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ORIGINAL

VALIDATION OF A WEB QUESTIONNAIRE ON PHYSICAL ACTIVITY FOR CHILDREN AND ADOLESCENTS

VALIDACIÓN DE UN CUESTIONARIO WEB SOBRE ACTIVIDAD FÍSICA PARA NIÑOS Y ADOLESCENTES

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ABSTRACT

The objective of the study was to carry out the concurrent validity of the WebCas questionnaire to evaluate physical activity (PA) in 140 students (10 to 16 years) divided into four groups, instructed to use an accelerometer and answer the WebCas questionnaire daily, which resulted in 213 days of PA monitoring. Statistical analyses were performed using the Mann-Whitney U-test, scatter plots (Bland and Altmann) and correlation coefficients. The correlation between PA (WebCas) measurements compared to acelerometry measurements (one day) showed low-intensity correlation (r = 0.22; p <0.001), moderate intensity (r = 0.48; p <0.04), an average of three days. Increased correlation was observed for the 5-day PA average (r = 0.67; p <0.01). The WebCas questionnaire presented satisfactory validity indicators.

KEYWORDS: Web Questionnaire; Physical Activity; Accelerometer; Validation.

RESUMEN

El objetivo del estudio fue llevar a cabo la validez concurrente del cuestionario WebCas para evaluar la actividad física (AF) en 140 estudiantes (10 a 16 años) divididos en cuatro grupos, instruidos para usar un acelerómetro y contestar el cuestionario WebCas diariamente, resultó en 213 días de monitoreo de AF. Los análisis estadísticos se realizaron utilizando la prueba U de Mann-Whitney, gráficos de dispersión (Bland y Altmann) y coeficientes de correlación. La correlación entre las mediciones de AF (WebCas) en comparación con las mediciones de acelerometria (un día) mostró correlación de baja intensidad (r = 0.22; p <0.001), moderado intensidad (r = 0,48; p <0,04), promedio de los tres días. Se observó mayor correlación para el promedio de AF de los 5 días (r = 0,67; p <0,01). El cuestionario WebCas presentó indicadores de validez satisfactorios.

PALABRAS CLAVE: Cuestionario web, Actividad física, Acelerometría, Validación.

1. INTRODUCTION

The regular practice of physical activity (PA) represents an important behavior for the healthy development and well-being of children and adolescents (Bacil *et al.*, 2018; Garcia *et al.*, 2019; Legnani *et al.*, 2019; Ramos, Jiménez-Iglesias, Rivera, & Moreno, 2016). Such a more physically active population tends to present better indicators of cardiometabolic health (Ekelund et al., 2012; Kim, Barreira, & Kang, 2016; Poitras et al., 2016), mental and cognitive function (Dale, Vanderloo, Moore, & Faulknera, 2019; Erickson *et al.*, 2019), and better health related behaviors (Charilaou, Karekla, Constantinou, & Price, 2009; Legnani *et al.*, 2015; Piola *et al.*, 2019; Silva *et al.*, 2019, Londal, Haugen, Lund, & Riiser, 2020).

Furthermore, the adoption of an active lifestyle in childhood and adolescence is of utmost importance to keep adequate levels of PA and less morbidity in later life (Hallal, Victora, Azevedo, & Wells, 2006; Vera-Estrada, Sánchez-Rivas, & Sánchez-Rodríguez, 2018).

The evaluation and monitoring of PA at the population level has been included in public health policies in a number of countries (Varela et al., 2018) and represents an important health indicator for children and adolescents, according to the World Health Organization (WHO, 2014). Although there are more precise methods and instruments to measure PA (such as accelerometers and pedometers) (Chandia-Poblete, D., Cortinez-O'Ryan, A., Ulloa-Lopez, C., & Aguilar-Farias, 2019, Martínez-Gómez et al., 2009, Mayorga-Veja, Saldías, & Viciana, 2020, Santos-Labrador, 2019), the high costs and difficulties of using these motion sensors on a large scale justify the use of questionnaires as a feasible alternative to this purpose (Chinapaw, Mokkink, Poppel, Mechelen, & Terwee, 2010).

