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PHYSICAL FITNESS AND HEALTH-RELATED QUALITY OF LIFE IN BRAZILIAN ADOLESCENTS: A CROSS-SECTIONAL STUDY

original paper
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ABSTRACT

Purpose. To compare physical fitness according to dimensions of Health-Related Quality of Life (HRQOL) in Brazilian adolescents.

Methods. A cross-sectional study of 588 adolescents (263 female) aged 12 to 17 years from a private school in Londrina, Paraná, Brazil. HRQOL was assessed by the Kidscreen-52 questionnaire. Four components of physical fitness were assessed: adiposity (sum of tricipital and subscapular skinfolds), muscular strength (handgrip test), flexibility (sit-and-reach test), and cardiorespiratory fitness (20m Shuttle run test). Differences in physical fitness across terciles of HRQOL were assessed using Analysis of Covariance.

Results. Adolescents with higher scores (3rd Tercile) of HRQOL in the physical well-being dimension presented higher cardiorespiratory fitness and lower skinfold thickness ($p < 0.05$) compared to adolescents with lower scores (1stTercile). Those with higher scores in psychological well-being and social support and peer relation dimensions also presented lower skinfold thickness ($p < 0.05$). Performance in handgrip strength and flexibility did not differ across terciles of HRQOL in any dimension analyzed ($p > 0.05$).

Conclusions. Adiposity and cardiorespiratory fitness seem to contribute to the physical well-being dimension of HQOL in Brazilian adolescents. Furthermore, adiposity also contributes to psychological well-being and social support and peer relations. Adiposity and cardiorespiratory fitness should be monitored to avoid low HRQOL in Brazilian adolescents.

Key words: adiposity, cardiorespiratory, flexibility, handgrip strength, mental health

Introduction

Monitoring the health of children and adolescents is necessary to prevent behaviors and risk factors at a young age that can lead to the development of chronic diseases in adult life. Among the aspects related to youth health, physical fitness is an important health predictor as it is related to cardiovascular and musculoskeletal risk factors [1–4]. Health-Related Quality of Life (HRQOL) has been used to monitor youth health as it is capable of discriminating young people with different chronic diseases [5] and health risk behaviors [6]. This tool is also a subjective indicator of health and presents variation among adolescents even in the absence of diseases [7].

Among children and adolescents with chronic diseases – and associated impairments in functional capacities- better physical fitness is associated with a higher HRQOL [8]. Likewise, there is growing evidence that cardiorespiratory and muscular fitness are associated with higher HRQOL in children and adolescents who do not have chronic diseases [9–14].

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Studies aiming to analyze the association between physical fitness and HRQOL in young people have been conducted in samples from developed countries, such as Australia, Canada, Portugal, Spain, the United Kingdom, and the United States [9-14]. To our knowledge, no study has been conducted on a sample of Brazilian adolescents. Results from high income countries cannot be generalized to lower income countries [15] due to different social, cultural, and economic characteristics. A recent study that included young people from 12 countries supports this lack of translation across populations as it determined that children of high-income countries tend to have higher HRQOL compared to low-to-middle income countries [6]. Furthermore, many previous studies that aimed to investigate the relationship between HRQOL and physical fitness in young people included children in samples [9, 11–14]. Due to changes on physical, psychological and behavioural characteristics that occur during adolescence, results from children cannot be generalized to adolescents.

Analyzing the relationship between physical fitness and HRQOL in a Brazilian sample could establish if the relationships described in developed countries also occur in young people from this developing country. The findings may help direct actions to improve HRQOL in this population. In addition, it will advance the knowledge about the contribution of physical fitness to HRQOL in adolescents, as scarce information is available on this topic compared to the amount of evidence demonstrating the relationship between physical fitness and cardiovascular health [1, 3, 4]. Thus, the aim of the present study was to compare physical fitness according to dimensions of HRQOL in adolescents from a private school in Londrina, Paraná, Brazil.

