

Sleep Quality and Its Associated Factors among Malaysian Adults: Cross-Sectional Findings from the May Measurement Month 2025 Participants

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Abstract

Background

Poor sleep quality is increasingly recognised as an important determinant of cardiometabolic health. However, community-based data integrating sleep assessment with blood pressure and body composition measures in Malaysia remains limited. This study aimed to determine the prevalence of poor sleep quality and its associated factors among participants of the May Measurement Month (MMM) 2025 blood pressure screening campaign in Malaysia.

Methods

This cross-sectional study included 907 adults (median age $\pm$ interquartile range: 40 ± 35 ; 67.4% females), recruited from community-based screening sites in the greater Klang Valley. Sleep quality was assessed using the Brief Pittsburgh Sleep Quality Index (B-PSQI) and categorised as good or poor based on a validated cut-off score. Data on sociodemographic characteristics, lifestyle behaviours (smoking, vaping, alcohol intake, caffeine consumption, and vigorous physical activity), hypertension status (including awareness and blood pressure control), and anthropometric/body composition measures were collected. Bivariate analyses were conducted using appropriate statistical tests, followed by multivariable logistic regression to identify factors independently associated with poor sleep quality after adjusting for potential confounders.

Results

Poor sleep quality was observed in 31.8% of participants. Ethnicity, vaping, and vigorous exercise were significantly associated with sleep quality. After adjustment, participants from other minority ethnic groups had higher odds of poor sleep compared with Malays (OR 3.44, 95% CI 1.39–8.52; $p = 0.008$). Past vapers (OR 0.23, 95% CI 0.08–0.66; $p = 0.006$) and never vapers (OR 0.29, 95% CI 0.10–0.83; $p = 0.021$) had lower odds of poor sleep compared with current vapers. Lack of vigorous exercise was associated with higher odds of poor sleep (OR 1.67, 95% CI 1.25–2.23; $p = 0.001$). Hypertension status and body composition indicators were not independently associated.

Conclusion

Nearly one in three MMM 2025 participants reported poor sleep quality. Minority ethnicity, current vaping, and physical inactivity were independently associated with poor sleep. Integrating sleep assessment and lifestyle counselling into cardiovascular screening initiatives may enhance preventive strategies in Malaysia.

Background

Sleep is a fundamental biological process essential for cardiovascular, metabolic, cognitive, and psychological health. Inadequate or poor-quality sleep has been associated with increased risks of hypertension, coronary heart disease, stroke, obesity, diabetes, and all-cause mortality [1, 2]. In recognition of its broad health implications, sleep duration and quality are increasingly considered integral components of cardiovascular risk assessment and preventive health strategies [3].

Globally, sleep disturbances are highly prevalent, with approximately 10–30% of the general adult population affected by sleep problems and poor sleep quality [4, 5]. In Asia, rapid urbanisation, longer working hours, shift work [6], and digital device use [7] have contributed to growing concerns about insufficient and disrupted sleep. In Malaysia, the National Health and Morbidity Survey 2023 found that the prevalence of insufficient sleep (< 7 hours) among adults was 37.7% [8], and available data suggest that sleep problems are common among working adults [9] and university students [10], with associations reported between poor sleep, psychological distress [10], and cardiometabolic risk factors [11]. However, large-scale community-based data examining sleep quality in conjunction with cardiovascular screening parameters remain limited.

Poor sleep is closely associated with hypertension and cardiovascular disease through multiple biological pathways, including sympathetic nervous system activation, hypothalamic–pituitary–adrenal axis dysregulation, endothelial dysfunction, and systemic inflammation [12, 13]. Short sleep duration and sleep fragmentation have been shown to predict incident hypertension and adverse cardiovascular outcomes in prospective studies [14, 15]. Conversely, individuals with established hypertension may experience impaired sleep due to nocturnal blood pressure variability, medication effects, or coexisting sleep disorders such as obstructive sleep apnoea [16]. Despite this bidirectional relationship, evidence on the association between subjective sleep quality and blood pressure (BP) control in community settings remains inconsistent.

Lifestyle behaviours also play a critical role in sleep health. Physical activity has been consistently associated with improved sleep quality and efficiency [17]. In contrast, nicotine exposure—through conventional cigarettes or electronic cigarettes—can delay sleep onset and alter sleep architecture due to its stimulant properties [18]. Emerging research suggests that e-cigarette use may be associated with sleep disturbances, particularly among younger adults [19]. Alcohol [20] and caffeine [21] intake are also known to influence sleep patterns, although their effects vary according to dose, timing, and individual susceptibility.

Anthropometric and body composition indicators, including obesity and central adiposity, are strongly associated with sleep disorders and sleep-disordered breathing [22]. However, the relationship between general adiposity measures—such as body mass index (BMI), waist circumference (WC), and visceral fat level (VFL)—and subjective sleep quality is less clear in community-based populations without formal sleep disorder assessment.

