Neighbourhood physical environment influences on children's outdoor play: a systematic review

Xin Zhao[1,2], Norhuzailin Hussain[1]*, Shureen Faris Abdul Shukor[1] and Ji Ning[2]

[1]Faculty of Design and Architecture, Universiti Putra Malaysia, Serdang, Malaysia, [2]Faculty of Art Design, Communication University of Shanxi, Jinzhong, China

Children's access to outdoor activities is restricted due to the continuous spread of urbanisation in public spaces. Therefore, figuring out how to improve outdoor physical space within the existing environment is becoming increasingly important. This study conducted a systematic review of 55 studies using PRISMA method to examine the link between the physical settings in neighbourhoods and children's outdoor play. Through Scopus databases to provide a complete list of journal articles based on stringent inclusion and exclusion standards. Identify the gaps by categorising the significant themes and aspects influencing children's play area requirements. Studies show that the physical environment of a neighbourhood is affected by several social factors besides the needs and preferences of children's games. It was also found that the most commonly used research methods in children's play spaces were survey and interview, and the Affordance Theory was widely used as a research framework. This research provides new design possibilities for children's play areas in residential neighbourhoods. These guidelines emphasise games with varied spatial qualities, the integration of spatial functions, the additional support requirements of parents for children's play, and the flexibility of children to utilise outside space. Consequently, this analysis identifies knowledge gaps and suggests research directions for future studies.

KEYWORDS

children, outdoor play, neighbourhoods, physical environment, literature review

1 Introduction

A large number of studies have proven that outside play benefits children's physical health and cognitive, social, and motor abilities (Gundersen et al., 2016; Bingley and Milligan, 2007; O'Brien and Morris, 2014). It can also enhance social cohesiveness, social integration, and community development (Qiu and Zhu, 2021). However, the area of children's outdoor play space is gradually shrinking in urban size, especially in developing countries in the process of urbanisation, such as China. Meanwhile, the number of game forms is gradually decreasing, with the attraction of electronic products contributing to children's increasing screen time (Bao et al., 2021). It is worth systematically summarizing what factors restrict their outdoor activities and how to encourage children to return outdoors for play activity. As a result, how to produce practical and effective outdoor design

method for residential areas adapted to today's diverse societal events has become a research gap.

The systematic review is a review method with relatively standardised analysis steps for the existing literature topics, which can comprehensively integrate the research topics in a particular field they desire to find (Higgins et al., 2011). Future research suggestions may be made by thoroughly analysing the current literature summarising study results and pinpointing knowledge gaps. Explore ways to improve the design of outdoor game spaces from the perspective of promoting existing research and development directions and assuming future trends. Especially for those existing problems, the research result has yet to make breakthroughs. It is possible to achieve creative inspiration by transforming research methods and ideas. Accordingly, this study analyses research trends, themes, techniques, and settings associated with outdoor game space in residential neighbourhood studies by thoroughly reviewing them. The literature review provides the following answers explicitly:

1. What kind of surroundings and assistance do kids need to offer to encourage them to play?
2. What are the major theoretical foundations of previous outdoor game spaces in residential neighbourhood studies?
3. What were the research methods used in previous studies of outdoor game space in residential neighbourhoods?
4. According to previous studies, what are the approaches to improving children's play spaces in residential neighbourhoods?

This literature review contributes to our understanding of current physical environment factors affecting children's outdoor games and how to improve children's outdoor play environment through a review of the empirical research that has been done (Attia, 2021; Nassar, 2021; Tarek et al., 2021). The structure of this paper is as follows. Firstly, the definitions of outdoor play environments and topics connected to them. Secondly, the outcomes of the 55 studies screened after the search methods for literature identification are given. After that, sort out the categories of children's outdoor play spaces and the crucial factors affecting them. Finally, future research agendas about the design method and practical contributions of the work are discussed.

2 Review topic and definitions of its related concepts

Various research directions have been identified on children's outdoor play involving environmental protection, psychology, medicine, health, and urban or rural construction after searching the literature in the database of Scopus and Web of Science (Bartie et al., 2016; Gundersen et al., 2016; Buck et al., 2019; Furneaux and Manaugh, 2019; Nordbø et al., 2020; Mottaghi et al., 2021). This study focuses on the physical environmental types and characteristics of children's outdoor play in residential neighbourhoods. Children's outdoor game venues are mainly around schools and neighbourhoods, while the latter is where they spend the longest and most frequently (Oakley et al., 2021). Children can play freely and unrestrainedly here in structured or unstructured games (Furneaux and Manaugh, 2019). The study takes the landscape design of residential neighbourhoods as the research scope. Differences in the perception of residential

neighbourhoods exist between different regional cultures and ethnic groups worldwide (Cubukcu et al., 2018). Warren (1981, p. 62) defines a *neighbourhood* as "a social organisation of a population residing in a geographically proximate locale," which is essential to the design and development of the urban environment (Kallus and Law-Yone, 2000; Mahmoudi Farahani, 2016). Neighbourhoods are divided into two types based on their management mode and space nature: gated communities and non-gated communities. Gated communities are apartment complexes surrounded by walls or guards and limited public access (Blandy, 2006). Accordingly, there are no walls or gates in the non-gated neighbourhoods to bar admission from strangers (Bint-e-Waheed and Nadeem, 2019). For statistical comprehensiveness, this study includes the above two types.

