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Validation of the Malaysian Physical Activity Questionnaire (Validation of Soal Selidik Kegiatan Aktiviti Fizikal (SKAF))

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Abstract

The purpose of this study was to determine the reliability and validity of the Soal Selidik Kegiatan Aktiviti Fizikal (SKAF) physical activity questionnaire, a self reported questionnaire designed to collect data from school children from Forms 1, 2 and 4. Methods: Study 1 assessed test-retest reliability by administering the questionnaire twice, 1 week apart to 60 students in Forms 1, 2 and 4. Study 2 assessed criterion validity using Caltrac accelerometers worn consecutively for 7 days and measured height and weight (n = 53, Forms 1 to 4). Results: The overall kappa/weighted kappa coefficient for the 1-week test-retest reliability of the questionnaire items indicated moderate agreement (mean 0.78 ± 0.24). Self-reported and accelerometer-measured average daily time spent performing light to vigorous physical activity were significantly correlated (LPA,

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MPA, HPA and VPA: Spearman r = 0.45, 0.51, 0.54, 0.44 respectively at p < 0.01); however, students tended to over report physical activity. Height and weight were not consistently over or under reported. Self-reported and measured body mass index were significantly correlated (Spearman r = 0.90, p < 0.01). The findings of these studies suggest that the SKAF physical activity questionnaire has acceptable reliability and validity and is suitable for use in large-scale school-based data collections for child and adolescent populations.

***Keywords**: Adolescent, self-reported, habitual physical activity*

Evidence highlighting the importance of physical activity to health is now stronger than ever and the benefits of physical activity to health are an increasing source of public interest. The links among physical activity, fitness and health are well established scientifically and medically and the evidence indicates that physical inactivity is a major risk factor for cardiovascular, metabolic and other diseases (Montoye, Kemper, Saris & Washburn, 1996). Similar links with children are not as well established since it takes time for unhealthy behavior to influence chronic diseases (Telford, Salmon, Jolley & Crawford, 2004). Nevertheless, a number of researchers do acknowledge that physical activity has many physiological and possibly psychological effects that will influence the health of children (Crocker, Bailey, Faulkner, Kowalski & McGrath, 1997). Studies have also shown that there is a substantial number of youths with risk factors due to lack of physical activity, that predispose them to develop chronic diseases later on in life (Sallis & Saelens, 2000; Sato, 2000).

In lieu of the growing awareness of the association between physical activity, health, growth and development, the assessment of physical activity has become increasingly important. Increased awareness, especially of the health benefits, highlights the need for accurate assessment of physical activity. Yet many problems persist in the accurate and comprehensive characterizations and quantification of physical activity and energy expenditure especially in children in non-laboratory settings under natural conditions. It will be a major challenge indeed, especially in the study of children's physical activity, to obtain reliable and valid measurements. Many researchers have used different instruments depending on whether physical activity is to be measured from a behavioral or physiological viewpoint (Brener, McManus, Galuska, Lowry & Wechsler, 2003). If researchers are to determine the connections between physical activity and health in children and the implications for later adulthood, they must have accurate and reliable instruments (Pols, Peters, Bueno-de-Mesquita, Ocke, Wentink, Kemper & Collette 1995).

In epidemiological studies, self-report is the recommended and most common method used to assess physical activity in children and youths (Raitakari, Taimela,

Porkka, Telama, Valimaki, Akerblom & Viikari, 1997; Rice & Howell, 2000). A major advantage of self-report instruments is that they can be administered to a large group of people in a time and cost effective manner. It was cited that the ease of administration, convenience, and the ability to characterize activity historically and low cost are the primary advantages of this method (Velsor-Friedrich, 2000). There are, however, many concerns with the data generated from self-report methods and many researchers, have expressed concerns about the accuracy of such measures (Kowalski, Crocker & Kowalski, 1997) It was further added that to advance research in pediatric exercise science, it is important to continue working to improve current physical activity assessment techniques (Telford, Salmon, Jolley & Crawford, 2004).

