Sedentary behavior and health-related quality of life in adolescents

Comportamento sedentário e qualidade de vida relacionada à saúde em adolescentes

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Abstract *Health-related quality of life (HRQoL) represents the perception of each person about different aspects of their lives in the health context (physical, psychological, social environment and interpersonal relationships). Among adolescents, HRQoL can change considering habits adopted in this phase of life. This study analyzed the association between time used on different sedentary behaviors (SB) and HRQoL in adolescents. This is a cross-sectional epidemiological study with adolescents between 10 - 15 years of age. The SB was measured using a questionnaire (n = 1,455 adolescents) and accelerometer (n = 844 adolescents), and HRQoL using KIDSCREEN – 27. Time on videogames/cell phones/tablets was inversely associated with overall HRQoL (β = -0.021; 95%CI: -0.026; -0.006), psychological well-being (β = -0.030; 95%CI: -0.050; -0.010), peer social support (β = -0.041; 95%CI: -0.066; -0.016) and school environment (β = -0.033; 95%CI: -0.056; -0.010) scores. Screen time was inversely associated with the school environment score (β = -0.011; 95%CI: -0.020; -0.003). Computer time was positively associated with the psychological well-being (β = 0.025; 95%CI: 0.006; 0.043) and peer social support scores (β = 0.029; 95%CI: 0.004; 0.053). It concluded that adolescents with more screen time had lower HRQoL. However, theses associations varied with the type and method of SB measurement and the HRQoL dimension.*

Key words *Sedentary behavior, Quality of life, Adolescents*

Resumo *A qualidade de vida relacionada à saúde (QVRS) representa a percepção de cada pessoa sobre os diferentes aspectos de sua vida no contexto da saúde (físico, psicológico, meio social e relacionamento interpessoal). Entre os adolescentes, a QVRS pode mudar em função dos hábitos adotados nessa fase da vida. Este estudo analisou a associação entre o tempo utilizado em diferentes comportamentos sedentários (CS) e a QVRS em adolescentes. Trata-se de um estudo epidemiológico transversal com adolescentes de 10 a 15 anos de idade. O CS foi mensurado por meio de questionário (n = 1.455 adolescentes) e acelerômetro (n = 844 adolescentes) e a QVRS pelo KIDSCREEN – 27. O tempo em videogames/celulares/tablets foi inversamente associado à QVRS geral (β = -0,021; IC95%: -0,026; -0,006), bem-estar psicológico (β= -0,030; IC95%: -0,050; -0,010), apoio social de pares (β = -0,041; IC95%: -0,066; -0,016) e ambiente escolar (β = -0,033; IC95%: -0,056; -0,010). O tempo de tela se associou inversamente ao escore do ambiente escolar (β = -0,011; IC95%: -0,020; -0,003). O tempo de computador foi positivamente associado ao bem-estar psicológico (β= 0,025; IC95%: 0,006; 0,043) e escores de apoio social dos pares (β = 0,029; IC95%: 0,004; 0,053). Conclui-se que adolescentes com maior tempo na tela apresentaram menor QVRS. No entanto, essas associações variaram com o tipo e método de mensuração do CS e a dimensão da QVRS.*

Palavras-chave *Comportamento sedentário, Qualidade de vida, Adolescentes*

Introduction

Recent years have seen a growing number of studies on health-related quality of life in adolescent[1,2], a multidimensional construct that represents people's self-perception of well-being and health levels[1]. It has been used in adolescents as an overall marker of health levels, to identify at-risk groups and to assess health-promoting interventions[1]. There is evidence that the quality of life of adolescents has declined in the past few decades[3,4] and identifying these changes is important from a public health standpoint[1].

