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Clusters of negative health-related physical fitness indicators and associated factors in adolescents

Combinação de indicadores negativos da aptidão física e fatores associados em adolescentes

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Abstract - Inadequate levels in health-related physical fitness components are associated with early cardiovascular mortality in adult life. The aim of this study was to analyze the association between clusters of negative physical fitness indicators with sociodemographic and lifestyle variables in adolescents. The survey was conducted with 866 students (14-19 years) from public schools of São José, Santa Catarina, Brazil. Aerobic fitness was assessed by the modified Canadian aerobic fitness test; muscle strength was measured by handgrip dynamometer; flexibility was assessed by the sit-and-reach test; body fat was measured by the sum of triceps and subscapular skinfolds. Sociodemographic and lifestyle variables were verified by questionnaire. The simultaneity of behaviors was evaluated by the ratio between observed and expected prevalence of inadequate physical fitness levels. The combination of negative physical fitness indicators was analyzed through multinomial logistic regression. The prevalence observed for the simultaneity of four negative physical fitness indicators was 30% higher than expected. Female adolescents were more susceptible to the presence of two, three and four negative physical fitness indicators. Adolescents who presented risk behavior in relation to screen time were more likely to present one, three and four negative physical fitness indicators. Female gender and risk behavior in relation to screen time were factors associated with the simultaneity of negative physical fitness indicators.

Key words: Adolescent health; Cross-sectional studies; Epidemiology; Prevention and control.

Resumo - *Níveis inadequados nos componentes da aptidão física relacionada à saúde estão associados à mortalidade cardiovascular precoce na vida adulta. Objetivou-se analisar a associação entre a combinação de indicadores negativos da aptidão física com variáveis sociodemográficas e do estilo de vida em adolescentes. Pesquisa realizada com 866 estudantes (14-19 anos) de escolas públicas de São José, Santa Catarina, Brasil. A aptidão aeróbia foi avaliada pelo teste canadense modificado de aptidão aeróbia; a força muscular foi mensurada por dinamômetro de preensão manual; a flexibilidade foi avaliada pelo teste de sentar e alcançar; a gordura corporal foi mensurada pelo somatório das dobras cutâneas do tríceps e subescapular. Variáveis sociodemográficas e do estilo de vida foram verificadas por questionário. A simultaneidade de comportamentos foi avaliada pela razão entre a prevalência observada e a esperada de níveis inadequados de aptidão física. A combinação de indicadores negativos da aptidão física foi analisada por meio de regressão logística multinomial. A prevalência observada para a simultaneidade de quatro indicadores negativos da aptidão física foi 30% maior que a esperada. Adolescentes do sexo feminino foram mais suscetíveis a presença de dois, três e quatro indicadores negativos da aptidão física. Adolescentes que apresentavam comportamento de risco em relação ao tempo de tela tiveram maiores chances de apresentar um, três e quatro indicadores negativos da aptidão física. Sexo feminino e comportamento de risco em relação ao tempo de tela foram os fatores associados a simultaneidade de indicadores negativos da aptidão física.*

Palavras-chave: *Epidemiologia; Estudos transversais; Prevenção e controle; Saúde do adolescente.*

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INTRODUCTION

Physical fitness composed of physiological components such as aerobic fitness, muscle strength, flexibility and body composition, is directly associated with health and well-being[1]. Inadequate levels in health-related physical fitness components are directly related to early cardiovascular mortality in adulthood and the development of chronic diseases (high blood pressure, metabolic syndrome and type 2 diabetes)[2-4], whose treatment costs worldwide were approximately US$ 863 billion in the year 2010[4].

High prevalence of adolescents with low aerobic fitness levels were observed in surveys conducted in North America (Canada and USA) and Europe (Spain), with values ranging from 13.0% to 32.0%[3,5,6]. A population-based study with adolescents in Canada found that approximately half of respondents had low strength levels[3]. In studies carried out with the participation of children and adolescents from countries such as Portugal, Hungary and Canada, the prevalence of low flexibility levels ranged from 38.4% to 68.0%[3,7,8]. Another physical fitness indicator presenting high prevalence in the adolescent population was excess body fat[3, 6]. In survey conducted with schoolchildren in the USA, 44.2% had excess body fat[6]. Research conducted with adolescents in cities in southern Brazil found that approximately eight out of ten boys and nine out of ten girls had unsatisfactory health levels for at least one physical fitness indicator; in addition, the percentage of adolescents with negative physical fitness indicators was 23.8%, 34.4% and 30.5% for body fat, muscle fitness and aerobic fitness, respectively[9,10].

