ORIGINAL ARTICLE

Associated Factors of Physical Activity Among 12 Years Old School Adolescents in Terengganu, Malaysia

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ABSTRACT

Introduction: Physical inactivity is prevalent among Malaysian children and adolescents, leading to obesity and multiple deleterious health implications. This cross-sectional study investigated factors associated with physical activity levels (PAL) among 12-year-old school adolescents in Terengganu, Malaysia. **Methods:** A total of 1,404 adolescents aged 12 years (46% boys and 54% girls) were recruited from selected schools in Kuala Terengganu and Besut districts of Terengganu. The body weight and height were measured, the BMI was classified based on WHO 2007 z-score cut-off levels, and the PAL was calculated using the C-PAQ questionnaire. Socio-demographic information, including parental education and household income, was collected. **Results:** The mean C-PAQ score was 2.54 ± 0.62, indicating moderate PAL. Boys demonstrated significantly higher PAL compared to girls across all physical activity domains ($p<0.001$). Rural participants also had higher PAL than their urban counterparts ($p=0.037$). Physical education (PE) sessions recorded the highest activity levels. Gender and household income were identified as significant predictors of PAL ($p<0.05$). **Conclusion:** Gender and household income were significant factors influencing PAL among 12-year-old school-going adolescents. Understanding these factors can be informed target interventions and public health strategies aimed at promoting physical activity and reducing obesity in this age group.
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INTRODUCTION

Physical activity (PA) can be defined as any bodily movement produced by skeletal muscle resulting in energy expenditure (1) which contribute to the daily energy equilibrium. Physical inactivity has been associated with increased in prevalence of chronic diseases worldwide (2). Based on current recommendation by WHO, children and adolescents aged 5 to 17 years old should engage with at least 60 minutes in moderate- to vigorous-intensity physical activity (MVPA) daily (3). However, data from multiple worldwide studies demonstrated that high proportion of children failed to meet the daily PA recommendation (4). In 2020, WHO reported that, approximately 81% of school adolescents aged 11-17 years were reported having PA less than recommended level with adolescent girls and those from Asia Pacific region having the lowest PAL as compared to boys and their counterparts from other regions (4). It has been speculated that decreased in PA among children and adolescents were mainly due to decline in active transport (e.g. cycling or walking) and school-based physical education (5). Besides, active behaviours among children also might have been displaced by technology-driven sedentary activity which contributed to the decline in PA (6,7).

PA offers protective benefits against obesity by increasing energy expenditure and regulating appetite(8). However, it is likely that interaction between PA and other lifestyle factors such as sedentary behaviours may potentially impede the protective effect of PA against obesity. Despite common knowledge that sufficient physical activity is associated with substantial health benefits in young people, the national data from Adolescent Health Survey (AHS) 2022 reported that 78.6% of adolescents did not meet the PA recommendations of doing at least 60 minutes of moderate- to vigorous-intensity PA (MVPA) per day (9). In Malaysia, only 14.7% of girls and 28.1% of boys aged 13-17 currently meet the guidelines. Moreover, the South East Asian Nutrition Surveys (SEANUTS) data among 1,702 children aged 7 to 12 years reported that level of physical activity was recorded high among boys, younger age, non-Chinese ethnicity, and normal body mass index category (10).

The SEANUTS study also found that the majority of Malaysian children failed to meet minimum PA recommendations and exceeded the maximum screen time of 2 hours/day recommendations. Furthermore, the recent Malaysian Report Card on Physical Activity for Children and Adolescents in 2022 revealed that four out of six indicators in the Daily Behaviours category received D- or C grades. These grades reflect the percentage of children and adolescents meeting defined benchmarks, with a grade of C indicating 47% to 53%, while a D- reflects 20% to 26% [Overall Physical Activity, Active Transportation and Diet (D-); Sedentary Behaviours (C)]. This pattern of poor physical activity levels remains consistent with the findings of the 2016 report card (11,12).