Health-related quality of life (HRQoL) can be determined by a complex interrelation of sociocultural[1], economic[3], psychosocial, emotional and environmental factors, in addition to the individuals' lifestyle[2]. Time spent on sedentary behavior has been associated with lower HRQoL[2,5-8]. This may be due to health problems such as depression, anxiety[9], low self-esteem, obesity, metabolic syndrome[10]; low physical activity levels[5], daily sleep time and quality[11], high consumption of unhealthy foods, poor school performance[10] and social relations[12], and are more frequent in those who spend more time on sedentary behaviors. However, most studies that analyzed the relation between sedentary behavior and HRQoL considered just screen time[6-8], watching television[5] or total time spent on these behaviors[2], measured by accelerometer, and these studies assessed adolescents from North America[5,7] and Australia[2,6,8].

In Brazil, data from a systematic review identified that the prevalence of excessive screen time in adolescents was 70.9% (95%CI: 65.5; 76.1) and TV time was 58.8% (95%CI: 49.4; 68.0)[13]. However, most studies that evaluated sedentary behavior in adolescents have considered screen time and television time, without considering the use of other types of behavior, such as the use of video games/cell phones/tablets and computers[13]. In addition, studies that assessed the total time spent on sedentary behavior measured by an accelerometer were carried out with preschoolers, not considering other age groups, such as adolescents[14].

The demands, peculiarities and implications inherent to adopting each sedentary behavior may lead to varying associations between these behaviors and the dimensions of HRQoL, depending on the measure (total screen time and time spent on each behavior) and dimension in question. Some sedentary behaviors may exert greater influence on social relations (for example,

family members, teachers, friends), affective feelings[12], self-perception, personal satisfaction[9]; and academic performance[10]. On the other hand, total sedentary behavior time may have more influence on the physical dimension indicators of quality of life since it reduces physical activity time[5,15] and alters lipid metabolism[16]. Studies with adolescents have demonstrated that time spent watching television is associated with unhealthy food consumption[17], obesity[10] and a larger amount of body fat[16]; playing videogames with less social interaction; using a computer with low self-esteem, poorer physical fitness[10] and less physical activity; and total time on these behaviors with lower sleep duration and quality[11].

Another important aspect to consider is that HRQoL varies with age[3,4] and the socioeconomic, cultural and environmental conditions of the adolescents[5]. To date, studies that have analyzed the relation between different types of sedentary behavior (television, computer, videogame and cellphone time) and HRQoL in adolescents are scarce, especially in middle-high income countries such as Brazil[18].

Costa *et al.*[18] in a study carried out in the southern region of Brazil, analyzed the association between screen time measured by five activities (studying, working, watching videos, videogames and using social media/chat applications) and HRQoL. Adolescents whose screen time at work was above four hours / day showed a reduction in HRQoL (β = -2.38; 95%CI: -4.52; -0.25). However, this study was carried out with older adolescents (16.4 years; SD = 1.0), did not consider the time spent in television and computer for school activity and leisure separately, the total time and did not consider the different domains that make up the HRQoL[18]. In this respect, the present study analyzed the association between time spent on different sedentary behaviors (SB) and HRQoL in adolescents.

Methods

This is a cross-sectional epidemiological study conducted using data collected in the first year (2014) of the LONCAAFS (Longitudinal Study on Sedentary Behavior, Physical Activity, Eating Habits and Adolescent Health) study, aimed at analyzing the relation between sedentary behavior, physical activity level, eating habits, quality of life and health indicators in public school adolescents from João Pessoa, Paraíba

state, Brazil. The study was approved by the Health Science Center Human Research Ethics Committee of the Federal University of Paraiba (Protocol 0240/13).

In 2018, João Pessoa, the capital of Paraiba state, had a population of 800,323 inhabitants (demographic density of 66.7 inhabitants/km²) and Human Development Index (IDH) of 0.658 (ranking 23rd among the 27 state capitals in Brazil)[19]. Around 7.5% (57,450) of the inhabitants are aged between 10 and 15 years, 90% of whom are enrolled in elementary school. In 2013 (the year of reference used for sampling), there were 65,734 students enrolled in 184 public schools (93 state and 91 municipal).

Sample size was determined considering the following parameters: estimated population of 9,520 (grade six students), 50% outcome prevalence; 95% confidence interval; maximum permissible error of 4%; design effect (*deff*) of 2; and an additional 40% to compensate for losses and refusals, resulting in a sample of 1,583 adolescents.

