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EFFECTS OF REPLACING SEDENTARY BEHAVIOR BY HIGHER LEVELS OF PHYSICAL ACTIVITY IN CHILDREN IN COMPLIANCE TO THE WHO GUIDELINES

UČINKI NADOMEŠČANJA SEDEČEGA VEDENJA Z VISOKO INTENZIVNO TELESNO DEJAVNOSTJO PRI OTROCIH V SKLADU S SMERNICAMI WHO

ABSTRACT

Objective: To estimate the effects of reallocating sedentary behavior time to achieve 60 minutes per day of moderate-to-vigorous physical activity (MVPA) on health markers, using the isotemporal substitution method. Methods: A sample of 285 Portuguese children and adolescents was categorized in two groups based on body fat percentage. The daily mean moderate to vigorous physical activity was determined using accelerometry. Capillary blood samples and blood pressure were obtained using standard procedures. Shuttle run was used to assess cardiorespiratory fitness and bioimpedance for body composition. Data were analyzed by isotemporal substitution analyses estimating the effect of reallocating, from sedentary behavior, the time needed to accomplish 60 minutes of moderate to vigorous physical activity, on health markers. Results: Replacing sedentary behavior with MVPA significantly reduced body fat percentage (B = 2.57; 95% CI: 1.93–3.22) and improved cardiorespiratory fitness in both normoponderal (B = 2.13; 95% CI: 1.52–2.74) and overfat (B = 2.05; 95% CI: 0.74–3.36) groups. Conclusion: Adding the extra time needed to accomplish the 60 min/day moderate to vigorous physical activity recommendation seems to favorably affect the body composition and cardiorespiratory fitness in normoponderal and overfat children and adolescents.

Keywords: Childhood, isotemporal substitution, obesity, overweight

IZVLEČEK

Cilj: Oceniti učinke prerazporeditve časa sedečega vedenja, z namenom dosega 60 minut zmerne do visoko intenzivne telesne dejavnosti (MVPA) dnevno, na zdravstvene kazalnike z uporabo metode izotemporalne zamenjave. Metode: Vzorčna skupina 285 portugalskih otrok in mladostnikov je bila razvrščena v dve skupini glede na odstotek telesne maščobe. Povprečna dnevna zmerna do visoko intenzivna telesna dejavnost je bila določena z uporabo pospeškometrov. Kapilarni vzorci krvi in krvni tlak so bili pridobljeni po standardnih postopkih. Za oceno srčno-dihalne vzdržljivosti je bil uporabljen 20-metrski stopnjevalni test, za telesno sestavo pa bioimpedanca. Podatki so bili analizirani z izotemporalno substitucijsko analizo za oceno učinka prerazporeditve časa sedečega vedenja v čas, potreben za dosego 60 minut zmerne do visoko intenzivne telesne dejavnosti na zdravstvene kazalnike. Rezultati: Nadomeščanje sedečega vedenja z MVPA je bistveno zmanjšalo odstotek telesne maščobe (B = 2,57; 95 % CI: 1,93–3,22) in izboljšalo srčno-dihalno vzdržljivost v obeh skupinah – tistih z normalno vrednostjo telesnega maščevja (B = 2,13; 95 % CI: 1,52–2,74) in tistih s prekomerno vrednostjo telesnega maščevja (B = 2,05; 95 % CI: 0,74–3,36). Zaključek: Podaljševanje časa, potrebnega za dosego priporočila 60 minut/dan zmerne do visoko intenzivne telesne dejavnosti, ima ugoden vpliv na telesno sestavo in srčno-dihalno vzdržljivost otrokih in mladostnikih z normalnimi in povečanimi vrednostmi telesnega maščevja.

Ključne besede: otroštvo, izotemporalna zamenjava, debelost, prekomerna prehranjenost

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INTRODUCTION

The obesity epidemic, once restricted to adults and elderly people, started affecting children and adolescents, and its prevalence grows rapidly in this age group (Kumar & Kelly, 2017). Childhood obesity tracks into adulthood and increases the risk of premature mortality (Wohlfahrt-Veje et al., 2014), and is often associated with comorbidities, such as breathing and locomotion impairment, increased risk of fractures, hypertension, early symptoms of heart disease and insulin resistance (WHO, 2018). In addition to the physiological aspects, obesity, especially during childhood, can also lead to psychosocial complications, which may include depression, body dissatisfaction, stigmatization, low self-esteem and extreme weight loss attempts, potentially harmful to health (Brown, Halvorson, Cohen, Lazorick, & Skelton, 2015).

