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Association Between Body Fat Percentage and Level of Physical Activity Among Adolescents in Kuala Nerus, Terengganu

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Abstract

Lack of physical activity among adolescents is one of the factors which lead to the accumulation of body fat and increase prevalence of obesity among Malaysian population. Therefore, this study was aimed to determine the association between body fat percentage and physical activity level among adolescents in Kuala Nerus, Terengganu. This cross-sectional study involved 300 participants consists of 44.7% male and 55.3% female aged between 10 to 16 years old. Anthropometric measurements included body weight, height and waist circumference. Body fat percentage (%BF) was assessed using bioelectrical impedance analysis (BIA). Physical activity was assessed by physical activity questionnaire (PAQ-C) and pedometers in a subsample (n = 50). The result shows that the mean body fat percentage and BMI of the participants were 23.02±9.41% and 20.03±4.77 kg/m^2, respectively. Mean PAQ-C score and pedometer steps count for both genders were 1.9±0.42 and 6079±1878, respectively. Male has higher PA level compared to female in their daily life based on PAQ-C score and pedometer steps count. PAQ-C score and pedometer step counts were negatively associated with %BF however there is no significant association between screen time and %BF. As a conclusion, the problems of obesity can be solved by providing strategies to promote active living among adolescents in Malaysia not only focus on increasing physical activity but also emphasise reduction in sedentary behaviours.

Keywords: adolescents, body fat percentage, physical activity

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Introduction

The problem of obesity is becoming a serious issue and getting worse day by day. In the era of globalisation, the lifestyle factors play an important role in obesity problem. It is estimated almost 340 million people who belong to that age group are in the state of overweight and obese in the year 2016 [1]. According to the WHO, over 340 million children and adolescents aged 5-19 were overweight or obese in 2016 [2]. In the same report, the prevalence of overweight and obesity among children and adolescents aged 5-19 has risen dramatically from just 4% in 1975 to over 18% in 2016. More than 124 million children and adolescents (6% of girls and 8% of boys) were reported obese. The presence of obesity can lead to the greater mortality rates and morbidity in the population since it can develop many health-related diseases such as metabolic syndrome, liver disease, cardiovascular disease and others.

Body composition is one of the indicators to measure the proportion of the body especially fat since it can influence the health outcome of an individual [3]. The higher the percentage of fat, the greater the risk in getting chronic diseases such as diabetes, cardiovascular disease and others. Measurement of body fat percentage is considered to be the best indicator in determining obesity and overweight in adolescents compared to BMI [4].

Physical activity (PA) also has been known as one of the factors which can reduce the risk in development of obesity. Regular and adequate levels of PA in adults are key contributors to energy expenditure and are essential for energy balance and weight control. Lack of PA, together with increase individual sitting hours, will contribute to the increase in prevalence of overweight and obesity among populations. However, studies among Malaysian populations have yielded contradicts results despite increasing in the rate of PA there is also increasing in overweight and obesity in the population. National Health and Morbidity Survey 2015 reported that Malaysian adults aged 18 years and above are becoming more physically active, with the prevalence of PA (achieving at least 10 MET-hours/week of total PA) increasing from 56.3% in 2006 [5] to 66.9% in 2015 [6]. Despite increasing in PA, Malaysia is still known as Southeast Asia's fattest country in 2015, due to a greater percentage of male and female who are overweight (48.6%) and obese 43.8% [7]. In Malaysia, the correlation between body fat percentage and the level of PA among adolescents is still limited especially in Terengganu since most of the study conducted has used BMI instead of body fat percentage as main indicator to measure obesity among population. Therefore, the aim of this study is to determine the body fat percentage and PA level as well as the association between PA level and body fat percentage among adolescents in Kuala Nerus, Terengganu.

Methodology

Study design and subjects

This cross-sectional study was conducted at schools in Kuala Nerus, Terengganu, which involved 300 students aged between 10 to 16 years old. The study was conducted after getting approval from UniSZA Human Research Ethics Committee (UHREC) [UniSZA.C/2/UHREC/628-2(94)], Ministry of Education (MOE) [KPM.600-3/2/3-eras (4480)], Terengganu State Education Department [P.T.06030-35(26)] and principals of the schools. Written informed consent was obtained from the students before measurements were taken. Children who are disabled, have chronic diseases, unable to read and write were excluded from the study.