Given the ongoing physical inactivity prevalent in Malaysia, it is crucial to determine the factors contributing to these trends so that more effective interventions can be developed. A recent review by Ahmad et al. highlighted a wide range of factors influencing PA levels among adolescents, including age, gender, socioeconomic status, and lack of social support from parents, family, and friends (13). Environmental factors such as inadequate or unsuitable facilities, and neighbourhoods that do not promote a healthy lifestyle, also contribute to physical inactivity (14). Despite the international evidence on associated factors of PAL among school adolescents, the studies conducted in Malaysia are still limited. Majority of local studies exploring associated factors of PAL were conducted in the central Peninsular area including Kuala Lumpur and Selangor (10,15–18), with limited focus on other regions, including the East Coast. In particular, there is a lack of research exploring physical activity and its associated factors among younger adolescents, such as 12-year-olds, in Terengganu, a state with distinct cultural and socioeconomic characteristics.

The current study seeks to address this gap by investigating physical activity levels among 12-year-old school-going adolescents in Terengganu, Malaysia. Specifically, the study aims to identify factors such as gender and socioeconomic status that may influence PA levels in this population. By focusing on this age group within a unique geographical and cultural context, the study offers new insights into the barriers and facilitators of physical activity, which can inform the development of targeted interventions to promote healthier behaviours. Understanding these factors is crucial for creating more effective public health strategies to combat physical inactivity and its associated health risks among Malaysian adolescents.

MATERIALS AND METHODS

Study design and study population

This cross-sectional study was conducted between November 2014 and June 2015 as part of the Health of the Adolescents in Terengganu study (HATs). Using purposive sampling, this study was conducted in two districts in Terengganu: Kuala Terengganu and Besut. This study involved all primary schools in Kuala Terengganu (98 primary schools) and Besut (54 primary schools) districts. Kuala Terengganu consists of 94.0% of urban area and 6.0% rural area, whilst Besut consists of 83.9% rural area and 16.1% urban area (19). Therefore, by including both districts, it represents the population from both urban and rural groups.

Surveys were collected from a total of 9,624 school adolescents. From that sample, only 3,498 participants returned the completed questionnaire. However, 2,094 participants were excluded for incomplete responses or other disqualifying circumstances. Thus, our final sample included 1,404 participants. This study specifically focused on 12-year-olds as they are at a critical stage of transition from childhood to adolescence, where physical activity patterns are established. There were 650 (46.3%) boys and 754 (53.7%) girls. About 67.7% were from urban schools and 32.3% were from rural schools. The majority of the participants were Malays (93.9%), 5.8% were Chinese, 0.2% were Indians and 0.1% were of other, or undefined ethnicity.

Outcome measurements

PAL of children was assessed using Children Physical Activity Questionnaire (cPAQ) (20). The questionnaire has been translated and validated among Malaysian schoolchildren with good internal consistency and acceptable validity (21). The cPAQ is a self-reported questionnaire designed to assess activity over the past week mainly for school children aged 8 to 14 years. Participants were asked to recall their involvement in sport (i.e. type and frequency) during the past seven days. It was followed by three questions regarding school based (physical education classes, recess and immediately after school) and two non-school based (evening and weekend) physical activity for the previous seven days. Each question contains five-point Likert scale, ranging from low (score = 1) to high (score = 5). The average score of all items was calculated to create a composite score with a higher value indicates a higher activity level. Physical activity level was also classified as low, medium and high according to tertiles of the score using the 25th and 75th percentiles for distribution. The minimum value was 1.0 and the maximum value was 4.67 whilst the range between the 25th and 75th percentile rank was 2.17 to 3.0.

Measurements of body weight and height were performed using calibrated analogue health scales (Tanita BC-587 Innerscan Body Composition Monitor and Seca 217 Portable Stadiometer) to the nearest 0.1 kg and 0.1 cm, respectively by trained physical education teacher (22). BMI-for-age Z-scores (BAZ) were calculated using WHO AnthroPlus software (23). Using the date of birth and measurement date, the

age of each participant was calculated to the precise day, and the BMI was calculated by dividing the body weight in kilograms (kg) by the height in meters squared (m2). Participants were all in good health prior to data collection and all measurements were taken in light sports attire without shoes during morning or early afternoon hours, i.e. between 8.30 am and 12.00 pm. The BMI categories were determined based on age- and sex-specific cut-off points derived from the WHO classification for 2007 (24). The BMI z-scores were then placed into the categories of severe thinness, thinness, normal weight, overweight and obese with the cut-off point of < -3SD, < -2SD, ≥ -2SD to ≤ +1SD, > +1SD and > +2SD, respectively based on the WHO 2007 Growth Reference.

