Original Article

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Association of Meal Irregularity and Chronotypes with Dietary and Sleep Patterns: A Cross-sectional Study

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ABSTRACT

Introduction: The circadian clock is a homeostatic regulation system comprising clock genes in the body that regulate various physiological and behavioural processes. Diet determines our health and the timing and periodicity of feeding, in addition to nutritional quality, influence circadian rhythms and metabolism significantly.

Aim: To assess the association of meal irregularity and chronotypes with dietary and sleep patterns.

Materials and Methods: This cross-sectional study was conducted on 375 female adults using the convenience sampling method. Information on socio-demographic characteristics, dietary patterns, sleep patterns, chronotypes, and physical activity was collected through a self-administered questionnaire consisting of 26 questions. Participants aged 18-40 years and who completed the study questionnaire were enrolled. Pregnant or lactating mothers and users of tranquilisers and psychotropic drugs were excluded. T-tests and one-way Analysis of Variance (ANOVA) were used for continuous variables, and the Chi-square test was used for categorical variables.

Results: A total of 197 (52.5%) participants reported consuming their meals at a regular time every day, while 178 (47.5%) did not. Concerning eating meals at a regular time every day, a significant association was found between eating meals at a regular time every day and the number of meals per day (Chi-squared, p-value <0.001). The data indicated that most participants were of the intermediate type (190, 50.7%), followed by the morning type (111, 29.6%), and then the evening type (74, 19.7%). Regarding the Morning-Evening Questionnaire (MEQ), there were significant associations between MEQ and the time of the last meal (Chi-squared, p-value=0.001), eating a meal after 9 pm (Chi-squared, p-value <0.001), and the need for a nap in the middle of the day (Chi-squared, p-value <0.001).

Conclusion: The present study suggests that the regular timing of eating is associated with the number of meals per day. Dietary and sleep patterns, including the time of the last meal, eating a meal after 9 pm, and the need for a nap in the middle of the day, were also associated with chronotype.

Keywords: Circadian clock, Meals, Morningness-eveningness preferences, Physical activity, Sleep/wake cycle

INTRODUCTION

The term "circadian" is derived from the Latin 'circa diem', meaning "approximately day" or "about a day" [1]. The circadian clock is a homeostatic regulation system comprising clock genes in the body that regulate various physiological and behavioural processes such as body temperature, hormonal secretion, and the sleep/wake cycle following a ~24-hour cycle [2]. It denotes the synchronicity between endogenous biological rhythms, exogenous rhythms, and behavioural rhythms [3]. Humans have evolved an active light phase predominantly devoted to energy replenishment, reproduction, and activity, and an inactive dark phase devoted to sleep, recuperation, and regeneration [4]. The suprachiasmatic nucleus located in the hypothalamus serves as the master pacemaker and is primarily responsible for controlling the endogenous circadian system, which is coordinated by ambient light and entrains secondary clocks in the brain and most peripheral tissues. It is noteworthy that the secondary clocks are also entrained by environmental cues and behaviours, such as eating and sleeping [5]. Studies have shown that repeated disruptions in eating and sleeping timing lead to obesity, type 2 diabetes, hypertension, dyslipidaemia, and cardiovascular disease [5,6]. Our diet determines our health, as in "it is what we eat that makes us who we are." The timing of eating is also recognised as an essential element affecting metabolic health along with what we eat [7]. Therefore, in addition to nutritional quality, the timing and periodicity of feeding influence circadian rhythms and metabolism significantly [8].

It is believed that a person's behavioural pattern is greatly influenced by their chronotype, which refers to the timing at which they engage in sleep, exercise, and other activities to perform at their best. Based on their circadian preferences, individuals are categorised into morning-type (M-type, also known as early chronotype, early bird, or lark type), evening-type (E-type, also known as night chronotype or owls type), and intermediate-type (I-type, also known as neither chronotype or hummingbird type) [9]. The M-type or early bird has been found to be related to a better lifestyle [10] and healthy dietary patterns [11], while in contrast, E-type or owls type individuals either skip breakfast or eat their meals quite late, and they are found to adhere to an unhealthy lifestyle [12]. Therefore, maintaining a regular timing of meals is significant and has been found to be valuable for neurodegenerative disorders, cancer, and ageing [13].

