

Physical Activity and Sedentary Behaviour among Adolescents in Petaling District, Selangor, Malaysia

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ABSTRACT

Physical inactivity is strongly associated with obesity and an increased risk of cardiovascular disease in children and adolescents. A cross-sectional study using multistage random sampling was conducted to determine associations between demographic characteristics, sedentary behaviours and physical activity among adolescents. Data were collected from 785 (414 males and 371 females) Form four students attending 15 schools in Petaling District, Selangor using an adapted self-administered questionnaire. Results showed that more females (50.1%) were physically inactive compared to males (39.6%) (Adjusted odds ratio (OR): 1.55, 95% confidence interval (CI): 1.12-2.15). Physically inactive adolescents were less likely to participate in intramural/house league sports (OR: 1.71, 95% CI: 1.19-2.44), school team sports (OR: 1.45, 95% CI: 1.03-2.04) and individual physical activities outside school (OR: 1.53, 95% CI: 1.11-2.12) compared to their physically active counterparts. Physically inactive adolescents were also less engaged in sedentary activities, such as television watching (OR: 0.69, 95% CI: 0.50-0.94), playing computer/video game (OR: 0.44, 95% CI: 0.28-0.72), talking on the telephone/mobile phone text messaging (OR: 0.47, 95% CI: 0.32-0.69) and reading (OR: 0.45, 95% CI: 0.24-0.86) compared to those who were physically active. In this study, physical activity coexists with sedentary behaviour in adolescents. Sedentary activities may not necessarily displace physical activity among youth. In addition, these data suggest that promoting organised sports in school and outside the school among youths may be a potential strategy for increasing physical activity in this population.

Keywords: Physical activity, sedentary behaviour, adolescent

INTRODUCTION

Physical activity is important for the normal growth, maintenance of physical fitness and psychosocial well being of children and adolescents.^[1] Physical inactivity is strongly associated with cardiovascular disease risk factors (high blood pressure, hypercholesterolemia, high triglyceride and high percentage body fat mass) and an increased risk of obesity in children and adolescents.^[2,3,4] Therefore, identifying the factors related to physical activity in this population is crucial to address the increasing prevalence of obesity and is of particular concern in children and adolescents.^[5]

In European and North American countries, the prevalence of physical activity (at least 60 minutes per day of moderate to vigorous physical activity for the past 7 days) ranged between 16-26% among children and adolescents (11-15 year olds).^[6] Reported prevalences of physical activities in Asian countries range from 2.8% in the Philippines to 30.2% in India.^[7] Figures on physical activity among children and adolescents in Malaysia are scarce. One study in Kuantan, Pahang which used the Physical Activity Questionnaire for Older Children to classify adolescents' physical activity levels based on mean scores, reported 35% of adolescents engaged in low physical activity, 61.5% moderate physical activity and only 3.0% high physical activity levels.^[8]

Adolescents spend most of their leisure time watching television compared to other sedentary activities.^[9] Therefore, television viewing is the most commonly used marker of sedentary activity.^[6,10] The American Academy of Paediatrics^[11] has recommended that children and adolescents spend no more than 2 hours per day watching television. However, the jury is still out on the usage of television viewing as a marker of sedentary activity for various reasons. For one, the amount of television watched per person has not changed for 40 years.^[12] Furthermore, reports on the association between television watching and physical inactivity among children and adolescents have been mixed. Some found a positive relationship^[13], while others reported a weak and negative relationship.^[12]

The "displacement hypothesis" proposes that sedentary behaviour is a competitor to physical activity. Increased time spent in sedentary activities such as television viewing may displace time allocated for physical activity in children and adolescents.^[14] But, the relationship between sedentary behaviours and physical activity is rather complex and requires

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further investigation. Many studies have shown that increased sedentary behaviours such as television viewing, playing video/computer game and surfing the internet are associated with less physical activity^[15, 16, 17], while, other studies failed to establish a relationship between sedentary behaviour and physical activity.^[18, 12, 10] In addition, physical activity may be differentially associated with different types of sedentary pursuit.^[19, 20] Hence, the main objective of our study is to evaluate the relationship between the amount of time spent on sedentary activities and physical activity. We have included other sedentary activities, i.e. video/computer games playing, surfing internet, chatting on the telephone and other productive sedentary activities (reading or doing homework) which are common among adolescents.

