E-B Environment - Behaviour Proceedings Journal

AcE-Bs2026Kuching

e-IPH e-International Publishing House Ltd., United Kingdom

https://www.amerabra.org/

14th Asian Conference on Environment-Behaviour Studies.

Damai Beach Resort, Kuching, Malaysia, 27-28 Mar 2026

Chronotype and Chrononutrition Behaviours of Adults with Coronary Artery Disease

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Abstract

Coronary artery disease (CAD) is a significant public health concern that is caused not only by underlying biological pathology but also by behavioural and environmental factors. Although the progression of CAD is not directly determined by chronotype and chrononutrition, these factors may influence behavioural and metabolic pathways linked with cardiovascular risk. This study aimed to examine the chronotype and chrononutrition behaviours of adults with CAD. A cross-sectional study was conducted among 259 subjects from an inpatient ward in a hospital in Selangor, Malaysia. Chronotype distribution was nearly balanced, with a predominance of morning chronotypes. Poor chrononutrition behaviours were commonly observed. Therefore, understanding the chronotype and chrononutrition behaviours may help to develop intervention strategies in planning secondary management for CAD.

Keywords: Chronotype; Chrononutrition; Coronary artery disease; Eating behaviour

DOI: https://doi.org/10.21834/e-bpj.v11i36.7780

1.0 Introduction

Coronary artery disease (CAD) is a common cardiac condition characterised by narrowing or blockage of the major coronary arteries (Frąk et al., 2022). It is recognised as a complex, multifactorial condition resulting from the interaction of genetic predisposition and numerous environmental determinants (Fedele et al., 2017). CAD is a significant public health concern that is caused not only by underlying biological pathology but also by behavioural and environmental factors. In Malaysia, over half a million adults or 2.5% of the population suffer from four non-communicable diseases, such as diabetes, hypertension, hypercholesterolemia, and obesity, which are the major risk factors for cardiovascular disease. Among these, 33.3% of adults in Malaysia have high cholesterol, which is equal to about 7.6 million adults (Institute for Public Health, 2023). According to a recent Ministry of Health Malaysia report, out of the ten leading causes of death, cardiovascular disorders and other circulatory diseases ranked first, which contributed to 21.49% of mortality in government hospitals (Ministry of Health Malaysia, 2024). Building upon this context, it is important to consider other behavioural and lifestyle factors that may influence cardiovascular risk.

Although the progression of CAD is not directly determined by chronotype and chrononutrition, these factors may influence behavioural and metabolic pathways linked with cardiovascular risk. Understanding chronotype and chrononutrition behaviours of this population is therefore important as it could help identify behavioural and lifestyle changes to support secondary management of coronary artery disease. This approach may improve metabolic control, enhance treatment adherence, and ultimately reduce the risk of disease progression and recurrent cardiovascular events. Hence, this study aimed to explore chronotype and chrononutrition behaviours of adults with coronary artery disease.

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DOI: https://doi.org/10.21834/e-bpj.v11i36.7780

2.0 Literature Review

2.1 Chronotype

Chronotype is a circadian phase marker, also referred to as circadian preference, and indicates a person's favoured time of day for an activity-rest cycle (Mazri et al., 2019). Morning chronotype refers to early risers or people who prefer to be active in the morning, while evening chronotype refers to late risers who prefer to engage in nighttime activities. Chronotype is influenced not only by circadian rhythms and the light-dark cycle, but also by societal and work schedules, and personal choices (Roenneberg et al., 2019). These preferences are expressed in daily behaviours, especially eating timing, which is frequently influenced or assisted by work schedules, family routines, and the surrounding food environment. Individuals differ considerably in their sleep timing (chronotype) and preferences (morningness-eveningness), which are linked to numerous important behavioural implications (Rahafar et al., 2018). Prior studies had shown that an evening chronotype was associated with increased cardiovascular risk (Frisk et al., 2022; Coşkun et al., 2025). Furthermore, it has been suggested that evening chronotypes may develop physiological and behavioural risk factors due to chronic misalignment between their internal biological timing and the external demands of work and social schedules, making them more vulnerable to cardiovascular disease (Roenneberg & Merrow, 2016).

