

Research Article

Association of Sociodemographic Characteristics, Physical Activity Level, Health Status, and Chrononutrition Characteristics with Nutritional Status Among Female Administrative Staff of District Health Offices in Perak, Malaysia

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Article History:

Received 15-07-2025

Revised 17-10-2025

Accepted 17-11-2025

Published 31-03-2026

Keywords:

eating misalignment,
inactivity, obesity, sitting,
weight status

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ABSTRACT

This study aimed to determine the sociodemographic, physical activity, health status, and chrononutrition factors associated with weight status among female administrative staff of district health offices. A cross-sectional study was conducted among 186 female administrative staff, selected using a cluster random sampling method. Weight and height were objectively measured and participants completed a self-administered online questionnaire comprising three sections: sociodemographic information, the Global Physical Activity Questionnaire (GPAQ-M), and the Chrononutrition Profile Questionnaire (Malay-CPQ). Based on international classifications, 39.8% of participants were overweight and 31.2% were obese. Most participants were aged 40–49 years (41.9%), of Malay ethnicity (91.4%), married (78.5%), had at least post-secondary education (47.8%), reported an individual income between RM2,000/USD220 and RM4,000/USD440 (82.3%). Self-reported health conditions indicated that 10.8% had diabetes, 16.1% had hypertension, and 14.0% had hypercholesterolemia. The majority of participants reported low physical activity (57.0%), and nearly half (47.8%) spent more than eight hours daily sitting or reclining. In this study, 18.9% of participants exhibited eating misalignment, while 17.7% experienced sleep misalignment. Multiple logistic regression analysis showed that individuals with hypertension were more likely to be overweight or obese (OR=4.33, 95% CI: 1.22–15.39, $p=0.023$). Similarly, having the last meal between 20:01 and 21:00 was significantly associated with a higher likelihood of overweight or obesity (OR=4.04, 95% CI: 1.39–11.70, $p=0.010$). In contrast, Malay ethnicity was associated with a lower likelihood of overweight or obesity (OR=0.09, 95% CI: 0.12–0.75, $p=0.026$). The prevalence of overweight and obesity among administrative staff in this study exceeded the national average. These findings highlight the need for workplace interventions that not only promote physical activity to reduce sedentary behaviour but also incorporate chrononutrition considerations into existing workplace health policies and programmes.

INTRODUCTION

In Malaysia, the burden of overweight and obesity continues to be high and increasing. Data for the National Health & Morbidity Survey (NHMS) 2023 reveal that overweight (32.6%)

and obesity (21.8%) characterized nearly half of adult (54.4%). Malaysian people according to an NHMS 2019 data (Institute for Public Health (IPH) 2023). This has increased public health concerns, especially in a country that experiences the dual burden of malnutrition

and increasing NCD prevalence. Thus, effective prevention strategies to mitigate obesity are critical to minimize its life-long health impacts and economic burden.

Chrononutrition is new, integrated with chronobiology and nutritional science, and explores how eating behaviors align with the body's circadian rhythms and how this aligns with metabolic regulation, body weight, disease risk, and risk factors. From this viewpoint, dietary health is influenced by food types and quantities but also by the timing of food consumption (Tahara *et al.* 2023). Meta-analysis of 45 studies reported that breakfast skipping was linked to an increased risk of overweight and obesity, particularly abdominal obesity (Ma *et al.* 2020). Longitudinal data from Japan also indicate that eating behaviors late in the evening (such as consuming dinner shortly before sleep or snacking late at night) are associated with increasing Body Mass Index (BMI) and risk of dyslipidaemia, metabolic syndrome, and abdominal obesity (Yoshida *et al.* 2018). Other studies have also identified consistent patterns in Japanese women between late dinner consumption and bedtime snacking with missing breakfast, and obesity and overweight status (Okada *et al.* 2019). Taken together, these results are consistent with chrononutrition recommendations that recommend energy and carbohydrate intake as early as possible in the day, and minimize late-night eating to support metabolic health and weight management (Tahara *et al.* 2023).

