Epidemiology

Physical activity, TV viewing, and human development index in Brazilian adolescents: Results from the National School Health Survey

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Abstract - aim: This study aimed to examine the association between physical activity (PA) indicators and TV viewing as a function of the Human Development Index (HDI). **Method:** This cross-sectional study was based on data from the National School Health Survey, which was composed of 102,072 students (14.28±1.03; 51.3% girls). Total PA, active commuting to school (ACS) and TV viewing were assessed by questionnaires and classified through a gradual scale ranging from "F" (low) to "A+" (high). The correlation between total PA, ACS, TV viewing and HDI was verified by Spearman's Correlation and presented in r_s. **Results:** HDI was positively associated with total PA [girls: $r_s = 0.572$ ($p < 0.001$); boys: $r_s = 0.843$ ($p < 0.001$)] and ACS [girls: $r_s = 0.433$ ($p < 0.001$); boys: $r_s = 0.554$ ($p < 0.001$)]; while a negative correlation was found between HDI and TV viewing [girls: $r_s = -0.330$ ($p < 0.001$); boys: $r_s = -0.348$ ($p < 0.001$)]. **Conclusions:** Brazilian adolescents from states with higher HDI were more active and spent more time watching TV than their counterparts from states with lower HDI.

keywords: Brazil, motor activity, sedentary behavior, social inequity.

Introduction

Regardless of the age group, physical inactivity and sedentary behavior are public health concern worldwide[1]. In this way, a study has shown that TV viewing, rather than total sedentary time, seems to be a better predictor of cardiovascular risk in children and adolescents[2]. In addition, adolescents who are less active and/or accumulate more hours watching TV are more likely to develop non-communicable disease[2,3]. On the other hand, being active during the childhood and adolescence may promote a set of other health benefits, such as improvements in cognitive profile and academic achievements[4].

In order to support agendas regarding physical activity (PA) promotion, especially to risk groups (i.e., those less active), studies identified the prevalence of adolescents who reach the global PA recommendations worldwide[5,6]. In Brazil, it is estimated that the percentage of adolescents who fail to achieve international recommendations is between 61% and 80.1%[5,6], whereas the prevalence of excessive TV viewing is about 58.8%[7]. However, these values are regarding the entire country. Considering Brazil's continental dimensions, few studies used cross-national data to analyze inequalities in PA and TV viewing within each country state[7–9]. In a previous research, scores were used to classify the national prevalence of PA and sedentary behavior among Brazilian adolescents. But the values were not presented stratified by states and the Federal District[9].

Health researchers also suggested that different health indicators[10], such as mortality by stroke[11] and PA[5], may be influenced by socioeconomic indicators. In this sense, to identify the role of socioeconomic indicators on PA in adolescents support interventions regarding health inequalities. Development stages from different countries and regions are commonly assessed through the Human Development Index (HDI), composed of information regarding life expectancy, education, and per capita income. HDI can range from 0 (low) to 1 (high), thus, it is expected that a given location will be further developed as its HDI approaches 1. Brazil has a large territory with known social inequalities between its states. In this context, we hypothesized that adolescents living in more developed areas may present higher PA levels, including more active commuting to school (ACS), and spend less time watching TV. Thus, identifying possible differences in PA or TV viewing profiles across the country can support more assertive public health policies, mainly to the groups most exposed to health risk behaviors. Considering this set of information, this study aimed to examine the association between PA indicators and TV viewing as a function of HDI.

Methods

This cross-sectional study was based on data from the National School Health Survey 2015 (PeNSE). The PeNSE is a school-based survey conducted in Brazil every three years, in order to assess the risk factors for health in students enrolled in public and private schools from all the Brazilian Regions (i.e., North, Northeast, Midwest, Southeast and South)[12]. We analysed

the entire sample of PeNSE, composed by 102,072 adolescents (51.3% girls, 14.28±1.03 years old) enrolled in the 9th grade of the basic education (equivalent to Junior High School level), selected from a probabilistic sampling process, which included schools from 26 state capitals, in addition to the Federal District, and 26 other cities, resulting in 53 strata. In the capital cities, the sampling process was carried out in two stages (schools as primary units and classes as secondary units); in other municipalities, stratification involved three stages (municipalities as primary units, schools as secondary units and classes as tertiary units). More details about PeNSE 2015 sampling process are available in a previous report[12].