May Measurement Month (MMM) is a global blood pressure screening initiative aimed at raising awareness of hypertension and improving cardiovascular risk detection [23]. The inclusion of sleep-related assessments within such a large-scale community screening context provides a valuable opportunity to explore the interplay between sleep quality, lifestyle behaviours, hypertension status, and body composition in a real-world Malaysian population.

Therefore, the present study aimed to: 1. Determine the prevalence of poor sleep quality among participants of the May Measurement Month 2025 campaign in the Greater Klang Valley, Malaysia, and 2. Examine the associations between sleep quality and demographic characteristics, lifestyle behaviours, hypertension status, and anthropometric/body composition indicators. Understanding these associations may inform integrated strategies for sleep health promotion within cardiovascular risk reduction programs.

Methods

Study Design and Setting

This study was a cross-sectional analysis conducted within the framework of the May Measurement Month (MMM) 2025 blood pressure (BP) screening campaign in the greater Klang Valley, Malaysia. MMM is a global annual initiative led by the International Society of Hypertension aimed at enhancing awareness, detection, and management of hypertension worldwide [23]. Screening was carried out between April and October 2025 across various community-based settings in Malaysia, including public venues, workplaces, universities, and healthcare facilities. Participating sites included the Universiti Malaya Medical Centre (UMMC) outpatient clinic (Kuala Lumpur), Universiti Putra Malaysia (UPM; Serdang), Sunway University (Subang Jaya), AEON Mall Nilai Health Campaign (Nilai), and the Shangri-La Hotel (Kuala Lumpur).

Beyond the standard MMM 2025 protocol—which included collection of basic sociodemographic information, lifestyle factors, dietary habits, and BP measurements [24]—all participating centres implemented additional health assessments. These comprised evaluation of sleep quality using the brief Pittsburgh Sleep Quality Index (B-PSQI) and comprehensive anthropometric and body composition measurements to further explore cardiometabolic risk profiles. The primary objective of this extended assessment was to examine the associations between sleep quality, anthropometric and body composition indicators, and both the presence of hypertension and BP control among individuals with hypertension.

Study Population

Individuals aged 18 years and above were eligible for inclusion. Participants were recruited through community outreach initiatives and voluntary participation at the respective screening sites. Those with missing data on sex, ethnicity, BP measurements, sleep, or anthropometric/body composition variables

were excluded. Only complete cases were retained for analysis, yielding a final analytical sample of 907 participants (87.7%) out of 1,034 individuals screened.

Hypertension status was defined based on on-site BP measurements obtained during a single visit and/or self-reported prior diagnosis by a healthcare professional, as captured in the MMM2025 questionnaire (“Have you ever been diagnosed with high BP by a health professional [except in pregnancy]?”) [24]. Participants were classified as hypertensive if they had a measured systolic BP (SBP) ≥ 140 mmHg and/or diastolic BP (DBP) ≥ 90 mmHg, or if they reported a previous medical diagnosis of hypertension. Those with measured SBP < 140 mmHg and DBP < 90 mmHg and without a prior diagnosis were considered normotensive. Among individuals identified as hypertensive, awareness was defined by self-report of a previous physician diagnosis. BP control was determined using the measured values at the time of screening: controlled BP was defined as SBP < 140 mmHg and DBP < 90 mmHg, whereas uncontrolled BP was defined as SBP ≥ 140 mmHg and DBP ≥ 90 mmHg.

Ethical approval for the study was obtained from the relevant institutional research ethics committee before data collection, i.e., UMMC Medical Research Ethics Committee (Approval number: MREC: 202535-14824), UPM Ethics Committee for Research Involving Human Subjects (Approval number: JKEUPM-2024-277), Sunway University Research Ethics Committee (Approval number: 2025/REC0104). The study was conducted in accordance with the principles of the Declaration of Helsinki. All participants received information regarding the study objectives, procedures, potential risks and benefits, and their right to withdraw without consequence. Written informed consent was obtained before participation. Data were anonymised and securely stored to maintain confidentiality.

Data Collection Procedures

Sociodemographic and Lifestyle Assessment

Participants completed a structured self-administered questionnaire, with trained research staff available to clarify any questions when needed. The questionnaire captured information on sociodemographic characteristics (age, sex, ethnicity, and years of education) as well as lifestyle behaviours, including smoking status, vaping use, alcohol intake, caffeine consumption, and participation in vigorous physical activity. These variables were treated as potential confounding factors and were adjusted for in the multivariable analyses.

BP Measurement

BP was assessed using validated automated devices (Omron HEM-7120, Omron HEM-7121, or Rossmax MJ701f) that were regularly calibrated. Measurements were performed by trained personnel in accordance with standardized protocols. Participants were instructed to sit quietly for a minimum of five minutes with their back supported and feet resting flat on the floor prior to the measurement. An appropriately sized cuff was applied to the upper arm at the level of the heart. At least two readings were

obtained, and the mean of the measurements was used in the analysis to enhance accuracy and reliability.

