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Factors associated with physical activity time among adolescents in Ho Chi Minh City, Vietnam

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ABSTRACT

Previous studies on factors associated with physical activity among adolescents in Ho Chi Minh City have lacked a specific framework. This study aimed to assess factors associated with moderate and vigorous physical activity time among Ho Chi Minh City's adolescents. We used the Health Belief Model to develop a more comprehensive survey. This cross-sectional study, conducted from January to May 2023, analyzed data from 301 students. Variables were measured using a self-management questionnaire with three sections: socioeconomics, physical activity, and the Health Belief Model. This study found that adolescents spent an average of 54.7 minutes per day engaging in moderate to vigorous physical activity. This duration was independently associated with convenience (Coefficient = 5.49; p = 0.002), self-efficacy (Coefficient = 5.63; p<0.001), having an exercise companion (Coefficient = 16.98; p<0.001), and the perception that more than 60 minutes of daily activity is needed (Coefficient = 16.82; p<0.001). The Health Belief Model has the potential to explain the time spent in moderate to vigorous physical activity among adolescents in Ho Chi Minh City. Self-efficacy, convenience, companionship, and perceptions of appropriate physical activity duration should be considered when developing intervention programs.

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1. INTRODUCTION

The World Health Organization (WHO) defines physical activity (PA) as "any bodily movement produced by skeletal muscles that requires energy expenditure" [1]. Physical activity is crucial for health, yet insufficient PA among adolescents remains a significant global public health issue. A pooled analysis of 298 population-based surveys from 2016 indicated that 81% of adolescents aged 11-17 worldwide did not meet the recommended levels of PA [2]. In Vietnam, the prevalence of insufficient PA remained above 75% from 2001 to 2019 [2], [3]. Ho Chi Minh City (HCMC), one of Vietnam's megacities, faces low levels of PA among adolescents. In 2020, studies of Trinh NTN revealed that the average moderate-to-vigorous physical activity (MVPA) time among 6 grade students in HCMC remained below 55 minutes per day [4], and more than 70% students spent over 120 min/day on sedentary activities [5]. In 2022, Linh LHH's study presented more favorable outcomes, with only 32.4% of junior students at HCMC only spending ≤60 minutes/day on MVPA [6]. Addressing this issue is crucial, as the WHO set a 15% reduction target in global insufficient PA by 2030 [7].

Developing evidence-based intervention programs is essential for achieving the target of PA. Theoretical frameworks are crucial tools for assessing factors associated with time spent on PA. Evidence shows that the health belief model (HBM), a psychological framework, effectively explains PA among adults [8]-[10] and adolescents [11], [12] through perceived threats, benefits, barriers, cues to action, and self-efficacy. These studies have demonstrated the great potential of the HBM in assessing and developing intervention models to improve physical activity among adolescents and adults.

Prior studies in HCMC and Vietnam identified several factors associated with insufficient PA among adolescents, including lack-of knowledge and health education, passive transportation, insufficient PA time (e.g., spending too much time on self-study, playing video games, or watching television), lack of encouragement and support from parents, lack of companions (e.g., parents, siblings, or friends), lack of playgrounds [6], [13]-[15]. These findings might be incomplete due to the lack of a specific framework such as HBM. This study aimed to assess factors associated with PA time among HCMC adolescents. We used the HBM to develop a more comprehensive survey. This allows for a comprehensive understanding of the factors associated to PA, leading to the development of more effective intervention programs.

2. METHOD

2.1. Setting

This study represented the initial phase of an intervention project targeting PA among adolescents in Ho Chi Minh City, Vietnam. Intervention programs need to be developed based on evidence appropriate to the population. Among Ho Chi Minh City adolescents, previous studies on factors associated with PA might be incomplete due to the lack of a specific theoretical framework. Based on the Health Belief Model, the findings provide evidence to inform the development of effective intervention strategies.

2.3. Study design and ethical approval

The cross-sectional study was conducted from January to May 2023. The protocol was approved by the Ethical Board of Pham Ngoc Thach University of Medicine (Approval No. 504/TĐHYKPNT-HĐĐĐ, signed on April 6, 2021). This report adheres to the STROBE checklist for cross-sectional studies [16].

2.4. Participants

Participants included students aged 11-15 years from two junior high schools in HCMC. Inclusion criteria required consent from both the student and their guardian. Students with mobility disabilities or those absent on survey days were excluded.