Another alternative to increase the PA monitoring on a wide scale is the possibility of using electronic devices with an application through the Internet (web-based questionnaire) for the application of questionnaires (Legnani, Legnani, Rech, Guimarães, & Campos, 2013; Saint-Maurice, & Welk, 2014). Such electronic questionnaires combined with information technology have the potential to be used with many people and in a wide territorial scope for their application. That would allow, e.g., for the monitoring of PA in national public monitoring policies or in the evaluation of the effectiveness of programs to foster this behavior in children and adolescents (Legnani et al., 2013).

However, there are few studies testing the validity of web questionnaires to measure PA in children and adolescents (Da Costa, et al., 2013; Legnani et al., 2013; Bortolozo, Santos, Pilatti, & Canteri, 2017; Manchola-Gonzalez, Bagur-Calafat, & Girabent-Farres, 2017). Some studies have provided information on web questionnaires to measure PA in children and adolescents aged 17 to 19 years, however, none of such studies related to the concurrent validity with PA measurements evaluated by accelerometers.

For this purpose, a web questionnaire entitled WebCas (www.legnaniwebcas.com.br) was made available on the Internet, which allows monitoring the practice of PA in epidemiological, cross-sectional and longitudinal studies in children and adolescents. The reproducibility of the printed version (Legnani *et al.*, 2019) of the electronic version (in presentation), has been proven in previous studies. Therefore, this study is intended to perform the concurrent validity of the WebCas electronic questionnaire for the evaluation of PA in children and adolescents from 10 to 16 years of age.

2. METHODS

2.1. POPULATION AND SAMPLE

This study presents a cross section to carry out the concurrent validation of the PA measurements using WebCas questionnaire versus the PA measurements obtained by accelerometers. The study was approved by the Human Research Ethics Committee of the Federal University of Paraná (UFPR), under the number: 684.147 / 2014. The minimum number of children and adolescents (from 10 to 16 years old) required for participation in the studio was calculated a priori, using the GPower application (Faul, Erdfelder, Lang, & Buchner, 2007), considering a type I error (α = 0.05) and a type II error (1-β = 0.80) and a dimension of 0.5 that resulted in a minimum of 23 participants. The studio was divided into three stages, inviting students, collecting and organizing data.

In the first stage, 140 students (4 classes of 35 students) from an urban public school in a capital city in Brazil, when the Free and Informed Consent Term (FICT) was distributed. In the second stage, the data collection, the students were divided into 4 groups, according to the 35 available accelerometers. For each group, the following procedures have been carried out: collection of FICT, collection of personal information (mobile phone number and electronic mail), measurement of the body mass (BM), height and configuration of the WebCas questionnaire (registration and training to complete Webcas), electronic signature of the Consent and Informed Agreement (CIA) and distribution of accelerometers.

Then the accelerometers have been distributed and instructions, both verbal and printed, on the use and care of the equipment have been provided. Each participant received instructions on how to use the accelerometer and contest the WebCas quiz daily for 7 consecutive days, from the moment they wake up to the time they go to bed, except during the bath or in water activities.

In order to control the effectiveness of reactivity to the use of accelerometers by the participants, they were programmed to start the collection at 24 hours of the day when they received the equipment, i.e., the accelerometer only started to collect data at the beginning of the next day (Corder, Ekelund, Steele, Wareham, & Brage, 2008).

Daily, participants received instructions by e-mail, text message by cell phone and messages by WhatsApp on the need to use the accelerometer and answer the WebCas questionnaire directly on the website of the Active and Healthy Behavior project – CAS – (www.legnaniwebcas.com.br).

After seven days, the accelerometers have been collected, then the data was downloaded to the system and the data matched the information from the WebCas questionnaire. It was found that 58 students submitted valid data, which resulted in 213 days of monitoring.

