DOI: 10.1590/1980-549720200102

ORIGINAL ARTICLE / *ARTIGO ORIGINAL*

Inequities in neighborhood public park use for schoolchildren's physical activity: multilevel evidence from Cordoba, Argentina

Desigualdades no uso do parque público de bairro para a atividade física de crianças: evidências multiníveis de Córdoba, Argentina

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ABSTRACT: ***Introduction:*** The complexity of urbanization processes across Latin American societies encourages investigating its implications in health conditions, especially during childhood. One of the possible links between them is recreation, a component of the daily life of children and, therefore, essential to produce health and life itself. The objective of this study was to examine the associations between neighborhood context and active public park use among school-aged children in Cordoba, Argentina. ***Methods:*** A cross-sectional study was conducted with 1466 children, aged 9 to 11, attending 19 schools and living in 110 neighborhoods. Multilevel models with Poisson distribution were used for the analyses, stratified by gender. Socio-demographic, behavioral, and physical covariates were included at the individual level, and socioeconomic neighborhood conditions at second level. ***Results:*** Girls residing in neighborhoods with a worse socioeconomic context were less likely to report frequent public park use for physical activity, while those from neighborhoods with better socioeconomic conditions were more likely to, regardless of individual characteristics. ***Conclusion:*** This study suggests that socioeconomic conditions of neighborhoods are associated with public park use for physical activity in school-aged girls, demonstrating gender inequality in the use and appropriation of public spaces.

Keywords: Park's recreational. Exercise. Residence characteristics. Child. Argentina.

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Conflict of interests: nothing to declare – **Financial support:** Ministerio de Ciencia y Tecnología del Gobierno de la Provincia de Córdoba (PID-2010 Res. no. 153/11) and Fondo Nacional de Ciencia y Tecnología (FONCYT PICT- 2012-1173 Res. no. 141/13).

RESUMO: ***Introdução:*** O processo de urbanização das sociedades latino-americanas estimula investigar suas consequências nas condições de saúde. Um dos elos possíveis é a recreação, componente do cotidiano das crianças essencial para a produção da saúde e da própria vida. O objetivo foi examinar as relações entre o contexto do bairro e o uso ativo do parque público entre as crianças em idade escolar em Córdoba, Argentina. ***Métodos:*** Foi realizado um estudo transversal com 1466 crianças que frequentam 19 escolas e moram em 110 bairros. Modelos multinível com distribuição de Poisson foram utilizados para as análises, estratificados por sexo. Covariáveis sociodemográficas, comportamentais e físicas foram incluídas no nível individual e as condições socioeconômicas do bairro, no segundo nível. ***Resultados:*** As meninas que residem em bairros com pior contexto socioeconômico foram menos prováveis a relatar o uso frequente de parques públicos para atividades físicas, enquanto aquelas provenientes de bairros com melhores condições eram mais prováveis, independentemente das características individuais. ***Conclusões:*** Este estudo sugere que as condições socioeconômicas dos bairros estão associadas ao uso de parques públicos para atividade física em meninas unicamente, demonstrando uma desigualdade de gênero.

Palavras-chave: Parques recreativos. Exercício físico. Características de residência. Criança. Argentina.

INTRODUCTION

Within urban spaces, the social reproduction of different social classes develops in the neighborhood, crossed by ethnic and gender relations, so that each neighborhood entails a particular form of social organization[1]. Therefore, the recognition of this territory is a basic step for the characterization of distinct social groups and their difficulties[2,3].

Approaches using neighborhoods as the main unit of analysis have been growing constantly in recent decades. In contrast, these are yet rarely used in Latin American countries, especially in Argentina. As research with a neighborhood approach grows, evidence confirming that health conditions are strongly related to community characteristics beyond individual ones is reinforced[4].

Physical activity (PA) has been one of the most studied determinants of health in recent years in relation to environmental characteristics. Nevertheless, the majority of research has focused on the adult population in developed countries[5-8]. Although a paradigm shift from individual to ecological conceptual models is observed, most of this turn has focused on the influence of neighborhood-built environment at the expense of neighborhood socioeconomic conditions (despite previous research showing that a favorable social environment was positively associated with several measures of PA and that built environment was not significantly related[9,10]).

