

Quality and Accessibility of Urban Parks from a Child-Friendly Perspective: A Case Study of Preschool Children in Barcelona

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ABSTRACT: Access to green spaces and playgrounds is a core indicator in the measurement of child-friendly cities and one of the necessary services provided by urban parks. This article focuses on preschool children with high demand and utilization rates in urban parks, and attempts to construct a rapid analysis and evaluation method that comprehensively considers the quality and accessibility of urban parks. Taking Barcelona, Spain's child-friendly city as an example, this article established a comprehensive framework, including the optimization of the Quality Index of Parks for Youth (QUINPY), and accessibility model based on field research, open source maps, official statistics, etc. Combining the population density distribution of preschool children, specific improvement suggestions are proposed—based on different needs and pain points, selecting suitable innovative measures such as improving the urban traffic and walking environment, rationally increasing structural facilities, or encouraging time-sharing and three-dimensional expansion of the possibility of space use. Hope this article can provide references for the development and construction of child-friendly urban parks in China.

KEY WORDS: child-friendly; urban parks; quality evaluation; accessibility; Barcelona

Introduction

In 1996, the United Nations Children's Fund and UN-HABITAT launched the Child-Friendly City Initiative (CFCI). The construction of a child-friendly living environment has made great progress in both international academic and practical fields. Currently, 1,157 cities and regions have obtained CFCI certification, but no city in our country has yet received this honor. CFCI emphasizes that children's living environment in cities, towns or communities should be safe, clean and tidy, with green spaces they can enter to play, entertain themselves and make friends. Urban parks are an important part of the green

space mentioned in CFCI. They provide greenery and play space for children. They are the main portal for them to experience nature, understand society, and develop interactive relationships [1], and are closely related to children's physical and mental health, social skills and personal development [2-5]. As one of the key points in constructing child-friendly cities, whether urban parks have the quality that meets children's needs and whether the public have convenient access to them are key issues at present, and they are among the hot topics in the discussion of landscape fairness [6-10].

In terms of child-friendliness, children of different a-

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ges have different needs for parks. Preschool children are an important and special type of “users” in parks. The needs and usage methods of this group are significantly different from others and are not easy to accurately understand, and they are often one of the main groups using parks. Therefore, this study focuses on preschool children and selects urban parks in Barcelona, Spain as a case to explore their quality and accessibility. On the one hand, Barcelona was awarded CFCI twice in 2007 and 2018, and has accumulated rich experience in the construction and management of child-friendly urban parks; on the other hand, Barcelona’s climatic conditions are similar to those in some parts of our country, encouraging and suitable for children’s outdoor activities, which is in line with the child-friendly construction goals of some cities in our country. In view of this, this study further attempts to construct an evaluation method that encompasses the internal quality and external accessibility of urban parks, so as to provide a reference for the child-friendliness oriented development and construction of urban parks in our country.

1 Concept definition

1.1 Urban park quality based on a child-friendly perspective

The services and benefits urban parks bring to children often vary with the quality of the park [11]. Urban park quality refers to the internal characteristics of the park including spatial design, maintenance management, safety, functional diversity, convenience facilities, etc. These factors can significantly affect the usage and benefits of a park [12]. The basic principle of quality evaluation is to effectively identify the people targeted by the park and evaluate whether the park most appropriately serves the groups that need the park most, especially relatively vulnerable groups such as low-income people, the elderly, and children [13]. Children are a group that is easily overlooked and underserved in park planning, design and management decisions [3, 14]. Accordingly, this study selected preschool children in the age range of 0-6 years old as the object of investigation. First, field surveys and literature prove that the age of children who frequently use parks is usually within this range [15], and children’s play facilities also take this age group into consid-

eration. Second, in terms of usage patterns, children of this age group are generally led by caregivers, who often choose parks based on distance and convenience; school-age children have a wider range of activities and are more capable, and their choice of parks is greatly influenced by preferences and peers.

Since 2000, the quality of urban parks has received more and more attention [8]. Its evaluation methods include the Quality of Open Space Tool (POST), Post Occupancy Evaluation (POE), the comprehensive evaluation model combining big data of online text and small data of questionnaires and interviews, etc. However, these methods rarely distinguish different age groups for analysis. This study focuses on preschool children, so the Quality Index of Parks for Youth (QUINPY) is introduced. This index is based on a geographical information system and constructs a child-friendly evaluation index system, which has been effectively applied in cases in European and American countries [16-18]. As far as this study is concerned, QUINPY is superior to evaluation methods that do not distinguish between groups and use many subjective indicators [6, 13] in two aspects. First, it fully considers the particularity of children’s needs for park use; second, when the number of research subjects is large, results can be obtained quickly without relying on massive questionnaires and interviews, and it has been proven to have high validity and strong operability [17, 18].

1.2 Accessibility of urban parks

In this study, the accessibility of urban parks refers to the opportunities and difficulty of people entering different urban parks, aiming to measure the external “opportunity potential” of urban parks. There are buffer zone analysis, network analysis, and topological analysis of urban road networks for evaluating the accessibility of urban parks as a unit in the public service supply chain [19, 20]. The third method often uses space syntax theory and models to quantitatively explain the spatial structure and organizational laws mathematically with the help of graph theory, and it measures the accessibility of parks by calculating indicators such as integration and selectivity [21]. In terms of the research object, Barcelona’s road network has good walking conditions, and most urban parks are

open, with multiple entrances. The topological data of the road network around the park can more accurately reflect the accessibility of the park; from the perspective of operability, it is relatively easy to obtain the ESRI Shapefile open-source vector data for the road network of the case site, and the spatial accessibility can be quickly calculated through the operation of space syntax, and presented intuitively in the form of tabular data and visual maps. Therefore, the space syntax model is introduced to conduct a more refined analysis of the supply side from the perspective of spatial relations. The method adopts a line segment model that fits the actual situation of preschool children entering the park by walking. This model can better simulate the walking connectivity between preschool children and urban parks, and it can intuitively reflect the supply

and demand relationship when combined with the population density of preschool children in the area where the park is located.

