DOI: 10.4025/jphyseduc.v31i1.3139

Original Article

PREDICTION OF CARDIORRESPIRATORY FITNESS BY SCREEN TIME IN SCHOOLCHILDRENS

PREDIÇÃO DE APTIDÃO CARDIORRESPIRATÓRIA POR MEIO DO TEMPO TELA EM ESCOLARES

Amanda de Oliveira[1], Flávio Ricardo Guilherme[1,2,3], Stevan Ricardo dos Santos[1], Maria Teresa Martins Fávero[1], Vânia Renata Guilherme[3] and **Wilson Rinaldi[4]**

[1]State University of Paraná, Paranavaí-PR, Brazil.
[2]Faculty of Technology and Sciences of Northern Paraná, Paranavai-PR, Brazil.
[3]Ingá University Center, Maringá- PR, Brazil.
[4]State University of Maringá, Maringá-PR, Brazil.

RESUMO

O tempo gasto em frente à telas, resulta em acúmulo de comportamento sedentário, o qual está relacionado com malefícios a saúde dos adolescentes, tais como uma baixa aptidão cardiorrespiratória. Nesse sentido esse estudo teve por objetico predizer a aptidão cardiorrespiratória por meio do tempo de tela em escolares. Estudo transversal, como amostra composta por 2.764, sendo 1.370 meninos e 1.394 meninas entre 10 e 18 anos rede pública de ensino de Paranavaí, Paraná. O questionário de autorrelato foi utilizados para estimar o de tempo de tela (TL), e a aptidão cardiorrespiratória (ACR) foi estimada por meio do teste de 20 metros multiestágios. Para verificar o poder preditivo do tempo de tela em relação a ACR, a Curva Roc foi utilizada. Os resultados mostraram que o tempo de tela foi considerado um bom preditor de aptidão cardiorrespiratória em meninos (dias de semana, fins de semana e semana toda), e de modo geral (meninos e meninas) apenas para os dias de semana. Na pesquisa, o ponte de corte de tempo de tela para meninos em dias de semana foi de 137 minutos (IC: 65-43), nos fins de semana de 165 minutos (58-51) e geral de 156 minutos (64-45). Já para a amostra geral (meninas e meninos) o ponte de corte nos dias de semana foi de 142 minutos (64-44). Para as meninas o tempo de tela não teve poder preditivo (IC > 0,50) e consequentemente não foi verificado o ponto de corte. Desse modo, conclui-se que o tempo de tela em meninos e de maneira geral (apenas nos dias de semana) foi capaz de predizer a aptidão cardiorrespiratória e que essa variável de fácil aplicação pode ser um instrumento importante para predizer a ACR no ambiente escolar.

Palavras-chave: Estilo de vida sedentário. Aptidão cardiorrespiratória. Adolescente.

ABSTRACT

The time spent in front of the screens, results in accumulations of sedentary behavior, which is related to health damages to adolescents, such as a low cardiorespiratory fitness. In this sense, this study aimed to predict cardiorespiratory fitness through screen time in schoolchildren. Cross-sectional study, as a sample composed of 2.764, of which 1.370 boys and 1.394 girls between 10 and 18 years old were the public school system of Paranavaí, Paraná, Brazil The self-report questionnaire was used to estimate screen time (ST) and cardiorespiratory fitness (CF) was estimated using the 20-meter multi-stage test, and to verify the predictive power of the screen time in relation to CF, the Roc curve was used. The results showed that screen time was considered a good predictor of cardiorespiratory fitness in boys (weekdays, weekends and all week), and in general (boys and girls) only for weekdays (Monday to Friday). In the survey, the screen time cut-off for boys on weekdays was 137 minutes (CI: 65-43), at weekends of 165 minutes (58-51) and general of 156 minutes (64-45). For the general sample (girls and boys), the cut bridge on weekdays was 142 minytes (64-44). For the girls the screen time had no predictive power (CI> 0.50) and consequently the cut-off point was not verified. Thus, it can be concluded that the screen time in boys and in general (only weekdays) was able to predict cardiorespiratory fitness and that this variable of easy application can be an important tool to predict CF in the school environment.