Factors affecting children's outdoor games mainly include social environment and physical environment. But some in-depth research reveals that part of the social factors will settle in the physical environment (Lee et al., 2021). In other words, the material environment can solve the needs of social factors. Through a systematic review, we try to find the material support hidden behind the social or family needs to improve children's outdoor play activities. In addition, urbanisation has increased the plunder of the natural environment, so children have fewer opportunities to contact nature (D'Haese et al., 2015). The space dominated by the natural landscape can also provide the wealthiest game materials for children's games and enhance the diversity and creativity of games (Mansor et al., 2016). The natural environment in the play space provided for children in the residential area should be paid attention to and included in the research topic. Therefore, in focusing on the material elements of children's outdoor games, the natural environment elements are taken as the critical part of the review and analysis, and the artificial amusement facility is abandoned. Finally, children's outdoor play is a form of unstructured games. These activities in term of outdoor sports competitions and special sports activities are excluded.

3 Systematic literature review methods

A systematic literature review summarises the available data for a specific period, finds knowledge gaps, and suggests areas for more research (Petticrew and Roberts, 2006). This demonstrates the current discourse boundaries. It differs from a narrative review because of its systematic approach. It thoroughly explains the methods for choosing, searching for, and analysing the literature to decrease biases and enhance transparency (Schmeisser, 2013). The search process follows the PRISMA approach (Preferred Reporting Items for Meta-Analyses and Systematic Reviews) (Moher et al., 2009), including a four-phase flow diagram to ensure the full-scale literature is trustworthy.

3.1 Search strategy

The list of articles was generated using Scopus database keyword searches. This enabled a more comprehensive search across a wide variety of fields. Although using the Web of Science database for analytical literature evaluations has become more common, Scopus remains the most comprehensive database, with information from
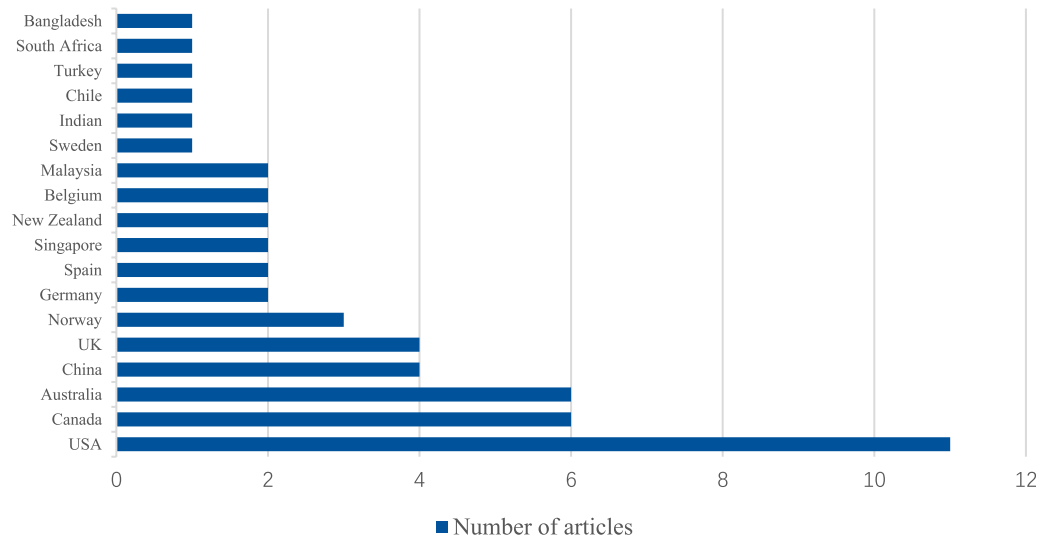
FIGURE 1
Prisma flow diagram of study selection process.
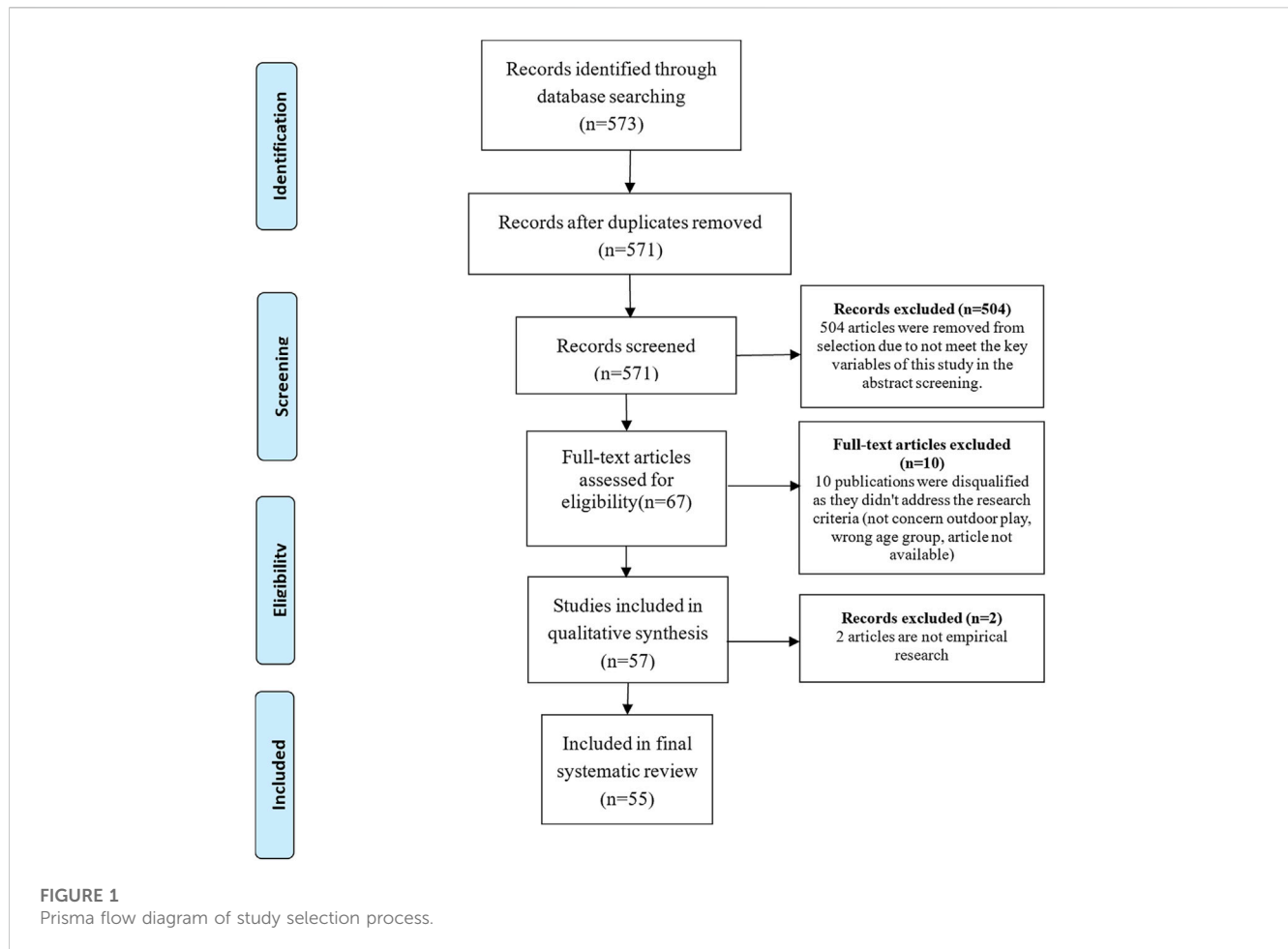
more than 20,000 journals and more exclusive articles than WOS in all categories (Falagas et al., 2008). It is the world's most extensive abstract and citation database for peer-reviewed literature (Mongeon and Paul-Hus, 2016).

