Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Effectiveness evaluation of the “Transformem els patis” intervention on schoolyard use in Barcelona: a mixed-methods approach

Esther Sanchez-Ledesma

esanchez@aspb.cat

Institut de Recerca Sant Pau https://orcid.org/0000-0001-9154-4553

Xavier Continente

Institut de Recerca Sant Pau https://orcid.org/0000-0003-4888-2754

Silvia Brugueras

Institut de Recerca Sant Pau

Constanza Vasquez-Vera

Institut de Recerca Sant Pau

María José López

Institut de Recerca Sant Pau

Research Article

Keywords:

Posted Date: November 12th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11549300/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations:
Tables 1 to 3 are available in the supplementary files section

Effectiveness evaluation of the "*Transformem els patis*" intervention on schoolyard use in Barcelona: a mixed-methods approach.

Esther Sánchez-Ledesma [a, b, c, d], Xavier Continente [a, b, c, *], Sílvia Brugueras [a, b], Constanza Vásquez-Vera [a, b], Maria José López [a, b, c]

[a] Sant Pau Research Institute (IR Sant Pau), C/Sant Quintí, 77-79, Barcelona, Spain

[b] Agència de Salut Pública de Barcelona (ASPB), Lesseps 1, Barcelona, Spain

[c] Spanish Consortium on Epidemiology and Public Health (CIBERESP), Av. Monforte de Lemos, 3-5, Madrid, Spain

[d] Department of Paediatrics, Obstetrics and Gynaecology, and Preventive Medicine and Public Health, Faculty of medicine, Autonomous University of Barcelona, Barcelona

Corresponding authors' address: Xavier Continente (xcontine@aspb.cat). Agència de Salut Pública de Barcelona (ASPB). Pl Lesseps 1. 08023. Barcelona. Spain

Abstract:

"*Transformem els patis escolars*" is a Barcelona City Council programme that transforms public primary school schoolyards into greener, co-educational, and community-oriented spaces. We evaluated the programme's effects on schoolyard use, activities performed, play dynamics, equitable relationships and students 'wellbeing from a gender perspective. A non-experimental, mixed-methods, pre-post evaluation was conducted in seven primary schools participating in the programme (years: 2022–2023). Quantitative data were collected through systematic observations before and after the intervention. Qualitative data were obtained through focus groups with teachers (N=7) and 5th and 6th grade pupils (N=36), and brief interviews with pupils (N=69). Data covered: schoolyard use; play group composition; play activities and dynamics; social interactions, equitable relationships and well-being. The transformation diversified play activities and modified play dynamics. Quiet play increased among boys (26.5% vs. 53.5%; p<0.001), while football declined (pre: 28.8%; post: 12.1%). In contrast, active sports increased among girls (0.4% vs. 6.7%; p<0.001) and mixed-gender groups (28.2% vs. 34.1%; p=0.033). Qualitative findings identified three main themes: a more versatile, equitable, and healthier schoolyard. Natural elements and multiple activity areas diversified play opportunities, reduced football dominance, promoted mixed-gender play and social interaction and enabled girls to a re-appropriate spaces previously dominated by boys. Teachers reported fewer conflicts and more inclusive dynamics, while students described improved well-being and high satisfaction with the intervention. Schoolyard transformations promoted more equitable use of space, diversified play opportunities, fostered inclusive social interactions, and enhanced students' wellbeing, highlighting the potential of schoolyard design to reduce gender inequalities in school settings.

Keywords: Program evaluation; Children; Schoolyards; Gender equity; Space Use; Wellbeing, Urban health

1.Introduction

By 2050, it is estimated that 68% of world's population will live in cities(1). Health inequalities tend to be more pronounced in urban areas, as they often include deprived neighbourhoods that concentrate poor populations(2). Research on place effects and health describes the importance of both physical-particularly the built environment- and socioeconomic environments as key determinants of urban health inequalities (2–4). Cities and local governments play a central role in addressing health inequalities through interventions in their everyday settings. A setting, such neighbourhoods, schools, and workplaces, is a physical or social context where people actively use and shape the environment and, consequently, where health-related problems are created or addressed. Urban interventions as promoting pedestrian areas, green spaces, schools surroundings transformations or access to public amenities and safe environments can contribute to healthier settings (5–7).

Schools constitute a primary setting for children's socialization and an optimal context for health promotion during the early life course (8). Within schools, schoolyards function as micro public spaces that structure children's everyday experiences, contributing to their socialisation, integration, autonomy, and physical and mental well-being (9,10). Their use is shaped by interactions between the physical (built) built environment (furnishings and spatial characteristics)(11,12); the social environment (peer interactions)(13,14); and the cultural environment (established rules and school restrictions)(15). Although schoolyards are often perceived as spaces where children freely choose their activities, their use and social dynamics are strongly influenced by gendered patterns and spatial design (16,17). In many schools, large central areas dedicated to competitive ball games are frequently occupied by boys, while girls and children engaging in other activities use smaller or peripheral spaces. Consequently, schoolyard design can reproduce gender roles and inequalities through the unequal distribution of space, resources and opportunities for play (17,18).