We should be concerned over Malaysian children's activity levels, and it should be based on concrete evidence. While there is well-founded evidence highlighting the importance of physical activity to children's health and concern over children's low activity levels, there is no activity information on such a scale available on Malaysian adolescents. Clearly, more information is desperately needed to determine just how active or inactive young people in this country are and to determine the extent of the alleged inactivity problem. Part of the aim of this research will also be to provide information on the physical activity patterns and levels of a sample of Malaysian adolescents.

The main purpose of this research, therefore, will be the development and evaluation of a self-report instrument, for the assessment of daily physical activity among Malaysian adolescents activity self-report for school children from Forms 1 to 4. The study was undertaken at a secondary school in Kuantan, in order to establish whether childrens' subjective reports on physical activity could be validated by the use of the Caltrac accelerometer as a criterion measure. The self-report should be suitable to measure physical activity in a large population, over periods long enough to be representative of normal daily life and with minimal discomfort to subjects. The self report will also be able to detect specific changes in the specific activity variables as well as providing detailed information on the distribution of activity habits among adolescents. Reliable and valid information about adolescents' physical activity will be crucial to the development, implementation and evaluation of public health policies to promote the adoption and maintenance of regular physical activity. This will allow the development of suitably targeted educational and promotional programs to increase levels of physical activity participation especially among Malaysian adolescents. The Soal selidik Kegiatan Aktiviti Fizikal (SKAF) was designed to be a self report to allow for the literacy level expected in the target population, and the standardization of data collection.

The Soal Selidik Kegiatan Aktiviti Fizikal (Skaf) Questionnaire

SKAF was designed to be used for large-scale school-based data collections. Thus, there were numerous issues to consider in the development of the student questionnaire. A self report format facilitates large-scale data collections by enabling fast and accurate processing of completed questionnaires while minimizing labor costs and transcription errors. The SKAF physical activity questionnaire consists of 63 items presented in a five-page booklet. Twelve items request 7-d recall of low physical activity (LPA), eleven for moderate (MPA), thirteen for high (HPA) and ten for vigorous physical activity (VPA). Responses are provided by indicating the number of hours (0-4 h) and 15-min increments (0-15 min) that each type of physical activity was performed for each day of the previous week. Thus, intensity, duration, and frequency data are collected, and weekday versus weekend analyses is possible. These physical activity items were designed to enable comparisons with results from previous physical activity surveys that classified physical activity levels based on energy expenditure ($kcal\text{-}kg^{-1}d^{-1}$). Items were included not only to measure self-reported physical activity levels but also to inform the planning and evaluation of school programs and policies. In addition to the two core physical activity items, other items asked about participation in physical activities (e.g., physical education, strength training, intramural sports, commuting to school), height, weight, and demographics (e.g., age, grade, sex). Pilot testing of the SKAF physical activity questionnaire included quantitative and qualitative studies to determine readability and comprehension. Establishing the psychometric properties of the SKAF physical activity student questionnaire is important for all potential users of SKAF data, including researchers and education stakeholders. The present paper details the reliability and validity testing of the SKAF physical activity questionnaire.

Study 1: Test-retest Reliability

The purpose was to assess the 1-week test-retest reliability of the SKAF physical activity questionnaire.

Methods: Study 1

The test-retest study for the SKAF physical activity questionnaire used convenience sample data from 60 students (Forms 1- 4) from a school in Kuantan. Students completed the physical activity questionnaire in class time

on two occasions in July 2008. At time 1, a research assistant administered the questionnaires in classrooms using a common protocol that included standardized instructions to the students (n = 60) in the school. One week later (time 2), the questionnaires were re-administered to the same classes (n = 60). The study employed active information with passive consent procedures to reduce demands on schools and to increase student participation rates. That is, researchers informed the parents of the students about the study via handouts taken back by the students to be shown to their parents.