PA measurement using the WebCas questionnaire

The WebCas electronic questionnaire was developed by adapting the sections extracted from the instruments used in international studies, divided into seven sections, which were described in a previous study (Legnani *et al.*, 2019). In order meet the objectives of this study, only the third session of the WebCas electronic questionnaire was taken into account, considering the PA that the person evaluated the previous day. In this session, 244 types of PA are listed, of which 35% of the metabolic equivalents (MET) come from research with children and adolescents, the rest comes from PA included in the adult compendium and corrected for its application to adolescents (Ridley, Ainsworth, & Olds, 2008).

Each activity listed is equivalent to a MET value, which represents its relative intensity in multiples of the resting metabolic rate (RMR) defined in 1.0 Kcal / kg (weight / hour), which were represented by a six-digit code (Farinatti, 2003;

Ridley et al., 2008; Fonseca, 2012). To facilitate the interpretation of these codes for the WebCas respondents in the printed version, the activities were grouped into eight PA domains: 1) Arts; 2) domestic activities; 3) personal care; 4) dance and gymnastics; 5) School activities and work; 6) sports activities; 7) Leisure and 8) Recreation (Legnani, 2015; Legnani *et al.*, 2019).

In addition, three categories of intensity have been highlighted: weak, moderate and strong, as well as the possibilities of carrying out activities according to the body positions (lying down, sitting and standing), which represent all the PA included in the compendium (Fonseca, 2012). With this information, it was possible to calculate the daily energy expenditure (DEE), divided every fifteen minutes.

To calculate a student's DEE relative to a specific PA, the MET values are multiplied by the student's RMR, as follows:ç

Kcal = MET value x RMR x body mass, duration of PA. Therefore, RMR = Kcal.kg-1 min-1; body mass (BM) = Kg, time = minutes[11]. TMRs were calculated using the equations: RMR = 0.084 X BM + 2.122 (for boys) and RMR 0.047 X BM + 2.951, for girls (Henry, & Rees, 1991; Fonseca, 2012). These results are expressed in megajoules / day (MJ / day), to determine the value in kilocalories per day (Kcal / day), the RMR result must be multiplied by a constant "239".
To identify the DEE, all PA performed during a day have been used to record, then the calculations have been performed for each activity performed during the previous day. After calculating the RMR and the DEE, the physical activity level (PAL) of the participants was calculated according to the following equation: DEE in kilocalories divided by the basal caloric expenditure, resulting in an estimated proportion up to two and a half times higher than RMR, according to the classification of the Institute of Medicine: sedentary [1–1.39], not very active [1.4–1.59], active [1.6–1.89] and very active [1.9–2, 5] Institute of Medicine of the National Academies [IOM] (2002).

2.2. MEASUREMENT OF PHYSICAL ACTIVITY BY ACCELEROMETERS

The PA evaluation was performed using triaxial accelerometers, of the ActiGraph GT3X and GT3X + models (ActiGraph; Pensacola, FL), which have the ability to capture accelerations in the three axes: vertical plane, with a range of 0.05 to 2.0 G with a response frequency of 0.25 to 2.5 Hz. The accelerometers were programmed using ActiLife v6 software. 11.6 Lite (ActiGraph; Pensacola, FL), the collected data was summarized in 10 second steps.

Data reduction was performed using MeterPlus software version 4.3 (SanTech; San Diego, CA). The PA was stipulated in total counts in the magnitude vector total count (TC) and in counts per minute (CPM), which was obtained by dividing the TC by the total minutes of accelerometer use. From these results, we obtained the general average of the number of movements in minutes made during the valid days, both individually and in groups, using Microsoft Office Excel 2007.

The data were analyzed considering as valid days those that presented 600 minutes of accelerometer use, the appearance of 30 consecutive minutes or more of counts with values equal to zero characterized the non-use of the device (Choi, Matthews, & Buchowski, 2011). Therefore, the data collected corresponding to at least 4 days of monitoring was considered as a valid week of use, being at least one day at the end of the week and three during the week (Corder et al., 2008).