Anthropometric Measurements

Height was measured by using SECA stadiometer model 213 (SECA, Germany) and weight was measured with SECA digital scale model 803 (SECA, Germany) to the nearest 0.1cm or 0.1kg, respectively. The participants were asked to wear light clothing and remove all the object that might altered the reading of the measurements. Body mass index (BMI, kg/m²) was calculated by dividing weight (kg) by the square of height (m). Waist circumference (WC) was measured at the midpoint between the lowest rib and iliac crest using a Rosscraft Antrotape (Rosscraft, USA) to the nearest 0.1 cm. Body fat percentage (%BF) was measured by bioelectrical impedance analysis by using Bodystat Quadscan 4000 (Bodystat Ltd, UK) with the incorporated formula in the instrument. Body fat percentage were classified into healthy, overweight and obese according to Heo et al. [8] Prior to the body composition measurement, subjects were required to fast for at least 4 hours, empty bladder, remove all objects that may interfere with body fat percentage readings and lie supine for 5 to 10 min.

Physical Activity and Sedentary Behaviour

Physical activity questionnaire was used to measure the level of physical activity of the participants. Since the study involved participants among adolescents, the Physical Activity Questionnaire (PAQ) adapted from Kowalski, Crocker & Faulkner [9] was selected to examine their physical activity level. The questionnaire was validated in Malay version with good internal consistency and internal validity. Students were required to complete 10 questions related to their daily PA over past 7 days. The first item includes the type and frequency of sports during the past 7 days. The second to eighth items assessed activity during physical education classes (PE), recess time, lunch time, after school, evenings, weekend and leisure time. A likert scale of one to five points was used for those items, ranging from low (score=1) to high (score=5). Item 9 was the frequency of engaging in physical activity in last week and items 10 required the children to report unusual activities in the previous week which had not been recorded in items 1 to 9. The PAQ-C score is the average score of these 10 questions. Then the average score was classified into few categories either low (less than or equal to 2.04), moderate (2.05- 2.89) or high (more than or equal 2.9) [10].

A random 50 subsample of the participants was given Omron Step Counter pedometer model HJ-321 (Omron, Japan) for 7 days. They were requested to wear pedometer when they awake in the morning until they retired at night except during sleeping, personal hygiene, swimming and cycling. A weighted average daily step count was then calculated from both weekdays and weekend days. The result of the pedometer considered acceptable if two criteria were met :1. the number of step counts exceeded 1000 steps per day, and 2. the period of pedometer was worn at least 10

hours per day. A minimum number of at least 3 weekdays and 1 weekend day was used for the calculation of average pedometer step counts. A cut-off value of 13,000 steps per day for boys and 11,000 steps per day for girls was used as recommended pedometer step counts [11]. Despite 50 participants, only 49 of them were able to return the pedometer safely after 7 days while another participant has lost it during the study was conducted.

Sedentary behaviour of the participants was assessed with a questionnaire adapted from the Child and Adolescent Physical Activity and Nutrition Survey (CAPANS)[12]. Children were required to complete the questions related to their sedentary activities over the past 7 days. The average time spent watching television, playing video games, surfing internet/ using computer were calculated from that reported weekdays and weekends. The sum of these weighted average variables forms the screen time variable in the study. "Non-screen time" included other sedentary behaviour besides screen time activities. The recommended screen time level of not more than 2 hours per day based on American Academy of Pediatrics was used in this study [13].

Data Analysis

The statistical analysis was conducted by using IBM SPSS Statistic Version 20.0. The first objective was analysed by using descriptive analysis to measure socio-demographic data, anthropometric measurements, physical activity and sedentary behaviour. In order to compare the steps, count between gender during weekend and weekdays, Mann-Whitney U test and Independent T test were chosen to analyse the data. Mann-Whitney U test and Kruskal Wallis Test were used to compare the pedometer steps count and PAQ-C mean score between age group. Lastly, multiple linear regression was used to measure the association between body fat percentage and the physical activity level among adolescents in Kuala Nerus, Terengganu.

Results

A total of 300 participants, with a subsample of 49 participants were assessed with pedometer, participated in the study. Two different weight factors were used in order to ensure that the results are representative of Kuala Nerus population children aged 10 to 16 years old. Descriptive statistics by socio-demographic characteristics was reported in Table 1. About half of the participants came from low-income family. Only 9.3 % of participants able to meet recommendation of screen time based on American Academy of Pediatrics (2001) while another 90.7 % of the participants failed to meet recommendation of the screen time. Furthermore, the table also revealed that male has higher daily screen times compared to female.