Material and methods

Design and sample

This is a cross-sectional study, part of the project entitled "Analysis of health-related quality of life and motor performance of schoolchildren", carried out in Londrina, Paraná, Brazil, in 2009.

Sample selection was non-probabilistic, and 588 students from a private school composed the sample (263 females and 325 males) according to the following inclusion criteria: A) being enrolled in the school participating in the study; B) submitting a consent form signed by parents or guardians to participate in the study; C) aged between 12 and 17 years; D) not having any chronic disease, or physical, metabolic or neurological injury that impeded the execution of study procedures.

Procedures

All procedures were performed at the school participating in the study in a single day. The procedures were administered by a team of researchers with experience in carrying out the measures. The self-reported questionnaire to estimate HRQOL was completed in the classroom in the presence of two researchers who provided necessary information. After filling in the questionnaire, the participants were referred to another room to perform skinfold measurements. The final step was physical fitness tests performed on a sports court. The order of execution of the tests was as follows: 1-) Handgrip strength test; 2-) Flexibility test; 3-) Cardiorespiratory fitness test.

Health-related Quality of Life (HRQOL)

The instrument used to estimate HRQOL was the *Kidscreen-52* questionnaire, translated and culturally adapted to Brazilian young people [16]. The questionnaire consists of 10 dimensions (D): D1 – Physical well-being; D2 – Psychological well-being; D3 – Moods and emotions; D4 – Self-perception: body image and self-esteem; D5 – Autonomy; D6 – Parents relation and home life; D7 – Perceived financial opportunities; D8 – Social support and peer relations; D9 – School functioning; D10 – Bullying and social rejection. The dimensions are distributed in 52 questions with a Likert scale of 0 to 5 points. The instrument has a score from 0 to 100 points, and the higher values represent a higher HRQOL.

Adiposity

To assess adiposity, tricipital and subscapular skinfolds were measured using a compass (Sanny, São Paulo, Brazil), with 0.1mm precision. The reproducibility of tricipital and subscapular skinfold measurements has been described elsewhere [17]. Adiposity was determined by the sum of the tricipital and subscapular skinfolds.

Flexibility, Muscular strength, and Cardiorespiratory fitness

Flexibility was assessed using the Sit-and-Reach test according to the procedures described by Wells & Dilon [18]. Handgrip strength was evaluated by dynamom-

etry using a digital dynamometer (Takei TKK 5401, Nigata, Japan). The procedures were standardized according to previous recommendations [19]. Cardiorespiratory fitness was estimated using the 20 m Shuttle run test. The test is characterized as progressive and starts at a speed of 8.5 km/h with increments of 0.5 km/h every minute until voluntary exhaustion [20].

Statistical Analysis

Descriptive statistics are presented as absolute frequency, mean, standard deviation, and minimum and maximum values. Participants were categorized into three strata (terciles) of physical fitness. The comparison of physical fitness according to HRQOL dimensions was conducted using Analysis of Covariance (ANCOVA) with sex and age as covariates. Multiple comparisons were performed with the Bonferroni post hoc test and the effect size was expressed as partial eta-squared (η_p^2). The effect size was interpreted as recommended by Richardson [21], which states a small effect size = 0.01 to 0.05, medium effect size = 0.06 to 0.13, and large effect size ≥ 0.14. The significance level was set at $p < 0.05$.

Ethical approval

The study was approved by the Ethics Committee for Research Involving Human Beings of the State University of Londrina, protocol 073/2007, according to Resolution 196/96 of the Brazilian National Health Council.

Informed consent

Parents or guardians of students who agreed to participate in the study signed a consent form wherein was described all procedures, researcher contact details, and possible risks and benefits of the study.

Results

The final sample was composed of 588 participants, 263 girls and 325 boys, with a mean age of 14.0 years. The description of the cardiorespiratory fitness, handgrip strength, flexibility, sum of skinfolds, and score for each dimension of the HRQOL are presented in Table 1.

Tables 2, 3, 4, and 5 present the comparisons of skinfold thicknesses, cardiorespiratory fitness, handgrip strength, and flexibility according to terciles of each HRQOL dimension.