Statistical Analysis: Study 1

Data from 60 students (30 boys and 30 girls) were included in the statistical analyses. There were no significant differences in self reported time spent performing high or vigorous intensity physical activity (p = 0.24 and 0.08, respectively). Weekly time spent performing LPA, MPA, HPA and VPA were calculated by summing the responses from the two 7-d recalls that reported time spent performing the activities, respectively, each day for the last 7 days. Weekly time spent performing low to vigorous physical activity (VPA) was calculated by summing the weekly time spent performing LPA, MPA, HPA and VPA. Energy expenditure (KKD, $kcal.kg^{-1}d^{-1}$) to classify physical activity levels was estimated from the two 7-d recalls, assuming LPA = 1.5 – 2.8 METs, MPA = 3.3 – 5.6 METs, HPA = 8.0 METs, and VPA = 10 METs. Respondents' physical activity levels were classified as inactive (< 3 KKD), moderately active (< 3-7.9 KKD), and active (> 8 KKD). Test–retest reliability was assessed for agreement beyond what would be expected by chance alone by using the kappa statistic for categorical responses and weighted kappa statistic for ordinal responses. Interpretation of values of kappa and weighted kappa were based on the classification system developed by Landis and Koch (Janz, Witt & Mahoney, 1995), where < 0.09 indicated poor agreement, 0.10-0.20 indicated slight agreement, 0.21-0.40 indicated fair agreement, 0.41-0.60 indicated moderate agreement, 0.61-0.80 indicated substantial agreement, and 0.81-1.00 indicated almost perfect agreement. All statistical analyses were performed using SPSS (version 16).

Results: Study 1

Table 1 presents the means and standard deviations of the physical activity variables, height, weight, and body mass index by gender and combined.

Table 1: Means and Standard Deviations of Height, Weight, Body Mass Index, and Physical Activity of Study 1 Participants Based on Self-report, Presented by Gender and Combined

	Boys			Girls			Combined		
	n	H	*SD*	*n*	H	*SD*	*N*	H	*SD*
Height (cm)	30	163.24	13.50	30	158.21	11.24	60	161.59	13.70
Weight (kg)	30	65.62	16.82	30	59.05	13.54	60	64.76	16.36
BMI ($kg.m^{-2}$)	30	22.95	4.81	30	21.86	4.63	60	22.34	4.74
LPA ($hr.wk^{-1}$)	30	5.83	4.74	30	4.99	4.51	60	4.96	3.85
MPA ($hr.wk^{-1}$)	30	2.05	1.38	30	1.59	1.48	60	1.73	1.50
HPA ($hr.wk^{-1}$)	30	0.98	0.88	30	0.97	0.79	60	0.95	0.86
VPA ($hr.wk^{-1}$)	30	0.81	0.69	30	0.69	0.60	60	0.88	0.80

BMI, body mass index; LPA (low physical activity); MPA (moderate physical activity); HPA, (high physical activity); VPA (vigorous physical activity).

Table 2 summarizes the kappa and weighted kappa coefficients for 1-wk test–retest reliability by item domain. Kappa and weighted kappa coefficients ranged from 0.71 to 0.95.

Table 2: Kappa and Weighted Kappa Coefficients for 1-wk Test-Retest Reliability of Items from the Skaf Physical Activity Questionnaire

Category	No. of Items	Kappa/Weighted Kappa (mean ± SD)
Demographics (e.g., grade, age, sex)	5	0.91 ± 0.01
Physical activity (e.g., active time in physical education)	3	0.95 ± 0.10
Health issues	3	0.73 ± 0.04
Involvement in physical activity	2	0.71 ± 0.03
Mode of transport to school	2	0.95 ± 0.01

Overall, the mean kappa/weighted kappa coefficient for the selected items was 0.78 ± 0.24. The range of coefficients for the items indicated moderate to almost perfect agreement. Table 3 summarizes the weighted kappa coefficients for the variables derived from SKAF physical activity questionnaire responses. There was moderate agreement for all LPA, MPA, HPA and VPA. Weekly sleep time and BMI resulted in substantial agreement. The mean kappa/weighted kappa coefficient for the 49 items and the derived variables was 0.58 ± 0.17. The mean and standard deviation of the kappa/weighted kappa coefficients by gender and grade are shown in Table 4.