Within this context, female administrative personnel are an important population for study. In Malaysia, the overweight and obesity burden among women is consistently higher than that among men (IPH 2023). Moreover, administration (which involves sitting for long hours) is associated with high sedentary time and a lack of regular activities, which can all make people more susceptible to weight gain (Bailey, 2021; Suhaimi *et al.* 2021). In NHMS 2020, the greatest prevalence of physical inactivity that was recorded in Malaysia was the case for Perak (41.6%) (IPH 2020), a status mirrored in a study among primary health workers in the same state where there was 45.6 per cent physical inactivity (Abu Saad *et al.* 2020).

This study aims to determine the sociodemographic variables, including physical activity, chrononutrition characteristics, and weight status in female administrative employees.

METHODS

Design, location, and time

This study employed a quantitative cross-sectional design involving female administrative staff working in District Health Offices (DHOs) across the state of Perak, Malaysia. At the time of data collection, a total of 402 administrative staff were employed in DHOs throughout Perak, of whom 294 were female. Ethical approval was obtained from the Medical Research and Ethics Committee, Ministry of Health Malaysia, on 24 May 2023 (NMRR ID-24-00855-9EE[IIR]).

Sampling

Eligible participants were female administrative staff aged 18 to 59 years who were not engaged in night-shift work. Individuals with diagnosed or self-reported sleep disorders were not excluded, as the study aimed to examine chrononutrition behaviours in a general working population without stratification by sleep-related conditions. Exclusion criteria included pregnancy, breastfeeding, engagement in night-shift work, and current participation in any weight loss intervention, such as prescribed diets, medications, or therapeutic treatments.

The sample size was calculated using Epi Info software (version 7.2.6.0) for a descriptive study design. Based on the NHMS 2019 report, the prevalence of overweight and obesity among Malaysian females was 54.7% (IPH 2019). Using this prevalence estimate and a 95% confidence level, the minimum required sample size was determined to be 166. A cluster random sampling method was applied whereby all eligible participants who met the inclusion and exclusion criteria were invited to participate. To achieve the required sample size, 10 health districts were randomly selected one by one until the target number was reached. Data collection was conducted from 1st June 2024 to 31st July 2024 at the designated study sites.

Data collection

Anthropometric measurements were conducted by a trained nutritionist. Body weight was measured using a portable Seca weighing scale and recorded to the nearest 0.1 kg. Height was measured using a portable Seca stadiometer and recorded to the nearest 0.1 cm. Body Mass Index (BMI) was categorized according to widely accepted international standards.

The sociodemographic section, adapted from NHMS 2019. Physical activity level was assessed using the Global Physical Activity Questionnaire–Malay version (GPAQ-M), translated and validated by Soo *et al.* (2015). Chrononutrition characteristics were assessed using the Chrononutrition Profile Questionnaire–Malay version (CPQ-M), translated and validated by Hairudin *et al.* (2023).

Data analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS) software version 27. Normality checks were conducted to determine the appropriate statistical tests for descriptive and inferential analyses. Multiple logistic regression analysis was used to identify significant predictors of BMI.

RESULTS AND DISCUSSION

Of the 280 female administrative staff invited to participate, 186 responded, yielding a response rate of 66.4%. The sociodemographic characteristics, BMI, physical activity levels, and sedentary behaviour of the participants are summarised in Table 1. The median age was 41 years (IQR: 37.0–46.0 years). IPH (2023) and surpass previous results among Malay female office employees in Kuala Lumpur (51.1%) and healthcare professionals in Perak (49.9%) (Jamil *et al.* 2019; Kit *et al.* 2020). Over half of participants (57.0%) reported low levels of physical activity, which is significantly higher than the national estimates in NHMS 2019 and NHMS 2023 (IPH 2020; IPH 2023). The prevalence of physical inactivity in this study, even while there was decline in physical inactivity of Perak from 41.6% in NHMS 2019 to 28.2% in NHMS 2023, is still worrying. Previous studies conducted in Malaysia indicated a reported prevalence of physical inactivity in the Malaysian population ranging from 32.6% for female Malay office staff in Kuala Lumpur to 45.6% for healthcare workers in Perak (Abu Saad *et al.* 2020; Jamil *et al.* 2019). Similarly, the REDISCOVER study, which involved 13,654 adults in Malaysia, found to have a physical inactivity prevalence of 37.3% (Nik-Nasir *et al.* 2022).