Although several surveys have been conducted to investigate the relationship between physical fitness indicators with sociodemographic and lifestyle factors in adolescents[9-11], such studies did not investigate the four physical fitness indicators (muscle strength, aerobic fitness, flexibility and body fat) simultaneously, although there is evidence of the interrelation of these components[12]. Investigating the negative health-related physical fitness indicators with sociodemographic and lifestyle factors in adolescents is justified, since in addition to verifying to what extent this particular group of schoolchildren can be screened, information in literature regarding these constructs is presented in their majority, bidirectionally[3,5,11]. Likewise, the verification of negative physical fitness indicators simultaneously is important because it is possible that the potential negative health effect caused by the combination of these indicators may be greater than the sum of each independent factor[13]. In addition, health problems associated with negative physical fitness indicators usually manifest throughout adult life; however, their development seems to begin in childhood and adolescence[14]. Thus, the early identification of modifiable aspects associated with health problems such as negative physical fitness indicators is important for the elaboration of strategies to prevent the onset of these diseases.

The aim of this study was to analyze the association between the clusters of negative physical fitness indicators with sociodemographic and lifestyle variables of adolescents from a city in southern Brazil.

METHODOLOGICAL PROCEDURES

This cross-sectional epidemiological school-based survey was carried out in the second half of 2014 in the city of São José, Southern Brazil. The municipality has Human Development Index (HDI) of 0.809 and a GINI index of 0.44[15].

The population of this research consisted of 5,182 students aged 14-19 years from public high school of São José, distributed in 11 eligible schools and 170 high school classes. The sampling process was determined in two stages: 1) stratified by state public high schools (n = 11); 2) conglomerate of classes, considering the study shift and teaching series (n = 170 classes). In stage two, all high school students who were present in classroom on the days of data collection were invited to participate in the study. The probabilistic sample consisted of 1,132 students. For the present study, only students who had all measures for the dependent variable (combination of negative physical fitness indicators - low aerobic fitness, low handgrip strength levels, low flexibility and excess body fat) and independent variables (gender, age, maternal schooling, breakfast, sleep hours / day, screen time and overall physical activity) were included, resulting in a sample of 866 individuals. Details on the estimates for sample size calculation and the entire sampling process (inclusion, exclusion criteria, eligibility) can be found in literature[16].

Since the present study used data to examine distinct issues of a broader research, statistical power was calculated, in which values between 83.2% and 100% were checked to test for associations between combinations of negative physical fitness indicators and gender, screen time and overall physical activity. For the other associations investigated (age, maternal schooling, breakfast and sleep hours), power was below 80%.

The study was approved by the Ethics Research Committee with Human Beings of the Federal University of Santa Catarina under CAAE protocol: 33210414.3.0000.0121. Only subjects who returned the informed consent form signed by parents (<18 years) or by themselves (≥18 years), together with the consent form signed by themselves, participated in the study.

The dependent variable was the combination of the following negative physical fitness indicators: low aerobic fitness, low handgrip strength levels, low flexibility and excess body fat. To classify individuals in relation to negative physical fitness indicators, scores ranging from 0 (with no negative physical fitness indicator) to four (four negative physical fitness indicators) were generated.

Aerobic fitness was measured using the modified Canadian Aerobic Fitness Test - mCAFT (1), validated in comparison to indirect calorimetry in Canadian men and women aged 15-69 years[17], and with sufficient discriminatory power to detect elevated blood pressure levels in young Brazilians[16]. Adolescents had to complete one or more stages of three minutes each (going up and down two steps with increasing intensity) at predetermined speed according to sex and age. The test was finalized only

when the subject reached 85% of maximal heart rate[1,] which was verified by means of a Polar® frequency meter model H7 Bluetooth® (Kempele, Finland). Oxygen expenditure and reference values for aerobic fitness were determined by the Canadian battery[1]. The equation of the aerobic fitness score is: *Score = 10 [17.2 + (1.29 x oxygen expenditure) – (0.09 x body weight in kg) – (0.18 x age in years)*. From this score, each participant was classified in one of five categories: (a) "Needs improvement"; (b) "Regular"; (c) "Good"; (d) "Very good"; (e) excellent". In this study, aerobic fitness was considered "adequate" for adolescents in categories (c), (d) and (e), and "low" for categories (a) and (b), where low aerobic fitness levels are inversely associated with blood pressure in adolescents[16].