Table 3: Weighted Kappa Coefficients for 1-wk Test-retest Reliability of Derived Variables from the Skaf Physical Activity Questionnaire

Derived Variable	Weighted Kappa
Weekly light physical activity - LPA (h)	0.50
Weekly moderate physical activity - MPA (h)	0.43
Weekly hard physical activity - HPA (h)	0.46
Weekly vigorous physical activity - VPA (h)	0.47
Weekly sleep time (h)	0.76
Body mass index ($kg.m^{-2}$)	0.85

Table 4: Kappa/Weighted Kappa Coefficients of the Shapes Physical Activity Questionnaire Items and Derived Variables, by Gender, by Grade, and Combined

	Kappa/Weighted Kappa Coefficient (mean ± SD)
Combined	0.58 ± 0.17
Male	0.54 ± 0.16
Female	0.59 ± 0.16
Forms 1	0.56 ± 0.16
Forms 2	0.48 ± 0.22
Forms 4	0.55 ± 0.17

Discussion: Study 1

The majority of items on the SKAF physical activity questionnaire had acceptable reliability. The results suggest that the test-retest reliability of the physical activity, height, and weight items from the SKAF questionnaire were comparable with other questionnaires for youth. For instance, the 2-wk test-retest reliability of the Adolescent Physical Activity Recall Questionnaire (APARQ) and the World Health Organization Health Behavior in School-Aged Children (WHO HBSC) survey were assessed in 226 grade 8 and 10 students (Booth, Okely, Chey & Bauman, 2001; Booth, Okely, Chey & Bauman, 2002).

The APARQ summarized physical activity into a three-category measure of activity, and weighted kappa coefficients ranged from 0.33 to 0.71, depending on grade and gender (Booth, Okely, Chey & Bauman, 2002). The WHO HBSC assessed frequency and duration of VPA performed outside school hours (Booth, Okely, Chey & Bauman, 2001). Weighted kappa coefficients ranged from 0.22 to 0.60, depending on grade and gender. The 1999 Youth Risk Behavior Survey included five physical activity questions, as well as height and weight Brener, Kann, McManus, Kitchen, Sunberg & Ross 2002; Brener, McManus, Galuska, Lowry & Wechsler, 2003). Kappa coefficients for 2-wk test-retest reliability among their 4619 students in grades 9-12 ranged from 0.46 to 0.84 for the physical activity questions (Bray, Wong, Morrow, Butte & Pivarnik, 1994), whereas the kappa coefficient for a three-level BMI classification based on

self-reported height and weight was 0.84 (Brener, Kann, McManus, Kitchen, Sunberg & Ross 2002). Lower test–retest reliability estimates indicated that there was a greater proportion of responses to the same item that did not match between times 1 and 2. However, differences in response to an item may reflect real change rather than response error when calculating kappa and weighted kappa coefficients. For example, a student could report at time 1 that he/she did not perform any moderate-intensity physical activity in the last 7 d and then report at time 2 that he or she performed 120 min of moderate physical activity in the last 7 d. Such responses would be inconsistent yet accurate if the student did indeed perform 120 min of moderate-intensity physical activity during the test–retest interval and not before. Week-to-week variation in the amount and/or intensity of physical activities performed, as well as time spent in sedentary activities, would be expected to some extent. Similarly, items in the school environment and school connectedness categories asked for subjective responses, such as opinions (e.g., the degree to which they agreed or disagreed that the indoor physical activity facilities at school met their needs) and feelings (e.g., the degree to which they agreed or disagreed that they felt close to people at school), which may also vary substantially from week to week. However, the analyses assumed that such inconsistencies were due to response error. Thus, kappa and weighted kappa coefficients may have been conservative estimates for some items.

Study 2: Criterion Validity Study

The purpose was to assess the criterion validity of two 7-d physical activity recalls and height and weight items of the SKAF physical activity questionnaire using accelerometers.

Methods: Study 2

The criterion validity study for the SKAF physical activity questionnaire used data from 60 students (Forms 1, 2 and 4) collected in July 2008 from one Kuantan school. Muscle Dynamics Fitness Network (USA) Caltrac is a lightweight electronic device equipped with a microcomputer, to assess daily body movement by recording vertical accelerations of the body. It weighs 400 gm, is 14 cm x 8 cm x 4 cm in size and is worn on the hip. The Caltrac measures vertical acceleration that causes a ceramic transducer to twist, resulting in an intensity dependent voltage output. A numerical score (kcal) will be provided by a liquid crystal display. The total kilocalorie (kcal) score is a function of the subject's basal metabolic rate calculated by a computer chip programmed with the subject's age, height, weight and gender, plus additional caloric expenditure resulting from body movement. The assumption of the validity of the device is

that body or limb accelerations closely reflect energy cost of the movement. The Caltrac is designed to provide activity counts that reflect the intensity and quantity of movement.