2.2 Chrononutrition Behaviours

Chrononutrition is an emerging behavioural concept that examines the synchronisation of the timing of food intake with the circadian rhythms that help regulate nutrition-related metabolic processes (Flanagan et al., 2021). The master circadian clock in the SCN controls the endocrine response to nutrient intake (Pickel & Sung, 2020). Although light exposure is the main zeitgeber, food intake also plays a role in entraining the circadian system and studies confirm that metabolic health is influenced by a confluence of dietary factors, which include the quantity and quality of food, along with its timing, regularity, and the distribution of energy across both a 24-hour day and multiple days (Katsi et al., 2022). This framework highlights how temporal eating patterns interact with circadian rhythms to influence metabolic health, and it can clarify the impact of meal timing on health preservation and chronic disease risk (Flanagan et al., 2021; Katsi et al., 2022). Due to circadian differences in energy intake and utilisation, the same meal eaten at different times of day may result in different responses (Stenvers et al., 2019). Eating at irregular times can therefore lead to abnormal metabolic regulation that increases the risk of cardiometabolic disorders, including type 2 diabetes, obesity, and eventually cardiovascular disease (Chellappa et al., 2019; Mason et al., 2020). Evidence suggested that consuming a greater proportion of daily energy earlier in the day and reducing late-night eating may improve glycaemic control and lipid profiles. For example, moving dinner from 21:00 to 18:00 has been shown to lower 24-hour blood sugar levels and enhance lipid oxidation the next morning (Nakamura et al., 2021). Although these approaches demonstrate promising benefits, their implementation into normal clinical practice for CAD patients remains limited, highlighting the need for further research across diverse populations, including those in Malaysia.

3.0 Methodology

3.1 Study designs and participants

This cross-sectional study was conducted from March 2023 to March 2024 at the inpatient wards of the cardiology department in a hospital in Selangor, Malaysia. Participants were recruited through convenience sampling. Inclusion criteria were adults with a confirmed diagnosis of coronary artery disease, aged 20 to 76 years. Exclusion criteria included shift workers due to potential disturbances of normal environmental and circadian cues.

3.2 Study procedures

Before the commencement of data collection, ethical approval was obtained from the UiTM Research Ethics Committee (REC/02/2023 (ST/MR/46)). Subjects were screened through medical records for eligibility based on the inclusion and exclusion criteria. Before recruitment into the study, informed consent was obtained from all eligible subjects. Participants self-administered the questionnaires under the supervision of the researcher. For participants who were unable to complete the questionnaire independently, a face-to-face, structured interview was conducted to support data collection.

3.3 Instruments

Consented subjects were given a set of printed questionnaires that consisted of four sections, which were sociodemographic characteristics, self-reported anthropometry, chronotype, and chrononutrition behaviours. Chronotype was assessed using the Modified Munich Chronotype Questionnaire for short-interval split-sleep in non-shift workers (MCTQ-split sleep), and chrononutrition behaviours were measured using the Chrononutrition Profile Questionnaire (CP-Q). The questionnaire was available in both Malay and English.

3.4 Data analysis

Descriptive statistics were used to summarise sociodemographic characteristics, chronotype categories, and chrononutrition behaviours, with quantitative variables presented as means and standard deviations and qualitative variables reported as frequencies and percentages. Results were presented to illustrate prevailing behavioural patterns rather than causal relationships. Analyses were conducted using IBM SPSS (Statistical Package for Social Science) version 27.0.

4.0 Findings

Table 1 shows the sociodemographic and characteristics of participants according to chronotype. A total of 259 adults with CAD participated in the study, comprising 194 (74.9%) males and 65 (25.1%) females. The mean age of the participants was 59.01 ± 9.408, which suggests that the participants were middle-aged to older adults. The distribution of chronotypes showed that 133 participants (51.4%) had morning chronotypes and 126 (48.6%) had evening chronotypes. More than half (53%) of male participants were evening chronotypes. In contrast, the majority (64.6%) of the female participants were morning chronotypes. When examined by age, morning chronotype individuals were older, with a mean age of 61.40 ± 9.078, while evening chronotype individuals were younger, with a mean age of 56.48 ± 9.120. The employment status of the participants showed that 39.8% were employed, 35.9% were retired, 17.0% were unemployed, and 7.3% were housewives or househusbands. When stratified by chronotype, the majority (60.2%) of working participants were evening chronotypes, while the proportions of unemployed individuals, and housewives or househusbands were relatively similar across chronotype groups. Based on the WHO body mass index classification, a large number of participants reported excess body weight, where 39.8% were overweight, and 29.3% were obese. Normal BMI was observed in almost one-third (30.1%) of participants, while underweight BMI was observed in only a small proportion (0.8%). However, BMI classifications were comparable between morning and evening chronotypes.

