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Criteria validity of the Netherlands physical activity questionnaire for children

Validade critério do Netherland Physical Activity Questionnaire para crianças

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Abstract - Physical activity measurement with accuracy and precision is extremely important in establishing the dose-response relationship between levels of physical activity and the different outcome possibilities. Subjective methods of measurement, such as proxy-reports have been used as a possibility to check physical activity in children. The aim of this study was to test the Netherlands Physical Activity Questionnaire (NPAQ), valid for Brazilian schoolchildren using physical aerobic fitness as a criterion. The study included 290 children aged 6-10 years from public schools of Itaúna/MG. NPAQ was applied to parents or guardians and children were tested using the Luc Léger test. NPAQ had mean score of 25 for children (25 for boys and 24 for girls) and VO_2max was 50.8 ml/kg/min for children (52.6 and 50.2 ml/kg/min for boys and girls, respectively). The Spearmam correlation test showed significant correlation (rsho = 0.146; p = 0.013) between NPAQ and VO2max, but the correlation is weak (Kappa -0.14). The results showed that NPAQ presented poor construct validity for physical activity measurement in a Brazilian schoolchildren sample, based on aerobic physical fitness criteria.

Key words: Child; Physical activity; Psychometric; Reproducibility of results.

Resumo – *A mensuração da atividade física com acurácia e precisão é de extrema importância no estabelecimento da relação de dose-resposta entre os níveis de atividade física e as diversas possibilidades de desfecho, sendo um desafio de extrema complexidade. A utilização de métodos subjetivos de mensuração, como os instrumentos proxy-reports, é uma possibilidade de verificação de atividade física em crianças. O objetivo deste estudo foi testar a validade do Netherland Physical Activity Questionnaire (NPAQ) em escolares brasileiros tendo como medida critério a aptidão física aeróbica. Participaram deste estudo 290 crianças de seis a 10 anos de idade, matriculados em escolas públicas do município de Itaúna/MG. Foi aplicado aos responsáveis o NPAQ e as crianças realizaram o teste de Luc Léger. O NPAQ apresentou um escore mediano de 25 para as crianças (25 meninos e 24 meninas) e o $VO_{2máx}$ foi de 50,8 ml/kg/min para as crianças (52,6 e 50,2 ml/kg/min para meninos e meninas, respectivamente). O NPAQ e o $VO_{2máx}$ apresentaram no teste de correlação simples de Spearmam r_{sho} = 0,146 (p = 0,013) correlação significativa, porém fraca (Kappa –0.14). Os resultados permitem concluir que o NPAQ apresentou fraca validade de constructo para mensuração de atividade física em uma amostra de escolares brasileiros, tendo como medida critério a aptidão física aeróbica.*

Palavras-chave: *Atividade Física; Criança; Psicometria; Reprodutibilidade dos testes.*

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INTRODUCTION

Physical activity measurement with accuracy and precision is extremely important so that a dose-response relationship can be established between levels of physical activity and the different outcome possibilities, involving prevention and control of chronic-degenerative diseases[1]. However, despite the importance of monitoring and evaluating levels of physical activity, it is known that measuring it is a great and extremely complex challenge. Ridley et al.[1] reported that physical activity is a multidimensional construct that can vary in intensity, duration, type and frequency and warn that there is no gold standard method capable of accurately measuring each of its four dimensions.

The methods of assessing levels of physical activity are divided into objective and subjective[2]. Objective methods include the measurement of physiological and/or biomechanical variables by means of electronic monitors, double-marked water (deuterium), accelerometers, pedometers, heart rate monitors and combined sensors (heart rate + accelerometer). Despite their great usability, these instruments still have high cost for epidemiological studies. Subjective methods are questionnaires, physical activity inventories and direct observations[2,3], which can be applied in epidemiological studies, usually for their practicality and low cost. Several authors have pointed out that there are limitations in the use of subjective instruments, such as difficulty in specifying the intensity of activities performed, difficulties of instruments that measure all the domains that compose the physical activity construct, difficulty in remembering and estimating the intensity of activities performed[4-7]. These factors could affect the validity in estimating the level of physical activity, especially when it comes to children under 10 years of age[8], and would compromise the results of studies using such instruments, reproducing erroneous dose-response outcomes between levels of physical activity and health[9,10].