Consequently, the study of health-related behaviors such as PA requires a complex approach to address the potential effects of communities and neighborhood dimensions on the behavior of individuals[8]. At the individual level, children's PA has been associated to categories such as age (as it increases, PA tends to decrease), gender (boys are more involved than girls), social support (family and peer support seems to be positively associated), screen

activities (as they increase, the time for PA decreases), socioeconomic status (as it improves, it promotes PA)[11,12].

Despite the recognized benefits of PA and the growing evidence of environmental influence on it, a large proportion of the children population does not meet the recommendations of the World Health Organization (WHO). The lastest Global School-based Student Health Survey showed that the proportion of students who were physically active for a total of at least 60 minutes per day on five or more days a week was 28% in Cordoba and Argentina[13].

Nowadays, more than 80% of the Latin American population lives in cities, constituting the most urbanized region of the planet. In Argentina, the urban population rises to 93%[14]. In this country, the city of Córdoba is the second most populated and presents great economic and social contrasts[15]. While some neighborhoods have high proportions of households with unsatisfied basic needs (UBN) (24%), others have values below the city average (5.8%)[16]. Besides, there is an unequal distribution of green spaces in different areas of the city, correlated with socioeconomic indicators[17].

According to Almeida-Filho, inequalities are the quantitative variation in collectivities that can be expressed by demographic or epidemiological indicators. Instead, health inequalities determined by income, education, and social class are products of social injustice; as they acquire meaning in the political field as a product of conflicts related to the distribution of wealth in society. Thus, they should be considered health inequities[18].

To date, little is known about how the socioeconomic characteristics of the neighborhood affect children's PA in Latin American countries, and even less about children's use of public spaces for PA. Therefore, studying the role of neighborhood public spaces in children's PA opportunities is particularly relevant in a city characterized by persistent socio-territorial segregation and strong privatization of the public sphere[19-24]. The objective of this study was to elucidate the associations between neighborhood context and the frequency of public parks (PP) use for PA among school-aged children in Cordoba.

METHODS

PARTICIPANTS

A cross-sectional study was carried out in a population of children from 4th to 6th grade — ages 9 to 11 years old — from municipal primary schools in Cordoba city, Argentina. The study was carried out between September and December 2011, during springtime.

Cordoba's primary education system consists of four different types of schools: national, state, municipal, and private. The municipal school system was created to compensate for the lack of state education. Currently, there are 37 institutions and almost 12,500 children, which represent approximately 3% of total primary schoolchildren (366,424 in 2010)[25]. According to municipal reports, these schools attend to families living in urban poverty contexts[26].

The eligible sample consisted of 4,820 children enrolled from 4th to 6th grade in municipal schools in 2011, and their primary adult caregivers. A sample size of 1,349 students was estimated considering an expected prevalence of 50% (due to multiple outcomes), a sampling error of 3.5 percentage points, a 95% confidence interval, and a design effect of 2.0.

For the sampling process, all the primary municipal schools in 2011 (37 schools) were stratified in an attempt to design two groups with a similar number of schools, taking into account the available statistical data on parental illiteracy: schools with more than 25% of parents with, at least, complete elementary education level (20 schools) and those below this cutoff (17 schools). Then, 10 from the first group and nine from the second were randomly selected. The 19 schools selected yielded a potential pool of 2,424 students.

Parents were called to school for a meeting with the research team. An explanation of the study was given, and a written informed consent was obtained from those who agreed to participate and let their children participate. A note explaining the study and the informed consent was sent through children to parents who did not attend the meeting. Children were also asked to assent to participate, regardless of their parents' consent.

When both agreed to participate, parents completed a self-administered questionnaire at school or at home. Children also completed a questionnaire read aloud by a research team member in the classroom, so that everybody could answer it at the same time and clear their doubts.

VARIABLES AND MEASURES

Parents' questionnaire included the following dimensions: family sociodemographic conditions and health history; child's health parameters and attention, PA, opportunities for PA in the neighborhood, eating habits at home and at school; and mother's health conditions (150 questions).

Instead, the children's questionnaire included dimensions of health-related quality of life: physical and psychological well-being, moods and emotions, self-perception, autonomy, domestic life, social and peer support, school environment, social acceptance and financial resources, screen behavior, eating habits and the Family Affluence Scale (80 questions).

