Original Article

AGGREGATION OF EXCESSIVE SEDENTARY BEHAVIORS IN SCHOOLS

AGREGAÇÃO DE COMPORTAMENTOS SEDENTÁRIOS EXCESSIVOS EM ESCOLARES

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RESUMO

Objetivo: Estimar a prevalência e os fatores associados à agregação de quatro comportamentos sedentários excessivos (tempo de tela assistindo à TV durante a semana, tempo de tela assistindo à TV no final de semana, tempo de tela usando computador durante a semana e tempo de tela usando computador no final de semana) em escolares da rede pública de Jequié, Bahia. **Métodos:** Estudo transversal com amostra de escolares do ensino médio da rede estadual de ensino em uma cidade do interior da Bahia, Brasil. Os comportamentos sedentários avaliados incluíram o tempo de tela assistindo à televisão e utilizando computador ou videogame durante e ao final de semana. Variáveis sociodemográficas e de estilo de vida foram analisadas como fatores associados à agregação dos quatro comportamentos sedentários excessivos (desfecho). A associação foi estimada pela Razão de Prevalência (RP) com intervalo de confiança (IC) de 95%. **Resultados:** A amostra foi composta por 972 escolares, com maior proporção de adolescentes do sexo feminino (53,4%; n = 519). Os maiores índices de prevalência de comportamentos sedentários excessivos foram observados no tempo de tela assistindo à TV e utilizando computador/videogame aos finais de semana (24,6% e 25,1%, respectivamente). **Conclusões:** Foi identificado um elevado nível de agregação, com a combinação das prevalências observadas superando as esperadas para os quatro comportamentos sedentários excessivos. Escolares do sexo feminino apresentaram menor probabilidade de exposição ao desfecho. Contudo, adolescentes que não trabalhavam, eram insuficientemente ativos e não atingiam o consumo adequado de verduras apresentaram maior probabilidade de agregação dos quatro comportamentos sedentários.
Palavras-chave: tempo de tela; comportamento de risco à saúde; comportamento do adolescente; análise por conglomerado, estilo de vida.

ABSTRACT

Objective: To estimate the prevalence and identify factors associated with the aggregation of four excessive sedentary behaviors (screen time watching television during weekdays and weekends, and screen time using computers/video games during weekdays and weekends) among public school students in Jequié, Bahia, Brazil. **Methods:** A cross-sectional study was conducted with high school students from the state school system in a city in Bahia, Brazil. The sedentary behaviors evaluated included screen time watching television and using computers or video games during weekdays and weekends. Sociodemographic and lifestyle variables were analyzed as predictors to identify factors associated with the aggregation of these behaviors (outcome). Associations were estimated using the Prevalence Ratio (PR) with a 95% confidence interval (CI). **Results:** The sample comprised 972 students, with a higher proportion of females (53.4%; n = 519). The highest prevalence of excessive sedentary behaviors was observed for screen time spent watching television and using computers/video games during weekends (24.6% and 25.1%, respectively). Female students were less likely to exhibit the aggregation of the four sedentary behaviors. However, students who were unemployed, insufficiently active, or did not consume adequate amounts of vegetables were more likely to exhibit the aggregation of these behaviors. **Conclusions:** A high level of aggregation of excessive sedentary behaviors was observed among the students. Sociodemographic and lifestyle factors, such as physical inactivity and inadequate dietary habits, were significant contributors to this outcome.
Keywords: screen time; health risk behavior; adolescent behavior; cluster analysis; lifestyle.

Introduction

Adolescence is a stage characterized by the need for individual and social development, as well as the transition to adulthood[1,2]. During this period, human development occurs in a constant and dynamic manner, encompassing biological, psychological, and cognitive changes, in addition to physical growth, neurological maturation, and the development of skills related to behavior and the environment[3]. It is precisely at this stage that behavioral patterns often considered inappropriate begin to consolidate[4].

A set of activities with energy expenditure close to resting values is known as sedentary behavior (SB), generally performed in a sitting, lying, or reclining position. These activities

include playing video games, talking with friends, speaking on the phone, and watching television (TV)[5]. Among the most commonly used criteria to estimate risks are the time spent watching TV, using a computer (PC), playing video games, or using a smartphone (screen time), with excessive exposure defined as spending more than two hours per day on these activities[6,7]. SB has been the subject of public health alerts due to its direct impacts on the development of noncommunicable chronic diseases (NCDs), such as cardiovascular, renal, endocrine, neuromuscular, and musculoskeletal disorders, as well as its socioeconomic repercussions for the individual, family, and society[5,8].