This study aims to identify spatial characteristics and play support for kids from communities in the innovation literature. Especially the state of kids' play in open areas. Therefore, a combination of phrases linked to the neighbourhood environment and children's play was utilised to select the peer-reviewed journal publications. Books, reports, editorials, and other non-peer-reviewed publications were specifically eliminated since peer-reviewed journals are the preferred and more reliable sources of information. Peer-reviewed journal articles were personally chosen for inclusion (Donohue and Fox, 2000). Articles were only considered if they were written in English due to the broader popularity and coverage of research and the writers' limited linguistic abilities. Articles were only taken into consideration if the whole text was accessible from the database, allowing for appropriate study and analysis. According to the subject of research, expand the scope of search keywords, and include related synonyms as much as possible. Since the number of papers on children's play environments is relatively stable, take the results of the past 10 years, from 2013 to 2022, as the research scope. The initial results of the search were 573 papers conducted in July 2022, with the search keywords as follows:

TITLE-ABS-KEY ("outdoor" OR "green space*" OR "environment*" OR "public space" OR "natur*" OR "landscape") AND TITLE-ABS-KEY ("play*" OR "game*") AND TITLE-ABS-KEY (child*) AND TITLE-ABS-KEY ("neighb*rhood*" OR "residential") AND (LIMIT-TO (SRCTYPE, "j")) AND (LIMIT-TO (PUBSTAGE, "final") OR LIMIT-TO (PUBSTAGE, "aip")) AND (LIMIT-TO (DOCTYPE, "cp") OR LIMIT-TO (DOCTYPE,"ar") OR LIMIT-TO (DOCTYPE,"ch") OR LIMIT-TO (DOCTYPE, "English"))

3.2 Inclusion/exclusion criteria

As the papers initially searched out will not all be close to the research purpose of this study, it is necessary to exclude those irrelevant papers according to the research questions using the method of PRISMA via the author's browsing of the abstracts and full texts (see Figure 1). The screening and eligibility checks proceeded as follows: Step 1) Two duplicate returns were identified by investigating the titles and abstracts. Step 2) All derived items were checked for consistency and accuracy of the keyword search by reading through titles and abstracts. In this stage, 67 articles out of 571 were selected, and the records were superficially screened for having a thematic match with at least children's outdoor play and in a residential neighbourhood to

FIGURE 2
Number of publications from different countries.

indicate potential eligibility and to investigate whether those records were flagged as children's free play without the behaviours of specific sports activities and recreational facilities. Step 3) By application of inclusion criteria to read the full text, and further screened and removed ten articles that did not relate to children's outdoor play behaviour and spatial form and three articles that did not overlap with children's age range from 3–12 years old. Step 4) By application of exclusion criteria, exclude two articles with no empirical results. Overall, the search procedure yielded 55 papers that meet all criteria.