The body mass index (BMI) is widely used to estimate overweight and obesity in children older than two years old. Among the pros, are the low cost and easy application. However, BMI has relevant limitations and may overestimate adiposity in children of short stature or with relative high muscle mass and underestimate adiposity in children with reduced muscle mass (Kumar & Kelly, 2017). As the pathologies associated with obesity are related to excessive fat mass, it is better to use an objective monitoring method to assess adiposity. Bioimpedance, although less accurate, than other more sophisticated methods, is a relatively inexpensive, portable, simple and fast method to use and provides an objective measure of body fat percentage (McCarthy, Cole, Fry, Jebb, & Prentice, 2006).

Along with nutrition, physical activity (PA) plays a critical role in the health and development of children and adolescents, including the maintenance of healthy weight (del Pozo-Cruz, Gant, del Pozo-Cruz, & Maddison, 2017). The practice of physical activity has decreased in recent years, and the time spent on sedentary behavior (SED) has increased alarmingly, especially among youth (Costa, 2017). There is ample evidence of an inverse association between moderate to vigorous physical activity (MVPA) and fat percentage among youth and children. In addition to improving cardiorespiratory fitness (CRF), it mitigates obesity-related comorbidities (Collings et al., 2017). Therefore, MVPA is considered an important component in the prevention of childhood obesity.

The World Health Organization advocate that young people, under the age of 18, should practice at least 60 minutes of MVPA a day, and says that additional time brings even more health benefits, improving muscle and cardiorespiratory fitness, bone health, metabolic and cardiovascular markers. PA can be practiced through games, sports, physical education classes, recreation, household chores and active transportation, such as walking or cycling, and can take place within the family, school, community areas, in sports clubs and in any other spaces suitable for the practice (WHO, 2018).

In one day, time can be classified as different behaviors in the physical activity continuum: sleeping hours, sedentary behavior, light physical activity (LPA) and MVPA. Since the number of hours in a day is finite, increasing time spent in one behavior reduces the time spent in the others. The isotemporal substitution model can be used to analyze how the reallocation of time between the different behaviors is associated with adiposity and other health markers (Dalene et al., 2017).

So far, most published papers using the isotemporal substitution method, used arbitrary amounts of time in substitutions. The purpose of this study is to replace an amount of time in each of the assessed groups, in order to comply with the 60 minutes of MVPA recommended by WHO. [replacement time = 60 - average MVPA (from each subgroup) minutes]. Based on this substitution, we will analyze how metabolic health markers are affected.

METHODS

The data in this study were collected as part of the SALTA (*Suporte do Ambiente para o Lazer e Transporte Activo*) project (Pizarro, Ribeiro, Marques, Mota, & Santos, 2013). A longitudinal study developed in the metropolitan area of Porto, Portugal. The aim of which was to investigate the social and environmental influences on physical activity. The project was approved by the ethics committee of the Faculty of Sports of the University of Porto and approved by the Foundation for Science and Technology and the Regional Section of the Ministry of Education.

A total of 652 individuals consented to participate and provided written authorization from their parents or legal guardians.

Measurements

Metabolic risk factors

Waist circumference (WC) was measured with a non-metallic tape measure, at the midpoint between the lowest rib and the highest point of the iliac crest, after a normal exhalation.

Blood samples were collected from the middle finger, with the students fasting, by trained professionals, according to the Center for Disease Control (CDC) protocol. Blood samples were collected in lithium heparin-coated tubes (35 μL, Selzer) and immediately analyzed with the Colestech LDX Analyzer to obtain values for total cholesterol (TC), HDL, LDL, triglycerides (TGR), and plasma glucose (GLU). Systolic and diastolic blood pressure were measured using a Colin brand digital sphygmomanometer, model BP 8800 (Critikron, Inc., Tampa, FL), on the right arm after resting for 5 minutes. During the measurement, the participants sat comfortably, with their backs supported and legs uncrossed. The arm was exposed, without constricting clothing, and supported at heart level. At least two measurements were performed, with a one-minute interval between them. If there was a difference greater than 5 mmHg between the first two measurements, additional measurements were performed. For the analyses, the average of two measurements with less than 5 mmHg difference was used. The mean arterial pressure variable was calculated using systolic and diastolic blood pressure using the formula: BAC + 2DAT/3

