Innovative Tools For Building Child-Friendly Communities: The Development And Application Of Child-Friendly Neighbourhood (CFN) Built Environment Audit Tools, Insights From Shanghai

Ye Zhan, Yifan Yu
Affiliation: Tongji University, China
Email: zhanye@tongji.edu.cn
yuyifan@tongji.edu.cn

Abstract
Neighbourhood environment is an important carrier of children's daily activities, but traditional urban planning and design often ignore the impact of micro-scale built environment on children's environmental perception. In the central urban area of Shanghai, which is characterised by high-density human settlements, integrating child-friendly concepts to carry out community renewal requires more consideration of the actual basis and renewal results. This study innovatively developed a "Child-Friendly Neighbourhood (CFN) Built Environment Audit Tools" that can systematically evaluate the micro-spatial elements in the three types of spaces within the 5-10 minute living circle of the community, including community streets, outdoor public spaces, and residential environments, to finely identify community space problems and help formulate special renewal plans for child-friendly communities.

Keywords
Child-friendly, Child-friendly Neighborhood, Built environment audit, Micro-scale

1.Introduction

In order to protect children's vulnerability in the built environment, the United Nations Children's Fund (UNICEF) and the United Nations Human Settlements Program (UN-Habitat) jointly launched the "Child-Friendly Cities Initiative (CFCI)". The initiative points out that the level of children's welfare protection is the ultimate indicator of healthy settlements, democratic society and good governance. In China, child-friendly cities and community construction have also become increasingly hot topics. In 2021, China's "14th Five-Year Plan" clearly proposed to comprehensively promote the concept of child-friendly in-depth urban planning and build 100 child-friendly cities. At present, the focus of China's urban planning work has shifted from incremental construction to stock renewal, focusing more on the optimal allocation of spatial resources and the improvement of residents' quality of life.

In the context of urban renewal, it is very important to carry out the practice of child-friendly environment construction, especially the community built environment at the community scale. The quality and spatial characteristics of the community built environment are most closely related to children's daily activities and environmental perception, and are also the last link that has been ignored by planning and design for a long time. At present, there is little systematic problem diagnosis and practical guidance in the construction of child-friendly urban spaces in China at the micro-scale, especially in the design of community spaces at the human scale.
The insecurity of children's travel, lack of physical activities, and reduction of games and social activities involve many built environment elements in various spaces such as streets, public spaces, and comprehensive environments in the community, especially the built environment elements at the meso-micro scale.

Therefore, the significance of this study is to fill the gap in the identification and definition of micro elements at the human scale in the community from a child-friendly perspective in the context of high-density human settlements. This study aims to structurally determine which built environment elements should be identified and evaluated as components of child-friendly

community environments based on the existing research and practical experience of international child-friendly community environments and the local practices of typical communities in Shanghai. The research results are the development of technical tools that can comprehensively and concisely identify the built environment elements (especially the meso-micro scale) issues that are most closely related to children in the community. The improvement and enhancement of this part of the built environment can bring more tangible sense of gain to children. Through structured evaluation and diagnostic tools, the community can systematically sort out the numerous built environment problems from a child-friendly perspective. At the same time, it helps communities make renewal decisions under conditions of limited funding and space resources. In areas where professional forces are scarce, universal decision-making basis will help local and grassroots community practices and even the long-term tracking and supervision of the effectiveness of built environment renewal.

2.Method

2.1. Methodological framework

The main research steps of this study are as follows:

(1) Structural definition of built environment elements of child-friendly communities, determine which built environment elements at the micro-scale are closely related to the quality of children's living and should be identified and reviewed as elements of child-friendly community environment.

(2) Based on the review of domestic and foreign child-friendly environment research and practical experience, develop Child-Friendly Neighbourhood (CFN) Built Environment Audit Tools that can structure and systematically identify problems of built environment elements at the micro-scale (human scale) and support community child-friendly renewal decisions in a refined and concise manner.

(3) Based on the local practice of Jiangpu Road Street, Yangpu District, Shanghai, the child-friendly community built environment audit tool is applied to conduct community built environment audits from a child-friendly perspective. With the context of Shanghai's high-density human settlement environment as the background, the shortcomings of existing community built environment elements at the human scale are analyzed, and spatial problems are diagnosed and warned. Then, planning intervention tools are provided to customize corresponding spatial decisions and support the implementation of child-friendly concepts at the community level.

2.2 Development of the CFN Tools

2.2.1 Assessment Principles and Subjects

What kind of community environment should be created for children to meet the specific needs of children is the first question that CFN responds to. Through a review of the characteristics and practice focus of child-friendly environments at home and abroad, it can be seen that the rights of children to health, nutrition, education, child protection, social inclusion, water, sanitation and personal hygiene proposed by UNICEF in the Child-Friendly Cities Initiative (1996) correspond to the five child-friendly environmental interest frameworks of "health, safety, citizenship, environment and prosperity" proposed in the Handbook on Building Child-Friendly Cities and Communities (2017) and the Handbook on Child-Friendly City Planning (2018). Combined with the elaboration of the goals of child-friendly city construction in China's "14th Five-Year Plan Outline", the guiding ideology and basic principles of child-friendly cities clearly put forward in the "Guiding Opinions on Promoting Child-Friendly City Fitness" issued by 23 departments including the National Development and Reform Commission, it is

concluded that "safety, health and inclusion" are the characteristics of international child-friendly environment consensus (Figure 2.1).

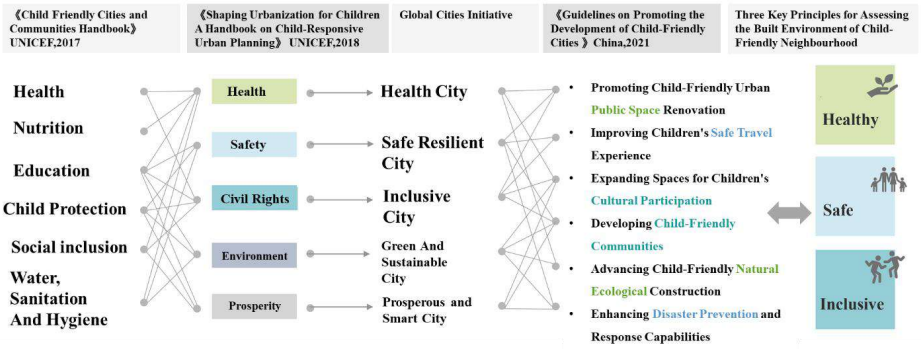


Figure 2.1

Therefore, based on the characteristics of international child-friendly environment consensus, this study proposes three principles for conducting child-friendly built environment assessment at the community level: (1) Safety principle: child-friendly environment can indicate various potential risks and provide children with material space elements and social supervision to ensure safety; (2) Health principle: reduce children's exposure to dangerous environments and provide children with environmental facilities to increase physical activities and participate in social life; (3) Inclusive principle: provide children with diverse services, fully respond to children's behavioral characteristics and activity needs at different ages, respect children's aesthetics and preferences, and create a spatial environment of appropriate scale, pleasant and comfortable for children.

The "Child-Friendly Community Built Environment Assessment Tool" (CFN Assessment Tool) proposed in this study is applied at the community level, with a special focus on the built environment within a 5-10 minute walking circle for children. In terms of assessment objects, it covers community streets and sections in areas frequently visited by children, outdoor public spaces, and residential environments in areas familiar to children. By stacking the three levels of community streets and sections, outdoor public spaces, and residential environments, the built environment elements within a 5-10 minute walking circle for children are comprehensively assessed from a child-friendly perspective. The construction system is shown in Figure 2.2, where community streets and sections are spaces where children's various travel activities take place. Outdoor activity spaces are places where children's recreational activities take place with certain spatial limitations, site designs, or activity facilities. Residential environment refers to the familiar area of children near their homes, usually within 100-200 meters of their homes, and no more than 300-400 meters (about 5 minutes for children to walk). In this study, residential area is a relative concept, referring to the environment composed of residential groups and surrounding environments that are similar in location or administrative affiliation to the residence of the child's family, and is physically or non-physically distinguished from the relatively complex external community environment.