In order to minimize such age-related intercurrences, Corder et al.[2] suggest that children and adolescents use proxy-report instruments. These instruments must be completed by parents or guardians, or even by their teachers. The theoretical assumption that supports this theory is that adults can better remember and report activities performed during the day, which could result in better validity in determining the level of physical activity when compared to self-report instruments[2,11,12]. On the other hand, the degree of kinship or coexistence and the interest in monitoring the child could result in less validity. In Brazil, the instrument that has such characteristics is the Netherlands Physical Activity Questionnaire[12]. This questionnaire had its psychometric qualities recently tested in Brazilian children living in the city of Pelotas, southern Brazil, and satisfactory validity was not found when compared to the criterion measure (accelerometry)[13]. No further studies have yet been carried out to confirm the low validity of this instrument, using criterion measures such as physiological indicators of physical fitness.

Validity is conceptually defined as the quality of the instrument in reporting precise measures of the phenomenon that is intended to be measured[14,15]. There are several types of validation, among them, face, construct, content and criterion. The criterion validity compares the instrument to be validated with a measure considered criterion[14]. In physical activity measures, traditionally, as quoted in several articles, the validity of self report and proxy report instruments has been obtained through combined pedometry, accelerometry/accelerometer methods and heart rate[12]. Thus, the present study aims to test the validity of the Netherlands Physical Activity Questionnaire (NPAQ) in Brazilian schoolchildren having aerobic physical fitness as a criterion measure.

METHODOLOGICAL PROCEDURES

Study type and design

This is a cross-sectional and correlational study. Due to the nature of the research, the results may be, with a small margin of error, generalized to the population represented by the sample.

Participants

The students selected to participate in this study were from the city of Itaúna, located 80 km from the Minas Gerais capital, Belo Horizonte, in the midwestern region of the state. It has population of 85,463 inhabitants and Human Development Index of 0.823, classified as high[16].

Population and sample

Study population: students aged 6-10 years enrolled in grades from 1 to 5 in all public schools in the urban area of Itaúna were eligible to compose the sample. These students constituted a universe of 4649 schoolchildren (data provided by the Municipal Department of Education and school register). The sample consisted of 228 children, with 5% probabilistic error. However, predicting losses, the final sample was defined in 456 children.

Sex and age classification was performed within each school so that age and sex ratios were maintained. With data obtained from each school, students were numbered in each grade in sequential order. Then, using a table of random numbers generated by the software Excel 2003, children of the corresponding number in the list created in each grade were selected, until reaching the number needed to compose the sample for that sex and age in that school.

Inclusion and exclusion criteria

Children were selected based on the age group of 6-10 years and enrolled in the state and municipal public networks, in the morning or afternoon shift, from the first to the fifth grades. Due to the difficulty of access and the small number of children enrolled in rural schools (279 children), representing about 6% of students in the municipality, they were not in-

cluded. Children with clinical and/or motor impairment that prevented the performance of physical tests were excluded.

Instruments, variables and collection procedures

Data collection was performed by questionnaire, anthropometric measurements and cardiorespiratory fitness test.

After parents' or guardians' consent, they filled out, in the presence of researchers, the following questionnaires and forms:

- Socioeconomic and demographic: housing conditions, parental profession, number of dwellers, number of rooms, number of children, ABEP questionnaire reporting the ownership of goods and educational level of the family head, etc.
- Personal history of the child: height and birth weight, whether full-term or not, breastfeeding, health problems, use of medications and medical appointments in the last year.
- Level of physical activity: measured using NPAQ_, translated into Portuguese. NPAQ_is a questionnaire that contains 7 questions (likert 1-5) about patterns of physical activity and must be answered by parents and / or guardians. The level of physical activity is calculated by the sum of the 7 questions, with score 25[13] as the cutoff point.

This instrument was originally validated for children aged 4-6 years; however, its validity has recently been extended for children and adolescents[13]. According to Janz et al.[17], the question about the number of hours per day that the child spent watching television, playing video games or on the computer was included.

Each school made available a room and a court for the accomplishment of anthropometric measures and the aerobic physical fitness test. Anthropometric evaluations were performed by an experienced evaluator in the area of cineanthropometry and performed in a reserved environment.

Anthropometric measurements were body mass, height, circumferences and skinfolds. To measure body mass, "Seca" digital electronic scale (Scales Galore, New York, USA), with maximum capacity of 150 kg and accuracy of 0.1 kg was used. Height was measured using "Alturaexata" vertical anthropometer (Alturaexata, Minas Gerais, Brazil), with graduation in centimeters (cm) up to 2.13 meters and accuracy of 0.001m.