Brief Pittsburgh Sleep Quality Index (B-PSQI)

The Pittsburgh Sleep Quality Index (PSQI) is a widely used self-administered instrument designed to assess sleep quality and disturbances over the preceding month. In the present study, a shortened six-item version, known as the Brief Pittsburgh Sleep Quality Index (B-PSQI), was utilised to measure key dimensions of sleep quality [25]. The B-PSQI includes items that capture essential components of sleep, namely sleep duration, sleep latency, frequency of sleep disturbances, and overall subjective sleep quality. As bedtime and wake-up time are incorporated in the calculation of sleep efficiency, the six questions generate five scored components. These components are summed to produce a global score ranging from 0 to 15, with higher scores reflecting poorer sleep quality. The B-PSQI has demonstrated satisfactory psychometric properties, with reported polychoric ordinal alpha of 0.79 and ordinal omega of 0.91, indicating good internal consistency. In accordance with recommended cut-off criteria, a global score greater than 5 was classified as poor sleep quality, while scores of 5 or below were categorised as good sleep quality [25].

Anthropometric and Body Composition Measurements

Anthropometric and body composition assessments were performed by trained staff in accordance with standardized procedures. Standing height was measured using a portable stadiometer (Seca 213). Waist circumference (WC) was measured at the midpoint between the lower border of the least palpable rib and the iliac crest, while hip circumference was measured at the level of the maximum protrusion of the buttocks, using a non-elastic measuring tape calibrated to maintain a constant 100 g tension [26]. Waist-to-hip ratio (WHR) and waist-to-height ratio (WHtR) were subsequently calculated by dividing WC by hip circumference and height, respectively. Body composition was evaluated using a bioelectrical impedance analysis (BIA) device (Omron HBF-375), which provided measurements of body weight, body mass index (BMI; kg/m²), total body fat (TBF; %), visceral fat level (VFL; %), subcutaneous fat (SF; %), skeletal muscle percentage (SM; %), and resting metabolic rate (RM; kcal). In addition to whole-body estimates, segmental analyses of subcutaneous fat and skeletal muscle mass for the trunk, arms, and legs were obtained. Standardised cut-off values were applied to categorise adiposity and related indicators. Overweight and obesity were defined as BMI ≥ 23 kg/m² and ≥ 27.5 kg/m², respectively [27]. High TBF was defined as $\geq 20\%$ in men and $\geq 30\%$ in women, while high VFL was defined as $\geq 10\%$ [28]. High SM was defined as $\geq 35.8\%$ in men and $\geq 28\%$ in women [28]. Central obesity thresholds were defined as WC ≥ 90 cm for men and ≥ 80 cm for women (WHO/IOTF/IASO, 2000), WHR ≥ 0.90 for men and ≥ 0.85 for women (WHO, 2011), and WHtR ≥ 0.50 [29].

Statistical Analysis

All statistical analyses were performed using IBM SPSS Statistics for Windows version 26.0 (IBM Corp., Armonk, NY, USA). The normality of continuous variables was assessed using the Kolmogorov–Smirnov

test, with $p < 0.05$ indicating deviation from normal distribution. Variables that were not normally distributed were summarised as medians with interquartile ranges (IQR), while normally distributed variables were presented as means with 95% confidence intervals (CI), where appropriate. Comparisons between participants with good and poor sleep quality were conducted using the Mann–Whitney U test for non-normally distributed continuous variables and Pearson’s chi-square test for categorical variables. Binary logistic regression analyses were performed to examine factors independently associated with poor sleep quality. Variables entered into the multivariable models included demographic characteristics (age, sex, ethnicity, years of education), lifestyle behaviours (smoking status, vaping, alcohol consumption, caffeine intake, and vigorous physical activity), hypertension-related variables (hypertension status, awareness, and BP control), and anthropometric/body composition categories. Adjusted odds ratios (ORs) with 95% confidence intervals (CIs) and corresponding p -values were reported. All multivariable models were adjusted for potential confounders identified a priori based on clinical relevance and existing literature. Statistical tests were two-sided, and a p -value < 0.05 was considered statistically significant.