Assessments

The assessments were verified through questionnaires and included data about PA, ACS and time spent watching TV during weekdays. These variables were classified according to the Global Matrix[5]. The Global Matrix is a cross-national initiative that analysed global variation in PA among children and adolescents from different countries using harmonized indicators of overall PA (e.g., sedentary behavior, active commuting). These indicators vary from F (low) to A + (high) and their construction considers the percentage of individuals who reach the recommendations for each of the outcomes, as shown in Chart 1.

Chart 1- Grades used to sort TV viewing, physical activity, and active commuting to school.

Grade	Percentage of adolescents who met the recommendations for each outcome
A+	94-100
A	87-93
A-	80-86
B+	74-79
B	67-73
B-	60-66
C+	54-59
C	47-53
C-	40-46
D+	34-39
D	27-33
D-	20-26
F	<20

Physical activity (PA) and Active Commuting to School (ACS)

The total PA was estimated by the sum of active time during physical education classes (PE), ACS, and active time outside school. The assessment of PA domains was made according to the following steps: 1) **The active time during PE**, which was estimated by multiplying the answer/results of the following questions: a) "*How many days did you take physical education classes at school?*"; b) "*How much time per day did you do physical activity or sport during physical education classes at school?*"; **2) The ACS** referred to active transportation (walking or riding a bicycle) used from home to school and from school to home, in the last seven days prior to the survey, which was estimated by the following questions: a) "*In the last 7 days, how many days were you walking or riding a bicycle to school?*"; b) "*When you go to school on foot or by bicycle, how much time do you spend?*"; c) "*In the last 7 days, how many days did you get back on foot or by bicycle from school?*"; d) "*When you come back from school on foot or by bicycle, how much time do you spend?*"**; 3) Activities performed outside school** referred to the engagement in some extra-school PA in the last seven days prior to the survey, which was estimated by the following questions: a) "*In the last 7 days, except for school physical education classes, how many days did you engage in any physical activity, such as sports, dancing, gymnastics, bodybuilding, wrestling or other activity?*"; b) "*Usually, how long per day did you do these activities (such as sports, dance, gymnastics, bodybuilding, wrestling or other activity)? (Not counting physical education classes)"*. For analysis purpose, considering total PA and ACS as outcomes of this study, those who meet ≥300 minutes/week in total PA were classified as "active"; while those who went to/from school ≥ 5 times per week were classified as "active commuting"[8].

TV viewing

TV viewing was assessed through the questions: "*On a typical weekday, how many hours a day do you watch TV? (do not count Saturday, Sunday and holiday)*". For statistical analysis, the cut-off of >2 hours/day was used to identify excessive TV viewing, based in previous studies carried out with Brazilian samples[7].

Human development index (HDI)

The HDI (referring to 2010) of each Brazilian state was obtained in the website of the Brazilian Institute of Geography and Statistics[13].

Data analysis

Descriptive statistics were performed by absolute and relative frequencies, in which the grades developed by Global Matrix[5] were used to classify each outcome according to the Brazilian state. The Kolmogorov-Smirnov revealed non-normality distribution of the outcomes. Hence, we used the Spearman Correlation models to each outcome according to sex, with state-specific percentage of adolescent reaching PA levels, TV viewing, and ACS as outcomes, and HDI as predictor. All statistical analyses were performed in SPSS® 22 (IBM, Armonk, New York, USA), with the statistical significance level of $p \leq 0.05$.

Results

The sample's characteristics are presented in Table 1. The average age was 14.27 years old, and no differences were observed between girls and boys. Boys were more active compared to girls. Slight differences were also observed in ACS and time watching TV, in which boys presented higher ACS and spent less time watching TV.

Table 1- Sample characteristics by sex.

	Girls	Boys	Total
	Mean or % (95% CI)	**Mean or % (95% CI)**	**Mean or % (95% CI)**
Age (years)	14.19 (14.18; 14.20)	14.38 (14.36; 14.39)	14.28 (14.27; 14.29)
Physical activity			
Ative	25.4 (24.7; 26.1)	44.0 (43.2;44.8)	34.5 (33.9; 35)
Inactive	74.6 (73.9; 75.3)	56.0 (55.2; 56.8)	65.5 (65.0; 66.1)
Mode of commuting to school			
Active	45.5 (44.7; 46.3)	43.2 (42.5; 44.0)	44.3 (43.8; 44.9)
Passive	54.5 (44.7; 55.3)	56.8 (56.0; 57.5)	55.7 (55.1; 56.2)
TV time			
Up to 2h	41.9 (41.1; 42.7)	38.7 (38.0; 39.49)	40.2 (39.7; 40.8)
>2h	58.1 (57.3; 58.9)	61.3 (60.6; 62.0)	59.8 (59.2; 60.3)

Data regarding achieved grades in PA, ACS and TV viewing according to the Brazilian region/state are presented in Table 2.