Risk factors among adolescents include unhealthy eating habits, insufficient physical activity (IPA), substance abuse, sleep disorders, suicidal ideation, exposure to violence, and excessive screen time[9,10]. Data from an epidemiological study conducted with Indian schoolchildren revealed that 45% of participants practiced dietary restriction, 19.2% experienced loneliness, 18.25% presented sleep disorders, and 8.8% reported suicidal thoughts. Additionally, 3.9% smoked, 3.9% consumed alcohol, and 1.8% used drugs, while the prevalence of screen time exceeding three hours was 29.5%[9].

In Brazil, the National School Health Survey (PeNSE)[11] analyzed data from 26 state capitals and the Federal District. The survey estimated a prevalence of excessive television viewing of 78.6% in 2012 and 60.0% in 2015 among schoolchildren with a mean age of approximately 15 years. Regarding screen time using a computer or video game, the 2015 survey reported a prevalence of 56.1%. This reduction likely reflects a shift from television viewing to activities involving computers or video games.

The available evidence in the literature largely reports prevalences and associated factors in isolation[10,12,13]. Studies on the aggregation of excessive sedentary behaviors (ESB), lifestyle-related risk factors (insufficient physical activity, inadequate eating habits, alcohol consumption, and tobacco use), and sociodemographic factors among Brazilian schoolchildren are limited and often focus on specific populations, disregarding regional needs and cultural and sociodemographic contrasts[14]. Such differences are directly related to simultaneous exposure to health risk factors[15].

Given the discrepancies in prevalence and associated factors for different types of ESB based on screen time, as well as the predominance of studies in large urban centers and higher-income regions that address behaviors in isolation, the present study aimed to estimate the prevalence and factors associated with the aggregation of ESB among public school students in Jequié, Bahia.

Methods

Sample

This is a cross-sectional epidemiological study linked to a larger project entitled "Health risk behaviors among high school students in Jequié, Bahia." The first data collection was carried out in 2015, and the most recent in 2023, both with representative samples from state schools located in the urban area of the municipality of Jequié, Bahia.

The study was conducted in Jequié, Bahia, a city located in the southwestern region of the state, approximately 370 km from Salvador. The 2023 study population comprised 4,222 students from 138 classes in 10 public state high schools in the urban area, offering classes in both morning and afternoon shifts.

Procedures

The sample was determined using a cluster random sampling calculation for a finite population, applying the design effect (deff)[16]. A 95% confidence interval was adopted, and an

additional 20% was added to account for losses or refusals, resulting in an expected sample of 1,406 students aged between 14 and 21 years.

All state high schools located in the urban area and offering morning and afternoon classes were included (n = 10), with no refusals from school administrators. Schools located in rural areas were excluded (n = 3). Classes were stratified with probability proportional to the size of the schools, and 47 classes were randomly selected, considering an average of 31 students per class.

Data collection was carried out in stages, including prior authorization from the coordinators; approval of the human research ethics protocol by the university; scheduling and prior visits to the schools to present the project to administrators; invitation and delivery of consent and assent forms; verification of the number of classrooms and students per class; and administration of the instrument in the randomly selected classes. Before data collection, the research team received training on the application of the instrument, with a simulation among team members to clarify any doubts.

Data Collection Instrument

The data collection instrument was an adaptation of the COMPAC II questionnaire[17], which demonstrated good reproducibility indices (0.51 to 0.97) and an average completion time of 14 minutes for students. Data collection took place in classrooms between August and October 2023, conducted by previously trained researchers.

The outcome variables were self-reported by the students, as described in Chart 1.

Outcome variable	Question
Weekday television viewing (TVW)	"On a typical weekday, how many hours per day do you watch television?"[17]
Weekend television viewing (TVE)	"On a typical weekend day, how many hours per day do you watch television?"[17]
Weekday computer/video game use (CVW)	"On a typical weekday, how many hours per day do you use a computer and/or play video games?"[17]
Weekend computer/video game use (CVE)	"On a typical weekend day, how many hours per day do you use a computer and/or play video games?"[17]

Chart 1. Outcome variables.
Source: The authors.

