ASSOCIATION BETWEEN CHRONONUTRITION PROFILE AND DIET QUALITY AMONG IIUM KUANTAN STUDENTS

NURANIZA AZAHARI, PhD (CORRESPONDING AUTHOR)

DEPARTMENT OF NUTRITION SCIENCES, KULLIYYAH OF ALLIED HEALTH SCIENCES, INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA, JALAN SULTAN AHMAD SHAH, 25200 KUANTAN, PAHANG, MALAYSIA

nuraniza@iium.edu.my

NURFARAH NAJWA RAHIM, BSc

DEPARTMENT OF NUTRITION SCIENCES, KULLIYYAH OF ALLIED HEALTH SCIENCES, INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA, JALAN SULTAN AHMAD SHAH, 25200 KUANTAN, PAHANG, MALAYSIA

binturahim01@gmail.com

ABSTRACT

Introduction: Chrononutrition is explained as a relationship between our body's circadian rhythm, that is 24 hours cycle changes that occur in the body in terms of physical, mental and behavioral changes. Certain physiological effects play an important part in regulating 24-hour cycle body clocks, affecting a person's eating behavior. The patterns of chrononutrition that were assessed in this study is important aspects that indicate the diet quality of IIUM Kuantan students since students are vulnerable to practice unhealthy lifestyles and poor dietary choices. Therefore, this study is aimed to determine whether there are association between chrononutrition profile and diet quality among IIUM Kuantan students. **Methods:** A cross-sectional study was conducted in order to determining the association between chrononutrition profiles and diet quality. A total of 129 undergraduate students participated in this study. Two questionnaires, which are Malaysia-translated version Chrononutrition Profile Questionnaire (CPQ-M) and Malaysia Healthy Eating Index (M-HEI) were distributed to the targeted participants and the data was collected to be analyzed for the results of the study. **Results:** The data obtained were statistically analyzed by using Statistical Package for Social Sciences (SPSS 26.0). The result showed no statistical significant for association between chrononutrition profile and diet quality (p>0.05). This contradicts with our prediction, where poor or good chrononutrition profile may influence the diet quality of the students. **Conclusion:** Thus, there was no association between chrononutrition profiles and diet quality among IIUM Kuantan students who live in the campus.

KEYWORDS: Chrononutrition, Diet Quality, Circadian Rhythms, Eating behaviors

INTRODUCTION

'Chrono-nutrition' is the study that show the interaction between biological rhythms and nutrition. It is related with distribution of energy, meal frequency and regularity, duration of the eating period, as well as the relative importance of chrononutrition to the metabolic health and chronic diseases risk (Flanagan et al., 2020). Oda (2015) said in the study that chrononutrition is a well-regulated eating habits that have a negative effect on regulatory feedback for transcription via the binding of Clock Bmal 1 to E-box, which forms the basis of biological clocks. Clock Bmal 1 and E-box are genes which control the regulation of circadian rhythms. Besides, Engwall (2018) also stated in the research study where the chrononutrition is known as the food intake that occurs throughout the 24-hour day or the circadian timing of food intake.

Meals are said to be an important part that have been discussed in relation to chrononutrition since it is expected from a few of the previous study that it may have correlation with the diet quality of an individual. A study has reported that meals are known as the strongest synchronizer which functions to synchronize the brain clock. "Chrono-nutrition" is the study that shows the interaction between biological rhythms and nutrition. It is related to the distribution of energy, meal frequency and regularity, duration of the eating period, as well as the relative importance of chrononutrition for metabolic health and the risk of chronic diseases (Flanagan et al., 2020). In the study, Oda (2015) stated that chrononutrition involves well-regulated eating habits that negatively affect regulatory feedback for transcription via the binding of Clock Bmal1 to the E-box, forming the basis of biological clocks. Additionally, Engwall (2018) noted in their research that chrononutrition refers to food intake throughout the 24-hour day or the circadian timing of food intake. Meals are considered crucial in relation to chrononutrition since several previous studies suggest a potential correlation with an individual's diet quality. One study reported that meals are the strongest synchronizer, functioning to align the brain's internal clock.

