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Patterns of physical activity and sedentary behavior among Brazilian schoolchildren: analysis based on types of behavior

Lizziane Andrade Dias[1,2*†], Gilmar Mercês de Jesus[1†] and Graciete Oliveira Vieira[1]

Abstract

Background Studies on physical activity (PA) and sedentary behavior (SB) patterns contribute to planning specifically-population-targeted health interventions. However, most do not assess PA and SB based on types. The current study identified patterns of PA and SB based on types and their association with demographic factors (age, school shift) and weekly attendance in physical education classes (PEC) among schoolchildren.

Methods Students from 11 Brazilian public schools with part-time schedules participated in this cross-sectional study in 2019 ($n = 2,477$; 9.1 ± 1.38 years, 53.2% girls). Participants self-reported PA, SB, and weekly attendance PEC in an online questionnaire. Data on age and school shift were gathered from the Municipal Education Department. PA and SB patterns were identified through a two-step cluster analysis, stratified by sex. The associations between PA and SB patterns and age (7–9 years old; 10–12 years old), school shift (morning; afternoon), and weekly attendance PEC (0/week; 1/week; ≥2/week) were analyzed by Logistic Regression.

Results Among girls, two distinct patterns emerged: "Active players" (n = 549, 44.1%) and "Sedentary/Household chores performers" (n = 697, 55.9%); and three patterns among boys: "Active play/Structured PA practitioners" (n = 322, 29.8%), "Sedentary on screen" (n = 369, 34.1%), and "Sedentary on academic tasks" (n = 390, 36.1%). Weekly attendance in PEC was associated with the composition of patterns for both girls and boys. Among boys, the 'Sedentary on screen' group was more likely to be in the 10–12 years age group.

Conclusions Boys and girls exhibited different PA and SB patterns. Active play and household chores contributed to the cluster solution among girls, whereas sports contributed to the cluster solution among boys. Attending PEC increased the odds of participants belonging to clusters with higher PA and lower SB. Identifying patterns of PA and SB by type, along with their associated factors, could inform intervention studies and help shape actions at the school level to increase PA and reduce SB among schoolchildren.

Clinical trial number Not applicable.

†Lizziane Andrade Dias and Gilmar Mercês de Jesus contributed equally to this work. Graciete Oliviera Vieira writing-original draft, and review.

*Correspondence:
Lizziane Andrade Dias
lizzidias@yahoo.com.br

Full list of author information is available at the end of the article

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Background

Physical activity (PA) is associated with benefits for children and adolescents, such as improved cardiorespiratory fitness [1], mental [2] and musculoskeletal health, as well as obesity prevention and control [3]. Additionally, PA has been associated with improvements in attention, academic performance, and executive functions [4]. Conversely, sedentary behaviors (SB) are related to reduced cardiorespiratory fitness, unfavorable cardiovascular outcomes [5], and increased consumption of unhealthy foods [6].

However, the health outcomes associated with the combined impact of PA and SB seem to be restricted to cardiometabolic aspects [7, 8]. Children exhibiting higher PA levels present lower waist circumference and lower blood levels of fasting insulin and triglycerides, particularly when minimizing time spent on SB [7], nevertheless, these effects can occur regardless of PA level [8]. Furthermore, individuals meeting PA recommendations can at the same time devote a significant amount of their time to SB [9], and over the long term, even the reduced risk of death from all causes associated with high PA levels may be less effective if there is an excess of SB [10]. Thus, combined analysis could be more appropriate [11], as isolating a single behavior may not sufficiently elucidate an array of habits associated with certain health outcomes [12].

Thus, studies on behavior patterns using person-centered methodologies, such as cluster analysis (CA) and Latent Class Analysis, have been conducted to understand better the interactions between PA and SB [13]. Studies employing CA with data from children and adolescents reveal a predominance of mixed profiles, characterized by high PA and SB levels [14, 15], as well as low levels for both [12, 14], and, at last, high PA and low SB levels [16]. However, the pattern with a high level of SB seems to be more common [13, 14].

PA and SB patterns are generally associated with factors such as sex [12, 13, 14, 15], age [14, 15], socioeconomic characteristics [13, 15], and school attendance [17]. A recent study noted that variables such as active commuting, engagement in sports clubs, and physical education classes at school also influenced PA and SB patterns [18]. Aira et al. (2020) [18] found that students with more active patterns spent more time in physical education classes per week.

Studies on PA and SB patterns help plan better-adapted and specifically-population-targeted health interventions [13], nevertheless, most do not assess PA and SB in terms of types, such as sports, active play, structured physical activity, and others. Research based on the sorting out of types of behaviors allows us to identify how groups differ qualitatively from each other [19], enabling the description of which activities contribute to better health outcomes. It also aids in understanding the aspects that determine each group's involvement in different behaviors [20]. Additionally, knowledge about behavior types complements studies utilizing accelerometry to identify patterns [21].