Single stage cluster sampling was used as follows: systematic selection of 28 schools (14 municipal and 14 state), distributed proportionately by region (north, south, east and west) and number of enrolled students. In the randomly selected schools, all grade six students were invited to take part in the study. A subsample was selected to use accelerometers. To that end, 17 schools were randomly drawn from the 28 included in the sample, distributed proportionally by type (municipal and state), region (north, south, east and west) and number of grade six students.

Data collection occurred between February and June and August and September 2014, in the student`s school and classroom. The adolescents completed a questionnaire, applied via a face-to-face interview, were submitted to anthropometric measures and used accelerometers. The collection team consisted of graduate and scientific initiation students in Physical Education and Nutrition from Federal University of Paraiba – UFPB.

The following sociodemographic variables were analyzed: sex (male = 0, female = 1), age (measured to two decimal points and categorized as 10-11 = 0, 12-13 = 1, 14-15 = 2), mother`s schooling level (incomplete elementary = 0; complete elementary and incomplete secondary = 1; complete secondary and university = 2) and economic class (Brazilian Association of Research Companies – ABEP)[20], categorized as: A/B = 2 (upper class); C = 1 (middle class) and D/E = 0 (lower class).

Levels of physical activity were measured using the Physical Activity Questionnaire for Adolescents (QAFA)[21]. The teenagers reported the frequency (days/week) and duration (minutes/day) of the activities engaged in for at least 10 minutes in the week before collection. Physical activity level was determined by adding the product of time and frequency, resulting in a minutes per week score.

Sedentary behavior was measured using a questionnaire developed to measure the variables of the LONCAAFS' Study. A pilot study was carried out to assess the reproducibility (Intraclass correlation coefficient – ICC = 0.69; 95%CI: 0.44 – 0.83). This questionnaire considered time spent watching television, playing videogames, using cell phones/tablets/computer, in the week before data collection, separating weekdays and the weekend. A score for each sedentary behavior was obtained (television, computer, videogame/cell phone/tablet) and screen time (television + computer + videogame/cell phone/tablet), as follows: average time spent on sedentary behavior on weekdays (Monday to Friday) multiplied by five, added to the average time on the weekend (Saturday or Sunday), multiplied by two. This value was divided by seven to estimate the average number of hours per day in sedentary behavior.

KIDSCREEN-27 was used to measure HRQoL[20]. This instrument is composed of five dimensions: physical well-being (five items); psychological well-being (seven items); autonomy and parent relations (seven items); peers and social support (four items); and school environment (four items). The adolescents answered questions using the week before data collection as reference. For analysis purposes, an overall score was calculated (Σ of the questionnaire items) x 100 / (number of questionnaire items x number of points on the scale) as well as for HRQoL dimensions (Σ of dimension items) x 100 / (number of dimension items x number of points on the scale). Scores varied from 0 to 100, the higher values indicating better HRQoL.

A subsample of adolescents used an ActiGraph GT3X accelerometer to measure physical activity and sedentary behavior for seven consecutive days, attached to the subject's waist, removing it only for water-related activities, bathing and sleeping. The ActiLife 6.10 program was used in data reduction, adopting the following criteria: having used the accelerometer for at least 6 hours/day for four or more days, one of which was on the weekend; periods of non-use were defined as 30 consecutive minutes with no recording; and

a 15-second epoch[22]. The following cutoff points were applied: sedentary behavior $\leq$ 100 counts/minute; moderate to vigorous physical activity $\geq$ 2,296 counts/minute[23]. Physical activity and sedentary behavior time were determined from the total time spent during the week (Monday to Friday) multiplied by five, and on the weekend (Saturday and Sunday) multiplied by two. This value was divided by seven to obtain the weighted mean in minutes per day spent on these behaviors.

Weight and height were measured according to Lohman, Roche and Martorell[24]. All the measures were taken in triplicate and the average value was used for analysis purposes. Body mass index (BMI) was determined from the measures of weight and height and classified according to World Health Organization criteria[25].