MATERIALS AND METHODS

Study design

A cross sectional study was carried out between June and December, 2008 in secondary schools in Petaling District, Selangor. Formal permission to conduct this study was obtained from the Ministry of Education of Malaysia. Ethical approval was obtained from the Universiti Kebangsaan Malaysia Research Ethics Committee. Participation was voluntary and written consent was obtained from students and their parents prior to the study. Non return of parental consent forms were considered as giving consent to participate in the study.

Sampling method

A list of 66 secondary schools in Petaling District (i.e., areas of Subang, Petaling, Damansara, Puchong/Seri Kembangan and Shah Alam), Selangor was obtained from the Selangor State Education Department. Fifteen secondary schools were chosen randomly consisting of 3 schools from each subdistrict i.e Subang, Petaling and Damansara. Four schools were selected from Puchong/Seri Kembangan and another two from Shah Alam, all added up to a total of 15 schools. A list of all Form 4 students from the selected schools were obtained from the school authorities and students were selected by simple random sampling. Epiinfo version 6 was used to calculate the sample size based on estimated 7% of overweight.^[21] The estimated form four students population was 16,327. The sample size calculated was 904 students based on 2.0% desired precision with design effect of 1.5 and confidence interval of 95%. An additional 10% was added to the figure to compensate for non-response. The final sample size was 994 students.

Selection criteria

The inclusion criteria were healthy Form four students in selected schools. Students with mental or physical disability and those with recent physical injury or using walking aid devices were excluded from the study.

Data collection

The level of physical activity and sedentary behaviours were assessed with an adapted adolescent physical activity recall questionnaire that has been validated and found to have moderate reliability and validity in Canadian adolescents.^[22] This questionnaire was translated into the Malay language and translated back into English by a language expert. The final Malay version questionnaire was evaluated by a small group of experts to check for appropriateness, relevance and comprehension. Socio-demographic characteristics including age, gender, ethnicity and parental education level were also recorded.

All members of the research team (research officer, staff nurses, research assistants) were given proper training pertaining to the study questionnaire. A detailed explanation was given to the students on each question in the questionnaire prior to administration at each data collection session. While students were answering the questionnaire, the research team stood by and provided assistance to those who had difficulty understanding the questions.

Physical activity

The participating students were asked to report on the frequency and duration (in hours or minutes) of moderate to vigorous physical activity they had performed in the past 7 days. These included school-related activities such as physical education. Vigorous physical activity is defined as physical activities that cause sweating, heavy breathing and increased heart rate. Meanwhile moderate physical activity is defined as physical activities of lower intensity that do not cause adolescents to sweat or breathe heavily.^[6, 25, 29] Physical activity level was dichotomised into physically active and physically inactive, using the following criteria: physically active if performed at least 60 minutes or more of moderate to vigorous physical activity everyday for the past 7 days; physically inactive if less than 60 minutes daily of moderate to vigorous physical activity on all 7 days during the past 7 days.^[23]

Sedentary behaviours assessment

Activities such as television watching, playing video/computer games and internet surfing, also called screen time activities, are commonly used measurements of sedentary behaviour.^[24] Adolescents spend most of their leisure time

watching television compared to any other activity.^[9] Our questionnaire captured data on frequency and duration (hours) engaged in sedentary activities in the past 7 days. Sedentary activities included watching TV/movies, playing video/computer game, surfing the internet, talking/text messaging on the phone, reading for leisure (magazines, story books, newspaper) and doing homework (written school assignments). In addition, students were asked to report on how they commuted to school whether actively (walking or cycling), passively (taking a bus, car, motorcycle or other motorised transports) or a mix of both (actively and passively). Lastly, the students were asked about their participation in intramural/house league sport, sport team (football, volleyball, basketball) or other physical activities in school (gymnastic, yoga) and individual physical activities (jogging, swimming, cycling,) after school.