Recently, several countries have promoted schoolyards transformations towards more naturalised and inclusive environments, encouraging diversity of play, physical activity, social interaction and community use (19–22). Previous studies suggest that interventions incorporating green areas, natural elements and multifunctional play spaces can reduce sedentary behaviour, support different forms of physical activity and promote positive social interactions, particularly among girls (23–25). Inclusive schoolyard designs may also contribute to more balanced spatial use and egalitarian social dynamics (18,26). However, most evaluations have primarily focused on naturalisation and physical activity outcomes (25,30–32), while evidence about the effects of schoolyard design on social relationships, gender equity and well-being remains limited.(23,27–29).

In this context, the Barcelona City Council launched the programme "*Transformem els Patis*" during 2020-2021, to transform primary school schoolyards into more naturalised, inclusive and community-oriented spaces. Transformations are developed through a co-creation process[1] involving the entire educational community and local organisations, according to six criteria: 1) a space for learning, co-education and socialisation; 2) a diversity of environments and playful and creative activities; 3) ensured contact with nature through green areas, soil and water; 4) comfort and connection with the surroundings; 5) balanced (re)distribution of spaces; and 6) diverse uses for the community and neighbourhood (30).

This study aimed to evaluate, from a gender perspective, the effects of "*Transformem els patis*" intervention on schoolyard use, play activities, social dynamics, equitable relationships and students 'wellbeing.

[1] The co-creation process was conducted between September 2020 and April 2021, and the physical transformation of the schoolyard took place between July 2021 and August 2021.

2. Methods

We conducted a non-experimental pre-post study using mixed methods. The study population comprised pupils from first to sixth grade (6-12 years) and teachers from public primary schools in Barcelona. Seven schools in the 2021-2022 programme edition were selected based on geographical and socioeconomic representation, the type of planned transformation and the feasibility of conducting schoolyard observations.

The study followed the guidelines laid down by the Declaration of Helsinki and received ethical approval from the Parc de Salut Mar Clinical Research Ethics Committee (code: 2023/10927).

2.1. Quantitative study

2.1.1. Data collection

Quantitative data was collected through 14 non-participant observations conducted before (May 2022) and after the transformation (May 2023) in the seven participating schools. At each measurement point, two 30-minute observations were conducted, one during break time and one at lunchtime. Schoolyards were divided into areas that were sequentially scanned, following the procedure described in a pilot study (19). A systematic observation sheet recorded schoolyard characteristic, group composition by sex and age, physical activity intensity, type of activity, and use of play materials and equipment.

2.1.2. Study variables

Observation sheets recorded quantitative information on observed groups characteristics: group size (single individual, small [2–4 children], medium [5–9 children], and large [10 or more children]) and composition by sex (all girls, all boys, and mixed).

For each group, the type of activity was classified into four categories: sports play, non-sports play, quiet play and other activities. Sports play included football, basketball and other sports; active non-sports play included activities involving movement such as running, chasing, climbing and balancing; and quiet play included talking, eating, resting, drawing, reading; imaginative play, board games arts and crafts and sand play.

Finally, physical activity level was classified as stretched or seated position, light (walking or standing), or vigorous (running).

2.1.3. Data analysis

We performed a descriptive analysis of all variables collected for the pre-and post-measurements. Although the group was the unit of observation, information was assigned to each individual within the group for analysis. Percentages were stratified according to group gender composition (boys, girls and mixed groups), and pre-post differences were assessed using chi-square tests. Analyses were conducted using Stata 15.1.

2.2. Qualitative study

2.2.1. Data collection

Qualitative data were collected through non-participant observations before and after the transformation, short interviews and focus groups.

In the 14 observations, field diaries documented the following dimensions: a) schoolyard use and spatial distribution; b) social interactions and conflicts; c) types of play; and d) use and schoolyard structures characteristics.

After the transformation, a total of 69 short interviews (3-5 minutes) were conducted between May and June 2023 with 39 girls and 30 boys from first to sixth grade (6 -12 years) at the participating schools. They were conducted at school dismissal time, and verbal informed consent was obtained from the accompanying adult. The themes explored in the interviews were: a) schoolyard use (spaces and elements); b) play dynamics; c) social interaction; d) fostering equalitarian relationships (gender and age); e) wellbeing; and f) satisfaction with the schoolyard.