Table 1. Demographic and characteristics of participants according to chronotype

Characteristics	Total (N=259)	Chronotype	
		Morning (n=133)	Evening (n=126)
Age[a]	59.01 ± 9.408	61.40 ± 9.078	56.48 ± 9.120
Gender			
Male	194 (74.9%)	91 (47%)	103 (53%)
Female	65 (25.1%)	42 (64.6%)	23 (35.4%)
Ethnicity			
Malay	220 (84.9%)	113 (51.4%)	107 (48.6%)
Chinese	9 (3.5%)	6 (66.7%)	3 (33.3%)
Indian	27 (10.4%)	13 (48.1%)	14 (51.9%)
Others	3 (1.2%)	1 (33.3%)	2 (66.7%)
Marital status			
Single	8 (3.1%)	3 (37.5%)	5 (62.5%)
Married	225 (86.9%)	113 (50.2%)	112 (49.8%)
Divorced	26 (10.0%)	17 (65.4%)	9 (34.6%)
Working status			
Working	103 (39.8%)	41 (39.8%)	62 (60.2%)
Retired	93 (35.9%)	59 (63.4%)	34 (36.6%)
Unemployed	44 (17.0%)	24 (54.5%)	20 (45.5%)
Housewife/husbehusband	19 (7.3%)	9 (47.4%)	10 (52.6%)
Smoking history			
Never	151 (58.3%)	90 (60%)	61 (40%)
Quit smoking	50 (19.3%)	26 (52%)	24 (48%)
Currently smoking	58 (22.4%)	17 (29%)	41 (71%)
Hypertension			
No	33 (12.7%)	11 (33.3%)	22 (66.7%)
Yes	226 (87.3%)	122 (54%)	104 (46%)
Dyslipidaemia			
No	56 (21.6%)	25 (44.6%)	31 (55.4%)
Yes	203 (78.4%)	108 (53.2%)	95 (46.8%)
Diabetes mellitus			
No	101 (39.0%)	49 (48.5%)	52 (51.5%)
Yes	158 (61.0%)	84 (53.2%)	74 (46.8%)
BMI WHO			
Underweight	2 (0.8%)	1 (50%)	1 (50%)
Normal	78 (30.1%)	37 (47.4%)	41 (52.6%)
Overweight	103 (39.8%)	52 (50.5%)	51 (49.5%)
Obese	76 (29.3%)	43 (56.6%)	33 (43.4%)

Table 2 shows six different chrononutrition behaviours across morning and evening chronotypes. The majority (70.3%) of participants reported poor/fair evening eating, while less than one-third (29.7%) reported good evening eating. Poor/fair evening eating was higher among evening chronotype (n=102) compared to morning chronotype (n=80), whereas good evening eating was higher among morning chronotype (n=53) compared to evening chronotypes (n=24). Evening latency patterns were largely unfavourable for the majority of participants in both chronotype groups, with almost all (96.9%) classified as having poor/fair evening latency. More than half (57.9%) of participants exhibited poor/fair eating window patterns. Morning chronotype individuals showed a slightly higher proportion of good eating window behaviour (n=59) than evening chronotype individuals (n=50). However, the poor or fair eating window remained consistent across both chronotype groups. The majority (90.3%) of participants reported good breakfast skipping behaviours, while the majority (89.6%) of participants reported poor/fair largest meal timing. The overall patterns observed for the largest meal across morning and evening chronotypes were similar. Conversely, good night eating behaviour was predominant, which was reported by 94% of participants, but it was consistent across chronotype groups.