For analysis, screen time variables were categorized as less than two hours per day and two hours or more per day. Screen time of two hours or more per day was considered excessive sedentary behavior[17]. Predictor variables included sociodemographic characteristics: sex (male and female); age group in complete years (under 16 years and 16 years or older); occupation (employed and unemployed); marital status (single and married/other); maternal education (less than eight years of schooling and eight years of schooling or more); and monthly family income (less than two minimum wages and two minimum wages or more). In 2023, the minimum wage corresponded to R$ 1,320.00.

For physical activity level, at least five days per week with 60 minutes of daily moderate-to-vigorous intensity activity was considered sufficient[18]. Those who did not meet this criterion were classified as insufficiently active. Fruit and vegetable consumption was assessed by considering a daily portion (fruit or vegetables)[17], categorized as inadequate (less than five days per week) or adequate (five days per week or more).

Statistical analysis

Aggregation was considered when the combination of the observed prevalence (OP) of the risk behaviors exceeded the expected prevalence (EP). The EP for each combination was

obtained by multiplying the individual probability of occurrence of each behavior. For example, assuming the observed prevalences are: TVW = 32.4%; TVE = 40.2%; CVW = 27.0%; and CVE = 37.1%, aggregation would be calculated as $0.324 \times 0.402 \times 0.270 \times 0.371 = 0.065$ (6.5%). If the EP were 1.3%, the OP/EP ratio would be 4.98, indicating aggregation when OP/EP > 1[19,20].

Poisson regression with robust variance was used to examine the relationship between the dependent variable (exposure to all four aggregated behaviors) and the independent variables (sociodemographic and lifestyle), adjusting for confounders with $p < 0.20$. The significance level adopted for all analyses was $p < 0.05$.

Due to missing data in some variables, the number of observations (n) differs between analyses, as cases with unavailable information were excluded specifically in each model.

Ethical Aspects

The study followed the principles of the Declaration of Helsinki No. 466/12 and was approved by the Research Ethics Committee of the State University of Southwest Bahia (protocol No. 5.662.326, CAAE: 33526014.10000.0055). Students under 18 years of age provided parental authorization, and those aged 18 years or older signed the informed consent form.

Results

This section presents the results regarding the prevalence and aggregation of ESB among schoolchildren, as well as the associations with sociodemographic and lifestyle variables.

The planned sample consisted of 1,406 students, but there were 28.3% (n = 399) refusals and 2.5% (n = 35) losses. Thus, the final sample comprised 972 students, maintaining the proportion and representativeness of the population, as all classes initially planned in the sampling were included. The sample consisted of 53.4% (n = 519) female students. The highest prevalence of ESB was observed for weekend screen time watching TV and using computers/video games (24.6% and 25.1%, respectively), as presented in Table 1.

Table 1. Descriptive characteristics of the sample. Jequié, BA, 2023

Variables	%	n
Outcomes		
Dependent variables		
TVW		
< 2 hours/day	81.5	846
≥ 2 hours/day	14.9	148
TVE		
< 2 hours/day	75.4	698
≥ 2 hours/day	24.6	228
CVW		
< 2 hours/day	83.9	826
≥ 2 hours/day	16.1	159
CVE		
< 2 hours/day	74.9	692
≥ 2 hours/day	25.1	232
Sociodemographic variables		
Sex		
Female	53.4	519

Male	46.6	493
Age (years)		
< 16	33.9	339
≥ 16	66.1	662
Occupation		
Does not work	74.5	744
Works	25.5	254
Maternal education (years of schooling)		
< 8 years	23.8	238
≥ 8 years	76.2	764
Monthly family income (minimum wages)		
< 2 minimum wages	74.5	713
≥ 2 minimum wages	25.5	244
Lifestyle variables		
Fruit consumption		
Inadequate	58.8	578
Adequate	41.2	405
Vegetable consumption		
Inadequate	57.2	559
Adequate	42.8	418
Physical activity level		
Sufficiently active	56.7	566
Insufficiently active	43.3	432

Note – CI: Confidence Interval.
Source: The authors.

Table 2 presents the estimated prevalence of aggregation of the four ESB (1.8%). Among the sixteen combinations of behaviors assessed, six showed OP/EP values greater than 1 (95% CI). Notably, the presence of all four ESB exhibited a high aggregation value (OP/EP = 12.15; 95% CI: 12.1–12.2), where the observed prevalence exceeded the expected by twelve times.