In turn, 3 one-hour focus groups were conducted in three schools with 36 pupils (16 girls; 19 boys and 1 non-binary student) from 5th and 6th grade who had previously participated in the co-creation process. Semi-structured guides covered the following themes: a) schoolyard use and space distribution; b) play activities; c) social interaction; d) equal relationships (gender and age); e) well-being and comfort; f) positive and negative aspects of the transformation; and g) overall assessment. Additionally, 2 focus groups were held with teachers -one with early childhood education teachers and another with primary school teachers- from the seven participants schools, involving a total of 7 teachers (6 women and 1 man). Semi-structured guides addressed the following themes: a) schoolyard naturalisation; b) schoolyard use; c) social interaction (gender and age); d) use of the schoolyard as a learning space; e) community use; f) physical and psychological well-being; g) strengths and areas for improvement; and h) overall assessment. All groups were facilitated by a moderator assisted by an observer.

2.2.2. Data analysis

Audio recordings, from the short interviews and focus groups were transcribed, anonymised and complemented with field diaries information and interview and focus group notes. We carried out a content analysis in which information was coded and organised into analytical categories until an explanatory framework was created. Differences in interpretation were discussed within the research team until consensus was reached. ATLAS ti-24 software was used to manage the analysis

To enhanced rigour and credibility, findings were triangulated by the research team to minimise interpretative bias and increase the analysis consistency.

2.3. Mixed-methods analysis

A convergent-parallel mixed-methods approach was followed in data collection and analysis (31). Quantitative and qualitative data were analysed separately and subsequently compared to identify convergence and divergence.

3.Results

3.1. Quantitative results

Table 1 describes the characteristics of the observed individuals before (pre) and after (post) the intervention, by group gender composition (boys, girls, and mixed groups). A total of 716 groups comprising 2,519 pupils were observed: 331 groups (1,187 individuals: 340 in groups of only boys; 284 in groups of only girls and 563 in mixed groups) in the pre-period and 385 groups (1,332 individuals: 273 boys; 460 girls and 599 in mixed groups). in the post period. Group characteristics by sex composition are presented in Table 1

Changes in group size were observed only in boys' and mixed groups after the transformation. After the transformation, large groups (≥10 children) among boys decreased from 6.5% to 0% ($p<0.001$), while small (2–4 children) mixed-gender groups increased from 22.9% to 29.2% ($p=0.023$).

[Insert Table 1]

Regarding types of play (Table 2), quiet play increased among boys (pre: 26.5%; post: 53.5%; $p<0.001$), including talking, eating or resting (pre: 16.8%; post: 37.7%; $p< 0.001$), while active sports—especially football (pre: 28.8%; post: 12.1%)—declined. Among girls, quiet play remained stable and higher than among boys, and active non-sportive play decreased (pre:30.6%; post:18,3%; $p<0.001$) whereas active sports play increased (pre: 0.4%; post: 6.7%: $p<0.001$), after the transformation. Active sports also increased in mixed groups (pre: 28.2%; post: 34.1%: $p=0.033$). Participation in football rose among girls (pre: 0%; post: 3.3%; $p=0.002$) and in mixed groups (pre: 17.2%; post: 23.4%; $p=0.009$), although boys kept playing football more frequently than girls. A similar pattern was observed for basketball (girls: pre: 0.4%; post: 3.0%; $p = 0.011$; mixed groups: pre: 3.4%; post: 8.4%; $p < 0.001$), and the percentage after the transformation was similar or higher than in boys.

Concerning physical activity levels, seated positions increased across all groups, particularly among boys (pre: 12.4%; post: 42.5%; $p=0.000$) and mixed groups (pre: 16.5%; post: 30.6%; $p< 0.001$) while light physical activity decreased across all group types. Finally, vigorous activity declined among boys (pre: 45.9%; post: 20.6%; $p<0.001$) but increased among mixed groups (pre: 27.0%; post: 33.4%; $p=0.018$).

[Insert Table 2]

3.2. Qualitative results

A total of 105 students participated in the evaluation: 69 in short interviews (39 girls and 30 boys) and 36 in focus groups (16 girls; 19 boys and 1 non-binary student). Furthermore, 7 teachers (6 women and 1 man) participated in focus groups.

To understand the intervention impact on schoolyard use, play dynamics, equitable relationships and wellbeing, three main themes emerged from students' and teachers' narratives: 1) *Physical and functional dimension: a more versatile schoolyard; 2) Social dimension: a more equitable and democratic schoolyard; and 3) Wellbeing dimension: a healthier schoolyard*. Key features of each theme are summarised in Table 3.

Theme 1. ***Physical and functional dimension: a more versatile schoolyard***

Students and teachers agree that the physical transformation -through naturalisation and new play infrastructure- has diversified schoolyard spaces and expanded their uses, increasing interaction opportunities among students of different genders and ages. The presence of multiple play areas reduced the dominance of a single central space (usually the sports court), creating multiple activity centres where students can be distributed. This space diversification also promoted greater diversity of

play. After the transformation, students engaged more frequently in free, imaginative and quiet activities, while competitive games, particularly football, became less dominant. Girls and mixed-gender groups engaged more frequently in sports and active non-sport play, while experimentation with natural elements was particularly common among girls and younger students. Social interaction also increased using shared spaces such as benches and the agora. Both, students and teachers, evaluated these changes positively, with girls reporting more frequent positive assessments.