Table 2. Chrononutrition Behaviours by chronotype

Chrononutrition Behaviours	Total (N=259)	Chronotype	
		Morning (n=133)	Evening (n=126)
Evening eating			
Good (<20:00)	77 (29.7%)	53 (68.8%)	24 (31.2%)
Poor/fair (≥20:00)	182 (70.3%)	80 (44.0%)	102 (66.0%)
Evening latency			
Good (>6:00)	8 (3.1%)	3 (37.5%)	5 (62.5%)
Poor/fair (≤6:00)	251 (96.9%)	130 (51.8%)	121 (48.2%)
Eating window			
Good (≤12:00)	109 (42.1%)	59 (54.1%)	50 (45.9%)
Poor/fair (>12:00)	150 (57.9%)	74 (49.3%)	76 (50.7%)
Breakfast skipping			
Good (1 day/week or less)	234 (90.3%)	124 (53.0%)	110 (47.0%)
Poor/fair (≥2 days/week)	25 (9.7%)	9 (36.0%)	16 (64.0%)
Largest meal			
Good (Breakfast)	27 (10.4%)	13 (48.1%)	14 (51.9%)
Poor/fair (Lunch/Dinner/Supper)	232 (89.6%)	120 (51.7%)	112 (48.3%)
Night eating			
Good (≥2 days/week)	244 (94.2%)	125 (51.2%)	119 (48.8%)
Poor/fair (1 day/week or less)	15 (5.8%)	8 (53.33%)	7 (46.7%)

5.0 Discussion

5.1 Chronotype

This study provides a descriptive overview of chronotype and chrononutrition behaviours of adults with coronary artery disease (CAD). The findings indicate a nearly balanced distribution of chronotypes, with a slight predominance of morning chronotypes. This relatively even distribution suggests that circadian preference in CAD patients may not strongly favour one chronotype over the other.

The distribution of chronotype among male participants was slightly higher in the evening chronotype group than in the morning chronotype group, and, conversely, female participants predominantly exhibited morning chronotypes. These findings reflect sex-related variations in the chronotype of adults with coronary artery disease. Similarly, previous studies suggest that evening chronotypes were more common among male adults, while morning chronotypes were more common among female adults, although this sex difference diminishes with advancing age, as older adults tend to have earlier wake-up times (Didikoglu et al., 2019; Randler & Engelke, 2019).

The age of participants in this study indicates that different life stages lead to chronotype variation, as morning chronotype was reported to be older and evening chronotype was younger. This age-related pattern reflects that older participants preferred earlier daily activities, whereas younger participants preferred later ones. The age-related shifts in circadian preference are often driven by earlier sleep-wake schedules in older individuals or by occupational demands and social timing among younger adults. This age-related finding was supported by previous studies reporting age-related changes in chronotype in adults (Didikoglu et al., 2019; Druiven et al., 2021), with a tendency toward eveningness during adolescence and early adulthood, followed by a gradual shift toward morningness with ageing.

In addition, working status appeared to coincide with chronotype patterns, where working individuals were more common among evening chronotypes, while retired individuals were largely morning chronotypes. This finding could imply that variations in chronotype could be due to work schedules and daily occupational routines, as prolonged working hours may lead to later activity and eating times. Besides, most of modern society lives in an environment where zeitgebers have weakened, with reduced natural light exposure during the day and excess artificial light at night, which exacerbate interindividual differences in chronotype (Roenneberg et al., 2022).

The body mass index distribution in this study shows a high prevalence of excess body weight in people with coronary artery disease, with most participants categorised as overweight or obese. This pattern was observed in both morning and evening chronotypes, which reflects that elevated body weight is a common characteristic in this clinical population, regardless of daily activity timing preference. This finding suggests that chronotype might not be the primary determinant of body mass index in this population, but instead other factors, such as lifestyle and environmental factors.

5.2 Chrononutrition behaviours

Participants showed a combination of good and poor chrononutrition behaviours, reflecting variability in daily eating behaviours among CAD patients. Majority of the participants had poor/fair evening eating, poor/fair evening latency, poor/fair eating window and poor/fair largest meal which shows that they usually have their last eating event of the day after 8:00 p.m., duration of first and last eating event spans more than 12 hours, duration of dinner to sleep onset less than 6 hours, and had their largest meal of the day later in the day either during lunch, dinner or supper. These findings show that CAD patients had a bad eating behaviour with a tendency towards delayed eating patterns, which may exacerbate the progression of the disease. Emerging data emphasise the importance of mealtimes in regulating metabolic processes and the close relationship between mealtimes and the biological clock (BaHammam & Almeneessier, 2020). Adverse temporal eating patterns, which are characterized by delayed and irregular eating timing, can cause desynchronisation of peripheral clocks and central clocks that leads to circadian misalignment (Ruddick-Collins et al., 2020), thereby increasing the risk of metabolic disorders (Almeneessier et al., 2018). Conversely, most of the participants had a good night eating behaviour, which indicates

that the frequency of waking up in the night to eat rarely occurs, or only happens for one day or fewer per week. Additionally, breakfast skipping was generally uncommon in the study population. Most participants had good breakfast skipping behaviour, indicating that they frequently take breakfast and skip it for only 1 day or fewer per week. These findings suggest that the participants had a relatively stable nocturnal routine and morning eating practices.

