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Physical activity and spatial use during school breaks in children aged four

Oscar Romero Ramos
Faculty of Educational Sciences, University of Málaga, Málaga, Spain, oromero@uma.es

Emilio Fernández Rodríguez
Faculty of Educational Sciences, University of Málaga, Málaga,Spain

Antonio Matas Terrón
Faculty of Educational Sciences, University of Málaga, Málaga,Spain

Gloria Gonzále Campos
Faculty of Educational Sciences, University of Sevilla, Sevilla, Spain

Robert Podstawski

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Physical activity and spatial use during school breaks in children aged four

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A Study Design
B Data Collection
C Statistical Analysis
D Data Interpretation
E Manuscript Preparation
F Literature Search
G Funds Collection

Oscar Romero-Ramos[1 ABDF], Emilio Fernández-Rodríguez[1 BE], Antonio Matas Terrón[1 C], Gloria González-Campos[2 EG], Robert Podstawski[3 EF]

[1] Faculty of Educational Sciences, University of Málaga, Málaga,Spain
[2] Faculty of Educational Sciences, University of Sevilla, Sevilla,Spain
[3] Department of Physical Education and Sport, University of Warmia and Mazury, Olsztyn, Poland

abstract

Background: The latest studies warn of obesity levels and sedentary lifestyles in children, and of the impact this has on health. This study analyses the quantity of physical activity and the use of space during school breaks, according to gender, in four-year-old pupils.

Material and methods: Pedometers and behavioural mapping were used as recording tools. Four behavioural categories were identified and 10 spatial categories. The procedure involves the development of primary measures (frequencies of appearance of each category and duration), as well as secondary measures (relative frequency, rate, relative duration and average duration). In addition to these descriptive measures, a correlation analysis was applied (Spearman's product-moment correlation coefficient) to the zone records, depending on time, taking into account that these records are measured at scalar level.

Results: The behavioural category that occurs most frequently is Dynamic Activity and there are no significant differences in the amount of physical activity engaged in during school break time when it comes to gender. The multizone category dominates in spatial use, although there are areas that are underutilised and others where activity is concentrated.

Conclusions: According to spatial use frequencies, both sexes share the same play space and there are no differences in spatial use according to gender. The dominant behavioural category is Dynamic Activity (DA), which equates to only 54% of school break time. We believe it would be interesting to increase this physical practice time during breaks, as a way of combating sedentary lifestyles in childhood.

Key words: pedometer, spatial use, early years education, obesity, health.

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Corresponding author: Oscar Romero Ramos, PhD, Erasmus Coordinator, Faculty of Educational Sciences. University of Málaga, Area of Physical Education and Sport, Campus Universitario de Teatinos, Málaga (Spain); phone no.: +34 952132470; fax: +34 952132479; e-mail address: oromero@uma.es.

INTRODUCTION

Epidemiological studies are raising the alarm about the number of children who are overweight or obese in educational establishments in the majority of developed countries, and how this might influence the health of these children, increasing problems with disorders such as hypertension, diabetes, or metabolic syndrome in these populations [1]. Spain has one of the highest rates of school obesity in Europe [2].

Physical activity (PA) is regarded as one of the mainstays for avoiding a sedentary lifestyle and keeping the population in optimum health [3], and studies demonstrate the importance of PA in childhood for the ages covered by this paper [4]. School sports, in the broad sense, mean all types of physical activity carried out during the school day, usually taking place at three specific periods: physical education class, break time and extracurricular activities [5], as a fitting framework for promoting physical education in children [6].

Looking at these three periods, the little time available for formal PE classes means that the recommended 60 minutes per day of PA for children is not guaranteed. Meanwhile, the PA that takes place during break time tends to be voluntary, and is not directed or planned. Furthermore, it is largely unknown how environmental, structural and social factors interact with the PA levels of children during this school time. Consequently, school breaks offer an opportunity to promote PA in children, since this has proven successful in various educational and governmental interventions [7, 8].

In fact, studies find that at school lunchtime, there is an increase in moderate to vigorous-intensity physical activity (MVPA), compared with other periods at school or moments during the week [9].

The pedometer has been used in several studies as a tool for assessing PA undertaken by schoolchildren [10], and as an alternative to increasing pupils' PA through step goal schemes [11]. On the other hand, there is increasing interest in quantifying PA from an environmental perspective, using direct observation [12, 13, 14] or behavioural mapping [15, 16], not only to record the quantity or levels of PA using pulsometers, pedometers or accelerometers, but also the type of activity and/or use of space during school time.

Behavioural categories have been recorded in several studies, such as Meneghini and Campos-de-Carvalho [15] and Bomfim and Campos-de-Carvalho [16], in which four behavioural categories were used, in other studies with accelerometers, where five categories were established according to the PA intensity [17].

