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Background

Sufficient physical activity (PA), particularly in adolescence, not only helps reduce the risk of non-communicable diseases (NCDs) but also improves cardiovascular health and enhances mental well-being [1, 2]. Studies have shown that regular PA is associated with better academic performance, reduced stress levels, and improved social interactions in children and adolescents [3–5]. Despite these benefits, 80% of adolescents do not meet the PA level recommended by the World Health Organization (WHO) [6], which states that “children and adolescents should engage in at least 60 min per day of moderate-to-vigorous-intensity PA across the week” [7].

Demographic factors, for example, age, sex, and body mass index (BMI) are related to PA levels [8, 9]. In particular, boys are more physically active than girls, according to some researchers [8]. A study on PA among Filipino youth revealed that a significant proportion of girls, up to 87%, failed to adhere to the recommended guidelines for PA compared to only about 18% of boys [10]. In Vietnam, the gender gap in PA may be further exacerbated due to reduced independence among girls [11].

Psychological factors, including self-efficacy, beliefs, and social influence, play a crucial role in determining levels of PA [12]. Studies have shown that high self-efficacy and enjoyment are essential for sustaining long-term PA in children [13]. In addition, the support of parents and physical education teachers is positively associated with the activity levels of children [14, 15].

Another contributing factor to PA behavior among adolescents is their sedentary lifestyle. Previous research has mainly concentrated on monitoring sedentary behavior via multimedia technology; nonetheless, sedentary behavior occurs not only when one is utilizing technological gadgets [16]. Furthermore, differences in cultural norms and educational systems can impact the extent and nature of sedentary behaviors in children. This disparity is largely attributed to cultural values that prioritize academic achievement and place greater emphasis on academic subjects over PA [11].

Most PA studies have been conducted in developed countries, leaving a significant research gap in low- and middle-income countries. Although several studies have examined PA levels in Vietnamese children, they have primarily focused on prevalence rates rather than investigating the underlying determinants of PA participation. Furthermore, these studies lack hierarchical analytical approaches that account for the complex interactions between demographic, psychosocial, and sedentary behavior factors.

Compared to global averages, PA levels among Vietnamese adolescents remain substantially lower, with only 18.2% of students aged 13 to 15 and 21.3% of those aged

16 to 17 engaging in sufficient PA daily [17]. Addressing these gaps, this study aims to assess the prevalence of PA and the psychosocial correlates of PA and sedentary behavior among adolescents in Ho Chi Minh City, Vietnam. Findings from this study will contribute to the existing body of literature and provide insights into promoting a healthier, more active lifestyle among adolescents.

Methods

Study design and sample size

This study adhered to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines to ensure comprehensive reporting (Supplementary Material 1) [18]. A cross-sectional study was conducted on 6th-grade students at Nguyen Du Secondary School in Go Vap District from March to May 2023. We selected this location because Go Vap District is the second most populous district in Ho Chi Minh City [19], and Nguyen Du Secondary School is one of the public schools with large class sizes in the district.

The sample size was calculated using the formula by

students with congenital disabilities or acute or chronic illnesses that could affect their participation in the study and biometric measurements, and (2) students who provided less than 75% of the required responses in the questionnaire.

Measurements

Demographic and anthropometric data

After completing the questionnaire, students' weight and height were measured using a digital weighing scale (model HD 379, Tanita Corporation, Japan) and a stadiometer (model 26SM, Tamil Nadu, India), respectively. Each measurement was taken twice by a trained collaborator in the school environment, with weight recorded to 0.1 kg and height to 0.1 cm accuracy. BMI was calculated as weight (kg) divided by height (m) squared. Crude BMI was utilized in this study as an independent variable to examine the association between anthropometric traits and PA. Though BMI classification according to WHO or Centers for Disease Control and Prevention (CDC) percentiles is recommended for age- and sex-adjusted interpretations of children's physical status [24], crude BMI remains a reliable and accepted indicator for assessing the relationship between body composition and physical fitness in pediatric populations [25, 26].