No significant relationship was found between physical activity level and BMI in this study. This result is in contrast to reports from Malaysian studies that have found an opposite

association between physical activity level and BMI (Abu Saad *et al.* 2020; Chong *et al.* 2023; Nik-Nasir *et al.* 2022). In the current study, sedentary behaviour was reported at a very high rate, with nearly 90% completing more than four and almost half more than eight sitting hours daily. These rates are significantly above national and work-based estimates reported over the past years (Irniza *et al.* 2022; Suhaimi *et al.* 2021). Sedentary behaviour was not significantly related to BMI in the present study however its potential health implications need to be appreciated. Previous evidence suggests that prolonged sitting is associated with increased odds of obesity (OR=1.45), indicating that individuals with obesity may be more likely to engage in sedentary behaviours (Silveira *et al.* 2022).

The results on differences in chrononutrition behaviors between workdays and weekends (Table 2) showed significant differences for wake-up time ($p<0.001$), first eating time ($p<0.001$), last eating time ($p=0.003$), bedtime ($p<0.001$), evening eating latency ($p=0.007$), eating window ($p<0.001$), sleeping window ($p<0.001$), eating midpoint ($p<0.001$), and sleep midpoint ($p<0.001$), with effect sizes ranging from medium to large (0.20–0.70). Participants' wake-up, sleep, and eating times were generally later on weekends compared to workdays. The gap between the last eating time and bedtime was shorter on workdays than on weekends. Participants also had a shorter eating window and longer sleep duration on weekends than on workdays. However, morning eating latency did not show a significant difference ($p=0.060$).

Table 3 presents the participants' eating occasion patterns and the occurrence of misalignment in eating and sleeping across a typical week, including habits such as breakfast skipping, snacking after dinner, late-night eating, and the timing of the largest meal. Regarding breakfast skipping, 50.5% of participants reported never skipping breakfast. For snacking after dinner, 39.2% reported snacking on one to two days per week. Concerning late-night eating, 84.9% indicated they never engage in this behavior. Most participants (78.0%) identified lunch as their largest meal of the day.

On workdays, the median eating midpoint was 14:02 (IQR: 13:30–15:00), shifting slightly later on weekends to 14:30 (IQR: 14:00–15:15). The corresponding median eating jetlag was 0.25 hours (IQR: 0.00–0.75). Most participants

Table 1. Sociodemographic, body mass index, physical activity and sedentary habit of the participants

Variables	n (%)
Age (Median (IQR))	41.00 (37.0 – 46.0)
18–29	11 (5.9)
30–39	69 (37.1)
40–49	78 (41.9)
50–59	28 (15.1)
Ethnic	
Malay	170 (91.4)
Chinese	0 (0.0)
Indian	9 (4.8)
Others	7 (3.8)
Marital status	
Never married	22 (11.8)
Married/Living with partner	146 (78.5)
Divorced/Widowed/Separated	18 (9.7)
Education level	
SPM	75 (40.3)
STPM/Certificate/Diploma	89 (47.8)
Degree/Master/Ph.D	22 (11.8)
Individual income level	
<RM2,000/USD220	16 (8.6)
RM2,000/USD220–RM4,000/USD440	153 (82.3)
>RM4,000/USD440	17 (9.1)
Household income level	
B40 (<RM4,850/USD1,067)	86 (46.2)
M40 (RM4,850/USD1,067–RM10,959/USD2,411)	98 (52.7)
T20(RM10,959/USD2,411)	2 (1.1)
Self-reported being diagnosed with	
Diabetes	
Yes	20 (10.8)
No	166 (89.2)
Hypertension	
Yes	30 (16.1)
No	156 (83.9)
Hypercholesterol	
Yes	26 (14.0)
No	160 (86.0)
Multiple condition (≥ 2)	
Yes	20 (10.8%)
No	166 (89.2%)
BMI classification	
Underweight (<18.5)	2 (1.1)
Normal (18.5–24.9)	52 (28.0)
Overweight (25.0–29.9)	74 (39.8)
Obese (>30.0)	58 (31.2)
Obese I (30.0–34.9)	29 (15.6)
Obese II (35.0–39.9)	13 (7.0)
Obese III (≥ 40.0)	16 (8.6)
Weight status	
Underweight/Normal	54 (29.0)
Overweight/Obese	132 (71.0)
Total MET minutes per week (Median (IQR))	720 (240.0–1260.0)
Physical activity level	
Low	106 (57.0)
Moderate	70 (37.6)
High	10 (5.4)
Hours spent sitting/Reclining (Median (IQR))	8.00 (6.00–12.00)
Sitting/Reclining category	
<4 hours	19 (10.2)
4–8 hours	78 (41.9)
>8 hours	89 (47.8)