Papers focusing on school breaks are approached from different study focuses, and most are carried out in primary education. These include studies that investigate the type of PA according to gender, finding differentiated behaviours in sports practice during break time [5, 18], others that assess the amount or intensity of PA during break time by both genders [17, 19, 20, 21], psychomotor profile according to gender [22] and aspects such as environmental or psychosocial variables [23]. At the early education stage, there is the study by McKenzie [14] examining the PA undertaken at school break time according to social variables (American and Mexican pupils).

There is great variation between the various studies concerning the amount of time in which data is recorded during break time, which varies between 15 minutes [19], 20 minutes [17], and 30 minutes [20].

This study aims not only to quantify, using a pedometer and through behavioural mapping, how much the pupils in the sample move during their free play at break time, but also how they use the space, based on an environmental perspective. This offers us a prospect of encouraging desirable behaviours and to intervene to promote health by encouraging PA during school breaks.

MATERIAL AND METHODS

PARTICIPANTS

119 pupils participated in the study, with a mean age of 4 years (65 boys aged 3.9 ±0.81 years, body mass 18 ±3.71 kg, body height 105.29±9.7 cm, body mass index 15.94 ±2.84 kg/m2 and 54 girls aged 4.05 ±0.75 years, body mass 18.03±3.34 kg, body height 106.2 ±10.04 cm, body mass index 16.06 ±2.6 kg/m2); the pupils were from four early education establishments.

MATERIALS

To assess physical activity during school break time, Yamax Digiwalker SW-200 (YDSW200) pedometers were used. This pedometer has been validated for use with children both in the laboratory and in the field [24].

To obtain BMI, weight and height were recorded. Both measurements were taken with the schoolchild barefoot and wearing light clothing. The means of the two weight and height ranges were used for subsequent statistical analysis.

Behavioural mapping was performed using a direct observation form. This was divided into nine quadrants, corresponding to the nine zones into which the school playground was divided, for the spatial positioning and recording of each of the behavioural categories (four categories). This record form contains data such as age, sex, height, weight, and steps taken. Studies, such as Nishikido [25], found a high correlation in the evaluation of the daily physical activity of early-school pupils performed with pedometers and direct observation.

PROCEDURE

The observers completed a period of familiarisation with the pedometers and record form prior to starting the study. The study was performed in compliance with the Declaration of Helsinki (2008) and school approvals were obtained, and school children and their legal guardians were fully informed about all the features of the study (i.e. a thorough description of the methods, potential risks, expected benefits, etc.; based on Thomas guidelines [26]) and were required to sign an informed consent document.

The number of steps and the behavioural mapping were captured during break time and the schoolchildren's free play at the early educational establishment. Data collection took place for 20 minutes. Although playtime was 30 minutes, this full break time could not be guaranteed, due to time lost during movements between the classroom and the playground, the time

allocated to eating during break time, etc. During break time, the teachers did not intervene or initiate activities with the children, so as not to interfere with the study.

The time the child spent in each of the nine zones, or multizone if the child moved continuously between different areas (10 spatial categories), of the school playground was recorded. Four predefined and mutually exclusive behavioural categories were therefore identified:

1. Passivity (P): The child observes situations and/or classmates around them, does not move in any way and does not pursue communicative or social activity with others.

2. Communication (C): The child does not move in any way and pursues communicative/social activity with other classmates.

3. Static activity (SA): The child engages in games and activities that do not require movement, but rather manipulative actions and static games.

4. Dynamic Activity (DA): The child engages in games and activities in which there is movement and physical activity.

Statistical analysis

Analysis of observational data can be carried out from different perspectives. In general, in the case of records of nominal systems (systems of categories), the procedure involves the development of primary measures (frequencies of appearance of each category and duration), as well as secondary measures (relative frequency, rate, relative duration and average duration).

In addition to these descriptive measures, a correlation analysis was applied (Pearson's product-moment correlation coefficient) to the zone records, depending on time, taking into account that these records are measured at a scalar level. Records were correlated in time (t) with successive records in times (ti+1). The ratio percentage calculated the coefficient of determination. SPS 22.0 was used for this analysis.

Results

Zones

Most of the time, the pupils tended to move in an undefined manner through zone 10 (multizone), recording a total frequency of 1,034 entries and 517 minutes in this category. After this, the zones with the greatest frequency and usage by our infants are zone 8 (846 instances and 423 minutes) and 9 (594 instances and 297 minutes). This tendency towards continuous movement and multizone use, as well as the use of zone 8 and 9 can also be observed in the rate; rate being understood as the average number of occurrences of each category per unit of time (Table 1 and Figure 1).

In the case of boys (Table 2), the zone with the highest entries is zone 8 (581 occurrences and 290.5 minutes), immediately followed by multizone 10 (550 occurrences and 290 minutes). The zone with the fewest entries for use by boys is zone 7 (58 occurrences and 29 minutes).