Statistical analysis

Time duration variables from hours and minutes were converted into minutes only before being analysed. Cases with missing, illogical or outlying values were removed from the analysis. Cases where the total amount of time for both sedentary and moderate to vigorous physical activity exceeded 960 minutes (16 hours), were also excluded from the analysis, based on the assumption that on average a person sleeps 8 hours a day. This procedure of data cleaning has been widely accepted for assessing time spent for physical activity (<http://www.ipaq.ki.se/scoring.pdf>). After excluding cases with missing or extreme values (n=154) and absent students (n=55), the total number of respondents remaining in the final data set was 785.

All statistical analyses were done using SPSS 11.5. Descriptive statistics were used to describe socio-demographic characteristics, physical activity and sedentary behaviour of the students. The Chi-square test for independence was conducted to determine the association between socio-demographic variables and physical activity; participation in sports and sedentary behaviour; and, physical activity and sedentary behaviour. Multivariate logistic regression was performed to identify the interrelation of socio-demographic factor, physical activity and sedentary behaviour.

RESULTS

A total of 785 form four students, comprising of 414 males (52.7%) and 371 females (47.3%) were assessed. A large majority of the students were Malays (62.7%), followed by Chinese (26.2%) and Indians (11.1%). Analysis of parental education level showed that 42.5% of the students' fathers had tertiary education, while almost half of the students' mothers had secondary or lower education (Table 1). Mean amount of time spent on physical activity and sedentary activities by gender are shown in Table 2. Females engaged in more moderate physical activity compared to males, while males perform more vigorous physical activity. Females spent more time watching television, talking on the phone, reading and doing homework, while males spend more time playing computer/video games and surfing the internet (Table 2).

Table 1. Sociodemographic characteristic of students (n = 785)

Variable		n	%
Gender	Male	414	52.7
	Female	371	47.3
Age	14	3	4
	15	18	2.3
	16	748	95.3
	17	16	2
Ethnicity	Malay	492	62.7
	Chinese	206	26.2
	Indian	87	11.1
Father's education level	None	9	1.1
	Primary	99	12.6
	Secondary	317	40.4
	Tertiary	334	42.5
	Others	26	3.3
Mother's education level	None	20	2.5
	Primary	82	10.4
	Secondary	383	48.8
	Tertiary	281	35.8
	Others	19	2.4

Table 2. Time spent on physical activity and sedentary activities by gender

	Male (n=414)		Female (n=371)	
	mean	±SD	Mean	±SD
Physical activity (Total)	1.37	1.15	1.23	1.19
Moderate (hour/day)	1.27	1.43	1.42	1.74
Vigorous (hour/day)	1.46	1.23	1.03	1.08
Sedentary activities				
Television watching (hour/day)	2.53	1.78	2.8	1.91
Playing computer or video game (hour/day)	1.25	1.35	0.46	0.83
Internet surfing (hour/day)	0.94	1.16	0.77	1.11
Talking on phone or text messaging (hour/day)	1.2	1.86	1.68	2.18
Reading for leisure (hour/week)	6.41	9.27	7.49	9.64
Homework (hour/week)	4.85	5.83	7.88	7.88

About 50.1% of female and 39.6% male students did not meet the recommendation of at least 60 minutes/day of moderate to vigorous physical activity. Male students were significantly more active compared to female students ($p=0.003$). There was a significant association between ethnic group and physical activity ($p=0.031$). Students of Chinese descent were found to be less physically active compared to Malay and Indian students. There was no association between parental education level and physical activity level.