Table 2 shows the classification of BMI, body fat percentage of participants, PAQ-C determined physical activity, pedometer-based physical activity and average screen time during weekend and weekdays. It shown that majority of the participants have normal body mass index and healthy body fat percentage but when comparing between two genders, female had higher BMI and body fat percentage compared to male. According to Norashikin et al. [10] baseline for each physical activity category, show that 74% of female participants has low physical activity level and only 1.3 % of the students belong to high physical activity group based on PAQ-C score. However, none of them are able to meet daily recommendation of steps count according to Tudor-Locke et al [11], since the total recommendation for female participants should be ≥ 11,000 steps per day while for males are ≥ 13,000 steps per day. The table also show that male (6195±2362) has higher steps count compared to female (5992±1454). Furthermore, the table also revealed that male has higher screen times compared to female daily.

Table 3 indicates the comparison between male and female for weekdays and weekends steps count. The result for weekdays steps count was determined by using independent T-test and Mann-Whitney U test for weekends steps count. In this table, the median weekdays step count for males is 6196±242 and weekends is 6196± 2362 while median steps for female during weekdays is 6154 ± 1660 steps and during weekends is 5992± 1454 steps. Both of the results shows that males have higher steps count compared to females during weekend and weekdays. However, there are no significant differences between gender.

Table 4 shows the relationship between physical activity level, screen time and body fat percentage among adolescents by using multiple linear regression method. There is significant relationship between pedometer steps count and physical activity level with body fat percentage. It is observed that for every one step increase in pedometer steps count, there will be 0.001% decrease in body fat percentage. The table also indicates that everyone score increases in physical activity level there will be 7.033 decrease in the body fat percentage. Pedometer steps count and physical activity questionnaire are the significant predicting factors for body fat percentage.

Discussion

This study was mainly focused on two indicators, which are low level of physical activity and high sedentary behaviour, that has been associated with the risk factors for overweight and obesity in children. The mean percentage of body fat are 23.0±9.4 which was slightly lower compared to a previous study that has been conducted among Malaysian population that involved in MyHeART study [14]. Another study conducted in Perak, 22.09% of adolescents are overweight and obese [15] which was 6% lower than the current study's findings. The result also highlighted that physical inactivity among participants are higher than the key findings from the Adolescent Health and Nutrition Survey conducted in 2017 since 61.3 % of the participants are physically inactive compared to NHMS 2017 [16] data which is 55.0%. According to World Health Organization [17], the prevalence of physical inactivity worldwide was 81% and South-East Asia Region recorded the lowest prevalence of insufficient physical activity (74%) compared to Eastern Mediterranean Region, the African Region and the Western Pacific Region (88%, 85% and 85%, respectively). When compared with our findings, our participants physical activity level is much lower compared to South-East Asia Region in general. Other than that, screen time data was also collected in order to support PAQ-C data and pedometer steps count data and the result revealed that although male has higher PAQ-C mean score and pedometer steps count, they also had slightly higher screen time compared to female.

Table 1 Socio-Demographic Characteristics of Subjects

Age (years)	Male (n= 134) n (%)	Female (n= 166) n (%)	Total(n=300)
10	31(23.1)	36(21.7)	67(22.3)
11	15(11.2)	3(1.8)	18(6)
13	36(26.9)	35(21.1)	71(23.7)
14	36(26.9)	32(19.3)	68(22.7)
15	0(0)	32(19.3)	32(10.7)
16	16(11.9)	28(16.9)	44(14.7)
Household income			
<RM 3860	144 (48)		
RM 3860-RM 8319	112(37.3)		
>RM 8320	44(14.7)		
< 2hours screen time			
Achieved	28 (9.3)		
Not achieved	272 (90.7)		