The Caltrac will be contained in a small pouch, which will be attached to an inelastic belt. It will be worn at the waist on the subject's dominant hip. This site was selected to duplicate monitor placement in other studies Freedson & Melanson, 1996). The Caltrac motion sensor will be worn by the subject, for seven consecutive days (5-weekdays and 2-weekend days). The Caltrac motion sensor will be able to estimate the total energy (kcal) used up by the wearer over the period worn. On the eighth day, subjects will be asked to complete the SKAF that is a self-report of their physical activity for the past week.

When used for children, it was suggested that the Caltrac should be secured on the hip on a fanny pack or some other type of pouch to discourage children from tampering with the device Ekelund, Sjostrom, Yngve, Poortvliet, Nilsson, Froberg, Wedderkopp & Westerterp, 2001; Foreyt, Brunner, Goodrick, Jeor & Miller, 1995. The output appears on a liquid crystal display and several buttons on the front panel will be used to program the device. A liquid crystal display will provide a numerical score (kilocalories). The total kilocalories score is a function of the basal metabolic rate (BMR) of the subjects, calculated by a computer chip programmed with the subject's age, height, weight and gender for all subjects. Subjects will also be instructed to record the Caltrac reading and the time of day both in the morning and on retiring for the night on a chart attached to an activity diary.

The Caltrac can be programmed to provide the output either in caloric expenditure units or in activity counts. Validation and reliability studies generally have shown that the device is an excellent tool for assessing activity behavior in children Landis & Koch, 1977). The Caltrac has also served as a reference method in validation studies (Freedson, 1991; Malina, 1999). In this study, the Caltrac will be programmed with height, weight, age and sex of the subjects, thus yielding total amount of kilocalories (kcal) spent in physical activity in 24 hours. The Caltrac will be detached from the waist at night, but it will still count resting metabolism during the time they were not worn.

Statistical Analysis: Study 2

To validate the SKAF scores, Pearson Product Moment Correlation will be computed between the scores and measurements taken. The correlation coefficient obtained will only describe the strength of a linear relationship between two variables. The Pearson Product Moment Correlation coefficient will be used for data that are normally distributed. If they are not, the Pearson Product Moment Correlation can be much influenced by outliers. In that case, a Spearman correlation based on ranks of the data

instead of actual values would be a better choice. The assessment of criterion validity will be based on the summary energy expenditure score where subject's self-report summary energy-expenditure score will be compared to the Caltrac energy expenditure.

To complete the self-report, subjects will first be asked to write the day and date at the top of each self-report and to record his or her own height and weight. For each day the subject will indicate whether or not he or she participated in any of the listed activities. If the answer is "yes" the student will then indicate which activities were pursued, and estimate the duration of each activity on a 6-point scale ranging from 1 to 15 minutes to more than 2 hours. The SKAF will provide information about the length of typical bouts of activity for each type of activity and on average across activities. In this study, for each chosen activity, the duration of the activity will be defined as the midpoint of the time interval (8 min. for 1 to 15, 23 min. for 16 to 30, and so forth). The number of minutes of activity for each day will be totaled and then averaged for the week. The resulting scores, total daily duration for any given day and average daily duration, are the two primary duration SKAF scores that will be used in this study.

Subjects will be asked about their activities over the past seven days, and a list of examples of activities in each category would be provided. Subjects will then list their activities in each category and quan-tify the time spent in each activity. Caloric expenditure will be estimated on the basis of 1 MET = I kcal kg^{-1} hr^{-1}. MET values will be multiplied times the hours spent in each of the five categories and the products summed to give kilocalories per kilogram per day. Kilocalories per day (kcal/day), will be derived by multiplying kilocalories by weight. These values will then be used to compare the real amount of physical activity reported by different individuals. This method of measuring phys-ical activity has several advantages. First, subjects will be specifically queried about the time spent in sleep and in light, moderate, hard, and very hard activities. Time in very light ac-tivities will be obtained by subtraction. More vigorous activity seems to be more salient and, thus, more easily recalled than less vigorous activities. This procedure will allow for the calculation of the total daily caloric expenditure as a physical activity index. Second, this approach will be efficient for subjects because they sleep 6-8 hours per day, and for the majority, most of their waking activity will be in the light category. Therefore, the subjects will need to account for only about 3-5 hours per day in a detailed fashion