Excluded from the analyses were adolescents outside the age range of interest (< 10 and > 15 years), those with any disability that limited their completing the questionnaire, those who refused to undergo anthropometric measures and/or did not comply with valid data criteria for using the accelerometer, and pregnant individuals.

Descriptive analysis used frequency distribution for qualitative variables and the mean and standard deviation (SD) for their quantitative counterparts. Linear regression was applied to relate time spent on sedentary behaviors (independent variables) to the overall HRQoL score and dimensions (dependent variables). The following potential confounding factors were considered: sex, age, mother`s education, economic class, BMI and moderate to vigorous physical activity.

All the independent variables and potential confounding factors were considered in creating the fitted models, regardless of p-value in raw analysis. Goodness of fit was assessed by verifying the normality and heteroscedasticity of residuals (Cook-Weisberg test: p-value more than 0.05 indicated homoscedasticity in residual behavior) as well as multicollinearity (VIF – Variance Inflation Factor < 5 indicated that the variables did not exhibit multicollinearity). All the analyses were conducted in Stata 11.0 and the significance level was at 5%.

Results

Of the 2,767 adolescents invited to take part in the study, 830 did not return the written informed consent form (29.9%), 372 refused to participate

(13.4%) and 110 were excluded. The final sample consisted of 1,455 adolescents. The data of 844 of the 1,031 students asked to use the accelerometer were analyzed (losses and refusal = 18.1%) (Table 1).

A majority of the subjects were girls, aged between 10 and 11 years, whose mothers had a secondary education and belonged to the middle-high socioeconomic classes. The most adolescents were classified as having normal weight (64.3%). The average overall HRQoL score was 80.7 (SD = 10.6) points, highest in the school setting dimension (85.2; SD = 14.8) and lowest in the physical well-being dimension (75.9; SD = 14.4). Average screen time and sedentary behavior were 245.7 (SD = 155.2) and 405.2 (SD = 86.7) minutes per day, respectively. Watching television was the sedentary behavior adolescents spent the most time on per day (sample: 150.6; SD = 114.1; subsample: 149.0; SD = 113.3 minutes/day) (Table 1).

The results of adjusted analysis indicated that time spent on the computer was positively and significantly associated with the psychological well-being dimensions (β = 0.025; 95%CI: 0.006; 0.043) in addition to social support and peer groups (β = 0.029; 95%CI: 0.004; 0.053). Time spent on videogames/cell phones/tablets was inversely associated with overall HRQoL score (β = -0.021; 95%CI: -0.026; -0.006), psychological well-being (β = -0.030; 95%CI: -0.050; -0.010), social support and peer groups (β = -0.041; 95%CI: -0.066; -0.016) and school environment (β = -0.033; 95%CI: -0.056; -0.010). Screen time was inversely associated with the school environment dimension (β = -0.011; 95%CI: -0.020; -0.003) (Table 2). Total sedentary behavior, measured by accelerometer, was not associated with the overall score or HRQoL dimensions (β = -0.006; 95%CI: 0.017-0.004).

Discussion

The findings of the present study demonstrated that adolescents who spent more time per day on sedentary behavior, such as playing videogames, obtained lower HRQoL scores. However, those who used the computer more exhibited higher HRQoL levels in the psychological well-being and social support dimensions.

Considering that adolescents may have a more affected mental health due to the inherent changes in the life stage of late adolescence[26], the prolonged use of these devices may reduce

Table 1. Sociodemographic characteristics, nutritional status, health-related quality of life, sedentary behavior time and moderate to vigorous physical activity of adolescents, João Pessoa, Paraíba, Brazil, 2014.