Outcome

Frequency of PP used for PA. Parents were asked about the frequency with which the child used the different spaces (closest to their homes) for PA, in their neighborhood of residence: clubs, soccer fields, other sports courts, other recreational or exercise rooms, schools with recreational facilities, walking or cycling paths, parks or squares, wastelands and other outdoor spaces. The response options were: never, rarely (once a month or less), sometimes (once every fifteen days), and frequently (once a week or more).

When modeling multivariate models, the frequent use (*versus* never, rarely or sometimes) was the expected outcome.

This question was obtained from the "Active Where?" survey of the Robert Wood Johnson Foundation's Active Living Research from the United States and adapted to the local population[27]. This set of questions taken from the US survey was cross-culturally adapted to be used in our population, showing good internal consistency (Cronbach's alpha of 0.86).

Individual covariates

Screen activities. These correspond to activities that could displace PA practice. Children were asked about the daily hours spent watching TV and/or using the computer during a usual week. Categories were constructed as follows: less than 2 hours per day, 2 to 3 hours per day, and more than 3 hours per day.

Social support. It refers to the quality of time shared with friends and other peers. It constitutes a dimension of the Health-Related Quality of Life measure inquired through the Argentinean version of KIDSCREEN-52 as follows: Were you with your friends during the last week? Did you share activities with other people? Did you have fun with your friends? Did your friends and you help each other? Could you talk about everything with your friends? Could you trust your friends? The response options were on a 5-point Likert-type scale: never, almost never, sometimes, almost always, and always. This domain is computed using Rash scores and transformed into T-values with a mean of 50 and a standard deviation of 10, based on the scores from the European reference data. The social support scale resulted in a Cronbach's alpha = 0.81, and acceptable infit-outfit values from the Rasch analysis when the Argentinean version was tested[28]. The variable was categorized into: low (score lower than 45), mean (from 45 to 55), and high (more than 55 points).

Mother's educational level. The highest level achieved by mothers was considered, grouped into: mothers who completed at most primary education, those who completed secondary education, and those with tertiary or university studies or more.

Nutritional anthropometric status. Weight and height were measured with a digital weighing scale and a portable height rod by trained staff. Children wore light clothes during the procedure. Body mass index (BMI) z-scores were calculated according to the WHO 2006 standards using its *AnthroPlus* software. Three nutritional anthropometric status were established: not overweight, overweight, or obese.

The research team was trained to conduct both surveys and to perform measurements.

Neighborhood variables

Neighborhood of residence. Parents reported the name of the neighborhood where the child lived in order to cross-check information with secondary sources (*e.g.*, National Census).

Socioeconomic context. It was obtained from the percentage of households with at least one UBN per neighborhood. The needs considered were:

- households with more than three people per room;
- households corresponding to inconvenient dwellings (piece of tenancy, hotel or pension room, box, and premises not built for room or mobile housing);
- households that do not have any kind of toilet;
- households with school-aged children (6 to 12 years old) who do not attend school;
- households with four or more persons per occupied member whose head has not completed the third grade of primary schooling.

The percentage of households with UBN varied between 0 and 24%. The variable was, therefore, ordinalized in three intervals: favorable context neighborhoods, when they had a low proportion of households with UBN (less than 8%); transitional context neighborhoods, those with an average proportion of households with UBN (from 8 to 16%); and critical context neighborhoods, those with a high percentage of households with UBN (more than 16%). This criterion was defined considering previous local studies, in order to compare results.

Information was obtained from the last National Census 2010 to determine the total number of households according to UBN condition by neighborhood[15]. The cartographic conformation of the neighborhoods constitutes a census approximation made by the General Direction of Statistics and Census of the Province of Cordoba based on the official and unofficial neighborhoods of Cordoba city and the census division used in the Census[16]. From that, the variable on neighborhood socioeconomic context was constructed.

All procedures performed were in accordance with the ethical standards of the *Comité de Ética del Hospital Nacional de Clínicas* (Ref. No. 066/10).

DATA ANALYSIS

Multilevel statistical models allow for the estimation of contextual effects of area-level factors by accounting for the spatial clustering of individuals within regions[29]. Three sets of multilevel models adjusted to Poisson distribution were carried out using STATA 14 software to estimate the association between individual and contextual characteristics, and high frequency of using PP for PA.

