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Original Article

Validity of a Questionnaire Evaluating Physical Activity Level in Young Children

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Abstract

Objective: To assess the validity of a questionnaire for evaluating the physical activity of young children as reported by parents.

Methods: Twenty-one male 1st grade elementary school children were the study subjects. The questionnaire contained 3 questions relating to the physical activity of children and was completed by their parents. These questions were: preference for physical activity: like very much, like, don't like; physical activity compared to peers: more than, the same as, less than peers; time spent on exercise activity per day: <30 min, 30–60 min, 60 min or more. We also assessed physical activity more objectively, using a small instrument for calculating total steps, energy expenditure originating from exercise, and total energy expenditure per day. The contribution of the questionnaire items to the objective indices was evaluated by linear regression analysis.

Results: Preference for physical activity was significantly associated with all the objective indices. Physical activity compared with peers had links with total energy expenditure. Time spent in activity was related to total steps and energy expenditure from exercise.

Conclusion: All the questionnaire items were valid measures for evaluating the physical activity level in young children and could be applied to a large epidemiological survey.

Key words: validity, questionnaire, physical activity, children, energy expenditure

Introduction

Childhood obesity has become a major public health concern in developed countries[1,2]. Since the prevalence of childhood obesity has increased rapidly over a short period of time, many studies have focused on the impact of lifestyle factors including physical inactivity and long TV watching on childhood obesity[3–7].

In epidemiological studies concerned with the relation between physical activity and obesity, structured questionnaires for estimating the level of physical activity on the basis of the duration and intensity of organized sports have been used in adolescents and adults[4,5]. The alternative, direct measurement of physical activity by use of a small instrument such as an accelerometer, is not feasible and very expensive. However, a questionnaire for estimating the level of physical activity in young children has not been established. In young children, some are very active when compared with their peers but are not involved in structured sports[3]. In this case, estimating physical activity level on the basis of the duration and intensity of structured sports may not be useful. Therefore, simple questions such as physical activity compared with peers, the preference of physical activity, or the total time spent in physical activity could be useful in evaluating physical activity levels particularly in young children. We have, therefore, examined the validity of these simple questions by reference to an accelerometer.

Methods

We are currently conducting a birth cohort study comprising of more than 10,000 children born in 1989[6,7]. The present study was conducted in November, 2000 as a sub-study of the follow-up survey.

Study population

A screening questionnaire was sent to 97 male children belonging to the 1st grade of 4 elementary schools in a district in Toyama City. Of 85 respondents, 42 children without chronic diseases and not participating in regular sports club activities were

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selected. An introductory letter was sent to the parents of the children. Parental permission to participate in the present study was obtained from 21 children and their parents who provided written informed consent. The study subjects were 21 male children, then aged 6 to 7 years.

Anthropometric measurement of the subjects

Anthropometric measurements were conducted at each elementary school. The heights and weights of children were measured in their shorts. Height was measured to the nearest 0.1 centimeter without shoes, using a rigid stadiometer. Weight was measured to the nearest 0.1 kilogram, using a weighing scale. Height and weight were measured twice by one trained examiner and the means were used in the analysis. Body mass index (BMI; weight (kg)/(height (m))^2 was also calculated as an index of body composition.

Assessment of physical activity level

The physical activity level of children was assessed using both the questionnaire and accelerometer.

With regard to the questionnaire survey, we used three kinds of questions. The first question relates to the preference for exercise activities and outdoor playing: do not like, like, like very much (anata no okosan wa undo ya sotoasobi ga suki desu ka?: suki dewa nai, suki, dai suki (in Japanese)). The second question compares their physical activity to that of their peers: less than, the same as, more than peers (anata no okosan wa dousedai no okosan to hikaku site kappatsu desu ka?: kappatsu dewa nai, daitai onaji, kappatsu de aru (in Japanese)). Finally, we asked for the total time spent in exercise activities and outdoor playing in one day, on average, as one of 3 levels: less than 30 minutes, 30 to 60 minutes, 60 minutes or more (anata no okosan wa heikin site ichinichi ni nanpun undo ya sotoasobi wo shimasu ka?: 30 pun miman, 30 pun ijo 60 pun miman, 60 pun ijo (in Japanese)). The questionnaire was completed by parents before the first measurement of their children's physical activity with the accelerometer.