For subsequent analyzes, the accelerometry data was combined with the recovery period from the PA list from the WebCas questionnaire. Each hour was classified into five levels: sedentary behavior (<150 MET) and light intensities (≥ 150 and <500 MET), moderate (≥ 500 and <4000 MET), vigorous (≥ 4000 and <7600 MET) or very vigorous (≥ 7600 METs). In addition, the total count was made in hours of each day and the average after seven days of monitoring (Trost, Mciver, & Pate, 2005).

Data collections were carried out from August to September 2014 (cross-sectional survey) by a trained team from the Center for the Study of Physical Activity and Health of the Federal University of Paraná (UFPR), supervised by the main investigator.

2.3. STATISTICAL ANALYSIS

To describe the characteristics of the sample, descriptive analysis procedures (mean, standard deviation, and frequency distribution) and location of outliers have been performed. The normality of the data was analyzed using the Kolmogorov-Smirnov test. Comparisons between genders, kcal / day, CPM and METS were made using the Mann-Whitney U test.

To compare the PA measurements obtained by WebCas with the PA measurements obtained by the accelerometer, and so identify systematic deviations and possible outliers, we used the statistical technique of the Bland and Altmann (1986) scatter plots and the presentation of their respective Correlation coefficients. All the analysis were carried out in the statistical programs SPSS (version 21.0) and Medcalc (test version) for Windows, adopting a significance level of 5% ($p < 0.05$).

3. RESULTS

Of 140 eligible participants in the first stage of the study, only 58 submitted valid information for at least one day, i.e., 600 minutes using the accelerometer and completing the WebCas questionnaire, resulting in 213 days of PA monitoring.

Of these, 51.7% were children and 65.5% attended full time. The average age was 14.18 ± 1.79 years. The mean values, SD, minimum and maximum values for each variable are described in Table 1.

Table 1: Anthropometric characteristics, energy expenditure (kcal / day), metabolic equivalents (METS), TC and CPM of the participants (n = 58).

	Minimum	Maximum	Average	Dp
Age (years)	10	16	14.18	1.79
Body mass (kg)	25	97.2	54.40	14.09
Height (m)	1.20	1.90	1.61	0.13
BMI (kg/m^2)	13.8	29.1	20.23	3.35
Kilocalories/day (Kcal)	1319.40	2693.22	1959.86	389.33
TC	1890.80	1301769.70	570228.59	223296.7
CPM	359.90	1653.30	721.18	261.36
METS	93	197	126.16	26.47

Legend: SD = standard deviation; BMI = body mass index; TC = total count, CPM = counts per minute and METS, express the average of the valid days of each subject
Source: own authorship

When considering the descriptive values (median and amplitude) of the variables related to the estimates of caloric expenditure (Kcal / day) and metabolic equivalents (METS), according to the days of the week, the day on which the students had the highest Kcal / day and METS scores on Sunday were 2060.67 (± 1115.29), 129 (± 102), respectively. The day with the lowest expenditure of Kcal / day was Thursday 1692.98 (± 1276.48), according to the METS, it was Monday 109 (± 84). There were no significant differences in any of the variables analyzed when the values were compared according to the days of the week ($p < 0.05$).

However, for objective measures of PA, the day students scored highest for TC = 609614.30 (± 129982.40) and CPM = 836.20 (± 1053.50) was Tuesday. The lowest scores were noticed on Monday for both variables, TC = 428951.40 (± 885365.00) and CPM = 573.80 (± 712.90), respectively.

According to the results presented in Table 2, the descriptive values (median and amplitude) of all valid days (n = 213), the median values were 1744.72 (± 1381.36) for Kcal / day, 512286, 80 (± 1571898.60) for TC, 635.90 (± 1578.50) for CPM and 114.00 (± 108) for METS. Therefore, there were statistically significant differences between boys and girls concerning the scores obtained in all the variables analyzed ($p < 0.05$).