Keywords: Sedentary lifestyle. Cardiorespiratory fitness. Adolescent.

Introduction

Adolescence is a period of life defined between 10 and 19 years, which results in important transformations, being them anatomical, biological, mental and behavioral[1]. Also, referring mainly to behavioral transformations, this phase brings with it countless opportunities for choices, such as those related to achieving the individual's personal well-being, which may interfere with adolescents' lifestyles[2]. It is of great importance that adolescents have a good lifestyle, choosing to adopt healthy habits, being able to maintain

them until adulthood[3,4]. Besides, an adequate lifestyle at this stage decreases the chances of problems related to sleep, food, physical activity and sedentary behavior[5-8].

Regarding sedentary behavior, this term is used to characterize activities that have an energy expenditure lower than 1.5 of the estimated metabolic equivalent (MET) and are carried out in a seated or reclined manner, thus, an adolescent who spends more than >120 min/day in front of the screen, for example, is already in inadequacy regarding sedentary behavior[9]. Thus, nowadays, with the ease of access to technology, adolescents have the opportunity to spend more time in front of computers, television, video games, thus enabling them to be in sedentary behavior[10].

Sedentary behavior is highly prevalent in adolescents in different places in the world[11-13]. Specifically in Brazil, the systematic review study showed prevalence varying, for example, in Foz do Iguaçu which adopted the point of the inadequacy of >120 min-day had a prevalence of 32%, already in Minas Gerais, adopting the same criterion of point of the inadequacy of <120 min-day, the prevalence variation was 88%[14]. Moreover, sedentary behavior has been associated with obesity and low cardiorespiratory fitness[15-17]. Regarding cardiorespiratory fitness, this is considered a health component, becoming an important predictor of cardiometabolic and protective risks regarding the appearance of cardiovascular diseases[18,19.]

Although CF is a good predictor of health in adolescents, its evaluation through field tests in the school environment requires prior familiarization of students, as well as care by the Physical Education professional, because it is a test that leads to maximum effort, situations of risk to the physical integrity of students may occur. Thus, identifying variables that are simple to apply and do not offer risks may be a good alternative for predicting CF in the school environment. Given the above, this study aims to predict cardiorespiratory fitness through screen time in schoolchildrens.

Methods

Study design and participants

This cross-sectional survey was characterized as a school census, since it involved the entire school population from Elementary II and High School, composed of students aged 10 to 18 from the eight public schools in the municipality, and according to data from the Paranavaí Regional Education Center for 2016, 3.483 students were enrolled in the eight schools in the city. The evaluations were made only in those schools invited, who agreed to participate in the survey and who presented the consente form signed by those responsible, totaling 2.764 adolescents, 1.370 boys and 1.394 girls. This study was approved by the Research Ethics Committee of the State University of Maringá, under opinion number 1.453.730, in accordance with the Declaration of Helsinki, and approved in the Brazilian Registry of Clinical Trials (RBR6BSNGD).

Procedures

Data collection took place during school hours. All classes of students were made aware of the purpose and importance of the study, and students were encouraged to participate in it. Data were collected by trained assessors and previously calibrated equipment. The variables analyzed were sociodemographic (age and gender), body mass index (BMI), cardiorespiratory fitness and screen time.

Sex was evaluated by a self-reported adolescent, and age determined in years, based on the difference between the date of birth (reported by adolescents) and the date of data collection. For BMI calculation, schoolchildrens were weighed wearing only the school uniform, barefoot, and without a coat or objects in their pockets. Stature was measured with a

Wiso® wall stadiometer (São José, Santa Catarina, Brazil), model E210, resolution of 0.1 cm, while body mass was determined on a digital scale (G-Tech® Glass Pro, Zhongshan, Guangdong, China), with a maximum capacity of 150 kg and resolution of 100 grams. Schoolchildrens were classified as underweight, overweight, and suitable weight[20].

