Journal of School Health

REVIEW ARTICLE

How Can Schools Increase Children and Adolescents' Physical Activity? A Systematic Review of Playground Features

Manuel Ávila-García[1,2,3] | Luis Miguel Medel-Carbonell[3] | Ana Ruiz-Alarcón[3] | Francisco Javier Huertas-Delgado[1]

[1]Inmaculada Teacher Training Centre, Sport and Health University Research Institute (iMUDS), University of Granada, Granada, Spain | [2]Universidad Isabel I, Burgos, Spain | [3]PA-HELP Physical Activity for Health Promotion Research Group, Department of Physical Education and Sport, Faculty of Sport Sciences, University of Granada, Granada, Spain

Correspondence: Luis Miguel Medel-Carbonell (luismimedel7@gmail.com)

Received: 7 October 2024 | **Revised:** 14 May 2025 | **Accepted:** 23 June 2025

Funding: This research was funded by the Consejería de Universidad, Investigación e Innovación and by ERDF Andalusia Program (B-SEJ-038-UGR18).

Keywords: educational stage | gender | physical activity | playground | school environment

ABSTRACT

Background: Our research examined the scientific literature to determine the influence of the playground environment (size, type of surface, playground marking, and access to equipment) on physical activity (PA) by gender across different educational stages (early childhood, primary, and secondary education).

Methods: The review process followed the PRISMA statement and inclusion criteria, as well as the PICOs framework to select the population and outcomes of the review. The studies were selected by two independent reviewers, and their quality was assessed using the Hawker tool.

Results: In early childhood education, the association between PA and playground markings and access to playground equipment showed no gender differences in terms of PA. In primary education, moderate-to-vigorous PA (MVPA) was higher for boys on artificial surfaces, multisport courts, and with access to sports equipment than for girls. In secondary education, boys performed more MVPA than girls both with and without sports equipment, and on multisport courts.

Conclusion and Implications: The design of the school playgrounds should consider the type of surface (green, natural, or artificial), playground markings (multisport or game courts), the availability of space during recess, and access to game equipment to meet the play preferences of boys and girls.

1 | Introduction

The benefits of daily physical activity (PA) have been highlighted in children and adolescents, specifically due to its benefits for physical health (e.g., improvements in body composition or cardiometabolic biomarkers) [1]. Daily PA is also associated with improved psychological health by mitigating cognitive decline or symptoms of depression, anxiety, and stress [2], and enhancing social support [3]. In this regard, the World Health Organization recommends that children and adolescents engage in at least 60 min of moderate-to-vigorous PA (MVPA) per day, but it is also important to increase movement of any intensity [4]. However, despite the importance of PA for health, a study carried out in 57 countries revealed that only a small proportion of children around the world (between 27% and 33%) meet the current recommendations [5]. Specifically, nearly 85% of children were not

sufficiently physically active [6]. In this sense, most of the interventions developed did not succeed in increasing PA levels among those who need it most, such as girls [7].

In this context, the educational center provides a great opportunity to increase daily PA [8], due to the large amount of time that children spend there [9]. Indeed, there are different alternatives that are proven to be effective in increasing children's PA levels such as: active commuting to/from school [10], Physical Education lessons [11], or PA during recess [12]. Specifically, school recess offers an opportunity for children and adolescents to be physically active [13], and could provide up to 40% of the recommended daily PA [14].

Due to the use of the playground as an area specifically designated for play or recreation [15], different studies have analyzed the percentages of MVPA during school recess in different countries. According to them, a gender gap was observed in relation to compliance with the recommended 40% of the daily PA (e.g., 32.6% boys and 24% girls in France [16], 32.9% boys and 25.3% girls in England [17] and 37.2% boys and 24.4% girls in Spain [18]). In this regard, several studies have examined the factors in the school playground environment that may contribute to improved PA during school recess. For instance, the availability of green areas and larger playground size [19, 20], playground markings [21, 22], specific areas for organized activities, teacher-supervised activities [23], or access to playground equipment [24, 25].

Different reviews have been conducted to systematize the scientific evidence, but they have focused on the effectiveness of intervention programs aimed at increasing PA during school recess, with a focus on early childhood and children [26, 27], children [28], and children and adolescents [29, 30]. However, to our knowledge, none of these reviews have analyzed gender differences, which is crucial given the need to increase PA in all children, but especially among girls [7].

Therefore, in order to implement effective interventions aimed at increasing PA levels in children and adolescents, an adequate understanding of how to optimally design school playgrounds is required. Moreover, it is crucial to analyze the different educational stages and how boys and girls may benefit from different playground characteristics based on their developmental maturity, to inform the most effective interventions.

Consequently, the objective of this review was to analyze the association of school playground structural elements (size, type of surface, playground markings and access to equipment) with PA time (light [LPA], moderate [MPA], vigorous [VPA], and MVPA intensity) during school recess by gender, differentiating by educational stage (early childhood, primary, and secondary education).

2 | Methods

2.1 | Literature Search

In this systematic literature review, the following databases (Pubmed, Web of Science, Scopus, and SportDiscus) were used to screen articles published from January 1, 2013, to March 31, 2025. The review process was guided by the PRISMA statement [31], and the PICOs framework was used to select the studies included in this review. Our systematic review protocol is registered in PROSPERO (registration number: CRD42024573410).

To search for studies in the different databases, four categories were defined: Physical Activity, School Environment, Population, and Gender. The specific terms used in the search were derived from a thorough review of the scientific literature. In addition, the Boolean operators AND and OR were used with the following keywords related to the aforementioned categories: (physical activity* OR exercise* OR motor activity OR sedentary*) AND (physical environment OR physical structures OR playground* OR school recess OR playground mark* OR game equipment OR green*) AND (kindergarten OR school OR elementary OR primary OR middle school OR high school OR secondary school OR toddler OR youth OR young OR adolescent* OR child* OR student*) AND (girls OR boys OR male OR female OR gender OR sex). These terms were adapted for use in each database (see Appendix).

2.2 | Data Collection

The search process was conducted by two independent researchers. Based on the guidelines provided by the PRISMA model, the inclusion criteria were as follows: (a) studies published in English and Spanish; (b) studies published between 2013 and March 2025; (c) studies conducted in early childhood education (ages 3–5), primary education (ages 5–11), and secondary education (ages 12–16); (d) studies that provided data separately by gender; (e) studies that provided cross-sectional results. In the case of intervention studies, baseline data had to be reported; (f) quantitative studies that provided PA outcomes according to the playground environment (size, type of surface, playground markings, and access to equipment). Regarding the exclusion criteria, these were: (a) studies focused on a population with any type of pathology; (b) methodological studies, reviews, theses, and conference publications.

According to the inclusion and exclusion criteria, a total of 1926 studies were obtained from the four databases: Web of Science (412 studies), Scopus (463 studies), Pubmed (336 studies), and SPORTDiscus (85 studies). Subsequently, 652 duplicate studies were removed. After reading the titles and abstracts, a further 568 studies were excluded. Finally, after a thorough review of the full texts, only 16 studies met both the inclusion and exclusion criteria. (see Figure 1).

