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Relative Validity of Administered Indonesian Version of the Short-Form International Physical Activity Questionnaire (IPAQ-SF) among Obese Adolescent Girl Population

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Abstract: Obesity has raised more concerns in developing countries than ever before as the prevalence continues to increase. Numerous studies seek to learn the role of physical activity in tackling obesity and related health problems. Several methods have been developed to measure physical activity; questionnaire methods are currently the cheapest and fastest compared to the other methods available. However, the validity of the questionnaire used should be a concern for investigators. This study's objective is to evaluate the relative validity of the Short-Form International Physical Activity Questionnaire (IPAQ) using a 24 h physical activity recall repeated 7 times. Obese adolescent female students were recruited from several junior high schools in Yogyakarta, Indonesia. The students were then administered a 24 h physical activity recall for seven consecutive days. They were also administered the IPAQ-SF. The results from the physical activity recall and the IPAQ-SF were then analyzed statistically to obtain the Spearman correlation coefficient. There was a small but significant correlation between total physical activity from the IPAQ-SF and the physical activity recall r = 0.24). Moreover, vigorous physical activity derived from the IPAQ-SF was also significantly correlated with that of the physical activity recall r = 0.28). Results from the Indonesian version of the IPAQ-SF had a small but significant correlation with physical activity recall. This result showed that the Indonesian version of the IPAQ-SF is a valid method for measuring physical activity among obese adolescent girls.

Key words: Physical activity, obesity, IPAQ, METs, validation

INTRODUCTION

Obesity can result from high energy and fat intake (Medawati *et al*., 2005) and also from a sedentary lifestyle (Hu *et al*., 2003). Therefore, aside from calorie restriction, physical activity is one of the first-line interventions for reducing excess body weight. Evidence shows that being physically active can give a person several benefits, including the reduction of all-cause and cardiovascular-related death, secondary prevention of cardiovascular disease and risk reduction of type 2 diabetes mellitus, cancer and osteoporosis (Warburton *et al*., 2006).

The measurement of physical activity is important to assess the association between active lifestyle and health and to monitor physical activity interventions in weight loss programs. Physical activity measurement can be validly measured using indirect calorimetry (Sirard and Pate, 2001), which is also a gold standard for energy-expenditure measurements. In epidemiological studies with a large number of samples, this method is nearly impossible to use because of the high cost and low applicability in field settings. The gold standard for physical activity measurement in a free-living context is the doubly-labelled water (DLW) technique, where subjects are asked to drink water containing stable isotopes ^{2}H and ^{18}O and then the difference in the elimination rate between the two isotopes reflects CO_2 production, which is then converted into the total daily energy expenditure (Hills *et al*., 2014). DLW only provides data on energy expenditure, so investigators cannot obtain information regarding the type, duration and intensity of physical activity (Hills *et al*., 2014). Other methods are probably better to use in this setting, including accelerometers and pedometers. However, these methods also require expensive investments and are therefore likely not preferable for a very large epidemiological study. Moreover, the abovementioned methods do not allow investigators to collect information about the type, duration and intensity of physical activity. A questionnaire is an appropriate tool to collect these data.

Several physical activity questionnaires have been developed to date. Questionnaires offer fast and simple administration, meaning less of a burden is placed on the subjects. One globally used physical-activity questionnaire is the International Physical Activity Questionnaire (IPAQ). Since its development on 1997 (Craig *et al*., 2003), IPAQ has been used in several studies in different countries worldwide, including the United States (Hoerster *et al*., 2015), the UK (Scholes *et al*., 2016), Belgium, Czech

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Republic, Denmark, Spain (Cerin *et al*., 2016), Norway (Belander *et al*., 2004) and Poland (Dmitruk *et al*., 2016). There are two types of IPAQ: the long-form (IPAQ-LF) and the short-form (IPAQ-SF). As indicated by the name, the long-form version contains more questions and therefore takes a longer time to fill out. In both long- and short-form versions, the questionnaire was designed to measure a person's physical activity for 7 days. Questions in the IPAQ are constructed based on several domains of physical activities, including leisure-time physical activity, domestic and gardening (yard) activities, work-related physical activity and transport-related physical activity (IPAQ Research Committee, 2005). While the long-form questionnaire asks about detailed activities in each domain, estimates of physical activities in a specific domain cannot be obtained using the short-form version. Data that can be obtained from the IPAQ-SF include scores for walking, moderate-intensity and vigorous-intensity activity. Investigators can also calculate the total energy expenditure from these activities and can categorize the physical activity levels into low, moderate and high.

Prior to administering questionnaires to specific populations, validity and reliability studies should be conducted in each setting, especially if the questionnaire undergoes modification or translation for use in specific cultural situations. In Indonesia, the IPAQ has not been validated, though the use of physical activity questionnaires for research in this country is emerging. Our study's objective was to evaluate the relative validity of the IPAQ-SF by analyzing the correlation between the IPAQ-SF and 7 x 24 h physical activity recall, specifically for use among obese adolescent girls.