Results

Association of Sleep Quality with Demographic and Lifestyle Factors

Age and sex were not significantly associated with sleep quality in both bivariate and multivariable analyses (all $p > 0.05$) (Tables 1 and 2). Ethnicity was significantly associated with sleep quality at the bivariate level ($\chi^2 = 16.131$, $p = 0.001$). Poor sleepers comprised a lower proportion of Chinese participants and a higher proportion of Indians and those from other ethnic groups compared with good sleepers. In the adjusted model, participants from other minority ethnic groups had significantly higher odds of poor sleep quality compared with Malays (OR = 3.44, 95% CI: 1.39–8.52, $p = 0.008$), whereas Chinese and Indian ethnicities were not independently associated (Table 2)

Table 1
Demographic, lifestyle habits, hypertension, and anthropometric/body composition categories among good and poor quality sleepers

Categories	Sleep Quality		Total (<i>N</i> = 907)
	Good (<i>n</i> = 619)	Poor (<i>n</i> = 288)	
Median age ± Interquartile Range	40 ± 33	39 ± 33	40 ± 35
<i>p</i>	0.335		
Ethnicity			
Malay	297 (48.0)	139 (48.3)	436 (48.1)
Chinese	249 (40.2)	92 (31.9)	341 (37.6)
Indian	65 (10.5)	44 (15.3)	109 (12.0)
Others ^a	8 (1.3)	13 (4.5)	21 (2.3)
χ^2 ; <i>p</i>	16.131; 0.001**		
Sex			
Male	200 (32.3)	96 (33.3)	296 (32.6)
Female	419 (67.7)	192 (66.7)	611 (67.4)
χ^2 ; <i>p</i>	0.094; 0.760		
Tobacco smoking			
Yes	22 (3.6)	9 (3.1)	31 (3.4)
No (but did in past)	247 (40.0)	101 (35.1)	348 (38.4)
Never	349 (56.5)	178 (61.8)	527 (58.2)
χ^2 ; <i>p</i>	2.296; 0.317		
Vaping			
Yes	6 (1.0)	10 (3.5)	16 (1.8)
^a Other ethnicities include indigenous groups of Peninsular Malaysia, Sabah, and Sarawak like Peninsular Orang Asli, Kadazan-Dusun-Murut Sabah, and Dayak Sarawak.			
WC: Waist circumference; WHtR: Waist-Height Ratio; WHR: Waist-Hip Ratio; TBF: Total Body Fat; VFL: Visceral Fat Level; BMI: Body Mass Index; SM: Skeletal Muscle.			
Continuous variables analyzed by Mann-Whitney U test; Categorical variables analyzed by Pearson’s Chi-square test; * <i>p</i> -value significant at < 0.05; ** <i>p</i> -value significant at < 0.01			

Categories	Sleep Quality		Total (<i>N</i> = 907)
	Good (<i>n</i> = 619)	Poor (<i>n</i> = 288)	
No (but did in past)	236 (38.2)	91 (31.8)	327 (36.2)
Never	376 (60.8)	185 (64.7)	561 (62.1)
χ^2 ; <i>p</i>	9.705; 0.008**		
Alcohol drinking			
Never/rarely	573 (92.7)	260 (90.9)	833 (92.1)
1–3 times/month	34 (5.5)	22 (7.7)	56 (6.2)
1–6 times per week/Daily	11 (1.8)	4 (1.4)	15 (1.7)
χ^2 ; <i>p</i>	1.756; 0.416		
Caffeine intake			
Never/<4 per month	57 (10.1)	28 (10.4)	85 (10.2)
1–6 times/week	312 (55.3)	149 (55.6)	461 (55.4)
1–3 times/day	183 (32.4)	84 (31.3)	267 (32.1)
4+/day	12 (2.1)	7 (2.6)	19 (2.3)
χ^2 ; <i>p</i>	0.279; 0.964		
Vigorous exercise			
Yes	398 (64.4)	152 (53.3)	550 (60.9)
No	220 (35.6)	133 (46.7)	353 (39.1)
χ^2 ; <i>p</i>	10.035; 0.002**		
Hypertension status			
Hypertensive	204 (33.0)	106 (36.8)	310 (34.2)
Normotensive	415 (67.0)	182 (63.2)	597 (65.8)
^a Other ethnicities include indigenous groups of Peninsular Malaysia, Sabah, and Sarawak like Peninsular Orang Asli, Kadazan-Dusun-Murut Sabah, and Dayak Sarawak.			
WC: Waist circumference; WHtR: Waist-Height Ratio; WHR: Waist-Hip Ratio; TBF: Total Body Fat; VFL: Visceral Fat Level; BMI: Body Mass Index; SM: Skeletal Muscle.			
Continuous variables analyzed by Mann-Whitney U test; Categorical variables analyzed by Pearson’s Chi-square test; * <i>p</i> -value significant at < 0.05; ** <i>p</i> -value significant at < 0.01			