Sleep is a physiological process that occurs periodically and leads to reduced consciousness, relaxation of muscles, and a decrease in sensory activity, essential for good health. Poor-quality, irregular, and short sleep are significant determinants of various disorders such as obesity, diabetes, cardiovascular diseases, and decreased overall performance [14]. Sleep disturbances are influenced by diet, with food choices shown to impact various sleep-related variables such as duration and quality [15]. Due to the limited availability of studies [2,10] that enumerate the association of meal irregularity and chronotypes with dietary and sleep patterns, this study was aimed to examine the association of meal irregularity and chronotypes with dietary and sleep patterns.

MATERIALS AND METHODS

This cross-sectional study was conducted on 375 female adults using a convenience sampling method, which, besides being efficient, is economical and easy to implement, especially when applied to a relatively homogeneous sample [16]. Participants were recruited from the student and staff population of King Saud University, Riyadh, Saudi Arabia, through a poster advertisement, and it took three months (September 2019-December 2019) to reach the desired sample size. The study was conducted following the principles outlined in the Helsinki Declaration. The study protocol was approved by King Saud University's Institutional Review Board (Reference #: KSU-SE-18-21). The study objective was explained to all participants, and all participants provided informed written consent. The study adhered to the principle of voluntary participation. The questionnaire was provided to 380 participants, and only five participants did not fill it out. Therefore, the response rate was 98.68%, which is considered an excellent response rate.

Inclusion criteria: Participants between 18 and 40 years of age and who completed the study questionnaire were included in the study.

Exclusion criteria: Presence of any acute disease, emotional incidents, pregnancy, lactation, or the use of drugs such as tranquilisers and psychotropic medications, as well as hospitalisation for any reason within the last six months were excluded from the study.

Sample size estimation: The sample size (375) was calculated to be within 0.05 of the population proportion with a 95% confidence level. The population proportion was assumed to be 0.50 as this proportion provides the most appropriate sample size [17].

Data collection: Data were collected through a self-administered questionnaire consisting of 26 questions delivered in Arabic, as the targeted study participants were native Arabic speakers. Anthropometric measurements were taken following standardised protocols. Height was measured to the nearest 0.1 cm using a portable stadiometer (Marsden HM-250P Leicester Height Measure) while participants stood with their head and knees straight without shoes or headgear. A digital scale (SECA) was used to measure the participant's weight on a firm flat surface, with footwear and heavy items were removed for accurate measurements. Weight was recorded to the nearest 0.1 kg. Body Mass Index (BMI) was calculated using the standard formula (body weight divided by the square of height) and expressed in units of kg/m^2. Body fat (%) was assessed using a Bioelectrical Impedance Analysis (BIA) device (Omron BF 508 body composition monitor). Participants were asked to remove their shoes and socks and keep their mobile phones away from the device. Blood pressure was measured using a sphygmomanometer (OMRON, Japan). Participants were asked to sit comfortably on a chair, relax with an arm stretched on the table and back supported. A Diastolic Blood Pressure (DBP) consistently ≥90 mm Hg and/or a Systolic Blood Pressure (SBP) ≥140 mm Hg were considered abnormal [18].

The questionnaire was designed by members of the research team, and a pilot study (results not reported in the study) involving 16 participants was conducted to confirm the reliability and validity of the questionnaire and to evaluate the participants' understanding. To ensure the validity and reliability of the questionnaire content, the researcher sent it to an expert in the field to provide feedback on the clarity of the questionnaire phrases. After reviewing the phrases and making necessary modifications, the final questionnaire was approved. Each participant was assured that the information provided was for study purposes only and would be kept confidential. Participants were allowed to interrupt or stop the questionnaire at any point without explanation. They were asked to provide consent for participation and completed the questionnaire in the presence of the researcher to facilitate responses to any requests for clarification about the questions. The questionnaire included the following sections:

Socio-demographic characteristics: Data regarding age and education level, was collected.