2.3 | Assessment of Quality of Studies

An assessment tool proposed by Hawker [32] based on a rating scale: Good, Fair, Poor, and Very Poor, was used to assess the quality of the studies. The quality assessment was not used as a basis for excluding stories, but to assist in the interpretation of the results (see Table 1).

Two reviewers evaluated the quality of the studies independently.

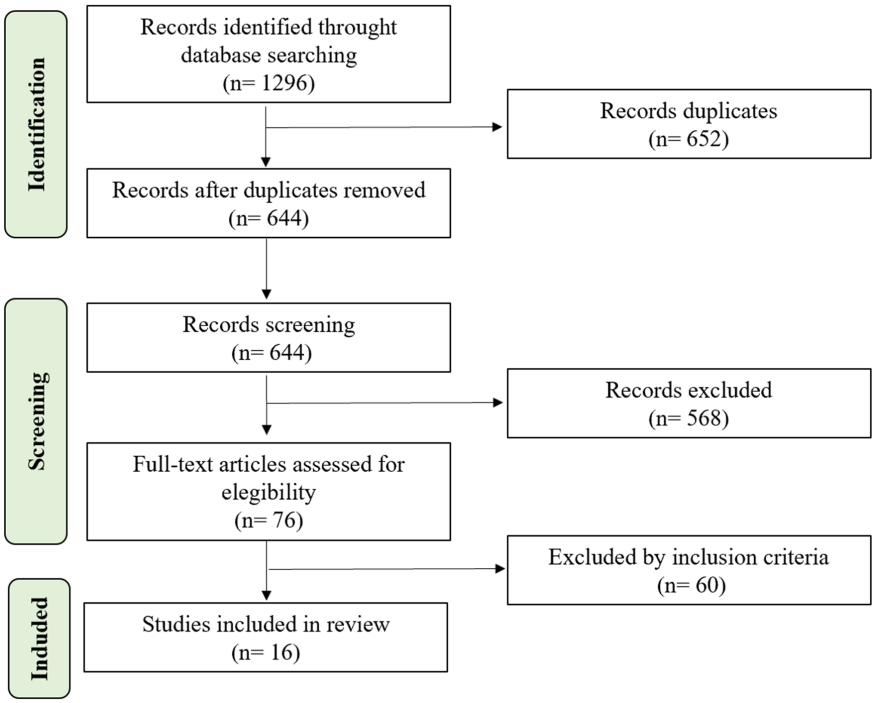

FIGURE 1 | Flowchart of the selection of the studies.

TABLE 1 | Assessment of the Quality of the studies.

Author	Abstract and title	Introduction and aims	Method and data	Sampling	Data analysis	Ethics and bias	Findings/ results	Transferability/ generalizability	Implications and usefulness
Anthamatten et al. [33]	Good	Good	Good	Good	Good	Good	Good	Good	Good
Anthamatten et al. [34]	Good	Good	Good	Good	Good	Good	Good	Good	Good
Gomes et al. [35]	Good	Good	Good	Good	Good	Good	Good	Good	Fair
Martensson et al. [36]	Good	Good	Good	Good	Good	Poor	Good	Good	Good
Andersen et al. [37]	Good	Good	Good	Fair	Good	Fair	Good	Good	Fair
Grant et al. [38]	Good	Good	Good	Good	Good	Good	Good	Good	Good
Pawlowski et al. [39]	Good	Good	Good	Good	Good	Good	Good	Good	Good
Dudley et al. [40]	Good	Good	Good	Good	Good	Good	Good	Good	Poor
Howe et al. [41]	Good	Good	Good	Good	Good	Good	Good	Good	Fair
Escaron et al. [42]	Good	Good	Good	Good	Good	Good	Good	Good	Good
Määttä et al. [43]	Good	Good	Good	Good	Good	Good	Good	Good	Good
Pereira et al. [44]	Good	Good	Good	Good	Good	Good	Good	Good	Poor
Graham et al. [45]	Good	Good	Good	Good	Fair	Fair	Good	Good	Good
Amholt et al. [46]	Good	Good	Good	Good	Good	Good	Good	Good	Fair
Raney et al. [47]	Good	Good	Good	Good	Good	Good	Good	Good	Good
Barenie et al. [48]	Good	Good	Good	Poor	Good	Good	Good	Good	Fair

3 | Findings

The systematic review includes 16 studies from 3 continents: 8 studies from Europe [35–37, 39, 43–46], 7 studies from America (all from the United States) [33, 34, 38, 41, 42, 47, 48], and 1 study from Oceania [40].

In relation to the age of the population, 1 study focused on early childhood education [43] and 12 studies focused on primary education [33–36, 38, 39, 41, 44–48]. One study covered both early childhood and primary education [40] and two studies addressed both primary and secondary education [37, 42].

Regarding the measurement of PA, different tools were used: five studies used an accelerometer [37, 39, 43, 44, 46], one study used a pedometer [36] and one study used a questionnaire [35]. Finally, other studies used observational tools, such as: six studies, SOPLAY (System for Observing Play and Leisure Activity in Youth) [33, 34, 38, 42, 45, 48]. One study used SOCARP (System for Observing Children's Activity and Relationships During Play) [40]. One study used VIDO (Video Direct Observation) [41] and finally, the study carried out by Raney et al. [47] used SOPLAY and SOCARP.

The playground environment was classified into four categories: size of the playground, type of playground surface, playground