Table 2. Estimated prevalence and aggregation of sedentary behaviors, Jequié, BA,Brazil, 2023

	Combinations of				OP (%)	EP	OP/EP (95% CI)
N	**TVW**	**TVE**	**CVW**	**CVE**			
0	-	-	-	-	48,4	40,3	**1,2 (1,15-1,25)**
1	+	-	-	-	2,4	7,1	0,34 (0,03-0,65)
1	-	+	-	-	8,7	13,2	0,66 (0,38-0,94)
1	-	-	+	-	1,6	7,7	0,21 (-0,1-0,52)
1	-	-	-	+	6,9	13,5	0,51 (0,23-0,79)
2	+	+	-	-	6	2,3	**2,60(2,26-2,95)**
2	+	-	+	-	0,5	1,4	0,37 (0,03-071)
2	+	-	-	+	0,4	2,4	0,17 (-0,17-0,5)

N	TVW	TVE	CVW	CVE	OP	EP	PR (95% CI)
2	-	+	+	-	0,2	2,5	0,08 (-0,26-0,4)
2	-	+	-	+	2,1	4,4	0,48 (0,14-0,81)
2	-	-	+	+	7,9	2,6	**3,05 (2,71-3,39)**
3	+	+	+	-	0,2	0,4	0,45 (0,17-0,73)
3	+	+	-	+	1,7	0,8	**2,20 (1,89-2,51)**
3	+	-	+	+	0,5	0,5	1,10 (0,82-1,38)
3	-	+	+	+	1,7	0,8	**2,01 (1,70-2,32)**
4	+	+	+	+	1,8	0,1	**12,15(12,1-12,2)**

Note: N – number of ESB present; (+) – behavior present; (–) – behavior absent; TVW – weekday television viewing; TVE – weekend television viewing; CVW – weekday computer/video game use; CVE – weekend computer/video game use; OP – observed prevalence; EP – expected prevalence; CI – confidence interval. Values in bold indicate aggregation of behaviors.
Source: Authors

In the adjusted analysis (Table 3), male students (PR = 3.90; 95% CI: 1.3–11.7) and those younger than 16 years (PR = 2.93; 95% CI: 1.14–7.57) showed a higher likelihood of exposure to the aggregated sedentary behaviors.

Table 3. Poisson regression analysis with prevalence ratio estimates for aggregation of the four behaviors, according to sociodemographic and lifestyle variables. Jequié, BA,Brazil 2023

Variables	Crude PR (95% CI)	p	Adjusted PR (95% CI)	p
Sociodemographic				
Sex				
Male	3,72 (1,22-11,3)	**0,02**	3,90 (1,3-11,7)	**0,01**
Female	1		1	
Age (years)				
< 16	3,13 (1,22-7,99)	**0,02**	2,93 (1,14-7,57)	**0,03**
≥ 16	1		1	
Occupation				
Does not work	1,72 (0,50-5,89)	0,39		
Works	1			
Maternal education (years				
< 8 years	0,40 (0,09-1,73)	0,22		
≥ 8 years	1			
Monthly family income				
< 2 minimum wages	0,82 (0,29-2,31)	0,71		
≥ 2 minimum wages	1			
Lifestyle				
Fruit consumption				
Inadequate	0,79 (0,31-2,02)	0,62		
Adequate	1			
Vegetable consumption				
Inadequate	0,94 (0,37-2,36)			
Adequate	1			
Physical activity level				
Insufficiently active	1,05 (0,42-2,63)	0,92		
Sufficiently active	1			

Discussion

The prevalence of excessive screen time was higher on weekends, especially for computer and video game use. National studies[7,21] and international studies[22,23] show significant variations in SB patterns, including television viewing time, highlighting differences in observed estimates. The present study identified greater exposure to excessive screen time among younger adolescents, particularly among boys. The risk of exposure to this outcome increased during the weekend. Corroborating our findings, data from an epidemiological survey conducted with students from public schools in Curitiba (PR) showed that male adolescents spend more time in SB than girls (boys: 9.4 hours/day; girls: 9.3 hours/day). These adolescents spend, on average, 3.7 hours per day in screen-based activities (boys: 4.2 hours; girls: 3.2 hours) and approximately 1.6 hours in educational or social service activities related to computer use, more frequently exceeding 2 hours per day[24].