2 Research design

2.1 Child-friendlycity Barcelona

Barcelona is the second largest city in Spain, with an area of 101 km² and a population of 1.62 million. In 2019, the city council managed more than 583.6 hectares of urban parks (Figure 1). Children account for 16% of Barcelona's population. The city council attaches great importance to the construction of child-oriented urban parks and is committed to "promoting the development of a municipal public life participation system with children as the protagonists."

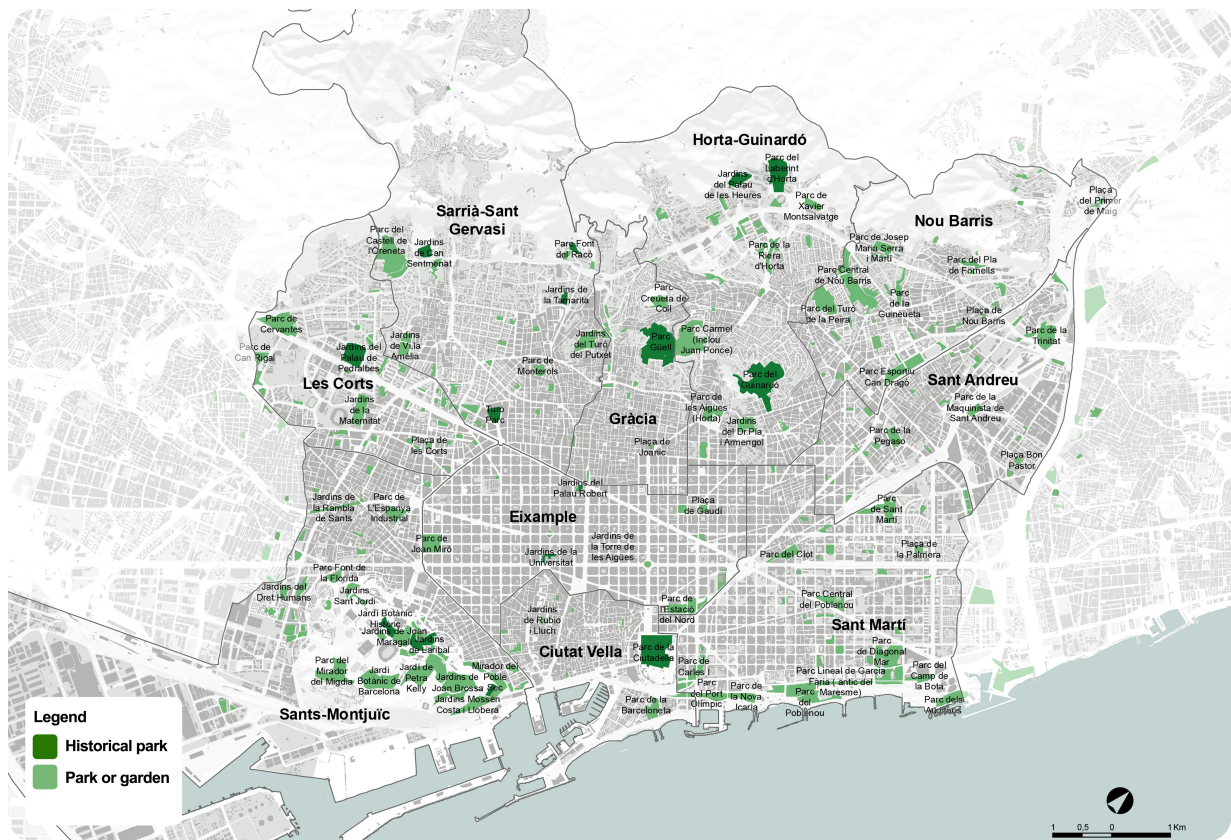


Figure 1 Distribution map of Barcelona's urban parks

2.2 Research methods and framework

Based on literature research and field research, we attempt to: (1) construct a child-friendly park quality evaluation system and conduct a corresponding evaluation of Barcelona's urban parks; (2) use the space syntax model to conduct an accessibility analysis of Barcelona's urban

parks based on a line segment model; (3) integrate the results of quality and accessibility evaluations to conduct an superimposed matrix analysis and superimposed evaluation of urban parks; (4) supersimpose the population density of preschool children in each community for analysis, and explore the advantages and disadvantages of different

types of urban parks based on the evaluation results and

put forward suggestions (Figure 2).