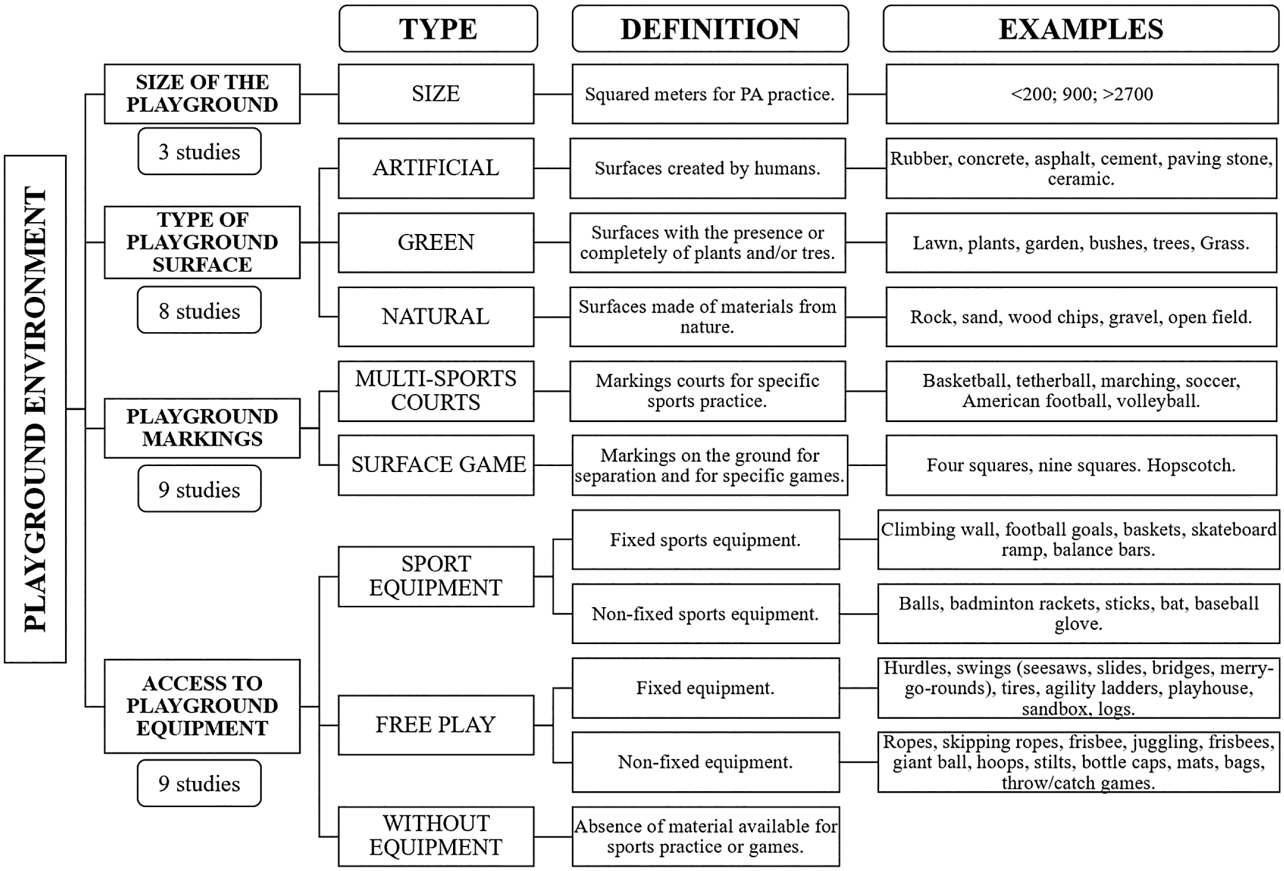

FIGURE 2 | Classification of the structural elements of the school playground.

markings, and access to playground equipment (Figure 2). The association between the school environment elements and PA is shown in Table 2.

3.1 | Size of the Playground

This category was analyzed in three studies, all of them focused on primary education. One study found that girls performed more PA in larger playgrounds compared to boys [34]. However, two studies did not report significant gender differences [35, 44].

3.2 | Type of Playground Surface

The type of playground surface was analyzed in eight studies (early childhood and primary education).

One study conducted in early childhood education showed no significant differences by gender [43].

In primary education, two of the seven studies included in the review reported higher levels of MVPA on artificial [33, 37], green [33], and natura [37] surfaces in boys than in girls. Meanwhile, three studies showed more MVPA on artificial [35], green [34, 41], and natural [34, 45] surfaces in girls than in boys. In contrast, one study associated lower PA on natural and artificial surfaces in girls than in boys [48]. Finally, another study revealed no gender differences [36].

3.3 | Playground Markings

Playground markings were analyzed in nine studies (early childhood, primary, and secondary education).

Classified by educational stage, one study involving early childhood and primary education presented an association for boys, reporting more VPA on multisport courts than for girls [40].

In primary education, from the total of eight studies, three studies reported more VPA [41] and MVPA [45, 47] on multisport courts in boys than girls. Another study showed increased PA time in both boys and girls [48]. Finally, four studies did not show significant gender differences [36, 38, 39, 46].

Finally, a study conducted with children and adolescents revealed that, on multisport courts, children performed more MVPA compared to adolescents. Additionally, MVPA levels were found to be higher in boys than in girls across both age groups [37].

3.4 | Access to Playground Equipment

Access to playground equipment was analyzed in nine studies (early childhood, primary, and secondary education). Classified by educational stage, two studies focused on early childhood education. One study, conducted in early childhood and primary education, found that boys performed more VPA than girls [40]. The other study showed no significant differences by gender [43].

TABLE 2 | Characteristics and results of the selected studies.

Authors/country/year	Participants/age/educational stage	Assessment method		Results
		Physical activity	Environment	
Anthamatten, Brink et al. [33] United States 2014	9 schools Primary education	SOPLAY	SOPLAY	*Type playground surface*: Boys performed more MVPA than girls on artificial surface (7.48%, $p = 0.002$) and green surface (15.65%, $p = 0.002$) *Access to playground equipment*: Boys performed more MVPA than girls in free play equipment (6.47%, $p = 0.003$) and areas without equipment (9.01%, $p > 0.001$)
Anthamatten, Fiene et al. [34] United States 2014	24 schools ($n = 9900$) 5–12 years old Primary education	SOPLAY	SOPLAY	*Size of the playground*: Girls performed 2.46% more PA than boys with the addition of each feature per 1000 square feet of space *Type playground surface* (*green and natural surface*) *and access to game equipment* (*sport game equipment*): A weak statistically significant association ($b = 2.73$, CI 0.36; 5.10; $p = 0.024$) with MVPA was observed only in girls
Gomes et al. [35] Portugal 2014	24 schools ($n = 1075$) 6–10 years old 47.62% girls Primary education	Godin and Sheophard questionnaire	Structured inventory constructed by the author	*Size of the playground*: School size had a significant effect on children's PA, with increasing school size increasing the total PA (0.254 ± 0.066, $p = 0.002$). There were no significant differences by gender
Mårtensson et al. [36] Sweden 2014	2 schools ($n = 197$) 10–13 years old Primary education	Pedometer (SW-200 Tokyo, Japan)	Geographic information systems program (ArcGIS.9/ArcMap 9.3)	*Type playground surface, playground markings and access to game equipment*: There were no statistically significant differences in PA between the different areas of the playground by gender
Andersen et al. [37] Denmark 2015	4 (between schools and high schools) ($n = 316$) 11–14 years old 53.2% girls Primary education and secondary education	Actigraph GT3X	QStarz BT-Q1000X GPS	*Type playground surface*: In children, boys performed more MVPA than girls on artificial surfaces (15% and 9%, $p = < 0.001$ respectively), green surface (31% and 23%, $p = 0.02$, respectively) and natural surface (21% and 15%, $p = 0.03$, respectively) Regarding differences between children and adolescents. Children performed more MVPA than adolescents on artificial surfaces (17% and 7%, $p > 0.001$, respectively) and natural surfaces (21% and 12%, $p = 0.01$, respectively) *Playground markings*: In children, boys performed more MVPA than girls on multisports courts (28% and 16%, $p = 0.001$, respectively) Regarding differences between children and adolescents. Children performed more MVPA than adolescents on multisports courts (27% and 15%, $p > 0.001$, respectively)
Grant et al. [38] United States 2015	1 school ($n = 61$) Primary education	SOPLAY	SOPLAY	*Playground markings* (*surface games*): The results obtained at baseline showed no significant differences by gender in the lines painted on the concrete: four squares, nine squares and hopscotch
Pawlowski et al. [39] Denmark 2016	1 school ($n = 81$) 10–13 years old 58% girls Primary education	Actigraph GT3X	BT-Q1000xt GPS	*Playground marking* (*soccer fields*): The results obtained at baseline showed no significant differences in PA by gender
Dudley et al. [40] Australia 2018	20 (schools) 4–12 years old Primary education	SOPARC	SOPARC	*Playground marking, access to playground equipment* (*sport equipment*): Boys performed 44.6% more VPA than girls (39.6%) in the sports practice of soccer, basketball, handball, rugby and touch football ($p < 0.01$)
Howe et al. [41] United States 2018	1 school ($n = 23$) 8–12 years old 52.17% girls Primary education	VIDO	VIDO	*Type playground surface*: Girls performed more MVPA than boys on green surface (field) (46% vs. 35%) ($p > 0.05$) *Playground marking*: Boys performed more VPA than girls on multisport courts (35%) than girls (14%) ($p > 0.05$) *Access to playground equipment* (*fixed sport equipment*): Girls performed more MVPA than boys in fixed sport equipment (77% vs. 61%) ($p > 0.05$)