In Brazil, few studies have analyzed PA and SB patterns in children aged seven to 12 years, which is a favorable period for implementing more effective interventions to encourage the adoption of healthy behaviors. Additionally, there are few studies analyzing patterns segmented by sex, even though preferences, motivation, and cultural aspects influence boys and girls in different way [22, 23, 24]. Previous studies showed that there are striking differences in the types of PA and SB in which girls and boys are commonly engaged [23]. Moreover, research examining patterns based on the types of PA and SB in children and adolescents has also reported differences between the sexes, with variations in the numbers and profiles of clusters [19, 20]. This approach aligns with arguments in the scientific literature that patterns are sex-specific [13].

As far as we know, only one study has evaluated the association of physical education classes (PEC) with different PA and SB patterns [18]. More studies analyzing this association are needed since PEC enables young people to develop skills to practice various types of PA and, at the same time, reduce time in SB [25, 26] including during free time [27].

Based on these aspects, the current study aimed to identify patterns of PA and SB based on types and their association with demographic factors and attendance frequency in physical education classes among Brazilian schoolchildren.

Materials and methods

Participants

A cross-sectional study was conducted in public elementary schools located in the urban area of Feira de Santana (northeast Brazil), ranked as the 33rd largest city in the country, with a population of 619,609 inhabitants in 2020, and a Human Development Index of 0.712 [28]. The sample size was determined considering a population of 15,920 students enrolled in 2nd to 5th grade classes, with an expected outcome prevalence of 50%, a margin of error of 3% points, and a design effect of 2.0 (due to cluster sampling). Thereby the sample size calculated was $n = 2{,}000$. Subsequently, an additional 20% was included to account for potential losses and refusals, resulting in a final sample size of 2,400 students.

The cluster sampling process involved three stages: (I) stratification of all elementary public schools in the urban areas based on the 11 geographic and administrative centers defined by the Municipal Education Department (which categorizes schools according to their geographic position, guiding the actions of the municipal education department); (II) random selection of one school from each center; (III) selection of participating classrooms (2nd to 5th-grades) within each school (159 classrooms), and invitation of all students in the selected classrooms to participate in the study. All 11 selected schools agreed to participate in the study.

Inclusion criteria comprised children with regular attendance (students did not miss classes during the study), parental authorization (Parents or guardians signed the Informed Consent Form), and expressing willingness to participate by personally reading and signing the consent form.

The study was authorized by the Research Ethics Committee of the State University of Feira de Santana (CAAE: 02307918.5.0000.0053; opinion number: 3.116.495). Data collection took place from March to October 2019, on weekdays (Tuesday to Thursday), during school hours.

Instrument for PA and SB assessment

PA and SB were assessed using an online self-administered questionnaire based on a previous-day recall: Web-CAAFE (available at: https://caafe.ufsc.br/portal/9/detalhes*).* This instrument was designed to gather informati on about the food consumption, physical activities, and sedentary behavior of Brazilian children aged 7–10 years. This questionnaire presented adequate acceptance, and ease of completion by children [29], as well as good validity and reliability when employed among students from Feira de Santana [30, 31].

The list of icons presented on the screen in the Web-CAAFE's screen contains one seated-position SB (e.g., homework, reading, writing, drawing, painting), four icons associated with the use of electronic devices (TV, video game, computer, and cell phone), and 27 icons categorizing physical activities into four groups: active play (play with a ball, play catch, soccer, dance, marbles, jump rope, gymnastics, elastics, play in the park, play in the water/swim, ride a bicycle, rollerblade/skateboard/ride a scooter, fly a kite, dodgeball, hide and seek, play with a dog, hopscotch), non-active play (board games, play with dolls/action figures, play with toy cars, spinning top/beyblade, listen to music, play musical instrument), structured PA (ballet, fight sports), and household chores (wash the dishes, sweep). A detailed description of culturally specific physical activity from Brazil can be found at: https://mapadobrincar.folha.com.br/brincadeiras/.

Data on participants' school grades, sex, age, and school shift (the period that a student is scheduled to study at school– morning or afternoon) were acquired from the Municipal Education Department. Information regarding weekly attendance in PEC was assessed using the question "*How many times a week do you attend physical education classes?*", included in the Web-CAAFE questionnaire. Instructions on how to complete the questionnaire were previously provided by the research team.

Classification of economic level

Socioeconomic status was investigated using the Brazilian Economic Classification Criteria, a questionnaire applied to parents or guardians of students, which classifies the economic level based on the ownership of items (fridge, freezer, car, washing machine, dishwasher, clothes dryer, DVD, computer, microwave, motorcycle), education of the head of the household, and access to public services [32]. Families were classified into classes according to the average monthly household income in the official currency of the Federative Republic of Brazil, Reais (R$): A (R$ 25,554.33), B-C (R$ 1,748.59 to R$ 25,554.32), and D-E (R$ 719.81 to R$ 1,748.58). Based on the average dollar exchange rate between March and October 2019, income ranges in these classes were: A (US$ 6,485.87) B-C (US$ 443.80 to US$ 6,485.86), and D-E (US$ 182.69 to US$ 443.79).