Table 3. Association between selected sociodemographic characteristics, sedentary activities and sport participation with physical activity (n=785)

Variable	Physical activity				df	χ^2 *	p-value	
	Active †		Inactive ††					
	n	%	n	%				
Gender	Male	250	60.4	164	39.6	1	8.766	0.003
	Female	185	49.9	186	50.1			
Ethnicity	Malay	286	58.1	206	41.9	2	6.958	0.031
	Chinese	98	47.6	108	52.4			
	Indian	51	58.6	36	41.4			
Father's education level	≤Secondary	240	56.5	185	43.5	2	1.035	0.596
	> Secondary	179	53.6	155	46.4			
	Others	16	61.5	10	38.5			
Mother's education level	≤Secondary	271	55.9	214	44.1	2	0.702	0.704
	> Secondary	152	54.1	129	45.9			
	Others	12	63.2	7	36.8			
Sedentary activities								
Television watching /day	< 2 hours	145	49.0	151	51.0	1	7.946	0.005
	≥ 2 hours	290	59.3	199	40.7			

Variable		Physical activity				df	χ^2 *	p-value
		Active †		Inactive ††				
		n	%	n	%			
Playing computer or video game /day	< 2 hours	341	51.9	316	48.1	1	20.108	<0.001
	≥ 2 hours	94	73.4	34	26.6			
Internet surfing /day	< 1 hour	265	52.0	245	48.0	1	7.027	0.008
	≥ 1 hour	170	61.8	105	38.2			
Talking on phone or text messaging	< 2 hours	312	51.3	296	48.7	1	18.33	<0.001
	≥ 2 hours	123	69.5	54	30.5			
Reading for leisure/ week	< 1 hour	37	40.7	54	59.3	2	9.07	0.011
	1-6 hours	241	57.4	179	42.6			
	≥ 6 hours	157	57.3	117	42.7			
Homework/ week	< 1 hour	30	42.3	41	57.7	2	10.391	0.006
	1-6 hours	260	60.0	173	40.0			
	≥ 6 hours	145	51.6	136	48.4			
Sports participation								
Intramural/house league sports	Yes	194	66.4	98	33.6	1	22.871	<0.001
	No	241	48.9	252	51.1			
School team	Yes	258	63.2	150	36.8	1	21.034	<0.001
	No	177	46.9	200	53.1			
Other physical activities in school	Yes	258	59.3	177	40.7	1	5.995	0.014
	No	177	50.6	173	49.4			
Individual physical activities outside of school	Yes	216	63.0	127	37.0	1	14.091	<0.001
	No	219	49.5	223	50.5			
Commuting to school	Actively	156	60.5	102	39.5	2	5.955	0.051
	Inactively	196	55.1	160	44.9			
	Mixed	83	48.5	88	51.5			

* Chi-square test for independence; † Physically active is defined as ≥ 60 minutes/day of moderate to vigorous physical activity; †† Physically inactive is defined as < 60 minutes/day of moderate to vigorous physical activity (U.S Department of Health and Human Services Department 2008)

Increased sedentary activities were positively associated with physical activity level (Table 3). Students who spent more than two hours daily on television viewing, playing video/computer game, internet surfing and talking on the phone or mobile phone text messaging were more physically active compared to their counterparts who spent less than two hours daily for the same activities. Those who spent more than one hour per week reading for leisure and doing homework were also more active than those who spent less than one hour per week.

Sixty percent of the students were actively commuting to school compared to 55.1% passive commuters and 48.5% mixed (active and passive) commuting (Table 3). However, no association was found between commuting to school and physical activity.

Multiple logistic regression tests were used to identify the factors related to physical activity. All variables with p value less than 0.25 in univariate analysis were included in the model (Table 3). After adjusting for all other variables, females were found 1.6 times more likely to be physically inactive compared to male students. Physically active adolescents were more likely to engage in sedentary activities, such as television watching, playing computer/video game, talking on the telephone/mobile phone text messaging and reading compared to their physically inactive counterparts (Table 4). In addition, participation in intramural/house league sports, school team sports and individual physical activities outside school were significantly associated with physical activity ($p < 0.05$) (Table 4). No interaction was observed among the variables.