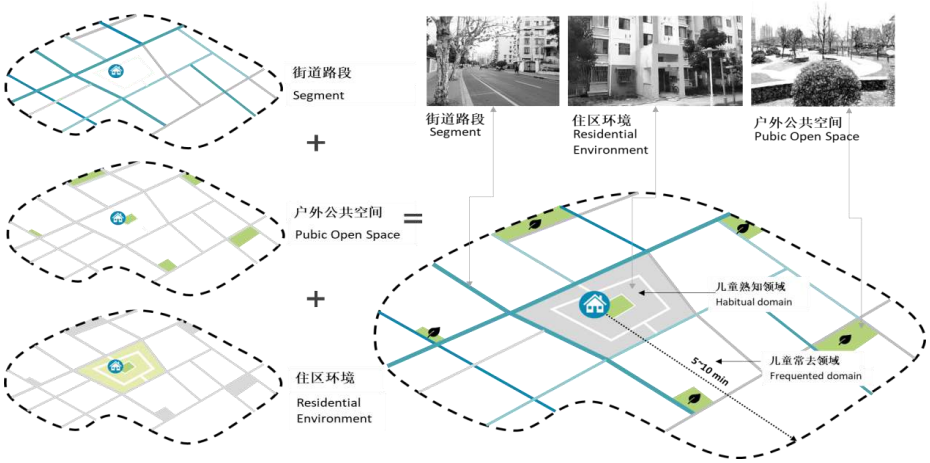


Figure 2.2

2.2.2 Review of Built Environment Audit Elements for Child-Friendly Neighbourhood Streets

In the field of child-friendly practice and research, this study selected the most representative policies and action plans of various countries, relevant design guidelines of international organizations, existing street built environment assessment tools and relevant policies and standards in my country for horizontal disassembly and comparison. It includes action plans and relevant policies related to child-friendly streets in different regions of eight countries, including Quebec, Canada, the United States, the Netherlands, and Australia, where in-depth practices have been carried out in the field of child-friendly; six design guidelines and guidelines related to streets from influential international organizations in the field of child-friendly: UNICEF, Bernard Foundation (BvLF), etc.; three street built environment assessment scales used in academic research and community practice; and five relevant guidelines and design standards issued by authoritative departments in China. Through disassembly and analysis, it is clear which street built environment elements are closely related to and cannot be ignored from the perspective of child-friendly, especially identifying the micro-elements that are easier to be improved in the context of stock renewal at the community human scale, so as to construct the evaluation content of child-friendly streets. The focus of child-friendly streets and traffic environments in terms of child safety, health and inclusion is sorted out. The complete scale is divided into 7 assessment dimensions and 17 assessment items, involving a total of 58 micro-built environment elements (Table 2.1). At the safety level, the focus is mainly on the stability of the motor traffic environment, providing a safe environment for children to walk and ride, ensuring the safety of children crossing the street, ensuring the safety of street ancillary facilities and barrier-free facilities, and providing street supervision and defense support for children's travel. At the health level, it includes providing children with clean and green street spaces, supporting and promoting children's walking, riding and other physical activities. At the inclusion level, it provides children with diversified and shared public services while ensuring the convenience of special services. Provide children with a comfortable and barrier-free environment for travel and the beauty and attractiveness of the street interface.

2.2.3 Review of Built Environment Audit Elements for Outdoor Public Spaces in Child-Friendly Neighbourhoods

The elements of this part of the scale are derived from action plans and related policies related to children's playgrounds and outdoor public spaces in different regions of seven countries,

including the United Kingdom, Wales, the Netherlands, Japan, and Australia, where in-depth practices have been carried out in the design of children's playgrounds and outdoor public spaces; and six design guidelines and guidelines issued by influential international organizations in the field of child-friendly design, such as UNICEF and the Play England Group. The complete scale is divided into 9 evaluation dimensions, involving a total of 30 micro-built environment elements. In terms of children's safety, it mainly involves three aspects: the surrounding environment safety of children's activity space, the safety of activity facilities, and the safety of landscape design. At the level of health principle, it mainly focuses on the potential of outdoor public space to promote the healthy growth of children, focusing on the support of outdoor activity venues for children's games, sports and other leisure physical activities, and the promotion and support of walking and cycling activities. At the level of inclusive principle, it mainly evaluates the comfort of outdoor activity space design for children, the diversified and convenient services, the slow accessibility of space and the attractiveness of design.

2.2.4 Review of Built Environment Audit Elements for Child-Friendly Neighbourhoods Residential Areas

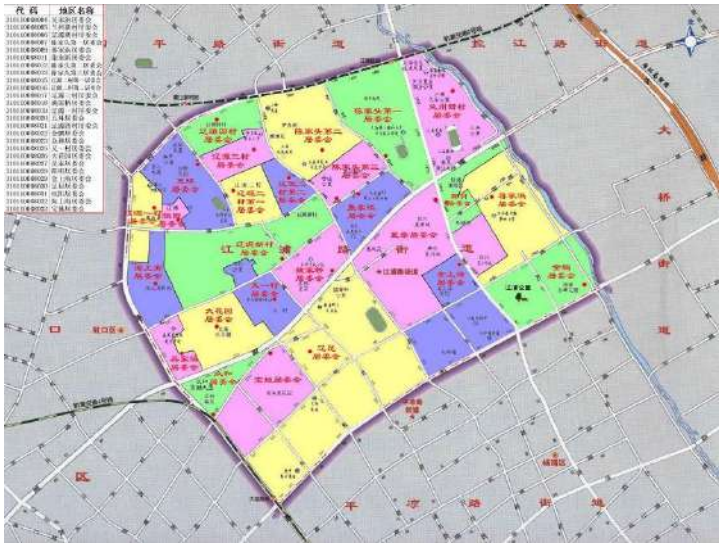
Through the analysis of domestic and foreign experience, it is found that residential areas are familiar areas for children's daily activities, and the built environment elements involved cover both transportation space and recreational space. Therefore, the unit of the CFN tool review and statistics in this study is the residential environment, but the specific objects of the outdoor space reviewed can be divided into sections between residential buildings, outdoor public spaces in residential areas and comprehensive levels of residential areas according to the nature of activities supported by the built environment elements. The specific evaluation elements are composed of these three parts. The complete scale is divided into 7 evaluation dimensions and 18 evaluation items, involving a total of 55 micro-built environment elements. The assessment is conducted from the perspective of child safety, involving aspects such as traffic safety between residential buildings and children's travel safety between residential buildings. The traffic safety between residential buildings is examined from three dimensions: traffic organization between motor residential buildings, motor traffic stability and parking facilities. The travel safety between residential buildings is examined from three dimensions: walking and cycling organization, children's travel guide sign setting and residential safety facilities setting. The assessment is conducted from the perspective of child health, involving aspects such as space support for children's physical activities and facilities support for children's physical activities. The spatial support capacity of children's physical activity venues is examined from four dimensions: venue selection, functional zoning, venue design and landscape aesthetics. The facility support capacity of children's physical activity venues is examined from three dimensions: safety facility setting, activity facility setting and service facility setting. The assessment is conducted from the perspective of child inclusion, involving aspects such as the diversity and convenience of public services, the comfort of children's travel environment and the attractiveness of the environment. The convenience of public services in residential areas is examined from the configuration of children's life services and education services. The comfort of children's travel environment is examined from the comfort of walking and cycling roads and facilities. The attractiveness of residential environments for children's activities is examined from three dimensions: green space landscape between residential buildings, public art and architectural interfaces between residential buildings.