Adolescents that were in the 1st tercile in the physical well-being and psychological well-being dimensions presented a significantly higher sum of skinfold thicknesses compared to those who were in the 3rd tercile, $p < 0.05$. Similarly, young people in the 1st tercile in the social support and peer relations dimension presented significantly higher skinfold thicknesses compared to those in the 2nd and 3rd terciles, $p < 0.05$, (Table 2). The effect sizes of the differences were small, varying from 0.010 to 0.037.

The comparison of cardiorespiratory fitness according to terciles of HRQOL dimensions is presented in Table 3. Participants who composed the 2nd and 3rd

Table 1. Characteristics of the study participants (n = 588)

Variable	Mean	Standard deviation	Minimum	Maximum
Age (years)	14.0	1.24	12.0	17.0
Cardiorespiratory fitness (ml/kg/min)	39.1	5.16	26.7	51.6
Handgripstrength (kg)	27.5	7.97	12.5	53.2
Flexibility (cm)	17.8	9.01	0	42.0
Skinfolds Thickness (mm)*	27.9	11.47	11.0	67.6
D1: Physical well-being	66.8	10.97	36.0	88.0
D2: Psychological well-being	82.9	12.83	37.0	100
D3: Moods and emotions	81.1	13.17	34.0	100
D4: Self-perception	77.6	10.75	44.0	100
D5: Autonomy	76.4	14.36	24.0	100
D6: Parents relation and home life	80.3	13.90	40.0	100
D7: Perceived financial opportunities	80.8	16.12	20.0	100
D8: Social support and peer relations	83.3	13.13	37.0	100
D9: School functioning	72.0	13.61	33.0	100
D10: Bullying and social rejection	90.2	11.31	40.0	100

*Sum of tricipital and subscapular skinfolds. D1 to D10: Dimensions of health-related quality of life questionnaire.

Table 2. Comparison of skinfold thicknesses according to Health Related Quality of Life (HRQOL) terciles

HRQOL dimensions	Skinfold thickness (mm)				
	1stTercile	2ndTercile	3rdTercile	η_p^2	*p*
D1: Physical well-being	**28.60(11.87)[a]**	**24.45(10.76)**	**22.93(16.78)**	**0.010**	**0.010***
D2: Psychological well-being	**28.28(11.48)[a]**	**26.12(11.66)**	**22.37(15.90)**	**0.037**	**0.010***
D3: Moods and emotions	26.10(11.16)	26.15(14.07)	24.82(14.67)	0.002	0.781
D4: Self-perception	25.77(11.98)	27.82(13.49)	23.04(15.03)	0.003	0.083
D5: Autonomy	27.33(12.10)	24.98(13.34)	24.85(14.60)	0.007	0.409
D6: Parents relation and home life	24.82(11.90)	27.25(14.63)	25.10(13.40)	0.006	0.468
D7: Perceived financial opportunities	26.52(13.21)	26.60(13.56)	22.43(12.84)	0.014	0.164
D8: Social support and peer relations	**29.02(13.58)[ab]**	**23.26(11.55)**	**24.71(14.10)**	**0.034**	**0.011***
D9: School functioning	25.09(12.42)	25.27(11.72)	27.05(15.98)	0.004	0.629
D10: Bullying and social rejection	24.25(11.18)	28.84(13.95)	24.82(14.49)	0.023	0.052

Values expressed as mean (standard deviation); F and p values for ANCOVA adjusted for age and sex; η_p^2 = Partial eta-squared; Multiple comparison tests: [a] $p < 0.05$ vs 3rdTercile; [b] $p < 0.05$ vs 2ndTercile. D1 to D10: Dimensions of HRQOL questionnaire. Bold figures denote significant differences ($p < 0.05$).