> *"I like there isn't just one area. It's divided into several areas, so we can go to whichever we prefer: the sand, sit on the benches, the agora, to play floor games…"* (Boy, 5th grade)

Students positively assessed the new play elements, particularly the sandpit and agora. Younger children used the sandpit mainly for exploratory and creative play, whereas girls and older students frequently used the agora for active non-sport play, resting and social interaction. Some older students considered the new equipment more suitable for younger children, although overall assessments were positive. Teachers also highlighted the value of versatile elements in facilitating interaction among children with disabilities.

Regarding physical activity levels, some students felt that they engaged in less vigorous activities because they now spend more time on quieter activities. However, students' narratives suggested the new schoolyard encouraged a wider variety of sports activities, reducing the dominance of football, and increased participation in active non-sport play, particularly among girls.

> *"I liked that they've put up the volleyball net, the basketball hoop and the goal, because that way we have more sports to play*" (Girl, 5th grade)

Concerning schoolyard use, teachers emphasized the need for clear rules and effective space management, including turn-taking, class schedules and the regulation of ball games, which were a common source of conflict. They also reported maintenance problems affecting vegetation, sand, water features and painted surfaces.

Theme 2. *Social dimension: a more equitable and democratic schoolyard*

After the transformation, changes in gender relations and play dynamics were observed, with an increase in mixed-gender play and relationships facilitated by a more balanced distribution of students across the schoolyard. This created opportunities for mixing between girls and boys and among students of different ages, particularly around structures such as the agora and stands, especially among younger children. Play diversity fostered more mixed dynamics across three types of activities: a) active sports play, such as basketball, volleyball and football, with greater participation by girls; b) active non-sport play, such as tag and hide-and-seek; and c) quiet play, including board games, drawing and chatting.

> *"We mix boys and girls. In my class, much more than last year. Maybe we play more together because of the new things they've put in "(*Boy, 6th grade)

Reducing football dominance encouraged more mixed gender and equitable play, particularly among younger students. Play also became more diverse, with fewer traditionally masculinised activities, such as football and video game fight re-enactments, and more quiet and mixed-gender play.

The transformation also encouraged social interaction. Teachers and students reported more opportunities for conversation and cooperative activities in areas such as benches, the agora, the sandpit and picnic tables.

These changes also promoted a more equitable use of the schoolyard. Before the transformation, the centrally located court was dominated by football, mainly played by older boys, while girls were often relegated to peripheral areas. The redistribution of space enabled girls, mixed groups and boys less interested in football to (re)appropriate central areas. However, some older boys perceived a loss of

space and power due to the smaller football area and the presence of elements that interfered with the game. By contrast, girls appreciated the calmer environment, as football no longer dominated the schoolyard.

> *"I like the schoolyard because it's quieter now. Before, it was basically all football, and we couldn't have our breakfast in peace without them kicking the ball at us" (*Girl, 5th grade)

Care-related activities also increased, particularly around naturalised elements, with girls and younger students engaging in activities involving plants and shared materials.

Finally, the transformation was associated with fewer schoolyard conflicts. The reduced dominance of football and the increase in quieter, less competitive activities with less physical contact contributed to a calmer and more inclusive environment

Theme 3. Wellbeing dimension: a healthier schoolyard

In general, students reported greater well-being after the transformation and enjoyed a wider range of play activities. They described the schoolyard as cooler, funnier, exciting, active and attractive, with girls generally reporting greater well-being and satisfaction than boys. Students valued the variety of spaces and games, noting increased opportunities for play and enjoyment Teachers also reported improvements in students' physical and psychological well-being, particularly among younger children, who are happier, more engaged, more relaxed and less bored:

> "*The children are happier, more relaxed... because each child plays where they feel most at ease and enjoy it most, there is no boredom. Before, conflict arose from boredom because they did not know what to play... Now it is a space of well-being"* (Woman. Primary school teacher).

The transformed schoolyard was also perceived as quieter and more comfortable, offering spaces for rest, socialising and calm, particularly among girls and younger students. Vegetation, shade and natural elements were associated with greater thermal comfort, contact with nature and opportunities for exploration and relaxation. Noise and conflicts also have decreased. Girls especially valued the calmer environment, as they were no longer frequently hit by footballs. Aesthetic improvements, including more colour, varied textures and decorative elements, were also positively evaluated:

> "*Before the schoolyard was grey and very emotionless (…) Now it is more colourful, more alive. They have added more textures*" (Girl, 5th grade).

Overall, students and teachers were satisfied with the transformation. However, maintenance of vegetation and naturalised elements remained a concern, while some boys perceived a reduction in space for their activities and some older students considered the schoolyard too "childish".