Table 4. Factors related to physical inactivity[#] (n=785)

Variable		n	Crude OR	95% CI	Adjusted OR [†]	95% CI
Sociodemography characteristics						
Gender	Male	414	1			
	Female	371	1.53**	(1.16, 2.03)	1.55*	(1.12, 2.15)
Ethnicity	Malay	492	1			
	Chinese	206	1.53*	(1.10, 2.12)	1.32	(0.92, 1.89)
	Indian	87	0.98	(0.62, 1.56)	1.00	(0.60, 1.67)
Sedentary activities						
Television watching /day	< 2 hours	296	1			
	≥ 2 hours	489	0.66**	(0.49, 0.88)	0.69*	(0.50, 0.94)
Playing computer or video game /day	< 2 hours	657	1			
	≥ 2 hours	128	0.39**	(0.26, 0.60)	0.44*	(0.28, 0.72)
Internet surfing /day	< 1 hour	510	1			
	≥ 1 hour	275	0.67**	(0.50, 0.90)	0.98	(0.69, 1.38)
Talking on phone or short message sending	< 2 hours	608	1			
	≥ 2 hours	177	0.46**	(0.32, 0.66)	0.47**	(0.32, 0.69)
Reading for leisure/ week	< 1 hour	91	1			
	1-6 hours	420	0.51**	(0.32, 0.81)	0.53*	(0.30, 0.95)
	≥ 6 hours	274	0.51**	(0.32, 0.83)	0.45*	(0.24, 0.86)
Homework/ week	< 1 hour	71	1			
	1-6 hours	433	0.49**	(0.29, 0.81)	0.63	(0.33, 1.18)
	≥ 6 hours	281	0.69	(0.41, 1.16)	0.85	(0.42, 1.70)
Participation in sports						
Intramural/house league sports	Yes	292	1			
	No	493	2.07**	(1.53, 2.80)	1.71*	(1.19, 2.44)
School team	Yes	408	1			
	No	377	1.94**	(1.46, 2.59)	1.45*	(1.03, 2.04)
Other physical activities in school	Yes	435	1			
	No	350	1.43*	(1.07, 1.89)	0.95	(0.68, 1.33)

Variable		n	Crude OR	95% CI	Adjusted OR†	95% CI
Individual physical activities outside of school	Yes	343	1			
	No	442	1.73**	(1.30, 2.31)	1.53*	(1.11, 2.12)
Commuting to school	Inactively	196	1			
	Actively	156	0.80	(0.58, 1.11)		
	Mixed	83	1.30	(0.90, 1.87)		

Hosmer and Lemeshow test - $\chi^2 = 7.342$, $p = 0.500$, # Physically inactive is defined as <60 minutes/day of moderate to vigorous physical activity (U.S Department of Health and Human Services 2008). † Adjusted for all the other variables; * $p < 0.05$; ** $p < 0.001$.

Logistic regression equation: Z (physical activity) = 0.203 + 0.439 (male) + 0.000 (Indian) + 0.533 (Intramural/house league sports) + 0.374 (school team) - 0.050 (Other physical activities in school) + 0.426 (Individual physical activities outside of school) - 0.467 (homework 1-6 hours/week) - 0.166 (homework 6 hours/week) - 0.629 (reading for leisure 1- 6 hours/week) - 0.795 (reading for leisure 6 hours/week) - 0.373 (watching TV 2 hours/week) - 0.023 (Internet surfing 1 hour/day) - 0.809 (Playing computer or video game 2 hours /day) - 0.759 (Talking on phone or short message sending 2 hours/day)

DISCUSSION

Numerous studies estimating the prevalence of physical activity have been done among children and adolescents around the world.^[6, 25] However, to compare physical activity prevalences across different countries pose a difficulty due to differences in methodology, scales, analysis and reporting as well as proposed physical activity criteria.^[26, 24] Differences in proposed physical activity may cause prevalence estimates to differ dramatically.