Data processing and analysis

To identify patterns, the daily frequencies of each physical activity and sedentary behavior type were obtained by summing reports from the morning, afternoon, and evening at the individual level. The frequencies of each PA and SB were converted into metabolic equivalents (MET) values according to the Compendium of Energy Expenditures for Youth [33], and grouped into the following categories: active play, non-active play, structured PA, household chores, use of electronic devices, and academic tasks. Subsequently, all groups of physical activity and sedentary behavior variables were converted to z-scores, and the two-step cluster analysis with treatment for discrepant values was performed, stratified by sex.

The log-likelihood distance measures were employed in this study. The determination of number of clusters was guided based on the literature review and statistical criteria, which included identifying the best combination of the lowest value of the Bayesian Information Criterion (BIC), the highest ratio of distance measurements, and the highest ratio of BIC changes. The quality of the cluster solution was further assessed using coefficient of measurement of cohesion and separation silhouette, considering values close to +1 as indicative of an adequate combination of the factor to its respective cluster. Additionally, the relative importance of each variable in the model was evaluated by values close to 1, indicating significant relevance.

PA and SB variables did not show a Normal distribution of probability as indicated by the Shapiro-Wilk test. Consequently, differences between the distributions of active play, non-active play, structured PA, household chores, academic tasks, and use of electronic devices throughout the patterns were assessed using the Kruskal-Wallis test for independent samples. Pairwise comparisons between patterns (Post ROC) were also conducted, with significance values adjusted by the Bonferroni correction to account for multiple tests. These analyses were also extended to all five sedentary behaviors and 27 physical activities, and the results were visually presented in graphical format. The cluster analysis was done on the SPSS statistic software, version 22.

PA and SB patterns were considered the outcomes, while age, school shift, and weekly attendance in physical education classes were the exposure variables. These variables were categorized into the following groups: age group (7–9 years; ≥10 years), school shift (morning; afternoon), and weekly attendance in physical education classes (0/week; 1/week; ≥2/week). Binary Logistic Regression and Multinomial Logistic Regression (both crude and adjusted) were used to verify the association between the identified patterns (outcomes) and exposure variables, among girls and boys, respectively. The analysis did not include data from 260 subjects who responded "don't know" regarding their weekly attendance in physical education classes. In addition, these individuals showed similar characteristics to those who remained in the analytical sample, although detailed comparisons are not provided.

Associations were expressed as odds ratio values (OR) and respective 95% confidence intervals (95%CI). The reference patterns for both girls and boys were defined as combinations of healthier profiles (High PA and Low SB). Statistical significance was determined by a p-value < 0,05.

Results

A total amount of 4,169 students were eligible to take part in the survey at the selected schools. By the time of the visit, 504 were not attending classes. Some students refused to participate ($n = 126$), were not authorized by the parents/guardians ($n = 755$), were not present on the days of data collection ($n = 120$), withdrew from taking part ($n = 8$), or did not complete the Web-CAAFE questionnaire ($n = 2$). After the data collection, a total of 2,654 children participated in the study. For data analysis, children with intellectual disabilities and those outside the intended age group (7–12 years) were excluded ($n = 177$) (Fig. 1). Thus, the analytical sample comprised 2,477 students (9.1 ± 1.38 years, 53.2% girls, 46.2% boys), whose characteristics are detailed in Table 1.

Most girls and boys fall within the 7–9 age range, attended school in the morning, and in one physical education class per week (Table 1). The response rate for the socioeconomic status assessment questionnaire was low, with complete data available for only 972 participants (39.2%). This subgroup was predominantly concentrated between socioeconomic classes B-C and D-E, with no notable differences between boys and girls. Thus, the association between economic class and clusters was not tested.

All individuals in the analytical sample were eligible for cluster analysis, as there were no incomplete data for the variables of interest. Two and three patterns were found among girls and boys, respectively (supplementary data–Table S1), classified according to the findings of Ferrar et al. [13]. The classification of the clusters was based on the groups of behaviors with higher z-scores in each cluster and they were named based on qualitative labels.

The patterns identified among girls were: Cluster 1 - "Active players" ($n = 549$, 44.1%), which presented a higher z-score of active play and lower z-scores of academic tasks, use of electronic devices and household chores; and Cluster 2 - "Sedentary/Household chores performers" ($n = 697$, 55.9%), with higher z-scores of academic tasks and household chores as well as lower z-scores of active play and structured play (Fig. 2).

Among boys, the patterns were: Cluster 1 - "Active play/Structured PA practitioners" ($n = 322$, 29.8%), with high z-scores of active play and structured play along with low z-scores of academic tasks, and use of electronic devices; Cluster 2 - "Sedentary on screen" ($n = 369$, 34.1%), with a higher z-score for the use of electronic devices and low z-score of non-active play, active play and structured play; and Cluster 3 - "Sedentary on academic tasks" ($n = 390$, 36.1%), whichshowed a higher z-score of academic tasks and low z-score of active play and structured play; (Fig. 2). The three patterns found among boys exhibited low z-scores for household chores.