(Continues)

TABLE 2 | (Continued)

Authors/country/year	Participants/age/educational stage	Assessment method: Physical activity	Assessment method: Environment	Results
Escaron et al. [42] United States 2019	14 schools 5 high schools ($n = 11{,}078$) 6–16 years old 48.66% girls Primary education and secondary education	SOPLAY	SOPLAY	*Access to game equipment*: In children, boys performed more MVPA in areas with/without equipment (69.2% and 60.6% respectively, $p < 0.0001$) as well as in girls (62.3% and 53.3% respectively, $p < 0.001$). In adolescents, boys performed more MVPA in areas with/without equipment (70.8% and 60.0%, respectively, $p = 0.02$) as well as in girls (50.8% and 29.3%, respectively, $p < 0.0001$)
Määttä et al. [43] Finland 2019	66 preschools ($n = 778$) 3–6 years old Early childhood education	Actigraph WGT3X-BT	EPAO	*Type of surface and access to game equipment*: There were no significant differences in PA by gender
Pereira et al. [44] Portugal 2020	19 schools ($n = 307$) 5–10 years old 50.16% girls Primary education	Actigraph GT3X+	Objetive audit	*Size of the playground and playground marking*: There were no significant differences in PA by gender
Graham et al. [45] United Kingdom 2021	1 school ($n = 528$) 5–11 years old 50.8% girls Primary education	SOPLAY	SOPLAY	*Type of Surface and playground markings*: Boys performed more MVPA on multisports courts (school playground areas: 4 [30%] and 7 [35%]) than girls (school playground areas: 4 [5%] and 7 [4%]). However, girls performed more MVPA on social areas (artificial surface) (36%) and climbing areas (natural surface) (18%) than boys (20% and 16%, respectively)
Amholt et al. [46] Denmark 2022	4 schools ($n = 376$) 9–12 years old Primary education	Axiviti AX3 Accelerometer	GPS Qstarz BT-Q1000x and Ortofotos de GeoDanmark	*Playground marking and access to game equipment*: There were no significant differences in PA by gender
Raney et al. [47] United States 2023	5 schools ($n = 2275$) 5–12 years old 48.1% girls Primary education	SOPLAY and SOCARP	SOPLAY and SOCARP	*Playground marking*: There was an interaction effect between location, area and gender for the activity score (F [31,2992] = 15.220, $p < 0.001$). Specifically, within multisport zones (e.g., handball, tetherball, 4-square), PA was higher in the playground with 10 unique play zones compared to playgrounds with fewer zones for boys from first and second grade and boys and girls from third to fifth grade
Barenie et al. [48] United States 2024	4 schools ($n = 292$) (51% girls) Primary education	SOPLAY	SOPLAY	*Type of surface and access to game equipment* (*sport equipment and free play*): In boys, it was highest on both swings (81% [95% CI: 75, 86]) and multisport courts (ball area) (83% [95% CI: 77, 89]) and lowest on green surface (64% [95% CI: 60, 67]). In girls, PA was highest on swings (82% [95% CI: 77, 86]) and lowest on artificial surface (56% [95% CI: 43, 69])

Note: n = number of participants.

Abbreviations: EPAO-SR, Environmental and Policy Evaluation Self-Report; GSHS, Global School-Based Student Health Survey; ISCOLE, School Environment Questionnaire; LPA, light physical activity; MVPA, moderate-to-vigorous physical activity; PA, physical activity; SOCARP, System for Observing Children's Activity and Relationships During Play; SOPARC, System of Observing Physical Activity in Recreation and Communities; SOPLAY, System for Observing Play and Leisure Activity in Youth; VIDO, Video Direct Observation; VPA, vigorous physical activity.

In primary education, from the total of the seven studies, three studies found that access to sports equipment was associated with more MVPA in boys [42] and girls [34, 41]. Another study reported more MVPA in boys during free play and without equipment [33]. In addition, another study showed more MVPA in children with access to free materials such as swings, in both boys and girls [48]. Finally, two studies did not report any significant differences by gender [36, 46].

Finally, the study conducted in both primary and secondary education found that boys reported higher levels of MVPA in areas with or without equipment compared to girls [42].

4 | Discussion

The aim of this review was to analyze the association of school playground structural elements (size, type of surface, playground markings, and access to equipment) with PA time (LPA, MPA, VPA, and MVPA intensity) during school recess by gender, differentiating by educational stage (early childhood, primary, and secondary education).

In early childhood education, only one study examined the relationship between PA time during recess and playground markings and access to game equipment. The study revealed no significant differences in PA by gender [43]. This observation could

be attributed to the absence of role differences at this stage of education, as children typically exhibit a strong preference for free and spontaneous play, such as exploratory and symbolic play, which does not involve competitive play [49]. The preference for this type of play could also explain the lack of gender differences in access to game equipment. In this regard, school playgrounds at this stage of education should provide open, and aesthetically pleasing environments that promote diverse forms of play [50, 51].

In primary education, the dimensions of playgrounds have received comparatively less attention than other aspects of the school environment. The study by Fiene et al. [34] was the only one that associated longer PA time with larger playgrounds in girls. Two other studies reported no gender differences [35, 44]. Due to the limited number of studies, further research is needed to fully understand its influence on the PA levels of boys and girls. However, other structural elements such as surface type, playground markings, and access to game equipment have shown significant differences, as outlined in this review. In this regard, it is possible that the distribution of space and access to game equipment have more influence on PA time during school recess, irrespective of gender, than the size of the playground itself.

Regarding artificial surfaces [33, 37], the use of multisport courts [40, 45, 48] and access to sports equipment [40, 42] were associated with higher VPA or MVPA in boys than in girls. Based on these structural elements of the playground, they appear to be mainly intended for activities in which competition is present. In these sports activities, there is a greater male dominance, which may discourage girls' participation. Also, the type of play is related to group size, with larger groups engaging in sports, while smaller groups tend to participate in walking or jumping games. Consequently, a study conducted with children employed a quantitative and qualitative analysis, revealing that factors such as group size (large groups) were associated with higher MVPA in boys during sports activities. In medium-sized and small groups, higher MVPA was associated with activities such as walking, skipping rope, and less motor-competent activities in girls [52]. However, two studies found that higher MVPA was only associated with access to sports equipment in girls [34, 41]. This result may be related to another study that found girls may also be motivated to participate in competitive sports such as football [53]. The scarcity of substantial MVPA outcomes in girls during such sporting activities may be associated with social factors, including boys' acceptance of girls with higher motor proficiency, as well as some rejection among girls through the use of terms such as "tomboys" [53].