Table 2: Descriptive values and differences between the genders of kcal / day, CPM and METS of the participants in the validation stage according to the days of the week and gender (n = 213 days).

	KCAL/DAY Median (Amplitude)	TC Median (Amplitude)	CPM Median (Amplitude)	METS Median (Amplitude)
Monday (n=32)	1706.98(1270.72)	428951.40(885365.00)	573.80(712.90)	109.00(84)
Tuesday (n=27)	1696.51(1178.49)	609614.30(129982.40)	836.20(1053.50)	123.00(83)
Wednesday (n=47)	1687.51(1235.94)	451378.25(109362.80)	558.35(1216.40)	109.50(78)
Thursday (n=31)	1692.98(1276.48)	536790.30(900963.90)	630.00(885.00)	110.00(75)
Friday (n=34)	1770.95(1373.82)	541796.50(129328.80)	684.45(1023.20)	116.00(99)
Saturday (n=23)	1962.66(1252.44)	495439.05(157172.10)	669.35(1559.50)	120.00(93)
Sunday (n=19)	2060.67(1115.29)	493463.65(961832.90)	648.55(1143.60)	129.00(102)
Total (n=213)	1744.72(1381.36)	512286.80(1571898.60)	635.90(1578.50)	114,00 (108)
Girls (n=100)	1887.75#(1301.83)	462813.60[b,#] (1436314.00)	598.400[c,#] (1578.50)	110.00[d,#] (82)
Boys (n=113)	1658.01[a*] (1381.36)	549327.10[b,*] (1299951.20)	695.90[c,*] (1455.80)	115.00[d,*] (105)

Legend: KCAL / DAY: caloric expenditure TC = total counts; CPM = counts per minute; METS: metabolic equivalent; Mann-Whitney U test: a = p <0.01; b = p <0.05; c = p <0.02; d = p <0.02; # ≠ *.

Source: own authorship

The correlation between PA measurements obtained through the WebCas questionnaire compared to CPM measurements showed a weak correlation (r = 0.22; p <0.001). The scatter plot shows that 3.2% of the student sample had scores outside the upper limit, which shows that these participants may have underestimated their energy expenditure, compared to the CPM (Figure 1).

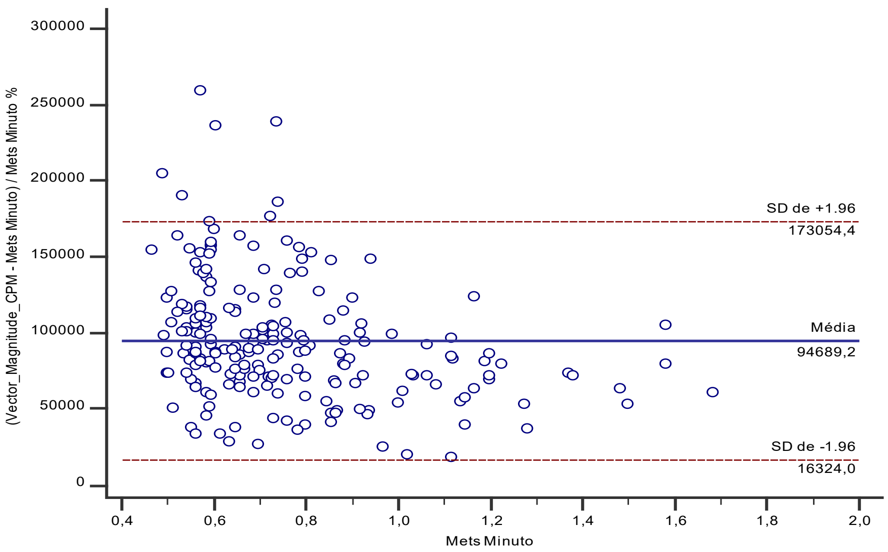

Figure 1: Agreement between the accelerometry measurements (one day) and the validation stage of the estimated metabolic equivalent (remember the previous day) of WebCas (n = 213)

When considering the average of the accelerometry and METS measurements for three days (two days a week and one weekend) of the students, the correlation between the measurements was moderate (r = 0.48; p <0.04). In this case, it was observed that only one piece of data was out of the limits of the agreement (Figure 2).