Physical Activity and Sedentary Behavior

The measurement was performed using an Actigraph accelerometer, model GT1M (Actigraph, Pensacola, FL). Participants wore the accelerometer fixed to an elastic strap on their right hip for seven consecutive days. Participants were instructed to use the accelerometer during all waking hours, except during bathing or other aquatic activities. Data were collected with a 30-second epoch and were considered valid if collected for a minimum of 8 hours per day on at least 4 of the 7 days (one measurement day was required during the weekend). 60 consecutive minutes of 0 were classified as invalid data. Data were processed using Actilife software (Actigraph LLC Pensacola, FL), and then classified into different levels of physical activity (SED, AFL, and MVPA), according to Evenson's cutoff points (2008).

Anthropometric measurements

Body mass, height, and waist circumference were measured with participants barefoot and wearing light clothing. Height was measured in centimeters with a SECA 206 tape measure (Hamburg, Germany). Body mass in kilograms and body fat percentage were measured with a TANITA digital scale, model BF-522 W (Tokyo, Japan). Body mass index (BMI) was calculated as body mass (kg) divided by the square of height (m) (Rolland-Cachera, 2011). Overweight and obesity were classified according to the specific fat percentage by sex and age according to the cutoff points developed by McCarthy (2006), creating two groups: normoponderal participants (NP) and overfat and obese participants (OF).

Cardiorespiratory fitness

The Shuttle Run test was performed for estimating the cardiorespiratory fitness of the participants. At the end of the test, the number of routes is counted, and subsequently converted into an estimate of the maximum VO2 in ml/kg/min (Silva et al., 2012) using the following formula: VO2max = 43.313 +4.567*sex - 0.560*BMI + 2.785*stage

Statistical analysis

Mean and standard deviation were calculated for every variable assessed. A linear regression model of isotemporal nature was used to quantify the transversal associations of the reallocation of sedentary behavior time for the same period in LPA and MVPA in metabolic health markers. Isotemporal substitution considers that time is finite during waking hours (Mekary, Willett, Hu, & Ding, 2009). The model can be expressed as in the following example:

CRF = b0 + (b1) * wearing time + (b2) * LPA + (b3) * MVPA, when we eliminate the sedentary time in the equation, the coefficient b1 for the total wearing time represents the omitted component, for instance, SED, while the remaining coefficients (b2, b3) represent the replacement of SED by this intensity, keeping the other intensities constant (Mekary et al., 2009). All analyses were adjusted for age, sex and wearing time of the accelerometer (hours / day). The substitutions were made with the number of minutes left to achieve the 60 daily minutes of PA recommended by the WHO, therefore, for the full sample, 18.51 minutes were replaced, in the normoponderal group (NP) 16.53 minutes and 22,53 minutes in the overfat group (OF).

Linearity assumptions were evaluated, and multicollinearity was verified using the variance inflation factor (VIF). VIF values were less than 2 in all analyses, indicating that multicollinearity was low.

The data were treated using IBM SPSS Statistics (version 26; SPSS, Inc., Chicago, IL). The level of significance was set at 5% ($p < 0.05$). Descriptive statistics were used to characterize the population.

RESULTS

Sample characteristics

Only students who met some prerequisites regarding the use of the accelerometer were included in this paper, being: Minimum use of 8 hours daily to be considered a valid day; minimum of 4 valid days (at least one day during the weekend). After eliminating data from the individuals who did not meet the requirements, the population evaluated using the isotemporal substitution analysis method, were 285 children and adolescents aged 10 to 14 years (11.58 ± 0.78), 151 females (53%) and 134 males. The general characteristics of the sample are shown in table 1.

We found that 33% of the sample is overfat or classified with obesity according to McCarthy's (2006) classification of body fat percentage by age and sex. Most girls and boys are normoponderal when adjusted by age and gender, 53.6% and 54.5%, respectively. 36.5% of the girls have a high fat percentage and 29.1% of the boys. Regarding cardiorespiratory fitness, we found that 50.3% of the girls are below the healthy zone, and only 5.3% have an athletic profile. Among boys, the majority are within the healthy zone (68.6%) or even above (7.5%) according to the FITescola® (2017) shuttle test classification.

Table 1. General characteristics of the sample.