The evaluation of the quality of the cluster solution for both girls and boys was reasonable (coefficient of measurement of cohesion and separation silhouette = 0.30). There were 59 subjects with discrepant data, and they were excluded from the cluster solution. Academic tasks proved to be important in the models of cluster solution for girls and boys, exhibiting a value of 1 in all clusters.

The Kruskal-Wallis test showed a cluster effect on the academic tasks [$\chi^2(1) = 918.04$; $p < 0.001$], use of electronic devices [$\chi^2(1) = 22.94$; $p < 0.001$], household chores [$\chi^2(1) = 32.91$; $p < 0.001$], active play [$\chi^2(1) = 45.57$; $p < 0.001$], and structured PA distributions [$\chi^2(1) = 8.32$; $p < 0.05$], among girls, but there was no difference in the distributions of non-active play between "Active players" and "Sedentary /Household chores performers" [$\chi^2(1) = 1.405$; $p = 0.236$]. Among boys, the clusters

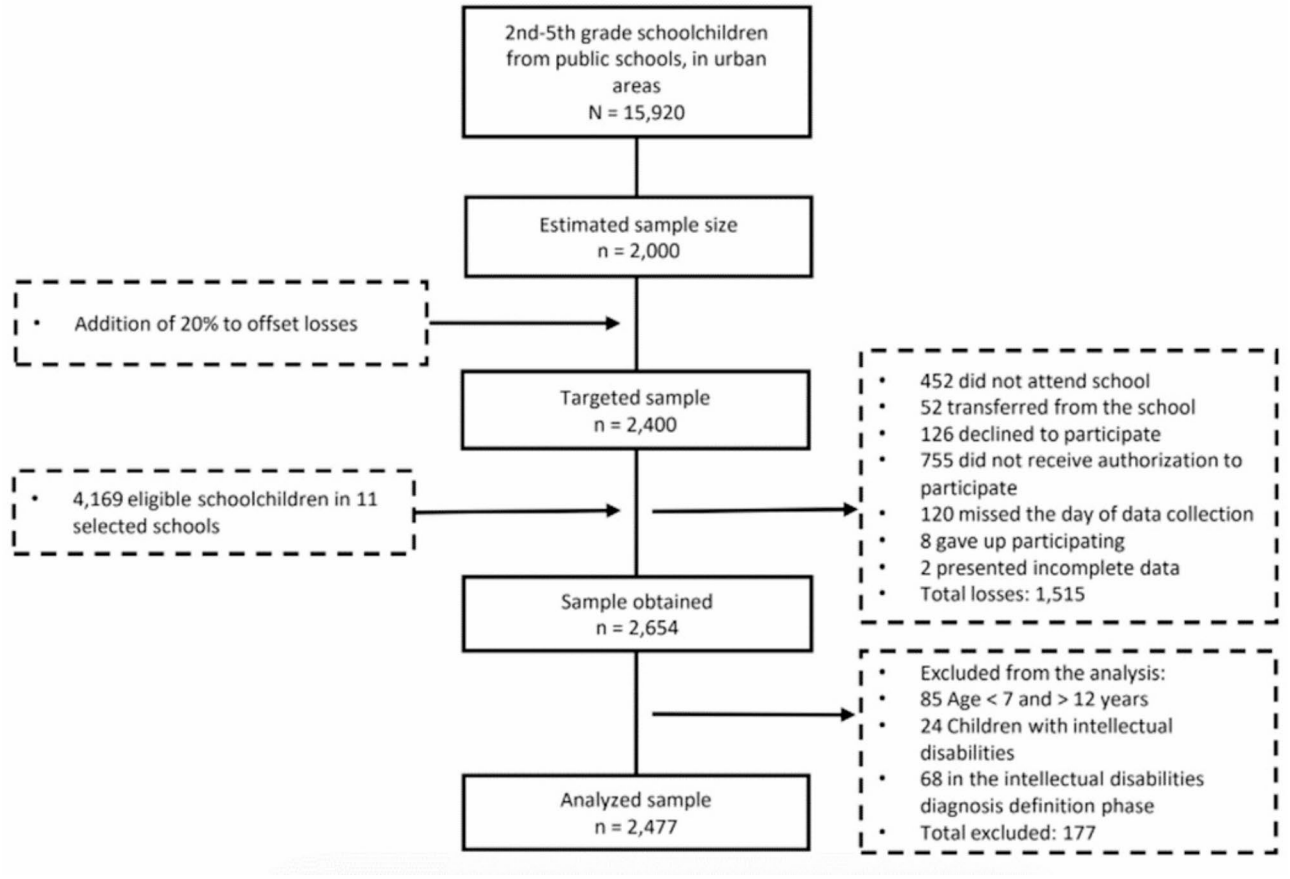

Fig. 1 Study flowchart

also had an effect on the academic tasks [$\chi^2(2) = 912.70$; $p < 0.001$], use of electronic devices [$\chi^2(2) = 146.313$; $p < 0.001$], active play [$\chi^2(2) = 396.54$; $p < 0.001$], and structured PA [$\chi^2(2) = 122.028$; $p < 0.001$]. However, there were no differences in the distributions of household chores and non-active play between the boys' clusters.