Categories	Sleep Quality		Total (<i>N</i> = 907)
	Good (<i>n</i> = 619)	Poor (<i>n</i> = 288)	
χ^2 ; <i>p</i>	1.294; 0.255		
Awareness among hypertensives			
Aware	112 (55.7)	70 (66.7)	182 (59.5)
Unaware	89 (44.3)	35 (33.3)	124 (40.5)
χ^2 ; <i>p</i>	3.428; 0.064		
BP control among hypertensives			
Controlled	66 (32.8)	38 (36.2)	104 (34.0)
Uncontrolled	135 (67.2)	67 (63.8)	202 (66.0)
χ^2 ; <i>p</i>	0.346; 0.556		
WC Class			
Normal	281 (45.4)	135 (46.9)	416 (45.9)
High	338 (54.6)	153 (53.1)	491 (54.1)
χ^2 ; <i>p</i>	0.173; 0.677		
WHtR Class			
Normal	249 (40.2)	110 (38.2)	359 (39.6)
High	370 (59.8)	178 (61.8)	548 (60.4)
χ^2 ; <i>p</i>	0.339; 0.560		
WHR Class			
Normal	331 (53.5)	164 (56.9)	495 (54.6)
High	288 (46.5)	124 (43.1)	412 (45.4)
^a Other ethnicities include indigenous groups of Peninsular Malaysia, Sabah, and Sarawak like Peninsular Orang Asli, Kadazan-Dusun-Murut Sabah, and Dayak Sarawak.			
WC: Waist circumference; WHtR: Waist-Height Ratio; WHR: Waist-Hip Ratio; TBF: Total Body Fat; VFL: Visceral Fat Level; BMI: Body Mass Index; SM: Skeletal Muscle.			
Continuous variables analyzed by Mann-Whitney U test; Categorical variables analyzed by Pearson's Chi-square test; * <i>p</i> -value significant at < 0.05; ** <i>p</i> -value significant at < 0.01			

Categories	Sleep Quality		Total (<i>N</i> = 907)
	Good (<i>n</i> = 619)	Poor (<i>n</i> = 288)	
χ^2 ; <i>p</i>	0.955; 0.328		
TBF Class			
Normal	185 (31.0)	81 (29.5)	266 (30.5)
High	412 (69.0)	194 (70.5)	606 (69.5)
χ^2 ; <i>p</i>	0.209; 0.648		
VFL Class			
Normal	392 (64.2)	177 (63.2)	569 (63.9)
High	219 (35.8)	103 (36.8)	322 (36.1)
χ^2 ; <i>p</i>	0.074; 0.786		
BMI Class			
Normal	234 (39.1)	103 (37.3)	337 (38.5)
Overweight	189 (31.6)	91 (33.0)	280 (32.0)
Obese	176 (29.4)	82 (29.7)	258 (29.5)
χ^2 ; <i>p</i>	0.275; 0.871		
SM Class			
Normal	480 (79.9)	216 (78.5)	696 (79.5)
High	121 (20.1)	59 (21.5)	180 (20.5)
χ^2 ; <i>p</i>	0.202; 0.653		
^a Other ethnicities include indigenous groups of Peninsular Malaysia, Sabah, and Sarawak like Peninsular Orang Asli, Kadazan-Dusun-Murut Sabah, and Dayak Sarawak.			
WC: Waist circumference; WHtR: Waist-Height Ratio; WHR: Waist-Hip Ratio; TBF: Total Body Fat; VFL: Visceral Fat Level; BMI: Body Mass Index; SM: Skeletal Muscle.			
Continuous variables analyzed by Mann-Whitney U test; Categorical variables analyzed by Pearson's Chi-square test; * <i>p</i> -value significant at < 0.05; ** <i>p</i> -value significant at < 0.01			

Table 2

Binary logistic regression of the association of demographic, lifestyle habits, hypertension, and anthropometric/body composition categories with poor sleep quality

Classes	B	S.E.	Wald	df	p	Adjusted Odds Ratio	95.0% C.I.	
							Lower	Upper
Ethnicity ^a								
Chinese	-0.227	0.161	1.993	1.000	0.158	0.797	0.582	1.092
Indian	0.380	0.224	2.879	1.000	0.090	1.462	0.943	2.266
Others	1.235	0.463	7.110	1.000	0.008*	3.437	1.387	8.519
Sex ^b								
Female sex	-0.040	0.152	0.068	1.000	0.795	0.961	0.713	1.295
Tobacco smoking ^y								
No (but did in past)	0.036	0.422	0.007	1.000	0.932	1.036	0.453	2.370
Never	0.269	0.418	0.413	1.000	0.520	1.308	0.576	2.969
Vaping ^y								
No (but did in past)	-1.475	0.539	7.486	1.000	0.006**	0.229	0.080	0.658
Never	-1.225	0.532	5.299	1.000	0.021*	0.294	0.103	0.834
Alcohol drinking ^y								
1–3 times/month	0.219	0.293	0.558	1.000	0.455	1.245	0.701	2.212
1–6 times/week/Daily	-0.269	0.595	0.204	1.000	0.652	0.765	0.238	2.453
Caffeine intake ^y								
^a Reference category = Malay; controlled for age and sex								
^b Reference category = Male sex; controlled for age and ethnicity								
^y Reference category = Smoker/vaper/non alcohol-drinker/non- or < 4 times/month caffeine drinker/vigorous exerciser; controlled for age, sex, and ethnicity								
[¥] Reference category = Normotensive/hypertensive aware/hypertensive with BP controlled/normal WC, WHR, WHtR, WHR, TBF, BMI, SM; controlled for age, years of education, ethnicity, sex, tobacco usage, vaping, alcohol drinking, caffeine usage, and vigorous exercise.								