2.5. Sample size and recruitment

The sample size was calculated to ensure a minimum of 10 observations for each variable in the model. Given that the HBM questionnaire employed in the study consisted of 30 questions, we established the minimum sample size for our study at 300 participants [17], [18]. In each school, we randomly selected four classes from grades 6, 7, 8, and 9. We invited all students, roughly 40 per class, to participate. Students received an introductory letter and a consent form for their guardians. On the day of the survey, students submitted the signed consent forms to the study collaborators. We included only those students who consented to participate and whose guardians also agreed.

2.6. Data collection and variable definitions

Variables were measured using a self-report questionnaire. Study collaborators instructed all students to complete the questionnaire in class. The questionnaire consisted of 47 items, three sections: socioeconomics (10 items), PA (7 items), and HBM (30 items). On average, students completed the questionnaire within 30-45 minutes. The reliance on self-reported data introduces the potential for recall bias (information bias). To mitigate this bias, data collection was conducted in class under the supervision of two trained study volunteers, who were responsible for instructing and explaining the self-report process to the students.

Time spent on PA was assessed using the Vietnamese adolescent physical activity recall questionnaire (V-APARQ). The V-APARQ has demonstrated high reliability and validity among Vietnamese adolescents. Recently, the V-APARQ was used in a study among adolescents in HCMC in 2020 and 2022 [6], [15]. Using the V-APARQ, students reported the time spent in organized and non-organized PA during a typical week in summer and school terms. The duration and frequency of each activity were reported. Time spent in MVPA was quantified in minutes per day, based on the compendium of physical activities [19]-[21].

The HBM was assessed across six domains: perceived threat (6 items), perceived benefits (6 items), barriers (3 items), conveniences (7 items), cues to action (2 items), and self-efficacy (6 items). The conveniences domain, which serves as the antonym of barriers, is an additional component. This HBM scale

was developed with reference to the study by Wu *et al.* [22]. The scale was translated and back-translated in parallel by two contributors. Items were evaluated using a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). Domain scores were calculated by averaging the items within each domain. The overall internal reliability of the HBM scale was 0.82, as indicated by Cronbach's alpha based on the data from this study.

2.7. Data analysis

The data were analyzed using STATA version 16. All students with any missing data on HBM or MVPA time were excluded from the analysis. Socioeconomic characteristics were presented as frequencies and percentages. MVPA time and HBM item scores were described using means and standard deviations. T-tests and ANOVA were used to assess differences in MVPA across groups. Poisson correlation was used to evaluate the association between HBM items and domains with MVPA time. Multivariable linear regression, adjusted for socioeconomic characteristics and refined through a stepwise backward procedure, was conducted to examine the independent association between HBM domains and MVPA time. A p-value of less than 0.05 was considered statistically significant.

3. RESULTS AND DISCUSSION

3.1. Results

A total of 326 students from eight selected classes were initially identified. After excluding 12 students (3.7%) due to a lack of consent from both the students and their guardians, the survey was administered to 314 students. An additional 13 students (4%) were excluded due to missing data on PA or the HBM. Ultimately, data from 301 students were analyzed, resulting in a response rate of 92.3% as shown in Figure 1.