Dietary pattern: This section was designed to gather information about dietary patterns. It included six questions to assess the number of meals the participant eats per day, whether she eats at a regular time daily, the number of meals eaten outside the home, the time she stops eating (time of the last meal), how many meals she consumes at night (after 9 pm), and how much time passes without eating.

Sleep pattern: Data on sleep patterns were collected through the following questions: 1) Night sleeping hours: "Less than 7h" or "7h and more"; 2) Number of wake-up times during sleep: "None," "1 time," "2 times," or "3 or more"; 3) Time spent trying to sleep: "0-15 minutes," "16-30 minutes," "31-45 minutes," or "46-60 minutes," "60 minutes or more"; 4) Do you need a nap in the middle of the day? "YES", "NO."

Physical activity level: The physical activity level of the participants was assessed using a short version of the International Physical Activity Questionnaire (IPAQ) developed by Craig CL et al., (2003). This short version provided information on the time spent walking, engaging in vigorous- and moderate-intensity physical activity, as well as time spent in sedentary activity [19]. It collected information related to the intensity of physical activity levels (low, moderate, high) [20].

Chronotype: The Morningness-Eveningness Questionnaire (MEQ) is the most widely used tool for identifying chronotypes. The validated Arabic version of the MEQ-short form was used in this study [21]. The total score of the MEQ ranges between 4 and 25. Higher scores (18-25) indicate morning-types (M-types), lower scores (4-11) indicate evening-types (E-types), and intermediate scores (12-17) indicate participants classified as intermediate types (I-types) [21].

STATISTICAL ANALYSIS

Data were analysed using the Statistical Package for the Social Sciences (SPSS 22.0; IBM Corp., New York, NY, USA). Continuous variables were expressed as mean±standard deviation, while categorical variables were expressed as frequency and percentage. T-tests and one-way ANOVA were used for continuous variables, and the Chi-square test was used for categorical variables. A p-value <0.05 was considered statistically significant.

RESULTS

The participants' socio-demographic and anthropometric characteristics are presented in [Table/Fig-1]. The participants had an average age of 23.61±5.87 years, weight of 58.63±12.13 kg, height of 157.74±5.26 cm, and a mean BMI of 23.55±4.68 kg/m^2. The majority of participants reported normal SBP (356, 94.9%)

Parameters	Mean±SD/n (%)
Age (years)[1]	23.61±5.87
Weight (kg)[1]	58.63±12.13
Height (cm)[1]	157.74±5.26
BMI (kg/m^2)[1]	23.55±4.68
Body fat (%)[1]	36.16±8.45
SBP (mmHg)[1]	102.42±12.62
Normal*	356 (94.9)
Abnormal*	19 (5.1)
DBP (mmHg)[1]	73.67±8.83
Normal*	299 (79.7)
Abnormal*	76 (20.3)
Education level	
Bachelor*	349 (93.1)
Postgraduate*	26 (6.9)
Physical activity level	
Low*	157 (41.9)
Moderate*	132 (35.2)
High*	86 (22.9)

[Table/Fig-1]: Characteristics of the study participants (n=375).
[1]Data are presented as *frequency and percentage N (%) and [1]mean±SD
BMI: Body mass index; SBP: Systolic blood pressure; DBP: Diastolic blood pressure

and DBP (299, 79.7%). Most participants (349, 93.1%) held a bachelor's degree. In terms of physical activity level, 157 (41.9%) participants had a low activity level, while 132 (35.2%) and 86 (22.9%) participants were engaged in moderate and high levels of physical activity, respectively.

[Table/Fig-2] illustrates the participants' socio-demographic characteristics in relation to eating at regular times. A total of 197 (52.5%) participants reported consuming their meals at regular times every day, while 178 (47.5%) did not. No significant differences were observed in age, weight, height, BMI, body fat, SBP, and DBP between the two groups.