Table 2.1

	Neighbourhood Street Segments	***Neighbourhood Public Open Space***	***Residential Area Environmental***
A01 Safe	B01 Safety of Travel Spaces	B01 Safety of Surrounding Environment	B01: Safety of Traffic Systems Between Residential Buildings
	B02 Safety of Auxiliary Facilities	B02 Safety of Activity Facilities	B02: Child Travel Safety Between Residential Buildings
		B03 Safety of Landscape Design	
A02 Healthy	B03 Physical Environment for Promoting Children's Health	B04 Support for Recreational Physical Activities Space	B03: Support for Children's Physical Activity Spaces
	B04 Social Activity Environment for Promoting Children's Health	B05 Support for Recreational Physical Activity Facilities	B04: Support for Children's Physical Activity Facilities
A03 Inclusive	B05 Diversity in Public Services	B06 Accessibility for Children's Active Travel	B05: Diversity in Public Services
	B06 Comfort of Travel	B07 Comfort of Site Design	B06: Comfort Between Residential Buildings
	B07 Attractiveness of the Environment	B08 Convenience of Service Facilities	B07: Environmental Attractiveness
		B09 Attractiveness of Space Design	

2.3 Application Practice of the CFN Tools

In order to test the applicability of the built environment assessment tool for child-friendly communities, the author conducted a built environment assessment of child-friendly communities in Jiangpu Road, Yangpu District, Shanghai. Jiangpu Road is located in the southwest of Yangpu District, Shanghai, from Lanzhou River to Kongjiang Road in the east, and from Dalian Road to Hongkou District in the west. It starts from Changyang Road in the



south and ends at Kongjiang Road in the north. The area under its jurisdiction is about 2.39 square kilometers, with 24 neighborhood committees (Figure 2.2). Based on the theory of urban residential morphology, Shanghai residential areas are divided into lanes, public housing and commercial housing areas. Among them, the residential types of lanes are Shikumen lanes or new lanes, which were mostly built in the 1930s and 1940s, and are generally row-style, two- or three-story residential buildings. Today's lanes are mostly characterized by small and compact outdoor spaces and old supporting facilities. Public housing refers to welfare housing developed and built by the government or state-owned enterprises and institutions for a large number of workers, which was built in the 1970s and 1980s. Commercial housing residential areas are the product of the rise of real estate development. The residential organization is no longer limited to the determinant type, and the point type and free type organization are rising. At the same time, residential buildings are no longer low-rise or multi-story, and the number of small high-rise and high-rise residential buildings is gradually increasing. At present, the Jiangpu Road area has formed a situation of multiple textures of public housing, lanes and commercial housing. The environmental characteristics of these three main types of residential areas in the area can reflect the characteristics of Shanghai's high-density human settlement environment to a certain extent. These three types of residential environments are also the main positions for child-friendly practices in the context of Shanghai's urban renewal. Therefore, this study will conduct a child-friendly community built environment assessment and review based on the selected Jiangpu Road area in Yangpu District. The review objects include 131*2 (both sides) street segments, 60 outdoor public spaces and 28 residential areas.

Figure 2.3

In order to interpret the CFN assessment results in a concise and intuitive way, the on-site review data is aligned and visualized with the geographic space in ArcGIS software. This includes constructing a double-sided assessment street segment line dataset to visualize the street segment assessment results, constructing an outdoor public space point dataset to visualize the outdoor public space assessment results, and constructing a residential area face dataset to visualize the residential environment assessment results and the community comprehensive assessment results (Figure 2.4).

Figure 2.4

3.Results

3.1 Comprehensive Evaluation Results of Child-Friendly Neighbourhood in Jiangpu Road Area

Taking the geometric center of each assessed residential area as the starting point and the 5-minute walk distance (400 meters) for children as the radius, the community life circle unit range of the assessment is delineated, and the street section assessment results, outdoor public space assessment results and residential environment assessment results within the assessment range are superimposed. From a child-friendly perspective, the micro- and medium-scale built environment elements of each community unit are comprehensively assessed.

Based on the comprehensive assessment results, horizontal and vertical comparisons between communities in the area can be carried out one by one to identify and judge common or differentiated built environment status issues. The on-site assessment was carried out in 28 communities in the Jiangpu Road area, including 2 lane residential areas, 10 public housing residential areas and 16 commercial housing residential areas. (Among them, the number of lane residential areas is relatively small, and they are collectively referred to as lane and public housing residential areas in the following classification). The evaluation results are divided into the upper quartile, median, and lower quartile of the overall score. Among the 28 evaluated community units (composed of the main residential area and surrounding streets and outdoor public spaces), 35.7% of the community units have relatively good child-friendly evaluation results (child-friendly comprehensive scores) based on the actual built environment, 20.7% and 34.5% of the community units have good and medium child-friendly evaluation results, and 6.9% of the community units have relatively poor evaluation results. In terms of the main residential area type attributes, the overall child-friendly evaluation results of the evaluated community units composed of public housing and lane residential areas and their surrounding environments are poorer than those of commercial housing residential areas. Only 8.3% of the community units have excellent child-friendly evaluation results, while this proportion is 56.3% in the evaluated community units with commercial housing residential areas as the main residential area type (Figure 3.1).

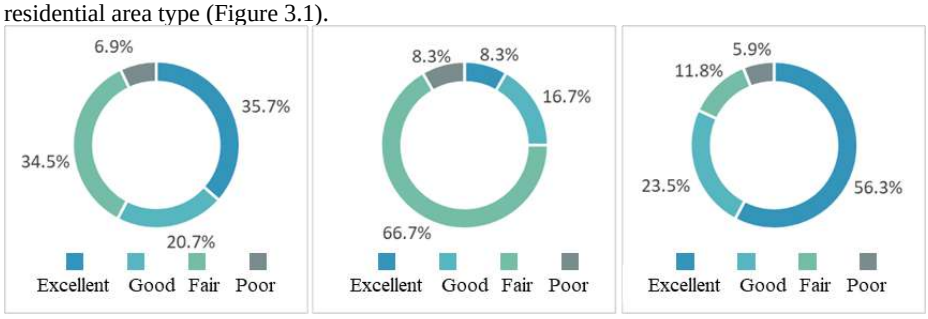


图 Figure 3.1 （Left: Overall communities Middle: Lanes and public housing communities Right: Commercial housing communities）

Through the geographic spatial visualization of the evaluation results in ArcGIS software, the spatial distribution of the evaluation results can be intuitively analyzed. In addition to helping the district to simply identify the comprehensive evaluation of the community, based on the sub-item evaluation results, the advantages and disadvantages of the three spatial dimensions of street sections, outdoor public spaces and residential environment can be further examined. In terms of the comprehensive evaluation results of child-friendly, the communities with relatively good practical foundations are concentrated in the west of Jiangpu Road District (east of Dalian Road) and the south of Zhoujiazui Road (Figure 3.2), and most of them are commercial housing communities (assessment units consisting of commercial housing residential areas as the main residential type and their surrounding environment). Communities with relatively poor practical foundations are concentrated in the north of Jiangpu Road District, and most of them are public housing and lane communities.