The screen time (ST) was evaluated by self-report, which according to systematic review[21] has reproducibility and validity acceptable for children and adolescents. Questions were asked about screen time spent per day on television, video game and computer (not including tablet or cell phone), first on weekdays (Monday to Friday) and then on weekend days (Saturday and Sunday). The screen time was calculated by the formula weighted average: [(minutes/weekdays x 5) + (minutes/weekend days x 2)] / 7. The cutoff point for inadequacy was >120 minutes/day according to Canadian guidelines for sedentary behavior in children and adolescents[22].

The cardiorrespiratory fitness (CF) was estimated from the application of the 20-meter multi-stage test, validated for children and adolescents (r = 0.89)[23]. The students were instructed to run to exhaustion between two lines separated by 20 meters, maintaining the rhythm of displacement according to the audio signals emitted. The test started at a speed of 8.5 km/h, increasing 0.5 km/h every minute, and ended when the participant could not reach the lines before the sound signal on two consecutive occasions or gave up due to voluntary fatigue of the task. During the test, the students received verbal stimuli from the evaluators, and all participants were previously familiar with the test. The cutoff points established by the *Cooper Institute for Aerobics Research* (Fitnessgram)[24] and the categories "risk zone" and "need to improve" were adopted for the classification, aggregated in the same category (insufficient level) according to sex and age (years) of adolescents. For boys, the values adopted were: 10-11 years (≤ 37.3); 12 - (≤ 37.6) 13- (≤38.6); 14- (≤39.6); 15- (≤40.6); 16- (≤41.0); 17- (≤41.2). For girls the cutoff points according to age were: 10-11 (≤ 37.3); 12 - (≤ 37.0) 13- (≤36.6); 14- (≤36.3); 15- (≤36.0); 16- (≤35.8); 17- (≤35.7). The estimate of VO2max was calculated using the following equation by Leger et al.[23], namely: VO2max = 31.025 + (3.238 x V) - (3.248 x Age**) + 0.1536 (Speed x Age).

Quality of Information

The quality of the information obtained by the questionnaire was done by means of a replicated application, with an interval of one week in a sub-sample of 124 students with the same characteristics. For that, the reproducibility values were calculated by the intraclass correlation coefficient (ICC) for the continuous variables and the Kappa Index for their dichotomous classifications, assuming satisfactory values >0.60 and >0.40[25-27,] respectively. In cases of asymmetry of data distribution in the contingency table, which compromised the interpretation and calculation of the kappa, the prevalence-adjusted kappa index and biases were used (PABAK). Reproducibility values are presented in Table 1.

Table 1. Quality control of information obtained from the questionnaire in a sub-sample of schoolchildrens in Paranavaí, Paraná (n = 124)

Variáveis	**ICC**	***Kappa***
Weekdays ST	0.59	-
Classification	-	0.675
Weekends ST	0.63	-
Classification	-	0.645
General ST	0.64	-
Classification	-	0.677

Note: CCI: Intraclass correlation coefficient; ST: Screen time
Source: The authors

Statistical analysis

For statistical analysis, the Kolmogorov-Smirnov Test, graphic methods and standardized values of asymmetry and kurtosis (±2Z) were used to identify data normality. The existence of discrepant elements (outliers) through Boxplots. The outliers were included in the analyses because they corresponded to the data of subjects with excessive screen time to which they were of interest for the study.

The Mann-Whitney U test for non-parametric independent samples and the Student "t" test for parametric independent samples, accompanied by the Lèvene test for analysis of variance homogeneity were used to compare boys and girls.

The ROC (Receiver Operating Characteristic) curve was used to diagnose the accuracy of insufficient levels of cardiorespiratory fitness (CF) through screen time. The curve was generated by plotting the sensitivity on the y-axis as a function of [1-especificity] on the "x" axis. The criterion used to obtain the cutoff points was the Younden Index (YI), defined as the sum of specificity and sensitivity minus one (E+S-1)[28]. The statistical significance of each analysis was verified by the area under the ROC curve (AUC) and the 95% confidence interval (95%CI). For the screen time to present a significant discriminatory ability, the area under the ROC curve should be between 1.00 and 0.50 and the larger the area, the greater the discriminatory power of the respective indicator. The 95% CI is another determinant of predictive ability, and to be considered a significant predictor of ROC, the lower limit of CI (Li-CI) cannot be < 0.50. All analyses were performed through the *Statistical Package for a Social Science* (SPSS), version 20.0, considering $p \leq 0.05$.