Parameters	Do you eat your meals at regular times every day[1]		p-value[2]
	No N=178 (47.5%)	Yes N=197 (52.5%)	
Age (years)	23.48±5.84	23.72±5.92	0.697
Weight (kg)	58.91±12.45	58.38±11.86	0.669
Height (cm)	157.59±5.16	157.89±5.35	0.580
BMI (kg/m²)	23.70±4.73	23.41±4.65	0.562
Body fat (%)	36.41±8.38	35.93±8.52	0.580
SBP (mmHg)	103.07±12.64	102.40±10.32	0.569
DBP (mmHg)	74.27±8.91	73.56±7.05	0.388

[Table/Fig-2]: Participants' characteristics relative to eating regularity.
[1]Data are presented as mean±SD. [2]p-value significant <0.05, T-test for independent samples
BMI: Body mass index; SBP: Systolic blood pressure; DBP: Diastolic blood pressure

[Table/Fig-3] shows the participants' dietary and sleep patterns in relation to eating regularity. There was a significant association between eating meals at regular times every day and the number of meals consumed per day (Chi-squared, p-value <0.001). However, no significant associations (p≥0.05) were found between eating meals at regular times every day and other dietary and sleep patterns, such as eating outside the home weekly, time of the last meal, eating a meal after 9 pm, hours between the last meal and the next day's meal, chronotype, night sleeping hours, number of wake-up times during sleep, time spent trying to sleep, and the need for a nap in the middle of the day. Additionally, no significant association (p-value=0.118) was observed between eating meals at regular times every day and physical activity level.

Parameters	Do you eat your meals at regular times every day[1]		p-value[2]
	No N=178 (47.5%)	Yes N=197 (52.5%)	
Meal/day			**0.001**
1 meal	20 (5.3)	4 (1.1)	
2 meals	88 (23.5)	78 (20.8)	
3 meals	59 (15.7)	98 (26.1)	
4 meals	7 (1.9)	10 (2.7)	
5≥	4 (1.1)	7 (1.9)	
Eat outside weekly			0.091
None	20 (5.3)	13 (3.5)	
1-3	133 (35.5)	164 (43.7)	
4-6	21 (5.6)	13 (3.5)	
7≥	4 (1.1)	7 (1.9)	
Time of the last meal			0.106
Before 9 pm	35 (9.3)	50 (13.3)	
At 9 pm	45 (12.0)	60 (16.0)	
After 9 pm	98 (26.1)	87 (23.2)	
Eat meal after 9 pm			0.287
No	35 (9.3)	52 (13.9)	
1 meal	130 (34.7)	137 (36.5)	
2 meals	11 (2.9)	7 (1.9)	
3≥	2 (0.5)	1 (0.3)	
The hours between the last meal and the next day meal			0.498
10 h or less	93 (24.8)	95 (25.3)	
11-16 h	37 (9.9)	53 (14.1)	
17-18 h	12 (3.2)	8 (2.1)	
19-20 h	9 (2.4)	8 (2.1)	
Other	27 (7.2)	33 (8.8)	
Chronotype			0.291
Evening type	40 (10.7)	34 (9.1)	
Intermediate type	91 (24.3)	99 (26.4)	
Morning type	47 (12.5)	64 (17.1)	
Night sleeping hours			0.147
Less than 7 h	134 (35.7)	135 (36.0)	
7 h and more	44 (11.7)	62 (16.5)	
Number of wake-up times during sleep			0.486
Non	45 (12.0)	52 (13.9)	
1 time	55 (14.7)	65 (17.3)	
2 times	36 (9.6)	46 (12.3)	
3≥	42 (11.2)	34 (9.1)	
Spending time trying to sleep			0.722
0-15 m	71 (18.9)	84 (22.4)	
16-30 m	51 (13.6)	63 (16.8)	
31-45 m	29 (7.7)	28 (7.5)	
46-60 m	12 (3.2)	11 (2.9)	
60>	15 (4.0)	11 (2.9)	
Do you need a nap in the middle of the day?			0.574
No	46 (12.3)	56 (14.9)	
Yes	132 (35.2)	141 (37.6)	
Physical activity level			0.118
Low	84 (22.4)	73 (19.5)	
Moderate	59 (15.7)	73 (19.5)	
High	35 (9.3)	51 (13.6)	