Classes	B	S.E.	Wald	df	<i>p</i>	Adjusted Odds Ratio	95.0% C.I.	
							Lower	Upper
Ethnicity ^a								
1–6 times/week	0.025	0.256	0.009	1.000	0.922	1.025	0.621	1.692
1–3 times/day	-0.063	0.273	0.053	1.000	0.817	0.939	0.549	1.604
4+ /day	0.171	0.537	0.102	1.000	0.750	1.187	0.414	3.398
Vigorous exercise ^Y								
No	0.511	0.149	11.809	1.000	0.001**	1.667	1.246	2.232
Hypertension [¥]								
Hypertension Presence	-0.209	0.173	1.446	1.000	0.229	0.812	0.578	1.140
Hypertensives Who Are Unaware	-0.558	0.284	3.866	1.000	0.049*	0.572	0.328	0.998
Hypertensives with BP Uncontrolled	-0.403	0.295	1.862	1.000	0.172	0.668	0.375	1.192
WC Class [¥]								
High	0.035	0.161	0.048	1.000	0.826	1.036	0.755	1.422
WHtR Class [¥]								
High	0.241	0.162	2.213	1.000	0.137	1.273	0.926	1.750
WHR Class [¥]								
High	-0.149	0.158	0.891	1.000	0.345	0.861	0.632	1.174
TBF Class [¥]								
^a Reference category = Malay; controlled for age and sex								
^ß Reference category = Male sex; controlled for age and ethnicity								
^Y Reference category = Smoker/vaper/non alcohol-drinker/non- or < 4 times/month caffeine drinker/vigorous exerciser; controlled for age, sex, and ethnicity								
[¥] Reference category = Normotensive/hypertensive aware/hypertensive with BP controlled/normal WC, WHR, WHtR, WHR, TBF, BMI, SM; controlled for age, years of education, ethnicity, sex, tobacco usage, vaping, alcohol drinking, caffeine usage, and vigorous exercise.								

Classes	B	S.E.	Wald	df	<i>p</i>	Adjusted Odds Ratio	95.0% C.I.	
							Lower	Upper
Ethnicity ^α								
High	0.183	0.177	1.067	1.000	0.302	1.200	0.849	1.698
VFL Class [¥]								
High	0.111	0.168	0.441	1.000	0.507	1.118	0.805	1.553
BMI Class [¥]								
Overweight	0.139	0.192	0.524	1.000	0.469	1.149	0.788	1.675
Obese	0.153	0.197	0.605	1.000	0.437	1.165	0.792	1.714
SM Class [¥]								
High	0.042	0.200	0.044	1.000	0.833	1.043	0.705	1.542
αReference category = Malay; controlled for age and sex								
βReference category = Male sex; controlled for age and ethnicity								
γReference category = Smoker/vaper/non alcohol-drinker/non- or < 4 times/month caffeine drinker/vigorous exerciser; controlled for age, sex, and ethnicity								
¥Reference category = Normotensive/hypertensive aware/hypertensive with BP controlled/normal WC, WHR, WHtR, WHR, TBF, BMI, SM; controlled for age, years of education, ethnicity, sex, tobacco usage, vaping, alcohol drinking, caffeine usage, and vigorous exercise.								

Among lifestyle behaviours, tobacco smoking, alcohol intake, and caffeine consumption were not significantly associated with sleep quality in either analysis. Vaping was significantly associated at the bivariate level ($\chi^2 = 9.705$, $p = 0.008$), with a higher proportion of poor sleepers reporting current vaping. This association persisted after adjustment, as past vapers (OR = 0.23, 95% CI: 0.08–0.66, $p = 0.006$) and never vapers (OR = 0.29, 95% CI: 0.10–0.83, $p = 0.021$) had lower odds of poor sleep quality compared with current vapers (Table 2).

Engagement in vigorous exercise was also significant in both analyses. Poor sleepers were less likely to report vigorous exercise (53.3% vs. 64.4%; $p = 0.002$), and those not engaging in vigorous exercise had 1.67 times higher odds of poor sleep quality after adjustment (OR = 1.67, 95% CI: 1.25–2.23, $p = 0.001$)

Association of Sleep Quality with Hypertension and Anthropometrics/Body Composition

Hypertension prevalence did not differ significantly across sleep groups ($p = 0.255$; Table 1), and hypertension status was not independently associated with poor sleep quality (OR = 0.81, 95% CI: 0.58–

1.14, $p = 0.229$; Table 2).