Prior to data collection, approval letter was obtained from the Ministry of Education, Terengganu State Education Department and UniSZA Human Research Ethics Committee (UHREC) (Reference: UniSZA.N/1/628-1Jld.2(11)). Permission was obtained from the respective school principals before study commencement whilst parental consent was acquired before any data collection procedure.

Statistical analysis

Data analysis was conducted using the via IBM SPSS Statistics for Windows, version 24.0 software (IBM Corporation, Armonk, New York, USA). The descriptive statistics were presented as means with standard deviation or percentage of prevalence, depending on the data distribution. For non-normally distributed data, median values and interquartile ranges (IQR) were reported. To examine variation in continuous variables between two groups, independent sample t-test was performed for normally distributed data, while the Mann-Whitney U test was utilised for non-normally distributed data. Pearson's chi-square test was used to determine the association between PAL and socio-economic status (SES) levels and their components (i.e. participant's gender, ethnicity, parents' educational level, parents' occupation, household income and household size).

Univariable and multivariable analyses were performed to determine the factors that are associated with the school adolescent's physical activity. In the first stage, simple linear regression was applied to determine the potential variable that is of great value for physical activity. The variables with p-value of or less than 0.25 were included for further multivariable analysis. Interaction, multicollinearity, model fitness and assumptions, outliers, and influential cases were checked. The final model was presented with the adjusted regression coefficients (b), 95% confidence intervals (CI), p-values, and coefficient of determinations (R2). A two-sided P value of less than 0.05 was considered statistically significant.

RESULTS

A total of 1,404 school-going adolescents aged 12 years were involved in this study, comprising 46.3% boys and 53.7% girls (Table I). The majority of participants were Malay (99.3%) and attended urban schools (67.7%). The median monthly household income was RM 1,500 (IQR: RM 3,171). Based on 10th Malaysia Plan (2011-2015), 62.2% of the parents were classified in low-income group, 20.1% parents were in middle income group and 17.9% parents were in high income group. The mean household size was 6.4±2.0. Regarding parental education, 73.1% of mothers and 68.1% of fathers had completed secondary school education, indicating a predominantly lower education background. Additionally, 59.6% of mothers were employed at the time of the study. The mean BMI of the participants was 19.07 ± 4.51 kg/m . Girls were significantly taller and heavier than boys ($p<0.05$). The overall prevalence of overweight and obesity was 17.4% and 15.1%, respectively, with boys showing a slightly higher prevalence of both overweight (50.8%) and obesity (50.2%) compared to girls.

Table II presents the physical activity scores obtained from the cPAQ assessment across various domains. The overall mean cPAQ score for all participants was 2.54 ± 0.62, indicating a moderate level of physical activity. The highest physical activity scores were recorded during Physical Education (PE) sessions. Boys exhibited significantly higher PAL compared to girls across all domains ($p<0.001$). Furthermore, boys consistently reported higher physical activity scores in each domain ($p<0.05$). When comparing participants based on geographical location, rural adolescents had significantly higher physical activity levels than their urban counterparts ($p=0.037$). However, there were no significant differences in PAL across ethnicity, household income, or BMI categories.

Table III shows the factors associated with the PAL from the multiple linear regression model. In the final model, being female (adjusted b = -0.422, 95% CI: -0.484, -0.359, $p < 0.001$), and having high household income level (adjusted b = -0.09, 95% CI: -0.179, -0.001, $p=0.049$) are significantly associated with the PAL of adolescents. Overall, the study found that the 11.6% variations in PAL of the adolescents are explained by this equation; cPAQ score = 2.806 – 0.422 (being female) – 0.09 (having high household income level), with an R2 value of 0.116.

DISCUSSION

This study provides important insights into the factors influencing physical activity levels (PAL) among 12-year-old school adolescents in Terengganu, Malaysia.