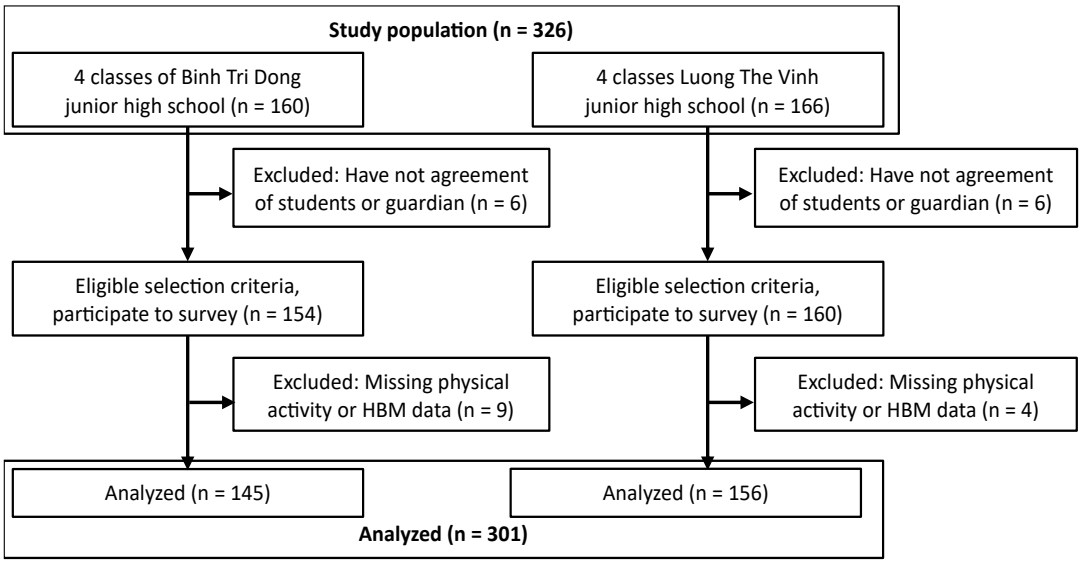

Figure 1. Sampling flow chart

Nearly half of the students (47.5%) are male, and 48.8% have a BMI within the normal range. In contrast, 32.6% are classified as underweight, while 18.6% are overweight or obese. The distribution across grade levels is balanced, with each grade comprising approximately 25% of the total. Regarding parental exercise habits, 41.9% of fathers and 39.5% of mothers engage in regular exercise. Over half of the students (54.5%) usually have an exercise companion. Notably, the majority of students (77.4%) perceive that less than 60 minutes of PA per day is adequate, as shown in Table 1.

The average MVPA time was 53.7±19.9 minutes/day, significantly lower than the WHO's recommended 60 minutes/day. Approximately 50.5% of students engaged in MVPA for ≤ 60 minutes/day. Significant differences in MVPA time were observed across various characteristics. Grade 6 students exhibited the highest MVPA levels (64.2±18.9 minutes), significantly outperforming other grades ($p<0.001$). Gender disparities were apparent, with males engaging in more MVPA (58.0±22.9 minutes) than females (51.8±17.1 minutes, $p=0.008$). Parental exercise habits were associated with students' PA;

those with fathers (60.8±21.8 minutes) or mothers (60.1±22.4 minutes) who exercised regularly reported higher MVPA time than those without such influences (p<0.001). The presence of an exercise companion also positively impacted MVPA (65.8±13.2 minutes with companions vs. 41.5±19.4 minutes without, p<0.001). Students' perceptions of appropriate PA duration were linked to their activity levels; those considering more than 60 minutes/day ideal had the highest MVPA (67.7±21.3 minutes, p<0.001). Furthermore, the mode of transportation to school was a significant factor; students who walked or cycled reported more MVPA (65.4±19.2 minutes) than those who rode motorcycles (48.5±18.5 minutes, p<0.001) as shown in Table 1.

Table 1. Univariate analysis of moderate and vigorous physical activity time and associated factors (n = 301)

Socio-economic characteristics		MVPA time (minutes/day)		p-value
Sub-groups	n (%)	Mean±SD	Differences (95%CI)	
Overall	301 (100)	54.7±20.3	-5.28 ((-7.58) – (-5.98))	<0.001
WHO recommendation[8]		60	*Reference*	
Gender				
Male	143 (47.5)	58.0±22.9	6.2 (1.7 – 10.8)	0.008
Female	158 (52.5)	51.8±17.1	*Reference*	
BMI group				
Normal	147 (48.8)	54.3±18.3	*Reference*	
Underweight	98 (32.6)	54.1±21.0	- 0.3 ((-5.5) – (4.9))	0.914
Overweight/Obesity	56 (18.6)	54.3±18.3	2.5 ((-3.8) – (8.8))	0.433
Grade				
Grade 6 (11 – 12 years old)	76 (25.2)	64.2±18.9	12.2 (18.4 – 6.0)	<0.001
Grade 7 (12 – 13 years old)	72 (23.9)	54.7±18.7	2.7 (8.9 – 3.6)	0.406
Grade 8 (13 – 14 years old)	76 (25.2)	48.0±19.4	-4.1 ((2.1) – (-10.2))	0.198
Grade 9 (14 – 15 years old)	77 (25.6)	52.0±20.7	*Reference*	
Regularly exercising father				
True	126 (41.9)	60.8±21.8	10.4 (5.0 – 15.0)	<0.001
False	175 (58.1)	50.4±17.9	*Reference*	
Regularly exercising mother				
True	119 (39.5)	60.1±22.4	8.8 (4.0 – 13.4)	<0.001
False	182 (60.5)	51.2±18.0	*Reference*	
Having an exercise companion				
True	164 (54.5)	65.8±13.2	24.2 (20.4 – 28.1)	<0.001
False	137 (45.5)	41.5±19.4	*Reference*	
Perception about appropriate PA time				
Do not need physical activity	22 (7.3)	36.2±23.8	*Reference*	
Lower than 60 minutes/day	233 (77.4)	48.9±19.7	12.7 (6.1 – 19.3)	<0.001
More than 60 minutes/day	46 (15.3)	67.7±21.3	31.5 (24.7 – 38.4)	<0.001
Vehicle to school				
Motorcycle	187 (62.1)	48.5±18.5	*Reference*	
Walking or Bicycle	108 (35.9)	65.4±19.2	16.9 (12.5 – 21.4)	<0.001
Public transport (bus)	6 (2.0)	56.3±9.4	7.8 (-7.4 – 23.1)	0.311