[Table/Fig-3]: Dietary and sleep patterns as well as physical activity relative to eating regularity.
[1]Data are expressed as frequency and percentage N (%). [2]p-value significant <0.05, Chi-square test

[Table/Fig-4] presents the participants' characteristics relative to chronotype. Most participants were classified as intermediate type (190, 50.7%), followed by morning type (111, 29.6%), and evening type (74, 19.7%). Significant differences between chronotype groups were only observed in age (p-value=0.017).

Parameter	Chronotype			p-value[2]
	Morning type N=111 (29.6%)	Intermediate type N=190 (50.7%)	Evening type N=74 (19.7%)	
Age (years)	24.93±6.97	23.14±5.27	22.82±5.28	**0.017**
Weight (kg)	59.82±13.72	57.85±10.91	58.84±12.57	0.395
Height (cm)	157.09±5.06	157.89±5.47	158.35±4.95	0.244
BMI (kg/m²)	24.20±5.24	23.21±4.26	23.44±4.82	0.205
Body fat (%)	36.80±9.01	35.89±8.08	35.87±8.56	0.631
SBP (mmHg)	101.58±13.53	102.72±10.56	104.42±10.22	0.257
DBP (mmHg)	72.59±9.29	74.22±7.57	75.02±6.64	0.092

[Table/Fig-4]: Participants' characteristics relative to chronotype.
[1]Data are presented as mean±SD. [2]p-value significant <0.05 tested by one-way ANOVA
BMI: Body mass index; SBP: Systolic blood pressure; DBP: Diastolic blood pressure

Significant associations were found between chronotype and the time of the last meal (p-value=0.001), eating a meal after 9 pm (p-value <0.001), and the need for a nap in the middle of the day (p-value <0.001). However, no significant associations (p-value ≥0.05) were noted between chronotype and other dietary and sleep patterns, as well as physical activity level, as shown in [Table/Fig-5].

Parameter	Chronotype			p-value²
	Evening type N=74 (19.7%)	Intermediate type N=190 (50.7%)	Morning type N=111 (29.6%)	
Meal/day				
1 meal	7 (1.9)	11 (2.9)	24 (6.4)	0.704
2 meals	35 (9.3)	84 (22.4)	166 (44.3)	
3 meals	29 (7.7)	82 (21.9)	157 (41.9)	
4 meals	1 (0.3)	9 (2.4)	17 (4.5)	
≥5	2 (0.5)	4 (1.1)	11 (3)	
Eat outside weekly				
None	6 (1.6)	17 (4.5)	10 (2.7)	0.794
1-3	59 (15.7)	147 (39.2)	91 (24.3)	
4-6	8 (2.1)	18 (4.8)	8 (2.1)	
≥7	1 (0.3)	8 (2.1)	2 (0.5)	
Time of the last meal				
Before 9 pm	11 (2.9)	35 (9.3)	39 (10.4)	**0.001**
At 9 pm	18 (4.8)	55 (14.7)	32 (8.5)	
After 9 pm	45 (12.0)	100 (26.7)	40 (10.7)	
Eat meal after 9 pm				
Non	11 (2.9)	36 (9.6)	40 (10.7)	**0.001**
1 meal	54 (14.4)	149 (39.7)	64 (17.1)	
2 meals	9 (2.4)	2 (0.5)	7 (1.9)	
≥3	0	3 (0.8)	0	
The hours between the last and the next day meal				
10 h or less	38 (10.1)	97 (25.9)	53 (14.1)	0.603
11-16 h	16 (4.3)	47 (12.5)	27 (7.2)	
17+18 h	3 (0.8)	13 (3.5)	4 (1.1)	
19-20 h	6 (1.6)	6 (1.6)	5 (1.3)	
Other	11 (2.9)	27 (7.2)	22 (5.9)	
Do you eat your meals at regular times everyday				
Yes	34 (9.1)	99 (26.4)	64 (17.1)	0.291
No	40 (10.7)	91 (24.3)	47 (12.5)	
Night sleeping hours				
Less than 7 h	60 (16.0)	135 (36.0)	74 (19.7)	0.098
7 h and more	14 (3.7)	55 (14.7)	37 (9.9)	
Number of wake-up times during sleep				
None	21 (5.6)	52 (13.9)	24 (6.4)	0.296
One time	27 (7.2)	51 (13.6)	42 (11.2)	
2 times	11 (2.9)	45 (12.0)	26 (6.9)	
≥3	15 (4.0)	42 (11.2)	19 (5.1)	
Duration spend trying to sleep (minutes)				
0-15	19 (5.1)	85 (22.7)	51 (13.6)	0.143
16-30	27 (7.2)	54 (14.4)	33 (8.8)	
31-45	14 (3.7)	29 (7.7)	14 (3.7)	
46-60	8 (2.1)	8 (2.1)	7 (1.9)	
≥60	6 (1.6)	14 (3.7)	6 (1.6)	
Do you need a nap in the middle of the day				
Yes	64 (17.1)	142 (37.9)	273 (72.8)	**0.001**
No	10 (2.7)	48 (12.8)	102 (27.2)	
Physical activity level				
Low	36 (9.6)	82 (21.9)	39 (10.4)	0.254
Moderate	22 (5.9)	70 (18.7)	40 (10.7)	
High	16 (4.3)	38 (10.1)	32 (8.5)	

