



Relationship Between Sedentary Behaviors and Sleep Duration in University Students from Five ASEAN Countries

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Abstract

Background: Sedentary behavior may negatively affect sleep.

Objectives: This study aimed to assess the effects of sedentary behavior and its different domains on sleep duration in ASEAN university students.

Methods: A cross-sectional survey in 2015 included 3266 university students from Indonesia, Malaysia, Myanmar, Thailand and Vietnam, median age 20.0 years (interquartile range 3.0 years).

Results: Overall, 50.8% of university students had normal sleep (7-9 hours), 44.8% short sleep (≤ 6 hours) and 4.4% long sleep (≥ 10 hours); 24.2% engaged in < 4 hours overall sedentary time a day, 43.3% in 4 to < 8 hours, 21.8% in 8 to < 11 hours and 11.8% in 11 or more hours overall sedentary behavior a day. In multinomial logistic regression analysis, ≥ 11 hours and more overall sedentary behavior a day, ≥ 4 hours overall internet use a day, ≥ 2 hours internet use for study a day, ≥ 5 hours internet for leisure, and ≥ 7 hours smartphone use a day were associated with short sleep. In addition, ≥ 5 hours internet for leisure, 2-3 hours internet use for study and 3-6 hours smartphone use a day were associated with long sleep. Overall, sedentary behavior was negatively associated with long sleep.

Conclusions: The study showed that sedentary behaviors and its different domains were associated with short sleep, while smartphone use, internet use for study and for leisure were positively, while overall sedentary behavior negatively associated with long sleep.

Keywords: Sedentary Behaviors, Sleep Duration, University Students, ASEAN

1. Background

High sedentary behavior, and both short sleep (< 7 hours) and long sleep (> 9 hours) are associated with morbidity and mortality. "Sedentary behavior refers to certain activities in a reclining, seated, or lying position requiring very low energy expenditure. It has been suggested to be distinct from physical inactivity and an independent predictor of metabolic risk even if an individual meets current physical activity guidelines" (1). In a systematic review "strong evidence of a relationship was found between sedentary behavior and all-cause mortality, fatal and non-fatal cardiovascular disease, type 2 diabetes and metabolic syndrome" (2). Both short and long sleep durations can increase the risk of morbidity (diabetes mellitus, cardiovascular disease, coronary heart disease, and obesity) and mortality (3, 4).

In a recent meta-analysis, sedentary behavior in-

creased the odds for insomnia and sleep disturbance (5), but less is known about the relationship between sedentary behavior and short or long sleep (6, 7). Among secondary-school students (15-19 years) in Saudi Arabia, high screen time was associated with daily sleep of 8 hours or longer (8). In a study among 2100 university students from Zagreb, "sedentary behavior in screen-time and total sedentary behavior were associated with both 'short' and 'long' sleep duration" (6). In a survey among adults (N = 6037) in five urban regions in Europe, an association was found between higher sedentary screen time (not for total or other sedentary behavior domains) and short sleep (7). "Computer use and time spent talking on the phone" among adolescents were associated with short sleep (9). In a study among young adults in Canada, sedentary behavior was not correlated with sleep duration (10). It appears that specific domains of sedentary behavior have different effects on short or long sleep duration (7).

2. Objectives

This study aimed to assess the effects of sedentary behavior and its different domains on sleep duration in ASEAN university students.

3. Materials and Methods

3.1. Study Design, Participants, and Procedure

A cross-sectional survey in 2015 included 3,266 university students from five ASEAN countries (Indonesia, Malaysia, Myanmar, Thailand, and Vietnam), median age 20.0 years (interquartile range 3.0 years). Details of the sampling and data collection procedures have been described previously (11). In brief, the questionnaire was available in English, then translated and back-translated into the languages of the participating study countries (Bahasa, Burmese, Thai, and Vietnamese) (11). In each participating country, the undergraduate students were studied in classrooms selected through a stratified random sample procedure (11). Each university department formed a cluster and was utilized as a primary sampling unit (11). For each selected department, the undergraduate courses offered by the department were randomly ordered (11). External research assistants asked classes of undergraduate students to complete the questionnaire at the end of a lecture period (11). Informed consent was attained from all participating students, and ethics approvals were obtained from all participating universities: The Ethics Committee of the University of Health Sciences, University of Malaya Medical Ethics Committee (MECID 201412-905), Research and Ethical Committee of University of Medicine 1, Committee for Research Ethics (Social Sciences) of Mahidol University (MU-SSIRB 2015/ 116 (B2), Committee of Research Ethics of Hanoi School of Public Health, and Research Ethics Committee, Faculty of Medicine and Health Sciences, Universitas Muhammadiyah Yogyakarta.

