASS21 Questionnaire

For the assessment of mental health, Depression, Anxiety and Stress Scale (DASS21) is used, which consists of 21 questions. The scoring consists of 4 categories for each of the questions which are:

a) Score 0: Did not apply to participants
b) Score 1: Applied to participants some degree or some of the time
c) Score 2: Applied to participants a considerable degree or a good part of the time
d) Score 3: Applied to participants very much or most of the time

The scoring was calculated and total up altogether according to each question that has been classified for each of the mental health problems multiplied by 2 in order to evaluate each level of the mental health problems. Thus, the rate of the total score for each mental health problem was assessed based on 5 stages which is normal, mild, moderate, severe and extremely severe.

c) Chrononutrition Profile – Questionnaire (CP-Q).

A summary of the scoring procedures can be found in Table 1. In essence, numerical values are computed and/or extracted for various chrononutrition behaviours, such as eating window, breakfast skipping, evening latency, evening eating, night eating, and largest meal. Since the CP-Q assesses behaviours separately for weekdays and weekends, additional calculations are necessary to generate a weighted aggregate score that accurately reflects weekly patterns (Engwall, 2018).

Table 1 Chrononutrition behaviour descriptions and scoring cutoffs for the chrononutrition profile

Chrononutrition Cutoff	**Description**	**Format**	**Scoring Cutoffs (Poor; Fair; Good)**
Eating Window	Duration between first eating event and last eating event	HH:MM	> 14:00 12:01 to 14:00 ≤12:00
Breakfast Skipping	Frequency of breakfast skipping	Days/Week	≥ 4 days/week 2-3 days/week 1 day/week or less
Evening Latency	Duration between last eating event and sleep onset	HH:MM	≤2:00 2:01 to 6:00 >6:00
Evening Eating	Last eating event of the day	HH:MM	≥23:00 20:00 to 22:59 < 20:00
Night Eating	Frequency of night eating	Days/Week	≥ 4 days/week 2-3 days/week 1 day/week or less
Largest Meal	Meal in which largest amount of food is eaten	Meal Name	Dinner/Supper Lunch Breakfast

To be more specific, separate values are computed for weekdays and weekends, which are then weighted to account for 5 weekdays and 2 weekend days. For instance, if the eating window is calculated as 10 hours on weekdays and 14 hours on weekends, the overall estimated eating window is determined as 11.14 hours. This calculation is derived by adding the product of weekday eating window (10 hours) multiplied by the number of weekdays (5 days) and the product of weekend eating window (14 hours) multiplied by the number of weekend days (2 days), and then dividing the sum by the total number of days (7 days).

The aggregate values of the Chrononutrition Profile (CP) are subsequently classified into one of three "chrononutrition behaviour cutoffs" for each specific behaviour (good, fair, and poor). The categorization of chrononutrition behaviour cutoff scores, which considers weekly frequencies (such as breakfast skipping and night eating), is determined by the percentage of days used as cutoffs in the CP scoring (Engwall, 2018).

Statistical Analyses

The Statistical Package for Social Sciences (SPSS) version 26.0 was used to analyse the data in this study. The significance level for a 95% confidence interval (CI) is set at 0.05.

For the type of analysis, the descriptive analysis is used to study the chrononutrition behavior and the mental well-being of the students. The Chi-Square Test of Independence is utilized to study and assess the association between chrononutrition behavior and mental well-being among IIUM students.

RESULTS AND DISCUSSIONS

Sociodemographic Information

A total of 336 undergraduate students from year 1 up to year 5 from all kulliyyahs of the Gombak, Kuantan, and Pagoh campuses participated in this study. Among these respondents, female students were the highest as compared to males with a percentage of 65.5% while 34.5% were contributed from male students. Students from Kulliyyah of Allied Health Sciences constitute the largest portion of 38.1% from the total sample. A total of 69% of students who participated in the study were from the Kuantan campus, 28.6% from Gombak, and only 2.4% from Pagoh campus. With regards to their BMIs, a total of 184 students (54.8%) has normal BMI, 68 students (20.2%) were overweight, 52 students (15.5%) were underweight, and 32 students (9.5%) were obese. Majority of the students have a normal BMI (Table 2)

Table 2 Demographic Data of the Students

Demographic	Category	Frequency (n)	Percentage (%)
Gender	Male	116	34.5%
	Female	220	65.5%
Year of study	Year 1	48	14.3%
	Year 2	92	27.4%
	Year 3	148	44.0%
	Year 4	44	13.1%
	Year 5	4	1.2%
Campus	Gombak	96	28.6%
	Kuantan	232	69.0%
	Pagoh	8	2.4%
Kulliyyah	Kulliyyah of Medicine (KOM)	16	4.8%
	Kulliyyah of Dentistry (KOD)	16	4.8%
	Kulliyyah of Pharmacy (KOP)	4	1.2%
	Kulliyyah of Allied Health Sciences (KAHS)	128	38.1%
	Kulliyyah of Nursing (KON)	4	1.2%
	AbdulHamid AbuSulayman Kulliyyah of Islamic Reveal Knowledge And Human Sciences (AHAS KIRKHS)	24	7.1%
	Ahmad Ibrahim Kulliyyah of Laws (AIKOL)	8	2.4%
	Kulliyyah of Architecture & Environmental Design (KAED)	20	6.0%
	Kulliyyah of Economics & Management Sciences (KENMS)	12	3.6%
	Kulliyyah of Education (KOED)	4	1.2%