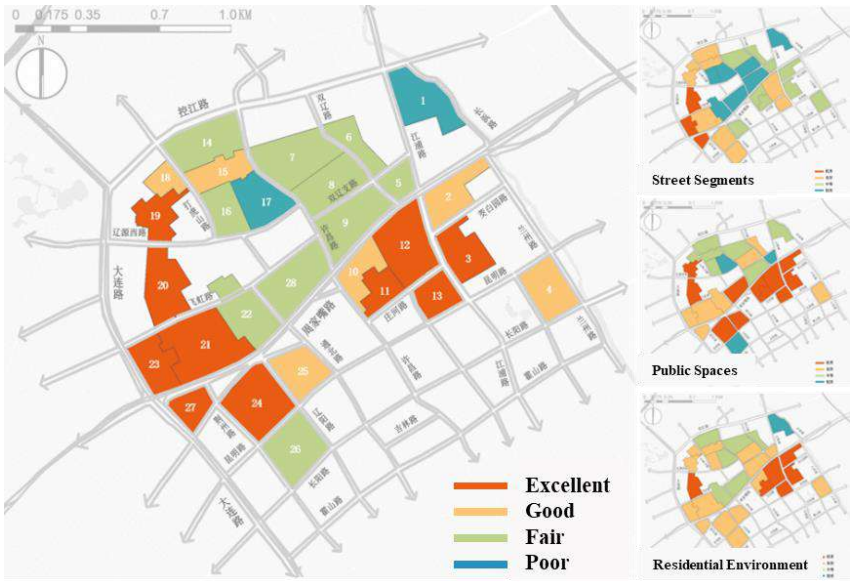


Figure 3.2

According to the CFN evaluation results, in the next step of the community environment adaptation and renewal decision-making, refer to the distribution of the "poor-excellent" situation on the actual basis, and divide the comprehensive child-friendly renewal of the community from level I (urgently in need of improvement) to level IV (optimization and improvement), child-friendly renewal of street sections, child-friendly renewal of outdoor public spaces and the order of child-friendly renewal of residential environment (Figure 3.3). According to the requirements of the evaluation items, the community built environment is gradually and targetedly rectified. Prioritize the rectification of the community built environment in the area in urgent need of improvement, which is an important bottom-line action. Improve and optimize the community built environment in the area with the highest evaluation standards, build a child-friendly community, and play a strong demonstration role.

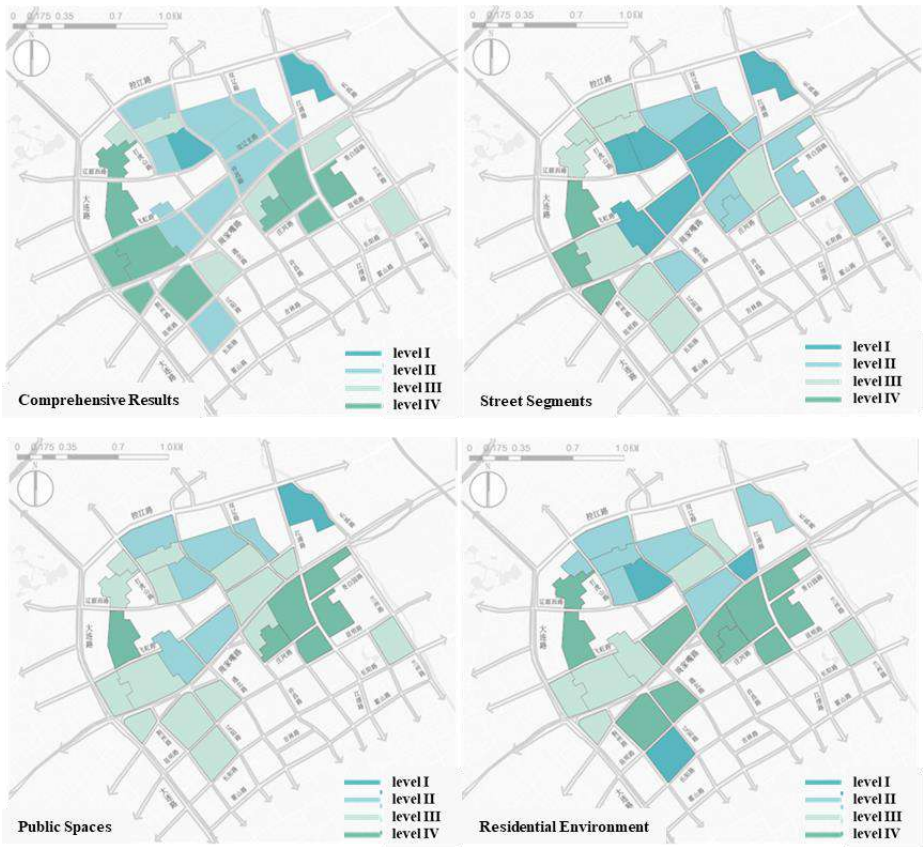


Figure 3.3

3.2 Evaluation Results of Street Segments in Child-Friendly Neighbourhood in Jiangpu Road Area

3.2.1 Child Safety Perspective

In terms of travel space safety, the area with good children's travel safety accounts for 25.8% overall, mainly located in the southern part of Jiangpu Road area (Figure 3.4), and the poor configuration area is mainly located in the middle and eastern part of Jiangpu Road area, accounting for 21.2%. Compared with the distribution of residential communities in Jiangpu Road area, it can be found that there is a certain misalignment between the areas where residential communities are concentrated in Jiangpu Road area and the areas with better configuration of travel space safety elements, which to a certain extent reveals the mismatch between children's travel safety needs and the actual basis, especially the road sections around the areas where alleys and public housing communities are concentrated in the middle of Jiangpu Road area have poor built-up environment, which should be paid attention to in the community child-friendly environment improvement action.

In terms of pedestrian space safety, the review indicators include the setting of pedestrian paths, the quality of pedestrian paths, and the standardization of temporary parking settings. As shown in Figure 3.5, in Jiangpu Road Subdistrict, the pedestrian space safety around the older communities in the north is poor, while the newly built blocks in the south are more complete. The southern section of Xuchang Road, Tongbei Road, and the southern section of Jiangpu Road are better equipped, while the eastern section of Feihong Road, Changbang Road, and Shuangliao Branch Road are poorly equipped, with major damage to the road surface, obvious traffic obstacles, and many other problems (Figure 3.6). During the assessment process, it was found that many non-motor vehicles or motor vehicles parked on sidewalks or non-motor vehicle lanes (Figure 3.7), which seriously affected normal traffic and brought safety hazards to children's travel. Similarly, at the level of cycling space safety, CFN road section assessment can help communities comprehensively review cycling space safety, including the setting of non-motor vehicle lanes, the gap between the actual basis of non-motor vehicle lane quality and the level of child-friendly cycling space safety configuration that should be achieved.