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In addition, girls (Table 2) have higher entries in multizone 10 (454 occurrences and 227 minutes) and zone 9 (306 occurrences and 153 minutes). Like the boys, they underutilise zone 7 (66 occurrences and 33 minutes).

Table 1. Statistics for the frequency and the duration in each zone of the school playground

Zones	Fz: frequency	Dz: Minutes duration	Uz: Rate	pi: Relative-Frequency
1	359	179.5	0.0025	0.0754
2	383	131.5	0.0027	0.0805
3	463	231.5	0.0032	0.0973
4	232	116	0.0016	0.0487
5	356	178	0.0025	0.0748
6	369	184.5	0.0026	0.0775
7	124	62	0.0009	0.0261
8	846	423	0.0059	0.1777
9	594	297	0.0042	0.1248
10	1034	517	0.0072	0.2172

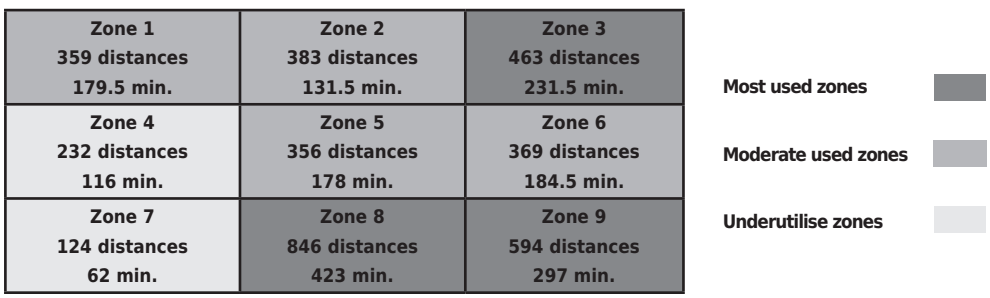

Fig. 1. The frequency and the duration in each zone of the school playground

Table 2. Statistics for the frequency and the duration in each zone of the school playground according to gender

Zones	Fz: frequency boys	Fz: frequency girls	Dz: Minutes duration boys	Dz: Minutes duration girls
1	210	149	125.5	74.5
2	199	184	106	92
3	225	238	113	119
4	119	113	64.5	56.5
5	155	201	77.5	100.5
6	185	184	92.5	92
7	58	66	29	33
8	581	265	290.5	132.5
9	288	306	144	153
10	580	454	290	227

Figure 2 shows the differences between boys and girls as regards the frequencies in each category. However, these differences are significant, according to Spearman's rank correlation test ($S = 24.5738$; $p = 0.001791$).

With regard to the sequences of the categories, the dominant categories throughout the observation period in the case of boys were categories 10 and 8, and the dominant frequency is category 8 (21 intervals), with a duration of 10.5 intervals and a rate of 0.017.

In the case of girls, in the sequence of events, category 10 (31 intervals) alternated with zones 8 (7 intervals) and 6 (2 intervals). Zone 6 stands out as dominant (Figure 3).

Figure 3 shows the sequence of dominant categories for boys and girls. The Spearman rank correlation coefficient of the sequences between boys and girls was calculated, and the values obtained were not significant (S = 9134.99; p = 0.378).