	Kulliyyah of Engineering (KOE)	20	6.0%
	Kulliyyah of Information & Communication Technology (KICT)	8	2.4%
	Kulliyyah of Languages and Management (KLM)	8	2.4%
	Kulliyyah of Science (KOS)	64	19.0%
BMI Category	Underweight	52	15.5%
	Normal	184	54.8%
	Overweight	68	20.2%
	Obesity	32	9.5%

n=336

Chrononutrition Behaviour of IIUM Students

Table 3 provides data on the chrononutrition behaviour of IIUM students. It includes various categories of chrononutrition behaviour, along with their frequency and percentage distribution.

Table 3 Chrononutrition Behavior of IIUM Students

Chrononutrition Behaviour	Category	Frequency (n)	Percentage (%)
Eating Window	Good (≤12:00)	152	45.2%
	Fair (12:01–14:00)	108	32.1%
	Poor (>14:00)	76	22.6%
Breakfast Skipping	Good (1 d/wk or less)	64	19.0%
	Fair (2–3 d/wk)	64	19.0%
	Poor (≥4 d/wk)	208	61.9%
Evening Latency	Good (>6:00)	24	7.1%
	Fair (2:01–6:00)	220	65.5%
	Poor (≤2:00)	92	27.4%
Evening Eating	Good (<20:00)	48	14.3%
	Fair (20:00–22:59)	172	51.2%
	Poor (≥23:00)	116	34.5%
Night Eating	Good (1 d/wk or less)	296	88.1%
	Fair (2–3 d/wk)	32	9.5%
	Poor (≥4 d/wk)	8	2.4%
Largest Meal	Good (Breakfast)	12	3.6%
	Fair (Lunch)	224	66.7%
	Poor (Dinner/supper)	100	29.8%

For eating window behaviour, most of the students (152 students, 45.2%) have good eating behaviour. Eating window indicates the duration between the first eating event and the last eating event. Students with good eating window only have an eating duration of 12 hours or less per day, while those with a fair eating window eat for more than 12 hours up until 14 hours per day. Students with a poor eating window eat more than 14 hours most of the day.

With regards to breakfast-skipping behaviour, the students were mostly categorized under the poor behaviour which indicates the practice of skipping breakfast more than 4 times per week. A high percentage of students (61.9%) were in this category.

Evening latency refers to the time interval between the last meal of the day and the time the students go to sleep. Students with good evening latency have a gap of more than 6 hours, while those with fair evening latency have a gap between 2 hours to 6 hours. Students with poor evening latency have a gap of 2 hours or less. In this study, it is important to highlight that 220 students (65.5%) have fair evening latency behaviour.

Evening eating represents the time at which students have their last meal of the day. Students with good evening eating behaviour finish their meal before 8:00 PM, while those with a fair behaviour finish between 8:00 PM and 10:59 PM. Students with poor behaviour have their last meal at 11:00 PM or later.

Majority of the students, which consists of 88.1% (296 students) have a good behaviour at night eating. This category indicates the frequency of eating during the night. Students with a good night eating behaviour eat during the night once a week or less. Those with a fair behaviour eat 2-3 times a week, while those with poor behaviour eat four or more times a week during the night.

Lastly, the largest meal of the day for the majority of the students was during lunch. Only a few students, consisting of 3.6% eat a lot during their breakfast. In this category, having the largest meal of the day during breakfast indicates a good chrononutrition behavior. Meanwhile having lunch as the largest meal is categorized fair chrononutrition behavior. Those who eat their largest meal of the day at night were considered to have poor chrononutrition.

State of IIUM students' emotional well-being.

Table 4 indicates the emotional well-being of the students according to each category. Based on the results, students with moderate depression are the highest with a total of 152 students (45.2%) while the lowest is the students who experience extremely severe stress with a total number of only 4 students (1.2%).

Table 4 Emotional Well-Being State of the students

Emotional State	Category	Frequency (n)	Percentage (%)
Stress	Normal	148	44.0%
	Mild	56	16.7%
	Moderate	84	25.0%
	Severe	44	13.1%
	Extremely severe	4	1.2%
Anxiety	Normal	84	25.0%
	Mild	52	15.5%
	Moderate	92	27.4%
	Severe	44	13.1%
	Extremely severe	64	19.0%
Depression	Normal	112	33.3%
	Mild	36	10.7%
	Moderate	152	45.2%
	Severe	28	8.3%
	Extremely severe	8	2.4%

This study found that the prevalence of moderate to extremely severe stress, anxiety and depression among IIUM students are 39.3%, 59.5% and 55.9%, respectively. This is higher compared to a previous study towards undergraduate students in Malaysia during the COVID-19 pandemic, whereby the prevalence for depression and anxiety were 29.4% and 51.3% respectively (Moy & Ng, 2021).