MET: Metabolic Equivalent of Task; RM: Ringgit Malaysia; SPM: *Sijil Pelajaran* Malaysia–equivalent to O-Level; STPM: *Sijil Tinggi Persekolahan* Malaysia–equivalent to A-Level; USD: US Dollar; B40: Bottom 40%–Refers to the bottom 40% of Malaysian households in terms of income; M40: Middle 40%–Refers to the middle 40% of income earners; T20: Top 20%–Refers to the top 20% of income earners

Table 2. Difference in chrono nutrition behaviors on weekday and weekend

Category	Workday	Weekend	p	Effect size
	Median (IQR)	Median (IQR)		
Wake-up time (Hours)	5:30 (5:00–6:00)	6:00 (5:41–6:30)	<0.001*	0.70
First eating time (Hours)	8:29 (8:00–9:00)	9:00 (8:00–9:59)	<0.001*	0.47
Last eating time (Hours)	20:00 (19:00–21:00)	20:00 (19:00–21:00)	0.003*	0.22
Bed time (Hours)	23:00 (22:00–23:00)	23:00 (22:30–24:00)	<0.001*	0.44
Morning eating latency	180.0 (120.0–210.0)	172.5 (120.0–210.0)	0.060	0.14
Evening eating latency	180.0 (120.0–240.0)	180.0 (120.0–240.0)	0.007*	0.20
Eating window	702.5 (641.3–750.0)	660.0 (600.0–720.0)	<0.001*	0.33
Sleeping window	420.0 (360.0–435.0)	420.0 (386.3–468.8)	<0.001*	0.39

If $p < 0.05$, indicating statistical significance; *: Will be used to mark the p-value; a: Effect size (r) in the Wilcoxon Signed-Rank test is as follows: 0.1=for a small effect; 0.3=for a medium effect; and 0.5=for a large effect

(81.2%) demonstrated stable eating schedules across the week, while 18.9% exhibited eating misalignment, predominantly due to delayed meal timing on weekends (16.7%); a smaller proportion reported advanced meal timing (2.2%).

The median sleep midpoint occurred at 02:15 (IQR: 01:45–02:30) on workdays and shifted to 02:30 (IQR: 02:15–03:00) on weekends, resulting in a median social jetlag of 0.38 hours (IQR: 0.00–0.75). The majority of participants (82.3%) maintained consistent sleep timing, whereas 17.7% delayed their sleep schedule on weekends. No participants reported advancing their sleep timing.

Differences in chrononutrition-related behaviours between weekdays and weekends were evident, likely reflecting greater schedule flexibility during weekends. Shifts in wake-up time, bedtime, and first and last meal timing observed in this study are consistent with findings reported among adult populations in Malaysia and Japan (Kaur *et al.* 2023; Nishimura *et al.* 2023). In line with previous studies, participants in the present study demonstrated shorter eating windows and longer sleep durations on weekends, patterns that may indicate mild circadian misalignment.

Eating jetlag and social jetlag were reported by 18.9% and 17.7% of participants, respectively, proportions that are lower than those reported in international studies (Nishimura *et al.* 2023). Although a higher proportion of participants with overweight or obesity exhibited eating and social jetlag, these associations were not statistically significant. Similar no significant findings have been reported in some studies (Dote-Montero *et al.* 2023), although others have observed significant associations between jetlag-related behaviours and adiposity (Kaur *et al.* 2023). One possible explanation is that the relatively short

duration of eating and social jetlag observed in this sample may have been insufficient to produce detectable metabolic effects.