In general, all states localized in the Northeastern region achieved PA score between "D-" to "D", while in other states the score the most frequent was "D+". Regarding TV viewing, only states located in Northern and Northeastern Brazil scored "C". When we evaluated the sex differences, girls showed lower PA grades in all states, while PA grades ranged from "D+" to "C" for boys among states. Regarding TV viewing, both sexes presented similar results (ranged from "D+" to "C"), as presented in Figure 1.

Table 2- Sociodemographic data from all Brazilian states and their respective grades of TV viewing, total physical activity, and active commuting to school.

Brazilian region/state	Human development index	TV viewing	Physical activity	Active commuting to school
North				
Rondônia	0.690	C-	D+	C-
Acre	0.663	C-	D+	C-
Amazonas	0.674	C	D+	C-
Roraima	0.707	C-	D+	D+
Para	0.646	C-	D	C-
Amapá	0.708	D+	D+	C-
Tocantins	0.699	C-	D+	C
Northeast				
Maranhão	0.639	C	D	C-
Piauí	0.646	C-	D-	D+
Ceará	0.682	C	D	D+
Rio Grande do Norte	0.684	C-	D	D+
Paraíba	0.658	C-	D	C-
Pernambuco	0.673	C-	D	C
Alagoas	0.631	C-	D	C-
Sergipe	0.665	D+	D	D+
Bahia	0.66	C-	D	C-

Southeast				
Minas Gerais	0.731	D+	D+	C
Espirito Santo	0.740	C-	D+	C+
Rio de Janeiro	0.761	D+	D+	C
São Paulo	0.783	D+	D+	C-
South				
Paraná	0.749	C-	D+	C-
Santa Catarina	0.774	C-	D+	C-
Rio Grande do Sul	0.746	C-	D+	C
Midwest				
Mato Grosso do Sul	0.729	C-	C-	C-
Mato Grosso	0.715	C-	D+	C-
Goiás	0.735	C-	D+	C-
Distrito Federal	0.824	C-	C-	C-