Among hypertensive participants, awareness showed a borderline bivariate association ($p = 0.064$). In the adjusted model, hypertensive individuals who were unaware of their condition had marginally-significant lower odds of poor sleep quality compared with those aware (OR = 0.57, 95% CI: 0.33–0.998, $p = 0.049$). BP control was not significantly associated in either analysis (Tables 1 and 2).

. No significant associations were observed between sleep quality and anthropometric or body composition measures—including WC, WHtR, WHR, TBF, VFL, BMI, or SM class—in both bivariate and multivariable analyses (all $p > 0.05$)(Tables 1 and 2).

Discussion

In this sample of May Measurement Month (MMM) 2025 participants in the greater Klang Valley, Malaysia, approximately one-third (31.8%) were classified as having poor sleep quality. Poor sleep was independently associated with minority ethnicity, current vaping, and lack of vigorous exercise, whereas hypertension status and adiposity-related measures were not significantly associated after multivariable adjustment.

The observed prevalence of poor sleep quality in this study is broadly consistent with international estimates, indicating that approximately 10–30% of adults experience clinically significant sleep disturbances or insufficient sleep [4, 5]. Although prevalence varies depending on the population studied and the assessment tools used, sleep complaints remain highly common across both high- and middle-income countries. Rapid urbanisation [30], longer working hours [6], increased screen exposure [7], and psychosocial stress [31] have all been implicated in the growing burden of sleep problems worldwide. Poor sleep is increasingly recognised as a major public health issue because of its wide-ranging health consequences. Evidence from epidemiological and experimental studies has demonstrated strong associations between inadequate sleep and adverse cardiometabolic outcomes, including hypertension, obesity, type 2 diabetes, and cardiovascular disease [1, 2]. Sleep disruption has also been associated with impaired cognitive performance, reduced concentration and productivity, mood disturbances, and diminished overall quality of life [32]. Furthermore, accumulating data suggest that poor sleep may contribute to increased healthcare utilisation and economic costs at the societal level [33, 34]. Collectively, these findings underscore the importance of incorporating sleep health into broader non-communicable disease prevention and health promotion strategies.

Demographic Factors

Ethnicity was significantly associated with sleep quality. Participants from minority ethnic groups, consisting of indigenous groups of Peninsular Malaysia, Sabah, and Sarawak, had more than threefold higher odds of poor sleep compared with Malays. However, the association between minority ethnicity and poor sleep should be interpreted cautiously. The “Others” group included only 21 participants and had a wide confidence interval, suggesting statistical instability. The elevated odds may be driven by the

small sample size and the heterogeneous nature of this category. Larger studies with better representation of minority groups are needed to confirm this finding. Nevertheless, ethnic disparities in sleep have been reported internationally, often attributed to socioeconomic differences, occupational demands, psychosocial stress, and environmental exposures [35, 36]. In the Malaysian context, cultural practices, shift work patterns, and urban living conditions may contribute to differential sleep patterns across ethnic groups, similar to the multi-ethnic Singaporean population [37]. Although Chinese and Indian ethnicity were not independently associated after adjustment, the elevated odds observed among other minority groups warrant further exploration, particularly with regard to social determinants of health and access to healthcare.

Age and sex were not significantly associated with sleep quality in our cohort. While global studies report poorer sleep quality among women [38, 39] and older adults [40, 41], the findings are not universal and may depend on population structure and measurement tools. The relatively wide age distribution and predominance of female participants in this opportunistic screening sample may partly explain the absence of significant associations.

Lifestyle Behaviours

Vaping emerged as a significant independent correlate of poor sleep quality. Current vapers had higher odds of poor sleep compared with past or never users. Nicotine is a central nervous system stimulant that increases sleep latency, reduces total sleep time, and alters sleep architecture [18]. Emerging evidence suggests that e-cigarette use is associated with sleep disturbances, potentially due to nicotine exposure and behavioural patterns associated with device use [19]. Our findings add to the growing literature highlighting the potential adverse sleep-related consequences of vaping in adult populations.

Engagement in vigorous exercise was protective against poor sleep. Participants who did not perform vigorous exercise had 67% higher odds of poor sleep quality. Regular physical activity has been consistently associated with improved sleep quality, shorter sleep latency, and greater sleep efficiency [17, 42]. Biological mechanisms may include thermoregulatory effects, circadian phase shifts, and reductions in anxiety and depressive symptoms [17]. From a public health perspective, promoting physical activity may confer dual benefits for cardiometabolic health and sleep quality.

