【Original Article】

The Validity of the Japanese Version of Physical Activity Questions in the WHO Health Behaviour in School-aged Children (HBSC) Survey

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ABSTRACT **Objective**: This study aimed to translate the physical activity (PA) questions in the WHO Health Behaviour in School-aged Children (HBSC) survey questionnaire into Japanese (HBSC-J) and to examine their validity.

Methods: Participants were the 5th grade primary school students (70 students aged 11.3 ± 0.3 years: 10.6-11.9 years). The questionnaire was translated into Japanese and refined through the processes of preliminary test, backtranslation into English and discussion with authors of original version. Validity was determined by comparing the data with accelerometer estimates. To assess the validity of the PA questions, we used Spearman rank correlation between the questions and the objectively measured moderate-to-vigorous PA (MVPA) or vigorous PA (VPA) by the accelerometer. Comparisons of the mean objective time in MVPA between students classified as a self-reported days at least 60 minutes/day of MVPA in ≥ 5 days students and < 5 days students according to the HBSC-J were carried out using unpaired t tests.

Results: A statistically significant positive correlation was found between MVPA and the number of days with at least 60 minutes/day of MVPA ($\rho = 0.339$). In addition, statistically significant positive correlations were found between VPA and the HBSC-J questions looking at the frequency of VPA ($\rho = 0.515$), and between VPA and the HBSC assessment of VPA duration ($\rho = 0.400$). Moreover, the MVPA time with the ≥ 5 days tended to be greater than that in students with less than 5 days.

Conclusion: The results suggest that the questionnaire is valid for evaluating MVPA and VPA patterns in Japanese primary school students.

Key words: questionnaire, validation, accelerometer, youth, epidemiology

Introduction

Physical activity (PA) is an important behaviour related to a number of health outcomes in children and adolescents[1,2]. Hallal et al.[3] described levels of PA worldwide using data for adolescents (13-15-years-old) from 105 countries. The proportion of 13-15-year-olds doing fewer than 60 min of moderate-to-vigorous intensity PA (MVPA) per day is 80.3% (95% confidence interval: 80.1-80.5%); boys are more active than are girls[3]. Moreover, recently, the "Report Cards on Physical Activity for Children and Youth" in 38 countries from 6 continents (representing 60% of the

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world's population) were released[4]. The average grade for overall PA around the world was D (low/poor). In the above studies, the overall PA levels for Japanese youth were unavailable due to lack of evidence. If levels of daily PA in Japanese children are evaluated with brief questions, future countermeasures against inactivity would be worked out by the Japanese government, local government, schools, and so on. Moreover, an international comparison will be possible.

In large-scale population surveys the use of a self-report questionnaire is the most feasible method for the measurement of PA[5]. Chinapaw et al.[6] detected 61 versions of PA questionnaires for youth and reviewed measurement properties of them. The WHO Health Behaviour in School-aged Children (HBSC) survey is one of the most comprehensive sources of data for school-aged students PA levels[7]. The HBSC research network collects data on 11-, 13- and 15-year-old boys' and girls' health behaviours. The above-mentioned international comparison study[3] used available data from 38 European countries, the USA, and Canada. However, a validation study should be conducted before using the HBSC questionnaire in different countries and cultures. The purpose of this study, therefore, was to examine the validity of the PA questions in the Japanese version of the WHO HBSC survey questionnaire among primary school students in Japan.

Methods

Participants

Our convenience sample included Japanese primary school students (fifth grade) from 5 primary schools in urban areas of Okinawa and Kyoto (n = 70: 33 boys and 37 girls). The participants were invited to participate in the study at their school using leaflets. Informed consent was obtained from all students, and the Ethical Committees of J. F. Oberlin University and University of the Ryukyus approved the study protocol (Receipt Number: 16023 and 368). All students and their parents consented to publication of the data. The data on anthropometric measurements and PA were collected on November 2016 and May 2017 in Kyoto, and on January and February 2017 in Okinawa prefecture during the school year.

Self-report questionnaire

The HBSC study protocol 2013/14 survey questionnaire was used. The questionnaire records three items. First, the MVPA item focuses on the total amount of activity and therefore includes all types of activities undertaken in and out of school hours. Second and third, the VPA item focuses on the responder's PA level in sports and exercise by asking the adolescent to report the frequency and total amount of time spent exercising vigorously outside school hours. HBSC allowed the researchers to make Japanese version of the questionnaire. To do this the questionnaire was firstly translated from English into Japanese by two researchers (CT and AK) independently and re-translated from Japanese into English to check the discrepancies by another professional translator with a disinterested viewpoint. Finally, the back-translated questionnaire into English was checked by a native speaker (NS) and co-worker and discussed with all researchers.