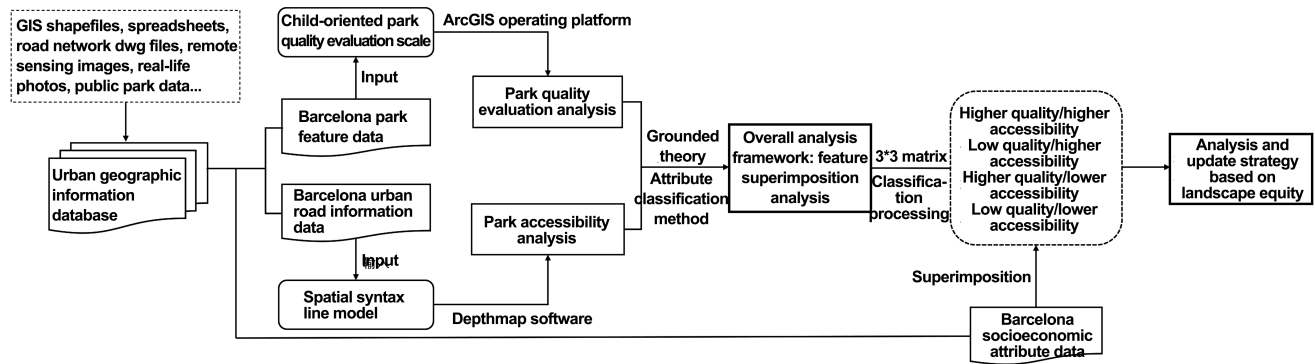


Figure 2 Research framework

Regarding the evaluation of child-friendly park quality, this study draws on the QUINPY proposed by Rigolon in 2016. The evaluation scale has a two-level structure and is constructed based on the following. First, databases such as Web of Science, Science Direct, Jstor and EBSCO host were searched, and “children” and “outdoor activities/parks/playgrounds/green spaces/public open spaces” were selected as keywords. A total of 80 closely related English literature in the fields of public health, landscape architecture, urban design, planning, environmental psychology and geography from 2000 to 2015 were screened. Based on this, the elements included in “park characteristics that attract children to play” and “green space characteristics preferred by children” were extracted and used as secondary indicators, because both characteristics have been widely proven to directly promote effective park use [11]. The secondary indicators obtained were then coded, and the indicators were regrouped and integrated using grounded theory, summarized into five categories of primary indicators, and the indicator counts appearing in the literature were used as the basis for weighting. The above study also further verified the effectiveness of the evaluation scale. It selected Denver, USA as a case city and invited well-known experts in the field to evaluate and rank the quality of the city’s six parks, proving that the evaluation results of the scale are effective [16].

Based on this scale, the present study made the following adjustments based on the current characteristics of Barcelona’s urban parks, the current child-friendly policies, interviews with local relevant departments such as the Urban Parks Institute and the Children and Youth Institute,

and field interviews with park users. (1) Two overly similar indicators in the secondary indicators were merged. Both indicators are related to the number of sports venues in Barcelona. (2) A secondary indicator “cultural and artistic facilities” was added. Considering that Barcelona’s public art, such as urban sculptures, is the result of the urban renewal policy of “combining art and community development” since the end of the 20th century, it is one of the main features of the city’s appearance and an important way for preschool children to get in touch with art, understand the city, and establish a sense of identity.

The adaptively adjusted evaluation system (Figure 3) is divided into 5 first-level indicators and 16 second-level indicators, namely: diversity of children’s recreational facilities (12 points), nature (5 points), park scale (3 points), maintenance level (3 points) and safety (3 points), with a total score of 26 points. Among them, the “diversity of children’s recreational facilities” with the highest weight emphasizes the importance of structural facilities suitable and attractive for children to play and the inclusiveness of urban parks, and it is also a group of indicators that mainly reflects the special needs of children. Many studies have shown that access to green and natural areas can have a positive impact on children’s physical and mental health, so the indicators in “nature” are included to measure the ability of urban parks to provide children with opportunities to get close to natural landscapes, reflecting the ecological service capacity of parks. “Park scale” is an important part of the park’s service capacity, but not its entirety, as is also reflected in the weight. The indicators “maintenance level” and “safety” are both at the management level

el, reflecting the soft quality of urban parks in serving children, and are a supplement to the aforementioned hardware evaluation. The weights of each indicator after adjustment were determined by the Analytic Hierarchy Process (AHP) combined with expert scoring. Experts in the fields of landscape architecture, child-friendliness, urban planning, and park management were invited to score the weights of each indicator through a questionnaire. The YAAHP software was then used to construct a hierarchical model for the scoring results. After consistency testing, the weight values of each indicator were finally obtained, and the results were highly similar to the weights of the reference scale.

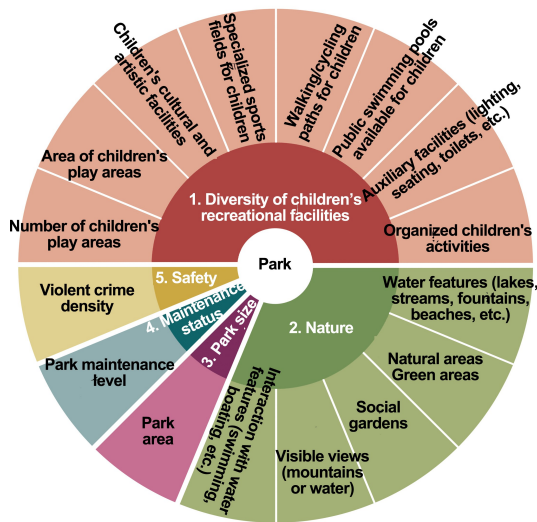


Figure 3 Child-oriented park quality evaluation scale

In terms of data sources, some indicators of the first, second and fifth categories in Figure 3 were collected through remote sensing images, online pictures, and supplementary field surveys. The scale of the park in the third category was obtained based on municipal statistical data. The maintenance level in the fourth category was scored according to the Barcelona Park Environment Standard. The violent crime density indicator in the fifth category was scored according to the crime rate data of the park area officially published.