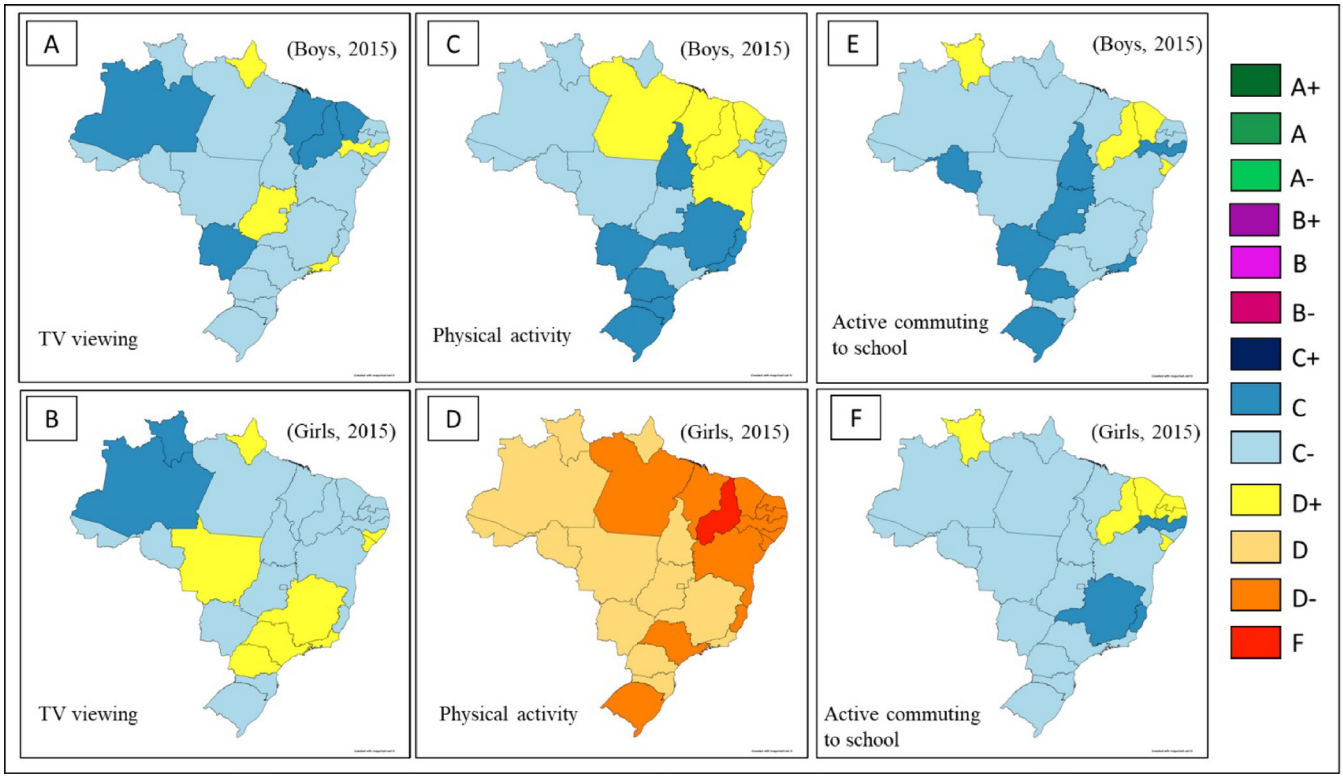

Figure 1 - Prevalence of Brazilian adolescents who reach guidelines for TV viewing [girls (A) and boys (B)], Physical activity [girls (B) and boys (E)], and Active commuting to school [girls (C) and boys (F)].

The correlation analysis showed that HDI was positively associated with PA [girls: r_s = 0.572 (p<0.001); boys: r_s = 0.843 (p<0.001)] and ACS [girls: rs = 0.433 (p<0.001); boys: rs = 0.554 (p<0.001)]; and negatively associated with TV viewing [girls: r_s = -0.330 (p < 0.001); boys: r_s = -0.348 (p<0.001)], (Figure 2).

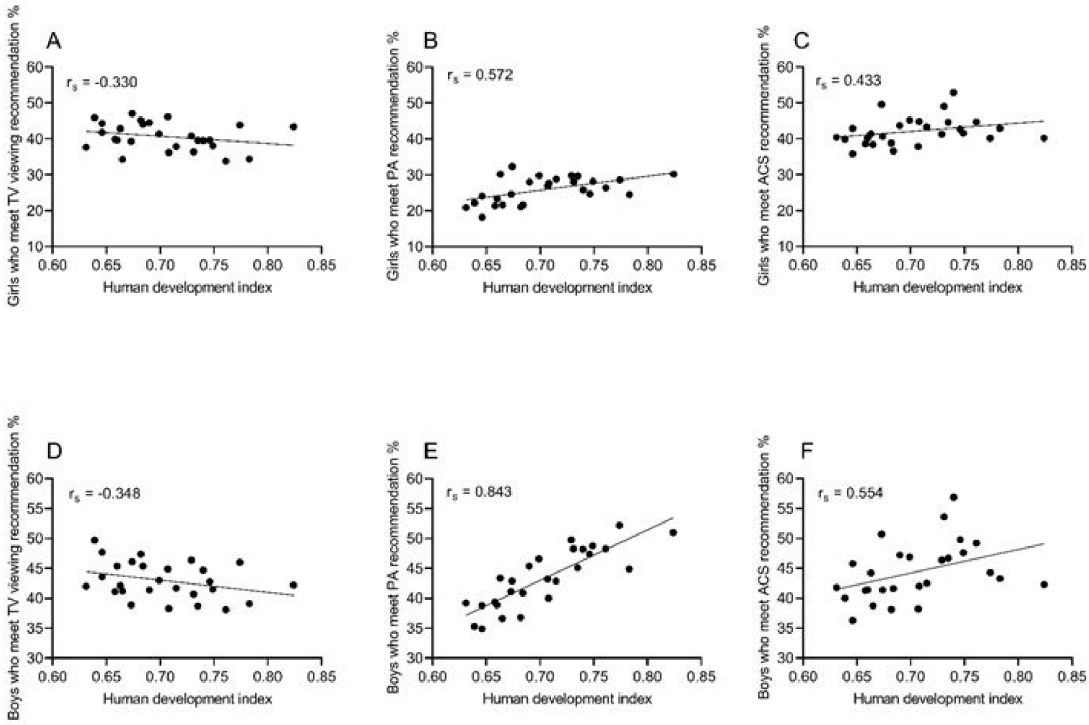

Figure 2 - Correlation between Human Development Index and meeting guidelines for TV viewing among girls (A) and boys (D), PA among girls (B) and boys (E), and ACS among girls (C) and boys (F) in Brazilian students. PA: physical activity. ACS: active commuting to school.