Three items measuring PA are included as mandatory in the HBSC 2013/14 survey, measuring MVPA and vigorous PA (VPA). Table 1 shows the questionnaire in Japanese. Before answering the three items, a definition of PA was shown: "Physical activity is any activity that increases your heart rate and makes you get out of breath some of the time. Physical activity can be done in sports, school activities, playing with friends, or walking to school. Some examples of physical activity are running, brisk walking, rollerblading, biking, dancing, skateboarding, swimming, soccer, basketball, football and surfing". The MVPA item records number of days: "Over the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day?" Each student answered the number of days in the past 7 days. The two VPA items assess the frequency and duration of VPA undertaken as a recreational/leisure pursuit outside of school hours as follows: "Outside school hours: how often do you usually exercise in your free time so much that you get out of breath or sweat?"; "Outside school hours: how many hours a week do you usually exercise in your free time so much that you get out of breath or sweat?" These questions were categorized into 7 or 6. Students answered the questionnaire on the seventh day after attaching a device.

Table 1　HEALTH BEHAVIOUR IN SCHOOL-AGED CHILDREN (HBSC) in Japanese version

HEALTH BEHAVIOUR IN SCHOOL-AGED CHILDREN (HBSC)
青少年健康行動質問票（HBSC 日本語版）(HBSC-J)

身体活動とは，心臓がドキドキしたり息切れしたりするような全ての活動のことです。身体活動は，スポーツや友だちと遊ぶこと，学校へ徒歩で通うことも入ります。身体活動のいくつかの例として，ランニング，速歩き，ローラースケート，自転車，ダンス，スケートボード，水泳，サッカー，バスケットボール，サーフィンなどがあります。

1.　あなたは，**最近の7日間**に，1日あたり少なくとも合計 **60 分間**の身体活動をした日は，何日ありましたか。それぞれの日に，あなたが身体活動に費やすすべての時間を**合計**して下さい。

0 日	1 日	2 日	3 日	4 日	5 日	6 日	7 日
○	○	○	○	○	○	○	○

2.　授業以外: あなたは，ふだん，自由な時間に，息切れしたり汗をかいたりするくらいの運動を**何回**しますか。

- ○　毎日
- ○　週に 4〜6 回
- ○　週に 2〜3 回
- ○　週に 1 回
- ○　月に 1 回
- ○　月に 1 回未満
- ○　まったくしない

3.　授業以外: あなたは，ふだん，自由な時間に，息切れしたり汗をかいたりするくらいの運動を**1週間に何時間**しますか。

- ○　ぜんぜんしない
- ○　およそ 30 分
- ○　およそ 1 時間
- ○　およそ 2〜3 時間
- ○　およそ 4〜6 時間
- ○　およそ 7 時間以上

Objective measurement of physical activity

Habitual MVPA and VPA were measured using a triaxial accelerometer (Active style Pro HJA-350IT, Omron Healthcare, Kyoto; dimensions 74 × 46 × 34 mm and weight 60 g including batteries). The device is described in detail elsewhere[8,9]. The students wore the accelerometer on the left side of the waist. The synthetic acceleration in all three axes was calculated using signals before and after high-pass filtering. The ratio of unfiltered to filtered acceleration was then calculated to identify non-ambulatory activities (e.g., playing games, playing with blocks, tossing a ball, and cleaning and clearing away) and ambulatory activities (e.g., walking and running). The device set the ratio of unfiltered to filtered synthetic acceleration as 1.16, for correct discrimination between non-ambulatory and

ambulatory activities[10]. The acceleration signals were calculated as the mean of the absolute values of accelerometer output in each axis over 10 s epochs. Because the predictive equations used for the Active style Pro were established for adults[9], the values of metabolic equivalent (MET) values recorded by the accelerometer are overestimated in primary school students[10]. We therefore used the following conversion equations[10]:

Ambulatory activities

$0.6237 \times$ MET value of Active style Pro $+ 0.2411$

$R^2 = 0.772$

Non-ambulatory activities

$0.6145 \times$ MET value of Active style Pro $+ 0.5573$

$R^2 = 0.880$

PA was monitored continuously for 7 days using the accelerometer. The students were requested to wear the devices at all times, except under special circumstances, such as dressing and bathing. In fact, many students wore the accelerometer during sleep. We analyzed data collected between 7:00 and 21:00 to exclude sleep time. Those periods used for the analyses were determined based on the questions on sleep. We included days in which ≥ 600 min (10 h) of wear time had accrued. Periods with ≥ 60 consecutive min of no acceleration were classified as "non-wear time". Penpraze et al.[11] and Cliff et al.[12] suggested at least 3 days were required for reliable PA monitoring in young children, and Trost et al.[13] suggested at least 4 days. In the present study, students with data from at least 3 weekdays and at least 1 weekend day were included in the analysis.

Analyses

As for accelerometer data, the time spent in each PA intensity each day was calculated using METs for each individual as the average number of weekday and weekend minutes spent in MVPA (METs ≥ 3.0) and VPA (METs ≥ 6.0). The mean weekly values were then calculated by weighting for 5 weekdays and 2 weekend days [Weighted data = ((mean for weekdays $\times$ 5) + (mean for weekend days $\times$ 2))/7].

To assess the validity of the PA questionnaires, Spearman rank correlation was used between the questions (number of days, frequency or duration) and the objectively measured MVPA or VPA. Each answer was digitized as follows: 1) "Number of days at least 60 min/day MVPA was 0 (day/week)": 0; "1 (day/week)": 1; "2 (days/week)": 2; "3 (days/week)": 3; "4 (days/week)": 4; "5 (days/week)": 5; "6 (days/week)": 6, and "7 (days/week)": 7. 2) "Frequency of VPA was every day": 7; "4 to 6 times a week": 6; "2 to 3 times a week": 5; "Once a week": 4; "Once a month": 3, "Less than once a month": 2, and "Never": 1. 3) "The duration of VPA was none": 1; "about half an hour": 2; "about 1 hour": 3; "about 2 to 3 hours": 4; "about 4 to 6 hours": 5, and "about 7 hours or more": 6.

It is important to know whether those identified as more active on the basis of self-report also had, on average, greater PA. Compliance with MVPA recommendations which is more than 60 min of MVPA/day was assessed in two ways: by creating binary variables for those achieving/not achieving $\geq$ 5days MVPA and $\geq$ 7days MVPA. Because the PA guideline for students can be interpreted in the first way as most of days in a week with 60 min or more of MVPA and in the second way as everyday (7 days/week) with spending 60 min or more of MVPA. Comparisons of the mean time in MVPA between students classified as active and inactive was carried out using an unpaired t test.

The statistical analyses were performed using IBM SPSS statistics 23.0 for Windows (IBM Co., Tokyo, Japan). All statistical tests were regarded as significant when p values were ≤ 0.05.

Results

Table 2 shows the characteristics of the study participants, time spent at MVPA and VPA by accelerometry, and frequency of MVPA and VPA, and duration of VPA by the questionnaire. The wear time of the accelerometer was considerably greater than the minimum criteria specified (at least 3 weekdays and 1 weekend, and more than 10 h each day) with most students exceeding the above criteria, with a mean of 6.5 days and 13.6 h.

A statistically significant positive correlation was found between MVPA and the question on number of days at least 60 min/day MVPA ($\rho = 0.339$, $p = 0.004$) (Table 3). A statistically significant positive correlation was found between VPA and the question on frequency ($\rho = 0.515$, $p < 0.001$), and a statistically

Table 2　Physical characteristics, daily physical activity levels by accelerometer and questionnaire