Additionally, another study associated higher PA on swings in girls during recess [48]. In this regard, a study that interviewed only primary school girls found they prioritized the use of areas such as swings, obstacle courses, or dance equipment over traditional sports facilities [54].

In relation to green and natural surfaces, higher MVPA was associated with boys [33, 37, 48] and girls [34, 41]. Nevertheless, another study found no significant differences by gender [36]. These results highlight the importance of these areas for promoting PA, particularly among girls, who tend to be less physically active in designated areas such as sports fields. In addition, these spaces can complement competitive games subject to rules that are primarily played on asphalt surfaces and may encourage girls to engage in PA. Consequently, additional studies are necessary to explore the design of green and natural spaces that encourage active play [25].

Regarding secondary education, only two studies analyzed this educational stage. Both studies indicated that boys were shown to be more physically active than girls, both with and without equipment [42], on natural and artificial surfaces, and on multisport courts [37]. Similar outcomes were shown in a systematic review that analyzed levels of PA in children and adolescents during school hours, specifically during school recess [55].

In this sense, regarding differences in PA by gender, girls may be less influenced than boys by socioecological factors at the individual level such as age and gender, family support, and the adequacy of school and community spaces that favor the choice of low- or high-intensity physical activities [56]. More studies are needed to corroborate these results regarding gender differences in PA, particularly between primary and secondary education. However, it is possible that the educational center's resources for promoting PA are more appealing to boys [57]. Therefore, this situation suggests that it may be necessary to restructure recess so that girls and adolescents receive the same opportunities to be physically active [58]. In this sense, the implementation of designated social areas, play spaces adapted to their motor competence levels, and the creation of inclusive spaces for ball games could contribute to maintaining PA in children and adolescents, with a potential improvement in PA time for girls [59, 60].

This systematic review has some limitations that merit mention. First, there is heterogeneity in the measurement of participants' PA due to the use of tools such as accelerometry, direct observation, or questionnaires, which can make comparison between studies difficult. There is also a lack of studies in early childhood and secondary education that specifically analyze PA during school recess by gender. In this sense, studies that focus on gender differences are necessary in order to establish strategies and adapt the environment to reduce gender differences in PA levels.

5 | Implications for School Health Policy, Practice, and Equity

Due to the importance of the educational center in the promotion of healthy habits such as PA, an analysis of the playground infrastructure can contribute to the development of strategies to increase PA at each educational stage, as well as to help reduce gender differences (see Figure 3):

- In early childhood education, school playgrounds should be open spaces that encourage free and spontaneous play in order to increase PA in both boys and girls.
- In primary education, areas or equipment designated for competitive play are often more beneficial to boys than to girls. In addition, green and natural surfaces, along with the incorporation of non-sports equipment such as swings and

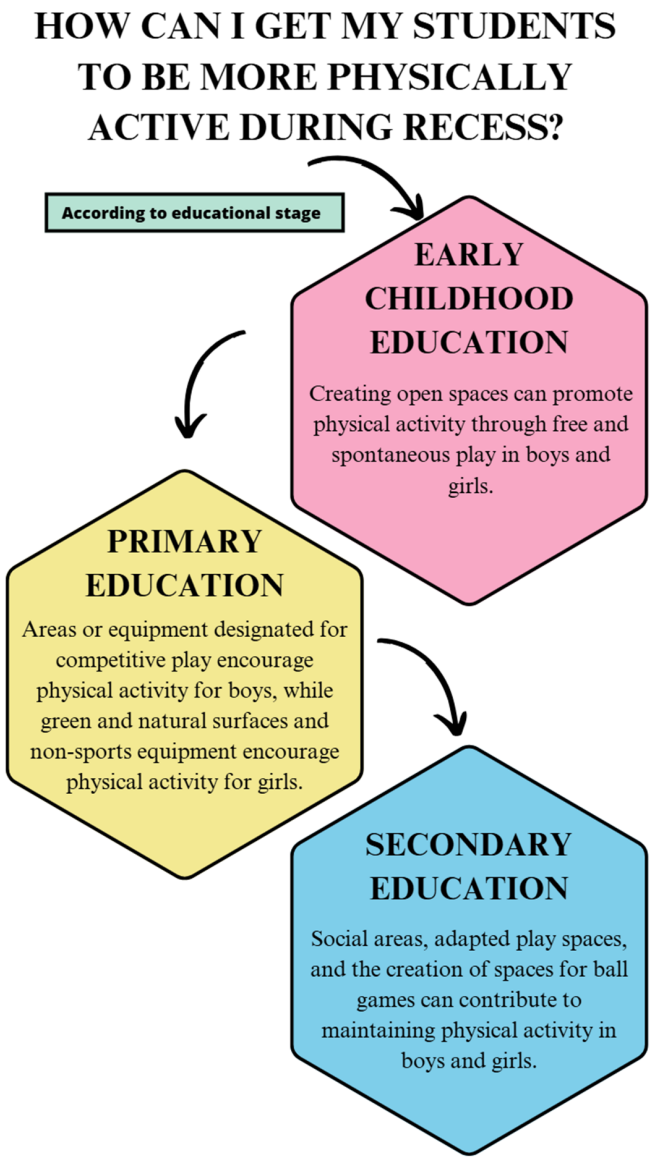

FIGURE 3 | Implications for educational center.

climbing structures, may promote increased PA among girls during school recess.

– In secondary education, the implementation of social areas, adapted play spaces, and the creation of spaces for ball games could contribute to maintaining PA in adolescents, with a potential improvement in PA time for girls.

Future reviews should examine the effect of the changes in the environment on PA levels in children and adolescents, taking into consideration the differences expressed by gender.

6 | Conclusions

It is important to consider playground characteristics to increase PA of both boys and girls across all educational stages. Specifically, it is suggested that the design of school playgrounds take into account the type of surface (green, natural, or artificial), playground markings (multisport or games courts), the availability of space during recess, as well as access to game equipment, in order to meet the play preferences of boys and girls. An appropriate design of the school environment tailored to the educational stage could contribute to the development of new intervention strategies and programs aimed at increasing PA in children and adolescents, while also reducing the gender gap in PA during school recess.

Acknowledgments

This research was funded by the Consejería de Universidad, Investigación e Innovación and by ERDF Andalusia Program (B-SEJ-038-UGR18).

Ethics Statement

The study protocol was conducted in accordance with ethical standards, as outlined in the Declaration of Helsinki (revised in 2013).

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

References

1. V. J. Poitras, C. E. Gray, M. M. Borghese, et al., "Systematic Review of the Relationships Between Objectively Measured Physical Activity and Health Indicators in School-Aged Children and Youth," *Applied Physiology, Nutrition, and Metabolism* 41, no. 6 (2016): S197–S239.

2. M. Rodriguez-Ayllon, C. Cadenas-Sánchez, F. Estévez-López, et al., "Role of Physical Activity and Sedentary Behavior in the Mental Health of Preschoolers, Children and Adolescents: A Systematic Review and Meta-Analysis," *Sports Medicine* 49, no. 9 (2019): 1383–1410.

3. H. Forsberg, X. Palma-Leal, A. Ruiz-Alarcón, et al., "How Parents' Perception of the Social Norm Is Associated With Their Adolescent's Commuting Behaviour to School," *Journal of Transport & Health* 36 (2024): 101786, https://doi.org/10.1016/j.jth.2024.101786.