Variables	Sample (n = 1,455)		Subsample (n = 844)	
	n	%	n	%
Sex				
Male	689	47.3	376	44.5
Female	766	52.7	468	55.5
Age range (years)				
10-11	812	55.8	495	58.7
12-13	545	37.5	296	35.1
14-15	98	6.7	53	6.2
Economic class				
A/B	447	35.4	264	35.6
C	750	59.4	445	59.9
D/E	65	5.2	33	4.5
Mother's education				
Upto grade 4	180	14.9	97	13.7
Incomplete elementary	313	26.0	166	23.5
Complete elementary	342	28.4	214	30.2
Complete secondary and university	369	30.7	231	32.6
Nutritional status				
Low weight	41	2.8	27	3.2
Normal weight	928	64.3	522	62.4
Overweight/obese	475	32.9	288	34.4
	Mean	SD	Mean	SD
Body weight	44.6	11.5	44.6	11.4
HRQoL (points)				
Overall score	80.7	10.6	81.3	13.8
Physical well-being	75.9	14.4	76.4	14.3
Psychological well-being	85.1	12.1	85.5	11.9
Autonomy and relation with parents	76.9	15.7	76.7	15.6
Social support and peer group	81.9	16.5	81.8	16.5
School environment	85.2	14.8	85.3	14.8
Sedentary behavior (min/day)				
Television*	150.6	114.1	149.3	113.3
Computer*	37.8	60.9	36.8	58.7
Videogame*#	29.6	51.7	29.9	54.7
Screen time*	245.7	155.2	242.3	156.1
Total time spent on sedentary behaviors **	-	-	405.2	86.7
Physical activity				
MVPA (min/wk)*	578.2	473.3	574.9	476.9
MVPA (min/day)**	-	-	11.2	10.6

SD = standard deviation; HRQoL = health-related quality of life; * = measure taken using a questionnaire; # = includes time using the videogame/cell phone/tablet; ** = measure taken using accelerometers; min/day = minutes per day; min/wk = minutes per week; MVPA = moderate to vigorous physical activity.

Source: Authors.

personal contact with friends, parents and other family members, study time[27] as well as daily sleep time and quality[11]. One of the explanations for the lower HRQoL levels in the psychological well-being dimension of adolescents that spent more time on videogames/cell phones/tablets may lie in the content of electronic games. Some games portray violent scenes that may trigger

Table 2. Linear regression for the association between time spent on sedentary behavior and the overall score, and the dimensions of health-related quality of life in adolescents, João Pessoa, Paraíba, Brazil 2014.

Sedentary behavior (min/day)	Health-related quality of life											
	Overall score		Physical well-being		Psychological well-being		Autonomy and relation with parents		Social support and peer group		School environment	
	Crude analysis											
	β	95%CI	β	95%CI	β	95%CI	β	95%CI	β	95%CI	β	95%CI
Television*	-0.003	-0.007; 0.002	-0.005	-0.011; 0.002	-0.005	-0.011; 0.001	0.001	-0.006; 0.008	-0.006	-0.014; 0.002	-0.004	-0.011; 0.002
Computer*	0.012	0.003; 0.020	0.003	-0.010; 0.016	0.011	0.001; 0.021	0.020	0.007; 0.033	0.027	0.013; 0.041	-0.007	-0.019; 0.006
Videogame*#	-0.009	-0.015; 0.005	0.001	0.014; 0.015	-0.013	-0.025; 0.001	0.002	-0.014; 0.018	-0.012	-0.029; 0.004	-0.025	-0.040; 0.011
Screen time*	-0.001	-0.009; 0.004	-0.002	-0.006; 0.004	-0.002	-0.006; 0.002	0.005	-0.001; 0.010	0.002	-0.004; 0.007	-0.007	-0.012; -0.002
Total time**	-0.007	-0.015; 0.001	-0.017	-0.028; 0.005	0.001	-0.008; 0.011	-0.009	-0.022; 0.004	-0.004	-0.017; 0.010	0.004	-0.008; 0.016
	Adjusted analysis											
Television*	-0.005	-0.012; 0.003	-0.009	-0.020; 0.002	-0.004	-0.014; 0.006	0.002	-0.011; 0.014	-0.006	-0.019; 0.007	-0.010	-0.022; 0.002
Computer*	0.019	-0.002; 0.028	0.010	-0.012; 0.031	0.025	0.006; 0.043	0.021	-0.003; 0.044	0.029	0.004; 0.053	-0.003	-0.026; 0.019
Videogame*#	-0.021	-0.026; -0.006	-0.013	-0.035; 0.010	-0.030	-0.050; -0.010	-0.016	-0.041; 0.009	-0.041	-0.066; -0.016	-0.033	-0.056; -0.010
Screen time*	-0.003	-0.009; 0.003	-0.003	-0.014; 0.003	-0.003	-0.010; 0.004	0.002	-0.008; 0.011	-0.003	-0.012; 0.006	-0.011	-0.020; -0.003
Total time**	-0.006	-0.017; 0.004	-0.008	-0.023; 0.007	0.008	-0.005; 0.022	-0.003	-0.019; 0.014	-0.005	-0.022; 0.012	0.003	-0.013; 0.019