Table I: Participants' distributions and characteristics

Variables	Boys *n* = 650	Girls *n* = 754	All *n* = 1,404	*p*-value[a] (χ^2)
Locality				
Rural	226 (34.8)	227 (30.1)	453 (32.3)	0.067
Urban	424 (65.2)	527 (69.9)	951 (67.7)	(3.5)
Ethnicity				
Malay	605 (45.9)	713 (54.1)	1318 (93.9)	0.265
Non-Malay	45 (52.3)	41 (47.7)	86 (5.8)	(1.3)
Economic status				
Household size (person)	6.35 ± 2.0	6.46 ± 2.0	6.41 ± 2.0	0.531
Household income (RM)[§]	1500 (IQR: 3300)	1600 (IQR: 3100)	1500 (IQR: 3171)	0.454[b]
Income level				
Low (< RM 2300)	460 (47.1)	516 (52.9)	660 (62.0)	0.832
Middle (RM 2300-5599)	103 (44.2)	130 (55.8)	214 (20.1)	(0.9)
High (> RM 5600)	87 (44.6)	108 (55.4)	190 (17.9)	
Mother's current working status				
Working	237 (46.1)	277 (53.9)	514 (40.5)	1.0
Not working	348 (46.2)	406 (53.8)	754 (59.5)	(0)
Education status				
Mother's educational level				
Primary education	55 (42.3)	75 (57.7)	108 (8.0)	0.591
Secondary education	455 (46.3)	527 (53.7)	982 (73.1)	(1.1)
Tertiary education	111 (47.8)	121 (52.2)	232 (17.3)	
Father's educational level				
Primary education	73 (44.5)	91 (55.5)	137 (10.9)	0.752
Secondary education	387 (45.4)	465 (54.6)	852 (68.1)	(0.6)
Tertiary education	113 (47.9)	123 (52.1)	236 (18.8)	
Anthropometric data				
Weight (kg)	39.31 ± 12.04	40.82 ± 11.73	40.12 ± 11.89	0.018*
Height (cm)	143.14 ± 10.23	145.12 ± 7.53	144.20 ± 8.94	<0.001*
BMI (kg/m^2)	18.91 ± 4.44	19.20 ± 4.57	19.07 ± 4.51	0.234
BMI *z-score*	0.20 ± 1.64	0.15 ± 1.57	0.17 ± 1.6	0.522
BMI categories				
Thin	50 (43.1)	66 (56.9)	116 (8.3)	
Normal	374 (45.0)	457 (55.0)	831 (59.2)	0.411
Overweight	120 (49.2)	124 (50.8)	244 (17.4)	
Obese	106 (49.8)	107 (50.2)	213 (15.2)	

Data are frequency (%) and Mean ± SD; [§]Median (IQR); [a]Sociodemograpic characteristics *vs.* genders (Pearson's chi-square test); [b]Household income *vs.* genders (Mann-Whitney test); Income level categories based on 10th Malaysia Plan 2011-2015. *p value less than 0.05 (Independent sample t-test).

Gender differences were particularly pronounced, with boys exhibiting significantly higher PAL compared to girls. This pattern is consistent with findings from other Malaysian studies, such as one conducted in Pahang, where girls were twice as likely to be in the low physical activity category compared to boys (25). The observed gender disparities in physical activity could be attributed to several factors, including sociocultural expectations, self-perception, and differences in the timing and impact of pubertal development. For instance, cultural norms in Malaysia may discourage girls from engaging in vigorous physical activities, perceiving them as either inappropriate or unappealing due to societal pressures on femininity and body image (26).

The physiological (hormonal) and psychological (cognitive and emotional) alterations associated with pubertal growth spurts may impact differences in physical activity levels between boys and girls. The onset and duration of puberty differ markedly between adolescents living in environments with varying childhood nutrition. According to Norris et al. (2022), normal-weight girls starts their adolescent's growth spurt at the age of ten and reach their peak velocity around the age of twelve. On the other hand, these ages differ by country, with the youngest being in developed countries and the oldest being the norm in the poorest countries (27). However, for boys, the adolescent growth spurt begins around age 12 and will surpass that of girls within one or two

Table II: Physical activity score from cPAQ and its domains by genders, ethnicity, household income level, school location, BMI categories and physical activity categories