3.2. Measures

3.2.1. Outcome Variable

Sleep duration: "Students were asked, on average, how many hours of sleep do you get in a 24 h period?" (12). Responses were divided into three categories: normal sleep (7 - 9 hours), short sleep (≤ 6 h), and long sleep (≥ 10 h) (13).

3.2.2. Exposure Variables

Overall sedentary behavior: The "International Physical Activity Questionnaire (IPAQ) short form" (14) was used to assess sedentary behavior: "During the last 7 days, how much time did you usually spend sitting on a weekday?"

Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television." Sedentary time was categorized into < 4 hours, $4 \leq 8$ hours, $8 \leq 11$ hours, and 11 or more hours a day (15).

Overall internet use: It was measured with the question, "How many hours do you normally spend in a day on the internet?" Overall, number of hours; for professional or study purposes, number of hours; for recreational or personal use, number of hours.

Smartphone use: Time spent on a smartphone was measured with the question, "How many hours do you normally spend in a day?" (Number of hours)

3.2.3. Confounding Variables

Sociodemographic items consisted of age, sex, and subjective wealth status (12). Tobacco use was measured with the item: "Do you currently use one or more of the following tobacco products (cigarettes, snuff, chewing tobacco, cigars, etc.?)" Response options were "yes" or "no" (16).

Binge alcohol use was assessed with the question, "How often do you have (for men) five or more and (for women) four or more drinks on one occasion?" (17) Any binge drinking in the past month was included in this analysis.

Physical activity was assessed with the "International Physical Activity Questionnaire (IPAQ-SF) short-form questionnaire" (14). Following the IPAQ manual, students were classified into three levels of physical activity, low, moderate, and high (18). In a validation study among Vietnamese adults, the IPAQ-SF was found to have acceptable criterion validity (19).

3.2.4. Other Health Factors

Body mass index (BMI) was assessed by standard anthropometric measurements was classified following Asian criteria: "underweight (< 18.50 kg/m²), normal weight (18.50 to 22.99 kg/m²), overweight (23.00 to 24.99 kg/m²), and 25.00 + kg/m² as obese" (20).

Self-rated health status was assessed with the item, "In general, would you say that your health is excellent, very good, good, fair or poor" (21). Responses were dichotomised into 0 = excellent-fair and 1 = poor.

Depressive symptoms were measured with the 10-item "Center for Epidemiologic Studies Depression Scale (CES-D-10)" (22). Scores of 15 or more were classified as severe depressive symptoms (22), Cronbach's $\alpha = 0.69$ (ranging from 0.60 in Indonesia to 0.73 in Malaysia). In validation studies in Malaysia (23) and Vietnam (24), the

CES-D showed good validity and reliability for depression, and the CES-D-10 showed good cross-cultural validity among university students across 27 low- and middle-income countries, including the study countries (25).

3.3. Statistical Analysis

Data analysis was conducted with STATA software version 14.0 (Stata Corporation, College Station, TX, USA). Descriptive statistics were used for the frequency, medians and interquartile range of the sample. Differences in proportions were calculated using Pearson's χ^2 -tests. Multinomial logistic regression was used to assess the association between different sedentary behavior domains and short and long sleep, while normal sleep was the reference category. All models were adjusted for confounding variables, including country, age, sex, wealth status, tobacco use, binge drinking, physical activity, BMI, depression and self-reported health status. No interactions and multicollinearity were found. $P < 0.05$ was considered significant.

4. Results

4.1. Sample Characteristics

Sample characteristics and sleep duration categories are shown in Table 1. Overall, 50.8% of the university students had normal sleep (7-9 hours), 44.8% short sleep (≤ 6 hours), and 4.4% long sleep (≥ 9 hours) (Table 1).

The prevalence of sedentary times in different sedentary domains is described in Table 2. For example, 24.2% engaged in < 4 hours overall sedentary time a day, 43.3% in 4 to < 8 hours, 21.8% in 8 to < 11 hours and 11.8% in 11 or more hours overall sedentary behavior a day. The highest percentage of short sleepers was found for all of the five different highest sedentary domains. For example, among the four overall sedentary domains, the highest prevalence of short sleepers (47.3%) was found for the highest overall sedentary domain (≥ 11 hours and more). Compared with the lowest category of each of the five sedentary domains (overall sedentary, overall internet use, internet use for study, internet use for leisure and smartphone use), students in the highest sedentary category had the highest prevalence of short sleep. The reverse was the case for the highest sedentary category of overall sedentary behavior and internet use for study had the lowest prevalence of long sleep (Table 2).