	Full sample (N=285)	**NP (N=191)**	**OF (N=94)**
Girls (%)	53,0	50,3	58,5
Age (years)	11,58±0,78	11,58±0,76	11,59±0,82
Height (m)	1,52±,08	1,51±,08	1,54±,07
Weight (kg)	48,43±11,65	43,32±7,76	61,27±9,78
BMI (kg/m²)	20,80±3,79	18,70±2,10	25,05±2,77
BFP (%)	23,13±8,14	18,68±5,12	32,17±5,05
WC (cm)	70,81±10,13	65,63±6,54	81,33±7,66
VO2max (ml/kg/min)	42,28±6,53	44,60±5,98	37,55±4,86
HDL (mmol/L)	49,00± 14,07	50,46±13,30	46,08±15,18
LDL (mmol/L)	86,67± 21,36	85,99±21,23	88,02±21,67
TC	149,22±24,50	150,18±26,39	149,54±25,09
GLY (mmol/L)	90,36± 7,70	90,75±7,87	89,59±7,33
MBP (mmHg)	79,61± 9,46	77,18±8,49	84,58±9,44
TRG (mg/dL)	69,59± 34,49	64,24±27,80	80,37±43,25
SED (min)	504,06± 72,40	499,17±71,90	513,99±72,79
LPA (min)	235,49± 52,40	238,23±52,16	229,92±52,71
MVPA (min)	41,49± 20,55	43,47±21,17	37,47±18,70
ISM (min)	18,51	16,53	22,53

Notes. BMI: body mass index; BFP: body fat percentage; WC: waist circumference; VO2max: maximum oxygen uptake; HDL: high density lipoprotein; LDL: low density lipoprotein; TC: total cholesterol; GLY: Glycemia; MBP: mean blood pressure; TRG: triglycerides; LPA: light physical activity; MVPA: moderate do vigorous physical activity and ISM: time reallocated; NP: normoponderal group; OF: overfat group.

Table 2 shows that the replacement of 18.51 minutes of SED with MVPA resulted in a reduction in the percentage of BF for the full sample (B = 2.57; 95% CI: 1.93-3.22). Tables 3 and 4 display the results of isotemporal substitutions of 16.53 and 22.53 minutes of sedentary time in the NP and OF groups, respectively, in each of the assessed variables. In the NP group, the replacement of 16.53 minutes of SED with MVPA was only positively associated with Vo2max (B = 2.13; 95% CI: 1.52-2.74) the replacement of the same period of SED with LPA was associated with WC (B = 0.35; 95% CI: 0.68-0.02). The other variables had no significant changes.

Table 2. Results of replacing 18.51 minutes of SED with MVPA on body fat percentage – Full Sample**.**

	Beta	**LECI**	**UECI**	**SIG**
%BF LPA	0,13	-0,15	0,41	0,343
%BF MVPA	**2,57**	**1,93**	**3,22**	**0,000**

Notes. BETA: regression coefficient; SIG: statistical significance; LECI: lower endpoint of confidence interval; UECI: upper endpoint of confidence interval; %BF: bodyfat percentage; SED: sedentary behavior. The numbers in bold refers to statistically significative changes.

Table 3. Results of replacing 16.53 minutes of SED with MVPA on health markers – Normoponderal Group.

	Beta	**LIIC**	**LSIC**	**SIG**
VO2max LPA	0,12	-0,15	0,40	0,376
VO2max MVPA	**2,13**	**1,52**	**2,74**	**0.000**
MBP LPA	-0,28	-0,71	0,15	0,192
MBP MVPA	-0,33	-1,32	0,64	0,503
GLY LPA	0,08	-0,35	0,50	0,707
GLY MVPA	0,31	-0,68	1,31	0,529
TRG LPA	-1,31	-2,78	0,17	0,080
TRG MVPA	-1,39	-4,83	2,05	0,427
LDL LPA	-0,07	-1,19	1,06	0,916
LDL MVPA	0,56	-2,07	3,21	0,674
HDL LPA	0,13	-0,56	0,84	0,704
HDL MVPA	-1,21	-2,84	0,45	0,152
TC LPA	-0,20	-1,50	1,11	0,765
TC MVPA	-0,89	-3,95	2,17	0,567
WC LPA	**-0,35**	**-0,68**	**-0,02**	**0,042**
WC MVPA	0,20	-0,55	0,96	0,601

Notes. BETA: regression coefficient; SIG: statistical significance; LECI: lower endpoint of confidence interval; UECI: upper endpoint of confidence interval; VO2max: maximum oxygen uptake; HDL: high density lipoprotein; LDL: low density lipoprotein; TC: total cholesterol; GLY: Glycemia; MBP: mean blood pressure; TRG: triglycerides; LPA: light physical activity; MVPA: moderate do vigorous physical activity and SED: sedentary behavior. The numbers in bold refers to statistically significative changes.