Regarding the accessibility analysis of urban parks, this study used spatial syntax calculations based on the road network data around the urban park and selected a line segment model optimized on the basis of the axis model. The advantage of this model is that it fits the re-

search of urban scale and considers the influence of spatial coordinate information and road length [22]. The depth-map 10.0 software developed by UCL was used in conjunction with the GIS analysis platform to measure the integration of the road network, reflecting the potential of a space to attract traffic. The integration is the inverse of the total depth. Global depth refers to the cumulative value of all topological depths from the central space to any other space after spatial remapping. The more topological steps a space needs to take to reach other spaces, the lower its accessibility. Therefore, the higher the integration, the higher the accessibility. Integration can be screened according to different radii, i.e., radiation ranges, and a commonly used walking radius of 500m was selected for local integration calculation based on the usage characteristics of preschool children [20, 21]. It was verified that it had a good fit with the visitor number after standardization, so it was used as the range of local integration.

2.3 Data preparation

The research object is the urban parks managed by the Barcelona City Council, with a total number of 159 (Figure 1). As shown in Table 1, this study obtained land use and sociodemographic data in 2018 through the Barcelona official statistics network. Open-source GIS data such as administrative boundaries, parks and road networks came from open-source maps and open urban databases.

Table 1 Data attributes and sources

Data category	Data category	Data year	Data sources
Urban statistics	Administrative area	2018	Barcelona Statistical Yearbook
	Urban park area	2018	Barcelona Statistical Yearbook
	Population of different ages	2018	Barcelona Statistical Yearbook
	Number of violent crimes	2018	Catalan Government Portal
Geospatial information data	Remote sensing data	2019	Google Maps
	Spatial vector data	2019	OpenStreetMap
	Road network vector data	2019	Barcelona open database(Carto BCN)
Online data	Real-life park map	2019	Google Maps and Facebook

3 Analysis results

3.1 Results of the child-oriented quality evaluation of parks

According to QUINPY, the quality of 159 urban parks in Barcelona was evaluated. In terms of the first-level indicator “diversity of children’s recreational facilities” (12 points), about 79% of urban parks in Barcelona have recreational spaces for children, most of which are slides, swings, seesaws and comprehensive recreational facilities. At present, there are not many stadiums that combine special sports to parks. Due to venue restrictions and other reasons, most sports facilities are simple fitness equipment and table tennis tables. More than 50% of the parks are equipped with cultural and artistic facilities, such as small art museums and galleries. The most distinctive public art installations are mainly sculptures, such as the sculpture “Woman and Bird” donated by local art master Joan Miró in his eponymous park, and the land art landscape “Sinking Sky” in the North Station Park, which provides a way for preschool children to recognize local cultural and artistic characteristics. In addition, more than 90% of the parks provide supporting facilities such as seats, lighting, picnic spots or washrooms, making it more convenient and comfortable for parents to accompany their children in activities in the park, which helps children and families establish a healthier interactive relationship. Only less than 16% of the parks in the city have organized children’s activities, and the richness of participation and multi-group interaction of children when using parks need to be improved. In the “nature” part, most parks have good greening. The natural geographical location of the city with mountains behind and the sea in front makes many parks enjoy good vegetation and landscape resources, but there are fewer interactive landscapes. The scale of the park and the safety of the surrounding communities vary greatly, and the overall maintenance level is high. Therefore, from the above perspectives, a good foundation has been laid in terms of child-friendliness oriented quality of urban parks, but there is still room for improvement.

The overall QUINPY score of Barcelona’s urban parks ranges from a minimum of 5 points to a maximum of 22 points, with an average of 11.57 (standard deviation of 3.76) and a median of 11. According to the score, the

159 urban parks are further divided into six categories by the natural break method (Figure 4). As shown in Figure 4, there are fewer parks in the old city and expansion area in the central part, especially the quality of parks in the expansion area is also low, and there are more parks in the north near the mountains and the south near the coastline, where the general quality of parks is higher. This spatial distribution feature is related to the development process of Barcelona. The old city began to be built since the Roman period, with flat terrain being the priority [23]. As a result, the area has a high building density and few green open spaces. In the modern historical city protection planning, the original form and pattern have been basically retained, so no large areas of green space have been added. The expansion area was planned and constructed in the mid-19th century, using a grid texture [23]. Many open spaces are located inside enclosed blocks. In addition, due to the rapid population growth in 1932, the planning of the original green space system was neglected to a certain extent, and large-scale construction occupied the green space of parks. Therefore, there are few large comprehensive parks in the built-up area of the expansion area. The areas near the coast and the mountains were developed later. During the new planning process, especially during the preparations for the Olympic Games, many large parks were built in the south [24], and their infrastructure was relatively complete. The communities in the west are close to the Collserola Mountains, and the communities in the east are close to the coast. Therefore, many high-quality parks have been created in combination with natural landscapes.