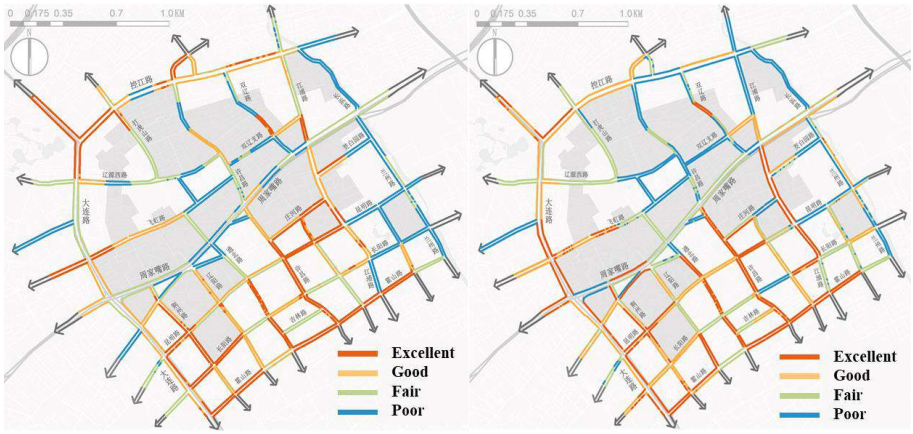


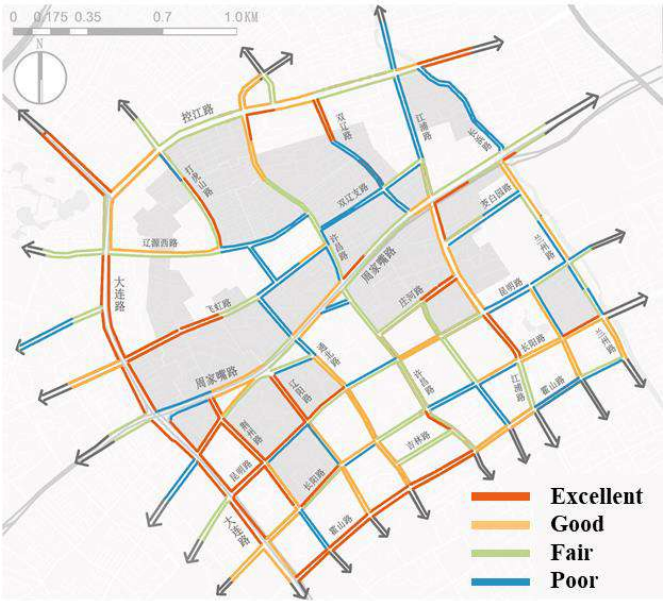
Figure 3.6

Figure 3.7

3.2.2 Child Health Perspective

The community should provide children with a clean and tidy street material space environment, which is closely related to children's health. In this section, the CFN tool mainly evaluates the material space environment elements that promote children's health, including the cleanliness of travel space (including cleanliness of walking and cycling space, cleanliness of resident activity places) and street greening conditions (including greening planting conditions and street greening maintenance quality elements). Overall, the comprehensive score is divided into quartiles, and the area with relatively good configuration accounts for 21.1% (Figure 3.8), which is concentrated in the southwest corner of Jiangpu Road Street, the southern section of Dalian Road, Jingzhou Road, Kunming Road, and the western section of Huoshan Road. Combined with the distribution of community types, it is found that this is an area where some commercial housing residential areas are concentrated. The proportion of relatively poor configuration is 20.3%, which is concentrated in the middle of Jiangpu Road Street. The area around the road section is the area where the central lanes and public housing communities of Jiangpu Road Street are concentrated.

Figure 3.8



3.2.2 Child Inclusion Perspective

Whether children enjoy various and convenient public services in urban street life is an important aspect of measuring the inclusiveness of children in the community. In the evaluation, the level of public services along the street is mainly evaluated from two aspects: public service facilities shared by all ages and special service facilities focusing on children. The evaluation of community street public service facilities shared by all ages includes five service elements: commercial services, cultural activities, daily travel, sports and fitness, and park green space. Special service facilities focusing on children include three service elements: growth education, child welfare, and maternal and child care. When the CFN evaluation tool was designed, the evaluation requirements for the configuration of public services and special service elements for children were formulated based on relevant practices and standards, and the evaluation was carried out accordingly, focusing on the accessibility of street public service configuration on sections covered by the five-minute walking circle of children. Overall, the configuration of

public services shared by all ages is better in the community living circle along Kongjiang Road, and the configuration of special service facilities for children is better in the places where the lanes and public housing communities in the north are concentrated (Figure 3.9; Figure 3.10).

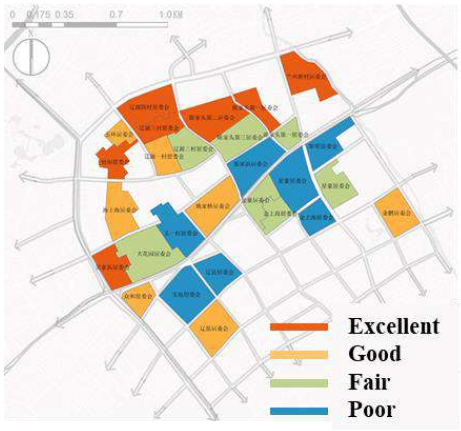


Figure 3.9

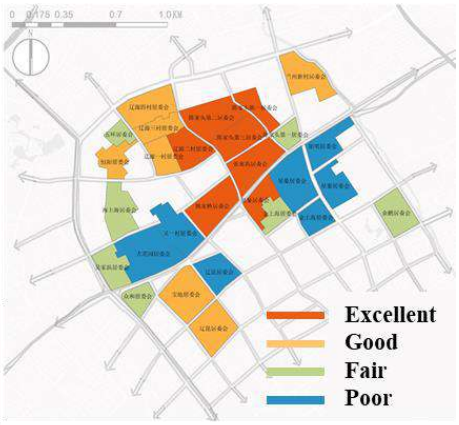


Figure 3.10

3.3 Evaluation Results of Child-Friendly Public Open Spaces in the Jiangpu Road Area

In this evaluation, a total of 60 community outdoor public spaces were evaluated (Figure 5.64). From the overall configuration (Figure 3.11), based on the upper quartile, median, and lower quartile of the overall score, 17% of the public spaces in Jiangpu Road Street were relatively well configured, and Yangming Jiangpu Point, Haishang Commercial Point, Liaoyuan Huayuan Point, Puhaoyuan Point, and Jinshanghai Public Space were well configured. Another 20% of public spaces were well configured, and 38% and 25% of public spaces were medium and poorly configured. In terms of the distribution of evaluation results of different types of public spaces (Figure 3.12), the public spaces in commercial housing residential areas had the best configuration of child-friendly elements, with 28% and 33% of public spaces being well configured overall, and only 6% of public spaces being poorly configured overall. Public spaces outside residential areas were second, with 22% and 17% of public spaces being well configured overall, 56% of public spaces being medium configured, and only 5% of public spaces being poorly configured. The actual foundation of public spaces in alleys and public housing residential areas is poor overall, with 54% of public space infrastructure items poorly configured, and only 4% and 13% of public space configurations being excellent and good overall.

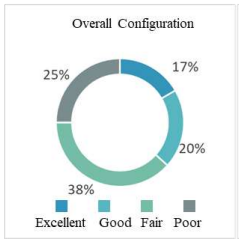


Figure 3.11

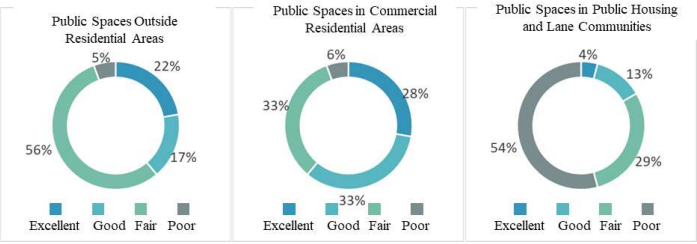


Figure 3.12

3.3.1 Child safety perspective

The assessment tool helps the community focus on the specific configuration shortcomings of outdoor public spaces from a child-friendly perspective, and examine them from a child safety perspective. The assessment dimensions include the safety of the surrounding environment, the safety of activity facilities and the safety of landscape design. The overall public space is best configured in terms of surrounding environment safety (Figure 3.13). 70% of the public space scores excellent in this dimension, and 61.7% of the public space configuration meets the evaluation requirements of the CFN tool (i.e. "setting location" and " Both sub-elements of "enclosed interface" are set for safety), and secondly, the configuration of landscape design safety is better, with 68.3% of the public space configuration scoring excellent. Overall, the safety of activity facilities is poor, with only 28.3% of public spaces configured as excellent. Judging from the configuration of different types of residential areas (Figure 3.14), the safety of the surrounding environment is the shortcoming of the allocation of public spaces outside the residential areas. Compared with the public spaces of commercial housing areas, lanes and public housing areas, only 50% of the public spaces are The proportions of the configuration being excellent and the other two types of configuration being excellent are 83.3% and 75% respectively. In terms of the safety of activity facilities and landscape design, the order of better allocation is public space outside the district, public space in commercial housing areas, and public spaces in alleys and public housing areas.