Girls and boys were modeled separately on the basis of previously found gender differences in PA and use of parks[30] (Table 1). The first set of models was adjusted only for individual covariates (models 1 and 3). The second set incorporated socioeconomic neighborhood context at the second level (models 2 and 4).

Boys models included a total of 384 children distributed in 77 neighborhoods; Girls models, 450 out of 81. The reason why the number of children varies from descriptive to multilevel results is related to the fact that, for the latter, data from the parents' survey

Table 1. Sample individual characteristics by gender. Cordoba city (Argentina), 2011.

Variables (n %)	Total (n = 1,777)	Girls (n = 934)	Boys (n = 843)	p-value
School grade				
4th	591 (33)	307 (33)	284 (34)	0.54
5th	624 (35)	321 (35)	303 (36)	
6th	558 (32)	304 (32)	254 (30)	
Mother's educational level				
None	162 (11)	90 (12)	72 (10)	0.02
Elementary school	885 (62)	472 (63)	413 (60)	
Middle or high school	319 (22)	142 (19)	177 (25)	
College or higher	73 (5)	42 (6)	31 (5)	
Social support				
Low	159 (14)	82 (14)	77 (15)	0.78
Medium	449 (40)	231 (40)	218 (41)	
High	502 (45)	269 (46)	233 (44)	
Nutritional anthropometric status				
Not overweight	686 (61)	370 (63)	316 (59)	< 0.001
Overweight	250 (22)	146 (25)	104 (19)	
Obese	190 (17)	71 (12)	119 (22)	
Screen activities per day				
Less than 2 hours	270 (25)	168 (30)	102 (20)	< 0.001
2–3 hours	593 (55)	322 (57)	271 (54)	
More than 3 hours	207 (19)	77 (14)	130 (26)	
Frequency of park use for PA				
Never	264 (22)	148 (24)	116 (21)	< 0.001
Rarely	218 (18)	132 (21)	86 (15)	
Sometimes	185 (16)	115 (18)	70 (13)	
Frequently	522 (44)	234 (37)	288 (51)	

PA: physical activity; p-value: χ^2 test.

was necessary, and not all children had them. That is, 704 children did not have any of the data necessary for multilevel analysis, so the statistical system automatically excluded those cases.

Incidence rate ratios (IRR) with 95% confidence intervals (95%CI) were estimated in all models. Parameters were estimated by the full information maximum likelihood method.

In order to measure inequalities, a relative measure based on *odds ratios* was obtained from a logistic regression analysis. Also, the Slope Index of Inequalities (SII) was used. This index represents the absolute difference in the fitted value of the health indicator between the highest (score of 1) and the lowest (score of 0) values of the socioeconomic indicator rank. The SII is one of the most used measures of inequality in epidemiological literature, along with ratios and differences[31].

All statistical tests were two-tailed and adopted a 5% significance level. Quantum GIS 3.2 software was used to create maps to help visualize neighborhood distribution.

RESULTS

The final sample consisted of 1,777 children and 1,313 adults (mothers in 86% of cases). The effective participation in the study was 64.3% of children, with a range of 29.8 to 82.5% in different schools; and 60.5% of adults, with a range of 37.5 to 84.2%. The difference between the participation of children and adults can be attributed to the lack of response in the parents' survey. The strategy of sending the questionnaire through their children could have caused it to get lost along the way.