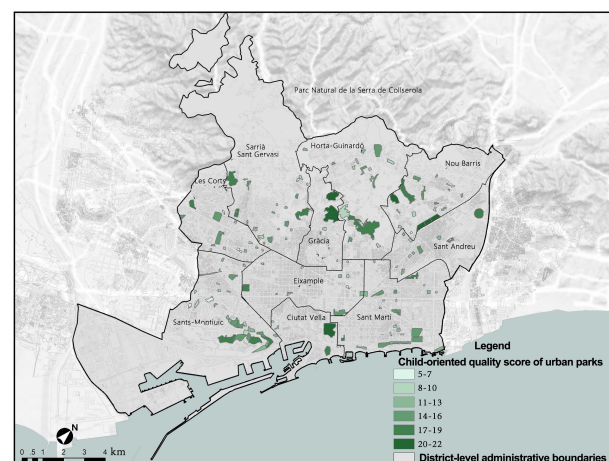


Figure 4 Child-oriented quality evaluation of urban parks

Based on the quality evaluation results, parks with different ratings, such as Joan Miró Park, Plaça de la Sagrada Família, Parc de l'Estació del Nord, and Parc de les Glòries, were selected for field research and interviews (Figure 5). Due to the limited expressive ability of preschool children, we conducted semi-structured interviews with the caregivers of preschool children who use urban parks, referring to the interview methods of existing studies [25, 26], to understand the users' satisfaction with the quality of the parks from a subjective perspective. In general, the QUINPY evaluation results are consistent with the subjective perceptions of the interviewed preschool children and their caregivers, further verifying the the quality evaluation results.



Figure 5 Park research interviews in Barcelona

3.2 Results of urban park accessibility analysis

The official open-source road network data was manually corrected, and 30,505 pre-processed urban road segments were imported into theDepthmap software and converted into segment models that can be analyzed. After passing the Node Count verification, the angle analysis calculation command was input, and the local integration results were output with the segment length as the weight. The buffer zone within the 500m service radius of parks in Barcelona was intercepted in GIS [21]. Based on the calculation results of the local integration (Figure 6), the accessibility of the parks was obtained through software statistics and mathematical calculations. The values ranged from 32.4 to 156.71, which were divided into six categories according to the natural break method (Figure 7). As shown in Figure 7, parks with high accessibility are mostly located in the city's geographical center extension area, as well as the coastal old town and Sant Martí district. The three main roads in the city: Diagonal Avenue (AV. Diagonal), Meridiana Avenue (AV. Meridiana) and Gran Via Avenue (AV. Gran Via) are the main factors for the high

accessibility of parks in this area. The regular and walkable road network also increases the opportunity potential of parks in this area. Take the Plaça de la Sagrada Família, which has the highest accessibility level, as an example. It is close to the main roads of the city, with a high density of surrounding road networks and excellent walkability. It is very convenient for preschool children to enter the park. Low-accessibility parks are located in areas of the city close to mountains and coasts, such as Parc Güell, designed by the architect Gaudí, which is located on the edge of the city and has a limited density of surrounding road networks. It is less convenient for preschool children to enter the park.

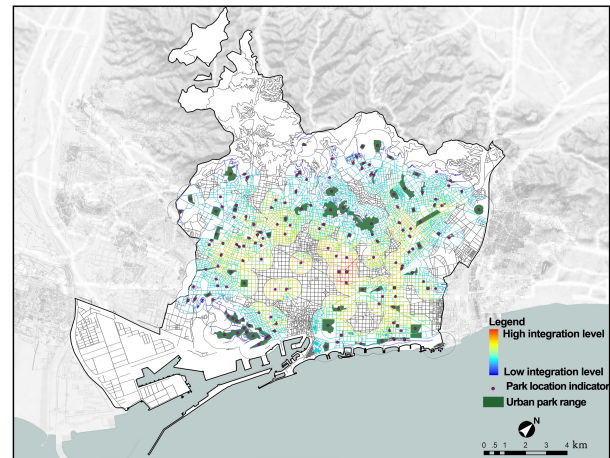


Figure 6 Local integration of roads within the buffer zone

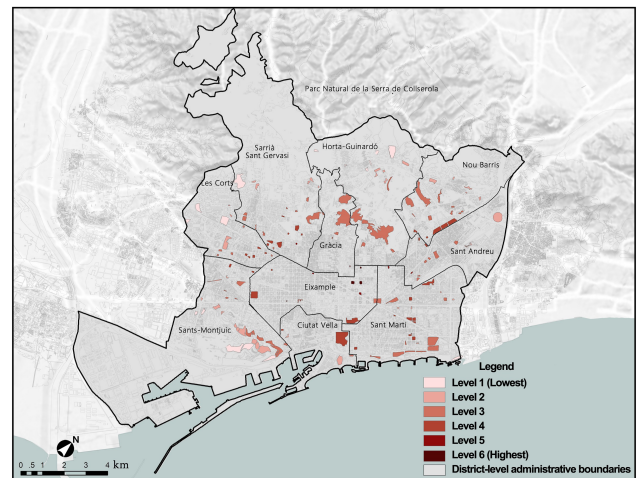


Figure 7 Accessibility classification of urban parks

3.3 Results of superimposed analysis of child-friendly quality and accessibility of urban parks

Based on the analysis results of the two dimensions

of child-friendly quality and spatial accessibility, this study further superimposed the analyses to comprehensively evaluate the internal use potential and external attraction potential of parks for preschool children, and then explore the specific advantages and disadvantages of parks in terms of function and layout. The superimposed analysis uses the classification results of the quality and accessibility of parks in the whole city as the boundary of “high quality-medium quality-low quality” and “high accessibility-medium accessibility-low accessibility,” and constructs a 3×3 matrix for park evaluation according to the grounded theory attribute classification method. Since parks in Barcelona have a good foundation for overall

quality and accessibility, and the focus of transformation and improvement is on low-quality and low-accessibility parks, “high quality” and “medium quality” as well as “high accessibility” and “medium accessibility” are further merged to obtain four major types of parks: higher quality/higher accessibility, higher quality/low accessibility, low quality/higher accessibility, and low quality/low accessibility (Figure 8). In addition, the evaluation results were further superimposed with the population density of preschool children in 73 neighborhoods in Barcelona, attempting to preliminarily explore the fairness of child-friendly distribution of parks in combination with the actual demand.