Handgrip strength (FPM) was measured using a Saehan® manual grip dynamometer (Seoul, South Korea). During evaluation, the adolescent stood with his arms outstretched at the side of the body, without the equipment leaning against his thigh. The equipment was located between the distal phalanges and the palm of the hand; then the adolescent was asked to take inspiration and maximum expiration, followed by the greatest pressure with the hand in the equipment[1]. The test was performed on both hands alternately, twice, and the best result of each hand was scored and added to obtain total force. FPM was classified according to gender. For boys, those with FPM less than or equal to 83 kgf were classified as "low", those with higher FPM were classified as "adequate"[1]. Girls with FPM results less than or equal to 53 kgf were classified as "low", and those with higher results were classified as "adequate"[1].

Flexibility was measured through the Wells bench using the sit-and-reach test. The test was performed twice and the highest value reached in the test was considered[1]. Flexibility was classified according to gender, and boys with flexibility less than or equal to 23 cm were classified as with "low flexibility", and those with higher flexibility were classified as with "adequate flexibility"[1]. Girls with flexibility results less than or equal to 28 cm were classified as with "low flexibility", and those with higher results were classified as with "adequate flexibility"[1].

Excess body fat was measured by two skinfolds (triceps and subscapular) with a Cescorf® adipometer (Porto Alegre, Brazil), through standardizations of the International Society of the Advancement of Kinanthropometry (ISAK). Anthropometric measurements were taken by a single level-1 ISAK certified evaluator. The results of skinfolds were summed and analyzed as proposed by Lohman[18], according to sex. Adolescents with sum ≥ 30 mm and ≥ 35 mm for boys and girls, respectively, were considered to have excessive body adiposity[18].

The independent variables investigated in the research were sociodemographic and lifestyle factors. Sociodemographic variables were sex (male / female), age in complete years and later categorized into 14/15, 16/17 and 18/19 years and maternal schooling, which was collected in complete years and categorized into up to eight years of study and eight years or more of study.

The questioning regarding breakfast is part of the "Fantastic Lifestyle" questionnaire, translated and validated for the Brazilian population[19]. This variable was collected by the question related to the usual week: "During the past 7 days, how many days did you have breakfast?" It was considered "frequent" breakfast individuals who said they had the meal from three to seven days per week[20]. Individuals who reported having breakfast from zero to two days per week were classified as having "infrequent" consumption[20]. This variable was classified in this way since there is an inverse relationship between breakfast intake and cardiometabolic risk factors[20].

The results in relation to the number of sleep hours / day were obtained based on a structured questionnaire through the question "What is your bedtime and wake time?" Based on this information, the following score was calculated: *((sleep hours from Monday to Friday x 4) + (number of sleep hours from Friday to Monday x 3)) / 7*[21]. The result was subsequently categorized into <eight hours of sleep / day and ≥ eight hours of sleep / day, since there is a direct relationship between few sleep hours (<8 hours / day) and increased health risk factors[21].

The time spent watching TV, using the computer (PC) and video game (VG), was collected through six questions used in a study in Brazil[22], referring to the number of hours and minutes of use of the equipment during the periods from Monday to Friday and on weekends. For the definition of total TV, PC and VG time, the sum of the number of hours during the week and weekends was divided by the seven days of the week. These variables were later categorized into less than 4 hours / day of screen time and time greater than or equal to 4 hours / day of screen time, since periods above 4 hours / day are considered behaviors unsuitable for health and are associated with increased risk of cardiovascular diseases[23]. These questions regarding screen time presented good reliability and reproducibility in Brazilian adolescents (ICC = 0.76, 95% CI: 0.70-0.81, kappa = 0.52)[22].

