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The Relationships between Physical Activity Levels, Enjoyment of Physical Activity, and Body Mass Index among Bruneian Secondary School Adolescents

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***Abstract*—**The purpose of the study was to examine the relationships between objectively measured physical activity levels (PALs), enjoyment of physical activity (EPA), and body mass index (BMI) among adolescents. A total of 188 12-14-year-old Bruneian secondary school adolescents (88 boys and 100 girls) voluntarily took part in this study. Subjects wore the RT3 accelerometer for seven consecutive days in order to measure their PALs. Times of students' engagement in total (TPA), light (LPA), moderate (MPV), and vigorous PA (VPA) were obtained from the accelerometer. Their BMIs were calculated from their body height and weight. Physical Activity Enjoyment Scale (PACES) was administrated to obtain their EPA levels. Four key enjoyment factors including fun factors, positive perceptions, unexciting in doing activities, and negative perceptions were identified. Subjects' social economic status (SES) was provided by school administration. Results show that all the adolescents did not meet the recommended PA guidelines even though boys were engaged in more MVPA than girls. No relationships were found between BMI and all PALs in both boys and girls. BMI was significantly related to the PACES scores ($r = -.22$, $p = 0.01$), fun factors ($r = -.20$, $p = 0.05$) and positive perceptions ($r = -.21$, $p < 0.05$). The PACES scores were significantly related to LPA ($r = .18$, $p = 0.01$) but not related to MVPA ($r = .04$, $p > 0.05$). After controlling for age and SES, BMI was only significantly related to the PACES scores in girls ($r = -.27$, $p < .01$) but boys ($r = -.06$, $p > 0.05$). Fun factors were significantly related to LPA and MVPA ($p < .01$) in girls while negative perceptions were significantly related to LPA and MVPA ($p < .01$) in boys. This study provides evidence that enjoyment may be a trigger of LPA but MVPA and may be influenced by their BMI status particularly in girls. Based on these findings, physical and health educators are suggested to not only make PA more enjoyable, but also consider gender differences in promoting adolescents' participation in MVPA.

***Keywords*—**Accelerometer, body mass index, enjoyment of physical activity, moderate to vigorous physical activity.

I. Introduction

WORLD Health Organization (WHO) had ranked Brunei Darussalam the highest obesity rate among Asian member countries [1]. Ministry of Health of Brunei Darussalam reported that some types of cancers, heart diseases, diabetes mellitus, cerebrovascular diseases and hypertensive diseases are the top five leading causes of death in Bruneian population [2]. These diseases are related to lifestyle and obesity that can be tracked from a person's childhood to adulthood. Engaging in regular physical activity (PA) has been found to decrease the prevalence of obesity, risk of cardiovascular disease-related death, diabetes and high cholesterol and some types of cancers [3]. Moderate-to-vigorous physical activity (MVPA) is an important independent predictor of adiposity in children and adolescents [4]. WHO recommended that that school-aged children and adolescents should accumulate at least 60 minutes of MVPA per day [5]. Therefore, it is critical to examine the PA patterns of Bruneian adolescents and encourage them to participate in MVPA.

Researchers have discovered that the enjoyment of physical activity (EPA) is one of the important factors to encourage children and adolescents to participate in regular PA [6]-[8]. However, subjective PA measurements used in these studies were reported to be inadequately accurate and valid in children and adolescents. It is, therefore, inconclusive to determine what intensities of PA may be related to EPA in adolescents. To measure PA objectively and accurately, the 3-dimensional RT3 accelerometer had been reported an acceptable validity in assessment of PA in children and adolescents [9]-[13].

While the link between obesity and reduced PA is well established, the relationship between obesity and EPA which may reinforce positive behaviors is rarely studied in adolescents. Therefore, the purposes of this study were: 1) to examine the relationships between PA patterns and BMI, 2) to examine relationships between BMI and EPA and 3) to explore what intensities of PA that EPA may induce among Bruneian adolescents.

II. Method

A. Participants and Settings

A total of 188 aged from 12 to 14 years old adolescents (100 girls and 88 boys) from four government secondary schools in Brunei Darussalam voluntarily participated in this study following ethical approval from the University Ethics Committee. Consent form was obtained from the Principals, and parents and participants. Overall, 85% of the students were Bruneian Malays, followed by those who were of Chinese (8%) and other origins.