For measuring abdominal and hip circumferences, flexible and inelastic 2-meter Venosan (Venosan Brazil, Pernambuco, Brazil) measuring tape was used, divided into centimeters and accuracy of 0.001 m, being careful not to compress the soft parts. For all measurements, Lohman et al.[18] standardization was used. BMI was calculated by the ratio between total body mass in kilograms and height in squared meters. For all anthropometric measures, three measurements were performed and the median was used.

The aerobic physical fitness test used was the Luc Léger test[19,20], which consisted of a round-trip run in a 20-meter course, with progressive inten-

sity until exhaustion. The test starts at 8.5 km/h and is increased by 0.5 km/h every minute until the child cannot keep pace with 2 consecutive beeps. The distance was demarcated on the sports court or other area with paved floor available within schools. All children were verbally encouraged to reach as many stages as possible. To determine the run pace, a portable stereo and a CD recorded with the test media were used. The final velocity (VF) of the test was used to estimate VO_2max using the formula (VO_{2max} = 14.49 – 2.143 VF + 0.00324 VF^2) proposed by the test protocol. This test was validated for children aged 12-14 years (r = 0.76), using the direct oxygen consumption measure[19] as gold standard, being used worldwide to evaluate the aerobic fitness of children and adolescents[21]. For the classification of the cardiorespiratory capacity, the 75th percentile was adopted according to the study of Gonçalves et al.[22].

Ethical aspects

The project was previously approved by the Departmental Chamber of Pediatrics of the Faculty of Medicine - Federal University of Minas Gerais, protocol No. 93/2009; and by the Ethics Research Committee of UFMG, protocol No. 0040.0.203.000-10, and by the Ethics Research Committee of the University of Itaúna, protocol No. 012/10. The study was carried out only with children whose parents authorized their participation by signing the free and informed consent form.

Statistics

Descriptive statistics (median and interquartile range), frequency tables and the non-parametric inference test were used for data analysis. To verify data normality, the Kolmogorov Smirnov test was used and the Mann Whitney test was used to verify differences between sexes. In order to evaluate the internal consistency of the instrument, Conbrach alpha was used. For criterion validity, the correlation of the VO_2max measurement obtained in Lec Leger versus the score generated by the NAPQ instrument through Spearman correlation was used. The Kappa test was used to verify concordance. For this, both NAPQ and VO_2max scores were dichotomized, adopting 75th percentile for VO_2 and value 26 for NAPQ. Subsequently, the Kappa test was used to verify the concordance among instruments. For all tests, significance level of $p < 0.05$ was used and the Statistic software for Windows version 10.0 was used.

RESULTS

Demographic data show that in the sample of 290 students, 158 were male, in the five ages surveyed, the distribution of participants ranged from 13.5% to 25.8%, and 42 participants had low birth weight and 20 were preterm infants, presenting 69.2% of families belonging to socioeconomic classes C1 and C2, with 80.8% of families having 1 to 3 children, and 40.7% of parents with basic education schooling and 8.6% illiterate. The internal consistency

of NAPQ obtained by the Conbrach alpha was 0.92. Table 1 shows the demographic and socioeconomic characteristics of children and parents.

Table 1. Demographic and socioeconomic characteristics of children and parents

Variables	N	%
Sex		
Male	158	52.3
Female	132	43.7
Age		
6 years	40	13.5
7 years	50	16.6
8 years	60	19.9
9 years	78	25.8
10 years	62	20.5
Low birth weight		
Yes	42	13.9
No	237	78.5
Losses	23	7.6
Preterm		
Yes	20	6.6
No	259	85.7
Losses	23	7.6
Socioeconomic classification		
B1	2	0.7
B2	26	8.6
C1	105	34.8
C2	104	34.4
D	52	17.2
E	1	0.3
Losses	12	4.0
Number of children		
1	56	18.5
2	108	35.8
3	80	26.5
4	23	7.6
5	14	4.6
+6	9	2.9
Losses	12	4.0
Parental schooling		
Illiterate	26	8.6
Elementary school	123	40.7
High school	58	19.2
Higher education	67	22.2
Graduate studies	13	4.3
Losses	15	5.0

Table 2 shows the descriptive results of the study variables. It was observed that significant differences were found for most variables, where boys had higher mean values in relation to girls, except for TV hours, which did not present significant difference between boys and girls.