Table 4. Results of replacing 22.53 minutes of SED with MVPA on health markers - OF Group.

	Beta	**LIIC**	**LSIC**	**SIG**
VO2max LPA	-126,93	-0,45	0,45	0,996
VO2max MVPA	**2,05**	**0,74**	**3,36**	**0,002**
MBP LPA	-0,16	-1,10	0,79	0,738
MBP MVPA	-0,43	-3,11	2,25	0,754

GLY LPA	**0,81**	**0,07**	**1,53**	**0,030**
GLY MVPA	0,97	-1,06	3,00	0,341
TRG LPA	1,82	-2,68	6,33	0,424
TRG MVPA	-3,24	-15,75	9,28	0,609
LDL LPA	-0,81	-3,06	1,46	0,482
LDL MVPA	2,21	-4,08	8,47	0,487
HDL LPA	-0,83	-2,41	0,74	0,294
HDL MVPA	2,86	-1,49	7,21	0,195
TC LPA	-1,26	-4,01	1,46	0,358
TC MVPA	4,42	-3,18	12,01	0,251
WC LPA	0,25	-0,52	1,01	0,525
WC MVPA	0,54	-1,62	2,70	0,620

Notes. BETA: regression coefficient; SIG: statistical significance; LECI: lower endpoint of confidence interval; UECI: upper endpoint of confidence interval; VO2max: maximum oxygen uptake; HDL: high density lipoprotein; LDL: low density lipoprotein; TC: total cholesterol; GLY: Glycemia; MBP: mean blood pressure; TRG: triglycerides; LPA: light physical activity; MVPA: moderate do vigorous physical activity and SED: sedentary behavior. The numbers in bold refers to statistically significative changes.

In the OF group, we found that a 22.53-minute replacement of sedentary time by MVPA also resulted in the improvement of Vo2max (B = 2.05; 95% CI 0.74-3.36). However, the replacement of the same period of sedentary time by LPA was associated with an increase in blood glucose levels (B = 0.81; 95% CI: 0.07-1.53,). There were no associations in the substitutions made for the same time and intensities in any of the other metabolic risk factors analyzed.

DISCUSSION

Most studies using the isotemporal substitution method chose replacement values without considering the actual time people spend in different activity levels, not considering the average time spent in each range of PA intensity in the assessed populations. When replacing sedentary time, in each of the groups, with the missing minutes to reach 60 minutes/day of MVPA, we found favorable results on the percentage of body fat and cardiorespiratory fitness. When replacing this same time of sedentary behavior with LPA, there were favorable changes on the waist circumference in the NP group and an increase in fasting plasma glucose in the OF group. No significant changes were identified in the other variables analyzed.

High levels of PA have been associated with decreased adiposity and higher levels of CRF (Ortega, Ruiz, & Castillo, 2013). In our sample, the replacement of 18.51 minutes of SED by MVPA, led to a significant improvement in BF%, whereas the replacement of the same period, of SED by LPA was not significant. Similar results were found in the studies by (Aggio, Smith,

& Hamer, 2015), (Loprinzi, Cardinal, Lee, & Tudor-Locke, 2015), where they found significant changes when replacing SED with MVPA but not LPA. Similar results were previously described by (Sardinha, Marques, Minderico, & Ekelund, 2017), also in a Portuguese population. In the aforementioned study, considering that relocating 30 minutes per day of sedentary time to MVPA may not be feasible for most children, a more realistic goal was set, that is, replacing 15 minutes of SED with 15 minutes of MVPA that also produced favorable reductions in adiposity and waist circumference.

On the other hand, some authors have had positive results in the body composition of young people when using the isotemporal replacement method, displacing SED to LPA, including (Collings et al., 2017), (del Pozo-Cruz et al., 2017) and (Hansen et al., 2018). Even so, in the same studies, substitutions involving MVPA obtained more favorable results.

There is sturdy evidence suggesting that CRF is an important indicator of cardiovascular health. In adults, low levels of CRF are considered predictors of mortality due to cardiovascular diseases. In young people, low CRF is associated with obesity and other symptoms of the metabolic syndrome (Ekelund et al., 2012). Moreover, high levels of CRF seem to mitigate obesity-related comorbidities (Collings et al., 2017).