Variables	All (n = 70) Mean ± SD			Boys (n = 33) Mean ± SD			Girls (n = 37) Mean ± SD		
Age (yr)	11.3	±	0.3	11.3	±	0.3	11.2	±	0.3
Height (cm)	142.4	±	6.1	141.4	±	6.0	143.4	±	6.1
Weight (kg)	35.0	±	6.5	34.8	±	6.3	35.1	±	6.8
Daily physical activity by accelerometer									
Time in METs ≥ 3 (min/day)	62	±	20	73	±	19	52	±	15
Time in METs ≥ 6 (min/day)	5	±	3	6	±	3	4	±	2
Daily physical activity by questionnaire									
Days of MVPA at least 60min/day (%)									
0 (day/week)	8.6			9.1			8.1		
1 (day/week)	10.0			3.0			16.2		
2 (days/week)	17.1			18.2			16.2		
3 (days/week)	18.6			21.2			16.2		
4 (days/week)	12.9			18.2			8.1		
5 (days/week)	8.6			9.1			8.1		
6 (days/week)	14.3			12.1			16.2		
7 (days/week)	10.0			9.1			10.8		
Frequency of VPA by questionnaire (%)									
Every day	15.7			24.2			8.1		
4 to 6 times a week	31.4			30.3			32.4		
2 to 3 times a week	37.1			30.3			43.2		
Once a week	10.0			12.1			8.1		
Once a month	2.9			3.0			2.7		
Less than once a month	0.0			0.0			0.0		
Never	2.9			0.0			5.4		
Duration of VPA by questionnaire (%)									
None	12.9			9.1			16.2		
About half an hour	17.1			9.1			24.3		
About 1 hour	12.9			15.2			10.8		
About 2 to 3 hours	27.1			30.3			24.3		
About 4 to 6 hours	21.4			24.2			18.9		
About 7 hours or more	8.6			12.1			5.4		

SD; standard deviation, METs; metabolic equivalents, MVPA; moderate-to-vigorous physical activity, VPA; vigorous physical activity.

Table 3　Spearman rank correlations between self-reported and accelerometry recorded physical activity levels

Variables	(n = 70)	
By questionnaire	MVPA by accelerometer (mins/day)	VPA by accelerometer (mins/day)
Days of at least 60 min/day MVPA (days/week)	0.339 (p = 0.004)	-
Frequency of VPA (days/week)	-	0.515 (p < 0.001)
Duration of VPA (hours/week)	-	0.400 (p < 0.001)

MVPA; moderate-to-vigorous physical activity, VPA; vigorous physical activity.

Table 4   Moderate-to-vigorous physical activity for students for days of participation question, categorized into two the categories of participation

Variables	(%)	MVPA by accelerometer (min/day)	
		Mean ± SD	p-value
Days of at least 60 min/day MVPA by questionnaire			
≥ 5 days	32.9	68.1 ± 19.6	0.074
< 5 days	67.1	59.1 ± 19.6	

MVPA; moderate-to-vigorous physical activity, SD; standard deviation.

significant positive correlation was found between VPA and duration (ρ = 0.400, p < 0.001). When the same analyses were performed in each sex, the comparable results were obtained (boys (n = 33): days of at least 60 min/day MVPA; ρ = 0.267, p = 0.120, frequency of VPA; ρ = 0.672, p < 0.001, duration of VPA; ρ = 0.417, p = 0.116, girls (n = 37): ρ = 0.576, p < 0.001, ρ = 0.439, p = 0.007 and ρ = 0.434, p = 0.007, respectively) with similar scatterplots between sexes), although a significant correlation was not found between MVPA and the question on number of days at least 60 min/day MVPA in the boys.

Table 4 shows the MVPA values for active and inactive students. The objectively evaluated MVPA time in students with achieving ≥ 5 days more than 60 min of MVPA/day according to the question tended to be greater than that in students with less than 5 days (p = 0.074). On the other hand, students with the ≥ 7 days were only 7. Thus, further analyses were not conducted due to a lack of statistical power.

Discussion

This study aimed to translate the PA questions in the HBSC survey questionnaire into Japanese (HBSC-J) and to examine their validity. Overall, the self-report questions on MVPA and VPA were moderately correlated with accelerometer data in terms of MVPA min/day and VPA min/day.

The present study collected PA data on November 2016 and May 2017 in Kyoto, and on January and February 2017 in Okinawa prefecture. In our previous study, significant seasonal variation in PA was found between spring season in the school year and summer season in the summer vacation[14]. However, there is no study of seasonal variation in PA among winter and spring seasons in Japan. The maximum temperatures in the present study were 10.5 (SD 1.4) and 21.6 (SD 2.8) degree on November 2016 and May 2017 in Kyoto. On the other hand, they were 18.5 (SD 1.4) and 18.5 (SD 2.0) degree on January and February 2017 in Okinawa prefecture[15]. Thus, all measurements were conducted under moderate weather, without heavy rain or snow, storm et al. Recently, Lewis et al. reported that daily maximum temperature was significantly associated with MVPA time in Australia and Canada[16]. MVPA time appears to be optimal when the maximum temperature ranges between 20 and 25 °C in both countries. Thus, the slight difference between seasons in 2 regions would not largely affect the results of the present study.