Table 2. Comparison of medians of the study variables of students from public schools in the city of Itaúna, MG

	Boys (n=158)		Girls (n=132)		Mann-Whitney U Test
	Median	Q1- Q3	Median	Q1- Q3	p
Age (years)	8.0	7.0-9.0	9.0	7.09- 9.0	0.936
Height (m)	1.35	1.27-1.41	1.33	1.24- 1.39	0.249
Body mass (kg)	29.4	25.7-36.1	27.6	23.2- 33.5	0.062
BMI (kg/m$^{2)}$	16.5*	15.1-18.5	15.7*	14.7- 17.9	0.033
Abdominal circ. (cm)	58.0*	55.0-64.9	56.2*	53.1- 62.5	0.007
Hip circ. (cm)	68.0	63.2-75.2	67.6	63.0- 74.2	0.761
Luc Léger level	5.0*	3.0-6.0	4.0*	3.0- 5.0	0.001
Final value (km/h)	10.7*	10.0-11.2	10.1*	9.7 10.6	0.001
$VO_{2máx}$ (ml/kg/min)	52.6*	45.9-54.4	50.2*	48.4- 51.8	0.001
NPAQ	25.0*	22.0-29.0	24.0*	20.0- 27.0	0.013
TV/Comp. (hrs)	3.0	2.0-4.0	3.0	2.0- 4.0	0.803
HR_{rest} (bpm)	87.0*	78.7-94.3	91.0*	84.2- 98.2	0.001

Note. * - difference between boys and girls, p <0.05.

Table 3 shows Spearman's simple correlation coefficients between reference variables and physical activity scores of the NPAQ questionnaire. Analyzing correlations without stratification, it was observed that VO_2max, level and number of trajectories in the Luc Léger test and the final velocity showed significant and positive correlations, while abdominal circumference showed significant and negative correlation. For males, only abdominal circumference and TV and computer hours presented significant and negative correlations. For females, only TV and computer hours showed significant and negative correlation.

Table 3. Spearman's simple correlation coefficient (rsho) between NPAQ physical activity scores and physical fitness variables, age and abdominal circumference, Itaúna, MG, 2010

Physical Activity Score Netherlands Physical Activity Questionnaire						
	General		Boys		Girls	
Reference variables	r_{sho}	p	r_{sho}	p	r_{sho}	p
Abdominal circ. (cm)	-0.138	0.019	-0.226	0.004	-0.112	0.200
$VO_{2máx}$ (ml/kg/min)	0.146	0.013	0.103	0.198	0.073	0.405
Luc Léger level	0.158	0.007	0.140	0.080	0.068	0.439
Luc Léger Perc	0.143	0.015	0.131	0.103	0.045	0.612
Final velocity	0.162	0.006	0.153	0.050	0.051	0.558
TV/Comp. (hrs)	-0.196	0.001	-0.163	0.042	-0.240	0.006
HR_{Rest} (bpm)	-0.090	0.125	-0.146	0.067	0.033	0.703

In Table 4, variables VO2max and NPAQ score were dichotomized, assuming the 75th percentile for VO_2 and score 26 for NPAQ. Based on this dichotomization, the concordance between VO_2max (P>75 - low cardiorespiratory capacity, P> 75 - high respiratory capacity) and the NPAQ score (Inactive <26; Active ≥ 26) were presented. For the Kappa test, the concordance between instruments was -0.14. This concordance value is considered by literature to be weak. Considering the VO_2max test as a

criterion for validity, when performing concordance among instruments, it was observed that 49 children with high cardiorespiratory capacity were considered inactive, while 84 children who presented low cardiorespiratory capacity were considered active. From these values, it could be inferred that 17% and 29% are false positives and false negatives, respectively.

Table 4. Concordance level between P75 and NPAQ score

		NPAQ score		Total
		< 26	> 26	
VO_{2max}	< P75	134	84	218
	> P75	49	23	72
Total		183	107	290

DISCUSSION

The present study aimed to verify the validity of an instrument (NPAQ) to be filled by parents or guardians on the physical activity levels of children younger than 10 years of age, with aerobic capacity as a criterion measure, as measured by the indirect Luc Léger test[20].