Experts declared that anxiety and depression are the top causes of mental health disorders among Malaysian students (Kotera, et al., 2020). Because of academic stress, students may struggle to prioritize their well-being, neglecting important aspects such as sleep patterns, dietary quality, and physical activity. These factors eventually contributed to having mental health issues among students.

Association between Chrononutrition Behaviour and Mental well-being among IIUM students

To analyze the association between chrononutrition behavior and mental well-being among IIUM students, a chi square test of independence was performed. The analysis focused on six specific chrononutrition behaviours: eating window, breakfast skipping, evening latency, evening eating, night eating, and largest meal. Table 5 shows the results of Chi-Square tests between each chrononutrition behavior towards each aspect of mental well-being state, namely stress, anxiety and depression.

Table 5 Summary of *p*-value of Chi-Square Test between Chrononutrition Behavior and Mental Well-Being State

Chrononutrition Behaviour	Stress	Anxiety	Depression
Eating Window	<0.05	0.59	0.107
Breakfast Skipping	<0.05	0.101	0.079
Evening Latency	<0.05	<0.05	<0.05
Evening Eating	<0.05	<0.05	<0.05
Night Eating	0.18	0.423	<0.05
Largest meal	<0.05	0.19	<0.05

Based on the results of chrononutrition behavior, the majority of IIUM students (61.9%) are categorized as "poor" under the breakfast-skipping behavior. This indicates that most of IIUM students skip breakfast more than four times a week. Breakfast is the most important meal of the day because it helps the human body to start their daily metabolism (Heo et al., 2021). Across all age groups, skipping breakfast showed a positive association with the likelihood of experiencing depression, stress, and psychological distress. In adolescence, it was also linked to higher odds of anxiety (López-Gil et al., 2022).

Eating window duration refers to the duration between the first eating event and last eating event. The majority of IIUM students (45.2%) have an eating window of less than 12 hours, indicating good behavior. Conversely, a total of 22.6% of students demonstrate poor eating window behavior, with a duration exceeding 14 hours of eating per day. A good eating window should be less than 12 hours per day, and it is aligned with the principle of time restricted feeding (TRF) which is a form of intermittent fasting in which all nutrient intake occurs within less than 12 hours every day (Gombert & Cenit, 2023). TRF has shown to give positive benefits towards the cardiometabolic health such as prevent excessive body weight gain, enhance sleep quality, and mitigate the decline in cardiac performance associated with age and poor diet (Melkani & Panda, 2017).

Next, two significant aspects of chrononutrition that have potential health implications are evening latency behavior, which denotes the time gap between the last eating event and sleep onset, and evening eating, which refers to the timing of the final meal of the day. This behavior refers to the evening chronotype. Chronotype represents an individual's preference for engaging in daily activities at specific times of the day. Individuals with an evening chronotype are inclined to experience a higher prevalence of health issues, such as psychological, neurological, and gastrointestinal morbidities, as well as higher mortality rates, in comparison to those with morning chronotypes (Makarem et al., 2020). According to Zou et al. (2022), having an evening chronotype poses a risk for developing depressive disorders and substance use disorders, whereas being a morning chronotype serves as a protective factor against these conditions. This study reveals that 27.4% and 34.5% IIUM students have poor evening latency and evening eating behavior respectively.

Next is the largest meal behavior. The largest meal refers to the meal in which the largest amount of food is eaten. More than half of IIUM students (66.7%) have their largest meal during lunch. In terms of behavior, having the largest meal during breakfast is considered good, while having it during lunch is deemed fair. Conversely, having the largest meal during dinner or supper is considered poor behavior. A total of 29.8% of IIUM students eat a large amount of food during their dinner and supper while only 3.6% have their largest meal during breakfast. There is a consistent correlation between the timing of the largest meal and their preference for sleep and wake times throughout the day and their overall health (Engwall, 2018).

Night eating on the other hand indicates the behavior of waking up at night to eat. Notably, it is worth mentioning that the majority of IIUM students (88.1%) exhibited positive behavior in this aspect, as they reported either not waking up at all or waking up only once per week to eat during the night.

CONCLUSION

In conclusion, the findings suggest that chrononutrition behaviors play a role in mental well-being. The timing of meals, breakfast skipping, evening latency, evening eating, night eating, and the largest meal are all important factors that may influence stress, anxiety, and depression levels. These findings highlight the significance of considering chrononutrition in interventions aimed at promoting better mental health outcomes.

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