SD represents the standard deviation; 95%CI denotes the 95% confidence interval

The analysis revealed significant associations between HBM items and MVPA time. Three of the six items in the "perceived threat" dimension positively correlated with MVPA time, including perceiving negative effects on health, perceiving the risk of overweight and obesity caused by physical inactivity, and feeling bored due to physical inactivity (R ranging from 0.120 to 0.178, p ranging from 0.037 to 0.002). Three of the six items in the "perceived benefit" dimension positively correlated with MVPA time, including perceiving health benefits, health improvement, and helping to achieve a healthy weight through PA (R ranging from 0.142 to 0.178, p ranging from 0.014 to 0.002). Six of the seven items in the "convenience" dimension positively correlated with MVPA time, including having convenient areas, parks, or open spaces near home for PA, easily finding suitable locations nearby for PA, family often engage in PA together, having suitable method for PA, have enough time for PA (R ranging from 0.163 to 0.261, p ranging from 0.005 to <0.001). All three items in the "barriers" dimension negatively correlated with MVPA time (R ranging from -0.195 to -0.261, p<0.001), indicating that students with lower levels of barriers engaged in higher MVPA time. All six items in the "self-efficacy" dimension positively correlated with MVPA time (R ranging from 0.131 to 0.280, p ranging from 0.023 to <0.001), indicating that students with higher levels of self-efficacy engaged in higher MVPA time. All two items in the "cues to action" dimension were insignificantly associated with MVPA time, as shown in Table 2.

Multivariable linear regression analysis revealed significant associations between two HBM domains and two additional factors with MVPA time. Higher self-efficacy (Coefficient = 5.63; 95% CI:

2.82–8.44; p<0.001) and perceived convenience of exercise (Coefficient = 5.49; 95% CI: 2.07–8.91; p = 0.002) were correlated with increased MVPA time. Similarly, having an exercise companion (Coefficient = 16.82; 95% CI: 12.92–20.72; p<0.001) and the belief in the necessity of more than 60 minutes of daily activity (Coefficient = 16.98; 95% CI: 10.61–23.35; p<0.001) were associated with higher MVPA time. Conversely, students who perceived no need for PA or who engaged in less than 60 minutes per day reported lower MVPA time. The study also indicated that a combination of self-efficacy and convenience from the HBM, along with specific perceptual and environmental factors, explained 50.3% of the variance in MVPA time as shown in Table 3.

Table 2. Associations between health belief model and moderate and vigorous physical activity time (n = 301)