4. F. C. Bull, S. S. Al-Ansari, S. Biddle, et al., "World Health Organization 2020 Guidelines on Physical Activity and Sedentary Behaviour," *British Journal of Sports Medicine* 54, no. 24 (2020): 1451–1462, https://doi.org/10.1136/bjsports-2020-102955.

5. S. Aubert, J. D. Barnes, I. Demchenko, et al., "Global Matrix 4.0 Physical Activity Report Card Grades for Children and Adolescents: Results and Analyses From 57 Countries," *Journal of Physical Activity & Health* 19, no. 11 (2022): 700–728.

6. R. Guthold, G. A. Stevens, L. M. Riley, and F. C. Bull, "Global Trends in Insufficient Physical Activity Among Adolescents: A Pooled Analysis of 298 Population-Based Surveys With 1·6 Million Participants," *Lancet Child & Adolescent Health* 4, no. 1 (2020): 23–35, https://doi.org/10.1016/S2352-4642(19)30323-2.

7. T. B. Hartwig, T. Sanders, D. Vasconcellos, et al., "School-Based Interventions Modestly Increase Physical Activity and Cardiorespiratory Fitness But Are Least Effective for Youth Who Need Them Most: An Individual Participant Pooled Analysis of 20 Controlled Trials," *British Journal of Sports Medicine* 55, no. 13 (2021): 721–729, https://doi.org/10.1136/bjsports-2020-102740.

8. World Health Organization, "Promoting Physical Activity in the Education Sector," 2018, http://www.euro.who.int/pubrequest.

9. T. L. McKenzie, "Physical Activity Within School Contexts: The Bigger Bang Theory," *Kinesiology Review* 8, no. 1 (2019): 48–53.

10. G. M. de Jesus, R. Henrique de Oliveira Araujo, L. A. Dias, A. K. Cerqueira Barros, L. D. Matos dos Santos Araujo, and M. A. Altenburg de Assis, "Influence of Active Commuting to School on Daily Physical Activity Among Children and Adolescents," *Journal of Transport and Health* 21 (2021): 101071, https://doi.org/10.1016/j.jth.2021.101071.

11. D. Iglesias, J. Fernandez-Rio, and P. Rodríguez-González, "Moderate-To-Vigorous Physical Activity in Physical Education: A Review of Reviews," *Journal of Teaching in Physical Education* 42, no. 4 (2022): 640–646.

12. B. Hyndman, *Contemporary School Playground Strategies for Healthy Students* (Springer, 2017).

13. J. J. Reilly, G. Johnston, S. McIntosh, and A. Martin, "Contribution of School Recess to Daily Physical Activity: Systematic Review and Evidence Appraisal," *Health Behavior and Policy Review* 3, no. 6 (2016): 581–589.

14. S. Pulido Sanchez and D. Iglesias Gallego, "Evidence-Based Overview of Accelerometer-Measured Physical Activity During School Recess: An Updated Systematic Review," *International Journal of Environmental Research and Public Health* 18, no. 2 (2021): 578.

15. C. D. Pfledderer, S. Kwon, I. Strehli, W. Byun, and R. D. Burns, "The Effects of Playground Interventions on Accelerometer-Assessed Physical Activity in Pediatric Populations: A Meta-Analysis," *International Journal of Environmental Research and Public Health* 19, no. 6 (2022): 3445, https://doi.org/10.3390/ijerph19063445.

16. A. Blaes, N. D. Ridgers, J. Aucouturier, E. Van Praagh, S. Berthoin, and G. Baquet, "Effects of a Playwound Marking Intervention on School Recess Physical Activity in French Children," *Preventive Medicine* 57, no. 5 (2013): 580–584, https://doi.org/10.1016/j.ypmed.2013.07.019.

17. N. D. Ridgers, G. Stratton, and S. J. Fairclough, "Physical Activity Levels of Children During School Playtime," *Sports Medicine* 36, no. 4 (2006): 359–371, https://doi.org/10.2165/00007256-200636040-00005.

18. P. Tercedor, V. Segura-Jiménez, M. Avila Garcia, and F. J. Huertas-Delgado, "Physical Activity During School Recess: A Missed Opportunity to Be Active?," *Health Education Journal* 78, no. 8 (2019): 988–999.

19. J. C. Bikomeye, J. Balza, and K. M. Beyer, "The Impact of Schoolyard Greening on Children's Physical Activity and Socioemotional Health: A Systematic Review of Experimental Studies," *International Journal of Environmental Research and Public Health* 18, no. 2 (2021): 1–20, https://doi.org/10.3390/ijerph18020535.

20. G. M. Lemberg, E. M. Riso, I. Fjørtoft, L. Kjønniksen, M. Kull, and E. Mäestu, "School Children's Physical Activity and Preferred Activities During Outdoor Recess in Estonia: Using Accelerometers, Recess Observation, and Schoolyard Mapping," *Children* 10, no. 4 (2023): 702.

21. G. Baquet, J. Aucouturier, F. X. Gamelin, and S. Berthoin, "Longitudinal Follow-Up of Physical Activity During School Recess: Impact of Playground Markings," *Frontiers in Public Health* 6 (2018): 283, https://doi.org/10.3389/fpubh.2018.00283.

22. E. Delidou, O. Matsouka, and C. Nikolaidis, "Influence of School Playground Size and Equipment on the Physical Activity of Students During Recess," *European Physical Education Review* 22, no. 2 (2016): 215–224, https://doi.org/10.1177/1356336X15598790.

23. E. Pardali, L. Kjønniksen, S. Bratland-Sanda, et al., "Pupils' Participation Roles in School-Based Physical Activity in the Context of Physically Active Learning and Recess: Experiences From Norwegian and Estonian Primary and Secondary School Pupils," *Frontiers in Sports and Active Living* 7 (2025): 1514764, https://doi.org/10.3389/fspor.2025.1514764.

24. K. Ishii, A. Shibata, M. Sato, and K. Oka, "Recess Physical Activity and Perceived School Environment Among Elementary School Children," *International Journal of Environmental Research and Public Health* 11, no. 7 (2014): 7195–7206, https://doi.org/10.3390/ijerph110707195.

25. D. Van Dyck, C. Timmerman, A. Hermida, et al., "Physical Activity During Recess in Elementary Schoolchildren in Belgium and Ecuador: The Role of the Physical Environment at School," *Journal of Sports Sciences* 40, no. 13 (2022): 1476–1485, https://doi.org/10.1080/02640414.2022.2086521.

26. Y. Escalante, A. García-Hermoso, K. Backx, and J. M. Saavedra, "Playground Designs to Increase Physical Activity Levels During School Recess: A Systematic Review," *Health Education & Behavior* 41, no. 2 (2014): 138–144, https://doi.org/10.1177/1090198113490725.

27. J. Carlos Pastor-Vicedo, J. Martínez-Martínez, M. López-Polo, and A. Prieto-Ayuso, "Recreos Activos Como Estrategia de Promoción de la Actividad Física: Una Revisión Sistemática [Active Recess as a Strategy to Promote Physical Activity: A Systematic Review]," *Retos* 40 (2021): 135–144, https://recyt.fecyt.es/index.php/retos/index.