The inclusion criteria were:

- Articles with children's outdoor play as the core focus of the study.
- Articles that addressed issues regarding the physical neighbourhood environmental use.
- Articles with a range of children from 3 to 12 years old, as this range is the most frequent stage of children's outdoor activities in the neighbourhoods (Shackell et al., 2008).

The exclusion criteria were:

- Only one article will be kept for reduplicated articles.
- Full text is not available within the selected database.
- Articles with no empirical results.
- Articles that addressed games with recreational facilities and competitive sports (For example, play basketball and football).
- Articles with activities not for fun or spontaneity.

4 Findings: the synthesis of the literature

This study aims to provide new ideas and specific methods for the future design of children's play environments in residential areas by summarising and analysing the scope of existing research. The physical environment is the research content. The research trends of the 55 included literature show a slight and continuous growth from 2013 to 2022, from only 1 in 2013 to 10 in 2021 (statistics for 2022 are incomplete), and 89% of them are from 2016 to 2022. This type of space covers almost all kinds of environments in residential neighbourhoods. Nearly half of them take the general residential area space as the research area, and the other half are researches on different spatial themes in the residential area. Outdoor play is affected by various physical factors in the space, which are not only affected by children's perceptions (Brussoni et al., 2020) but also involve a large number of parents' perceptions and parental support (Roberts et al., 2016; Kepper et al., 2019; Olsen et al., 2019). There are 26 quantitative studies in the selected literature, using survey, experiment, GIS, and accelerometer measurements. Nineteen qualitative studies use interviews, observation, photo elicitation, focus groups, activity diaries, and ten mixed-methods studies. The whole collection of papers covers a variety of country situations (see Figure 2): the most significant proportion is conducted in the United States (11), followed by Canada (6), Australia (6), the United Kingdom (4), China (4), New Norway (3), Malaysia (2), Spain (2), Singapore (2), Belgium (2), Germany (2), Zealand (2), India (1), Bangladesh (1), Sweden (1), South Africa (1), Chile (1), and Turkey (1).

4.1 Overview of theoretical foundations

Table 1 (Articles marked with serial numbers, see Supplementary Appendix S1) displays the theories and research frameworks pertinent to children's outdoor play used in the investigated articles. Only 14 empirical publications had a clear theoretical foundation, while 41 might be classified as a-theoretical. The majority of publications, 9 out of 14, use the affordances hypothesis from ecological perceptual psychology established by

TABLE 1 Relevant theories in outdoor play research.

Theory	Explanation (example)	Articles
Affordance	A person may make use of an environment's inherent functional possibilities for action to satisfy their wants or pursue their interests. Neighbourhood activity affordances are the possibilities in the immediate surroundings that a person perceives or uses to participate in play, leisure, and socialising	1,3,9,22,23,27,51,52
Attention Restorative Theory	The function of "natural scenery" in recovery: It "employs the mind without exhaustion and yet trains it; newly emerging it and yet lightens it," and by exerting this influence over the body, provides the whole system with the effect of refreshing rest	10
Place Attachment	Place attachment is strengthened when caretakers of children use green play spaces to meet each other, build relationships, and build social trust. This makes for a stronger sense of community and general wellbeing	36
Human Territoriality Theory	It describes human behaviour involving purposeful or inadvertent territorial defence in urban settings and indoor places	15
Theory of Loose Parts	It argues that play areas with a wide variety of mobile things encourage open-ended play in which one object may be used in various ways in connection to other objects, thanks to an individual's inventiveness	30
Theory of Children's Mental Development	Children that have a more developed theory of mind will be more empathetic and will have a better understanding of their peers' emotional responses	49
Naturalistic Intelligence	Children typically have well-developed senses of sight, hearing, smell, taste, and touch, and they make extensive use of these senses to observe and classify elements of nature	54
Bourdieu's Theory of Practice	A person's habitus is the collective collection of socially taught but otherwise taken-for-granted dispositions and ways of behaving that one develops through activities and experiences in daily life	1

Gibson (1979). The idea of affordances may be created, perceived, employed, or shaped (Sandseter, 2009), which might perfectly capture the spirit of children's play. Other theories, such as the theory of loose parts (Furneaux and Manaugh, 2019), place attachment (Oscilowicz et al., 2020), attention restorative theory (Gundersen et al., 2016), theory of children's mind development (Bao et al., 2021), naturalistic intelligence (Zhang and Tamminga, 2022), and Bourdieu's theory of practice combined with affordance theory, can examine children's (Ergler et al., 2013). However, studying with a single theory often requires a macro-framework structure and inevitably needs more cohesive analysis. For example, in the process of parental companionship in children's play, parents' psychological needs are often ignored, such as their restoration to the environment and feeling of place attachment, which can affect their initiative to accompany children. And children also have different natural aesthetic needs during outdoor activities, which will put higher requirements on integrating other theories. According to the subject of the study, the majority of these ideas have fundamental applications without showing any theoretical growth or originality.