Psychosocial factors related to PA

PA self-efficacy, family influence on PA, and beliefs in PA outcomes were assessed using a modified version of the Self-Efficacy, Social Influences, and Beliefs scales developed by Saunders et al. [12]. The PA self-efficacy included 16 items rated on a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree). PA self-efficacy score was calculated using the average score of all selected responses. The family influence on PA consisted of 8 items rated on a 5-point scale ranging from 1 (never)

Table 2 Participant characteristics and related factors in PA

Abbreviations: BMI Body mass index, PA Physical activity, PAQ-C Physical Activity Questionnaire for Older Children, SD Standard deviation

[†] Chi-square test and independent T-test were used to examine significant gender differences at p -value < 0.05

^① Data expressed as frequency (percentage)

^a Small screen recreation includes watching television/videos/DVDs and using a computer for fun (e-communications, e-games, internet surfing)

^b After-school education includes doing homework (on or off a computer) and out-of-school tutoring

^c Passive travel includes motorized travel (motorbike/car/bus)

^d

the model explained 7.2% of the variance in PA for the total sample [$F(2, 472) = 18.27, p < 0.001$]. We also found that BMI was the only significant negative predictor of the PAQ-C score for both boys and girls. In the second step, the model explained 65.9% of the variance [$F(7, 467) = 129.11, p < 0.001$], and its predictive power was significantly increased when psychosocial factors related to PA were included. For boys, self-efficacy, beliefs in PA outcome, and family influence were positive predictors of the PAQ-C score. In contrast, for girls, self-efficacy, enjoyment of PA, family influence, and teacher influence were positive predictors. In the final step, variables representing time spent on sedentary behavior were added. This addition improved the predictive power of the model, explaining 68.4% of the variance in PA

for the total sample [$F(12, 462) = 83.40, p < 0.001$]. Out of the five variables included, small screen recreation, after-school education, and social activities were identified as significant independent predictors. For boys, small screen recreation and after-school education were found to be positive predictors of the PAQ-C score. For girls, small screen recreation, after-school education, and social activities were identified as positive predictors.

Discussion

The purpose of this study was to examine the factors that influence PA in children using hierarchical regression analysis. The study focused on 475 6th-grade students in Ho Chi Minh City, Vietnam, and considered demographic, psychosocial, and sedentary behavior