Overall physical activity was assessed by the following question of the Brazilian version of the Youth Risk Behavior Surveillance (YRBSS) questionnaire used in the United States, translated and validated for Brazil[24]: "During the past seven days, on how many days were you physically active for at least 60 minutes a day? (Consider moderate and / or vigorous physical activity)". This questioning had answers categorized as not meeting recommendations (zero to four days) and meets recommendations (five days or more)[25].

The chi-square test of heterogeneity was used to evaluate differences between groups for each risk factor. To evaluate the combination of the most frequent negative physical fitness indicators, the ratio between observed prevalence and expected prevalence (O / E) was calculated for each possible combination. The prevalence observed for the sample of this study was identified, and the expected prevalence was calculated by multiplying the individual probability of each risk factor based on its occurrence in the study population. Through this process, it is possible to identify combinations that are above or below expectations[13].

Associations between the dependent variable "combination of negative physical fitness indicators" and other independent variables were analyzed using multinomial logistic regression, with odds ratio (OR) and confidence intervals (CI 95%), and category "without negative physical fitness indicator" was considered as a reference. Interactions among all independent variables were tested; however, no statistical significance was detected for interactions. In the adjusted analysis between combination of negative physical fitness indicators and sociodemographic and lifestyle variables, all variables were inserted at the same level, regardless of p value in the crude analysis, remaining in the model those with p value ≤ 0.20, according to the backward method. Moreover, such analyses were controlled by all independent variables tested in that model. For the evaluation of the final model, a saturated model was estimated, so that the adjustment parameters could be compared to each other. In these comparisons, the multiple determination coefficient (R^2), the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC) were estimated. Significance level of p <0.05 was adopted for all statistical tests. Statistical analysis was performed using Stata 13.0 software (STATA Corp. College Station, Texas, USA), considering the sample weight and the design effect.

RESULTS

Of the 866 students evaluated in this research, nine out of ten (87.4%) had low aerobic fitness and eight out of ten had low FPM levels (82.9%). A little less than two fifths of subjects had low flexibility (39.8%) and approximately one quarter had excess body fat (27.1%). The other sample characteristics are shown in Table 1.

In relation to the low aerobic fitness, higher prevalence was observed for individuals who remained 4 hours / day or more in front of the screen and who did not comply with recommendations regarding the practice of overall physical activity. In relation to the low FPM levels, higher prevalence was observed in girls, in students who slept more than or equal to 8 hours / day and in those showing risk factor in relation to screen time (≥ 4 hours / day) and who did not meet recommendations regarding the practice of overall physical activity. For low flexibility, higher prevalence was observed for students whose mothers had higher schooling. Female adolescents presented higher prevalence of overweight (Table 2).

The prevalence observed for the simultaneity of four risk factors was 30% higher than expected. Regarding the simultaneity of three risk factors, the most prevalent was the combination of low aerobic fitness, low FPM levels and low flexibility (21.1%); however, this result was close to the expected value (21.0%). However, for the combination of three factors, low aerobic fitness, low flexibility and excess body fat, the prevalence (1.7%) was 10% higher than expected (1.6%). The most prevalent simultaneous risk factors were low aerobic fitness and low FPM levels (30.4%), which was lower than expected (31.8%). Regarding the prevalence observed for

one risk factor, the most prevalent was low aerobic fitness (7.8%) followed by low FPM (6.3%), with values 20% and 40% higher than expected. The prevalence observed for individuals without risk factor was 1.7%, 90% higher than expected (0.9%) (Table 3).

Table 1. Distribution of students from state public schools of São José, SC, Brazil, 2014.

Variables	n	% (CI95%)
Gender		
Male	406	46.8 (40.8-52.7)
Female	460	53.2 (47.2-59.1)
Age group (years)		
14-15	255	31.8 (30.3-33.2)
16-17	509	57.4 (55.1-59.6)
18-19	102	10.8 (9.0-13.0)
Maternal schooling*		
9 – 11 years	369	43.8 (30.2-58.3)
0 – 8 years	486	56.2 (41.7-69.7)
Breakfast †		
Frequent	526	60.0 (53.7-66.0)
Infrequent	334	40.0 (34.0-46.2)
Sleep hours ‡		
≥ 8 hours of sleep	447	50.9 (47.3-54.5)
< 8 hours of sleep	410	49.1 (45.5-52.6)
Screen time §		
< 4 hours/day	118	13.7 (8.7-20.9)
≥ 4 hours/day	701	86.2 (79.1-91.2)
Overall physical activity a ||		
Meets	201	22.8 (19.4-26.6)
Does not meet	641	77.2 (73.4-80.6)
Handgrip strength		
Low	715	82.9 (71.8-90.2)
Adequate	151	17.1 (9.8-28.2)
Aerobic fitness		
Low	760	87.4 (79.5-92.5)
Adequate	106	12.6 (7.5-20.5)
Flexibility		
Low	341	39.8 (24.0-58.1)
Adequate	525	60.2 (42.0-76.0)
Body fat		
No excess	632	72.8 (70.7-74.9)
Excess	234	27.1 (25.1-29.3)