Item	Description	Item score	MVPA time	
		Mean±SD	R	p-value
	Perceived threat	3.59±0.69	0.129	0.025
21	Physical inactivity increases the risk of overweight and obesity	2.97±1.08	0.178	0.002
20	Physical inactivity makes me feel bored	3.64±1.02	0.127	0.027
16	Physical inactivity will negatively affect health	3.97±1.02	0.120	0.037
18	Physical inactivity causes my weight to increase	3.97±1.03	0.062	0.285
19	Physical inactivity limits my physical development	3.33±1.19	0.027	0.636
17	Physical inactivity makes me feel sluggish and tired	3.67±1.04	0.004	0.948
	Perceived benefits	4.14±0.68	0.180	0.002
22	Physical activity brings health benefits to me	4.38±0.90	0.178	0.002
25	Daily physical activity helps me achieve a healthy weight	4.03±1.00	0.164	0.004
23	Daily physical activity will improve my health	4.33±0.95	0.142	0.014
26	Daily physical activity helps me improve physical health	4.15±0.96	0.109	0.060
24	Daily physical activity helps me prevent overweight and obesity	4.22±0.95	0.102	0.077
27	Daily physical activity helps me feel happier and more refreshed	3.73±0.98	0.075	0.194
	Conveniences	3.14±0.56	0.398	<0.001
14	Having suitable method for physical activity	3.30±1.15	0.261	<0.001
11	Convenient areas near my home for physical activity	3.11±1.26	0.218	<0.001
13	Have enough time for physical activity	2.92±1.25	0.212	<0.001
9	Easily find suitable locations nearby for physical activity	2.95±1.10	0.195	<0.001
15	My family often engage in physical activity together	3.07±1.16	0.167	0.004
10	Parks or open spaces near my home for physical activity	3.12±1.22	0.163	0.005
12	The schoolyard is convenient for physical activity	3.51±1.18	0.088	0.126
	Barriers	3.14±0.72	-0.355	<0.001
30	Feeling too lazy for physical activities	3.33±1.11	-0.260	<0.001
29	Physical activities are not safe for me	2.60±1.06	-0.259	<0.001
28	Physical activities make me too tired	2.65±1.05	-0.195	<0.001
	Self-efficacy	3.20±0.66	0.332	<0.001
1	I belief that I can spend 60 minutes on daily physical activity	2.91±1.10	0.280	<0.001
6	I belief that I can increase my physical activity levels	3.01±1.07	0.262	<0.001
5	I belief that I can reduce sedentary time	3.05±1.10	0.219	<0.001
4	I belief that I can spend free time each day to physical activity	3.51±0.91	0.179	0.002
2	I belief that I can engage in physical activity even without a workout partner	3.22±1.12	0.176	0.002
3	I belief that I can schedule time for physical activity	3.50±0.98	0.131	0.023
	Cues to action	3.36±0.92	0.065	0.262
8	My family often encourage me to engage in physical activity	3.59±1.13	0.055	0.342
7	My friends often encourage me to engage in physical activity	3.14±1.08	0.053	0.356

SD represents the standard deviation; R indicates Pearson correlation

Table 3. Factors associated with moderate and vigorous physical activity time - multivariable linear regression (n = 301)

Characteristics	MVPA time		
	β	Coefficient (95% CI)	p-value
Self-efficacy	0.184	5.63 (2.82 – 8.44)	<0.001
Conveniences	0.151	5.49 (2.07 – 8.91)	0.002
Usually having an exercise companion	0.414	16.82 (12.92 – 20.72)	<0.001
Perception about appropriate PA time			
Do not need physical activity		*Reference*	
Lower than 60 minutes/day	0.232	9.41 (3.76 – 15.06)	0.001
More than 60 minutes/day	0.407	16.98 (10.61 – 23.35)	<0.001

β denote the standardized coefficient; 95%CI denote the 95% confidence interval; R-squared = 50.3%

3.2. Discussion

Ho Chi Minh City, one of Vietnam's two megacities, exhibits a low level of PA among adolescents. Our study revealed that junior high school students participated in an average of 53.7±19.9 minutes of

MVPA per day, which falls short of the World Health Organization's recommended 60 minutes for maintaining a healthy lifestyle. Multivariable linear regression analysis revealed that a combination of the self-efficacy and convenience domains of the health belief model, perceptions regarding the suitability of PA time, and the presence of an exercise companion accounted for 50.3% of the variance in MVPA time. These insights can inform the development of PA interventions for junior high school students in HCMC, Vietnam. Below, we discuss several key points related to the study's findings.

Our study revealed that nearly half of the students (47.5%) were male, with an even distribution across grade levels. These findings align with those of a previous study by Linh LHH et al. in two other junior high schools in HCMC in 2022. Although both studies were conducted in HCMC among the same populations, the prevalence of overweight and obesity in our study was 18.6%, which is considerably lower than the 46.5% reported by Linh LHH's study [6] and 45% to 56% reported by Ngoc-Trinh TN' study [5]. Some recent study in Vietnam on children aged 5 to 15 found that the prevalence of overweight and obesity ranged from 25% to 59% [23]-[25]. This discrepancy highlights the heterogeneity among school age children within HCMC and Vietnam. Consequently, caution is necessary when generalizing the results of our study.

In our study, approximately 50.5% of students engaged in MVPA for ≤60 minutes/day. Linh LHH's study presented more favorable outcomes, with only 32.4% of students spending ≤60 minutes/day on MVPA [6]. Another study by Trinh NTN revealed a low level of PA in 2020, with average MVPA time remaining below 55 minutes per day [4], and more than 70% students spent over 120 min/day on sedentary activities [5]. Collectively, our study, Linh LHH's, and Trinh NTN's studies highlight the lack of PA among junior high school students in HCMC, underscoring the critical need for interventions to promote PA.