Results

Table 2 shows the characteristics of the sample as well as the screen time during weekdays, weekends and general, and the percentage (%) of cases of general ST inadequacy. The results show significant differences ($p \leq 0.05$) between boys and girls in all variables except for overall screen time and % screen time inadequacy.

Table 2. Anthropometric characteristics and screen time in public schools in Paranavaí. Paraná (n = 2.764)

Variables	**Average ± SD**		**p- value**
	Male (n = 1.370)	**Female (n = 1.394)**	
Age (years)	14.5 ± 2.0	14.3 ± 2.0	0.040a*
Mass (Kg)	58.4 ± 16.5	54.9 ± 13.6	< 0.001b*
Height (Cm)	166.6 ± 11.8	159.3 ± 7.6	< 0.001a*
BMI	21.02 ± 4.52	21.51 ± 4.72	< 0.001b*
General ST (min)	255.3 ± 215.8	235.9 ± 196.8	0.053b
Inadequacy	**n: (%)**	**n: (%)**	
ST	990 (72.7)	987 (71.1)	0.380c*

Note: SD: Standard Deviation; BMI: Body Mass Index; ST: Screen Time; a: Independent Student "t" Test; b: Mann Whitney U Test; c: Chi-Square Test. Significant Values for $p \leq 0,05$
Source: The authors

Table 3 presents the area under Roc Curve, which was used to verify the existence of the predictive power of ST (weekly, weekend and general) for CF in schoolchildrens of both sexes. The results show that in general (boys and girls), the screen time only had predictive power for weekdays, and when stratified by sex, only males obtained satisfactory values (lower CI > 0.50.) concerning the CF prediction by means of the screen time.

Table 3 Area under the Roc Curve

Variables	Area under the ROC curve (IC = 95%)		
	General (n = 2.764)	**Female (n = 1.394)**	**Male (n = 1.370)**
Weekdays ST	0.53 (0.51 – 0.55)*	0.52 (0.47 – 0.56)	0.55 (0.52 – 0.58)*
Weekends ST	0.53 (0.50- 0.55)	0.51 (0.47 – 0.55)	0.55 (0.52 – 0.59)*
General ST	0.53 (0.50 – 0.56)	0.52 (0.48 – 0.56)	0.55 (0.52 – 0.59)*

Note: ST: screen time. *Significant values: Area under the curve and Lower Limit-IC > 0.50
Source: The authors

Table 4 shows the cutoff points found for the ST in the variables and groups that had predictive power. For boys on weekdays the cutoff point was 137 minutes (CI: 65-43), on weekends 165 minutes (58-51) and the sum of the week (general) was 156 minutes (64-45). For the general sample (girls and boys) the cutoff point on weekdays was 142 minutes (64-44). For the girls the screen time had no predictive power (CI > 0.50) and consequently the cutoff point was not checked.

Table 4. Cutoff points for CF prediction by screen time in schoolchildreens of Paranavaí-Paraná (n = 2.764)

Variables	Cutoff Points (Sensibility [%] – Specifity [%]) YI		
	General (n = 2.764)	**Female (n = 1.394)**	**Male (n = 1.370)**
Weekdays ST	142 (64 - 44) 74	NSP	137 (65 - 43) 79
Weekends ST	PNS	NSP	165 (58 - 51) 95
General ST	PNS	NSP	156 (64 - 45) 80