Well-regulated eating behavior is closely associated with circadian rhythm functioning and also impacts an individual's diet quality. This statement indirectly influences an individual's body mass index and determines their nutritional and health status. Some studies indicate that poor chrononutrition can be attributed to unbalanced diets, frequent skipping of breakfast, increased snacking frequency, and insufficient time between the last meal and sleep onset. This underscores the importance of daily health management, including controlling behaviors like meal timing and sleep scheduling, to establish a healthy lifestyle. The primary focus of this study is to elucidate the association between the chrononutrition profile—how the circadian rhythm affects diet quality—among undergraduate university students. Most university students are noted to exhibit poor eating patterns and dietary intake due to academic demands, leading to unhealthy food choices stemming from inadequate chrononutrition behaviors.

A recent study highlighted certain behavioral patterns that may impact an individual's chrononutrition profile, such as the eating window (time-restricted feeding), evening latency (time between eating and bedtime), breakfast skipping, night eating, timing of evening eating, and timing of the largest meal (Engwall, 2018). Chrononutrition involves the interplay between nutrition and the circadian rhythm, providing valuable insights into managing food intake throughout the day (Norsham et al., 2023). According to Rosnani & Nor Azwani (2020), poor food intake can diminish diet quality. Insufficient nutritional intake may arise from unhealthy dietary practices and eating behaviors, particularly among university students. Consequently, the chrononutrition profile can influence diet quality in terms of meal timing and eating practices.

MATERIALS AND METHODS

A cross-sectional study was conducted among 156 students from all Kulliyyahs of IIUM Kuantan. The sample size was determined using a single proportion formula based on a study by Yong Qi Kwan et al. (2021), which found that 38.6% of the participants were engaged with night eating syndrome (NES).

A convenient sampling method was employed to collect data from the targeted respondents. The inclusion criteria encompassed undergraduate male and female students from all Kulliyyahs on this campus. Postgraduate students were excluded from this study as it primarily aimed to assess the understanding level of undergraduate students. Additionally, international students were not included due to their minority representation and students diagnosed with sleep disorders were also excluded.

The study protocol was approved by the IIUM Research Ethics Committee (IIUM/504/14/11/2 IREC 2023-KAHS/DNS). A consent form was attached to each questionnaire distributed to respondents, providing them with the necessary information to answer the questions. All provided information was treated as strictly confidential.

Questionnaires

Two types of questionnaires have been selected for use: the Malaysia-translated version of the Chrononutrition Profile Questionnaire (CPQ-M) and the Malaysia Healthy Eating Index (M-HEI). The questionnaire items were originally crafted in English to ensure comprehension among the students. The CPQ-M was adopted from Chong et al. (2022) and consist of short-answer and multiple-choice questions, along with scoring methods from Engwall (2018). The questionnaire is divided into six sections, with questions depend on the individual's meal timing, including morning, lunch, nighttime, late nighttime, and early and late eating behaviors.

The M-HEI questionnaire, adapted from the study by Karami & Mohd Shukri (2022), explores deeper into participants' dietary intake by requiring them to provide the number of daily servings consumed for nine food groups. These groups align with the Malaysia Dietary Guidelines (MDG) 2020 and encompass vegetables, fruits, rice, other cereals, whole grain cereal-based products and tubers, fish, poultry/eggs/meat, legumes, milk and milk products, and fats/oil and sugar. To aid participants in responding to the questionnaire, examples of foods corresponding to each of the nine food groups were provided as references.

Statistical Analyses

The statistical analysis was done using Statistical Package for the Social Sciences Version 26 (SPSS 26.0). Each of the chrononutrition profile and diet quality data were analyzed using descriptive analysis and Fisher's exact test was used to determine the association between chrononutrition and diet quality among IIUM Kuantan students. The study was set with a 95% confidence interval (CI) at p values <0.05 was considered statistically significant.

RESULTS

Sociodemographic Characteristics

A total of 129 respondents from both male (12.4%, n=16) and female (87.6%, n=113) undergraduate students of IIUM Kuantan participated in this study. The sociodemographic characteristics are presented in Table 1.