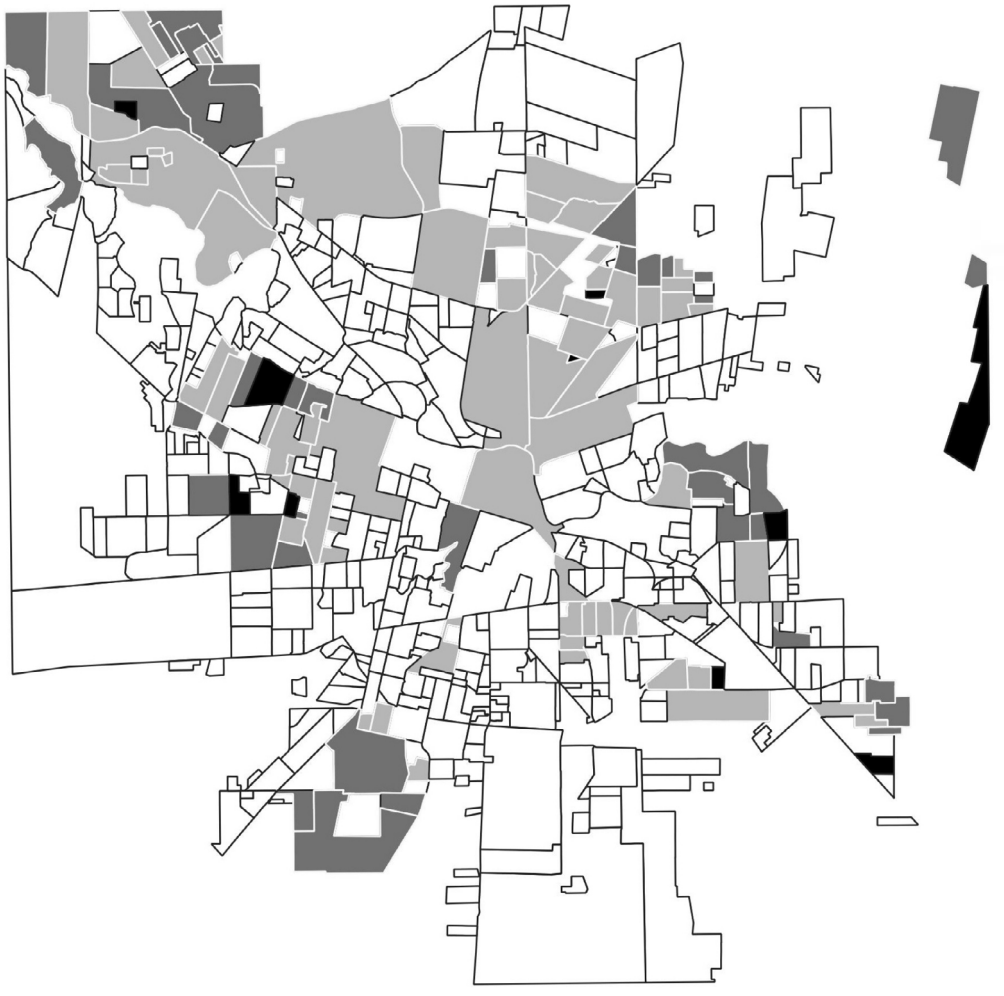
Children were evenly distributed throughout school grades and there were more girls (53%) than boys. Most mothers (62%) had only completed elementary school. Obesity was more frequent in boys than in girls, whereas overweight was more frequent in girls than in boys. Also, boys used parks for PA more frequently and spent more hours engaged in screen activities than girls. Less than half of the sample was classified as frequent users of neighborhood PP (Table 1).

Most neighborhoods were classified as favorable, although most children lived in those classified as transitional. No differences were found in the distribution of girls and boys.

Figure 1 shows geographical distribution according to the context of poverty. Differences were found between the context of neighborhood and geographical area ($p < 0.005$).

Regarding boys, the models observed in Table 2 show that individual and neighborhood variables were not related to the outcome of interest. Instead, girls' models show that the critical socioeconomic neighborhood context was negatively associated with frequent use of PP for PA (IRR = 0.44; 95%CI 0.21 – 0.91).

Multilevel models without stratifying by gender showed that the neighborhood poverty context was also important in the use of PP for PA. As neighborhood context deteriorates, children's use of PP for PA decreases considerably, regardless of individual variables. Furthermore, gender was associated with our outcome (IRR = 0.68; 95%CI 0.55 – 0.84).



*Favorable: light grey; transitional: dark grey; critical: black; not included/no information: white. The city's Southeast zone contains most critical context neighborhoods while Southwest and Northeast accumulate transitional context neighborhood. Northwest, North, and West zones comprise mostly favorable context neighborhoods

Figure 1. Geographical distribution of neighborhood sample according to socioeconomic context. Cordoba city (Argentina), 2011*.

The frequency of use of PP for PA in boys was 48%, or 1.48 times, higher in neighborhoods with better socioeconomic conditions than in those in worse conditions (95%CI 1.14 – 1.93). In girls, this percentage climbs to 60% (95%CI 1.24 – 2.06). Additionally, the SII equals 26.8, which represents the difference between frequently using the PP for PA and not using it frequently. This also indicates that this frequency in favorable context neighborhoods is 26.8 percentage points higher than in critical context ones (95%CI 0.16 – 0.37).