[Insert table 3]

4.Discussion

This study suggests that "*Transformem els patis*" programme diversified schoolyard use and play, reduced the dominance of football among boys, and increased opportunities for quiet activities and quality rest. Girls and mixed-gender groups participated more frequently in active sports, while mixed-gender play and interaction across ages increased. The transformation also supported the (re)appropriation of central spaces by girls, mixed-gender groups and boys less interested in football. Qualitative findings further suggest positive effects on students' well-being.

4.1. Schoolyard use and types of play.

Our findings indicate that the physical schoolyard transformation diversified spaces and play activities, decentralising activity from the central football court and creating multiple activity centres. This may have reduced overcrowding and improved equitable access to space. Previous research shows that multifunctional zones -such as green areas, active and social play spaces and non-competitive zones- encourage diverse play, reduce the spatial dominance of ball games and allow more students to be active simultaneously (18,24), supporting more inclusive and gender-balanced participation (18,32).

The increased variety of schoolyard areas has also led to more diverse play. Quantitative and qualitative findings showed increases in quiet, imaginative and non-sport active play among both genders. This may be explained by the introduction of natural elements, naturalised surfaces and varied play equipment, that previous studies have associated with more active and creative play during recess (20,24,33) and more participation in activities beyond sports, fostering creativity (18,19).

Our study showed that girls and mixed-gender groups participated more in active sports, including basketball, volleyball and football, while boys' participation declined. This shift may reflect football's reduced spatial dominance, creating opportunities for more participants (18). Some studies have shown that accessible structures, green spaces and varied surfaces have been associated with increased physical activity, particularly among girls and mixed-gender groups (18,23,24,34). This increase in quiet activities and seated positions-particularly among boys- also suggests that schoolyard transformation can modify gendered patterns of physical activity (20,23). Consistent with previous research, reducing football's centrality may lower boys' intense physical activity while encouraging more diverse, calmer and prosocial play (24,25,35). However, teachers highlighted the need for effective schoolyard management, including clear rules, ball game regulation and material maintenance, to sustain diverse play and equitable dynamics, suggesting that physical transformation alone may be insufficient without appropriate governance (36,37).

4.2. Play dynamics and social relationships

After the transformation, students and teachers reported increased social interaction among boys and girls of different ages. The new schoolyard layout and diversity of play opportunities supported more mixed dynamics, supporting our quantitative data on group mixing and promoting more gender-mixed play**.** This finding aligns with previous research linking varied, flexible and nature-based play areas to more prosocial and inclusive interactions (20,21,24).

The transformation also promoted a more equitable occupation of schoolyard space. Qualitative findings revealed a (re)appropriation of non-peripheral areas by girls, mixed-gender groups and boys less interested in football, driven by the football reduced dominance and the introduction of alternative equipment and ballgames. These changes coincided with increased participation of girls in active sports and more mixed-gender play, potentially reducing competition over space and fostering more equitable social relationships, as previous research on gendered spatial dynamics suggests (18,20,26,38).

The transformation also provided areas for relaxing and quiet activities, including talking, sitting, having breakfast, crafts and imaginative play, which were associated with increased social interaction and more positive atmosphere. Teachers and students reported fewer conflicts, particularly those previously linked to competitive sports. This is consistent with research linking fewer conflicts to less competitive play environments (19,20,24,39); improved thermal comfort, as extreme heat can increase irritability and aggression (40), and the presence of natural elements that promote calmness (20,22,41).

Naturalised areas also encouraged care-related practices, such as watering plants and maintaining the space, fostering interaction across ages and genders. These practices were particularly evident among girls and younger students, consistent with evidence of gendered patterns in caregiving play (42). As previous studies described, involving children in designing and maintaining green spaces plays also has educational value and promotes environmental awareness (43–46).

4.3. Health and wellbeing

Our results suggest that the transformation contributed to a healthier and more comfortable schoolyard. The observed increase in low-intensity activities and quiet play areas aligns with reports of greater relaxation, enjoyment, contact with nature, improved thermal comfort, fewer conflicts and less boredom suggesting benefits for physical comfort and psychological students' well-being (25,28,44,47).

As mentioned, diverse play areas help to reduce the dominance of any single activity, creating a calmer, more diverse and inclusive environment. Less noise and fewer conflicts—often associated with football's central role— may help children, particularly girls and younger students, feel more comfortable. This aligns with research showing that less hierarchical, more diverse play environments promote comfort and equitable participation across genders (39,48).

Naturalisation has also supported students' well-being. Previous studies have associated contact with greenery, shade and natural materials with calmness, thermal comfort and cooperative and prosocial play (25,47). This highlights the importance of integrating nature into schoolyards, as an active component of children's daily experiences, consistent with evidence that nature-based schoolyards enhance calmness, social interaction and satisfaction (24,25).

The improved physical and thermal comfort, together with aesthetic enhancements, was positively perceived by students and teachers. Colours, textures and more inviting play spaces appeared engaging, particularly for girls, suggesting that inclusive designs can help address gendered-related barriers to participation and comfort (49). Nevertheless, some challenges remain. Concerns about green space maintenance highlight the need for long-term sustainability of transformed schoolyards (20,50).