β = coefficient of linear regression; 95%CI = 95% confidence interval; * = measures collected via questionnaire; # = includes time using videogames/cell phones/tablets; ** = measures collected via accelerometers; min/day = minutes per day; analysis adjusted for sex, age, economic class, mother's school, father's school, body mass index; time spent on moderate to vigorous physical activity measured by accelerometer and total physical activity determined by questionnaire.

Source: Authors.

aggressive thoughts and behaviors[28]. Adolescents that spend many hours on these games display more signs of aggressiveness[28] and attention deficit[29], which may lead to greater difficulty in socializing with friends, teachers and parents[27], resulting in possible negative perceptions of their relations and the social support received from these groups. Alternatively, increasing the time of physical activity can act as a protective factor in reducing symptoms of depression and anxiety among these adolescents[30].

Experimental studies have demonstrated that the use of smartphones may reduce enthusiasm for social relations with peers, which can interfere in relationships with schoolmates and result in lower perceived psychological well-being[12]. The increase in recreational screen time has been associated with lower perceived psychological well-being in adolescents[31]. Time playing electronic games accounts for the most time spent by adolescents on screen activities.

Longer screen time was associated with lower HRQoL scores in the school environment dimension. Studies with adolescents demonstrated that screen time is associated with lower academic performance and attention in class[10]. Spending more time on screen activities may compromise school tasks and attention during class, due to the high volume of information absorbed when using these devices[32]. This would act as mental pollution, leading to worse academic performance and creating conflicts with parents, teachers and the adolescents themselves[32]. Using screen devices at night is associated with later sleep times, less sleep duration and quality and sleepiness in

class[11]. These factors compromise concentration, favoring lower school performance.

The fact that the present study used a cross-sectional design does not rule out the possibility that the more introspective students, with lower self-esteem and symptoms of depression and anxiety, spend more time on social networks and electronic games. Systematic reviews have identified a relation between longer sedentary behavior time and the presence of depression, anxiety[2], hyperactivity, inattention[9], and lower self-esteem levels in adolescents[10].

Higher HRQoL levels in the psychological well-being, social support and peer group dimensions were observed in adolescents that spent more time on the computer. This association remained significant after stratifying for the purpose of using this equipment: educational *vs.* recreational. The Technology Acceptance Model 2[33] suggests that the intention to use a particular technology involves the perceived ease of access, social influence and the subjective norms proposed by society. Access and/or having a computer and the use of programs and systems result in greater adolescent use of this equipment and its perception as a status symbol. In addition, the computer is a means to disseminate virtual games, seek social relations and entertainment.

Better perceived HRQoL for the psychological well-being and social support dimensions of peers associated with the use of computers may be related to the fact that having access to this material good, mainly connected to the internet, expands the possibilities of obtaining it quickly and disseminating different contents such as, for example, social media, where young people can make this one of the communication channels, thus promoting a greater sense of belonging to the desired social groups. Another factor that can explain this relationship is that adolescents with greater access to computers can reflect on a scenario of families with better socioeconomic conditions (higher income and educational level of parents), housing, and social relationships among its members. In recent years, the number of households with the use of computers and internet access has been increasing[34]. In particular, in the present study, as they are low-income students (most of the C and D/E classes), it is possible that the adolescents who reported using the computer would be those with the best socioeconomic status. These factors can improve the perception of indicators such as psychological well-being and peer social support in adolescents. However, it should be warned that the excessive

use of screen devices, including the computer, can contribute to health problems such as difficulties in relating to family members and people around them[35], depression[9], and anxiety[10].