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B. Measures

1. Anthropometric Measures

Each child was measured for standing height (in meters [m]), body mass (in kilograms [kg]). Body mass and standing height were measured using a calibrated standard electronic weighing scale (Holtain, Dyfed, Britain) and a wall mounted stadiometer (Mettler Toledo IDL Plus, Eichfahig, Germany), respectively. BMI was calculated using body mass and height according to the formula BMI = body mass·height^{-2} (kg·cm^{-2}).

2. Physical Activity

Objective measurements of PA were collected over a seven consecutive day period using the RT3 accelerometer (Stayhealthy, Monrovia, CA), total daily counts, times spent on light PA (LPA [1000-2499 counts·minute^{-1}]), moderate PA [MPA: 2500-3399 counts·minute^{-1}]), vigorous PA (VPA: [> 3400 counts·minute^{-1}]) and MVPA (>2500 counts·minute^{-1}) were derived from the accelerometer [12].

3. Physical Activity Enjoyment Scale

The Physical Activity Enjoyment Scale (PACES) (Cronbach's $\alpha = .90$) was administrated [14]. Participants were asked to rate using a 5-point Likert-type scale (1 = "Strongly Disagree" to 5 = "Strongly Agree"). The principle component factor analysis was conducted on the correlations of the 16 variables on enjoyment items (Table I). Four factors (fun factors, positive perceptions, unexcited and negative perceptions) were initially extracted with eigenvalues equal or greater than 1.00. Orthogonal rotation (Varimax) of the factors yielded the factor structure. The first factor (item 15, 14, 1, 4, 11) which was categorized as fun factors accounted for 19.3% of the variance. The second factor (item 6, 9, 8, 10) categorized as positive perceptions accounted for 19.3% of the variance. The third factor, unexciting (item 7, 13, 5, 2, 16) accounted for 16.4% of the variance and the fourth factor (negative perceptions: item 12, 3) had accounted for 12.7% of the variance.

4. Social Economic Status

Social economic status (SES) regarding family income and parents' education levels was obtained from school administration.

C. Statistical Analyses

A principal components factor analysis was conducted on the correlation of the 16 variables on enjoyment items before computing the variables by using Orthogonal Varimax rotation. Mean and standard deviation of enjoyment levels, BMI and PA data were computed. Pearson product-moment correlation analysis was used to examine the relationships between BMI, the PACES scores and PA components. Partial correlation analysis was conducted to examine the relationships between EPA and BMI after adjusting for age and SES and the relationships between EPA and PA components after adjusting for BMI, age and SES. The significant levels were set at $p \leq .05$.

III. Results

A total of 188 adolescents (88 boys and 100 girls) were final sample for data analysis. Table II shows that boys were engaged in more MVPA (boys: 5.69±4.14 minute·day^{-1}, girls: 2.93±2.26 minute·day^{-1}, $t = 6.32$, $p < .01$), more MPA (boys: 4.70±3.57 minute·day^{-1}; girls: 2.64±2.0 minute·day^{-1}, $t = 5.60$, $p < .01$), and more VPA (boys: 1.12 ±.12 minute·day^{-1}; girls: .29±.39 minute·day^{-1}, $t = 5.7$, $p < .01$) than girls. Both boys and girls reported that they had positive EPA levels but did not differ in the PACES scores ($p > .05$). As indicated in Table III, BMI was significantly related to the PACES scores ($r = -.18$ $p < .01$) but not related to all the PA components ($p > .05$) and LPA was only significantly related to the PACES scores ($r = .18$ $p < .01$). Table IV shows the gender differences in correlations between BMI and enjoyment factors. There was significant relationship between BMI and the PACES scores in girls ($r = -.27$, $p = .01$) but boys ($r = -.06$, $p = .63$). There was a significant relationship between BMI and negative perceptions in both boys ($r = .24$, $p = .01$) and girls ($r = .29$, $p = .01$). Table V shows the gender differences in correlations between enjoyment factors and the PA components (LPA versus MVPA). After adjusting for age, BMI, and SES, the PACES scores were found to be significantly related to LPA ($r = .30$, $p = .01$) but MVPA ($r = .13$, $p = .27$) in girls only. Furthermore, fun factors were found to be significantly related to both LPA ($r = .54$, $p = .001$) and MVPA ($r = .40$, $p = .001$) in girls only while positive perceptions were significantly related to both LPA ($r = .18$, $p = .05$) and MVPA ($r = .25$, $p = .009$) in boys only.