In this study, neither wake-up time nor bedtime was significantly associated with weight

Table 3. Eating occasion pattern in a typical week and occurrence of misalignment in eating and sleeping

Variables	n (%)
Breakfast skipping frequency (Median (IQR))	0.0 (0.0–4.0)
Never	94 (50.5)
1–2 days	30 (16.1)
3–4 days	20 (10.8)
5–6 days	34 (18.3)
Everyday	8 (4.3)
Snack after dinner frequency (Median (IQR))	2.0 (1.0–3.0)
Never	39 (21.0)
1–2 days	73 (39.2)
3–4 days	48 (25.8)
5–6 days	15 (8.1)
Everyday	11 (5.9)
Late night eating frequency (Median (IQR))	0.0 (0.0–0.0)
Never	158 (84.9)
1–2 days	20 (10.8)
3–4 days	7 (3.8)
5–6 days	1 (0.5)
Everyday	0 (0.0)
Largest meal occasion	
Breakfast	27 (14.5)
Lunch	145 (78.0)
Eating jetlag (Hours) (Median (IQR))	0.25 (0.00–0.75)
Eating misalignment status	
No Misalignment	151 (81.2)
Yes–Delay	31 (16.7)
Yes–Advance	4 (2.2)
Social Jetlag (Hours) (Median (IQR))	0.38 (0.00–0.75)
Sleeping misalignment status	
No Misalignment	153 (82.3)
Yes–Delay	33 (17.7)
Yes–Advance	0 (0.0)

status, a finding that aligns with observations from adult populations (Taylor *et al.* 2016), but contrasts with evidence from adolescent studies suggesting an association between earlier wake-up times and higher BMI (Zhang *et al.* 2024). Similarly, no significant association was observed between first eating time and BMI, consistent with findings from recent studies conducted in adult populations (Tang *et al.* 2023; da Cunha *et al.* 2023). In contrast, other studies, particularly those conducted in Brazil, have reported associations between later eating times and higher BMI (Crispim *et al.* 2024), highlighting potential population- and context-specific differences. A significant finding in this study was that a last eating time between 8:01 PM and 9:00 PM was associated with an increased likelihood of overweight or obesity, supporting findings from Lopez-Minguez *et al.* (2019) and others. Late eating has been linked to disrupted metabolism, poorer glucose regulation, and increased fat storage.

The average eating window in this study was 11.5 hours, similar to U.S. findings but longer than those reported among Malaysian young adults (Kaur *et al.* 2023). No association with BMI was found, which aligns with previous Malaysian research (Juliana *et al.* 2023), although NHANES data suggested links with abdominal obesity (da Cunha *et al.* 2023). Sleep duration averaged around seven hours, but nearly half of participants slept less than this, with a higher proportion among overweight and obese participants. No significant association was found, consistent with local studies (Chan *et al.* 2021), though global meta-analyses have indicated that short sleep duration increases obesity risk (Zhou *et al.* 2019).

Morning Eating Latency (MEL) and Evening Eating Latency (EEL) were not significantly associated with weight status, despite some evidence suggesting that delayed eating patterns may contribute to weight gain (Longo-Silva *et al.* 2025). The lack of association in this study could be due to sample characteristics or relatively short latency durations. Breakfast skipping was reported by 49.5% of participants, contrasting with national data (Mognard *et al.* 2023). While breakfast skipping was not significantly associated with BMI in this study, meta-analyses suggest it increases obesity risk (Ma *et al.* 2020). Late-night eating behaviors, including snacking after dinner (39.8%) and

waking up to eat (3.2%), were not associated with BMI in this study but have been linked to metabolic risks and night eating syndrome in other populations (Okada *et al.* 2019). Most participants identified lunch as their largest meal (78.0%). No significant association was observed between largest meal timing and BMI, consistent with Juliana *et al.* (2023), though some Brazilian studies suggest having dinner as the largest meal is linked to higher BMI (Longo-Silva *et al.* 2024).