The objectively evaluated MVPA time with ≥ 5 days of more than 60 min of MVPA/day tended to be greater than for that with less than 5 days (Table 4). However, the previous study only examined the relationships between the frequency and duration of VPA questions of the original English version of the HBSC survey and participants' aerobic fitness for discriminant validity[17]. The study reported for both questions students classified as active had significantly higher aerobic fitness than those classified as inadequately active. In addition, Spearman's correlation coefficients between objectively evaluated MVPA or VPA time and these questions were relatively higher than those indicated in many of the previous studies using various kinds of PA questionnaires[6]. According to the previous review, for primary school children (mean age > 6 and < 12 y), the correlations between MVPA by questionnaires and accelerometry were found from r = 0.28 (by the Girls Health Enrichment Multisite Study Activity Questionnaire) to r = 0.38 (by the Physical Activity Questionnaire for Children). The correlations with VPA were found from r = −0.04 (by the Children's Leisure Activities Study Survey (self-report)) to Spearman r = 0.33 (by the Oxford Physical Activity Questionnaire)[6]. There is no study for Japanese children. Thus, our study using accelerometer data added further evidence on validity of the Japanese PA questions. The duration captured for VPA via the questionnaire was higher than time spent in VPA captured via accelerometer. In the

case of the questionnaire, the students might have recorded all activity as VPA (e.g. sports club activity), although the activity was perhaps, at times, of moderate intensity or less.

In some cases for boys, significant correlations were not obtained, although the correlations were positive values. The scatterplots suggest that there appeared no gender differences in the relationships (not shown). The numbers for some categories are not sufficient, which may lead to the insignificant results in those cases. However, the gender difference should be investigated in detail in future studies. Moreover, the HBSC research network collects data on 11-, 13- and 15-year-old boys' and girls' health behaviours[7]. The present study focused on the 5th grade of primary school children. However, for example, about 70% of boys and 50% of girls in the 2nd grade of junior high school in Japan belong to the sports clubs at their schools[18]. Therefore, the results of the present study may be applicable only to students in the upper grades of primary school. The validity of the HBSC-J questionnaire should be examined in wider range of age group.

Conclusion

This study confirms the validity of the HBSC-J questionnaire in the 5th grade of primary school children. For more availability, it should be examined in wider range of age group. The results suggest that the questionnaire provided acceptably valid estimates in MVPA and VPA patterns in Japanese primary school students.

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【原　著】

WHO Health Behaviour in School-aged Children（HBSC）survey の身体活動量に関する質問票の日本語版の妥当性

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要　旨

目的：本研究は，WHO Health Behaviour in School-aged Children（HBSC）survey の質問票のうち，身体活動量(PA)の質問票を日本語に訳し(HBSC-J)，その妥当性を検討することを目的とした。

方法：対象者は，小学校 5 年生の児童であった(70 名の平均年齢は 11.3 ± 0.3 歳: 10.6〜11.9 歳)。質問票は，日本語訳を行ったうえで予備調査にて精査し，英語に逆翻訳を行い，オリジナル版と齟齬がないか検討した。妥当性は，加速度計で評価したデータとの比較により検討した。PA の質問票の妥当性を評価するために，質問票と加速度計を用いて客観的に測定された中高強度活動(MVPA)あるいは高強度活動(VPA)に対して，スピアマンの順位相関を用いた。また，HBSC-J によって自己申告された「1 日当たりの MVPA が少なくとも 60 分」が 5 日以上と 5 日未満の 2 群に分類し，対応のない t 検定を用いて MVPA の客観的な平均所要時間を比較した。

結果：加速度計による MVPA の所要時間と 1 日当たりの MVPA が少なくとも 60 分の日数は，有意な正の相関がみられた（ρ = 0.339）。更に，加速度計による VPA の所要時間と HBSC-J における VPA の頻度（ρ = 0.515）や持続時間（ρ = 0.400）との間には，有意な正の相関がみられた。また，加速度計による MVPA の所要時間は，1 日当たりの MVPA が少なくとも 60 分 5 日以上群が，5 日未満の群に比較して高い傾向にあった。

結論：これらの結果から，日本人児童において，HBSC-J による MVPA や VPA のパターンの推定に関する妥当性が認められた。

Key words：質問票，妥当性，加速度計，青少年，疫学

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