4.4 Strengths and limitations

This study has several limitations. First, systematic observation cannot capture all activities simultaneously, and observation periods were relatively short. Standardised procedures and trained observers helped minimise this limitation, while qualitative data provided additional perspectives on schoolyard use. Second, individualising data may have resulted in duplicate observations, as children frequently moved between play groups. However, the aim was to analyse interactions within the schoolyard rather than individual behaviours. Individualisation may also have introduced misclassification of activity-related variables, particularly in larger groups where only the predominant activity level was recorded. However, these limitations affected both pre- and post-intervention assessments and are unlikely to have substantially biased the estimated differences. Finally, the absence of a comparison group limits internal validity and causal inference. Nevertheless, no other interventions were implemented in the schoolyards during the study period, making alternative explanations unlikely. In this context, the mixed-methods design strengthened results interpretation, showing consistency between qualitative and quantitative findings.

The study has several strengths. It provides evidence on the effects of an innovative urban planning intervention that has rarely been evaluated and adopts a holistic approach encompassing play diversity, physical activity, spatial use, materials and social relationships. Combined with a mixed-methods design, enables comprehensive understanding through data triangulation. Another strength is the analysis of multiple outcomes. To our knowledge, this is one of the first studies to examine gender-mixed interactions and equalitarian relationships following this type of intervention. Finally, incorporating children's and teachers' perspectives provides a richer understanding of its impact on everyday schoolyard experiences.

5. Conclusion

Schoolyard transformations diversified space use and play, reducing boys' dominance of football while encouraging more active play and central-space use by girls, mixed-gender groups and boys less interested in football. Quieter areas for calm activities supported social interaction and fostered a more inclusive schoolyard that accommodates diverse play and promotes students' well-being. These findings underscore the importance of extending the programme to other schools in Barcelona and similar urban settings to promote versatile, coeducational and healthy schoolyards.

CRediT authorship contribution statement

Esther Sánchez-Ledesma: Writing – original draft, Investigation, Formal analysis, Data curation. Xavier Continente: Writing – review & editing, Validation, Methodology, Investigation, Conceptualization. Sílvia Brugueras: Writing – review & editing, Methodology, Investigation, Conceptualization. Constanza Vásquez-Vera: Writing – review & editing, Methodology, Conceptualization. María José López: Writing – review & editing, Supervision, Methodology, Conceptualization.

Data availability

Data will be made available on request.

Declaration of competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

We would like to thank all the schools involved in the "Transformem els patis" evaluation, especially the children and teachers who participated. We would also like to thank the project working group of the Barcelona City Council: Emma Cortés (Institute of Childhood and Adolescence), and Mar Camarasa and Blai Martí (Gender Mainstreaming Department). We also thank Mariona Ferrer from the Public Health Agency of Barcelona for her support during the fieldwork. This paper has been carried out as a part of the PhD programme in Biomedical Research Methodology and Public Health of Esther Sánchez-Ledesma at the Autonomous University of Barcelona.

References

1. UN-Habitat. Cities and Climate Action [Internet]. World Cities Report. 2024. 342 p. Available from: https://login.ezproxy.net.ucf.edu/login?auth=shibb&url=http://search.ebscohost.com/login.aspx?direct=true&db=edo&AN=85504112&site=eds-live&scope=site

2. Borrell C, Pons-Vigués M, Morrison J, Díez E. Factors and processes influencing health inequalities in urban areas. J Epidemiol Community Health [Internet]. 2013;67(5):389–91. Available from: http://www.ncbi.nlm.nih.gov/pubmed/23413097

3. De Snyder VNS, Friel S, Fotso JC, Khadr Z, Meresman S, Monge P, et al. Social conditions and urban health inequities: Realities, challenges and opportunities to transform the urban landscape through research and action. J Urban Heal. 2011;88(6):1183–93.

4. Diez Roux A V., Mair C. Neighborhoods and health. Ann N Y Acad Sci. 2010;1186:125–45.

5. Pérez K, Palència L, López MJ, León-Gómez BB, Puig-Ribera A, Gómez-Gutiérrez A, et al. Environmental and health effects of the Barcelona superblocks. BMC Public Health [Internet]. 2025;25(1). Available from: https://doi.org/10.1186/s12889-025-21835-z

6. Continente XG, Lopez-muley C, Lopez-muley C, Continente X, Fons MF, Guxens M, et al. An urban intervention to transform the school surroundings in Barcelona: a mixed- methods evaluation of "Let's Protect Schools" effects on road safety, street liveliness, and wellbeing. 2025;

7. Seyedrezaei M, Becerik-Gerber B, Awada M, Contreras S, Boeing G. Equity in the built environment: A systematic review. Build Environ [Internet]. 2023;245(August):110827. Available from: https://doi.org/10.1016/j.buildenv.2023.110827

8. Pulimeno M, Piscitelli P, Colazzo S, Colao A, Miani A. School as ideal setting to promote health and wellbeing among young people. Heal Promot Perspect. 2020;10(4):316–34.