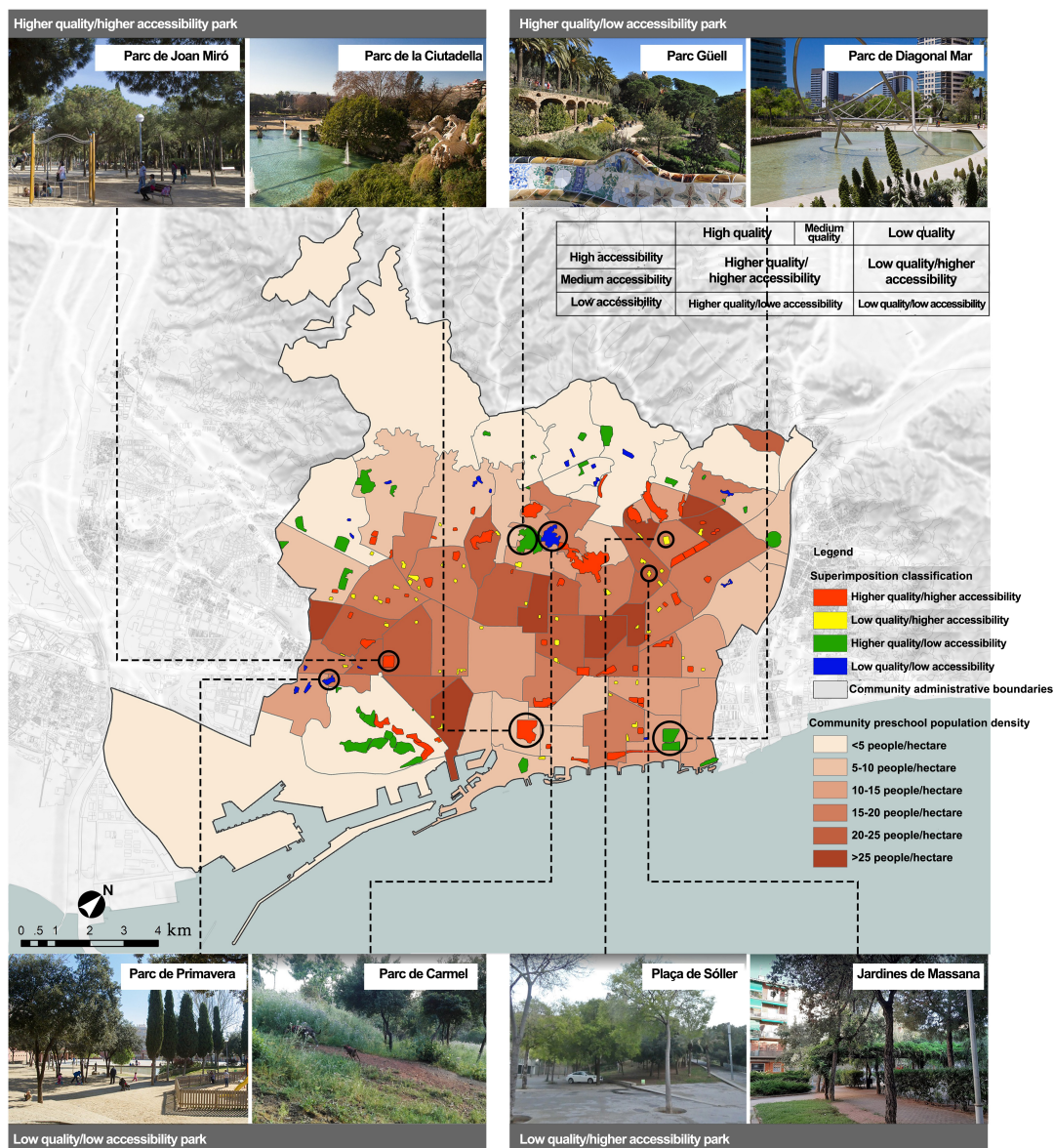


Figure 8 Superimposed analysis of park quality and accessibility

(1) Higher quality/higher accessibility

As shown in Figure 8, the number of such parks accounts for about 35% of the total. In terms of quality, such parks can provide convenient and high-quality services for preschool children. Most of them are well-known, historic, and large parks. As the city's business card and important attractions of the tourist city of Barcelona, they have received preferential treatment in terms of municipal funds and management. Such parks have good accessibility. On the one hand, they are mostly located on the sides of the Meridiani Avenue, one of the main traffic axes of the city, and on the other hand, they are located in the periphery of the expansion area with a well-developed road network and in high-income areas. The superimposed analysis of the child distribution density in the urban area of Barcelona shows that the child density in the areas where such parks are located is also high, which is more in line with the actual demand for children.