IV. Discussion

This study examined the relationships between BMI, EPA and objectively measured PALs in adolescents. The key findings of this study are 1) Bruneian adolescents in this study accumulated extremely low MVPA even though most of them self-reported positive enjoyment levels, 2) there were no significant relationships between BMI and all the PA components, 3) the PACES scores had a weak but significant relationship with BMI and were only related LPA but MVPA, 4) BMI may induce negative perceptions in adolescents, and 5) fun factors were a key source for girls to participate in both LPA and MVPA while positive perceptions were an important factor for boys to participate in both LPA and MVPA.

The median time that the Bruneian adolescents spent on MVPA was 4 minute·day^{-1} (boys: 5.69±4.14 minute·day^{-1}; girls: 2.93±2.26 minute·day^{-1}) which was far below the recommended 60 minute MVPA minute·day^{-1} and the least time spent on MVPA per day compared to the results from other countries [15]-[18]. The adolescents in this study were almost not involved in any VPA. Ruiz [15] reported that the children who were engaged in more than 40 minutes of VPA per day had lower body fat than those who were engaged in

10–18 minutes of VPA per day while children who cannot meet the physical activity guidelines of at least 60 minutes of MVPA would have higher risk of being overweight and obesity. The finding of no association between PA and BMI in this study was inconsistent with some previous findings which reported a negative correlation [19]-[21]. However, it should be reported cautiously due to extremely low PALs of the Bruneian adolescents.

Another finding of this study indicates that BMI was significantly related to the total PACES scores ($r = -0.18$, $p = 0.01$) while the PACES scores were related to LPA ($r = 0.18$, $p = .01$) but MVPA ($p > .05$). This shows that adolescents with high BMIs may have lower enjoyment levels which may affect their participation in LPA but MVPA. To encourage adolescents to participate in high intensity of PA, to consider enjoyment only is insufficient. Other alternative strategies should be explored. These strategies could be the improvement of physical capabilities and sound prescriptions of the frequency, intensity, type and duration of exercise.

Self-determination theory, competence motivation theory and social cognitive theory (SCT) have been extensively used to understand and predict PA behaviors. According to these theories, individuals are more likely to participate in PA if they are capable and perceive enjoy and fun. In SCT, environment usually refers to physical environments but human physiological conditions. Findings from this study show that SCT may be the best model to explain obesity occurrence through triadic reciprocal causation of human physiological conditions which are considered a micro environment, personal factors and cognitive influence, and PA behaviors among adolescents in free living settings. Finding of positive correlations between BMI and negative perceptions in both boys and girls is consistent with the previous research [22]-[24]. These findings may also explain that a vicious cycle may exist; that is: adolescents become fatter – less enjoyable – less active. Some recent research also shows the support to the trend among adolescents in free living conditions [25], [26]. Another interesting finding from this study is a gender difference in associations of specific enjoyment factors and LPA and MVPA: fun factors are significantly related to LPA and MVPA among girls while positive perceptions were significantly related to LPA and MVPA among boys.

Although this study was cross-sectional in nature and other confounding factors such as eating habit were not considered, our results have highlighted that BMI may affect adolescents' enjoyment levels which, in turn, influence their PA participation particularly MVPA. Fun factors and positive perceptions posit the positive sources for boy and girls respectively to participate in both LPA and MVPA. However, the EPA to PA and BMI to the EPA explain less than 20% of the variance, respectively. There is 80% of the variance is not accounted for. The results could contribute to the understanding and implementation of alternative strategies using sound frequency, intensity, types and duration of exercise with the consideration of the gender difference of fun factors and positive perceptions in encouraging more active lifestyle among adolescents.