Regarding the objective measurement of physical activity, we used an accelerometer (Calorie Counter Select II, Kenz, Japan), which has been confirmed to be a valid measure for estimating the physical activity level[8]. Detailed information of the methodology for calculating the indices from measurements using this small instrument were reported previously[9]. In summary, this instrument provides a small counter that measures amplitude and frequency of acceleration of body movement every 4 seconds and grades the intensity as one of 10 levels. The graded intensity was transformed into the corresponding coefficient of physical activity (Ka; coefficient as determined by the level of physical activity (kcal/kg/4 sec)). Then, the energy expenditure originating from exercise per 4 seconds (C) was calculated as Ka×W (weight in kg). The basal metabolism (B) was calculated as follows: B=Kb×A×T. (Kb: standard value for basal metabolism per body surface area (kcal/m^2/hr); A: body surface area (cm^2)=$W^{0.444}\times H^{0.663}$ (height in cm)×88.83; T: time in hour). Energy expenditure originating from minimum body movement (X (kcal/4 sec)), which includes light physical activities such as standing and talking, was calculated every 4 seconds as follows: X=Kx×B (Kx: coefficient for minimum body movement as estimated by energy metabolic rate; B: basal metabolism). Finally, the total energy expenditure (E) was calculated as follows. E=10/9(B+C+X). The total energy expenditure and energy expenditure originating from exercise activity was calculated every 4 seconds and summed during the 24 hours. The index 'total steps per day' was also calculated.

The measurement was conducted on the day when gym class was not held at school. One examiner attached the instrument to each subject after school. Physical activity was monitored and the objective indices including total steps per day, energy expenditure originating from exercise activity, and total energy expenditure were calculated for 24 hours. The measurement was conducted twice at an interval of approximately one week. The objective indices were averaged in the analysis.

Statistical analysis

A test for a linear trend of one-way analysis of variance (ANOVA)[10] was performed to evaluate significance of the linear trend of the mean of the objective indices among groups with different physical activity levels as reported by parents. Multiple linear regression analysis was performed to clarify the linear trend of the relation between the objective indices and physical activity, adjusted for possible confounding variables.

All statistical analyses were performed by SAS[11]. A two-tailed *P* value of less than 0.05 was considered to be significant.

Results

Table 1 shows the results of testing for the linear trend of the mean of the indices among groups with different preferences in physical activities. Subjects with a preference for physical activity were significantly associated with an increasing trend in total steps, energy expenditure originating from exercise activity, and total energy expenditure. Although an increasing trend was also observed in height, weight, and BMI, this trend was not significant. Age was not related to the degree of preference. The relation

Table 1 Increasing trend of the mean of the indices among groups with different preferences in physical activities

	do not like (n=6) mean (±SD)	like (n=8) mean (±SD)	like very much (n=7) mean (±SD)	trend test p value
age (year)	7.22 (0.36)	7.14 (0.28)	7.18 (0.26)	0.791
height (cm)	118.0 (3.76)	120.0 (6.41)	122.4 (6.71)	0.193
weight (kg)	21.8 (2.80)	23.0 (4.25)	26.0 (6.98)	0.155
BMI (kg/m^2)	15.6 (1.22)	15.9 (1.55)	17.1 (2.88)	0.376
steps (steps/day)	10,018 (2,081)	13,529 (1,680)	13,275 (2,614)	0.014
expenditure 1 (kcal/day)	128.4 (33.0)	191.1 (39.7)	208.1 (63.3)	0.007
expenditure 2 (kcal/day)	1,630 (106)	1,722 (179)	1,855 (200)	0.030

Abbreviations: BMI: body mass index; steps: total steps per day; expenditure 1: energy expenditure originated from exercise activity per day; expenditure 2: total energy expenditure per day.

Table 2 Increasing trend of the mean of the indices among groups with different physical activities compared with peers

	less than peers (n=6) mean (±SD)	similar to peers (n=7) mean (±SD)	more than peers (n=8) mean (±SD)	trend test p value
age (year)	7.15 (0.37)	7.23 (0.25)	7.14 (0.25)	0.937
height (cm)	116.6 (4.24)	121.4 (5.37)	122.6 (6.71)	0.057
weight (kg)	21.3 (2.80)	23.8 (4.13)	25.9 (7.05)	0.107
BMI (kg/m^2)	15.6 (1.09)	16.0 (1.62)	17.0 (2.97)	0.476
steps (steps/day)	11,138 (2,087)	12,897 (2,773)	13,291 (2,623)	0.126
expenditure 1 (kcal/day)	142.9 (31.0)	188.4 (55.9)	205.3 (63.2)	0.037
expenditure 2 (kcal/day)	1,586 (113)	1,784 (135)	1,852 (200)	0.005

Abbreviations: BMI: body mass index; steps: total steps per day; expenditure 1: energy expenditure originated from exercise activity per day; expenditure 2: total energy expenditure per day.

Table 3 Increasing trend of the mean of the indices among groups with different time spent in exercise activities

	<30 min/day (n=6) mean (±SD)	30–60 min/day (n=7) mean (±SD)	60 min/day≤ (n=8) mean (±SD)	trend test p value
age (year)	7.29 (0.35)	7.14 (0.27)	7.11 (0.26)	0.269
height (cm)	119.9 (4.83)	118.6 (5.82)	121.8 (6.92)	0.576
weight (kg)	23.5 (3.22)	22.3 (4.01)	25.0 (7.02)	0.623
BMI (kg/m^2)	16.3 (1.05)	15.8 (1.54)	16.6 (2.93)	0.763
steps (steps/day)	9,618 (1,652)	13,525 (1,100)	13,612 (2,509)	0.001
expenditure 1 (kcal/day)	136.7 (39.4)	184.7 (47.6)	205.3 (60.0)	0.022
expenditure 2 (kcal/day)	1,683 (119)	1,726 (174)	1,795 (237)	0.288

Abbreviations: BMI: body mass index; steps: total steps per day; expenditure 1: energy expenditure originating from exercise activity per day; expenditure 2: total energy expenditure per day.