Among them, the more typical ones are Parc de la Ciutadella and Parc de Joan Miró. Parc de la Ciutadella (Figure 9) located in the central urban area was built in the late 19th century. It was converted from a military castle during the historical period when industrial land occupied a large amount of urban space. It has become a rare large park in the city center, accommodating various leisure and cultural activities suitable for children. The park received full marks in a first level indicator, the diversity of recreational facilities. In addition to complete supporting facilities and three well-equipped children's play areas, the castle architecture and sculptures representing the history of Catalonia allow children to be exposed to nature while also being influenced by history and art. At the same time, the "nature" indicator score is also high, mainly because the park has an open water surface for playing and boating. The modern-style Parc de Joan Miró (Figure 10) is equipped with six different types of children's activity spaces, which are concentrated on the open sand on the southeast side of the park, three of which are separated by fences and three are open. There are spaces composed of a single large complex children's recreational facility, as well as spaces composed of multiple facilities; there are unified signs outside the area, indicating the applicable age.

At the current stage of urban renewal, it is difficult to open new large-scale high-quality parks in areas with good accessibility. Therefore, such high-quality and highly accessible parks are scarcer. We should focus on maintaining their good service level and maintenance management to make them more effective.

(2) Lowquality/higher accessibility

This type of park accounts for about 32% of all parks in this study. The main reason for their low quality is the small area, which means the corresponding facilities and natural landscapes that can be accommodated are also relatively limited, and the service satisfaction provided to children is low. However, their accessibility is good, and they are mostly scattered in areas with convenient transportation such as university towns and expansion areas. By superimposing it with the density distribution of preschool children, it can be seen that such parks are often located in areas with high child density and high demand, so such parks have great transformation potential.

Among them, the more typical Jardines de Massana and Plaça de Sòller are both small-scale parks serving a community. Comparing the quality indicators of these two parks with the first-class high-quality/highly accessible Parc de la Ciutadella and Parc de Joan Miró after normalization (Figure 11), it was found that their main disadvantages are the lack of dedicated children's play areas, insufficient diversity of recreational facilities, and weak natural environment. Under the limitation that the park area cannot be expanded, one solution is to explore the possibility of increasing space utilization and functional diversity through three-dimensional design, such as referring to the design of the open space near the Rotebro Stadium in Sweden (Figure 12-a, 12-b), making full use of the wall to expand the activity space, and accommodating multifunctional children's facilities in a small place. The second way of improvement is to explore the multi-time composite function of limited space, serving multiple purposes by simple layout changes at different times, like the Chess Park in California, USA (Figure 12-c, 12-d), which is also a small venue. It provides a place for playing chess and resting during the day and a small movie theater at night. At the same time, its small open stage and multifunctional

wide seats also provide children with a multi-purpose space for performances and creative activities.



Figure 9 Parc de la Ciutadella plan and real scene photos

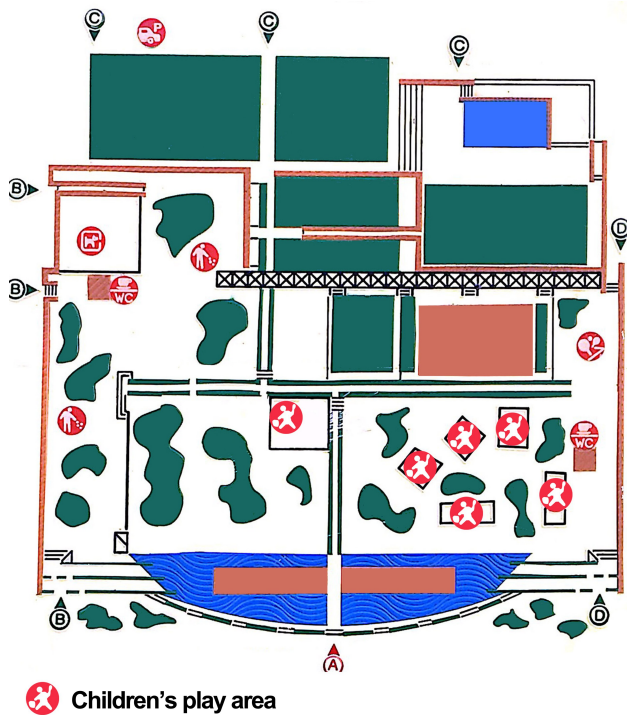


Figure 10 Parc de Joan Miró plan and real scene photos

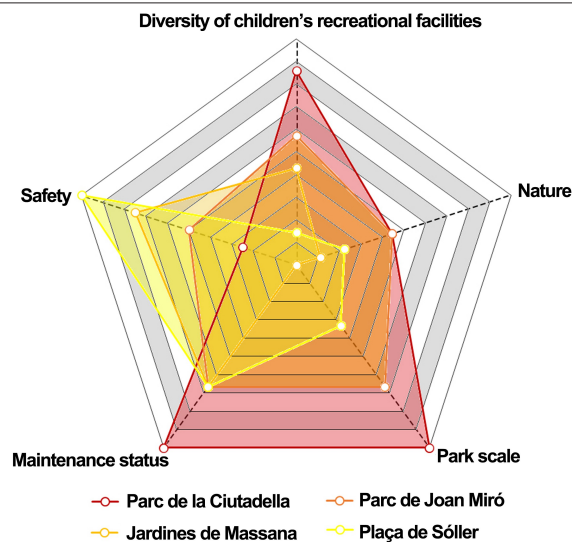


Figure 11 Child-friendly quality evaluation of two types of parks

Figure 12 12-a, 12-b Real view of open space near Rotebro Stadium in Sweden and functional zoning;
12-c, 12-d Real view of Chess Park in California, USA