Table 1 Sociodemographic characteristics of respondents (N=129)

Sociodemographic Characteristics	Subjects		Mean ± SD
	n	%	
Age			21.56 ± 1.463
Gender			
Male	16	12.4	
Female	113	87.6	
Kulliyyah			
Kulliyyah of Allied Health Sciences	79	61.2	
Kulliyyah of Sciences	22	17.1	
Kulliyyah of Pharmacy	14	10.9	
Kulliyyah of Medicine	7	5.4	
Kulliyyah of Nursing	4	3.1	
Kulliyyah of Dentistry	3	2.3	
Year of Study			
Year 1	30	23.3	
Year 2	22	17.1	
Year 3	70	54.3	
Year 4	7	5.4	
Scholarship			
JPA	17	13.2	
MARA	32	24.8	
PTPTN	28	21.7	
Self-Sponsored	46	35.7	
Others	6	4.7	
Medical History			
Yes	28	21.7	
No	101	78.3	
Smoking Status			
Actively smoking	1	0.8	
Not smoking	128	99.2	
Alcohol Intake			
Yes	0	0	
No	129	100	
Exercise Patterns (or is it Physical Activity Level?)			
Active	34	26.4	
Sedentary	95	73.6	

The majority of respondents who participated in this study were around 21 to 22 years old, corresponding to second- and third-year undergraduate students. The distribution was consistent across all six Kulliyyahs,

with the highest response rate coming from the Kulliyyah of Allied Health Sciences (61.2%, n=79). Over a quarter of the total respondents were self-sponsored (35.7%, n=46). Additionally, there were students who received scholarships and financial assistance during their studies. Furthermore, majority of students reported having no medical history (78.3%, n=101), and nearly all students stated that they were non-smokers (99.2%, n=128). All participants refrained from alcohol intake, and the majority of students reported having a sedentary daily lifestyle (73.6%, n=95).

Chrononutrition Profile

Five aspects were assessed to determine the chrononutrition profile: eating windows on weekdays and weekends, evening latency, breakfast skipping, evening eating, and night eating. Among these, eating windows on weekdays and weekends, as well as night eating, received mostly good scores from the students. The remaining aspects of the chrononutrition profile displayed a high number of students scoring fair to poor."

Table 2 Chrononutrition profiles of respondents (N=129)

Chrononutrition Profile		Mean ± SD	Score	n (%)
Eating Windows	Weekdays	0.70 ± 0.777	Good	64 (49.6)
			Fair	40 (31.0)
			Poor	25 (19.4)
	Weekends	0.36 ± 0.624	Good	92 (71.3)
			Fair	27 (20.9)
			Poor	10 (7.8)
Evening Latency	Weekdays	1.34 ± 0.508	Good	2 (1.6)
			Fair	81 (62.8)
			Poor	46 (35.7)
	Weekends	1.23 ± 0.508	Good	5 (3.9)
			Fair	89 (69.0)
			Poor	35 (27.1)
Breakfast Skipping		1.18 ± 0.814	Good	33 (25.6)
			Fair	40 (31.0)
			Poor	56 (43.4)
Night Eating		0.07 ± 0.285	Good	121 (93.8)
			Fair	7 (5.4)
			Poor	1 (0.8)
Evening Eating		1.12 ± 0.559	Good	13 (10.1)
			Fair	87 (67.4)
			Poor	29 (22.5)

Diet Quality

The assessment of diet quality reveals that a majority of undergraduate students having poor diet quality(n=111), while only a small number of them indicated practicing a moderate diet quality (n=18). None of the students reported of having a good quality diet during their time living on campus.

Table 3 Diet quality of the respondents (N=129)

Diet Quality Category	n (%)
Poor diet quality	111 (86.0)
Moderate diet quality	18 (14.0)
Good diet quality	0 (0.0)

Association between Chrononutrition Profile and Diet Quality

Table 4 shows the association between chrononutrition profile and diet quality among IIUM Kuantan students. The result shows that there are no statistically significant association between diet quality and five chrononutrition profiles—eating windows, evening latency, breakfast skipping, night eating, and evening eating.