4.2 Overview of research methods

In terms of the methods used in the body of literature on children's outdoor play (see Table 2), surveys were most frequently used (accounting for 32.73%) among the 55 articles to be conducted, which use the technical means of a questionnaire, GIS, GPS, accelerometer, and photo elicitation, followed by the interview method, accounting for 20%. The data collected from these two methods are not only for children; parents account for a large

proportion. As children in the low age group have limited cognitive ability to answer all the questions, parents need to assist in the response. It can be seen from the table that, in addition to the single use of the survey method, it is also closely combined with the interview method. This is an ideal research process, from qualitative research in the early stages to obtain data to the verification process of quantitative analysis in the later stages (Gundersen et al., 2016). More than two methods account for 50% of the total.

From the tables above, the direct way to get information about children's outdoor activities is through surveys and interviews. Children's outdoor activities are not involved in how they have played in the past. This happens because some neighbourhoods do not have enough space for kids to play outside often (Bao et al., 2021). Although there are studies that track children's play behaviours over time, they do not look at the historical evolution of play forms. As a comprehensive understanding of the current situation of children's play can be obtained through the historical evolution of children's play and interviews with parents. Therefore, it is not only necessary to conduct interviews with children but also to explore more knowledge about children's play activities from the perspective of parents and historical documents as much as possible. It is important to use free play or structured games as a background for studying the spatial characteristics of different residential areas.

4.3 Overview of neighbourhood environments

Table 3 describes the different physical environments where children were used for outdoor play in neighbourhoods. It covers all

TABLE 2 Summary of the research methods.

Methods	2013–2014	2015–2016	2017–2018	2019–2020	2021–2022	Total	%
Case Study		2	1			3	5.45
Experiment		1	1			2	3.64
Interview	1	2		6	2	11	20.00
Survey		5	1	8	4	18	32.73
Survey & Interview		2	3	4		9	16.36
Interview and observation			2		2	4	7.27
Interview and observation & Survey				1	1	2	3.64
Focus groups			1			1	1.82
Observation			1			1	1.82
Secondary data				1	2	3	5.45
Secondary data & Survey					1	1	1.82
Total	1	12	10	20	12	55	100.00

the environmental types in and around the communities of eastern and western countries. There are not only spaces covering the general residential neighbourhood (accounting for 50.9%) but also thematic spaces, such as public green spaces (14.5%), streets (14.5%), community parks (12.7%), playgrounds (5.4%), play streets (5.4%), backyards (5.4%), school neighbourhoods (3.6%), and other microscale environments (3.6%). It can be found that the natural environment and streets are the places with the highest research frequency because of their spatial characteristics and various forms, and they are also the most preferred play environments for children (Mansor et al., 2016; Oke and Middle, 2016; Oakley et al., 2021).

The game street coincides with the street space but is not classified as the same column because it is a new game mode. It refers to a project form that closes the street within a fixed duration and allows children to play to alleviate the lack of play space or for safety needs. Moreover, mediator or moderator variables affecting children's play are also summarised in this list to clarify which physical characteristics play a role in the influencing link of children's outdoor play. The influencing factors in some studies are not limited to one intermediate variable. Studies may be across different intermediate elements simultaneously, so the total value of the percentages is more than 100%. From the table, another part of the research directly corresponds to the influence relationship between children's behaviour activities and the game space to identify its internal logic. But the data is often obtained from preferences through interviews or observations, without thinking about the physical form of the space in terms of categories and structured content in the games themselves, which are challenging to obtain systematically from observations. These data are needed to think from the historical perspective of the game, as the evolution of children's play is closely related to the natural environment (Kahn et al., 2018). It has been proven that children's games should be most common in residential areas, where kids spend more than half of their free time (Hayball et al., 2018). Therefore, starting with the activities around existing artificial facilities or spaces does not cover children's creative and independent characteristics.

4.4 Overview of Children's perception of physical environment

Children's perception of the environment is vibrant, and all kinds of literature have diverse methods of obtaining children's sensory data. This subsection summarises all children's environmental perceptions of outdoor play activities, including the physical and spatial aspects of the environment, according to different gender groups (see Table 4). These perceptions are expressed in the form of comparisons, preferences, conditions, strengths, weaknesses, characteristics, and recommendations. In the column on the perception of the physical environment, children's preference for natural environments (Mansor et al., 2016; Zeng and Li, 2018; Lai and Low, 2019; Yoon and Lee, 2019; Zhang and Tamminga, 2022) and children's preference for playing games in diverse environments accounted for the highest proportion (Holloway and Pimlott-Wilson, 2018; Loebach and Gilliland, 2019; Mears et al., 2020; Zhang and Tamminga, 2022), and the rest perception of the physical environment is relatively average. In terms of gender differences, boys have more dynamic characteristics regarding field expansion needs and spatial location movement than girls (Mansor et al., 2016; Wang et al., 2017).

Children have various expectations for the geographical environment to realise their expectations for diversified game forms. They can not only participate in community planning and design but also play by empowering children to use the environmental elements in the space in their daily play activities. There have been factors of children's lack of freedom in games. According to Casas and Corominas (2021), 67% of kids did not quite agree that they had enough freedom to do anything they wanted in their area. It is necessary to explore how to meet the needs of children to manipulate various elements in the environment as game materials. It can be seen that reorganised spaces and diverse backgrounds with natural features should be reserved in children's play spaces. These spaces should show natural traces as

TABLE 3 Physical factors affecting Children's outdoor play spaces.