In this study, no significant associations were identified between time watching television and the HRQoL dimensions. In recent years, the time spent by adolescents watching television has decreased and the use of computers, tablets, video games, and cell phones has increased[36]. Data from the National School Health Survey – PeNSE of 2009[37] and 2015[38], showed a reduction in the proportion of students from public schools in the city of João Pessoa, Paraiba, who spent more than two hours watching television, from 80.3% to 65.1%. This migration from television to new digital platforms may explain its absence in the association with HRQoL observed in the present study.

However, it is important to underscore the negative effects on physical and mental health[10] of excessive computer use, as well as the adoption of strategies with parents to reduce the likelihood of adolescents' replacing active with sedentary behaviors. For example, Babey *et al.*[39] found that the lack of knowledge parents have about activities that can be developed in their children's free time was related to the latter's prolonged screen time. Thus, strategies that involve parents' or caregivers' knowledge of open and safe places in their neighborhood may help increase physical activity, as well as develop social relationships between adolescents and the community.

Total time spent on sedentary behavior was not associated with HRQoL, which may have occurred because the accelerometer measures the time spent on all sedentary behaviors including, for example, class time, book reading, school-related tasks, meals and displacements. Another explanation may be the limitations of these devices and the cutoff points, used to measure and establish sedentary behavior time. This could have masked the specific associations between certain sedentary behavior and the different dimensions of HRQoL. The significant associations found between sedentary behavior and HRQoL were observed in studies that considered screen time, watching television[5], using the computer and/or videogames/cell phones/tablets separately[8].

The inverse association found between playing videogames and psychological well-being, social support and peer group and the school environment demonstrates how specific sedentary behaviors can be harmful to

adolescents' HRQoL. These findings indicate how much the sedentary behaviors interferes with routine issues such as social engagement of adolescents and are supported by theories that we have already presented, such as the replacement of time in physical and social activities by screens and on-line games.

Future studies could use quantitative-qualitative approaches to better understand the relation between specific types of sedentary behavior and the dimensions of HRQoL. Another challenge is to establish "adequate" vs "inadequate" levels of screen time exposure and total sedentary behavior time, considering the different measuring devices.

The results identified in this study are limited to adolescents aged 10 to 13 years old and from public schools, considering that the perceptions about the domains of HRQoL and sedentary behaviors in which adolescents are involved change with age and can be different among adolescents from public and private schools due to their sociodemographic and economic characteristics. The strengths of this study are that it was conducted with a sample of adequate size

to test the proposed hypotheses; data collection was carried out by a previously trained team that were unaware of the hypotheses, used validated instruments and combined objective and subjective measures of sedentary behavior. This is also one of the first Brazilian studies analyzed the relation between different types of sedentary behavior (television, computer, videogame and cellphone time) and HRQoL in adolescents, using questionnaires and accelerometers.

In conclusion, associations between time spent on sedentary behaviors and HRQoL varied with the type and method of sedentary behavior measurement and the HRQoL dimension. Time spent on videogames/cell phones/tablets exhibited a negative relation with a large number of HRQoL dimensions (psychological well-being, social support, peer group and school environment), in addition to overall score. Using a computer was related to higher overall HRQoL, psychological well-being, social support and peer group scores. Screen time were associated with lower HRQoL levels for physical well-being and school environment, respectively. The objective measure of sedentary behavior was not associated with HRQoL levels.

Collaborations

Lucena JMS and Farias Júnior JC participated in the conception, study planning, data collection and analysis and writing of the manuscript. Silva ECC participated in the collection and analysis of data and writing of the manuscript. Loch MR did a critical analysis and review of the study.

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