The present study found that the prevalence of adolescents who met the 60 minutes moderate and vigorous physical activity (MVPA) was 60.4% among males and 49.9% among females. This is similar to the rates reported in Kuantan, Pahang (77.9% among males and 54.9% among female adolescents in the moderate/high physical activity level category).^[8] Studies in Xi'an, China and Singapore also reported similar rates (63% among males and 47% among females in Xi'an^[27] and in Singapore (73% overall).^[28]

But, the prevalence of physical activity (perform 60 minutes MVPA) reported in this study is higher compared to East Asian countries, European and North American countries.^[6, 25, 29] The prevalences in East Asian countries (India, China, Sri Lanka, Philippines, Thailand, Myanmar and Indonesia) reported from the Global School-based Student Health Survey (GSHS) from 2003 to 2008 ranged from 3.7 to 31% for males and 2.1 to 29.1% for females.^[25, 29] While, the Health Behaviour in School-aged Children (HBSC) study, WHO 2005/2006 reported 20% male and 12% female adolescents (15 year olds) perform 60 minutes MVPA in Europe and North America.^[6] The prevalence found in our study is far higher than the GSHS and the HBSC, which may be because of the substantial difference in sample size. Therefore, a larger scale and more representative study is needed to provide a better estimate of the prevalence of physical activity among adolescents in this country.

The American Academy of Paediatrics^[11] in 2001 recommended that children and adolescents should not spend more than two hours watching television per day. In our study, 62.5% of the respondents (59.9% males and 65% females) spent two or more hours per day watching television. This prevalence is higher than the rates reported for adolescents in China and in Vietnam which were 24%^[27] and 29.7%^[30], respectively. However, the prevalence is similar to that reported from the HBSC (Health Behaviour in School-aged Children) among 15- year olds in developing countries in Europe and North America which was 68% overall.^[6]

Univariate analysis and multivariate analysis showed that female adolescents were significantly less physically active compared to boys. Our finding is consistent with findings from previous studies in other countries.^[7, 13, 20, 31] This may be explained by the fact that male adolescents' prefer more vigorous activities and team sports.^[32, 33] In addition, female adolescents' perceived barriers of physical activity were consistently higher compared to males. Among the main barriers to physical activity reported by female adolescents were time allocated for schoolwork, family activities and not being in the mood for physical activity^[34], prefer to watch television and play electronic games to physical activities, and having no one to be physically active with.^[35]

Ethnicity was not associated with level of physical activity. While in Western countries, differences in physical activity levels between ethnic groups have been shown. McMurray *et al.*^[37] in 2000 found that African Americans adolescents perform physical activities of varying intensity more frequently compared to whites adolescents. In contrast, Eisenmann *et al.*^[36] in 2002 reported that more white adolescents performed moderate and vigorous compared to Hispanic and African-American teens. Prior to that, a review by Sallis *et al.*^[13] in 2000 had concluded that there was consistent evidence that Non-Hispanic Whites are more physically active compared to other ethnic groups. But, the

review was limited to studies from Europe and North America and did not include Asian countries.

There was no association between parental education level and adolescent physical activity in this study. This finding is consistent with a report by Chen *et al.* in 2007.^[38] Shi *et al.*^[39] in 2006 reported that children of high socioeconomic status were found to spend more time reading, doing schoolwork and less time on outdoors because of stricter parental monitoring.^[39] But, other studies have shown that adolescents with highly educated parents were more physically active (spent more time for extra-curricular activity and sports club) compared to those whose parents were less educated.^[40, 41]

This study showed that adolescents who are active in team sports and house league sports and individual physical activity outside school were more physically active compared to those who did not participate in sports activities. Similarly, Santos^[33] found that physically active adolescents engaged in more organised sports (with guidance of a coach) and team sports compared to less active adolescents. Participation in organised sports^[42], extracurricular exercises (team or individual), number of events organised annually and number of physical education sessions per week in school^[43] was found to increase adolescent physical activity.