Table 2. Incidence rate ratio of high frequency use of neighborhood PP for PA according to individual and neighborhood characteristics based on multilevel Poisson models. Cordoba city (Argentina), 2011[#].

Level of analysis	Variables	Model 1 Boys		Model 2 Boys		Model 3 Girls		Model 4 Girls	
		IRR (95%CI)	p	IRR (95%CI)	p	IRR (95%CI)	p	IRR (95%CI)	p
1º level	School grade								
	6th	1	-	1	-	1	-	1	-
	5th	0.98 (0.70 – 1.98)	0.938	0.98 (0.70 – 1.37)	0.907	0.99 (0.68 – 1.46)	0.992	0.99 (0.67 – 1.45)	0.956
	4th	1.05 (0.74 – 1.48)	0.792	1.05 (0.74 – 1.49)	0.783	1.06 (0.72 – 1.56)	0.760	1.09 (0.74 – 1.61)	0.662
	Mother's educational level*								
	High	1	-	1	-	1	-	1	-
	Middle	0.94 (0.69 – 1.27)	0.672	0.98 (0.72 – 1.33)	0.898	1.04 (0.73 – 1.47)	0.836	1.09 (0.76 – 1.56)	0.643
	Elementary	1.10 (0.67 – 1.80)	0.700	1.16 (0.71 – 1.92)	0.551	0.85 (0.48 – 1.50)	0.580	0.89 (0.50 – 1.57)	0.688
	Social support								
	High	1	-	1	-	1	-	1	-
	Medium	0.98 (0.73 – 1.31)	0.905	0.98 (0.73 – 1.31)	0.894	1.08 (0.78 – 1.50)	0.635	1.10 (0.79 – 1.52)	0.578
	Low	0.76 (0.49 – 1.20)	0.238	0.76 (0.49 – 1.20)	0.244	0.66 (0.39 – 1.11)	0.118	0.66 (0.39 – 1.11)	0.114
	Nutritional anthropometric status								
	Not Overweight	1	-	1	-	1	-	1	-
	Overweight	1.22 (0.87 – 1.71)	0.237	1.22 (0.87 – 1.70)	0.253	0.99 (0.70 – 1.42)	0.989	0.99 (0.69 – 1.41)	0.947
	Obese	1.05 (0.75 – 1.48)	0.763	1.05 (0.75 – 1.48)	0.768	0.87 (0.53 – 1.44)	0.594	0.85 (0.51 – 1.40)	0.522
	Screen activities								
	< 2 hours/ day	1	-	1	-	1	-	1	-
	2–3 hours/ day	1.17 (0.80 – 1.72)	0.423	1.18 (0.81 – 1.74)	0.391	0.81 (0.58 – 1.14)	0.222	0.79 (0.56 – 1.11)	0.168
	> 3hs/day	1.24 (0.81 – 1.90)	0.314	1.27 (0.83 – 1.94)	0.267	0.85 (0.52 – 1.39)	0.523	0.88 (0.54 – 1.44)	0.611

Continue...

Table 2. Continuation.

Level of analysis	Variables	Model 1 Boys		Model 2 Boys		Model 3 Girls		Model 4 Girls	
		IRR (95%CI)	p	IRR (95%CI)	p	IRR (95%CI)	p	IRR (95%CI)	p
2º level	Neighborhood socioeconomic context								
	Favorable	-	-	1	-	-	-	1	-
	Transitional	-	-	0.87 (0.65 – 1.17)	0.363	-	-	0.87 (0.63 – 1.22)	0.423
	Critical	-	-	0.76 (0.47 – 1.23)	0.266	-	-	0.58 (0.33 – 1.00)	0.052

#No. of observations: boys' models 384, girls' 450. No. of neighborhoods: boys' models 77, girls' 81; *high: college or higher; middle: secondary education; elementary: elementary school; PP public parks; PA: physical activity; IRR: incidence rate ratios; 95%CI: 95% confidence interval.