Discussion

We aimed to examine the association between PA indicators and TV viewing as a function of the HDI. Few studies investigated indicators of PA and TV viewing considering the country's inequalities, which should be especially important for large countries, such as Brazil. We observed that the scores of TV viewing were similar for both sexes, ranging from D+ to C-. Therefore, our results showed that regardless of state, few girls and less than half of boys achieved PA guidelines. The ACS was rated as a "C-" in most of the Brazilian states, for both sexes. Moreover, the correlation analyses revealed that HDI was negatively associated with TV viewing, and positively associated with PA and ACS among Brazilian adolescents.

Brazilian adolescents who live in states with higher HDI tended to accumulate more TV time. These data are in accordance to the Global Matrix 3.0, which suggests that high screen time among adolescents is of greater concern in high and very high HDI countries[5] . The Brazilian Institute of Geography and Statistics revealed that the North region presented more prevalence of households without television, while the Southeast the lower. This information can help to understand the relationship between HDI and TV viewing. Corroborating these findings[14], a study pointed out the positive association between number of TVs in household and screen time[15]. In addition, negative effects of sedentary behaviors on health have been presented in the scientific literature, in which those who spend more than 2h/day watching TV are likely to show lower levels of PA and other health indicators, such as psychosocial health when compared with their peers who meet TV viewing guidelines[16]. Thus, reducing sedentary behaviors, including TV viewing, may benefit Brazilian adolescents, especially those who live in states with high HDI. Furthermore, researches can be used to guide interventions aiming to reduce sedentary behaviors among adolescents in different contexts, such as home[17] and during school time[18].

We also found a positive association between HDI and PA, for both sexes. Similarly, a study comprising adolescents from 47 low-to-middle income countries showed a negative association between HDI and physical inactivity[19]. This relationship seems to be related to a greater opportunity of engagement in PA due to the presence of parks, playgrounds, and sport courts in states with the highest HDI[20,21]. Moreover, physical education lessons and active time at school can be a source to increase PA among adolescents. A study carried out in Brazil presented that those enrolled in schools from regions with better HDI are more likely to have more PE per week, which can help students to reach PA guidelines[22].

The specific indicator of ACS was also positively associated with HDI, indicating that those who live in states with higher HDI are more likely to be active in their transport to/from school. In developing countries, ACS has been identified as "necessity-driven" and is the most frequent mode to go/return

from schools by adolescents from these regions[23,24]. Our study is not able to present information about the socioeconomic level of the subjects; however, some information may help to explain the higher prevalence of ACS among the most developed states. For example, Brazilian states with low HDI have a higher prevalence of people living in rural areas compared with states with high HDI[25]. In this sense, the Brazilian Government provides free-of-cost motorized transportation to those who live far from schools. According to specific regulations, this is important to promote access and adherence to education; however, it may be associated with passive commuting[26], but more studies are needed to clarify "barriers" and "facilitators" to ACS among different Brazilian states.

Our study presents a limitation that must be mentioned: the values of PA and TV viewing can be overestimated[27] or underestimated[28], respectively, when assessed by a self-reported questionnaire. Given that the PA level was estimated by self-reported questionnaires, we cannot identify the intensities of each activity accurately. In addition, sedentary behavior was also estimated by a single question about time watching TV. Although sedentary behavior is more complex than just "TV viewing", studies have been using this variable as a proxy of sedentary behavior[29]. Strengths of this study include the mapping of Brazilian's pattern of PA and TV viewing in adolescents, according to the HDI of each state. In addition, we used a large representative adolescents' sample (n = 102,072), allowing extrapolation of our results and improving external validity.

In summary, higher HDI was associated with higher PA levels and more time watching TV among Brazilian adolescents. This data are useful for both public health policymakers and for those who are in direct contact with adolescents (e.g., physical education professional [teachers], health practitioners, parents). Policymakers may propose more specific initiatives aiming to promote PA in less developed areas of Brazil. This may include the development of safer environments for ACS. Teachers, health practitioners, and parents may also promote PA in adolescents' routines. For example, the promotion of more active time during PE, active time outside school, ACS, and health education (e.g., showing the consequences of health risk behaviors).

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