28. A. C. M. Suga, A. A. d. P. da Silva, J. R. Brey, P. H. Guerra, and C. R. Rodriguez-Añez, "Effects of Interventions for Promoting Physical Activity During Recess in Elementary Schools: A Systematic Review," *Jornal de Pediatria* 97 (2021): 585–594.

29. A. M. Parrish, A. D. Okely, R. M. Stanley, and N. D. Ridgers, "The Effect of School Recess Interventions on Physical Activity: A Systematic Review," *Sports Medicine* 43 (2013): 287–299.

30. R. P. Bailey, R. Payne, A. Raya Demidoff, N. Samsudin, and C. Scheuer, "Active Recess: School Break Time as a Setting for Physical Activity Promotion in European Primary Schools," *Health Education Journal* 83, no. 5 (2024): 531–543, https://doi.org/10.1177/00178969241254187.

31. D. Moher, A. Liberati, J. Tetzlaff, et al., "Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement (Chinese Edition)," *Journal of Integrative Medicine* 7, no. 9 (2009): 889–896.

32. S. Hawker, S. Payne, C. Kerr, M. Hardey, and J. Powell, "Appraising the Evidence: Reviewing Disparate Data Systematically," *Qualitative Health Research* 12, no. 9 (2002): 1284–1299, https://doi.org/10.1177/1049732302238251.

33. P. Anthamatten, L. Brink, B. Kingston, E. Kutchman, S. Lampe, and C. Nigg, "An Assessment of Schoolyard Features and Behavior Patterns in Children's Utilization and Physical Activity," *Journal of Physical Activity and Health* 11, no. 3 (2014): 564–573, https://doi.org/10.1123/jpah.2012-0064.

34. P. Anthamatten, E. Fiene, E. Kutchman, et al., "A Microgeographic Analysis of Physical Activity Behavior Within Elementary School Grounds," *American Journal of Health Promotion* 28, no. 6 (2014): 403–412, https://doi.org/10.4278/ajhp.121116-QUAN-566.

35. T. N. Gomes, F. K. dos Santos, W. Zhu, J. Eisenmann, and J. A. R. Maia, "Multilevel Analyses of School and Children's Characteristics Associated With Physical Activity," *Journal of School Health* 84, no. 10 (2014): 668–676, https://doi.org/10.1111/josh.12193.

36. F. Martensson, M. Jansson, M. Johansson, A. Raustorp, M. Kylin, and C. Boldemann, "The Role of Greenery for Physical Activity Play at School Grounds," *Urban Forestry & Urban Greening* 13, no. 1 (2014): 103–113, https://doi.org/10.1016/j.ufug.2013.10.003.

37. H. B. Andersen, C. D. Klinker, M. Toftager, C. S. Pawlowski, and J. Schipperijn, "Objectively Measured Differences in Physical Activity in Five Types of Schoolyard Area," *Landscape and Urban Planning* 134 (2015): 83–92.

38. V. Grant, B. Brown, G. Swaney, et al., "Community-Identified Strategies to Increase Physical Activity During Elementary School Recess on an American Indian Reservation: A Pilot Study," *Preventive Medicine Reports* 2 (2015): 658–663, https://doi.org/10.1016/j.pmedr.2015.08.012.

39. C. S. Pawlowski, H. B. Andersen, J. Troelsen, and J. Schipperijn, "Children's Physical Activity Behavior During School Recess: A Pilot Study Using GPS, Accelerometer, Participant Observation, and Go-Along Interview," *PLoS One* 11, no. 2 (2016): e0148786, https://doi.org/10.1371/journal.pone.0148786.

40. D. A. Dudley, W. G. Cotton, L. R. Peralta, and M. Winslade, "Playground Activities and Gender Variation in Objectively Measured Physical Activity Intensity in Australian Primary School Children: A Repeated Measures Study," *BioMed Central Public Health* 18 (2018): 1101, https://doi.org/10.1186/s12889-018-6005-5.

41. C. A. Howe, K. A. Clevenger, B. Plow, S. Porter, and G. Sinha, "Using Video Direct Observation to Assess Children's Physical Activity During Recess," *Pediatric Exercise Science* 30, no. 4 (2018): 516–523, https://doi.org/10.1123/pes.2017-0203.

42. A. L. Escaron, C. Vega-Herrera, N. Steers, et al., "Factors Associated With Leisure Time Physical Activity Among Schoolchildren in a Predominantly Latino Community," *Journal of School Health* 89, no. 6 (2019): 444–451.

43. S. Maatta, J. Gubbels, C. Ray, et al., "Children's Physical Activity and the Preschool Physical Environment: The Moderating Role of Gender," *Early Childhood Research Quarterly* 47 (2019): 39–48, https://doi.org/10.1016/j.ecresq.2018.10.008.

44. S. Pereira, A. Reyes, M. A. Moura-Dos-Santos, et al., "Why Are Children Different in Their Moderate-To-Vigorous Physical Activity Levels? A Multilevel Analysis," *Jornal de Pediatria* 96, no. 2 (2020): 225–232, https://doi.org/10.1016/j.jped.2018.10.013.

45. M. Graham, M. Wright, L. B. Azevedo, T. Macpherson, D. Jones, and A. Innerd, "The School Playground Environment as a Driver of Primary School Children's Physical Activity Behaviour: A Direct Observation Case Study," *Journal of Sports Sciences* 39, no. 20 (2021): 2266–2278, https://doi.org/10.1080/02640414.2021.1928423.

46. T. T. Amholt, J. F. Jespersen, M. Zacho, A. Timperio, and J. Schipperijn, "Where Are Tweens Active in School Playgrounds? A Hot-Spot Analysis Using GPS, Accelerometer, and GIS Data," *Landscape and Urban Planning* 227 (2022): 104546, https://doi.org/10.1016/j.lurbplan.2022.104546.

47. M. A. Raney, E. Daniel, and N. Jack, "Impact of Urban Schoolyard Play Zone Diversity and Nature-Based Design Features on Unstructured Recess Play Behaviors," *Landscape and Urban Planning* 230 (2023): 104632, https://doi.org/10.1016/j.lurbplan.2022.104632.

48. M. J. Barenie, E. K. Howie, K. A. Weber, D. Thakur, C. M. Murphy, and M. R. Thomsen, "Where the Children Play: Gender Gaps in Recess Physical Activity by Age and Playground Area," *Preventive Medicine Reports* 41 (2024): 102699, https://doi.org/10.1016/j.pmedr.2024.102699.

49. R. Gamboa Jiménez and C. Cacciuttolo Juárez, "Juego Libre y Espontaneo en el Patio de Recreo en Educación Infantil . . . ¿ A Qué Juegan Los Niños?," in *11° Congreso Argentino de Educación Física y Ciencias* (Universidad Nacional de La Plata, Facultad de Humanidades y Ciencias de la, 2015).

50. J. Schipperijn, C. D. Madsen, M. Toftager, et al., "The Role of Playgrounds in Promoting Children's Health–a Scoping Review," *International Journal of Behavioral Nutrition and Physical Activity* 21, no. 1 (2024): 72.