(3) Higher quality/low accessibility

This type of park accounts for about 20% of the total, including famous parks such as Parc Güell and the park near the Montjuïc that was renovated before the Olympic Games. The high quality of this type of park is reflected in their large area, good natural landscape, open space and rich structural facilities, and they are located in a community with good public security. However, in terms of accessibility, due to their relatively marginal distribu-

tion and sparse road network, they cannot conveniently serve children in the surrounding area despite their high quality. There are relatively few children in the surrounding area, and the demand is not high. However, as a type of park with a large area and high carrying capacity, they can consider sharing the needs of children across the city, thereby improving the efficiency of park space use. It is recommended that, while reasonably improving walking accessibility, more bus routes should be added or public

transportation fees should be reduced or exempted at different time periods to encourage some families who live far away to bring their children to such parks on weekends; the service frequency of public transportation should be reasonably increased to strengthen the transportation connection with densely populated areas, so that people including preschool children can reach and visit this type of parks more conveniently.

(4) Low quality/low accessibility

This type of park amounts to about 13% of the total. They have neither good accessibility nor the ability to provide good services for children. Parks in this category need to be improved in many aspects during the renewal. From the perspective of quality evaluation, the score results of the first-level indicator “diversity of recreational facilities” show that there is no shortage of recreational areas in such parks, but there are almost no organized children’s activities. Other major weaknesses are “safety” and “maintenance level,” which reflect the “soft power” of the park. The low accessibility is due to the fact that most of them are distributed in areas with inconvenient transportation on the edge of the city, such as the Horta-Guinardó district in the northwest. Combined with socioeconomic indicators, in the communities where such parks are concentrated, the child density is mostly not low, while the income index is in the middle and lower reaches of the city. Therefore, from the perspective of fairness in resource allocation, more efforts should be made to improve their service capabilities.

4 Conclusion and outlook

This study takes child-friendliness as the starting point, attempts to construct an evaluation framework that integrates park quality and accessibility analysis, and conducts a corresponding evaluation and diagnosis using urban parks in Barcelona, Spain as a case study. In terms of evaluation methods, combining park quality evaluation with accessibility analysis based on geographic information data provides a relatively fast and direct method for measuring the child-friendly service level of parks at the urban scale, and provides a certain basis for subsequent improvement and optimization. Given the universality of geographic information data sources, this analysis framework

can be quickly applied to the analysis of other urban cases.

In terms of empirical analysis, the quality evaluation results of urban parks in Barcelona based on QUINPY show that regarding spatial distribution, high-quality parks are less in the middle of the city and dense at the edge, which is closely related to the city’s topographic conditions and construction and development process. The accessibility evaluation results show a trend of gradually weakening from the city center to the edge. Improvement measures need to be combined with the needs of children in each community, so this study further superimposes the child population density for analysis and attempts to take the fairness of distribution into consideration. Combined with specific indicator scores, it is recommended that the improvement of park quality be combined with improving urban governance and park maintenance levels. Barcelona’s city parks are uniformly managed, constructed, renovated and maintained by the Municipal Parks and Gardens Institute of the City Council. The maintenance and management funds are uniformly allocated throughout the city, and the organization formulates a uniform budget. Therefore, parks with high demand and low supply can be the focus of municipal funding and management improvement. Specific measures include maintenance and renewal of relevant facilities, environmental cleaning, optimization of the configuration of natural elements such as greenery. At the same time, public safety management should be strengthened to improve safety and provide a more secure environment for children to travel and play outdoors. In the case of limited funds, the public can also be encouraged to participate in enhancing resident autonomy. For example, an autonomous organization for the use of children’s parks can be established in the community to mobilize the power of residents. It can not only help each other maintain the environment and safety of the park, but also organize a variety of children’s activities, thereby improving the child-friendly service quality of the park space.

Our country has entered a period of stock development, shifting from focusing on quantity to pursuing quality, prioritizing people and social justice, and child-friendliness is becoming one of the focuses of urban construc-

tion. The evaluation framework built in this study with preschool children as the research object can help designers and managers clearly diagnose the relevant advantages and disadvantages of urban parks in macro layout and micro design, and then formulate more targeted improvement plans. Based on the “quality-accessibility” evaluation, we can further refine the balance between children’s needs and park supply in the future, not only from the perspective of distributive justice, but also from the perspectives of procedural justice and interactive justice [27] to optimize the fair design and governance of landscapes for children. Besides adding structural facilities, the improvement strategies adopted based on the evaluation results can also encourage appropriate innovative measures, such as using the site in different time periods, expanding the possibility of space use by three-dimensional design, and actively exploring residents’ self-organization. Barcelona is developing a shared campus strategy, attempting to supplement the public green space available for preschool children to play by establishing a shared campus partnership with educational and private institutions and opening the campus at appropriate time periods. In general, improvement plans based on the evaluation results need to take into account both suitability and operability, and mobilize and integrate multiple forces to improve the child-friendliness and landscape justice of urban parks.

Figure and table sources

Figure 1: adapted from the report “Social and Environmental Services of Barcelona Green Spaces”

Figures 2 and 3: drawn by the author

Figures 4, 6-8, 11: drawn by the author based on the analysis results

Figure 5: taken by the author

Figures 9 and 10: adapted by the author based on documents on the official website of the City Council

Figure 12: adapted by the author based on online pictures (URL: <http://www.archdaily.cn/>; <http://wbla-hk.com/content/view?id=381>)

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