Spots	Physical mediating/Moderating factors of outdoor play	Articles	%
Neighbourhood environment	Physical risky factors	6, 23, 38,48	50.9
	Differences between urban and rural Environmental	4,19, 39,46	
	Natural elements	11, 22, 38, 49, 54	
	Urban villages and modern residential areas	15	
	Neighbourhood typologies	18	
	The outdoor environment and organised clubs	20	
	Exposure, accessibility, and relative building facade	22, 49,53	
	Residential density	24,33, 50	
	Walkability	26	
	Distance between play space and residence	12,55	
	Supporting physical environment	35, 39	
	N/A	28,31, 37, 47, 51	
Parks	Environmental differences caused by the seasonal transition	1	12.7
	Walkability	17	
	Natural elements	3	
	Distance between park and residence	1,25	
	N/A	27, 34, 40	
Play Streets	N/A	2, 8, 16	5.4
School neighbourhoods	Walkability	5	3.6
	Diverse data	9	
Natural environments (green space)	Natural elements	7, 10, 29, 44, 52	14.5
	Quality	41	
	N/A	36, 45	
Playgrounds	Categories of playgrounds	13	5.4
	Walkability	17	
	N/A	40	
Streets	Patterns and Accessibility	14,21,24,29,30, 42, 50	14.5
	N/A	43	
Microscale physical environments	Geometric configuration	42	3.6
	N/A	43	
Yards or gardens	N/A	32, 43, 44	5.4

much as possible, such as seasons or the passage of time, or the optimised combination of natural elements to trigger children's game exploration activities.

4.5 Overview of parents' support

With the help of parents, children can learn critical games and social skills when they play outside (Washington et al., 2019). According to the actual investigation, parents often support children's play by accompanying them, more likely as they are concerned about the safety of their children's outdoor games. Even in a moderate environment, parents still have inexplicable concerns (Kepper et al., 2019). Table 5 shows six ways for parents to support children's play. From the perspective of several of these articles, playing with their child, taking children to a location to play, and optimising the setting reached the top three, accounting for 79% of the total literature involving parent support. The rest include providing material, conditional support, and others, accounting for the remaining 21%. It can be seen from the table that some

TABLE 4 Children's perception of the physical environment.

Population	Perception of the physical environment	Forms of perception	Articles
All	Older children tend to use parks and football fields; young children choose playgrounds and outdoor facilities	Compare	7
	Residential areas and urban villages are both considered natural spaces as the first choice of outdoor spaces		15
	Suburb neighbourhoods had plenty of nice areas to play outside than those in urban neighbourhoods		29
	Urban children praise their physical environment, and rural children expect diversified environments		19
	Positive feelings towards nature	Preference	7, 22,29,33, 54
	Prefer the freedom of green spaces without the control of their parents		10
	Near-home streets as popular outdoor play destinations		14
	Willing to participate in the game in a diversified environment		20,34,41, 54
	Children's location preference for play is influenced by the spatial form	Conditional	42
	Walkable school neighbourhoods hinder outdoor play	Disadvantage	5
	Providing specifically designed facilities for play would restrict the motivation to look for affordances		52
	Atypia and multi-purpose functions can promote game exploration more than general modules	Advantage	13,54
	They could create use of the equipment for their imaginations if they cannot recognise the original use	Characteristic	13,33
	Older children Explore the natural environment at a long distance		41
	Building safe neighbourhood roads should widen roads and extend the footpath into the roadway for children's play (such as hopscotch markings)	Advice	21
	Build more suitable equipment for their age		23,34
Boys	Prefer streets, mound area	Preference	7
	Extend their outdoor play areas	Characteristic	7
	Possess greater territory sense than girls	Compare	15
Girls	Within the permitted boundaries	Characteristic	7
	Need more private territory	Advice	15

papers involve more than two types of parental support approaches for their children's outdoor play. In terms of the specific performance of the table, it implies an additional need for environmental assistance apart from the functions of children's games. In addition to the particular space function requirements, intergenerational interaction has positive benefits. A study also found that fathers' participation in children's games can fully mobilise children's enthusiasm for playing games (Gottzén and Kremer-Sadlik, 2012).

Although parents support their children's outdoor play in various ways, satisfaction regarding support behaviours and processes has not been explored from the parent's perspective. Previous research always placed children at the centre of our study, with parents often acting as a supporting force in their development. But the physical and mental exhaustion of parents accompanying their children should also be given attention. The natural environment could enhance parents' restorative psychological and other functional needs by capturing their physical and psychological feelings in the outdoors (Gundersen et al., 2016). Especially in a passive state of accompaniment, there is a need to clarify parents' individual needs in the process

of accompaniment and how these needs are met. When designing the functional space for children's games, parents' subjective feelings or practical needs should also be considered. Therefore, factors of parents' support that used to be overlooked should be paid attention to.