Table 3. Comparison of cardiorespiratory fitness according to Health Related Quality of Life (HRQOL) terciles

HRQOL dimensions	20m Shuttle run test (ml/kg/min)				
	1stTercile	2ndTercile	3rdTercile	η_p^2	*p*
D1: Physical well-being	**37.05(4.51)**	**40.17(5.10)[a]**	**40.90(5.17)[a]**	**0.086**	**0.001**
D2: Psychological well-being	38.33(4.70)	40,40(6.06)	38.87(4.71)	0.023	0.052
D3: Moods and emotions	38.61(4.99)	39,47(5.39)	39.04(5.02)	0.006	0.469
D4: Self-perception	38.31(5.25)	40.01(4.85)	39.18(5.22)	0.012	0.214
D5: Autonomy	38.81(5.13)	39.30(5.58)	39.12(4.80)	0.001	0.835
D6: Parents relation and home life	39.22(5.34)	39.14(5.21)	38.64(4.82)	0.003	0.697
D7: Perceived financial opportunities	38.55(4.83)	39.88(5.41)	38.61(5.24)	0.007	0.435
D8: Social support and peer relations	38.21(5.22)	40.12(5.26)	38.95(4.83)	0.028	0.028
D9: School functioning	39.18(5.47)	39.29(5.08)	38.56(4.84)	0.009	0.334
D10: Bullying and social rejection	38.98(5.31)	39.12(5.30)	39.10(4.96)	0.003	0.662

Values expressed as mean (standard deviation); F and p values for ANCOVA adjusted for age and sex. η_p^2 = Partial eta-squared; Multiple comparison tests: [a] $p < 0.05$ vs 1stTercile.D1 to D10: Dimensions of HRQOL. D8 variable did not present statistical significance in multiple comparison test. Bold figures denote significant differences ($p < 0.05$).

Table 4. Comparison of handgrip strength according to Health Related Quality of Life (HRQOL) terciles

HRQOL dimensions	Handgrip strength (kg)				
	1stTercile	2ndTercile	3rdTercile	η_p^2	*p*
D1: Physical well-being	27.79(8.39)	27.32(7.44)	27.00(7.99)	0.002	0.783
D2: Psychological well-being	27.62(7.14)	28.90(9.18)	25.98(7.70)	0.020	0.078
D3: Moods and emotions	27.89(7.70)	27.32(8.56)	27.03(7.46)	0.002	0.738
D4: Self-perception	27.34(7.73)	27.25(7.72)	27.82(8.78)	0.007	0.386
D5: Autonomy	28.06(8.63)	26.42(7.03)	27.69(8.11)	0,020	0.075
D6: Parents relation and home life	28.43(8.08)	27.12(7.81)	26.28(7.75)	0.022	0.060
D7: Perceived financial opportunities	26.72(7.80)	28.24(7.73)	27.37(8.75)	0.003	0.646
D8: Social support and peer relations	28.06(8.45)	28.10(7.89)	26.06(7.39)	0.017	0.117
D9: School functioning	27.97(8.11)	28.28(8.13)	25.77(7.47)	0.017	0.110
D10: Bullying and social rejection	26.74(7.51)	28.80(8.37)	27.00(8.04)	0.008	0.375

Values expressed as mean (standard deviation); F and p values for ANCOVA adjusted for age and sex.
η_p^2 = Partial eta-squared; D1 to D10: Dimensions of HRQOL questionnaire.

Table 5. Comparison of flexibility according to Health Related Quality of Life (HRQOL) terciles

HRQOL dimensions	Flexibility(cm)				
	1st Tercile	2nd Tercile	3rd Tercile	η_p^2	*p*
D1: Physical well-being	17.27(8.81)	17.54(8.31)	18.80(10.07)	0.013	0.218
D2: Psychological well-being	17.50(8.88)	18.30(9.00)	17.55(9.30)	0.004	0.623
D3: Moods and emotions	18.64(9.68)	16.93(8.45)	17.79(9.02)	0.007	0.409
D4: Self-perception	17.88(8.75)	16.64(9.23)	18.92(9.21)	0.007	0.412
D5: Autonomy	18.46(8.26)	16.11(9.00)	18.59(9.75)	0.016	0.129
D6: Parents relation and home life	16.99(8.73)	18.52(8.61)	17.82(9.92)	0.003	0.671
D7: Perceived financial opportunities	17.34(9.49)	18.40(8.49)	17.28(9.08)	0.010	0.275
D8: Social support and peer relations	17.72(9.49)	18.75(8.78)	16.74(8.73)	0.011	0.241
D9: School functioning	16.41(9.48)	18.71(8.55)	18.14(8.99)	0.011	0.241
D10: Bullying and social rejection	17.85(8.26)	17.97(8.87)	17.55(9.89)	0.002	0.737