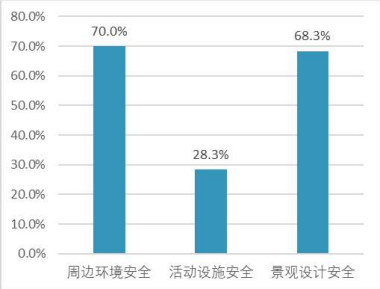


Figure 3.13

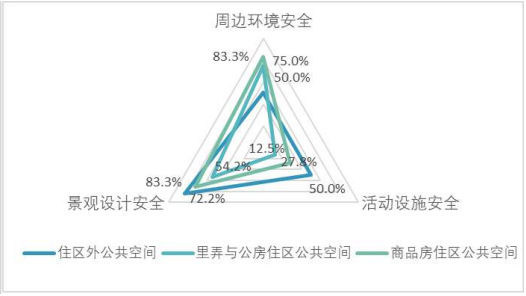


Figure 3.14

3.2.2 Child Health Perspective

At the level of children's health, the CFN outdoor public space assessment dimensions include three dimensions: support for walking and cycling activities, support for children's leisure physical activity space, and support for leisure physical activity facilities. At the level of children's health, the CFN outdoor public space assessment dimensions include three dimensions: support for walking and cycling activities, support for children's leisure physical activity space, and support for leisure physical activity facilities. Among them, the walking and cycling support assessment factors include whether there are facilities to promote walking and awake activities, such as fitness trails and cycling trails. In the leisure physical activity space dimension, the support provided at the venue space level is assessed, including the area of the activity area, the cleanliness of the venue, and whether there are corresponding support venues for leisure physical activities such as children's games and sports, including children's game space, children's ball or track and field sports space, and playable natural space. From the overall assessment data analysis (Figure 3.15), the public space in the entire Jiangpu Road area performed relatively average in the three dimensions of children's health. Among them, the assessment results of leisure physical activity space support were relatively good, with 33.3% of public spaces performing well, but only 3.3% of public spaces performing well. The second is walking and cycling support, with 11.7% of public spaces performing well and 1.7%

performing well. The support for public space leisure and physical activity facilities is relatively poor, with only 8.3% and 5% of public spaces being well and well configured.

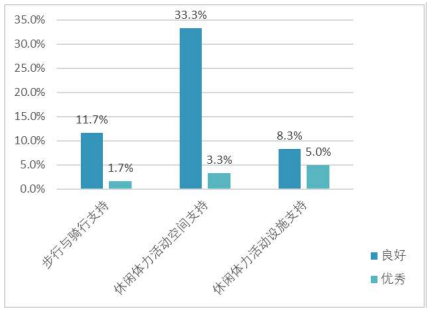


Figure 3.15

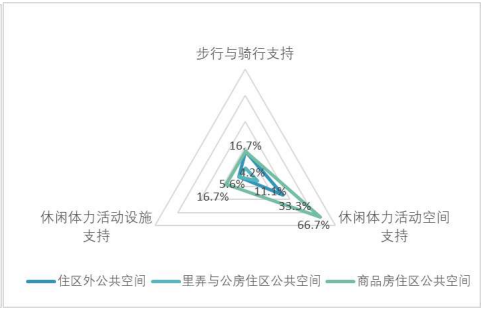
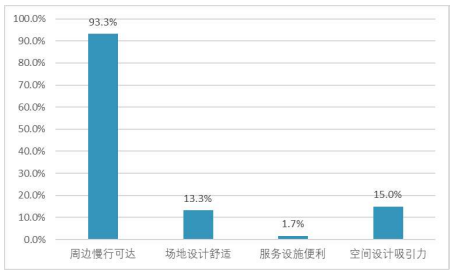


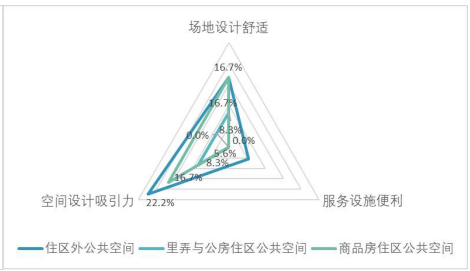
Figure 3.16

From the evaluation results of different types of residential environments (Figure 3.16), the configuration of public spaces in commercial housing residential areas in three dimensions is relatively good overall, especially in the dimension of children's leisure and physical activity space support, with 66.7% of public spaces being well configured. However, the public spaces in lanes and commercial housing residential areas are relatively poor in terms of children's leisure and physical activity space and facility support. Overall, it can be seen that there is a mismatch between "space" and "facilities" in the public space of Jiangpu Road Street. There is also a large gap in the configuration of public spaces in different types of residential areas. The main problem of public spaces in commercial housing residential areas is "there is space, but no facilities", while in the public spaces of lanes and commercial housing residential areas, children's activity support facilities and space are very scarce, which is manifested as "neither space nor facilities".

3.2.3 Child Inclusion Perspective

Child-friendly public spaces should be inclusive, so that all children can reach and use the space in a positive way, and the space design should respect children's preferences, provide children with comfortable, barrier-free venues and various convenient service facilities. Overall, 93.3% of the public spaces in Jiangpu Road are equipped with sufficient and reasonably located entrances and exits, and the surrounding areas can be reached by walking, cycling or public transportation. In terms of the comfort of children using public spaces, the performance is relatively poor in terms of the comfort of the site design and the attractiveness of the space design. Only 13.3% and 15% of the public space configurations can meet the CFN assessment requirements. The performance is the worst in the setting of convenient service facilities. Only 1.7% of the public space configurations can meet the CFN assessment requirements (Figure 3.17). Focusing on the shortcomings of the configuration of public spaces in different types of





residential areas, because the three types of public spaces perform well in the dimension of surrounding slow-moving accessibility, and are quite different from the requirements of several other dimensions, this item is excluded for analysis. The results show (Figure 3.18) that the status quo of the three types of public spaces at the level of inclusiveness has certain similarities. Overall, the public spaces outside residential areas performed well in terms of spatial attractiveness and convenient service facilities, with 22.2% and 5.6% of public space configurations meeting the assessment requirements for child-friendly communities. The public spaces in lanes and public housing performed poorly in terms of site design comfort, convenient service facilities, and spatial design attractiveness.

