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# Chronotype and Chrononutrition Behaviours of Adults with Coronary Artery Disease

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**Abstract**

This study offers insights into an individual's circadian preference and the temporal eating behaviour that comprises six selected chrononutrition behaviours. This study aimed to explore the chronotype and chrononutrition behaviours of adults with coronary artery disease. The findings suggest that adults with CAD had a nearly balanced chronotype distribution with a slight predominance of morning chronotypes, and diverse chrononutrition behaviours, with a predominance of poor behaviours. The findings highlight that chronotype and chrononutrition behaviours could be important factors to consider in planning secondary management strategies for CAD.

Keywords: Chronotype; Chrononutrition; Coronary Artery Disease; Eating behaviour


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## 1.0 Introduction

Coronary artery disease (CAD) is a common cardiac condition characterised by the narrowing or blockage of major blood vessels (Frąk et al., 2022). CAD has a diverse aetiology and is primarily recognised as a complex, multifactorial condition resulting from the interaction of genetic predisposition and numerous environmental determinants (Fedele et al., 2017). It is a significant public health concern that is caused not only by underlying biological pathology but also by behavioural and environmental factors. In Malaysia, more than half a million adults or 2.5% of the population suffer from four non-communicable diseases, such as diabetes, hypertension, high cholesterol, and obesity, which are significant 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). It is known that the progression of CAD is not directly affected by chronotype and chrononutrition. However, chronotype and chrononutrition may influence behavioural and metabolic pathways that are associated with cardiovascular risk. Thus, understanding the chronotype of CAD patients can help in contextualising individual circadian preferences, and describing temporal eating patterns may help identify potential behavioural risk patterns and areas for targeted intervention, thereby providing baseline insight for future research and clinical strategies.


DOI:

## 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 (Fabbian et al., 2016). Chronotype is influenced not only by circadian rhythms and the light-dark cycle, but also by societal and work schedules, and personal choices (Czeisler & Buxton, 2017; 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 timings (chronotype) and preferences (morningness-eveningness), which are linked with 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 internal physiological timing and externally imposed timing of work and social activities, making them more vulnerable to develop 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), and it focuses not only on what is eaten but also when it is taken (Pot et al., 2016). Moreover, it investigates the health impact of three different dimensions of feeding behaviour, which are regularity of meals, frequency and timing of food intake (Codoñer-Franch et al., 2023), and addresses the complex relationship between temporal eating patterns, circadian rhythms and metabolic health, to clarify the impact of meal timing on health preservation and chronic disease risk (Flanagan et al., 2021; Katsi et al., 2022). Although light exposure is the predominant zeitgeber, food intake also serves to entrain the circadian system and study confirms 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 the 24-hour day and multiple days (Almoosawi et al., 2019; Katsi et al., 2022). Although chrononutrition has attracted significant interest, descriptive data in clinical populations, especially among adults with CAD, remain limited. Understanding the chronotype and eating-time behaviours of this population is important for determining behaviour and lifestyle-based changes to provide secondary management of coronary artery disease. Therefore, this study aimed to explore chronotype-related patterns of chrononutrition behaviours among adults with coronary artery disease.

## 3.0 Methodology

*3.1 Study designs and participants*

This study employed a cross-sectional design to explore chronotype-related patterns of chrononutrition behaviours among adults with coronary artery disease. A total of 259 adults with a confirmed diagnosis of coronary artery disease, aged between 20 to 76 years old, were recruited from the inpatient ward through convenience sampling. Individuals working shifts were excluded due to potential disturbance 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 subjects involved. Participants were required to self-administer 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 assist with data collection.

*3.3 Instruments*

Chronotype was assessed using the Modified Munich Chronotype Questionnaire for short-interval split-sleep in non-shift workers (MCTQ-split sleep), which evaluates sleep-wake timing on workdays and free days. Chrononutrition behaviours were measured using the Chrononutrition Profile Questionnaire (CP-Q). The instrument captures behavioural aspects of eating timing, including the largest meal, evening eating, evening latency, eating window, night eating, and breakfast skipping.

*3.4 Data analysis*

Descriptive statistics were used to summarise socio-demographic characteristics, chronotype categories, and chrononutrition behaviours. 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 socio-demographic 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/husehusband | 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 inversely 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 common among male adults, while morning chronotypes were more common among female adults, although this sex difference diminishes with advancing age because older adults are associated with early wake-up timing (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, the majority of modern society lives in an environment where zeitgebers have grown weak, with reduced natural light exposure during the day and excess artificial light at night, which exacerbate interindividual chronotype differences (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 emphasize the importance of mealtimes in regulating metabolic processes and how closely they relate to 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; St-Onge et al., 2017). Meanwhile, the majority 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. The majority of 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 in this clinical population, 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 variances in the daily behaviour of 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 due to various environmental factors. Consistent with previous research that revealed that people with the evening chronotype eat their meals substantially later than people with the morning chronotype (Nimitphong et al., 2018; Ruiz-Lozano et al., 2016).

## 6.0 Conclusion and Recommendation

This study provides insight into chronotype and chrononutrition behaviours among adults with coronary artery disease. Morning and evening chronotypes were both commonly observed among adults with coronary artery disease, with evening chronotype more prevalent among males, older participants, and active workers, while morning chronotype is more common among females, younger participants, and retirees. There was a high prevalence of excess body weight among participants regardless of chronotypes. 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. This study provides descriptive insights into chronotype and chrononutrition behaviours in a clinical population, specifically CAD patients. The findings emphasise that chronotype and chrononutrition behaviours are important factors to consider in planning secondary management strategies for coronary artery disease (CAD). However, the cross-sectional design adopted limits causal interpretation, and the behavioural data were self-reported, which may lead to recall bias. Overall, the findings highlight that adults with coronary artery disease have a distinct chronotype distribution and diverse chrononutrition behaviours.

## Limitations

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 socio-demographic 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 precisely reflect long-term habitual dietary behaviours.

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## Paper Contribution to 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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