Values expressed as mean (standard deviation); *F* and *p* values for ANCOVA adjusted for age and sex.
η_p^2 = Partial eta-squared; D1 to D10: Dimensions of HRQOL questionnaire.

tercile of the Physical well-being dimension presented significantly higher cardiorespiratory fitness than those in the 1st tercile ($p < 0.05$). No significant differences were found in cardiorespiratory fitness according to any other dimension tercile. No significant differences were identified for handgrip strength and flexibility according to the tercile for any HRQOL dimension, $p > 0.05$ (Tables 4 and 5).

Discussion

To our knowledge, this was the first study to compare health-related physical fitness according to different HRQOL dimensions in Brazilian young people. The main results were that adolescents with higher HRQOL scores in physical well-being, psychological well-being, and social support and peer relation dimensions presented lower values of skinfold thickness. In addition, participants with higher scores in the physical well-being dimension presented higher cardiorespiratory fitness compared to those with lower scores in this dimension.

Comparison of the results presented in this study with others already conducted is limited due to the variety of instruments available to estimate the HRQOL of young people. Although the instruments evaluate the same variable, the questionnaires are composed of different dimensions. The most commonly used instruments are Impact of Weight on Quality of Life-Kids (IWQOL-KIDS), Pediatric Quality of Life Inventory (PedsQL), Kidscreen-10, and Kidscreen-52.

One variable that impairs youth HRQOL is being overweight. This finding was demonstrated in a study with a sample of 10 European countries. The results showed that overweight young people present lower scores in physical well-being, mood and emotions, self-perception, social support and peer relations, social acceptance, and bullying dimensions of the KIDSCREEN-52 questionnaire [22]. In Australians there is an inverse association between body mass index and HRQOL scores in the physical health, psychosocial health, emotional functioning, and social functioning dimensions of the PedsQL questionnaire [12]. Similarly, in Canadians, an inverse association between body fat and HRQOL scores was found for physical and social functioning using the PedsQL [13].

The results of the present study reinforce the evidence that higher adiposity can result in lower HRQOL in young people. Even though there are differences between the HRQOL questionnaires, the results corroborate previous studies regarding higher scores in the physical and psychological well-being and social support and peer relation dimensions in those with lower adiposity. Researchers also adopted different methods to assess adiposity such as body mass index [12, 22], dual-energy X-ray absorptiometry [13], and skinfold thickness as used in the present study. Despite being measured differently, the values present high correlations and predict cardiovascular risk in a similar way [3].

Regarding cardiorespiratory fitness, the results found in the present study partially corroborate those described in North American school-aged children. Cardiorespiratory fitness was positively associated with HRQOL, assessed using the PedsQL instrument, in physical and mental functioning dimensions [9]. Similar results were found in a sample of Portuguese adolescents. However, cardiorespiratory fitness was positively associated with the overall HRQOL score estimated by the KIDSCREEN-10 [10]. In another study, cardiorespiratory fitness was also positively associated

with HRQOL in physical well-being, self-perception, social support and peer relations, and social acceptance and financial resource dimensions of the KIDSCREEN-52 [11]. The results presented, in addition to previous studies, demonstrate the contribution of cardiorespiratory fitness to HRQOL in young people.