In contrast, tobacco smoking, alcohol consumption, and caffeine intake were not independently associated with sleep quality in our adjusted models. Although these factors are known to influence sleep physiology [18, 20, 21], their effects may depend on dose, timing, and chronicity of use, which were not captured in detail in this study.

Hypertension and Body Composition

Contrary to expectations, hypertension status and BP control were not independently associated with poor sleep quality. Short sleep duration and poor sleep have been associated with incident hypertension and adverse cardiovascular outcomes in longitudinal studies [14–16]. However, cross-sectional associations are less consistent, and sleep quality may be influenced by factors other than BP per se,

such as obstructive sleep apnoea, stress, or medication use. Interestingly, hypertensive individuals who were unaware of their condition had marginally significantly lower odds of poor sleep compared with those aware, possibly reflecting heightened symptom perception, anxiety, or health-related concerns among those diagnosed.

Similarly, no significant associations were observed between sleep quality and anthropometric or body composition indicators, including BMI, overall and central adiposity measures, and SM mass, in contrast with a similar multi-ethnic large population study in Singapore [37]. Although obesity is strongly associated with sleep disorders such as obstructive sleep apnoea [43], subjective sleep quality does not always correlate directly with adiposity measures, particularly in community-based samples without formal sleep disorder assessment.

Study Strengths, Implications, and Limitations

This study leverages data from a relatively large community-based MMM campaign, providing contemporary insights into sleep health within the context of cardiovascular screening in Malaysia. The integration of detailed BP, anthropometric, body composition, and lifestyle data allowed for comprehensive adjustment of potential confounders.

Our findings highlight the need to address modifiable behaviours—particularly vaping and physical inactivity—in efforts to improve sleep health. These behaviours are amenable to intervention through counselling and community-based programmes and improving them may yield dual benefits for both sleep and cardiometabolic health. Given the bidirectional relationship between sleep and cardiovascular risk, incorporating brief sleep assessments into hypertension and cardiovascular screening initiatives could support early identification of at-risk individuals and strengthen integrated non-communicable disease prevention strategies.

This study has several limitations. Its cross-sectional design precludes causal inference, and sleep quality was assessed using a self-reported measure without objective verification. Hypertension status was based on single-visit BP measurements and/or self-report, which may lead to misclassification. Residual confounding from unmeasured factors such as socioeconomic status, mental health, and shift work cannot be excluded. The opportunistic sampling strategy and use of bioelectrical impedance analysis may limit generalisability and measurement precision. Potential selection bias may have also occurred, as health-conscious individuals were more likely to participate. Females were overrepresented in the sample, which may affect generalisability. Additionally, the study was conducted in the urban greater Klang Valley, limiting applicability to rural or other Malaysian populations.

Conclusions

In summary, approximately one in three MMM 2025 participants reported poor sleep quality. Minority ethnicity, current vaping, and lack of vigorous exercise were independently associated with poor sleep, whereas hypertension and anthropometric/body composition measures were not. These findings

highlight the need to incorporate sleep health promotion—particularly targeting modifiable lifestyle behaviours—into cardiovascular risk reduction strategies in Malaysia.

Abbreviations

B

PSQI—Brief Pittsburgh Sleep Quality Index

BMI

Body Mass Index

BP

Blood Pressure

BIA

Bioelectrical Impedance Analysis

CI

Confidence Interval

DBP

Diastolic Blood Pressure

IQR

Interquartile Range

MMM

May Measurement Month

OR

Odds Ratio

PSQI

Pittsburgh Sleep Quality Index

RM

Resting Metabolic Rate

SBP

Systolic Blood Pressure

SF

Subcutaneous Fat

SM

Skeletal Muscle

TBF

Total Body Fat

UMMC

Universiti Malaya Medical Centre

UPM

Universiti Putra Malaysia

VFL

Visceral Fat Level
WC
Waist Circumference
WHR
Waist—to—Hip Ratio
WHtR
Waist—to—Height Ratio

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the relevant institutional research ethics committee before data collection, i.e., UMMC Medical Research Ethics Committee (Approval number: MREC: 202535-14824), UPM Ethics Committee for Research Involving Human Subjects (Approval number: JKEUPM-2024-277), Sunway University Research Ethics Committee (Approval number: 2025/REC0104). Written informed consent was obtained from all participants before enrolment.

Consent for publication

Not applicable

Availability of data and materials

The datasets used and analysed during the current study are available from the corresponding author on reasonable requests.

Competing interests

All authors declare that they have no competing interests.

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Authors' contributions

Conceptualization: YCC; Methodology: YHS and YCC; Data collection: YHS, HCB, KC, MHC, JJ, and SMC; Formal analysis: YHS and YCC; Writing - original draft preparation: YHS and YCC; Writing - review and editing: YHS, HCB, KC, MHC, JJ, SMC, and YCC; Supervision: YCC. All authors have read and agreed to the published version of the manuscript.

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