4.1.2. Associations with Short and Long Sleep

In multinomial logistic regression analysis, ≥ 11 hours and more overall sedentary behavior a day, ≥ 4 hours overall internet use a day, ≥ 2 hours internet use for study a day,

Table 1. Sample characteristics

Variable	Sample, No. (%)	Sleep Duration, %		
		7-9 hrs	≤ 6 hrs	≥ 10 hrs
All	3266	50.8	44.8	4.4
Sociodemographic Factors				
Country				
Indonesia	231 (7.0)	35.1	60.6	4.3
Malaysia	1023 (31.1)	39.9	58.0	2.2
Myanmar	433 (13.2)	40.8	51.8	7.3
Thailand	762 (23.9)	69.2	26.8	4.0
Vietnam	817 (24.8)	68.1	26.6	5.3
Age in years				
18-19	958 (29.6)	45.6	47.9	6.5
20-21	1451 (44.3)	50.9	45.8	3.2
22-30	857 (26.1)	56.5	39.4	4.1
Sex				
Female	2040 (62.6)	49.4	46.0	4.7
Male	1226 (37.4)	53.3	42.7	4.0
Wealth status				
Low	2174 (66.8)	54.2	40.7	5.1
High	1092 (33.2)	44.0	52.8	3.1
Lifestyle factors				
Current tobacco use				
No	3179 (97.7)	51.2	44.4	4.4
Yes	76 (2.3)	36.8	56.6	6.6
Binge drinking (past month)				
No	3184 (97.5)	51.1	44.5	4.4
Yes	82 (2.5)	40.2	53.7	6.1
Physical activity				
Low	1747 (49.9)	48.9	46.8	4.3
Moderate	1001 (34.4)	53.9	42.3	3.8
High	493 (15.7)	51.5	42.2	6.3
Other Health Factors				
Self-rated health status				
Moderate/good	3175 (97.3)	50.9	44.6	4.5
Poor	89 (2.7)	47.2	50.6	2.2
Body mass index				
Normal	1803 (56.6)	52.0	42.6	5.3
Underweight	671 (21.1)	51.7	43.7	4.6
Overweight	316 (9.9)	45.5	51.0	3.5
Obesity	393 (10.4)	42.0	55.7	2.3
Depressive symptoms				
No	2923 (89.4)	51.9	43.7	4.4
Yes	343 (10.6)	41.7	54.2	4.1

≥ 5 hours internet for leisure, and ≥ 7 hours smartphone use a day were associated with short sleep. In addition, ≥ 5

Table 2. Sedentary Behavior Domains by Sleep Duration Categories (N = 3,266)

Sedentary Domain	Total Sample, No. (%)	Normal Sleepers, No. (%)	Short Sleepers, No. (%)	Long Sleepers, No. (%)	P Value
Overall sedentary					
< 4	787 (24.2)	412 (52.4)	316 (40.2)	58 (7.4)	< 0.001
4 - < 8	1414 (43.3)	771 (54.5)	560 (39.9)	79 (5.6)	
8 - < 11	712 (21.8)	383 (53.8)	287 (40.3)	42 (5.9)	
≥ 11	385 (11.8)	186 (48.2)	182 (47.3)	17 (4.5)	
Overall internet use					
≤ 3	1068 (32.7)	616 (57.5)	404 (37.7)	51 (4.8)	< 0.001
4 - 6	1202 (36.8)	637 (52.9)	521 (43.2)	47 (3.9)	
≥ 7	996 (30.5)	407 (41.1)	537 (54.2)	46 (4.6)	
Internet use: study					
≤ 1	1193 (37.1)	713 (60.1)	425 (35.8)	49 (4.1)	< 0.001
2 - 3	1308 (40.6)	588 (45.2)	647 (49.8)	65 (5.0)	
≥ 4	718 (22.3)	317 (44.7)	368 (51.9)	24 (3.4)	
Internet use: leisure					
≤ 2	1330 (41.1)	712 (53.5)	568 (42.7)	51 (3.8)	< 0.001
3 - 5	947 (29.3)	517 (54.5)	394 (41.6)	37 (3.9)	
≥ 5	960 (29.7)	400 (42.4)	490 (52.0)	53 (5.6)	
Smartphone use					
≤ 2	877 (26.9)	504 (57.3)	345 (39.2)	31 (3.5)	< 0.001
3 - 6	1273 (38.6)	679 (53.2)	532 (41.7)	65 (5.1)	
≥ 7	1112 (34.1)	472 (42.8)	586 (53.1)	46 (4.2)	

hours internet for leisure, 2 - 3 hours internet use for study and 3 - 6 hours smartphone use a day were associated with long sleep. Overall, sedentary behavior was negatively associated with long sleep (Table 3).