DISCUSSION

Multilevel models indicated the importance of neighborhood context in the use of PP for PA during childhood, especially for girls. As the neighborhood context deteriorates, the use of PP decreases considerably in the group of girls, regardless of individual variables. Also, inequality measures gave evidence of social and gender disparities in using PP to develop PA. This brings forward original evidence to the comprehension of social complexity in approaching leisure-time PA in a local context, focusing on childhood.

Critical neighborhoods would probably have streets and sidewalks in worse conditions, less lighting, and PP without care, compared to favorable ones. The poor quality of PP were problems regularly mentioned by children's mothers in the previous studies[32]. Therefore, although there are PP in the neighborhood, their poor conditions could make children use them less and prefer to spend leisure time at home. Supporting this, half of the sample of children spent two hours or more on screen-based activities[33]. In Portugal, adolescents living in neighborhoods with recreational facilities were more likely to be active[34].

In addition, feelings of unsafety are widely spread in the discourses of community members[32]. Neighborhood trust and social networks facilitate collective action[35]. The lack of public space produced by perceived unsafety results in the impossibility to create community resources, intensifying the sensation of insecurity. This generates a circular and cumulative process in which the loss of places where citizenship and collective trust produces insecurity, promoting the reclusion into the private sphere[36]. Related to this, lower neighborhood safety and social disorder were significantly associated with less PA in children from Chicago, Illinois[37].

Focusing on gender inequality, we observed that neighborhood poverty has a stronger impact on girls' PA. This pattern is verified (in an aged group) in a Brazilian study in which

there is a greater presence of men compared to women in parks. The authors partially attribute this to the fact that many of these spaces are designed for predominantly male activities, such as football or basket, with fewer areas for walking, running, or cycling, usually preferred by women[38]. However, it should be noted that these assessments may also be incorporating a gender bias. Moreover, research developed in Spain also found a great absence of women in the public space which, according to the authors, shows the need for an urban design that considers the needs and interests of women[39].

PA and sports should be conceived as socially constructed phenomena that have been perpetuating male hegemony throughout history. Moreover, urban planning has mainly reflected the interests of adult men, while women and children appear merely as objects[40]. The use and perception of public space have clear gender connotations and are a sample of the hierarchical relationship between men and women. Women have been historically relegated to the private space, so their relationship with the public space and PA reflects and reinforces their place in society[39]. And this has been observed even since childhood.

CONCLUSIONS

This is an original study that focuses exclusively on children to determine whether the socioeconomic context of the neighborhood influences the PP used for PA. One of its main strengths is helping to understand socioeconomic and gender disparities in the opportunity children have to develop their right to use public spaces for being physically active.

The limitations of this study relate to the fact that the study population was that of children who attended only municipal schools. Therefore, results cannot be extrapolated to the entire school-aged population. Secondly, although the sample of schools was randomly selected and inclusion criteria were pragmatic, the response rate decreased mainly due to a lack of parents' participation, compromising the external and internal validity. Data from non-participants could not be obtained, but it can be assumed that children from more vulnerable families were more likely not to participate. However, in the current analysis, the mother's educational level was not associated to the dependent variable, and we cannot suspect a high risk of selection bias. What limited our conclusions was the precision of results and the statistical significance due to a lower sample size and stratified analysis. Another limitation was the use of self-reported information, since this type of data is subject to recall bias or social desirability issues. However, people's perceptions of their use of neighborhood spaces contribute to how they use and recognize their environment[41].

Health inequalities determined by socioeconomic and gender conditions should be considered as health inequities[18]. PA is a fundamental way to promote an appropriation of the public space and to create shared spaces for the exercise of citizenship. This is crucial for understanding what policies are required in territories of greater social vulnerability.

ACKNOWLEDGMENTS

The authors are grateful to the staff from the Secretariat of Education of the Municipality of Cordoba; to the community of municipal schools, teachers, students and their families and to the staff of CIESS for their helpful contribution during fieldwork. Finally, thanks to scientific policy promoted by Argentinean government from 2003 to 2015.

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Received on: 09/23/2019
Revised on: 03/03/2020
Accepted on: 03/19/2020

Contribution of the authors: J. L. worked on the conception, design, analysis and interpretation of data, also drafted the manuscript, revised it critically, and approved the final version. S. B. participated in the design, revision and approval of the manuscript.