5 Directions for future research

For the past decade's research on children's games, most outdoor activities innovations are children's behaviour characteristics and preferences. In contrast, the research on space features needs to be revised. Because the neighbourhood environment around the world is very different, the regions with sufficient outdoor game space pay much more attention to traffic safety and social security problems. In contrast, the outdoor game space in high-density residential areas will be subject to many restrictions, such as the severe shortage of outdoor play space for children in China. In addition, the research on game types is less and rarely involves the matching relationship between game types and physical environment characteristics. Furthermore, parents in any

TABLE 5 Ways for parents to support children's play.

Ways of parental support	Performance	Articles
Play with their child	Parents are involved in children's play	20,35, 28
	Actively lead children to play	17, 39
	Accompany with children	2, 25,27, 43
	Fathers are involved in more physical activities with their children at parks than mothers	27
Take children to a location to play	to "plan a trip" before going out to play away from residence	1, 39,43
	take the child to the park or playground	17
	frequent park use	18
Provide material	Provide pets to accompany children to play	27
	provide extra equipment for children	20
Optimise the setting	Strengthening the connection between parents and nature can foster children's games in nature	45
	Through built environment characteristics to strengthen intergenerational interaction	25,27,35
Conditional support	Allowed to roam more when they are with friends or peers	25
	Allow their kids to play outside independently around their house if another neighbour they trust can check	26,43
	Be permitted independent play if parents are informed about where the children are at all times	43
Others	Mothers expressed the desire for increased community events or programs to be physically active	26
	Children with autism spectrum disorder (ASD) require too much parental supervision for outdoor play, even within supportive neighbourhoods	48

region are willing to accompany children in outdoor games, regardless of the starting point. At the same time, it did not consider the additional needs of parents during the outdoor accompanying process. It is necessary to propose future research prospects based on the above reasoning.

5.1 The influence of space form on structured play

In general, the term "structured play" refers to a task-oriented activity requiring a child to follow instructions to accomplish it (Tortella et al., 2019). Structured games are often reflected in the teaching process, which is more prominent in the teaching form (Singh, 2021). Children's cognitive, social, and motor development is affected differently by play in various situations (Fjørtoft and Sageie, 2000; Ashley, 2011). According to Bartlett (1999), play is influenced by the local environment, including how children interact with one another in that context. Children's games can also be promoted in the natural environment. However, due to the environmental constraints of neighbourhoods and the popularity of electronic devices, people have gradually moved away from structured games like traditional ones. Fewer rule games may increase kids' likelihood of aggressively acting (Sayer et al., 2004). The previous description has shown that children's outdoor games are more based on facilities, needing more experiences of game control or organisation by children themselves, which will make children gradually lose the enjoyment of social features of the play. Therefore, it is necessary to strengthen the cultivation of structured games corresponding to the environment besides the teaching scope,

which would let children have the experience of guidance by rules in a play space.

The structured games played in outdoor activities, often performed by traditional games, involve regional cultural research. For example, studies from Southeast Asian countries and a few European countries mentioned it (Sutton-Smith, 1998; Frost, 2010; Genggong, 2018). The relatively small portion of studies in this area may result from the regional environment and cultural differences. For example, the population density of residential areas will affect the mixed use of space. Since most structured games are characterised by intergenerational transmission, these game activities are based on the natural environment as the context, without too many auxiliary facilities. Therefore, it is vital to introduce natural elements into the space design and shift from the design process of simple geometric forms to the details of practical functions. Furthermore, the landscape dominated by the natural environment also satisfies children's psychological preference for being close to nature. There is much potential for research to find new ways to design game environments for kids that will make their outdoor activities more fun.

Furthermore, children's outdoor play space is limited in high-density residential communities. To rationally allocate and utilise limited neighbourhood outdoor space for children to play games requires familiarity with the types of behaviour, characteristics, and frequency of children's games. Integrating the game process of structured games require spatial elements with corresponding spatial matching. In a rule-driven way, even if there are no artificial game facilities or venues, it can also satisfy children's game behaviour.

5.2 Multifunctional adaptability of the play spaces

The adaptable design of residential game space refers to the functional ambiguity of children's game space, which can meet the functional needs of different groups of people to solve the problem of hard play due to limited space. The spatial function of the residential area needs to serve different groups of people, but the main service objects are children and the elderly. For example, in China's cultural background and high-density living environment, many families rely on intergenerational assistance to take care of children (Zhang et al., 2022). Because the elderly are more relaxed at home after retirement and the young and middle-aged are busy with work, they can only rely on their grandparents to take care of their children. So how to create an environment suitable for the needs of different people in the limited outdoor space is particularly important. To define the features of outdoor play spaces for children, it is also essential to list the functional needs of other groups, such as outdoor exercise for the elderly and outdoor sports for young and middle-aged people. All of these things need to be planned and designed together. Specifically, how to efficiently combine children's play space with other functional spaces is especially important for developing outdoor spaces in high-density residential areas. For instance, it is possible to use spatial elements as a unit to analyse the design combination method under various functional requirements, which has rarely been involved in previous studies. In addition, there are different types of children's games. How to rationally plan and design the residential area with the natural elements and spatial features supported by different types of games and the play behaviours of children of different ages will be a subject worthy of in-depth study. Playgrounds serve not just as locations for kids to play but also as a means of fostering interpersonal communication (Oke and Middle, 2016). In other words, the facilities in the children's playground can not only provide exclusive sports events but also form a connection or undertake in a structured way, through different equipment, to meet the needs of children's other free forms of play, thus promoting social activities.