MATERIALS AND METHODS

Subjects: The subjects were recruited from junior high schools in the city of Yogyakarta, Indonesia. Student-name lists were obtained from each school and were used for the recruitment process. The subjects' ages ranged from 13 to 15 years old. Female students were weighed and their heights were measured, from which their body mass indexes (BMI) were calculated. The BMIs of the students as well as their age data were then entered into WHO-Anthro software. The BMIs for age z-scores were obtained from the software and used for the determination of obesity status. Obesity is defined as a BMI for age of 95th percentile or higher (Han *et al*., 2010). Obese girls were then invited to participate in this study. From a total of 2120 female students screened, 79 students met the criteria and were willing to participate in this study. However, two students were excluded from analysis because of incomplete data. Data from 77 students were analyzed. This study obtained ethical clearance from the Ethical Committee of the Medical Faculty, Universitas Gadjah Mada, Indonesia (no. KE/FK/179/EC).

Measurement of physical activity: The relative validity of the IPAQ-SF was assessed by comparing the results with those from the 7 x 24 h physical activity recall. In order to obtain the data for the physical activity recall, subjects were asked about the type and duration of each physical activity they did from morning until night. Durations were recorded in minutes. Physical activity recall was administered through interviews by the research team on each day of the week. The intensity of each activity was determined by referring to Compendium Physical Activity Tracking Guide Table and expressed as metabolic equivalents (METs) (Ainsworth *et al*., 2000). Energy expenditure was calculated by multiplying each physical activity METs with the duration in minutes. Energy expenditure units were expressed as METs-min. The total daily energy expenditure was obtained by summing the energy expenditure from each activity. The total daily energy expenditure from all seven days were summed, resulting in total energy per week (Total PA_{REC}) in METs-min/week. Physical activity was categorized into Vigorous PA_{REC} (8 METs and above) and Moderate PA_{REC} (4 to 8 METs). Each activity that fell into one of either category was also summed for all seven days.

An Indonesian-translated IPAQ-SF was administered after the 7-day data collection for the physical activity recall was completed. Subjects were asked the number of days and the duration of physical activities, which were categorized into vigorous intensity, moderate intensity and walking activity. The data obtained were analyzed in accordance with the 'Guidelines for data processing and analysis of the International Physical Activity Questionnaire (IPAQ)-short and long forms' from the official IPAQ website (IPAQ Research Committee, 2005). According to these guidelines, the number of days, the duration and the METs value of each physical activity category were multiplied to obtain the energy expenditure in METs-min/week. The METs values of each physical activity category are: vigorous intensity (8 METs), moderate intensity (4 METs) and walking activity (3.3 METs).

Data analysis: We predicted that each physical activity category derived from the IPAQ-SF was correlated with the actual physical activity obtained from the 7 x 24 h physical activity recall. Spearman's rank correlation coefficient was used to evaluate the correlation of total, vigorous and moderate activities between the IPAQ-SF and the 7 x 24 h physical activity recall. A P-value of less than 0.05 is considered statistically significant.

RESULTS

Subjects' characteristics: All subjects were teenagers who were 13.71±0.90 years old. Although there were small variations in body weight, height and absolute BMI, the BMI percentile did not vary much as indicated by the smaller standard deviation. Moreover, the BMI percentile range was narrow: from 97.20 to 99.90 (data not shown).

Table 1: Subjects' characteristics (77 female adolescents)

Parameters	Mean±SD
Age (years)	13.71±0.90
Weight (kg)	70.67±8.20
Height (cm)	153.99±5.36
Body mass index	29.75±2.57
BMI percentile	98.94±0.76
Mid-upper-arm circumference (cm)	31.80±2.60
Waist circumference (cm)	89.20±6.57
Hip circumference (cm)	104.93±5.85
Systolic blood pressure (mmHg)	114.61±8.11
Diastolic blood pressure (mmHg)	79.16±5.78
Fasting blood glucose (mg/dL)	88.39±18.10

This finding showed that, although the subjects were different in terms of body size and age, the degree of obesity was similar across subjects. The mean of the mid-upper-arm circumference of the subjects was 31.80±2.60 cm. The waist and hip circumferences were 89.20±6.57 and 104.93±5.85 cm, respectively. Subjects' mean systolic blood pressure was 114.61±8.11 mmHg, while their mean diastolic blood pressure was 79.16±5.78 mmHg.

Descriptive data from the IPAQ and physical activity recall

Since the IPAQ only measures the contributions of energy expenditure from vigorous, moderate and walking physical activities, the difference in the total energy expenditure of both methods is remarkable. The mean total physical-activity energy expenditure from physical activity recall was 13478.01±96.06 MET-min/week. This amount was calculated from the whole 24 h of activity. The mean energy expenditure from the IPAQ was only 2402.51±269.11 MET-min/week. Substantial differences in numbers were also found with the vigorous physical activity. Apparently there was considerable overestimation of involvement in vigorous activity as recorded in the IPAQ compared to the physical activity recall (905.87±176.66 vs., 160.62±41.80 METs-min/week). There was also overestimation of moderate PA, though not as large as that of vigorous PA.