Figure 3.17 Figure 3.18

3.4 Evaluation Results of Child-Friendly Residential Area Environment in the Jiangpu Road Area

3.4.1 Child Safety Perspective

From the perspective of child safety, residential built environment should be evaluated. Residential areas should create a stable traffic environment for children, encourage children to walk and ride, and reduce travel injuries. The evaluation content mainly focuses on the safety environment between residential buildings in terms of traffic safety between residential buildings and travel safety between residential buildings for children at the micro-scale. Overall, no residential environment fully meets the evaluation requirements. The scores are divided into upper quartile, median and lower quartile. 34% of residential areas have excellent status in terms of child safety (Figure 3.19), 28% and 24% of residential environments have good and medium performance, and another 14% of residential environments have poor performance. Furthermore, there are obvious or even extreme differences in different types of residential

environments (Figure 3.20; Figure 3.21). The status quo of child safety factors in lanes and public housing residential areas is relatively poor. There is no residential area with excellent performance, 17% and 50% of residential environments have good and medium performance, and 33% of residential environments have poor performance. In the commercial housing residential areas, there are no residential areas with poor performance, 59% of the residential areas have excellent environmental performance, and 35% and 6% of the residential areas have good and medium environmental performance. Compared with commercial housing communities, the improvement of the built environment in the lanes and public housing communities in terms of children's safety is very urgent.

Figure 3.19 Figure 3.20 Figure 3.21

3.4.2 Child Health Perspective

Residential areas should support children's diverse physical activities and create a healthy physical activity environment for children in residential areas. Therefore, we focus on the design of public spaces in residential areas and examine the support for children's physical

activity spaces and physical activity facilities in residential areas. To ensure the consistency of the assessment, the detailed assessment elements in this part are the same as the CFN outdoor public space assessment elements. Only a brief description of the assessment results of residential public spaces and the gaps and shortcomings in the actual foundation between different types of residential areas is given. The above quartile, median, and lower quartile assessment results show that, at the level of children's health, 17.24% of the residential areas in the Jiangpu Road area have a relatively good environmental status configuration (Figure 3.22), 27.59% and 31.03% of the residential areas have a good and medium status, and another 24.14% of the residential areas have a poor actual foundation. There are obvious differences in quality based on reality between different types of residential areas (Figure3.23; Figure 3.24). In terms of children's health, only 8.33% of the residential environments in alleys and public housing areas are excellent, and 41.67% of the residential environments are poor. In commercial housing areas, 23.53% of the residential environments are excellent, and only 11.76% of the residential environments are relatively poor.

Figure 3.22

Figure 3.23

Figure 3.24

3.4.3 Child Inclusion Perspective

Compare the five dimensions of diverse and convenient public services, comfortable children's travel environment, and attractive environment, including green landscape between residential buildings, public art between residential buildings, and architectural interface between residential buildings, to better focus on the shortcomings of community built environment configuration. From the evaluation results, the overall performance of the comfortable children's travel environment in the residential area is relatively good, while the performance of the public art element between residential buildings is relatively poor (Figure 5.143). There is also a clear dislocation and difference in the configuration of good and bad elements between different types of residential areas (Figure 5.144). Lanes and public housing residential areas are better than commercial housing residential areas in terms of diverse and convenient public services, but are significantly inferior to commercial housing residential areas in other dimensions.

Figure 3.25

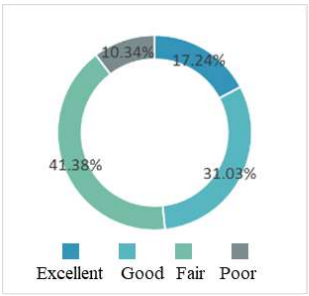


Figure 3.26

Figure 3.27

4.Ddiscussion

4.1 Assessment Aspects of Child-Friendly Neighbourhood Street Segments

In terms of safety, the speed limit area of the motor traffic calming design is insufficient and the design is simple. The safety of walking and cycling space is affected by problems such as road damage and traffic obstacles. There is a lack of child-friendly measures such as painted crosswalks for children to cross the street. There are safety hazards in the auxiliary facilities, and the common boards for humans and machines are not separated. The design of children's guide signs to improve readability and easy recognition is insufficient.

In terms of health, there are problems such as garbage dumping around the alleys and public housing communities, and some sections of the road are not greened. The width of the cycling path in the social activity environment is insufficient, and the design of street resident activity venues is not enough to support children's activities.

In terms of inclusion, the configuration of children's special service facilities around commercial housing communities is poor. In terms of children's travel comfort, some streets are equipped with child-friendly, brightly colored soft pavements that are easy to identify (Figure 4.1). There are few colorful soft pavements for children's travel comfort, and public transportation transfer facilities lack detailed child-friendly designs. The environmental attractiveness lacks child-friendly design, and there are messy electric poles, graffiti and other influences.

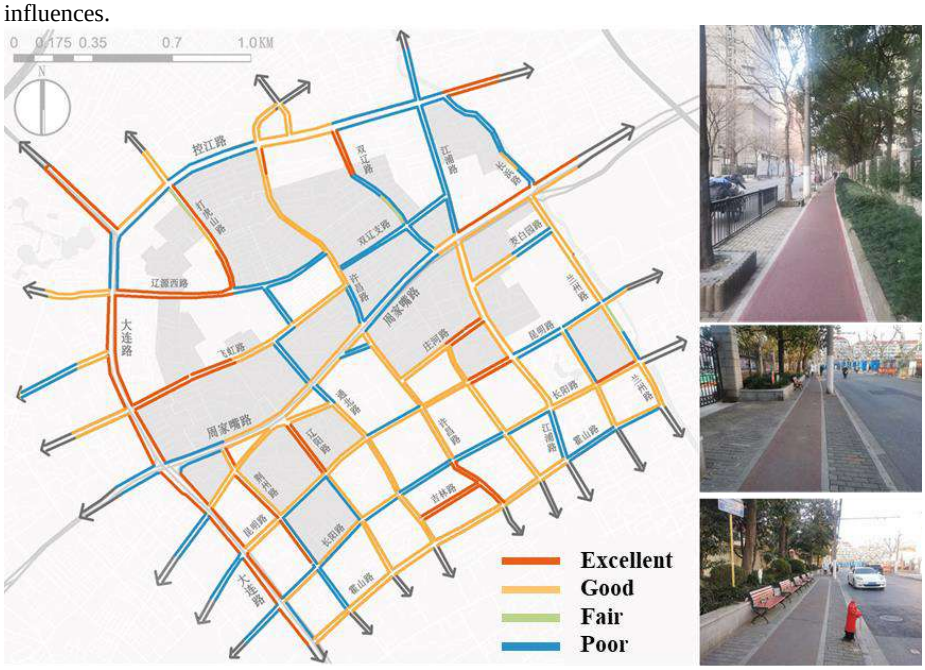


Figure 4.1

In general, in the subsequent child-friendly renewal of the community, the improvement measures can be roughly divided into five categories: first, to adjust the cross-section of the street pavement, such as widening the walking and cycling space; second, to add various child-

friendly street facilities, such as traffic calming measures, child-friendly travel guide signs, child-friendly crossing facilities, etc.; third, to optimize the child-friendly design of street landscapes, such as street greening, child-friendly street public art design, etc.; fourth, to enhance the various service functions of street children, such as life convenience, leisure activities, etc.; fifth, to formulate corresponding management measures. In particular, compared with some street built environment element updates involving limited resources and complex measures (such as street cross-section adjustments, etc.), some flexible and simple ones, such as adding various child-friendly street facilities, are often also the "shortcomings" that are in short supply in the actual basis.

4.2 Assessment Aspects of Child-Friendly Neighbourhood Public Open Spaces

In terms of safety, the safety assessment of the surrounding environment and landscape design of outdoor public spaces is good, but the safety assessment of activity facilities is relatively poor. The enclosure interface safety, landscaping and activity facilities are well maintained, but the lack of vehicle-ban facilities leads to random vehicle entry, and children's playgrounds are used as parking lots, especially in lanes and public housing communities. Instructions and information signs lack child-friendly design, and insufficient lighting facilities pose safety hazards.