Of the 60 participants, 53 (28 boys, 25 girls) had usable accelerometer data and completed the questionnaire. The relationship between self-reported and objectively measured variables was determined using Spearman rank–order correlations. To assess the accuracy of self-report, the measured values were subtracted from the SKAF values to obtain the difference in values. The data analysis for this research would be done using the software program, SPSS for Windows version 16. The variables that would be analyzed are Caltrac readings

(in kcal•kg $^{-1}$day $^{-1}$ or kcal•kg $^{-1}$week $^{-1}$), and 7-day physical activity recall. Alpha was set at 0.05 a priori.

Results: Study 2

Table 5 presents the means and standard deviations of the physical activity variables, height, weight, and BMI by gender and combined. The correlation between self reported and accelerometer-measured energy expenditure performing various levels of physical activities were modest (r = 0.44 – 0.54) but significant ($p < 0.01$).

Table 5: Means and Standard Deviations of Height, Weight, Body Mass Index, and Physical Activity of Study 2 Participants Based on Self-report, Presented by Gender and Combined

	Boys			Girls			Overall		
	n	H	*SD*	*n*	H	*SD*	*n*	H	*SD*
Height (cm)	28	161.26	13.80	25	157.21	11.33	53	160.59	12.80
Weight (kg)	28	64.13	16.42	25	58.47	12.13	53	62.76	16.82
BMI (kg.m^{-2})	28	21.46	4.57	25	21.39	4.71	53	21.34	4.86
LPA (hr.wk^{-1})	28	8.37	7.23	25	7.64	6.44	53	8.16	6.22
MPA (hr.wk^{-1})	28	3.09	2.58	25	2.64	2.31	53	2.78	2.14
HPA (hr.wk^{-1})	28	1.57	1.33	25	1.42	1.27	53	1.53	1.41
VPA (hr.wk^{-1})	28	1.24	1.04	25	1.16	1.02	53	1.20	1.12

BMI, body mass index; LPA, light physical activity; MPA, moderate physical activity; HPA, high physical activity and VPA, vigorous physical activity.

The correlation for energy expenditure performing all levels of physical activity derives from SKAF with the Caltrac readings were significant (see Table 6). Self-reported time spent performing physical activity was higher compared with measured values for a large majority of the participants.

Table 6: Spearman Correlations between Self-reported and Objectively Measured Variables

Variable	Spearman *r*	*p*
BMI (kg.m^{-2})	0.90	< 0.0001
Height (cm)	0.97	< 0.0001
Weight (kg)	0.98	< 0.0001
Average daily LPA (EE : kcal. day^{-1})	0.45	< 0.01
Average daily MPA (EE : kcal. day^{-1})	0.51	< 0.01
Average daily HPA (EE : kcal. day^{-1})	0.54	< 0.01
Average daily VPA (EE : kcal. day^{-1})	0.44	< 0.01

BMI, body mass index; LPA, light physical activity; MPA, moderate physical activity; HPA, high physical activity and VPA, vigorous physical activity, EE, energy expenditure