Correlation between 7 x 24 h activity recall and IPAQ:

As shown in Table 3, there was a significant correlation ($p = 0.04$) between the two methods: 7 x 24 h activity recall and the IPAQ. The Spearman's correlation coefficient was 0.24, indicating that there was a weak correlation between the two methods. Furthermore, we were also interested to see if the IPAQ can accurately predict the quantity of physical activity at different levels of intensity. Apparently, the correlation of vigorous PA between the IPAQ and the physical activity recall was significant, with a correlation coefficient of 0.28. No significant correlation was found for moderate PA between the IPAQ and the physical activity recall.

DISCUSSION

In our study, the total physical activity from the IPAQ-SF and the physical activity recall were statistically significant with a correlation coefficient of 0.24. According to other validation studies in systematic review, the correlation ranged from 0.09 to 0.39 (Lee ***et al.***, 2011). There are large differences in total PA between the IPAQ-SF and physical activity recall (2402.51±269.11 vs. 13478.01±96.06 METs-min/week). The main reason for this difference is low-intensity physical activity, which is not recorded in this questionnaire. Still, the IPAQ-SF overestimates the METs from moderate PA by double and severely overestimates the vigorous PA by more than five times. This difference may result from difficulties in estimating the week-long physical activity duration in the IPAQ, even though there was a correlation found between vigorous PA in both methods $r = 0.28$). This finding was similar to previous studies that showed that there was a significant correlation with vigorous PA but not with moderate and low PA (Vandelanotte ***et al.***, 2005).

The IPAQ-SF asks for the frequency and duration of physical activities, which fall into three categories: vigorous, moderate and walking. Therefore, the subjects were asked to decide by themselves which physical activity fell into which category. Discriminations were made by the characteristics of each physical activity. According to the IPAQ-SF, vigorous physical activities are the type of activities that require hard physical effort and make breathing much harder than normal and moderate physical activities are the type of activities that require hard physical effort and make breathing somewhat harder than normal (IPAQ Research Committee, 2005). The accuracy of the data might be questionable if the questionnaire is self-administered. In our study, the IPAQ was administered by the research team, who were available to answer questions about the classification of physical activities. Difficulties in the categorization of physical activity were probably the cause for low yet significant correlations between total and vigorous physical activity.

Physical activity recall was used to assess IPAQ-SF validity. Using physical activity recall, we could obtain information on all types of activities done by the subjects during the 7 days of investigation. This type of data cannot be obtained by other methods such as doubly-labelled water or movement detectors (accelerometer and pedometer). Physical activity recall is probably the best method to obtain all physical activity types and duration data from individuals. This method, however, relies on the subjects' memory and therefore may not be suitable for the elderly or people with memory disorders (Warren ***et al.***, 2010) (Grimm *et al.*, 2012).

As explained before, the IPAQ-SF only covers vigorous, moderate and walking activities. No low-intensity activities are recorded in this questionnaire (IPAQ Research Committee, 2005). Because of this, we cannot compare the low-intensity activities from the IPAQ-SF with the physical activity recall. Moreover, no correlation test was performed on walking activities due to the fact that no data about this type of activity were obtained from the physical activity recall.

Table 2: Descriptive data from the international physical activity questionnaire (IPAQ) and the physical activity recall

Physical activity measurements	Mean±SD
IPAQ-SF measurements	
Total PA_{IPAQ} (MET-min/week)	2402.51±269.11
Vigorous PA_{IPAQ} (MET-min/week)	905.87±176.66
Moderate PA_{IPAQ} (MET-min/week)	905.56±158.07
7 x 24 h physical activity recall measurements	
Total PA_{REC} (MET-min/week)	13478.01±96.06
Vigorous PA_{REC} (8 METs and above; MET-min/week)	160.62±41.80
Moderate PA_{REC} (4-<8 METs; MET-min/week)	414.59±58.39

Table 3: Spearman correlation coefficients of physical activity (PA) energy expenditure from the international physical activity questionnaire (IPAQ) and the physical activity recall

IPAQ measurements	7 x 24 h physical activity recall measurements	r
Total PA (MET-min/week)	Total PA (MET-min/week)	0.24*
Vigorous PA (MET-min/week)	Vigorous PA (8 METs and above; MET-min/week)	0.28*
Moderate PA (MET-min/week)	Moderate PA (4-<8 METs; MET-min/week)	-0.51

*Statistically significant, p<0.05

To summarize, the total PA derived from the Indonesian version of the IPAQ-SF showed a small but significant correlation with 7 x 24 h physical activity recall. Therefore, the IPAQ-SF is a valid method for measuring total PA. Other investigators, however, should be careful when using the data from the several categories of physical-activity intensity. The correlation of vigorous PA between the IPAQ-SF and physical activity recall was significant; therefore, the data from this type of intensity can be considered valid. The problem is with moderate PA because we did not observe any significant correlation.

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