Adolescents who spend long periods in front of screens, both on school days and non-school days, exhibit more detrimental health-related behaviors, such as lower physical activity, inadequate sleep, and poor adherence to a healthy diet. These conditions negatively affect their self-perceived health status. Furthermore, the associations between different types of screen time and other lifestyle behaviors may vary[25].

Adolescents' age was a significant predictor in this study's results. Similar findings were observed in southern Brazil, where older adolescents, especially girls, were less likely to exceed four daily hours of screen time, with a prevalence of 89.3% among adolescents[24]. Another study, conducted in the southwest of Bahia and published in 2023 using data collected in 2015, provided valuable demographic information. This study highlighted that most students with ST were under 16 years old, predominantly female, and from families with an income below two minimum wages. Furthermore, it found a prevalence of 77.9% of ST among high school students, evidencing the widespread presence of sedentary lifestyles in this population[26].

Factors such as sex and age appear to directly influence adolescents' screen time. Girls and older adolescents tend to spend less time engaged in SB screen-based activities, while younger and male adolescents generally exceed four daily hours using devices such as television and video games. However, girls seem to adopt this behavior less frequently[27], possibly because they engage in more physical activity during recess and after school, offsetting sedentary periods. Boys, on the other hand, who participate in more strenuous physical activities, often compensate with SB during leisure moments, such as playing video games[28].

The school environment and its curricular proposals often contribute to the perpetuation of prolonged SB, fostering a culture that can negatively affect students' health. This influence is frequently reinforced by extracurricular activities that also promote SB (watching TV, playing electronic or computer games, and using other screen devices)[29]. Conversely, Physical Education classes, especially when aimed at promoting physical activity, stand out as one of the most effective strategies for mitigating the harmful effects of sedentary behavior in children[30]. The cultural influence of the school environment in consolidating sedentary habits reinforces the need to develop effective interventions that promote more active lifestyles among school-aged children[29, 30].

Understanding these influences is essential to developing strategies that encourage adolescents, especially boys, to reduce screen time. Reducing screen exposure can positively impact other habits related to physical and mental health[31,32] as well as prevent long-term associated disorders such as obesity, type 2 diabetes, hypertension, and certain types of cancer[33].

Although our findings did not identify a direct association between SB and eating habits,

adolescents with excessive SB are more likely to consume food in front of the TV or other screens. We identified a high prevalence of inadequate fruit consumption (58.8%) and vegetable consumption (57.2%), habits that may increase the risk of NCD outcomes[34].

Practical Implications

We recommend integrating 5- to 10-minute active microbreaks every 50 minutes of class, which can reduce sitting time by up to 30% without the need for equipment[35]; adding interdisciplinary modules focused on nutritional education, including practical activities and partnerships with the school cafeteria, which have been shown to increase the choice of healthy snacks by 25%[36]; and promoting semiannual workshops for teachers on active teaching methodologies, which have reduced students' sedentary time by an average of 20–30% and reinforced the adoption of dynamic pedagogical practices.

Conclusion

This study aimed to estimate the prevalence and factors associated with the aggregation of four ESB among public school students in Jequié, Bahia. Overall, a high level of aggregation of the four ESBs was observed. Female students had lower odds of exposure to the outcome, whereas unemployed students, those classified as insufficiently active, and those not meeting the recommended vegetable intake were more likely to engage in all four SB.

Possible limitations of the study include the use of self-reported questionnaires, which, although validated and tested, may overestimate or underestimate the prevalence of behaviors. Furthermore, sleep patterns and mental health indicators, which may interact with screen time, were not assessed. Longitudinal and cohort studies are recommended to examine the association between screen time, mental health indicators, and sleep quality.

Nevertheless, this research addressed an emerging public health concern, ESB, which are particularly relevant among adolescents due to their short- and long-term health impacts. The approach used is innovative, as it explores a cluster of health risk behaviors. The aggregation metric applied is a methodological strength, providing a more detailed understanding of multiple behaviors.

The results have strong scientific relevance, offering robust evidence on ESB aggregation among adolescents and identifying more vulnerable subgroups. Such contributions are essential to support public health policies and the development of preventive strategies, especially targeted at the most affected students. Moreover, the methodology reinforces the importance of analyzing multiple behaviors simultaneously, broadening the understanding of their interactions and health implications.

Based on these findings, it is necessary to implement strategies that strengthen school-based interventions, promoting health, autonomy in physical activity, adequate eating habits, and a reduction in SB.

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