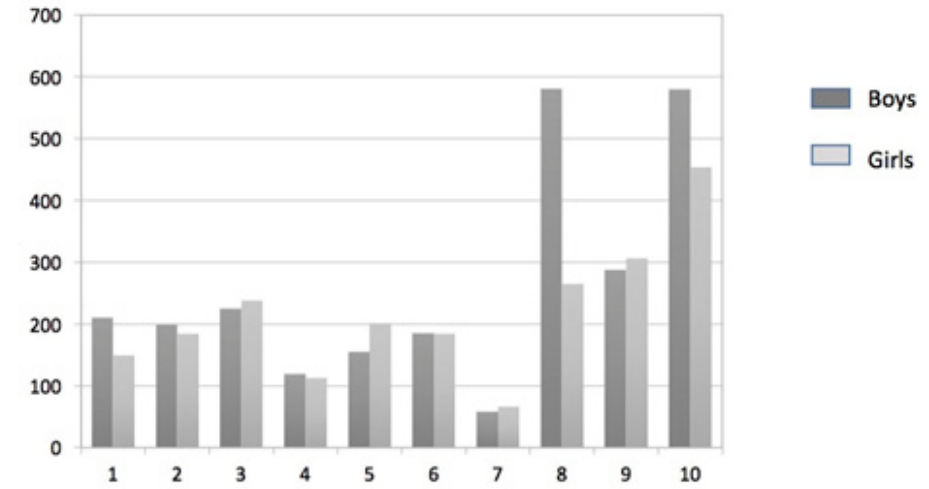

Fig. 2. Selection frequencies of each zone according to gender

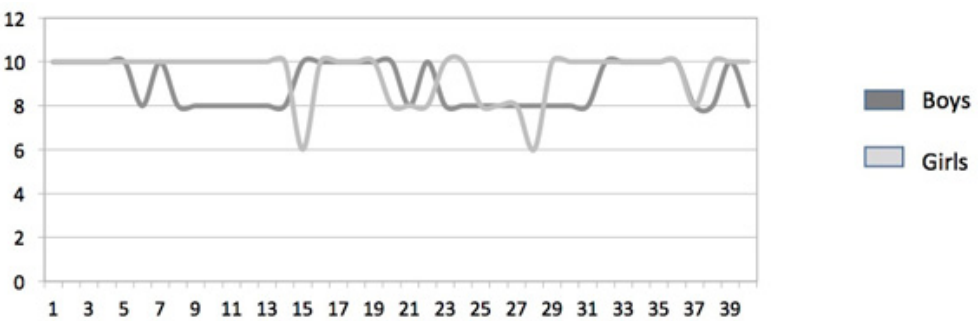

Fig. 3. The sequence of categories for boys and girls

According to the correlation between the number of boys compared with the number of girls and its influence on the numbers of occurrences and the time in the different zones, the value is 0.8352951336. This result suggests that there are no differences in the time that the pupils spend in the different zones according to gender.

Behaviour

In the case of the four behavioural categories assembled, the category with the highest frequency is DA (2,571 instances and 1285.5 minutes' duration), followed by SA (1,313 instances and 656.5 minutes). The DA category's rate is 0.018, while the SA category has a rate of 0.009. The statistical summaries are presented in table 3.

Table 3. Descriptions of the behaviour category

Bahaviour category	Dc: Minutes duration	Uc: Rate	pi: Relative frequency
DA – Dynamic activity	1285.5	1285.5	0.5410353535
SA – Static activity	656.5	656.5	0.2763047138
C – Communication	232	232	0.0976430976
P – Passivity	202	202	0.085016835

The dominant category in all intervals was DA, so no sequence analysis was carried out. According to these results, the duration in this dominant category (DA) corresponded to 54% of the total break time. The rest of the time is distributed between the remaining categories, which are less interesting from the point of view of health habits and physical activity. With regard to the number of steps taken according to gender, the girls took an average of 1,242.1 steps and the boys 1,313.9.

DISCUSSION

In analysing spatial use by pupils aged 4 in early years education, the multizone category 10 dominates (1,034 instances), which, together with the dominance of the behavioural category DA (2,571 instances), makes the categories the most interesting from the health point of view, since they both involve motor movement, and therefore physical activity in the children.

Multizone 10 alternates in dominance of use with zones 8 and 9, while zones 4 and 7 are underutilised. No studies with similar results were found, although it may be interesting to identify zones that are underutilised in school break time spaces to encourage their use. Likewise, these results obtained on frequencies of use suggest that in our sample, both sexes share the same play space. Our result does not concur with studies by other authors who have found that girls and boys at primary level use recreational space differently, either in the amount of space used, where boys use much more space than girls [27], or in the differential use of the zones, with boys using more space and co-opting the centre, while girls use the peripheral spaces [18]. However, these studies were carried out with students of other ages, at primary level.

Other studies have suggested that the amount of PA during break time is greater in young and adolescent boys than in young and adolescent girls, such as that by Beighle [19] carried out in relation to boys aged 9.5; in schoolchildren aged between 5 and 12 [17, 20, 23, 28]; in young and adolescent boys [12, 21]. Similarly, with regard to age groups, studies indicate that younger boys are more active when compared with adolescent boys, even in similar contexts [21].

The study carried out at early years level by Shabanski [29] in boys aged 3 to 4 years also suggests that the entry for the number of daily steps in boys (9,766 steps) is slightly higher than that of girls (9,689 steps). Pagels [30] analysed the number of steps per minute during the preschool day in children aged 3 to 5, and found differences in the number of steps across those ages: 12.3 (± 3.0) steps per minute in boys aged 3, 15.8 (±6.0) in boys aged 4, and 20.9 (± 8.8) in boys aged 5; the difference between 3 and 5 years of age being significant (p = 0.014).

CONCLUSIONS

1. In our results, there are no significant differences between gender and behavioural category DA, or the number of steps completed during break time (65.69 ±24.98 steps per minute in boys and 62.1 ±30.23 steps per minute in girls).

2. As was noted earlier, the dominant behavioural category is Dynamic Activity (DA), which equates to 54% of school break time. This means that for slightly more than half the time, pupils engage in activities that involve physical stimuli, with the remaining time distributed between other categories, less interesting from the point of view of health habits and physical activity. We believe it would be interesting to increase this physical practice time during breaks, as a way of combating sedentary lifestyles in childhood and high levels of overweight.

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