Table 2 Physical characteristics and physical activity levels among subjects

Body composition	Male (n=134) n (%)	mean±SD	Female (n=166) n (%)	mean±SD	Total (n=300) n (%)	mean±SD
Body Mass Indeks						
Severe thinness	7(5.2)	18.8±4.3	2 (1.2)	21.0±4.9	9 (3)	20.0±4.8
Thinness	16 (11.9)		3 (1.8)		19 (6.3)	
Normal	93 (69.4)		116 (69.9)		209 (69.7)	
Overweight	16 (11.9)		21 (12.7)		37 (12.3)	
obese	2 (1.5)		24 (14.5)		26 (8.7)	
Body Fat Percentage						
Healthy	100(74.6)	16.9±8.1	116(69.9)	28.0±7.3	216 (72)	23.0±9.4
Overweight	28 (20.9)		45(27.1)		73 (24.3)	
Obese	6(4.5)		5(3.0)		11 (3.7)	
PAQ-C determined physical activities						
Low (≤2.04)	61(45.5)	2.1±0.4	123(74.1)	1.8±0.4	184 (61.3)	1.9±0.4
Moderate (2.05-2.89)	70(52.2)		42(25.3)		112 (37.3)	
High (≥2.9)	3 (2.2)		1(0.6)		4(1.3)	
Pedometer- based physical activity						
Meet recommended step count	0(0)	6195±2362	0(0)	5992±1454	0(0)	6079±1877
Do not meet recommended steps count	21 (42.9)		28 (57.1)		49(100)	
Total screen time (hours)						
Weekdays		5.3±2.8		4.6±2.8		4.9±2.8
Weekend		6.2±2.9		6.1±3.7		6.2±3.4

Table 3 Comparison of weekday and weekend steps count between gender

	Male(n=21) median (IQR)	**Female(n=28)** median (IQR)	**p- value**
Weekdays steps count	6195 (2421)	6154 (1660.80)	0.258[a]
Weekend steps count	6195 (2362)	5992 (1454.59)	0.275[b]

*Mann-Whitney U Test[b] reported values were median (IQR); independent T-test[a])

Table 4 The association between PAQ-C mean scores, pedometer steps count, screen time and body fat percentage among adolescents

Dependent variable	**Independent variable**	**β**	**95% CI**	**T-statistics**	**p-value**	**R^2**	**Adjusted R^2**
Body fat percentage	Constant	45.939	30.266,61.611	5.904	-	0.177	0.123
	PAQ-C mean score	-7.033	-13.468, -0.597	-2.201	0.033*		
	Average pedometer steps count	-0.001	-0.003,0.00	-2.216	0.032*		
	Average screen time	-0.120	-0.970,0.729	-0.286	0.776		

*Significant at p< 0.05, multiple linear regression

Generally, individual who has high physical activity should has low screen time activity. Nevertheless, the findings of the present study are consistent with the previous studies which show that, boys had higher physical activity level simultaneously with higher screen time, in comparison to girls [18]. There is a good possibility that children who participated in active sports and activities also practises sedentary behaviour at other times [19].

There are no significant differences between weekends and weekdays step count among gender although males have higher steps count compared to females in their daily life. Previous studies supported this study where they found that, boys more likely to participate in the school's sport events or activities compared to girls [20]. Another study in Morocco also found that boys are more physically active during weekend compared to girls because they stated that girls are more likely to spend their times with sedentary activities[15] while another study yielded contradicts result with this study which reported that female has higher steps counts during weekend compared to male due to house chores activity during the weekend [21].

Pedometer steps count and PAQ-C mean score have significant association with body fat percentage but not with screen time. It can be proven by many previous studies, where they found that individual who done more physical activities was also associated with a lower body fat percentage within each category of BMI, compared with the least active individuals [22]. Moreover, another study also able to find significant differences between pedometer and control group in terms of not only BMI but also body fat percentage. These findings shows that the active respondents were associated with significant decreases in BMI as well as body fat percentage [23]. Based on the above said, it is crucial to highlight that physical activity is one of the main contributors in the energy balance especially in maintaining weight and preventing weight and body fat gain [24].

Conclusion

As a conclusion, adolescents in Kuala Nerus, Terengganu has normal BMI and healthy body fat range. Boys have both higher activity level and screen time as compared to girls. All of the children did not meet the minimum physical activity and most of them exceeded the maximal screen time recommendation. There was a significant association between physical activity and pedometer steps count towards body fat percentage. Therefore, by replacement of an overall less active behaviour with moderate and vigorous physical activity may provide a viable solution to improve BMI and %BF. Hence, it will help in reducing childhood obesity in Malaysia.

Finding from this study, suggested that stakeholders in education, sports and health should put mechanism that will guide all the children at schools to participate in physical activities. Such activities that in turn will act as reducing excessive body fat percentage which can help in health condition and academic performance. Other than that, in order to enhance the physical activity of adolescents, schools should be fully equipped with relevant facilities and equipment to attract student to participate in physical activities.

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