Several studies were conducted with the aim of validating proxy report instruments[1,3-5,7,8]. In the study by Murph[23] and collaborators, the validity of the report of teachers and caregivers on the level of physical activity of 213 children and adolescents (6-18 years) was investigated, using the maximum test in cycloergometer as criterion. The results of the study showed significant moderate and strong correlation, respectively, for teachers (r = 0.59) and caregivers (r = 0.82). In the study by Manios[24] and colleagues, the validity of two proxy report instruments was correlated with the heart rate of 39 children (6-10 years). Both instruments had significantly positive correlations when correlated with heart rate (instrument 1 - r = 0.49, instrument 2 - r = 0.69). Although the above studies used instruments different from those of the present study, the theoretical assumptions that support the construction of proxy report questionnaires are the same. All of them have, as a characteristic, the report of parents / guardians or teachers about the behavior in relation to the practice of physical activity.

Some studies[3-5] showed significantly good correlation levels, which probably allowed researchers to indicate the use of proxy reports in population studies for the measurement of physical activity. However, their use should be viewed with care[12]. Many authors[8-13] and studies[4,5,7,8] have pointed to weaknesses in proxy report or self-report (daily) questionnaires in the measurement of physical activity and indicated the combination with the use of accelerometers. Telford et al.[25] tested the validity of the Children's Leisure Activities Study Survey (CLASS) in 280 children aged 5-12 years using accelerometry as a criterion measure and found correlation values between -0.05 and .09 for physical activity. Bieleman et al. [13] interviewed 369 mothers, fathers or guardians of children aged 4-11 years in the city of Pelotas, RS. The authors assumed a score of 25 in NPAQ as cutoff point

and found sensitivity and specificity values respectively of 68.0% (95% CI = 60.5 - 74.8) and 50.0% (95% CI = 37.2 - 62.8). This means that for every two inactive children, one would be considered active. Janz et al.[17] interviewed 204 mothers, fathers or guardians of children aged 4-7 years using NPAQ. The results showed low correlation values between NPAQ scores and total counts / min (= -0.33) and vigorous activity time / day (= -0.36). Bieleman et al.[13] and Janz et al.[17] used NPAQ; however, they used the accelerometry measure as a criterion, while our study used the indirect cardiorespiratory capacity measure. Despite this difference, the results of this study were similar to those of our study. In our study, it was found that 46% of children investigated presented erroneous classifications by parents or guardians and correlations between NPAQ and the Luc Leger test were weak. These results reinforce that instruments that estimate levels of physical activity in children, whether self-reported by parents or guardians, should be used with caution.

The use of questionnaires, diaries and self-reports to measure physical activity in children and adolescents has been questioned by several authors. The estimation of physical activity has been questioned when using questionnaires. A study by Corder et al.[8] entitled "Is it possible to estimate and evaluate physical activity and energy expenditure in young people using self-reports?" investigated children aged 4-17 years using accelerometry and double-marked water as criterion, respectively, for physical activity and energy expenditure. The average validity of instruments (Youth Physical Activity Questionnaire, Children's Physical Activity Questionnaire, Child Heart and Health Study in England Questionnaire, Swedish Adolescent Physical Activity Questionnaire) evaluated to measure physical activity was 0.32 when correlated with accelerometry, while to measure energy expenditure, there is an underestimation of energy expenditure values around 23 $kcal.kg^{-1}.min^{-1}$ and mean correlation values of r = -0.38.

Our study reinforces that the NPAQ self-report questionnaire presents low validity to estimate physical activity. Given the low performance of the instrument, some issues should be raised, especially regarding the relationship between physical activity and health.

It is important to highlight that this study may present limitations in the aerobic fitness of children/adolescents, since an indirect method was used to validate the NPAQ questionnaire. However, the study has large sampling n, which made it impossible to perform an aerobic test based on the direct method. Despite these limitations, the study advances in the sense that proxy-report questionnaires should be used with caution.

CONCLUSION

NPAQ showed weak validity in a sample of Brazilian schoolchildren, having as criterion aerobic fitness verified through the indirect Luc Léger test.

COMPLIANCE WITH ETHICAL STANDARDS

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Ethical approval

Ethical approval was obtained from the local Human Ethics Research Committee – Federal University of Minas Gerais, number 93/2009 and the protocol was written in accordance with standards set by the Declaration of Helsinki.

Conflict of interest statement

The authors have no conflict of interests to declare.

Author Contributions

Conceived and designed the experiments: VOD, RG. Performed the experiments: VOD; RG; JAL. Analyzed data: VOD; RG. Contributed with reagents/materials/analysis tools: VOD; RG; JAL; LAS; BPC; DES. Wrote the paper: VOD; BPC; RG.

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