In terms of health, the area of public space available for activities and the cleanliness of the venue are good, but the support for children's games and sports spaces is insufficient, especially in lanes and public housing communities. Children's game facilities, preschool game facilities, ball and track and field sports facilities are insufficient, and fitness facilities are not suitable for young children. There is a mismatch between "space" and "facilities", especially the problem of insufficient configuration of children's game facilities is more prominent.

In terms of inclusiveness, the surrounding slow-moving accessibility is good, but the venue design is comfortable, the space design is attractive, and the convenience service facilities are the worst. In terms of site design comfort, more than 70% of public spaces can meet the assessment requirements of site flatness, but only 30% of public spaces are paved with soft pavement suitable for children, and only 10% of public spaces are designed based on site color guidance (Figure 4.2). The recreational facilities are well-equipped, but the space design is not attractive enough, and there are problems with water management and safety protection.

Figure 4.2

4.3 Assessment Aspects of Child-Friendly Residential Area Environment

In terms of safety, the traffic organization between residential buildings in lanes and public housing areas is chaotic, and insufficient parking facilities for motor vehicles lead to messy parking, obstructing traffic and occupying children's activity space. The road surface is often high-difference, end cracks, and damage. There is a lack of special cycling organizations and facilities, which leads to interference between cycling, walking and driving. There are few child-friendly facilities in child-oriented signs, and there is no barrier-free design at the entrance and exit of the residential area.

In terms of health, the physical activity space for children in lanes and public housing areas is poorly configured, and the functional space and venue design of game space and sports space are insufficient. Only a few residential areas are equipped with complete safety facilities and children's activity facilities, and there are fewer children's game facilities and sports facilities.

In terms of inclusiveness, the children's travel environment is comfortable, public services are diverse and convenient, and the green landscape and building interface are good, but the public art elements are poor. Public services are richer in lanes and public housing areas, but other aspects are inferior to commercial housing areas. Commercial housing areas have better rest facilities and sunshade facilities, and green spaces and greening beside houses are common, while there are problems such as garbage and parking encroachment in green spaces beside houses in lanes and public housing communities.

Cluster green space provides environmental support for children in residential areas to contact nature. In the practice of international child-friendly communities, more emphasis is placed on the "playability" and "play value" of outdoor spaces such as open green space. Unlike traditional children's playgrounds, nature-based construction methods can allow children to interact more with nature. Based on this, the CFN residential audit reminds the community to pay attention to the playability of cluster green space and green space next to houses. The on-site audit results show that 64.71% of the cluster green spaces in commercial housing residential areas have designs that enhance children's "playability". The main construction method is to lay paths in the green landscape and place recreational facilities and fragmented venues (Figure 4.3).

Figure 4.3

5.Conclusion

By combing through the relevant policies, action plans and design guidelines for child-friendly construction at home and abroad, this study constructs a "child-friendly community built environment assessment technical tool" suitable for China's stock renewal background, covering multi-level spaces such as community streets, outdoor public spaces and residential environments. At the same time, relevant application methods are proposed, including development models, statistical and visualization methods and technical results. The application example of on-site assessment in the Jiangpu Road area of Shanghai shows to a certain extent that the constructed innovative tool has application value in community space problem diagnosis and planning decision-making intervention. Compared with the renewal of some community built environment elements involving limited resources and complex measures, some flexible and micro-community built environment elements are more scarce in the reality. The renewal of these elements is an important potential part for effectively exerting governance results and enhancing children's sense of gain.

After conducting on-site assessments from a child-friendly perspective, it is found that there is still a lot of room for the improvement of the child-friendly micro-scale built environment in existing communities. Taking street improvement as an example, it is very important to adjust the cross section of the street pavement, such as widening the walking and cycling space, but the implementation cost also increases accordingly. In particular, compared with the cross section adjustment, adding various child-friendly street facilities, such as traffic calming measures, child-friendly travel guide signs, and child-friendly crossing facilities, is more flexible and effective. The evaluation found that these are also the important parts missing from the existing built environment. Similarly, taking the improvement of outdoor public space as an example, there is a general mismatch between "space" and "facilities" in existing communities. Compared with the past, the problem of tight stock land resources has been deeply understood. In fact, the problem of insufficient configuration of children's play facilities in public spaces is also prominent, which is manifested as "there is space but no facilities" or "there is neither space nor facilities". Focusing on these important potential parts in child-friendly renewal can effectively play the renewal effect and enhance children's sense of gain in the practice of child-friendly communities.

In this study, only the common parts of the micro-built environment elements in the community involved in the relevant materials of child-friendly practices at home and abroad are sorted out and reviewed. In fact, due to unavoidable objective factors such as differences in national development levels and the diversity of existing built environments, it is very important to localize the evaluation tools for different built environment contexts. The system constructed in this study is only applied in the Jiangpu Road area, which has certain limitations. Furthermore, by expanding the application sample, expert review and interviews in the child-friendly field, the evaluation elements and evaluation rules can be iteratively updated, and the evaluation content can be dynamically adjusted, which can improve the reliability and universality of the evaluation tools. With the intelligentization of data collection methods, it provides the possibility of extensive and continuous environmental evaluation, which has further exploration significance for continuously improving the quality of life of children in the community and supervising the built environment of children's lives.

Reference

[1] Babb, C.W., 2014. Built environment auditing, active mobility and children's wellbeing (Doctoral dissertation, Curtin University).
[2] Aerts, J., 2018. Shaping urbanization for children: A handbook on child-responsive urban planning. New York: Unicef.
[3] Unicef, 2018. Child friendly cities and communities handbook. UNICEF: Geneva, Switzerland.
[4] Voce, A., 2018. Cities alive: designing for urban Childhoods. Children, Youth and Environments, 28(2), pp.78-81.
[5] Brussoni, M., Gibbons, R., Gray, C., Ishikawa, T., Sandseter, E.B.H., Bienenstock, A., Chabot, G., Fuselli, P., Herrington, S., Janssen, I. and Pickett, W., 2015. What is the relationship between risky outdoor play and health in children? A systematic review. International journal of environmental research and public health, 12(6), pp.6423-6454.
[6] Sharmin, S. and Kamruzzaman, M., 2017. Association between the built environment and children's independent mobility: A meta-analytic review. Journal of Transport Geography, 61, pp.104-117.
[7] Kent, J.L. and Thompson, S., 2014. The three domains of urban planning for health and well-being. Journal of planning literature, 29(3), pp.239-256.
[8] Kruse, J., Kang, Y., Liu, Y.N., Zhang, F. and Gao, S., 2021. Places for play: Understanding

human perception of playability in cities using street view images and deep learning. Computers, Environment and Urban Systems, 90, p.101693.
[9] Siu, K.W.M., Wong, Y.L. and Lam, M.S., 2017. Inclusive play in urban cities: a pilot study of the inclusive playgrounds in Hong Kong. Procedia engineering, 198, pp.169-175.
[10] Miller, L.J., Schoen, S.A., Camarata, S.M., McConkey, J., Kanics, I.M., Valdez, A. and Hampton, S., 2017. Play in natural environments: A pilot study quantifying the behavior of children on playground equipment. Journal of Occupational Therapy, Schools, & Early Intervention, 10(3), pp.213-231.
[11] Sallis, J.F., Conway, T.L., Cain, K.L., Carlson, J.A., Frank, L.D., Kerr, J., Glanz, K., Chapman, J.E. and Saelens, B.E., 2018. Neighborhood built environment and socioeconomic status in relation to physical activity, sedentary behavior, and weight status of adolescents. Preventive medicine, 110, pp.47-54.
[12] Global Designing Cities Initiative, 2020. Designing streets for kids. New York, NY: Global Designing Cities Initiative, National Association of City Transportation Officials, nd.