51. I. Lousen, J. Arvidsen, and C. S. Pawlowski, "Children's Play Behaviour and Engagement With the Schoolyard Environment," *International Journal of Play* 13 (2024): 311–327, https://doi.org/10.1080/21594937.2024.2425532.

52. E. Powell, L. A. Woodfield, and A. A. M. Nevill, "Children's Physical Activity Levels During Primary School Break Times: A Quantitative and Qualitative Research Design," *European Physical Education Review* 22, no. 1 (2016): 82–98, https://doi.org/10.1177/1356336X15591135.

53. C. S. Pawlowski, C. Ergler, T. Tjørnhøj-Thomsen, J. Schipperijn, and J. Troelsen, "'Like a Soccer Camp for Boys': A Qualitative Exploration of Gendered Activity Patterns in Children's Self-Organized Play During School Recess," *European Physical Education Review* 21, no. 3 (2015): 275–291.

54. C. S. Pawlowski, J. Veitch, H. B. Andersen, and N. D. Ridgers, "Designing Activating Schoolyards: Seen From the Girls' Viewpoint," *International Journal of Environmental Research and Public Health* 16, no. 19 (2019): 3508, https://doi.org/10.3390/ijerph16193508.

55. A. Grao-Cruces, V. Segura-Jiménez, J. Conde-Caveda, et al., "The Role of School in Helping Children and Adolescents Reach the Physical Activity Recommendations: The UP&DOWN Study," *Journal of School Health* 89, no. 8 (2019): 612–618, https://doi.org/10.1111/josh.12785.

56. R. M. Telford, R. D. Telford, L. S. Olive, T. Cochrane, and R. Davey, "Why Are Girls Less Physically Active Than Boys? Findings From the LOOK Longitudinal Study," *PLoS One* 11, no. 3 (2016): e0150041, https://doi.org/10.1371/journal.pone.0150041.

57. A. Grao-Cruces, M. J. Velásquez-Romero, and F. Rodriguez-Rodríguez, "Levels of Physical Activity During School Hours in Children and Adolescents: A Systematic Review," *International Journal of Environmental Research and Public Health* 17, no. 13 (2020): 1–23, https://doi.org/10.3390/ijerph17134773.

58. J. Manuel Frago-Calvo, B. Murillo, L. García-González, A. Aibar, and J. Zaragoza, *Physical Activity Levels During Unstructured Recess in Spanish Primary and Secondary Schools*, vol. 38 (European Journal of Human Movement, 2017).

59. T. T. Amholt, C. S. Pawlowski, M. Toftager, and J. Schipperijn, "Motivating School Playgrounds for Tweens: The WHERE, WHAT, and WHY," *International Journal of Play* 3 (2024): 1–19.

60. G. M. Lemberg, M. Kull, J. Mäestu, E. M. Riso, and E. Mäestu, "The Associations of Different Recess Types on Physical Activity and Sedentary Behaviour in Estonian Primary School Students," *European Journal of Public Health* 35 (2025): 563–569, https://doi.org/10.1093/eurpub/ckaf052.

Appendix

Web of Science

Abstract: (((AB = ("physical activity*" OR "exercise*" OR "motor activity" OR "sedentary*")) AND AB = ("physical environment" OR "physical structures" OR "playground*" OR "recess school" OR "playground mark*" OR "game equipment" OR "green*")) AND AB = ("kindergarten" OR "school" OR "elementary" OR "primary" OR "middle school" OR "high school" OR "secondary school" OR "toddler" OR "youth" OR "young" OR "adolescent*" OR "child*" OR "student*")) AND AB = ("girls" OR "boys" OR "male" OR "female" OR "gender" OR "sex").

Título: (((TI = ("physical activity*" OR "exercise*" OR "motor activity" OR "sedentary*")) AND TI = ("physical environment" OR "physical structures" OR "playground*" OR "recess school" OR "playground mark*" OR "game equipment" OR "green*")) AND TI = ("kindergarten" OR "school" OR "elementary" OR "primary" OR "middle school" OR "high school" OR "secondary school" OR "toddler" OR "youth" OR "young" OR "adolescent*" OR "child*" OR "student*")) AND TI = ("girls" OR "boys" OR "male" OR "female" OR "gender" OR "sex").

Scopus: Título and Abstract

TITLE-ABS ("physical activity*" OR "exercise*" OR "motor activity" OR "sedentary*") AND TITLE-ABS ("physical environment" OR "physical structures" OR "playground*" OR "recess school" OR "playground mark*" OR "game equipment" OR "green*") AND TITLE-ABS ("kindergarten" OR "school" OR "elementary" OR "primary" OR "middle school" OR "high school" OR "secondary school" OR "toddler" OR "youth" OR "young" OR "adolescent*" OR "child*" OR "student*") AND TITLE-ABS ("girls" OR "boys" OR "male" OR "female" OR "gender" OR "sex").

Pubmed: Título and Abstract

((("physical activity*" [Title/Abstract] OR "exercise*" [Title/Abstract] OR "motor activity" [Title/Abstract] OR "sedentary*" [Title/Abstract])

AND (“physical environment” [Title/Abstract] OR “physical structures” [Title/Abstract] OR “playground*” [Title/Abstract] OR “recess school” [Title/Abstract] OR “playground mark*” [Title/Abstract] OR “game equipment” [Title/Abstract] OR “green*” [Title/Abstract])) AND (“kindergarten” [Title/Abstract] OR “school” [Title/Abstract] OR “elementary” [Title/Abstract] OR “primary” [Title/Abstract] OR “middle school” [Title/Abstract] OR “high school” [Title/Abstract] OR “secondary school” [Title/Abstract] OR “toddler” [Title/Abstract] OR “youth” [Title/Abstract] OR “young” [Title/Abstract] OR “adolescent*” [Title/Abstract] OR “child*” [Title/Abstract] OR “student*” [Title/Abstract])) AND (“girls” [Title/Abstract] OR “boys” [Title/Abstract] OR “male” [Title/Abstract] OR “female” [Title/Abstract] OR “gender” [Title/Abstract] OR “sex” [Title/Abstract]).

SPORTDiscus

Abstract: AB (“physical activity*” OR “exercise*” OR “motor activity” OR “sedentary*”) AND AB (“physical environment” OR “physical structures” OR “playground*” OR “recess school” OR “playground mark*” OR “game equipment” OR “green*”) AND AB (“kindergarten” OR “school” OR “elementary” OR “primary” OR “middle school” OR “high school” OR “secondary school” OR “toddler” OR “youth” OR “young” OR “adolescent*” OR “child*” OR “student*”) AND AB (“girls” OR “boys” OR “male” OR “female” OR “gender” OR “sex”).

Title: TI (“physical activity*” OR “exercise*” OR “motor activity” OR “sedentary*”) AND TI (“physical environment” OR “physical structures” OR “playground*” OR “recess school” OR “playground mark*” OR “game equipment” OR “green*”) AND TI (“kindergarten” OR “school” OR “elementary” OR “primary” OR “middle school” OR “high school” OR “secondary school” OR “toddler” OR “youth” OR “young” OR “adolescent*” OR “child*” OR “student*”) AND TI (“girls” OR “boys” OR “male” OR “female” OR “gender” OR “sex”).