5. Discussion

The study focused on studying the relationship between sedentary behavior and sleep duration in a large university student population in five ASEAN countries. The study showed that increased overall sedentary behavior, overall internet use, internet use for study, internet use for leisure and smartphone use increased the odds for short sleep. These findings are consistent with a number of previous studies in adolescents and adults (6-8), conforming the increased risk for short sleep to increased sedentary behaviors. Some previous studies (7, 10) found that only screen time and not overall sedentary behavior and sedentary behaviors in non-screen time domains were associated with short sleep, while in this study the association existed for overall sedentary behavior as well as screen time.

The study found that increased smartphone use, internet use for study and for leisure increased and overall sedentary behavior decreased the odds for a long sleep. Similarly, among university students in Zagreb, sedentary behavior in screen-time and total sedentary behavior were associated with long sleep (6). The latter finding may be

explained due to the small sample size of long sleepers in this study. It could be assumed that university students in this study mainly used sedentary behavior time as screen-based sedentary time (internet use and smartphone use and possibly television watching, which was not independently assessed in this study). Several mechanisms have been proposed for explaining the link between increased screen time and short or long sleep, e.g., the emission of blue light from screens possibly suppresses the secretion of melatonin and delays sleep onset and the interaction with social media may stimulate the wake system (26, 27).

Study limitations were comprised that the study was cross-sectional, so no causal conclusions can be drawn between sedentary behavior and sleep duration. Participating universities were conveniently selected, and university students are a selective group of young adults in general, and the prevalence of sedentary behavior and sleep duration may be different in other groups of young adults. The measures utilized in this study were based on self-report, e.g., on sedentary behaviors and sleep duration, and more elaborate measures with objective verification should be used in the future.

5.1. Conclusions

The study showed that sedentary behaviors and its different domains were associated with short sleep, while smartphone use, internet use for study and for leisure were

Tables 3. Associations with Short and Long Sleep, with Normal Sleep as Reference Category

Sedentary Domain Hours/Day	Short Sleepers vs. Normal Sleepers		Long Sleepers vs. Normal Sleepers	
	AOR (95% CI) ^a	P Value	AOR (95% CI)	P Value
Overall sedentary				
< 4	1 (Reference)		1 (Reference)	
4 - < 8	0.97 (0.88, 1.08)	0.603	0.71 (0.58, 0.87)	< 0.001
8 - < 11	0.95 (0.85, 1.07)	0.381	0.78 (0.62, 0.99)	0.039
≥ 11	1.28 (1.12, 1.46)	< 0.001	0.62 (0.45, 0.84)	0.043
Overall internet use				
≤ 3	1 (Reference)		1 (Reference)	
4 - 6	1.22 (1.02, 1.45)	0.029	0.89 (0.59, 1.35)	0.590
≥ 7	1.83 (1.52, 2.20)	< 0.001	1.31 (0.85, 2.02)	0.216
Internet use: study				
≤ 1	1 (Reference)		1 (Reference)	
2 - 3	1.76 (1.48, 2.08)	< 0.001	1.80 (1.08, 2.37)	0.020
≥ 4	1.79 (1.47, 2.19)	< 0.001	1.11 (0.66, 1.86)	0.699
Internet use: leisure				
≤ 2	1 (Reference)		1 (Reference)	
3 - 5	0.88 (0.74, 1.05)	0.144	0.94 (0.60, 1.46)	0.779
≥ 5	1.37 (1.15, 1.63)	< 0.001	1.65 (1.09, 2.56)	0.018
Smartphone use				
≤ 2	1 (Reference)		1 (Reference)	
3 - 6	1.08 (0.90, 1.39)	0.398	1.60 (1.02, 2.52)	0.040
≥ 7	1.61 (1.33, 1.95)	< 0.001	1.58 (0.97, 2.57)	0.065

^aAOR: Adjusted Odds Ratio; Adjusted for country, age, sex, wealth status, tobacco use, binge drinking, physical activity, BMI, depression and self-reported health status

positively, while overall sedentary behavior negatively associated with long sleep.

Footnotes

Authors' Contribution: Supa Pengpid and Karl Peltzer designed the study and analyzed the data and wrote the manuscript. All authors read and approved the final version of the manuscript.

Declaration of Interest: The authors declared no conflicts of interest.

Ethical Approval: Ethics approvals were obtained from all participating universities: The Ethics Committee of the University of Health Sciences, University of Malaya Medical Ethics Committee (MECID 201412-905), Research and Ethical Committee of University of Medicine 1, Committee for Research Ethics (Social Sciences) of Mahidol University (MU-SSIRB 2015/116 (B2)), Committee of Research Ethics of Hanoi School of Public Health, and Research Ethics Committee, Faculty of Medicine and Health Sciences, Universitas Muhammadiyah Yogyakarta.

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Patient Consent: Informed consent was attained from all participating students.

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