CI = confidence interval; a = physically active at least 60 minutes per day on five or more days of the week; * Variable with 11 missing data; † Variable with 6 missing data; ‡ Variable with 9 missing data § Variable with 47 missing data; || Variable with 24 missing data.

The odds ratio for the presence of one negative physical fitness indicator compared to the absence of negative indicators were three times higher in students who had screen time equal to or greater than 4 hours / day. There were also 190% and 630% more chances of presenting two negative physical fitness indicators, respectively, in female students and in those

who presented screen time equal to or greater than 4 hours / day, when compared to those without negative physical fitness indicator. Higher odds ratio of simultaneously presenting three negative physical fitness indicators, compared to those with no negative indicators, were found in female students (OR: 7.5; 95% CI = 2.5-22.8). In addition, female students and those who presented risk behavior in relation to screen time were approximately 19.5 and 8.8 times more likely of simultaneously presenting four negative physical fitness indicators.

Table 2. Characteristics of negative physical fitness indicators according to sociodemographic and lifestyle variables of students from state public schools of São José, SC, Brazil, 2014.

Variables	Low aerobic fitness		Low handgrip strength levels		Low flexibility		Excess body fat	
	n	(%)	n	(%)	N	(%)	N	(%)
Gender		p= 0.08 [a]		p= 0.03 [a]		p= <0.01 [a]		p= <0.01 [a]
Male	348	(45.7)	323	(45.1)	111	(32.5)	53	(22.2)
Female	412	(54.3)	392	(54.9)	230	(67.5)	181	(77.8)
Age group (years)		p= 0.30 [a]		p= 0.05 [a]		p= 0.79 [a]		p= 0.85 [a]
14-15	223	(29.3)	221	(31.0)	102	(29.9)	67	(28.7)
16-17	452	(59.5)	416	(58.1)	202	(59.0)	141	(60.0)
18-19	85	(11.2)	78	(10.9)	37	(11.1)	26	(11.3)
Maternal schooling*		p= 0.64 [a]		p= 0.84 [a]		p= 0.01 [a]		p= <0.61 [a]
9 – 11 years	321	(43.1)	304	(43.2)	128	(38.3)	103	(45.3)
0 – 8 years	428	(56.9)	403	(56.8)	210	(61.7)	128	(54.7)
Breakfast †		p= 0.54 [a]		p= 0.95 [a]		p= 0.21 [a]		p= <0.01 [a]
Frequent	464	(61.2)	434	(61.0)	198	(58.1)	119	(50.7)
Infrequent	290	(38.8)	275	(39.0)	140	(41.9)	114	(49.3)
Sleep hours ‡		p= 0.71 [a]		p= 0.01		p= 0.15 [a]		p= 0.88 [a]
≥ 8 hours of sleep	394	(51.9)	383	(53.6)	186	(55.0)	122	(52.2)
< 8 hours of sleep	358	(48.1)	325	(46.4)	151	(45.0)	110	(47.8)
Screen time §		p= 0.02 [a]		p= 0.02 [a]		p= 0.28 [a]		p= 0.60 [a]
< 4 hours/day	96	(13.2)	89	(13.0)	41	(12.5)	34	(15.4)
≥ 4 hours/day	622	(86.8)	588	(87.0)	280	(87.5)	186	(84.6)
Overall physical activity [c]		p= 0.01 [a]		p=<0.01 [a]		p= 0.05		p= 0.24 [a]
Meets	165	(22.2)	153	(21.9)	67	(20.3)	48	(21.2)
Does not meet	573	(77.8)	540	(78.1)	263	(79.7)	180	(78.8)

a = Chi-square test; b = Minimum wage of R$ 724,00; c = physically active at least 60 minutes a day on five or more days of the week

Table 3. Prevalence of combination of negative physical fitness indicators in students from state public schools of São José, SC, Brazil, 2014.