9. Ferré, M. B., Guitart, A. O., & Ferret MP. Children and playgrounds in Mediterranean cities. Child Geogr. 2006;4(2):173–83.

10. Hodges, V.C., Centeio, E.E. and Morgan CF. The Benefits of School Recess: A Systematic Review. Sch Heal [Internet]. 2022;92:959–67. Available from: https://doi.org/10.1111/josh.13230

11. Aminpour F, Bishop K, Corkery L. The hidden value of in-between spaces for children's self-directed play within outdoor school environments. Landsc Urban Plan. 2020;194(October 2019).

12. Huberty JL, Beets MW, Beighle A, Welk G. Environmental modifications to increase physical activity during recess: preliminary findings from ready for recess. J Phys Act Health. 2011;8 Suppl 2(Suppl 2).

13. Baines E, Blatchford P. The decline in breaktimes and lunchtimes in primary and secondary schools in England: Results from three national surveys spanning 25 years. Br Educ Res J. 2023;49(5):925–46.

14. Massey W V., Thalken J, Szarabajko A, Neilson L, Geldhof J. Recess Quality and Social and Behavioral Health in Elementary School Students. J Sch Health. 2021;91(9):730–40.

15. Jerebine A, Fitton-Davies K, Lander N, Eyre ELJ, Duncan MJ, Barnett LM. "All the fun stuff, the teachers say, 'that's dangerous!'" Hearing from children on safety and risk in active play in schools: a systematic review. Int J Behav Nutr Phys Act. 2022;19(1):1–25.

16. Barenie MJ, Howie EK, Weber KA, Thakur D, Murphy CM, Thomsen MR. Where the children play: Gender gaps in recess physical activity by age and playground area. Prev Med Reports [Internet]. 2024;41(November 2023):102699. Available from: https://doi.org/10.1016/j.pmedr.2024.102699

17. Karsten L. Children's use of public space: The gendered world of the playground. Childhood. 2003;10(4):457–73.

18. Amilburu A, Pérez de Villarreal M, Scotton P. The impact of schoolyard design on children's physical activity and play preferences through a gender lens: a systematic review. J Adventure Educ Outdoor Learn [Internet]. 2026;00(00):1–26. Available from: https://doi.org/10.1080/14729679.2026.2644352

19. Periañez J, Continente X, Sanz-mas M, Drou-roget G, Espelt A, Peria J. Evaluación piloto del programa « Transformem els patis » en escuelas de primaria de Barcelona. Gac Sanit. 2024;38.

20. Sanz-Mas M, Continente X, Brugueras S, Marí-Dell'Olmo M, Oliveras L, López MJ. Evaluating the effect of green, blue, and gray measures for climate change adaptation on children's well-being in schoolyards in Barcelona. Landsc Urban Plan. 2025;253(September 2024).

21. van den Bogerd N, Struiksma M, Hovinga D, Maas J. From green to greener: Exploring associations between green schoolyard design and primary school children's recess behaviors. Urban For Urban Green [Internet]. 2025;107:128809. Available from: https://doi.org/10.1016/j.ufug.2025.128809

22. Gerstein, Bates, Bohnert. Evaluating a Green Schoolyard Transformation: A Protocol Utilizing the RE-AIM Framework. Child Youth Environ. 2021;31(1):187.

23. Hazlehurst MF, Wolf KL, Simmons C, Nieto C, Steiner MK, Garrett KA, et al. Physical activity and social interaction assessments in schoolyard settings using the System for Observing Outdoor Play Environments in Neighborhood Schools (SOOPEN). Int J Behav Nutr Phys Act. 2023;20(1):1–12.

24. Raney MA, Daniel E, Jack N. Impact of urban schoolyard play zone diversity and nature-based design features on unstructured recess play behaviors. Landsc Urban Plan [Internet]. 2023;230(January 2022):104632. Available from: https://doi.org/10.1016/j.landurbplan.2022.104632

25. van Dijk-Wesselius JE, Maas J, Hovinga D, van Vugt M, van den Berg AE. The impact of greening schoolyards on the appreciation, and physical, cognitive and social-emotional well-being of schoolchildren: A prospective intervention study. Vol. 180, Landscape and Urban Planning. 2018. 15–26 p.

26. Giaouri S, Pliogou V, Kalerante E. Schoolyards as Inclusive Spaces: Teachers' Perspectives on Gender, Disability, and Equity in Greece. Educ Sci. 2025;15(11).

27. Marsigliante S, Gómez-López M, Muscella A. Effects on Children's Physical and Mental Well-Being of a Physical-Activity-Based School Intervention Program: A Randomized Study. Int J Environ Res Public Health. 2023;20(3).

28. Bikomeye JC, Balza J, Beyer KM. The impact of schoolyard greening on children's physical activity and socioemotional health: A systematic review of experimental studies. Int J Environ Res Public Health. 2021;18(2):1–20.