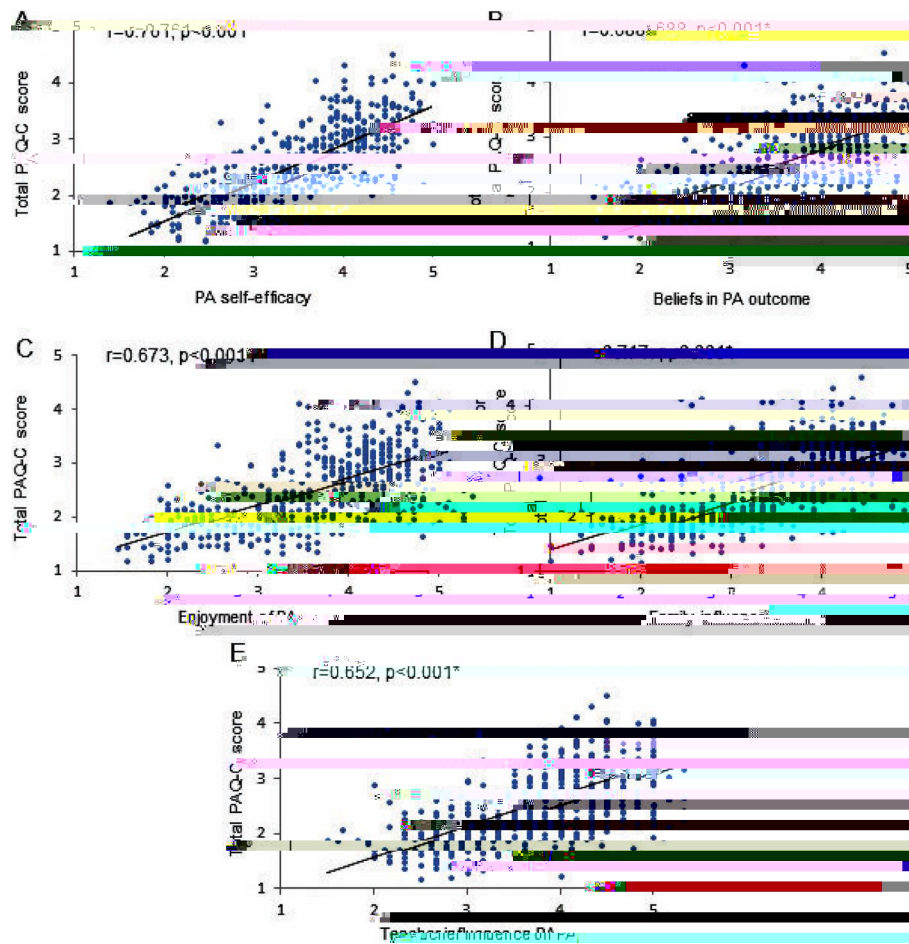


Fig. 1 Scatter plots and Pearson coefficients (r) show correlations between PAQ-C and psychosocial factors (n = 475). Correlations of PAQ-C with **A:** PA self-efficacy; **B:** beliefs in PA outcomes; **C:** enjoyment of PA; **D:** family influence on PA; **E:** teacher influence on PA. *Significant correlations at p < 0.05. PA = physical activity; PAQ-C = Physical Activity Questionnaire for Older Children

factors. The findings would better provide a comprehensive understanding of various aspects of children’s PA by revealing gender-specific determinants and common elements within the group.

Prevalence of PA

Our study revealed that the average PAQ-C score was 2.5 ± 0.7 , which is lower compared to a survey of 994 ethnically diverse children (3.23 ± 0.64) [33] but similar to findings in a group of adolescents in China (2.62 ± 0.68) [34]. Additionally, we discovered that 36.8% of the children met the WHO recommended PA guidelines. This percentage is significantly lower than the findings of Linh LHH et al.’s study on 318 secondary school students in urban Ho Chi Minh City, Vietnam (36.8% vs. 67.6%) [35]. On the other hand, this proportion is higher than that observed in a study assessing the prevalence of sufficient PA among students across 34 countries, which reported PA rates in several Asian countries, including the

Philippines (9%), Myanmar (20.0%), Indonesia (22.0%), and China (30.0%). In comparison, the rate for Vietnam was 18.2% [36].

Our findings revealed gender differences in PA levels, with boys being more physically active than girls. Similar gender disparities have been reported in countries on other continents [8, 37, 38], as well as studies conducted in Vietnam, for example, those by Trang NH et al. and To GQ et al., which also found that boys participated in PA more frequently [11, 39]. In Vietnamese culture, academic achievement is prioritized over extracurricular activities like physical exercise. Students typically spend around 9 h at school each day (from 6:00 AM to 4:00 PM). After school, the majority of students devote their time to doing homework and attending additional tutoring sessions. This cultural emphasis on education may partly explain the lower levels of PA observed among adolescents, in particular girls, who may experience pressure to focus on pursuing grades rather than engaging

in activities. As well, traditional gender roles in Vietnam tend to assign more passive roles to girls, restricting their participation in physically demanding activities such as sports. Boys are often encouraged to participate in outdoor activities; in contrast, girls may not receive the same encouragement or opportunities [40].

Demographic, anthropometric factors, and PA

We found significant differences in several anthropometric indices between boys and girls. Boys had a higher average BMI and height compared to girls, consistent with national growth standards and earlier studies on adolescent development in Vietnam [41, 42]. The higher BMI of boys may be indicative of variations in adipose distribution and muscle mass, which could influence their PA levels and preferences [43].

Age was not found to be predictive of PA levels for any group. This result contradicts other studies reporting that PA tends to decline with age during childhood

and adolescence [38, 44]. Perhaps the narrow age range of our sample (mean age of 11.8 years) might not allow for detecting the age-related differences in PA. A broader age span would likely reveal more distinct trends in the behavior associated with the developmental process.