Risk factor	Low aerobic fitness	Low handgrip strength	Low flexibility	Excess body fat	Prevalence			
					n	Observed % (IC95%)	Expected %	O/E
4	+	+	+	+	87	9.9 (4.2-13.7)	7.8	1.3
3	+	+	+	-	183	21.1 (11.5-35.5)	21.0	1.0
	+	+	-	+	101	11.4 (8.5-15.2)	11.8	1.0
	+	-	+	+	15	1.7 (1.0-2.7)	1.6	1.1
	-	+	+	+	03	0.4 (0.3-0.4)	1.1	0.4
2	+	+	-	-	257	30.4 (20.4-39.8)	31.8	0.9
	+	-	+	-	23	2.5 (0.9-6.5)	4.3	0.6

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Risk factor	Low aerobic fitness	Low handgrip strength	Low flexibility	Excess body fat	Prevalence			
					n	Observed % (IC95%)	Expected %	O/E
	+	-	-	+	25	2.8 (2.1-3.7)	2.4	1.2
	-	+	+	-	26	3.1 (0.4-19.9)	3.0	1.0
	-	+	-	+	03	0.4 (0.3-0.6)	1.7	0.2
	-	-	+	+	00	0.0 (0.0-0.0)	0.2	0.0
1	-	-	-	+	00	0.0 (0.0-0.0)	0.3	0.0
	-	-	+	-	4	0.5 (0.3-0.9)	0.6	0.8
	-	+	-	-	55	6.3 (5.1-7.7)	4.5	1.4
	+	-	-	-	69	7.8 (3.0-18.6)	7.0	1.2
0	-	-	-	-	15	1.7 (1.2-2.2)	0.9	1.9

CI: Confidence interval; + presence of risk factor; - absence of risk factor; O: Prevalence observed; E: Prevalence expected; O / E: Ratio between observed and expected prevalence.

Table 4. Association between negative physical fitness indicators and sociodemographic and lifestyle variables of students from state public schools of São José, SC, Brazil, 2014.

	One negative indicator [a]		Two negative indicators [a]		Three negative indicators [a]		Four negative indicators [a]	
	n (%)	RC (IC95%)	n (%)	RC (IC95%)	n (%)	RC (IC95%)	n (%)	RC (IC95%)
Gender								
Male	91 (70.4)	1	183 (55.1)	1	106 (34.9)	1	15 (16.9)	1
Female	37 (29.6)	1.3 (0.3-6.1)	151 (44.9)	2.9 (1.4-6.2)	196 (65.1)	7.5 (2.5-22.8)	72 (83.1)	19.5 (4.6-82.6)
Age group								
14-15 years	33 (25.4)	1	105 (31.7)	1	90 (29.5)	1	25 (26.3)	1
16-17 years	77 (60.2)	0.7 (0.1-.5.8)	188 (56.1)	0.3 (0.1-3.3)	178 (59.1)	0.4 (0.1-2.7)	56 (63.7)	0.4 (0.1-4.4)
18-19 years	18 (14.4)	0.5 (0.1-1.8)	41 (12.2)	0.3 (0.1-6.5)	34 (11.4)	0.3 (0.1-8.6)	6 (7.0)	0.2 (0.1-1.9)
Maternal schooling								
9-11 years	60 (47.3.)	1	141 (43.2)	1	130 (43.8)	1	31 (36.5)	1
0-8 years	66 (52.7)	0.7 (0.2-4.0)	188 (56.8)	1.4 (0.3-7.1)	169 (56.2)	1.2 (0.2-6.1)	55 (63.5)	1.5 (0.3-7.0)
Breakfast								
Frequent	84 (65.0)	1	215 (64.4)	1	171 (57.4)	1	47 (53.1)	1
Infrequent	44 (35.0)	1.0 (0.2-.13.1)	117 (35.6)	0.9 (0.1-11.1)	127 (42.6)	1.1 (0.5-27.8)	40 (46.9)	1.2 (0.6-26.3)
Sleep hours								
≥ 8 hours of sleep	60 (46.8)	1	173 (51.4)	1	161 (53.9)	1	49 (56.1)	1
< 8 hours of sleep	67 (53.2)	0.5 (0.3-1.1)	159 (48.6)	0.5 (0.4-6.5)	137 (46.1)	0.5 (0.4-7.3)	37 (43.9)	0.5 (0.1-7.1)
Screen time								
< 4 hours/day	25 (20.7)	1	36 (11.2)	1	41 (14.3)	1	10 (11.7)	1
≥ 4 hours/day	96 (79.3)	3.4 (1.3-8.6)	280 (88.8)	7.3 (2.1-25.8)	244 (85.7)	6.8 (0.7-64.8)	72 (88.3)	8.8 (3.9-19.9)
Overall physical activity								
Meets	41 (32.8)	1	83 (25.2)	1	58 (19.7)	1	13 (15.9)	1
Does mot meet	85 (67.2)	1.3 (0.3-5.3)	241 (74.8)	1.2 (0.2-8.3)	235 (80.3)	1.5 (0.2-11.3)	71 (84.1)	1.8 (0.4-7.8)