Note: YI: *Younden* Index; NSP: Non significant predictor.
Source: The authors

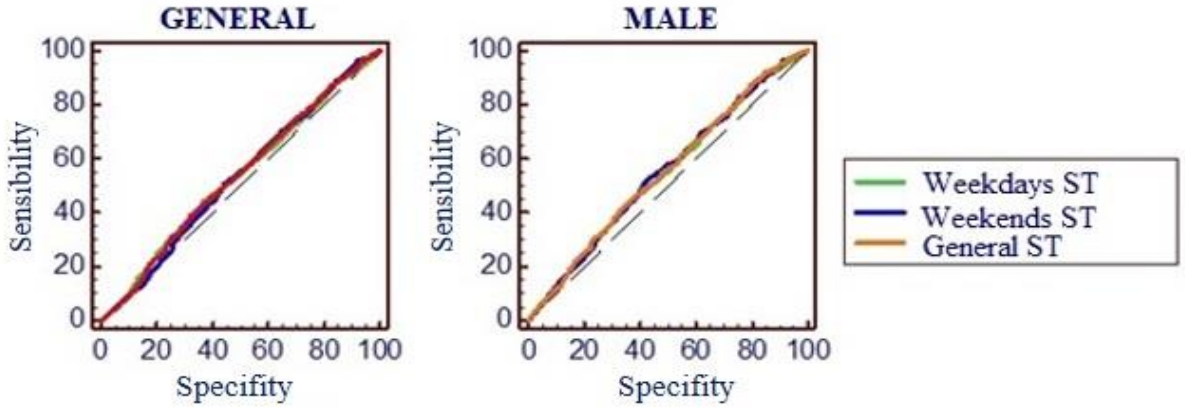

Figure 1. ROC curve of screen time for prediction of cardiorespiratory fitness in schoolchildrens from Paranavaí, Paraná (n=2,764)
Source: The authors

Discusssion

This study aimed to predict the cardiorespiratory fitness through the screen time in schoolchildrens in the city of Paranavaí, and the relationship between cardiorespiratory fitness and screen time has already been shown in the literature and generally associated with harm to health, as in the study of [29], conducted with adolescents aged 7 to 17 years, which showed that adolescents who had low cardiorespiratory fitness had screen time greater than 120

minutes/day. Similarly, the longitudinal study conducted in New Zealand with children and adolescents aged 5 to 15 years, where they were followed until 26 years, showed that inadequate screen time from childhood is also associated with low CF[30]. One possible explanation is that screen time displaces the physical activity time of schoolchildrens. In other words, the more time they spend using electronic devices, the more time in sedentary behavior accumulates, which results in less time throughout the day for physical activity, and this decrease leads to an increase in obesity indicators, seen even in a previous study with schoolchildrens from Paranavaí in 2013[31], and decrease in CF[32], which may explain this relationship found in the studies.

In this context, the present study showed through the area on Roc Curve that the screen time can predict the cardiorespiratory fitness in male adolescents on weekdays, weekends, and general screen time, and only on weekdays (Monday to Friday) in both sexes. For the girls, ST had no predictive power for CF.

There is no consensus in the literature about the association between sex and sedentary behavior, and one of the possible explanations for these differences in literature may be the fact that most epidemiological researches use indirect methods in evaluations, such as the self-report of the daily time spent on sedentary behavior, which despite its validity has already been tested in other previous articles[33,34] this type of analysis may underestimate or overestimate the real time spent on these activities, thus making it difficult to elucidate on the subject.

Another reason is the lack of inclusion of the cell phone in this analysis, because although the adolescent who uses cell phones constantly does not need to be seated to use them, that is, he may be using the cell phone and at the same time walk, which in this case is considered a physical activity, but what has been seen is the use of these devices in sedentary behavior (standing, sitting or lying down), and thus this lack of analysis may have influenced the findings of this research, as well as previous research. Finally, the participants in this study are aged between 10 and 18 years and the levels of biological maturation may have been widely different in the sample. Thus, the absence of sexual maturation analysis in this study presents itself as a limitation of the study, considering the association of this variable with cardiorespiratory fitness35,[36] and a possible stratification of the results by maturation level would better elucidate this question.

Despite the divergence of results about screen time between the sexes[37,38] this research showed that both boys and girls have excessive screen time in average values and inadequacy. On the other hand, about the use of the Roc Curve to check levels of accuracy of cardiorespiratory fitness through screen time, to our knowledge no article was found in the literature, which would serve as a basis for a more targeted discussion. Despite this absence, this type of analysis has been widely used in the area of health, because it is considered an excellent statistical method and a good predictor of variables of difficult evaluation and logistics[39-42], such as the evaluation of CF in the school environment.