29. Zapatero-Ayuso JA, Ramírez E, Rocu P, Navajas R. Orientaciones para el cambio de los patios escolares como impulsores de la igualdad de género a través de la actividad física Guidelines for change of the playground as drivers of gender equality through physical activity. Ágora para la Educ Física y el Deport. 2021;23:241–64.

30. Ajuntament de Barcelona. Transformem els patis [Internet]. 2026 [cited 2026 Apr 15]. Available from: https://ajuntament.barcelona.cat/educacio/ca/transformem-els-patis

31. Kaur M. Application of mixed method approach in public health research. Indian J Community Med. 2016;41(2):93–7.

32. Urda Peña L, Amoroso S. Los espacios escolares como 'tercer educador': estrategias proyectuales desde el feminismo y las perspectivas de género. 2024;1035–53.

33. Lim C, Donovan AM, Harper NJ, Naylor PJ. Nature elements and fundamental motor skill development opportunities at five elementary school districts in British Columbia. Int J Environ Res Public Health. 2017;14(10).

34. Reimers AK, Knapp G. Playground usage and physical activity levels of children based on playground spatial features. J Public Heal. 2017;25(6):661–9.

35. Dyment, J., & O'Connell TS. The impact of playground design on play choices and behaviors of pre-school childrene. Child Geogr. 2013;11(3):263–80.

36. Arnold JP, Farello A, Özkoca N, Ozenbaugh I, Braxling C MW. Improving recess through collaboration: exploring the facilitators and barriers to sustaining positive playground behavior. J Sch Heal. 2024;94:985–93.

37. Massey, W. V., Perez, D., Neilson, L., Thalken, J., & Szarabajko A. Observations from the playground: Common problems and potential solutions for school-based recess. Health Educ J. 2021;80(3):313–26.

38. Pawlowski CS, Veitch J, Andersen HB, Ridgers ND. Designing activating schoolyards: Seen from the girls' viewpoint. Int J Environ Res Public Health. 2019;16(19).

39. Pawlowski, C. S., Ergler, C., Tjørnhøj-Thomsen, T., Schipperijn, J., & Troelsen J. 'Like a soccer camp for boys' A qualitative exploration of gendered activity patterns in children's self-organized play during school recess. Eur Phys Educ Rev. 2015;21(3):275–91.

40. Jennifer K. Vanos. Children's health and vulnerability in outdoor microclimates: A comprehensive review. Environ Int. 2015;76:1–15.

41. Bates CR, Bohnert AM, Gerstein DE. Green schoolyards in low-income urban neighborhoods: Natural spaces for positive youth development outcomes. Front Psychol. 2018;9(MAY):1–10.

42. Kung KTF. Preschool Gender-Typed Play Behavior Predicts Adolescent Gender-Typed Occupational Interests: A 10-Year Longitudinal Study. Arch Sex Behav [Internet]. 2021;50(3):843–51. Available from: https://doi.org/10.1007/s10508-021-01976-z

43. Blanc N, Clauzel C, About C, Riché AL, Gippet M, Bortolamiol S. Schoolyards greening for connecting people and nature: an example of nature-based solutions? npj Urban Sustain. 2025;5(1):1–11.

44. van den Bogerd N, Hovinga D, Hiemstra JA, Maas J. The Potential of Green Schoolyards for Healthy Child Development: A Conceptual Framework. Forests. 2023;14(4):1–16.

45. Zhang, Z., Stevenson, K. T., & Martin KL. Use of nature-based schoolyards predicts students' perceptions of schoolyards as places to support learning, play, and mental health. Environ Educ Res. 2022;28(9):1271–1282.

46. Vincent AS. The garden in movement as a space and practice of care. Landsc Res. 2026;1–15.

47. Eling J, Cummins S. Impacts of Green Space Interventions in Educational Settings on Children and Young People's Mental Wellbeing: a Systematic Review. medRvix Prepr Serv Heal Sci [Internet]. 2025; Available from: http://medrxiv.org/lookup/doi/10.1101/2025.01.09.25320287

48. Ávila-García M, Medel-Carbonell LM, Ruiz-Alarcón A, Huertas-Delgado FJ. How Can Schools Increase Children and Adolescents' Physical Activity? A Systematic Review of Playground Features. J Sch Health. 2025;95(9):765–75.

49. Sanz-Mas M, Continente X, Brugueras S, Marí-Dell'Olmo M, Oliveras L, López MJ. Evaluating the effect of passive cooling strategies in school buildings on children's well-being in Barcelona: A quasi-experimental, mixed methods study. Sci Total Environ. 2024;949(June).

50. Jansson, M., Gunnarsson, A., Mårtensson, F., & Andersson S. Children's perspectives on vegetation establishment: Implications for school ground greening. Urban For urban Green. 2014;13(1):166–74.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Table12quantitativetables.docx
- Table3qualitativetable.docx