Discussion: Study 2

The results indicated that responses to the core SKAF physical activity items correlated with objectively measured physical activity. There was a significant correlation between SKAF and accelerometer estimated time spent performing LPA, MPA, HPA, VPA, and energy expenditure. Although the significant correlation coefficients were modest, they were comparable with the results of previous studies that used accelerometers to validate self report questionnaires in children and adolescents Cameron, Manske, Brown, Jolin, Murnaghan & Lovato., 2007; Jacobs, Ainsworth, Hartman & Leon, 1993). For instance, the Physical Activity Questionnaire for Older Children (PAQ-C) and Physical Activity Questionnaire for Adolescents (PAQ-A) were moderately correlated with a Caltrac accelerometer in children ($r = 0.39$, $p < 0.05$) (Brener, McManus, Galuska, Lowry & Wechsler, 2003). and adolescents ($r = 0.33$, $p < 0.05$) (10), respectively. Similarly, a modified weekly activity checklist correlated with an MTI accelerometer ($r = 0.30$, $p < 0.01$) in 109 participants aged 8–16 years (Landis & Koch, 1977) However, not all studies found significant correlations. Using the Children's Leisure Activities Study Survey (CLASS) 7-d checklist for physical activity recall, Spearman correlations for self-reported and accelerometer measured time spent in moderate, vigorous, and total physical activity were all non significant (21). Generally, it appears that the strength of correlations between the SKAF physical activity questionnaire and an accelerometer were as robust as other youth 7-d physical activity recalls that were significantly correlated with the accelerometer.

Although accelerometers are frequently used as criterion measures of physical activity in studies to validate self-report questionnaires, there are a number of limitations associated with accelerometer. They have a limited ability to assess bicycling, locomotion on a gradient, or other activities with limited torso movement, and they may not be sensitive to many of the complex movement patterns exhibited by children during free play Cameron, Manske, Brown, Jolin, Murnaghan & Lovato., 2007). In addition, the use of accelerometer count cut points to determine MPA and VPA may create measurement error. Similarly, converting accelerometer counts to units of energy expenditure may result in additional measurement error. Nevertheless, accelerometers provide an objective and no reactive tool for assessing physical activity and are considered an acceptable means to validate self-report questionnaires (Pols, Peters, Bueno-de-Mesquita, Ocke, Wentink, Kemper, & Collette 1995). The results of this study indicated that there was a modest correlation between SKAF-estimated and measured height, weight, and BMI, respectively, and are similar to the results of previous studies.

In a study of the 1999 Youth Risk Behavior Survey (YRBS), the Pearson correlation between self-reported and measured height, weight, and BMI for 4619 students in grades 9–12 ranged from 0.82 to 0.94, depending on grade and

gender.[5] The results of the National Health and Nutritional Examination Survey, Cycle III (NHANES III), which used an interview format, also showed similar results. The correlation between self reported and measured weight ranged from 0.87 to 0.94, depending on gender or race, whereas the correlation for height ranged from 0.82 to 0.91 (Pols, Peters, Bueno-de-Mesquita, Ocke, Wentink, Kemper & Collette 1995).

General Discussion

Together, the results of these studies suggest that for large-scale school-based data collections, the SKAF physical activity questionnaire had acceptable test–retest reliability among Forms 1, 2 and 4 students and acceptable validity for the core physical activity, height, and weight items. Moreover, these results were comparable in reliability and validity with similar self-report measures for this age group (Booth, Okely, Chey & Bauman, 2002; Brener, McManus, Galuska, Lowry & Wechsler, 2003; Craig, Cameron & Russell, 2001). Thus, the SKAF questionnaire appears suitable for assessing group-level physical activity and BMI of students in Forms 1, 2 and 4. Although some measures may not be suitable for assessing these variables at the individual level, this was not the purpose for which it was designed.

There were a number of items on the SKAF questionnaire that provided information on physical activity behaviors and context related to physical activity whose validity has not been evaluated. For instance, it was not possible to validate the items pertaining to participation in intramural and interscholastic sports using accelerometry. However, it has been recognized that it is important not only to gather data on the amount of physical activity in which children and adolescents engage but also to gain an understanding of physical activity patterns and influences.[24] Behavioral and contextual information is critical for the development of effective strategies to promote physical activity among children and adolescents. The importance of this type of information, the adequate test–retest reliability, and evidence from readability and comprehension studies support the inclusion of these items on the SKAF questionnaire. Changes to questionnaire items and additional reliability and validity testing will be considered, based on the results of these studies and others, as well as feedback from schools, public health practitioners, and other stakeholders. This latter feedback is critical if SKAF is used to provide feedback that guides planning and evaluation at the school level, as is intended. However, these results suggest that the current SKAF physical activity questionnaire has adequate reliability and validity, which is a critical component to developing an effective local data collection and feedback system to facilitate the planning and evaluation of school-based interventions

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