In this sense, it becomes necessary that future studies seek to show that it is possible to use simpler means of predicting CF, such as self-reported screen time, so it would not be necessary to conduct exhaustive and maximum tests in the school environment, the quiet take risks to adolescents. Also, this study provides an important foundation for health care professionals, which enables them to use this method to investigate how their students are about screen time and consequently infer about CF, as well as to encourage teachers to talk about the harm this type of behavior causes to health and its relationship with CF, which in turn is the main variable of health-related physical fitness.

Conclusions

The results showed that screen time in boys but not in girls was able to predict cardiorespiratory fitness. However, future investigations are necessary to elucidate the screen time as a predictor of cardiorespiratory fitness, and thus avoid that this health-related fitness component is not monitored in the school environment, even if done through other predictive variables, as in the case of screen time.

References

1. Ferreira MDA. Alvim NAT. Teixeira MLDO. Veloso RC. The knowledge of adolescents: lifestyle and care for their health. - Enferm 2007;16(2):217–224. Doi: 10.1590/S0104-07072007000200002
2. WHO. Physical status: The use and interpretation of anthropometry. Report of a WHO Expert Committee. Geneva: World Health Organization technical report series; 1995.
3. Aaron DJ. Storti KL. Robertson RJ. Kriska AM. LaPorte RE. Longitudinal study of the number and choice of leisure time physical activities from mid to late adolescence. Arch Pediatr Adolesc Med 2002;156(11):1075. Doi: 10.1001/archpedi.156.11.1075
4. Malina RM. Tracking of physical activity across the lifespan. Res Q Exerc Sport 1996 Sep;67(3 Suppl):S48-57.
5. Ferreira JS. Diettrich SHC. Pedro DA. Influência da prática de atividade física sobre a qualidade de vida de usuários do SUS. Saud Debat 2015;39(106):792–801. Doi: 10.1590/0103-1104201510600030019.
6. Guimarães LM. Oliveira DS. Influence of healthy eating for longevity and disease prevention. Rev Interciêcia e Soc 2014;3(2):60–67.
7. Müller MR. Guimarães SS. Sleep disorders impact on daily functioning and life quality. Estud Psicol 2007; 24(4):519–528. Doi: 10.1590/S0103-166X2007000400011
8. Santos A. Andaki ACR. Amorim PRS. Mendes EL. Factors associated with sedentary behavior in 9- to 12-year-old school children. Motriz Rev Educ Fis 2013;19(3 SUPPL):25–34. Doi: 10.1590/S1980-65742013000700005
9. Behaviour S. Letter to the editor: Standardized use of the terms "sedentary" and "sedentary behaviours." Ment Health Phys Act 2013;6(1):55–56. Doi: 10.1139/h2012-02
10. Jong E. Visscher TLS. HiraSing RA. Heymans MW. Seidell JC. Renders CM. Association between TV viewing. computer use and overweight. determinants and competing activities of screen time in 4- to 13-year-old children. Int J Obes 2013;37(1):47–53. Doi: 10.1038/ijo.2011.244
11. Alexandre M. Silva AM. Sedentary behaviour in adolescentes attended by the family health strategy in Cuiaba. Brazil. Rev Bras Ativ Fis Saúde 2016;21(4):344–54. Doi: 10.12820/rbafs.v.21n4p344-354
12. Tenório MCM. Barros MVG. Tassitano RM. Bezerra J. Tenório JM. Hallal PC. Physical activity and sedentary behavior among adolescent high school students. Rev Bras Epidemiol 2010;13(1):105–117. Doi: 10.1590/S1415-790X2010000100010
13. Ekelund U. Luan J. Sherar LB. Esliger DW. Griew P. Cooper A. Moderate to vigorous physical activity and sedentary time and cardiometabolic risk factors in children and adolescents. JAMA 2012;307(7):704-712. Doi: 10.1001/jama.2012.156
14. Filho VCB. Campos W. Lopes A. Epidemiology of physical inactivity. sedentary behaviors. and unhealthy eating habits among Brazilian adolescents : A systematic review. Ciênc Saúde Coletiva 2014;19(1):173–194. Doi: 10.1590/1413-81232014191.0446
15. Hobbs M. Pearson N. Biddle SJH. Hobbs M. Pearson N. Foster PJ. et al. Sedentary behaviour and diet across the lifespan: An updated systematic review. Br J Sports Med 2015;49(18):1179-1188. Doi: 10.1136/bjsports-2014-093754
16. Sigmundová D. Sigmund E. Hamrik Z. Kalman M. Trends of overweight and obesity. physical activity and sedentary behaviour in Czech schoolchildren: HBSC study. Eur J Public Health 2014;24(2):210–215. Doi: 10.1093/eurpub/ckt08
17. Syndrome M. Diabetes T. Hamilton MT. Hamilton DG. Zderic TW. Role of low energy expenditure and sitting in obesity. metabolic syndrome. type 2 diabetes. and cardiovascular disease. Diabetes 2007;56(11):2655–2667. Doi: 10.2337/db07-0882
18. Bangsbo J. Krustrup P. Duda J. Hillman C. Andersen LB. Weiss M. et al. The Copenhagen Consensus Conference 2016 : Children. youth. and physical activity in schools and during leisure time. Br J Sports Med 2016;50(19); 1177-1178. Doi: 10.1136/bjsports-2016-096325