	N	Physical activity During Physical Education	School-based Physical activity	Outside-of-school Physical Activity	Overall Physical Activity	*P*-value
Overall	1404	3.29 ± 1.11	2.00 ± 0.65	2.96 ± 0.97	2.54 ± 0.62	
Gender						
Boys	650	3.47 ± 1.16[a]	2.22 ± 0.70[a]	3.23 ± 0.98[a]	2.76 ± 0.64[a]	<0.001*
Girls	754	3.14 ± 1.05	1.81 ± 0.55	2.73 ± 0.90	2.34 ± 0.54	
Ethnicity						
Malay	1318	3.27 ± 1.11[b]	2.01 ± 0.66	2.99 ± 0.97[b]	2.54 ± 0.62	0.146
Chinese	81	3.53 ± 1.15	1.98 ± 0.65	2.64 ± 0.91	2.46 ± 0.63	
Indian	3	4.67 ± 0.58	1.78 ± 0.51	2.83 ± 1.89	2.61 ± 0.92	
Others	2	3.50 ± 2.12	1.33 ± 0.47	1.25 ± 0.35	1.67 ± 0.71	
Household income, MYR						
Low (<2300)	976	3.32 ± 1.13	2.01 ± 0.67	2.97 ± 0.97	2.55 ± 0.62	0.126
Middle (2300 to 5599)	233	3.23 ± 1.10	2.01 ± 0.64	3.00 ± 0.98	2.54 ± 0.64	
High (>5600)	195	3.22 ± 1.04	1.93 ± 0.60	2.85 ± 0.97	2.45 ± 0.59	
School location						
Rural	453	3.35 ± 1.02	2.05 ± 0.70[c]	3.00 ± 0.97	2.59 ± 0.64[c]	0.037*
Urban	951	3.27 ± 1.16	1.98 ± 0.63	2.94 ± 0.97	2.51 ± 0.61	
BMI categories						
Underweight	116	3.30 ± 1.12	2.07 ± 0.59	3.12 ± 0.99	2.62 ± 0.64	0.09
Normal	831	3.27 ± 1.15	2.00 ± 0.66	2.92 ± 0.98	2.52 ± 0.63	
Overweight	244	3.38 ± 1.06	2.02 ± 0.65	3.06 ± 0.93	2.60 ± 0.61	
Obese	213	3.28 ± 1.05	1.93 ± 0.66	2.92 ± 0.97	2.48 ± 0.61	
Physical activity categories						
Low (<2.16)	491	2.69 ± 0.95	1.50 ± 0.33	2.13 ± 0.61	1.91 ± 0.27	<0.001*
Moderate (2.16 to 3.00)	516	3.34 ± 0.99	1.96 ± 0.39	3.03 ± 0.60	2.55 ± 0.18	
High (>3.00)	370	4.02 ± 1.02	2.72 ± 0.62	3.97 ± 0.75	3.35 ± 0.34	

Data presented as mean ± SD. [a]Significant difference in mean score of physical activity domains between genders (Independent sample t-test), [b]Significant difference in mean score of physical activity domains between ethnicity (One-way ANOVA test), [c] Significant difference in mean score of physical activity domains between school locations (Independent sample t-test). *P*-value indicates level of significance in general linear model for the overall physical activity as indicated by the cPAQ (Children Physical Activity Questionnaire

Table III: Multiple Linear Regression of factors associated with physical activity among 12 years old school adolescents in Terengganu (n=1404)

Variables	Regression coefficient (β)	95% CI	*t*	*P*-value
Constant	2.806	2.743, 2.870	86.731	<0.001
Genders				
Female	-0.422	-0.484, -0.359	-13.313	<0.001
Household income level				
High	-0.09	-0.179, -0.001	-1.973	0.049

Backward Multiple Linear Regression applied. Model assumptions are fulfilled. Adjusted for School Location, Gender and Household income level; R= 0.342, R^2= 0.117, Adjusted R^2= 0.116, F= 61.385, *P*<0.001.

years. These differences may influence activity levels, as increased self-consciousness during puberty can reduce participation in physical activities, especially among girls (28). Additionally, pubertal maturity in girls is negatively associated with physical activity levels, further supporting the need for gender-sensitive interventions.