Previous evidence suggests that later eating is associated with higher total energy intake, poorer overall diet quality, and unfavourable metabolic responses, which together may promote weight gain (Lopez-Minguez *et al.* 2019; Jakubowicz *et al.* 2013). Consuming food late at night may result in a misalignment between nutrient intake and endogenous circadian rhythms, thereby impairing glucose regulation, reducing insulin sensitivity, and altering lipid oxidation. These metabolic alterations may, in turn, facilitate greater fat storage.

Variables that were significantly associated with overweight or obesity in the bivariate analysis ($p < 0.05$) were included in simple logistic regression to evaluate their individual effects. Independent variables with a $p < 0.25$ —namely ethnicity, hypertension status, physical activity level, and last eating time quartiles—were subsequently entered into the multiple logistic regression model. The results of the multivariate analysis are presented in Table 4.

The final model was statistically significant ($\chi^2(6) = 28.692$, $p < 0.001$), indicating that the selected predictors collectively contributed to the likelihood of being overweight or obese. The model demonstrated moderate discriminatory ability, correctly classifying 73.7% of cases. The Nagelkerke R^2 value of 0.204 suggests that approximately 20.4% of the variability in overweight and obesity status was explained by the model. Model adequacy was further supported by a non-significant Hosmer–Lemeshow goodness-of-fit test ($p = 0.943$), indicating good agreement between observed and predicted outcomes.

The analysis revealed that participants with hypertension had a significantly higher likelihood of being overweight or obese (OR=4.33, 95% CI: 1.22–15.39, $p = 0.023$). The variable representing multiple conditions (≥ 2 diseases) was not entered into the multiple regression analysis as it did not reach statistical significance in the bivariate analysis. Malay participants had a

Table 4. Multiple logistic regression analysis among selected variables with weight status

Variables	B	SE	Wald	p	OR (95% CI)
Ethnic					
Malay	-2.37	1.06	4.98	0.026	0.09 (0.12–0.75)
Other	-	-	-	-	1.00
Hypertension status					
Yes	1.47	0.65	5.14	0.023	4.33 (1.22–15.39)
No	-	-	-	-	1.00
Physical activity level					
Low	0.62	0.35	3.09	0.079	1.86 (0.93–3.70)
Moderate-High	-	-	-	-	1.00
Last eating time					
Q2 (19:01–20:00)	-0.11	0.43	0.07	0.790	0.89 (0.39–2.06)
Q3 (20:01–21:00)	1.40	0.54	6.61	0.010*	4.04 (1.39–11.70)
Q4 (>21:00)	0.56	0.52	1.17	0.281	1.76 (0.63–4.89)
Q1 (<19:01)	-	-	-	-	1.00

If $p < 0.05$, indicating statistical significance with multiple logistic regression; *: Will be used to mark the p-value; Q1, Q2, Q3, Q4: Quartiles 1 to 4

lower risk of overweight or obesity compared to participants from other ethnic groups (OR=0.09, 95% CI: 0.12–0.75, $p=0.026$). Additionally, participants in the third quartile of last eating time (20:01–21:00) had a significantly higher risk of being overweight or obese (OR=4.04, 95% CI: 1.39–11.70, $p=0.010$). However, low physical activity level (PAL) was not a significant predictor but showed a trend toward higher odds compared to participants with moderate to high PAL (OR=1.86, 95% CI: 0.93–3.70, $p=0.079$).

Hypertension (OR=4.33) and having the last meal between 8:01 PM and 9:00 PM (OR=4.04) were significant predictors of overweight and obesity in this study. The association between hypertension and obesity is well established, with excess body weight contributing to higher cardiac output and vascular resistance (Jiang *et al.* 2020). The relationship between hypertension and obesity should be interpreted with caution, as the cross-sectional design of this study does not allow for causal inferences. Moreover, previous research has consistently identified obesity as a predictor and potential underlying cause of hypertension, which may influence the observed association in this study.