OR = Odds ratio; CI = confidence interval; a = Adjusted analysis for all independent variables; b = the reference category corresponds to no negative physical fitness indicator. The final model formed by variables gender, age, screen time and overall physical activity presented pseudo R2 = 0.0579; AIC = 10,062.18 and BIC = 10,171.65. In comparison to the subsaturated model (pseudo R2 = 0.0623, AIC = 10.031,75 and BIC = 10.177.70) and the null model (pseudo R2 = 0, AIC = 13.619,64, BIC = 13.638.69). By means of the likelihood ratio test, it was verified that the final model is approximate to the subsaturated model (p = 0.58) and different from the null model (p = <0.01).

DISCUSSION

The main findings of this study were that students had high prevalence of

negative physical fitness indicators. The observed prevalence of simultaneity of four negative physical fitness indicators was 30% higher than expected. In addition, approximately nine out of ten students had simultaneously one or more negative physical fitness indicators. Female students were more likely to have simultaneously two, three and four negative physical fitness indicators. In addition, it was verified that to have risk behavior in relation to screen time was associated with the simultaneous presence of one, two and four negative physical fitness indicators.

Regarding the prevalence of negative physical fitness indicators in the population-based study conducted in Canada with students similar to the present study, lower values in relation to the prevalence of low aerobic fitness, low FPM levels and excess body fat and higher values for the prevalence of low flexibility were found[3]. In another study conducted with adolescents in the city of Florianópolis, Brazil, lower prevalence was verified for body fat, muscular fitness and aerobic fitness compared to results verified in this study[10]. In the study that gathered information regarding the aerobic fitness levels of children and adolescents from 27 countries, an annual decline of 0.36% in the levels of this component was observed during the period from 1958 to 2003[26]. In another study carried out with a representative sample of children and adolescents in Canada, there was a decrease in the FPM levels in the period from 1981 to 2008[3]. In addition, the consumption of industrialized foods rich in empty calories by children and adolescents[27] is increasing, which directly contributes to increase body fat, and these factors (decline in aerobic fitness, FPM levels and consumption of processed foods rich in empty calories) could possibly justify the high prevalence of low aerobic fitness, low FPM levels and excess body fat identified in the study.

Despite the lower values regarding the prevalence of low flexibility levels, in the present study, 39.8% of students presented low flexibility, a result that should be analyzed with care by health managers, since low flexibility levels in adolescents are inversely associated with motor competence, which may negatively reflect the performance in sports and other physical fitness indicators[7]. In addition, in the present study, girls presented higher prevalence of low flexibility compared to boys, results that diverge from findings in literature[3]. A possible justification for these findings is the cutoff point adopted by the test battery used in the present study, with a higher value for the classification of flexibility in girls in relation to boys. Such classification had a Canadian population as reference and may not be suitable for individuals from other countries such as Brazil. However, the use of cutoff points of the applied instrument is justified, since in addition to providing classification for flexibility and other physical fitness indicators in isolation according to sex and age, the values obtained in each test alone are attributed to a score that allows classifying the individual in relation to the general physical fitness level[1].