Table 4 Regression coefficients and significance of the questionnaire findings

	r^2	age β (±SE)	BMI β (±SE)	questionnaire β (±SE)
preference for physical activity				
steps (steps/day)	0.17	1162 (1997)	-315 (293)	1833 (694)^b
expenditure 1 (kcal/day)	0.43	31.5 (36.0)	10.5 (5.29)^a	32.0 (12.5)^b
expenditure 2 (kcal/day)	0.61	133.4 (98.4)	53.0 (14.5)^c	75.9 (34.2)^b
physical activity compared with peers				
steps (steps/day)	0.15	680.3 (2175)	-214 (318)	1223 (722)
expenditure 1 (kcal/day)	0.35	23.8 (38.4)	12.0 (5.60)^b	23.4 (12.7)^a
expenditure 2 (kcal/day)	0.72	132.3 (83.5)	50.7 (12.2)^d	99.7 (27.7)^c
time spent in physical activity				
steps (steps/day)	0.33	2154 (1842)	-209 (251)	2126 (593)^c
expenditure 1 (kcal/day)	0.51	47.4 (34.4)	12.5 (4.69)^b	35.6 (11.1)^c
expenditure 2 (kcal/day)	0.58	148.1 (106.0)	59.6 (14.5)^d	59.2 (34.1)

Significance level: ^{a} $p<0.1$, ^{b} $p<0.05$, ^{c} $p<0.01$ ^{d} $p<0.001$

Abbreviations: BMI: body mass index; steps: total steps per day; expenditure 1: energy expenditure originating from exercise activity per day; expenditure 2: total energy expenditure per day; r^2: coefficient of determinants; β: beta coefficient; SE: standard error.

between physical activity compared with peers and the objective indices are presented in Table 2. More active subjects compared with peers had links with higher levels in energy expenditure originating from exercise activity and total energy expenditure per day. Height was marginally related to the level of physical activity, while age, weight, BMI, and total steps per day did not show a significant trend among the 3 groups. The results of the trend test of the relation between the time spent in physical activity and the objective indices are presented in Table 3. There were significant increasing trends in the relation between time spent in physical activity and all 3 objective indices. There were no significant trends for age, height, weight, or BMI.

Multiple regression analysis was performed to control for possible confounding factors including age and BMI. The results are shown in Table 4. To construct regression models, each category of the questionnaire item was treated as a continuous variable. Then the beta coefficients in the column of the questionnaire findings in Table 4 indicate an average increase in the 3 objective indices per incremental increase in the categories of the questionnaire items. After adjustment for age and BMI, the association of the objective indices and physical activity reported by parents remained significant in several regression models.

Discussion

Self-reported questionnaires evaluating the physical activity level are widely used in epidemiological studies. Most of the questions used in studies on adolescents and adults estimate physical

activity on the basis of the intensity and duration of the physical activity[4,5]. However, in epidemiological studies on children, a previous study suggested that some children were very active compared with peers but were not involved in structured sports[3]. In this case, a questionnaire evaluating physical activity in children based on the intensity and duration of physical activity could lead to a masking and misclassification of the physical activity level of children[3]. We, therefore, used 3 simple questions to evaluate the physical activity level as a whole. The findings of the present study suggests that all 3 physical activity indices reported by parents are linked to the objective physical activity level, although the significance and strength of the relation depends on each subjective measure. Therefore, the present questionnaire may be a useful measure for evaluating the physical activity level in children. Since the indices reported by parents cannot be transformed into real energy expenditure, the present questionnaire could be applied to evaluate relative physical activity, particularly in young children. However, in Japan, the participation rate in regular sports club activities increases with age from approximately 40% in elementary school children to 70% in junior high school students[12]. Although the present questionnaire could evaluate relative daily physical activities of young children, it may be better to add a separate physical activity questionnaire based on the duration and intensity of organized sports to evaluate regular sports club activities particularly for higher-grade schoolchildren.

It should be noted that the present study has some limitations in the interpretation of the results. Firstly, because we did not assess simultaneous physical activity levels on the basis of the intensity and duration of the physical activity as used in the field studies on adolescents and adults, the reason for the different strengths and the significance of the relation between each subjective and objective index is not necessarily clear. Secondly, the present study was carried out on a small number of subjects. However, the level of physical activity of children reported by parents was strongly and positively linked to the level of the 3 more objective indices. For this reason, the results may not be distorted by an increase in the number of subjects.

In conclusion, the present physical activity questionnaire could be a valid indicator that links to the more objective indices representing physical activity. Since the physical activity questionnaire contains simple questions, these indices are measuring tools for evaluating the relative physical activity of children and could be applied to a large epidemiological study.

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