19. Kantomaa MT. Tammelin T. Ebeling H. Stamatakis E. Taanila A. High Levels of physical activity and cardiorespiratory fitness are associated with good self-rated health in adolescents. J Phys Act Health 2015;12(2):266–272. Doi: 10.1123/jpah.2013-0062
20. Conde WL. Monteiro CA. Body mass index cutoff points for evaluation of nutritional status in Brazilian children and adolescents. J. Pediatr 2006;82(4);266–272. Doi: 10.2223/JPED.1492
21. Lubans DR. Hesketh K. Cliff DP. Barnett LM. Salmon J. Dollman J. et al. A systematic review of the validity and reliability of sedentary behaviour measures used with children and adolescents. Obes Rev 2011;12(10):781–799. Doi: 10.1111/j.1467-789X.2011.00896.x
22. Tremblay MS. Leblanc AG. Kho ME. Saunders TJ. Larouche R. Colley RC. et al. Systematic review of sedentary behaviour and health indicators in school-aged children and youth. Int J Behav Nutr Phys Act 2011;8(1):98. Doi: 10.1186/1479-5868-8-98
23. Léger L. Mercier D. Gadoury C. Lambert J. The multistage 20 metre shuttle run test for aerobic fitness. J Sports Sci 1988;6(2):93–101. Doi: 10.1080/02640418808729800
24. Meredith MD. Welk GJ. Fitnessgram/activitygram: Test Administration Manual. 4th ed. Dallas:The Cooper Institute; 2010.
25. Byrt WJ. The idea of a promotions appeal system. Aust J Public Adm 1966;25(4):297–308.
26. Landis JG. Koch G. The measurement of observer agreement for categorical data. Biometrics 1977;33(1):159-174.
27. Hill MM. Hill A. Investigação por questionário. Lisboa: Edições Sílabo; 2009.
28. Youden WJ. Index for rating diagnostic tests. Cancer 1950;3(1):32–35. Doi: 10.1002/1097-0142(1950)3:1<32::aid-cncr2820030106>3.0.co;2-3
29. Reuter CP. Burgos MS. Pritsch CV. Silva PT. Marques KC. Souza S. et al. Obesity, cardiorespiratory fitness, physical activity and screen time in school children from urban and rural area of Santa Cruz do Sul, Brazil. Cinergis 2015;16(1):52-56. Doi: 10.17058/cinergis.v16i1.6271
30. Hancox RJ. Milne BJ. Poulton R. Association between child and adolescent television viewing and adult health: a longitudinal birth cohort study. Lancet 2015;10;364(9430):257–262. Doi: 10.1016/S0140-6736(04)16675-0
31. Guilherme FR. Molena-Fernandes CA. Guilherme VR. Fávero MTM. Reis EJB. Rinaldi W. Physical inactivity and anthropometric measures in school children from Paranavai. Parana. Brazil. Revista Paulista de Pediatria 2015;33(1):50–55. Doi: 10.1016/j.rpped.2014.11.009
32. Pfledderer CD. Burns RD. Brusseau TA. Association between access to electronic devices in the home environment and cardiorespiratory fitness in children. Child (Basel) 2019;6(1). Doi: 10.3390/children6010008
33. Rey-López JP. Ruiz JR. Ortega FB. Verloigne M. Vicente-Rodriguez G. Gracia-Marco L. et al. Reliability and validity of a screen time-based sedentary behaviour questionnaire for adolescents: The HELENA study. Eur J Public Health 2012;22(3):373–377. Doi: 10.1093/eurpub/ckr040.