The results of the present study identified observed prevalence 30% higher than expected prevalence for the simultaneity of four negative

physical fitness indicators. These findings should be carefully observed by health managers, since in addition to the fact that behaviors adopted during adolescence tend to remain during adult life, negative physical fitness indicators are directly associated with chronic non-communicable diseases, which in turn represent the highest cause of mortality worldwide[14]. Moreover, the identification of the highest prevalence observed in relation to that expected for the simultaneity of four negative physical fitness indicators is of concern, since the negative health effect due to the combination of different negative indicators tends to be greater than the exposure to only one Indicator[12]. Thus, the findings of the present study reinforce the need to carry out interventions that take into account factors related to the combination of negative physical fitness components such as restricting the period that adolescents spend in sedentary behavior aiming at improving these physical fitness indicators[14].

Approximately nine out of 10 students had one or more negative physical fitness indicators simultaneously. These results corroborate findings in literature, which verified high prevalence of students with negative physical fitness indicators[3,9]. A survey conducted in a city in southern Brazil with students of the same age group as the present study found that 75.4% of boys and 88.5% of girls presented low physical fitness in at least one physical fitness indicator (body composition, muscle and cardiorespiratory fitness). The increasing urbanization of developing countries such as Brazil has been directly related to the presence of negative physical fitness indicators[11], considering the reduction of spaces for the practice of physical activity and sports. In addition, higher age (> 13 years) among adolescents was directly associated with lower participation in sports, which may have contributed to the high prevalence of individuals with one or more negative physical fitness indicators[28].

The population subgroup most prevalent for the simultaneity of two, three and four negative physical fitness indicators was composed of female students. Other surveys have also shown lower performance of women in relation to physical fitness indicators[5,8]. During systematic (regular) physical activity, physiological adaptations such as cardiac hypertrophy and increase in the number of oxygen and organic transporters, such as increased muscle recruitment, increased joint mobilization and increased energy expenditure are generated, and the lower involvement in physical activity of girls (18.8%) compared to boys (27.6%) in the present study (data not shown) could imply lower magnitude of these adaptations, reflecting worse prognoses regarding aerobic fitness, muscular strength, flexibility and body fat[29].

Students who were at risk for screen time were more likely to have one, two, and four negative physical fitness indicators simultaneously. The long period in front of the screen is associated with increased caloric intake and excess body fat[23], which in turn is directly related to lower maximum oxygen consumption and low aerobic fitness levels[30]. In addition, body immobility resulting from high sitting periods is considered a stressor for

the organism[14], which may contribute to a decrease in muscular strength levels and flexibility[29].

The results identified in the present study in relation to the high prevalence of students who individually and simultaneously presented negative physical fitness indicators should be observed with caution, since the large number of cutoff points used to classify physical fitness indicators indicate a lack of consensus on the standardization to be used[1,2,6,9]. Thus, further studies should be carried out to determine specific cutoff points based on reference parameters in order to allow the comparison of results.

The insufficient statistical power of the sample to test some associations (age, maternal schooling, breakfast and sleep hours) is a study limitation, and future studies with adjustments in relation to the sample size are necessary to allow the extrapolation of results for the population of interest. However, it should be highlighted that this study followed methodological strictness by means of previous training of the team and the use of validated instruments for data collection, which provide reliability to results. Another study limitation was the use of cutoff points developed in countries other than Brazil. The collection of information regarding aspects related to lifestyle was carried out by means of a questionnaire, which allows a response bias, is also considered a limitation of the present investigation, as well as the cross-sectional design, which prevents the establishment of causal relationships. However, the present study presents contributions to the health area, as it identified subgroups susceptible to the simultaneity of negative physical fitness indicators, which allows prioritizing these individuals in terms of strategies aimed at the maintenance of adequate physical fitness indicators. Interventions in the school environment such as increasing the number of physical education classes, encouraging sports practices through extracurricular projects, lectures for adolescents, parents and tutors regarding the importance of maintaining healthy habits can positively contribute to physical fitness indicators.

CONCLUSIONS

It could be concluded that the observed prevalence of students who simultaneously presented four negative indicators of physical fitness was 30% higher than expected. In addition, approximately nine out of ten students had simultaneously one or more negative physical fitness indicators and being female and risk behavior in relation to screen time were the factors associated with the simultaneity of negative physical fitness indicators.

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