[Table/Fig-5]: Dietary and sleep patterns as well as physical activity relative to eating chronotype.
¹Data are expressed as frequency and percentage N (%). ²p-value significant <0.05, Chi-square test

DISCUSSION

This study aimed to examine the associations of meal irregularity and chronotypes with dietary and sleep patterns among female adults.

A significant association was observed between eating meals at regular times every day and the number of meals per day. Zerón-Rugerio MF et al., shed light on the significance of eating frequency as a potential zeitgeber for the circadian system [22]. Mealtime is essential for entraining circadian rhythms, particularly the peripheral circadian clocks [23]. Adverse health consequences have been associated with irregular meal timing, including obesity, blood sugar levels, cholesterol, and blood pressure [24]. Wehrens SMT et al., have suggested that a 5-hour delay in mealtimes can lead to a comparable delay in the phase of circadian rhythms, and late eating can also disrupt the daily rhythm of salivary microbiota diversity [25].

In this study, almost half of the participants (197, 52.5%) reported that they eat their meals at regular times every day, but 135 (36%) of them sleep less than seven hours. Additionally, 178 (47.5%) reported not having meals at regular times every day, and 134 (35.7%) among them also sleep less than seven hours. Knutson KL and Van Cauter E linked sleep disorders with increased hunger, reduced lipid and glucose metabolism, and changes in the hormonal signals responsible for regulating food intake [26]. Arakawa M et al., noted that delayed bedtime is associated with less sleep, daytime sleepiness, increased sleepiness, and unhealthy dietary habits in junior high school students [27]. In a National Diet and Nutrition Survey (NDNS) study in the UK population, the prevalence of sleeping less than seven hours in individuals aged 19 to 64 years was 34% [28], and a similar percentage (36%) has been reported in the USA among adults aged 20 years or older who sleep six hours or less on weekdays or workdays [29].

Individuals with irregular meal times also had a higher risk of poorer overall sleep quality, longer sleep latency, and shorter sleep duration compared with those who did not have irregular meal times [30]. Imaki M et al., in a study on male Japanese workers aged between 20 and 59 years, reported a significant association of short sleep duration (<6 hours/day) with irregular meal patterns [31]. Among Iranians, sleep quality has been found to be associated with breakfast frequency, bedtime, and dinner time [32]. In this study, an insignificant association was observed between sleep duration and sleep quality with irregular meal patterns. Theorell-Haglöw J et al., reported that both long and short sleep durations with poor sleep quality were related to irregular meal patterns [33].