The comparisons between cluster pairs (Post ROC) showed significant differences in the distributions of academic tasks, use of electronic devices, and active play between "Active play/Structured PA practitioners", "Sedentary on screen" and "Sedentary on academic tasks" among boys. However, there was no difference in the distributions of structured physical activities between "Sedentary on screen" and "Sedentary on academic tasks" ($p > 0.05$).

The comparisons between the distributions of each type of physical activity and sedentary behavior throughout the patterns, showed a difference in the distributions of PA and SB, except for playing with a cart, hide and seek, playing with a ball, riding a bike, and video games among girls (Fig. 3), and playing catch, and ballet among boys (Fig. 3).

The variables included in the Binary and Multinomial Logistic Regression models did not present multicollinearity among them (VIF < 10, details not shown). The reference for comparison was cluster with greater reports of active play and structured physical activities for both sexes (Table 2). The association between sociodemographic variables and patterns was varied. Among girls, only the weekly frequency in PEC presented an association with patterns of PA and SB. Girls in the "Sedentary /Household chores performers" pattern presented 2.1 more chances of not attending PEC compared to girls in the cluster "Active players". Among boys, the chances of belonging to the clusters were influenced by the older age group ("Sedentary on screen" pattern) and attending less than two PEC per week ("Sedentary on screen" and "Sedentary on academic tasks" patterns).

Discussion

Three patterns of PA and SB were identified among boys, while girls exhibited two distinct patterns. The "Sedentary/Household chores Performers" pattern included the higher percentage of girls (55.9%), with active play and household chores as the most reported activities. The other pattern found among girls was "Active players" (44.1%), which showed a higher z-score of active play.

Table 1 Sample characteristics

	Girls (*n* = 1317)	Boys (*n* = 1160)
Age[a]		
7–9 years	800 (60.7)	705 (60.8)
≥ 10 years	517 (39.3)	455 (39.2)
School shift[a]		
Morning	680 (51.6)	593 (51.1)
Afternoon	637 (48.4)	567 (48.9)
Socioeconomic status (*n* = 525)[a]		
A	8 (1.5)	2 (0.4)
B-C	349 (66.5)	291 (65.1)
D-E	168 (32)	154 (34.4)
Weekly attendance in Physical Education classes (*n* = 2,217)[a]		
None	130 (11.1)	87 (8.3)
One day	689 (58.9)	566 (54.1)
≥ two days	351 (30)	394 (37.6)
Physical Activity[b]		
Active play	9.78 (10.5)	13.60 (11.6)
Non-active play	0.70 (1.3)	0.94 (1.5)
Strutuctured PA	1.17 (3.0)	1.54 (4.3)
Household chore	1.80 (2.8)	0.74 (1.9)
Sedentary behavior[b]		
Use eletronic devices	2.15 (2.0)	2.43 (2.4)
Academic tasks	1.02 (1.0)	0.71 (0.9)

[a] = frequency (%); [b] = mean (standard deviation) of physical activity and sedentary behavior MET; PA = physical activity; SB = sedentary behavior

Boys exhibited one pattern characterized by active play and structured PA (29.8%), with high reporting of these groups of activities, while most participants fell into "Sedentary on academic tasks" pattern (36.1%). The third pattern was "Sedentary on screen" (34.1%), which, like the "Sedentary on academic tasks" pattern, presented low reporting of active play and structured PA. Active play and sports were the most frequent activities among boys. Considering SB, the most frequent activities were playing on the cell phone, academic activities, and watching TV, regardless of sex.

Patterns were associated with at least one exposure variable. While the weekly attendance of PEC was associated with the composition of patterns for both girls and boys. Age was only associated with boys' patterns.

Other studies examining patterns based on the types of PA and SB in children and adolescents have also reported differences between the sexes, with variations in the numbers and profiles of clusters [19, 20]. Three patterns were identified in American adolescents of both sexes (11–17 years old) [20], with the largest cluster among boys labeled as "active" (42.1% of the sample). In this group, boys were most likely to engage in traditional sports activities and physical conditioning activities. On the other hand, among girls, 47.6% belonged to the "sedentary" class, characterized by greater use of the screen, internet, and computer, and watching DVD and movies [20]. Similarly, in Ireland, six and five PA and SB patterns were identified in girls and boys, respectively [19]. Despite the identification of more patterns in the study by the authors, the "non-participation" class (35%) was composed of a greater number of girls. On the other hand, among boys, the "active in team sports" class had more students (31.4%).

Differences related to SB were also observed among the five patterns identified in Chinese boys and girls. Three patterns were characterized by high sedentary behavior, of which two patterns among boys presented a predominance of screen use (sedentary TV viewers and sedentary game players), while among girls only one pattern showed high use of screens (sedentary TV viewers) [34]. It is important to consider the cultural and socioeconomic differences between the students included in our study and those surveyed by Patnode et al. [20], Lawler et al. [19], and Huang & Wong [34]. Despite these variations and the limitations of comparability, given the methodological distinctions (such as the age group of the sample, assessment instruments, and data analysis techniques), our results were similar, as, in previous studies, more active profiles and greater adherence to sports, along with profiles with high use of electronic devices, had been identified, particularly among boys.