Overall, chrononutrition behaviours showed slight differences between morning and evening chronotypes, suggesting similar behavioural patterns across chronotype groups, except for evening eating. Evening latency and the largest meal appeared predominantly poor across both chronotypes, while the eating window showed only minor differences across chronotypes. Night eating and breakfast skipping are predominantly good in both chronotype groups, with only minor differences. Meanwhile, evening eating reported some differences between morning and evening chronotypes. A contrasting pattern was observed, whereby a large number of those with good evening eating were morning chronotypes, whereas poor/fair evening eating was higher among evening chronotypes. This pattern illustrates the variations in daily behaviour among people with different chronotypes. As such, morning chronotypes were more likely to take their last meal earlier in the day, which corresponds to earlier sleep-wake cycles, whereas evening chronotypes may have delayed meal timing, potentially influenced by environmental and social factors. Consistently, previous research has shown that people with an evening chronotype eat their meals substantially later than those with a morning chronotype (Nimitphong et al., 2018; Ruiz-Lozano et al., 2016). These findings are clinically relevant, as emerging evidence suggests that avoiding late-night meals and adhering to early eating schedules resulted in significant improvements in HDL-C and triglyceride levels (Yu et al., 2023), suggesting that chrononutrition could be a feasible approach for managing lipids and CAD progression.

6.0 Conclusion and Recommendation

This study provides descriptive insights into chronotype and chrononutrition behaviours in a clinical population, specifically CAD patients. In summary, morning and evening chronotypes were both commonly observed among adults with coronary artery disease. Evening chronotype was more prevalent among males, younger participants, and active workers. Meanwhile, morning chronotype was more common among females, older participants, and retirees. Chrononutrition behaviours showed mixed patterns, with poor/fair patterns observed for evening eating, evening latency, largest meal timing, and eating window, while good patterns were observed for night eating and breakfast skipping behaviours. Similar chrononutrition behaviour patterns across chronotypes were observed, except for evening eating. Overall, the findings highlight that adults with coronary artery disease have a distinct chronotype distribution and diverse chrononutrition behaviours.

This study has several limitations. Participants were recruited from a single tertiary care facility, which may limit the external validity of the findings. As a result, the findings may not be fully representative of all CAD patients in Malaysia, particularly those from various geographic regions, healthcare settings, or sociodemographic backgrounds. Chrononutrition behaviours were measured using self-reported measures, which may be prone to recall and social desirability biases. As participants were required to report past eating patterns, inaccuracies in memory or misreporting may have occurred. Consequently, the reported meal timing behaviours may not accurately reflect long-term habitual dietary behaviours. Based on our findings, future research should incorporate real-time dietary and sleep assessment methods to overcome recall bias and improve the accuracy of dietary and sleep pattern assessments. Beyond these recommendations, new directions could explore the relationship between chronotype and chrononutrition behaviours to examine how different chronotypes influence chrononutrition behaviours.

Acknowledgements

This research article was financially supported by Universiti Teknologi MARA and the Institute of Postgraduate Studies (IPSIS), UiTM. The authors also gratefully acknowledge the Ministry of Higher Education (MoHE) Malaysia for providing the FRGS grant (FRGS/1/2021/SKK06/UITM/03/3). The authors wish to convey their appreciation to all parties involved in this study.

Paper Contribution to the Related Field of Study

This study contributes to the growing field of chrononutrition research by providing descriptive data on chronotype and temporal eating behaviours among adults with coronary artery disease in Malaysia. To our knowledge, limited studies have examined circadian preference and chrononutrition patterns within a clinical cardiovascular population. The findings offer baseline evidence that may inform future analytical and interventional studies targeting circadian-aligned dietary strategies in CAD patients.

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