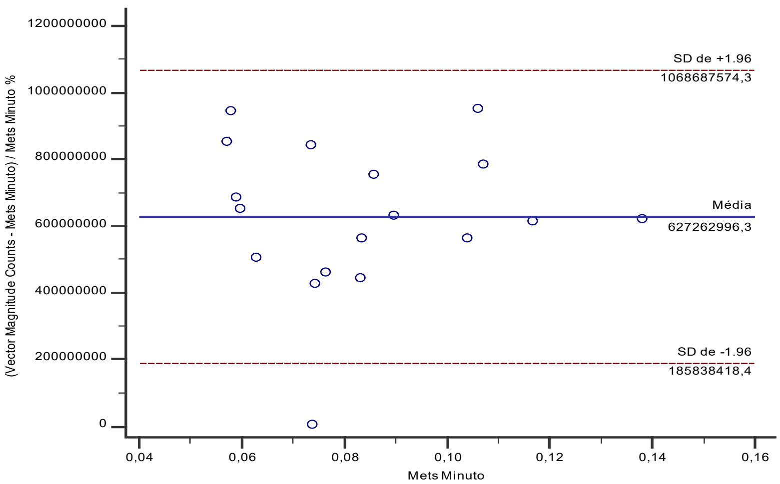

Figure 2: Agreement between accelerometry measures and metabolic equivalents (METS), average 3 days (two days a week and one on the weekend), WebCas validation step (n = 19).

However, when analyzing the average of the 5 days (three days of the week and two of the weekend), there was a moderate correlation (r = 0.67; p <0.01) between the results of WebCas and the results obtained by accelerometers. One of the students presented a value out of the upper limit of agreement (Figure 3).

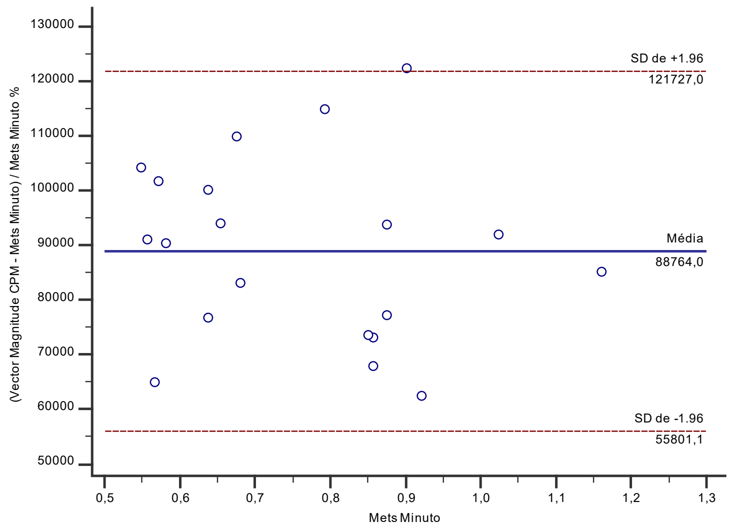

Figure 3: Agreement between accelerometry measurements and metabolic equivalents (METS), average 5 days (three days a week and two on weekends), WebCas validation step (n = 20).

4. DISCUSSION

The present study aimed to present validity data from the WebCas web questionnaire for the evaluation of PA in schoolchildren, as compared to the measurements obtained through accelerometry, considering the Kcal / day and METS evaluated by WebCas. The results showed statistically significant correlations, however, of low intensity (r = 0.22), between the WebCas and PA measurements for the previous day.