Despite the cross-sectional design adopted, some information may explain the results found in the present study. Young people with higher adiposity and lower cardiorespiratory fitness presented lower HRQOL scores in the physical well-being dimension probably due to the inverse association between physical activity and adiposity [23] and the positive association between physical activity and cardiorespiratory fitness [24]. In addition, the physical well-being dimension assesses whether the young people have a lot of energy and perceive themselves to be in good shape. Higher adiposity results in metabolic overload due to body fat accumulation, which means that they demand higher relative oxygen consumption for the same intensity of submaximal effort compared to those with lower adiposity [25]. Young people with greater adiposity perceive themselves as having less energy likely due to the greater effort required to perform physical activities. Conversely, those who are more active present greater cardiorespiratory fitness and functional capacity compared to young people with low fitness [24] and therefore have greater vigor for physical exertion.

Similar to the physical well-being dimension, adiposity was inversely associated with psychological well-being, constituted by questions about life satisfaction, mood, and happiness. This can be explained by the fact that the increase in adiposity impairs the state of mood [26] and life satisfaction [27] in young people. Likewise, adolescents with a higher HRQOL score in the social support and peer relation dimension, which assesses the relationship with friends, presented lower adiposity compared to those with lower scores. This result shows that higher accumulation of body fat can deteriorate the relationship between adolescents and their peers. This finding may be explained by the preference that eutrophic young people present in choosing as friends their peers who are not overweight, the same not occurring in overweight young people [28]. Due to the higher proportion of eutrophic young people, those with higher adiposity may have less experience in group activities, impairing their HRQOL in this dimension.

The results found for muscular strength are contrary to those described in young people from the United States and Spain [9, 11]. Gu et al. [9] demonstrated that muscular strength is associated with HRQOL in physical and mental functioning dimensions. In another study, muscular strength was associated with the general HRQOL and physical well-being dimension in schoolchildren of both sexes and with self-perception, autonomy, social support and peers and financial resources dimensions only in boys [11]. Conversely, our results corroborate those found recently in Portuguese adolescents, where muscular strength, estimated by perception of physical fitness, was not associated with HRQOL [10]. A relevant aspect that may explain the disagreement between the results of studies involving muscular strength and health-related quality of life is the muscular strength test used. Different tests were used to estimate muscle strength: Curl-up and Push-up [9], handgrip strength and long jump [11], physical fitness perception [10], and handgrip strength in the present study. Although all tests described are muscular strength indicators, there is great variability in the correlation coefficients between strength tests in young people [29, 30].

The performance in the flexibility test also did not vary according to HRQOL tercile scores in any of the dimensions studied. This result corroborates those described in young people from the United States and Portugal [9, 10]. Flexibility tests are widely used in children and adolescents as they are associated with musculoskeletal disorders such as low back pain [2]. However, there is no evidence that flexibility is associated with HRQOL in young people which was confirmed by the results of the present study.

Some limitations and strengths of the study should be considered. The sample used is not representative of Brazilian adolescents, an aspect that limits the comparison with studies conducted with representative samples from other countries. In addition, no information was collected about the habitual physical activity of the young people. Recently, it has been shown that physical fitness mediates the relationship between physical activity and HRQOL [9]. Therefore, it is not possible to state that the results would be maintained if the analysis were adjusted by physical activity. The present sudy is supported with a strong foundation of the use of a multivariate analysis, a complete battery of physical fitness, and a valid instrument to analyze the HRQOL in Brazilian adolescents. Moreover, the results have a practical application in the field of public health, as actions aimed at increasing cardiorespiratory fitness and reducing adiposity could benefit young people by promoting HRQOL, an important population health indicator.

Conclusions

Adiposity and cardiorespiratory fitness seem to contribute to HRQOL. Brazilian adolescents with higher HRQOL scores in the physical well-being dimension presented higher cardiorespiratory fitness and lower skinfold thickness. Furthermore, those with higher scores in psychological well-being and social support and peer relation dimensions also presented lower skinfold thickness. Conversely, handgrip strength and flexibility were similar across terciles of dimensions of HRQOL in the sample studied.

Disclosure statement

No author has any financial interest or received any financial benefit from this research.

Conflict of interest

The authors state no conflict of interest.

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