Increasing PA among adolescents is a critical global goal, relevant to Vietnam and HCMC. Developing evidence-based intervention programs is crucial to achieving the aforementioned target. Theories and models serve as invaluable tools for experts in crafting such programs. Our study demonstrated the HBM significantly explain PA behaviors among adolescents in Ho Chi Minh City, Vietnam. Independent factors associated with MVPA time included: convenience (Coefficient=5.49; 95% CI: 2.07–8.91; p=0.002), self-efficacy (Coefficient = 5.63; 95% CI: 2.82–8.44; p<0.001), having an exercise companion (Coefficient = 16.98; 95% CI: 10.61–23.35; p<0.001), and perceiving the need for more than 60 minutes of daily activity (Coefficient=16.82; 95% CI: 12.92–20.72, p<0.001). The findings emphasized the role of perceived confidence in one's ability to engage in physical activities and the impact of environmental factors on adolescents' activity levels. Convenient access to spaces, facilities, and the availability of time, skill, and exercises positively influenced MVPA. Adolescents with higher self-efficacy beliefs and more convenient access spent more time in MVPA, consistent with the foundational principles of the HBM. Many previous studies among adolescents confirmed the association between self-efficacy and PA [26]-[30]. Additionally, the convenience of facilities, area, and social, family and peer support were associated with MVPA time [31]-[35]. These findings demonstrate a robust association between the MVPA time with HBM domains of self-efficacy and convenience. However, the application of HBM in previous studies among HCMC adolescents was lacking. Several studies in HCMC found many items associated with physical inactivity, including passive transportation, lack of PA time (e.g., spending too much time for self-study or playing video game or watching television), lack of encouragement and support from parent, lack of companion (e.g., parents, siblings, or friends), lack of playground [6], [13]-[15]. However, lacking a specific framework may lead to incompletely considering dimension, so the perceived threats, perceived benefits, self-efficacy, barrier and conveniences were not considered. In our study, the application of the HBM model is a new approach in Vietnam aimed at providing a more comprehensive assessment.

Additionally, in our study, perceptions of the appropriate duration for PA and the presence of an exercise companion were significantly associated with MVPA time (Coefficient = 16.98; 95% CI: 10.61–23.35; p<0.001 and coefficient = 16.82; 95% CI: 12.92–20.72, p<0.001, respectively). The association between PA time and having an exercise companion, including parents, siblings, and friends, was also evident in Linh LHH's study [6]. These factors, in conjunction with the HBM, accounted for 50.3% of the variance in MVPA duration according to the multivariable analysis in our study. The findings underscore the importance of incorporating the HBM and socioeconomic characteristics to elucidate PA behaviors in adolescents. Additionally, self-efficacy, convenience, companionship, and perceptions regarding suitable PA duration should be considered when developing intervention programs for schools in our study, with cautious generalization to Ho Chi Minh City.

3.3. Strengths and limitations

The application of the HBM model is a strength in our study. It helps to assess the influencing factors on PA more comprehensively and systematically. This compensates for the current limitations of studies in Vietnam, which do not rely on a specific model. We used a multivariable linear regression model to control confounding factors and to estimate correlations more accurately.

Our study has several limitations that warrant acknowledgment. First, the cross-sectional design limits our ability to infer causality. Second, the reliance on self-reported data introduces the potential for information bias. Third, the generalizability of our findings is limited, as our sample comprised participants from only two schools in two districts of HCMC. Consequently, caution is necessary when generalizing the results of our study.

4. CONCLUSION

This study revealed that junior high school students in HCMC fell short of the World Health Organization's recommended 60 minutes of MVPA. The application of the HBM has the potential to explain MVPA time among adolescents in HCMC. Self-efficacy, convenience, companionship, and perceptions of appropriate PA time associated with MVPA time. These factors should be considered when developing school-based intervention programs. In the future, the relationship between the HBM and PA, as well as the effectiveness of HBM-based interventions to promote PA, should continue to be assessed and expanded in coverage to allow for broader generalization to adolescents in Ho Chi Minh City and across Vietnam.

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AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

INFORMED CONSENT

We have obtained informed consent from all individuals included in this study.

ETHICAL APPROVAL

The research related to human use has been complied with all the relevant national regulations and institutional policies in accordance with the tenets of the Helsinki Declaration and has been approved by the authors' institutional review board or equivalent committee.

DATA AVAILABILITY

The data that support the findings of this study are available on request from the corresponding author, [HKT]. The data, which contain information that could compromise the privacy of research participants, are not publicly available due to certain restrictions.

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