TABLE I
ROTATED COMPONENT OF ENJOYMENT ITEMS

	Rotated Components			
	1	2	3	4
Q15.PA makes me feel good	.715	.116	-.050	.027
Q 1.Enjoy doing PA	.710	.253	.021	.332
Q14.PA makes me feel I'm successful	.624	.242	.248	-.020
Q4.Enjoy & satisfied with any PA	.619	.597	.182	.007
Q11.PA is fun and exciting	.530	.494	.290	.211
Q6.PA gives me energy	.308	.764	.075	.107
Q9.PA makes my body feel good	.258	.743	.360	.081
Q8.PA was very pleasant	.092	.734	.119	.240
Q10.PA gives me something out of it	.493	.530	.019	.251
Q7.PA makes me sad	-.056	.149	.877	.124
Q13. PA does not attract me	-.124	.516	.684	.149
Q5. Does not enjoy doing PA	.361	.139	.647	.455
Q2. Bored doing PA	.533	.002	.575	.277
Q16. I rather do something than doing PA	.344	.116	.456	.122
Q12. Doing PA always disappoint me	-.011	.214	.236	.867
Q3 I disliked doing PA	.253	.174	.207	.801

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

TABLE II
DESCRIPTIVE STATISTICS OF DEMOGRAPHIC VARIABLES, PHYSICAL ACTIVITY AND ENJOYMENT SCORES

	Boy (n = 88)	Girl (n = 100)	Total (n = 188)	r	p
Age (yr)	12.64 ± .69	12.84 ± .79	12.8 ±.75	-7.97	.43
Height (m)	156.53 ± 7.6	149.67 ± 4.25	152.80 ± 6.89	8.17	.001**
Weight (kg)	51.59 ± 12.7	46.24 ± 10.89	48.69 ± 11.98	3.05	.03*
BMI (kg/m²)	21.10 ± 4.78	20.74 ± 4.76	20.89 ± 4.76	.75	.58
TPA (count)	192743.88 ± 82545.22	172027.96 ± 70118.76	180880.92 ± 76204.1	2.07	.04*
LPA (min)	41.59 ± 21.66	41.26 ± 20.97	43.11 ± 21.33	1.54	.13
MPA (min)	4.5 ± 3.77	2.76 ± 2.11	3.46 ± 3.01	4.04	.001**
VPA (min)	1.12 ± 0.12	0.29 ± .39	.55 ± .87	5.71	.001**
MVPA (min)	5.69 ± 4.14	2.93 ± 2.26	4.07 ± 3.46	6.32	.001**
PACES scores	3.69 ± .59	3.75 ± .53	3.73 ±.55	-8.4	.40

TABLE III
CORRELATIONS BETWEEN BODY MASS INDEX, PHYSICAL ACTIVITY COMPONENTS AND ENJOYMENT OF PHYSICAL ACTIVITY (N=188)

Variables	BMI	TPA	MVPA	VPA	MPA	LPA
BMI	1					
TAC	-.03	1				
MVPA	-.01	.60**	1			
VPA	-.03	.32**	.67**	1		
MPA	-.01	.61**	.96**	.48**	1	
LPA	-.06	.86**	.64**	.27**	.65**	1
Enjoyment	-.177**	.19**	.04	.01	.04	.181**

TABLE IV
COMPARISON OF GENDER DIFFERENCES IN CORRELATIONS OF BODY MASS INDEX AND ENJOYMENT FACTORS AFTER ADJUSTING FOR AGE AND SOCIAL ECONOMIC STATUS

	Boys BMI (n= 88)		Girls BMI (n = 100)	
	r	p	r	p
Enjoyment	-.06	.63	-.27	.01**
Fun factors	-.11	.24	-.02	.83
Positive perceptions	-.26	.01**	-.11	.35
Unexcited	.13	.18	.09	.43
Negative perceptions	.24	.01**	.29	.01**

TABLE V
COMPARISON OF GENDER DIFFERENCES IN CORRELATIONS BETWEEN ENJOYMENT FACTORS AND LIGHT PHYSICAL ACTIVITY VERSUS MODERATE TO VIGOROUS PHYSICAL ACTIVITY AFTER ADJUSTING FOR AGE, BODY MASS INDEX AND SOCIAL ECONOMIC STATUS

	Boys (n= 88)				Girls (n = 100)			
	LPA		MVPA		LPA		MVPA	
	r	p	r	p	r	p	r	p
Enjoyment	.03	.78	.03	.78	.30	.01**	.13	.27
Fun factors	.01	.92	.04	.68	.54	.001**	.40	.001**
Positive perceptions	.18	.05*	.25	.01**	.17	.15	.14	.22
Unexcited	-.11	.27	-.09	.35	-.05	.70	-.03	.77
Negative perceptions	-.16	.09	.01	.91	.08	.48	.03	.81

*Significant differences (*p <.05. **p < .01)

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