However, correlation indicators of moderate intensity were observed in the data pooled in three and five days (r of 0.48 and 0.67, respectively). PA measurements assessed using the WebCas questionnaire (METS), as compared to accelerometer PA measurements (CPM) demonstrated a weak intensity correlation for one day of the week.

These results are similar to those found in other studies, in a systematic review (Farias Júnior, Lopes Ada, Florindo & Hallal, 2010), they identified 52 questionnaires in hard copy format to evaluate the habitual practice of PA, with 42 questionnaires, 6 daily and 4 structured interviews. Of these, most were tested with adolescents from North American countries, of both genders and different age groups, objective measures of PA served as a reference criterion to evaluate most of the instruments, but only 11 had been tested in over a time, although none of them were designed to be applied in a web form.

Regarding the electronic questionnaires, another systematic review 17 showed similar results. Of the 11 questionnaires measuring the practice of PA in children and adolescents found in the review, only six had validated their PA measurements against accelerometers or pedometers, as well as the correlations found ranged from weak to moderate intensity (> 0.20 to <0.60). It indicates that PA measurements obtained through web questionnaires tend to be underestimated (Legnani et al., 2013).

When comparing PA measurements (Accelerometers x WebCas one day), the correlations found in this study were similar to other findings (Philippaerts *et al.,* 2006; Storey, & McCargar, 2012), in which they tested electronic instruments for the PA metering. However, when PA measurements collected in three or five days are considered, the correlations observed in the present study are higher than those found with the Recovering multimedia activity for children and adolescents (MARCA) questionnaire (Ridley, Olds, & Hill, 2006). Therefore, it was found out that PA measurements evaluated through WebCas increase their precision as the days of monitoring increase.

The use of electronic questionnaires has already been tested in Brazilian primary school students and has demonstrated to be an interesting strategy (Da Costa et al., 2013; Legnani et al., 2013). From a scientific and practical point of view, the results of this study are promising, as they show the possibility of using a low-cost and comprehensive data collection instrument that can provide more accurate information on the practice of PA among schoolchildren.

Among the limitations of this study, we can highlight the use of the physical activity compendium to evaluate the energy expenditure of students, since it is known that only 35% of the physical activities listed are derived from activities carried out by children and adolescents. Another aspect to consider concerns the use of accelerometers and the completion of WebCas for seven consecutive days, the students finished the completion at home, without the supervision of the researchers, this procedure was different from the WebCas application methodology used in the previous phases of the study, in which the students responded in the presence of at least one researcher, this fact may have affected the quality of the self-reported data in the questionnaire.

Among various positive points, the WebCas questionnaire stands out as the first "multicomponent" electronic questionnaire, aimed at Brazilian children and adolescents, with the ability to evaluate different behaviors related to the health of this population. Another positive point was the validation using PA measurements by accelerometers on different days of the week. It has not been done very often in studies of this nature (Legnani et al., 2013) and seems to be a pioneer in evaluating the validity of a questionnaire with these characteristics for the specific population.

Furthermore, WebCas has an administrative module, in which researchers can include or delete variables according to the context of interest, which provides WebCas with more functionality than similar questionnaires. Another original aspect of WebCas is the fact that it offers the possibility for participants to receive instant feedback on their responses, at the end of completion, this also applies to responses grouped by school (general report), by age and gender.

5. CONCLUSION

The WebCas questionnaire presented indicators of the low intensity correlation with the PA record from the previous day. However, correlation indicators of moderate intensity were found in the data pooled in three and five days of the week. These results are not different from results of other questionnaires available in the literature with the same purpose as indicated through the web questionnaire with validity indicators similar to other instruments available in the literature, to evaluate and monitor the practice of PA in children and adolescents.

Therefore, the authors suggest that the properties of WebCas be tested in other sociocultural contexts, since it is an instrument based on the resources of information technology, it does not require paper and printing, saving financial and natural resources as well as time, since It can be filled in on the computer or tablet and smart phones, discarding the input of data by the researchers, in addition to results such as: energy expenditure, the body mass index is calculated automatically.

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