Although there was no significant association found between PA level and BMI groups, majority of obese adolescent reported to have high PA. This finding was consistent with previous local suggesting that adolescents with higher BMI may still be physically active (29,30). However, it is possible that these findings could be influenced by self-report bias, as children often overestimate their PA. Self-reported questionnaire like cPAQ is subjective in nature and depends on perceptions of the adolescents towards their PA. Previous findings have already indicated that children tend to overestimate their PAL, which may account for this difference (31). Overweight and obese adolescents are also prone to overestimate the intensity and duration spent on activities. In addition, Ballesteros et al. (2021) have suggested that over-reporting of physical activity among young female adolescents may be related to physical self-concept (32). Besides, overweight girls also perceived themselves as doing as much or more exercise than normal-weight girls, while in reality, they were moving less (33).

In addition to gender and BMI, location played a significant role in physical activity levels, with rural adolescents reporting higher PAL compared to their

urban counterparts. This rural-urban disparity in physical activity has been noted in previous studies (10,16,34). Specifically in Malaysia, urban school adolescents were less physically active than their rural counterparts (10). Indeed, the disparity between the built environment and the level of safety in metropolitan environments restricts options for physical activities (35). Urbanisation and development not only alter the surrounding built environment, but also affect socioeconomic and nutritional trajectories, which eventually lead to obesogenic lifestyle shift. Likewise, urbanites that were lack of physical activities or activities with minimal energy expenditure were likely to engage in long hours of watching television or videos, gadgets and computer games (36,37). This was challenged by a research conducted by Lee and Ham on elementary school children in Korea, which found that rural students were more likely to become obese despite being more physically active than urban children (38). A recent review and meta-analysis on the rural-urban differential in obesity among children and adolescents in the United States discovered that the rural population was 26% more likely to become obese than the urban population. Nonetheless, the study found that obese adolescents in rural areas were more physically active than their counterparts in urban areas (39). In addition to the locality, this study also found that household income had influenced the level of physical activity among adolescents. In agreement with this study, Jo Ann Andoy-Galvan found a strong relationship between PAL and socioeconomic status among Malaysian adults (40). A cohort study among children in UK found that lower income has contributed to poorer physical activity behaviors which could lead to obesity (41). In addition, a local study discovered that socioeconomic status was one of the obesity predictors in which may be associated with its influence towards the parental perception that determines the children behaviors (34,42).

The present study was the first study to date that had attempted to investigate the relationships between potential determinants of physical activity among school adolescents in two districts of Terengganu, Malaysia. In view of the importance of physical activity, the present study attempts to shed new light on the factors affecting participation in physical activity among school adolescents in Terengganu. The findings of the present study suggested that school-based exercise program should be directed primarily at female students. The program should include altering female misperceptions that exercise can make one look masculine. However, there are potential contributing factors that are associated with the children's PAL, thus, another research on the hierarchical regression model that study other factors should be conducted in the future. This study provide evidence regarding the health status of the entire school adolescents population in two districts of a Malaysian state with a suburban setting. The findings of parameters linked with physical activity could result in a more precise and specific target for prevention and intervention programs among school-aged adolescents.

The present study, however, was limited to certain constraints. The cross-sectional design of the data does not allow us to draw causal inferences. Besides, this study which was conducted among school adolescents aged 12 years old however might not represent the older age group (i.e. among secondary school adolescents). Thus, further study is required to evaluate the reliability among the older age group. Incorporating other variables, such as pubertal stage and body image, in future research would strengthen the understanding of factors influencing physical activity. The facts that this study utilised self-reported questionnaire also subject to potential biases, such as social desirability and recall bias. Thus, to acquire a better understanding and reduce any potential bias, it is suggested to use objective measures of physical activity (e.g., accelerometers, pedometer) or employing multiple data sources to triangulate the findings.

CONCLUSION

In conclusion, this study highlights the significant role of gender and household income in influencing physical activity levels among 12-year-old school adolescents in Terengganu, Malaysia. These findings underscore the need for targeted health promotion strategies that prioritise increasing physical activity among female adolescents and those from higher-income families. School-based programs should incorporate engaging, gender-sensitive activities that encourage consistent participation, particularly among girls. Specifically, school-based interventions that make physical activity more enjoyable and less stigmatised for girls, alongside programmes that encourage active play and sport in both urban and rural settings, are essential. By developing culturally relevant and sustainable initiatives, can foster long-term behavioural changes that improve the overall health and wellbeing of adolescents.

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