Previous studies have shown that, on average, more energy intake, low-quality diet and poor metabolic performance result from consuming food later on, which could drive a higher fat accumulation stage (Lopez-Minguez *et al.* 2019; Jakubowicz *et al.* 2017). Mismatch between the timing of food consumption and circadian rhythms has been implicated in derangement of glucose regulation, insulin sensitivity and lipid oxidation. Among the participants in the present study, Malay ethnicity

was associated with a smaller risk of overweight and obesity (OR=0.09), but this association should be judged with caution because of the relatively small sample group of non-Malay. Low physical activity level may not have been a significant predictor in the fully adjusted models, but its borderline association, however, and its proven role in energy balance, remain important factors for consideration (Bradbury *et al.* 2017). The results together underscore the need for work-related health interventions that target lifestyle both physical activity, and what, in this case, is associated with meals. The common pathophysiological factors underlying hypertension and obesity, such as insulin resistance and heightened sympathetic activity (Jiang *et al.* 2020), also facilitate the application of integrated health promotion interventions.

This study is one of the few in Malaysia to simultaneously assess sociodemographic factors, health status, PA, sedentary behavior and detailed chrononutrition related factors in relation to BMI. A vital strength is this holistic analytical strategy. A number of limitations should be noted, however. A cross-sectional design will hinder a causal inference. In addition, this study is carried out in female administrative staff working in district health offices in Perak. The generalisability of these findings to other occupational groups and populations is limited by the focus on female administrative staff working in these offices. With the reliance on self-reported behavioral data recall and social desirability bias may be introduced in our work. More detailed ethnic comparisons were limited due to the small number of non-Malay participants. Moreover, dietary information about energy

balance mechanisms was limited due to a lack of comprehensive dietary data. Future studies may incorporate mixed-methods designs, objective measurement methods for physical activity (e.g., accelerometry) and thorough dietary evaluations. Longitudinal and intervention-oriented studies are particularly desirable for elucidating causal pathways, and to assess the significance of targeted workplace interventions.

CONCLUSION

The results of the current study bring to light a high prevalence of overweight and obesity in female administration personnel. Hypertension emerged as a significant predictor signifying the established two-way relationship between high body weight and high blood pressure; it is suggested that obesity causes the disease in a positive feedback mechanism including insulin resistance, systemic inflammation, and sympathetic nervous system activity. Late last meal timing, and especially late at night, i.e. after 8 PM, was also recognized as an important predictor that further reinforced the significance of chrononutrition in body weight control.

Low physical activity was not an important predictor in the corrected model, however, its role in maintaining energy balance and general well-being is well established. Low physical activity and long-term sedentary behavior are also common among female administrative staff, the study found. Family responsibilities, especially involving evening chores and children's schooling, might also exacerbate late meal timing in participating couples. They may lead to an irregular meal schedule, an unsteady sleep schedule, and metabolic disorders that together, can encourage weight gain.

All other chrononutrition related factors were not significantly associated with overweight and obesity but their effect on the regulation of weight may not be discounted. Delays in sleep and timing of meal-time on weekends indicate possible circadian aberration, and shorter eating windows paired with longer sleep duration imply altered energy intake and expenditure patterns. The existence of eating and social jetlag, reflecting the variance between weekday to weekend behaviours, also highlights the need for studying temporal patterns for future studies and workplace interventions. Such findings have real-world relevance for workplace health initiatives.

Our policies should seek to decrease sedentary behaviour, and should promote physical activity through regular movement breaks, ergonomic workstations and organized exercise programs. Promoting the practice of proper eating times whilst being open to healthier meals when working at a company level helps improve metabolic health. Flexible job arrangement to be able to meet personal and family responsibilities might help administrative staff adopting more balanced lifestyles reducing overweight and obesity.

ACKNOWLEDGMENT

The authors would like to express their sincere gratitude to all the participants, nutritionists and staff involved in the data collection process for their valuable support and contributions.

DECLARATION OF CONFLICT OF INTEREST

The authors have no conflict of interest.

DECLARATION OF GENERATIVE AI IN SCIENTIFIC WRITING

Declaration of AI assistance in the course of preparing this manuscript, the authors made limited use of artificial intelligence-based tools to support language refinement and improve overall readability. All outputs generated by these tools were critically reviewed, revised, and verified by the authors, for the accuracy, and originality of the final published work.

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