Table 4 Association between chrononutrition profile and diet quality (N=129)

Association between diet quality and:		*p*-value
Eating Windows	Weekdays	0.643
	Weekends	0.353
Evening Latency	Weekdays	1.000
	Weekends	0.806
Breakfast Skipping		0.340
Night Eating		0.082
Evening Eating		0.608

DISCUSSION

Food intake that occurs throughout the 24 hours per day for a week indicates the chrononutrition profile of a person. The result of the descriptive analysis showed that more than half of the students that participated in this study had less than 12 hours gap between their first and last eating events for both weekdays and weekends. Time-restricted feeding (TRF), defined as consuming food within a designated time frame, has been associated with health benefits. Students often have early morning schedules due to classes and late sleep onset due to commitments and assignment workload (Sing Chen Yeo et al., 2023 and Jansen et al., 2020). This study also reported that most of the students had a period of 2 to 6 hours between their last eating event and their sleep onset since it shows a fair result that indicates the undergraduate students had hours of break before starting to sleep. Prior studies suggest that allowing the body 2 to 3 hours before sleep for digestion may be beneficial (Kinsey & Ormsbee, 2015).

In this study, 43.4% of students reported of skipping breakfast more than four days a week. Breakfast skipping is common among students due to their busy lifestyles. According to Jayaveloo, Mat Daud, and Abd Rahman (2021), students need to rush in the morning and have different classes to attend, contributing to have a breakfast on their own rather than with friends. Moreover, evening eating that has been observed among students indicates that a high number of them had their last meal between 8.00 p.m. to 10.59 p.m. (67.4%) and more than a quarter of students also reported that they were still eating after 11.00 p.m. Engwall (2018) stated in the research study that those with a later sleep midpoint tend to have unhealthier diets and and consume more calories in the evening. Other than that, night eating among students was observed during this study where it can be concluded that students who had already fallen asleep were less likely to wake up to eat.

The present study revealed that the majority of students had poor diet quality (86%), with no students achieving a good diet quality score. This finding highlight that, despite being science students, their dietary intake and knowledge about diet quality are still poor (Rosnani Ayob & Nor Azwani, 2020). Abraham et al. (2018) clearly expressed that young adults commonly establish their eating patterns during their years in college and the behavior continues until they become adults. The university environment and student life are also another element that contributes in shaping their food choices for their daily meal routines (Sogari et al., 2018).

The chrononutrition profile closely relates to the timing of meals in determining a person's diet quality. The issue of late chronotype or evening chronotype has arisen among students because of their hectic schedules and workloads. Most of the students are practicing late chronotype behaviors. Late chronotype behaviors are associated with poorer dietary adherence (Fatin Hanani Mazri et al., 2019). However, in this

study, the association between diet quality and five chrononutrition profiles—eating windows, evening latency, breakfast skipping, night eating, and evening eating were not statistically significant. In line with the findings, Steger et al. (2022) discovered that the eating windows had no impact on the diet quality while Marie-Pierre St-Onge et al. (2016) confirmed that diet quality closer to bedtime influences sleep architecture, which is in contrast with the present findings.

Moreover, the most common behavior practice by the students is skipping breakfast at least once a week on campus. According to Min et al. (2011), individuals who regularly consume breakfast tend to have a more diverse dietary intake across various food groups when compared to those who frequently skip breakfast. This study also shows that there is no association between night eating among students and their diet quality. This finding contradicts the research conducted by Hernandez et al. (2016), which demonstrated that eating at night is associated with higher food consumption, encompassing both regular meals and snacks, during these late hours. Lastly, evening eating was also found to have no association with diet quality among students since the result shows no statistically significant. These findings also differ from a previous study by Sebastian et al. (2022), where the impact of late evening eating on the total Healthy Eating Index (HEI) score demonstrated statistical significance for nearly all common late evening eating patterns.

CONCLUSION

In conclusion, the dietary habits of IIUM Kuantan students, referred to as chrononutrition profiles, were found to have no significant association with their diet quality. Despite possessing good knowledge about nutrition, they tend to adopt an unhealthy lifestyle with poor dietary choices during their early adulthood phase. The majority of students exhibited poor diet quality, with only a few demonstrating a fair diet quality. This indicates that the importance of maintaining good dietary quality is not being practiced among IIUM undergraduate students. Based on the results of this study, it can be concluded that the hypothesis is not supported, as there is no significant association between chrononutrition profiles and diet quality. Consequently, it is crucial to promote and emphasize healthy dietary compliance and practices among these students to improve the future health of this population

ACKNOWLEDGEMENT

The authors would like to thank all the students of IIUM Kuantan for their cooperation as the respondents who take part in the study.

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