In our sample, differences were observed in the most frequent types of PA between the clusters of girls and boys. The preference for fight sports and soccer among boys and activities such as jumping rope and sweeping among girls have already been observed in a previous study with students from a public school in the same city [23]. These differences may be connected to cultural gender aspects and the limited social and family support for the engagement of girls in sports [22]. These aspects restrict their participation in activities associated with femininity, according to prevailing social norms [35]. The norms reinforce the social roles traditionally attributed to women and men and can lead girls to perceive themselves as less physically competent and less satisfied with engaging in physical activities [22] and choose light and indoor activities.

Cultural influences and preferences for certain types of activities can be altered or expanded by the presence and weekly attendance of PEC. These classes not only increase opportunities for practicing physical activities [25, 26] but also contribute to a reduction in sedentary behavior (SB) time [25] and are associated with higher levels of physical activity (PA) both within and outside the school environment [27].

In our study, we observed that clusters with more active play and structured PA were associated with weekly attendance of PEC. The influence of PEC was also

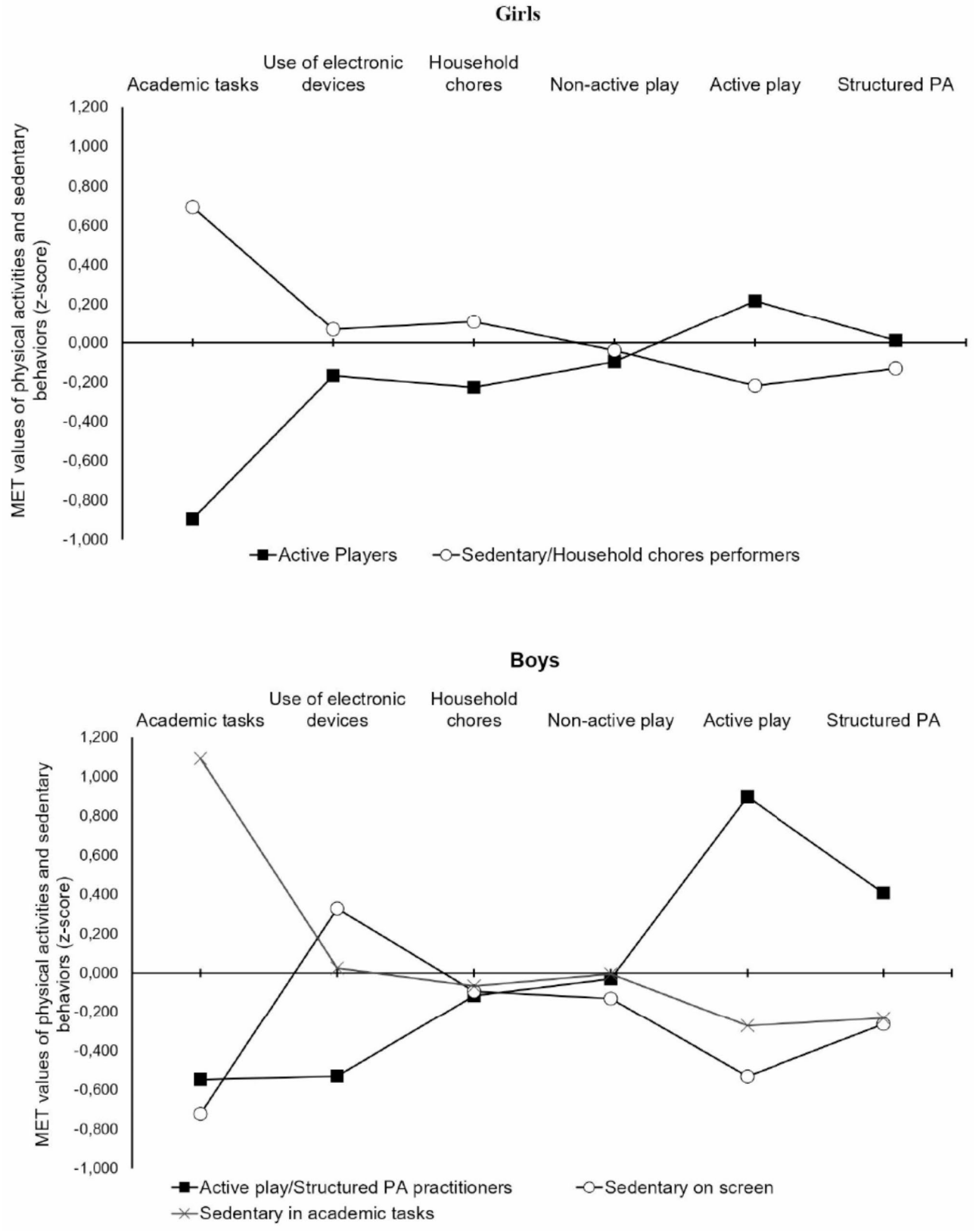

Fig. 2 Comparison of types of PA and SB throughout the patterns among girls and boys