34. Hardy LL. Bass SL. Booth ML. Changes in sedentary behavior among adolescent girls: A 2.5-Year prospective cohort study. J Adolesc Heal 2007;40(2):158–165. Doi: 10.1016/j.jadohealth.2006.09.009
35. Aires L. Pratt M. Lobelo F. Santos RM. Santos MP. Mota J. Associations of cardiorespiratory fitness in children and adolescents with physical activity. active commuting to school. and screen time. J Phys Act Health 2011;8 Suppl 2:S198-205. Doi: 10.1123/jpah.8.s2.s198
36. Werneck AO. Silva DR. Oyeyemi AL. Fernandes RA. Romanzini M. Cyrino ES. et al. Tracking of physical fitness in elementary school children: The role of changes in body fat. Am J Hum Biol 2019;31(3):e23221. Doi: 10.1002/ajhb.23221
37. Rivera IR. Silva MAM. Silva RDTA. Oliveira BAV. Carvalho ACC. Atividade física. horas de assistência à TV e composição corporal em crianças e adolescentes. Arq Bras Cardiol 2010;95(2):159–165. Doi: 10.1590/S0066-782X2010005000065
38. Christofaro DGD. De Andrade SM. Mesas AE. Fernandes RA. Farias Júnior JC. Higher screen time is associated with overweight. poor dietary habits and physical inactivity in Brazilian adolescents. mainly among girls. Eur J Sport Sci 2016;16(4):498–506. Doi: 10.1080/17461391.2015.1068868
39. Prati RC. Batista GEAPA. Monard MC. Curvas ROC para avaliação de classificadores. IEEE Lat Am Trans 2008;6(2):215–222. Doi: 10.1109/TLA.2008.4609920
40. Virtuoso Jr. JS. Tribess S. Paulo TRS. Martins CA. Romo-Perez V. Physical activity as an indicator of predictive functional disability in elderly. Rev Lat Am Enfermagem 2012;20(2):259–65. Doi: 10.1590/S0104-11692012000200007
41. Almeida RT. Almeida MMG. Araújo TM. Abdominal obesity and cardiovascular risk: performance of anthropometric indexes in women. Arq Bras Cardiol 2009;92(5):345-350. Doi: 0.1590/S0066-782X2009000500007

42. Oliveira LC. Ferrari GLM. Araújo TL. Matsudo V. Overweight. obesity. steps. and moderate to vigorous physical activity in children. Rev Saude Publica 2017;51(38):1–12. Doi: 10.1590/s1518-8787.2017051006771

Author's **ORCID**:
Amanda de Oliveira: https://orcid.org/0000-0002-4546-0049
Flávio Ricardo Guilherme: https://orcid.org/ 0000-0003-4808-6192
Stevan Ricardo dos Santos: https://orcid.org/ 0000-0002-7081-4830
Maria Teresa Martins Fávero: https://orcid.org/ 0000-0002-0354-472X
Vânia Renata Guilherme: https://orcid.org/ 0000-0001-8358-1012
Wilson Rinaldi: https://orcid.org/ 0000-0001-5593-3666

Received on Dec, 13, 2018.
Reviewed on Oct, 27, 2019.
Accepted on Dec, 20, 2019.

Author for correspondence: Flávio Ricardo Guilherme, Ametista Street, 2295, Jardim Real, Maringá-PR, Brazil, Zip Code 87083-029. E-mail: flaviorg88@gmail.com