5.3 Explore diverse natural game materials that can be utilized

In previous studies on outdoor activities in residential areas, children's movement behaviour was identified as the most important factor, followed by social and cultural factors. However, it has rarely involved how children access various elements of the outdoors. The prerequisite for children to interact with the environment is allowing as many behaviours as possible without dividing interaction types. There have been factors of children's lack of freedom in games, as children disagreed that they had adequate freedom to do anything they wanted in their neighbourhood (Casas and Corominas, 2021). In many gated communities, the community management department is responsible for maintaining everything in the community, and the use rights of children in outdoor spaces are largely restricted. In the future, it will be necessary to explore

how to meet the needs of children by using various elements in the environment as game materials. On the premise of ensuring the safety of children, reduce the amount of maintenance on material things in the community, especially for children exploring the natural environment. Thus, children's outdoor play should be free and open, especially with a preference for natural elements and resources. Only by abandoning the design concept that only meets the visual landscape needs of adults and reducing its restrictive use for children can the nature of children's games be satisfied. For example, children like to pick flowers, leaves, fruits, and seeds from plants to observe and participate in imaginative games. However, this kind of openness does not mean altogether abandoning management but flexible design according to the environmental characteristics and conditions of a different residential geographic feature to promote the interaction between people and nature. Accordingly, it is necessary to explore the strategy by changing the community management mode with a more resilient landscape design model, which can encourage kids to go outside and explore to help them interact with nature better.

5.4 Explore the settings of parental support for children's play

Parents support their kids to play outside in many different ways, from keeping an eye on them to interacting with them so they can play safely. However, the previous literature did not mention why parents have different ways of support. It is worth further studying whether they are based on parents' preferences or the limitations of physical environmental characteristics. First, we learned from the previous article that parents' outdoor supportive behaviours could be divided into participating in interactive games and supervising. Then, the starting point of parents' participatory play behaviour is based on the development and guidance of children's play or their attachment to or preference for the environment. Whether the supervising-type parents provide the space characteristics and physical environment elements suitable for the social interaction between parents in the process of accompanying, there must be some reasons behind the occurrence of these two situations. For example, whether the parents' memory attachment to the environment is caused by visual stimulation when playing with children, which promotes the parents' pleasure or physical and mental restoration (Geografie et al., 2014; Ratcliffe and Korpela, 2016). Parents need to supervise their children when playing outside with them. They are often involved in work or family affairs and should have additional functional facilities to meet their needs. Even if there is no task at hand, the place can also provide sports and leisure facilities that parents can experience during the playing process to stimulate their potential needs. Of course, this design strategy needs to go through systematic thinking rather than intersperse and embellish the local functions of space or via a single operation with a concrete form. It is critical for functional compatibility in the design style of the shape. Because of the insufficient space in many high-density neighbourhoods, it is challenging to distribute multiple functional facilities.

6 Limitations

This study has several limitations that must be taken into account when involving its findings. First, although we have used the most comprehensive database with significant number of content without using other databases, we have limited our search to it due to the limited number of researchers. Our final body of knowledge may have omitted some other relevant articles. Therefore, given sufficient time and researchers, it would include more relevant literature if based on more databases like EBSCO and Science Direct. Second, this review uses as many combinations of different synonyms of keywords as possible for a comprehensive and detailed search. Still, it is also inevitable to miss some relevant literature that does not use these words, which may result in omissions in certain behaviours and perceptions in children's play activity. In the future, new keywords can be discovered through extensive literature reading, thereby adding some search keywords and improving the coverage of the review. Finally, there may be more results for future research directions. It is a cognitive judgment based on the combination of local environmental characteristics and population characteristics as determined by researchers. If researchers from different regions are involved, they are likely to develop other directions based on their cultures and factors. Therefore, researchers' cognition determines their judgment on future research directions. Future study may go beyond these limitations and expand our results by conducting replicated researches in diverse contexts.

7 Conclusion

Identifying children's needs for outdoor play space should be more comprehensive and practical. Earlier studies on children's outdoor space usually focus on children's play location with its related accessibility and play material elements, lacking the incorporated analysis of play space and community environment functions. For this reason, the research direction of the multifunctional adaptability of the community space is proposed. In addition, children's outdoor activities involved children's perception and parents' perception. This study can shift the topic of children's play spaces from a macro to a micro perspective that focus on natural elements in space design. From the parents' perspective, their accompaniment to children's games is common worldwide. Still, it rarely involves their needs during the accompaniment process, from which we propose an insightful and easily overlooked direction. Finally, previous studies on children's outdoor activities did not involve classification, which makes it challenging to design a targeted play space. Through the analysis of rule-based games, the demand for spatial morphological features can be clearly identified. In conclusion, the systematic incorporation of various physical environment elements in this study determined areas for improvement in the current design of children's play spaces.

Author contributions

XZ developed and wrote the whole study framework and each section's manuscript. NH and SS are XZ's doctoral supervisors, responsible for the correction of the content of the full text in the later stages. JN is in charge of literature searching and coding from the Scopus database. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fbuil.2023.1193309/full#supplementary-material

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