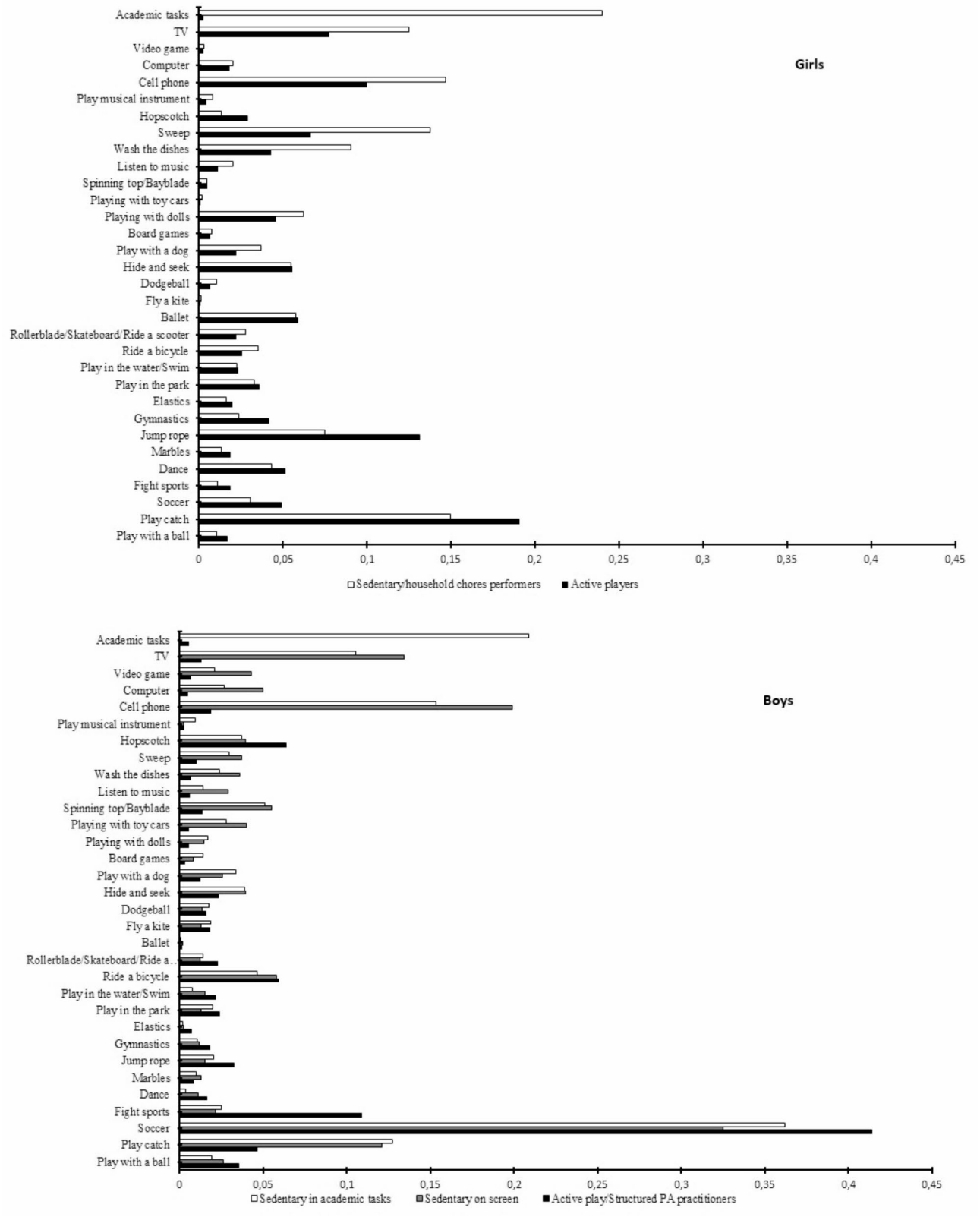

Fig. 3 Comparison of types of PA and SB throughout the patterns among girls and boys

Table 2 Association between patterns of PA and SB and exposure variables, stratified by sex

Variables	Girls[a, c]		Boys[b, c]			
	Sedentary/ Household chores performers		Sedentary on screen		Sedentary on academic tasks	
	OR (IC95%)	*p*-value	OR (IC95%)	*p*-value	OR (IC95%)	*p*-value
Age						
≥ 10 years	1.23 (0.96–1.57)	0.099	1.51 (1.08–2.11)	0.015*	1.32 (0.95–1.84)	0.101
7–9 years	1		1		1	
School shift						
Morning	0.87 (0.68–1.10)	0.251	1.02 (0.74–1.40)	0.912	0.84 (0.61–1.16)	0.290
Afternoon	1		1		1	
Weekly attendance in Physical Education classes[a]						
None	2.11 (1.35–3.27)	0.001*	2.85 (1.43–5.72)	0.003*	3.64 (1.84–7.22)	0.000*
One day	1.24 (0.95–1.63)	0.114	1.45 (1.03–2.03)	0.030*	1.67 (1.19–2.33)	0.003*
≥ Two days	1		1		1	

[a] Binary logistic regression; [b] Multinomial logistic regression; [c] The reference is Cluster 1 (Active players among girls; Active play/Structured PA practitioners among boys)

* $p \leq 0,05$

observed in a longitudinal study with 254 Finnish adolescents, ranging from the ages of 15 to 19 [18], and those classified as "Inactivity maintainers" reported less school physical education durations (mean 108 min) compared to activity maintainers (144 min), decreases from moderate BP (143 min), and increasers (170 min). Taking into account the methodological differences, these results support and corroborate the findings of our study [18].