Most of the participants in this study (267, 71.2%) reported that they eat atleast one meal after 9 pm. As a result of a late evening meal, glucose metabolism may be disrupted, leading to obesity with higher postprandial glucose levels [34] and also affecting serotonin levels. Serotonin levels are highly sensitive to nutrients depending on the timing of macronutrient consumption [35]. A deficiency in sleep negatively impacts brain mechanisms involved in food selection, leading to the selection of foods likely to cause weight gain, which in turn supports the association between short sleep durations and metabolic effects [36].

Insignificant differences (p-value ≥0.05) in anthropometric variables were found between the chronotype categories, except for age. A previous study examined chronotypes and their association with obesity-related lifestyle behaviours among young female adults and reported that chronotype was not associated with anthropometry [3]. In different regions, with individuals of different ages, genders, and sample sizes, researchers have found inconsistent results when examining the association between chronotypes and BMI scores. However, in this study, a significant difference in age was reported between the chronotype categories (p-value=0.017). Almoosawi S et al., have also shown that age plays a role in influencing chronotypes [37]. Al Abdullatif RA et al., conducted studies among young adult Saudis and reported that most of the study samples were of the intermediate type, which was consistent with the results obtained in this study [3]. Studies conducted on some Western populations have also reported similar findings [38].

The results of the current study showed a significant (p-value <0.001) association between chronotype and the need for a nap in the middle of the day. The frequency of participants classified as M-type who required a nap in the middle of the day was higher compared to the I-type and E-type groups. Similar to this study, Al Abdullatif RA et al., studied chronotypes and their association with obesity-related lifestyle behaviours among young female adults, and Upadhyay D et al., studied the association between daytime sleepiness and chronotype for undergraduate medical and paramedical students, both reporting a statistically significant association between chronotype and daytime sleepiness. In contrast, Rique GLN et al., did not report any significant association between chronotype and daytime sleepiness [3,39,40]. Therefore, chronotype and sleep may have an effect on the timing and content of meal intake, thereby impacting meal regularity.

In this study, a significant association was observed between the time of the last meal and chronotypes. It was noted that 100 (26.7%) I-type individuals, followed by 45 (12%) E-type and 40 (10.7%) M-type individuals, ate their meal after 9 pm. Various studies [12,41] have reported that evening-type individuals had significantly later meal timings compared to morning-types. Additionally, it was observed that 9 (2.4%) E-types, followed by 7 (1.9%) M-types and 2 (0.5%) I-types, ate two meals after 9 pm. Lucassen EA et al., also observed a significant association between chronotype and night eating, where Evening-type individuals were found to be linked to the intake of more calories after 8:00 pm [41]. Being a diurnal creature, human bodies are designed to be active during the day, resting and fasting at night. A person's intake of food during the day provides the body with substrates to support metabolic processes, while at night, the body maintains metabolic homeostasis by utilising stored energy and substrates. Therefore, food consumption during the rest phase violates our internal clock rhythm and contributes to various diseases [42].

Limitation(s)

Interpreting the results of the current study requires consideration of some limitations. The cross-sectional design did not allow for drawing any directionality in the relationships. Furthermore, there is a possibility that memory biases and reporting biases affected the data to some extent, but it is extremely difficult to determine the extent of these biases.

CONCLUSION(S)

This study provides an insight into the relationship between eating regularity and chronotypes with diet and sleep. Overall, this study suggests that the regular timing of eating is associated with the number of meals per day. Furthermore, chronotype is associated with dietary and sleep patterns, including the time of the last meal, eating meals after 9 pm, and the need for a nap in the middle of the day. Future larger cohort studies involving both males and females of different ages are recommended.

Authors contribution: MAH: Acquisition of data, contribution to conception, design, interpretation of data, review and edit the manuscript; FA: Contribution in data analysis and interpretation; MAB: Contribution to conception reviewing the manuscript; SA: Contribution in study validation and writing the initial manuscript. All authors critically read and approved the final version of the manuscript.

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