The relationship between level of physical activity and sedentary behaviour is complex. In this study, students who were physically active were also engaged in sedentary activities. Other studies reported a positive relationship or no relationship between sedentary behaviour and child or adolescent physical activity level. Sedentary behaviour does not necessarily oppose physical activity, but on the contrary, may coexist with it. An adolescent may perform physical activity for more than 60 minutes a day, and also engage in sedentary activities.^[44] A longitudinal study in 2007 by Taveras *et al.*^[10] found that the variation in time spent watching TV was not associated with leisure physical activity. In the same year, Chen *et al.*^[38] reported that highly physically active youths spent more time on sedentary activities (sitting) compared to those who were less active physically, and explained that this may be because Taiwanese adolescents spend more time studying especially during public and university entrance exam years, therefore, adolescents may be trying to balance long study hours with sports or exercise. The review by Sallis *et al.*^[13] suggested that there is no association between time watching television and physical activity level. Another recent systematic review suggested that there was no firm evidence showing sedentary behaviour (playing video games and using the computer) reduces physical activity among children and adolescents.^[45]

This contradicts the 'Displacement Hypothesis' that an increase in a certain type of activity will displace other types of activities^[14], which has been observed in previous studies. Increase in screen time (watching television and playing video or computer games) were associated with decreased physical activity.^[16, 17, 20] A recent meta analysis found a weak and negative relationship between watching television and computer/video gaming with physical activity.^[15]

Eventhough to date, there is lack of conclusive proof that sedentary behaviour displaces physical activity in adolescents, sedentary behaviour should still be limited as it contributes to reduced energy consumption and encourages positive energy balance.^[44] Furthermore, some studies have shown that sedentary behaviour is linked to consumption of snacks and high energy foods among children and adolescents.^[46, 47]

Self-reported physical activity using validated self-administered questionnaires is necessary in epidemiological studies and surveys where objective measurement is not practicable. Among the advantages of this method are; its convenience and does not cause discomfort besides the ability to record physical activity history and low cost.^[48] However, other studies have shown that objective measurements such as accelerometry are more accurate and suitable for use in large-scale studies involving children and adolescents.^[49] The questionnaire used in this study was developed for Canadian adolescents, but comprehensibility and relevancy of the questionnaire were assessed and adjusted to suit the local context. While frequency, duration and intensity of physical activity were assessed using the self-report questionnaire, information on the types of physical activity frequently performed by adolescents such as type of games and individual or team sports were not. Future studies need to evaluate the types of physical activities preferred by adolescents so that more effective programs may be implemented such as providing access to the facilities and equipments for adolescents to play sports. Assessing physical activity in children and adolescents using questionnaires may result in overestimated or underestimated physical activity levels.^[49, 50] Comparisons of physical activity prevalence with previous studies are limited as the other studies used different self-administered questionnaires designed for different purposes resulting in a wide variation in questionnaire validity.^[51] As the design of the present study was cross-sectional it is not possible to infer causal relationships. Longitudinal studies are required in order to further explore and confirm these findings and better understand the predictors of physical activity and sedentary behaviour among Malaysian adolescents.

In conclusion, our findings show that more females are physically inactive compared to males. Physically inactive adolescents are less likely to participate in intramural/house league sports, school team sports and individual physical activities outside school compared to their physically active counterparts. Therefore, promoting organised sports in school and outside the school among youths may be a potential strategy for increasing physical activity in this population. Physically inactive adolescents are also less engaged in sedentary activities, such as television watching, playing computer/video game, talking on the telephone/mobile phone text messaging and reading compared to those

who are physically active. In this study, physical activity coexists with sedentary behaviour in adolescents. Sedentary activities do not necessarily displace physical activity among youth.

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