Among girls, the "Active players" pattern, characterized by more PA and less SB, also presented more chances of having two or more PEC per week. This finding suggests that the provision of diverse sports, games, and playing activities for girls in PEC contributes to the development of self-efficacy, motivation, and perceived competence [36], in addition to increased engagement in PA. Conversely, a previous study identified that students engaging in sports outside school have a higher frequency of PEC [37], a result that suggests a bidirectional relationship between PEC and sports physical activities performed in other settings.

Additionally, we observed that boys within the "Sedentary on screen" pattern were more likely to be older. Studies that evaluated patterns based on the types of PA and SB did not investigate the association with age. Studies that assess screen time corroborate the positive association of this behavior with age [38]. Longitudinal studies show that time spent on behaviors such as watching TV, using computers, and playing video games significantly increases over 1, 2, 3, or 4 + years of follow-up [39]. There is strong evidence indicating age as a factor inversely associated with physical activity, with adolescents presenting fewer active profiles than children [40]. This aspect explains why older adolescents are more likely to belong to the pattern "Sedentary on screen". The absence of association between age and other predominantly sedentary patterns can be explained by the lack of significant differences in reports of physical activities compared to the pattern considered more active for boys and girls.

The current study has some limitations: data based on self-report, which may be influenced by social desirability or memory bias; self-reported weekly attendance PEC can contain understanding and recall bias; and the fact that CA is susceptible to the researcher's subjectivity in choosing the most appropriate analysis method and cluster solution for the sample, even when there is support in the existing literature in making such decisions.

However, some positive aspects strengthen the results. Our research was carried out with a heterogeneous and representative sample, enhancing the likelihood that the findings reflect the study population's reality. The Web-CAAFE has been established as a valid and reliable questionnaire for assessing physical activity in children aged between seven and 15 years, though validity for reporting of sedentary behaviors could not be adequately evaluated [30]. This result does not imply that Web-CAAFE's reporting of sedentary behaviors is inaccurate, but requires caution in the interpretation of the results. Additionaly, the questionnaire may be less susceptible to recall bias since it requires only one day's recall [41]. Furthermore, the chosen analysis method is recommended for large samples [42] and the selection criteria regarding the quality and number of clusters were defined based on both literature and statistical criteria.

Conclusion

Boys and girls exhibited different patterns of PA and SB. Active play and household chores contributed to defining the patterns among girls, whereas sports contributed to defining the patterns among boys. Attending PEC increased the odds of participants belonging to clusters with higher PA and lower SB.

This study advances in the identification and understanding of PA and SB patterns according to gender, based on the report of the group of types of physical activity, a dimension often overlooked in other studies, which gives it an innovative character. Grouping the types of physical activity and sedentary behaviors can be informative for the formulation of public policies, guide intervention studies, and shape actions at the school level.

Abbreviations

95%CI	95% Confidence Intervals
BIC	Bayesian Information Criterion
CA	Cluster Analysis
MET	Metabolic Equivalents
OR	Odds Ratio
PA	Physical Activity
PEC	Physical Education Classes
SB	Sedentary Behavior

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12887-025-05522-x.

Supplementary Material 1

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Author contributions

L. A. D: conceptualization, methodology, project administration, investigation, formal analysis, writing-original draft, and review. G.M.J: conceptualization, methodology, project administration, investigation, formal analysis, writing-original draft, and review. G. O. V.: writing-original draft, and review.

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Data availability

The datasets generated and/or analyzed during the current study are not publicly available due to restrictions imposed by the Research Ethics Council. However, they can be made available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

The study adhered to ethical standards outlined in Resolutions No. 466/2012 and No. 510/2016 of the Brazil's National Research Ethics Council (CAAE No. 02307918.5.0000.0053, Opinion No.: 3.116.495). The study protocol received approval from the Research Ethics Council of the State University of Feira de Santana. Parents or guardian signed the Informed Consent Form for the study. The informed consent was obtained from all subjects parents or their legal guardian(s).

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Author details

[1]Postgraduate Program in Public Health, State University of Feira de Santana, Feira de Santana, Bahia CEP: 44036-900, Brazil
[2]Rua Araraquara, n 10, Condomínio Parque Lagoa Grande, Quadra B, Bloco 17, apto. 302, CASEB, Feria de Santana, Bahia CEP: 44052-061, Brasil

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