In our result, BMI was identified as a significant negative predictor of PA for the overall sample and boys but less so for girls. This inverse relationship has been supported by previous studies [45]. Nonetheless, the interaction between PA and BMI may be bi-directional, leading to a vicious cycle of low PA and obesity. Numerous studies have shown that regular PA has a positive effect on maintaining or reducing BMI, particularly in children and adolescents [46]. On the other hand, children with high BMI often face difficulties in engaging in physical activities due to mobility issues or reduced endurance [47]. Additionally, psychological factors comprising low self-esteem and social stigma related to weight may also

Table 3 Hierarchical regression to identify predictors of log mean PAQ-C score for boys and girls

Variables	Total, n = 475	Boys, n = 241	Girls, n = 234

Table 3 (continued)

Variables	Total, n = 475					Boys, n = 241					Girls, n = 234							
	b	SE (b)	t	95% CI	R ²	aR ²	b	SE (b)	t	95% CI	R ²	aR ²	b	SE (b)	t	95% CI	R ²	aR ²
Cultural activities ^d	-0.011	0.012	-0.023	-0.87	-0.03	0.01	-0.016	0.020	-0.030	-0.78	-0.06	0.02	0.003	0.015	0.008	0.22	-0.03	0.03
Social activities ^e	-0.048	0.017	-0.078	-2.83**	-0.08	-0.01	-0.022	0.025	-0.037	-0.91	-0.07	0.03	-0.051	0.025	-0.079	-2.05*	-0.10	-0.00

Abbreviations: BMI Body mass index, PA Physical activity, PAQ-C Physical Activity Questionnaire for Older Children

^a Small screen recreation includes watching television/videos/DVDs and using a computer for fun (e-communications, e-games, internet surfing)

^b After-school education includes doing homework (on or off a computer) and out-of-school tutoring

^c Passive travel includes motorized travel (motorbike/car/bus)

^d Cultural activities include reading for fun, doing hobbies or crafts, and playing/practicing a musical instrument

^e Social activities include sitting and chatting with friends, hanging out, using the telephone, and religious activities (going to temple or meditation)

* p < 0.05, ** p < 0.01, *** p < 0.001

BMI may not be a strong predictor of PA levels among girls due to lower societal expectations for them to engage in vigorous activities, which can reduce the impact of higher BMI on their PA participation [49]. Alternatively, recent evidence suggests that body fat distribution plays a more significant role in determining PA levels in girls, as it affects mobility and self-perception in ways that BMI alone cannot capture [50]. Relying solely on BMI may overlook these complex variations in body composition that influence PA, highlighting the need for more comprehensive measures to assess PA in girls.

Psychosocial factors and PA

According to our findings, there were positive correlations between PA levels and psychosocial factors, aligning with previous research conducted among fifth-grade students in Ho Chi Minh City, Vietnam [39], as well as reports from other international studies [51, 52]. Self-efficacy appeared to have the most robust correlation to PA, as both boys and girls who exhibited higher self-efficacy engaged in greater amounts of PA. This highlights the importance of self-confidence in children's capability to engage in PA as well as social impact in promoting regular PA in youngsters, as proposed by social cognitive theory [53].

The study showed that belief in PA outcomes was significant for boys and the overall sample but not for girls. This gender difference may reflect that boys' levels of PA are more influenced by their perception of the benefits of PA, whereas girls might be affected by other factors namely enjoyment. These findings support previous studies suggesting that belief in positive outcomes is a significant motivator for PA, especially in boys [54]. Interestingly, enjoyment of PA was a significant predictor only for girls, indicating that the extent of PA is directly related to how much they enjoy the activity. This finding is consistent with the systematic review of qualitative studies about PA among children and adolescents, highlighting the importance of enjoyment in sustaining activity among female students [55].

Both family and teacher influences were significant predictors for the overall sample and girls, but teacher influence was not significant for boys. Many studies have confirmed that practical and emotional support from the

worldwide were using the internet, with Vietnam alone accounting for over 68 million users, primarily adolescents [65]. Consistent with the findings of Prince SA et al. [66], our hierarchical analysis showed a negative relationship between PAQ-C scores and sedentary behaviors, such as small screen recreation and after-school education for both sexes. Boys spend more time on devices, whereas girls engage more in non-physical activities.

Overall, our study highlights the need for multifac-