Regarding cardiorespiratory fitness, significant improvements were observed when reallocating 16.53 minutes and 22.53 minutes of SED by MVPA in the NP and OF groups, respectively. The substitution of identical time, from SED to LPA did not result in significant changes.

These results coincide with the studies by (Collings et al., 2017) and (Hansen et al., 2018), ratifying that light physical activity does not seem to be sufficient to positively alter the values of cardiorespiratory fitness, being necessary to engage in physical activity of moderate to vigorous intensity. Considering our results, it seems important to us to publicize the need to reduce sedentary time and increase physical activities of higher intensities, even for short bouts of 15 to 20 minutes, in order to obtain health benefits for the youth.

Contrary to expectations, regarding metabolic risk factors, namely blood pressure, lipid profile and glucose, no significant associations were found in replacing the time spent in sedentary behavior with MVPA. In his study, (Hansen et al., 2018) analyzed an ICAD database, collected in several countries and with a population of 20,871 children and adolescents, and found that the time spent in MVPA was significantly associated with all cardiometabolic results, regardless of gender, age, time of use of the monitor, time in SED and waist circumference. In combined analyzes, higher levels of MVPA were associated with improvements in cardiometabolic risk factors.

Conversely, in the NP group, the reallocation of SED by LPA caused a beneficial and statistically significant change in the waist circumference. This result coincides with the study by (Collings et al., 2017), which also obtained favorable results to body composition, with the replacement of 20 minutes of sedentary time with LPA. In that same study, the author found that, a lower intensity of PA (> 2 METs) is required to improve the levels of total adiposity in comparison to cardiorespiratory fitness (> 3 METs) in children aged 6 to 8 years.

In the OF group, the replacement of SED by AFL proved to be significant for blood glucose rates, however this result was contrary to our hypotheses since this substitution resulted in an increase in glucose values. Such results were unexpected. A possible explanation for this result may be related not only to PA, but also to food. In (Dalene et al., 2017) something similar occurred, and the author raised the hypothesis that, a meal or activity involving the consumption of snacks could be computed in the lower intensities of light physical activity spectrum. (Huang, Wong, He, & Salmon, 2016) also brings relevant information, in the same sense, that within the same intensity the consumption of caloric snacks can affect the results.

In spite of the less pronounced effects, there are more opportunities to increase LPA during a day, when compared to MVPA, for example, with light commuting and domestic chores (Garcia-Hermoso, Saavedra, Ramirez-Velez, Ekelund, & Del Pozo-Cruz, 2017). There is also an additive effect of LPA and MVPA, where both contribute to the total energy expenditure, with beneficial effects on health (Loprinzi et al., 2015). Furthermore, the positive effects of LPA may be more relevant in sedentary and less fit populations, and in children and adolescents with obesity.

The discrepancy between the results found in the different studies can be partially explained by the different methodologies used in the research. Among them, different motion sensors, sensor placement, data processing methods and / or different cutoff points to categorize the intensity of PA (Aggio et al., 2015). This study used objective measures of PA (accelerometers); however, some limitations arise from this process: The assessment took place in one week only (minimum of 4 valid days) and, generalized as representative of the movement pattern of each individual in the sample. In addition, the accelerometers used have the limitation of being improper to water activities and may lead to underestimation in the PA levels. Participants wore accelerometers only while awake, which excluded sleep, an important factor for health and obesity. In future studies, it would be better to use accelerometers that can be worn in aquatic environments; that perform analysis of postural variation, and used 24 hours a day, so that the analyzes are more accurate. Another limitation of this study was that, when applying the requirements for selecting individuals, the population was reduced from 652 to 285, and as it is not representative of the population, the conclusions cannot be generalized. Finally, because this is a cross-sectional study, causation cannot be established.

CONCLUSION

The results of this study suggest that adding the remaining minutes to reach 60 minutes of moderate to vigorous physical activity per day, and the consequent reduction in the time spent in sedentary behavior, can bring benefits to the body composition and cardiorespiratory fitness of children and adolescents, thus improving their general health. Moreover, it gives us an idea of how much time should be the minimum change in normoponderal and Overfat groups and estimate the potential changes in CRF.

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Ethics approval statement

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Declaration of Conflicting Interests

The authors have no conflicts of interest to declare.

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