

The influence of cognized neighborhood environment
on children's health and outdoor activities: a case
study of shanghai

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Abstract: Children's health and outdoor activities are closely related, with the increasing of childhood obesity and the improvement of people's health consciousness, urban planning and spatial design promoting children's outdoor activities will become increasingly important. Selecting children and teenagers of 6-18 years old in Shanghai as the object, this research conducts a network questionnaire survey to obtain the data and quantitatively analyzes the spatial-temporal characteristics of their health and outdoor activities. A relationship model between the children's outdoor activities and cognized neighborhood environment is established, using the logistic regression model. Results show that children in shanghai have a high incidence of obesity and are lack of outdoor activities. The time of outdoor activities is concentrated in the daytime of weekends, and the activity venue is concentrated in the green lands and exercise fields in the community or the parks nearby. Children's vigorous activities tend to happen with high time consumption and frequency in the vacant street space and sidewalks along the street. At the city level, some parts of Shanghai can see remarkably high concentration or low concentration of children's outdoor activities, and the frequency and time consumption of children's vigorous activities within the Inner Ring is significantly higher than that in other rings. Neighborhood environmental factors have significant associations with children's health and outdoor activities. Curb parking, environmental harmony and civilization, neighborhood relationship, and the quality of children's activity facilities have a significant correlation with children's outdoor activities, especially with their activity frequency.

Keywords: Children; Health; Outdoor activity; Neighborhood environment; Shanghai

Introduction

The origin of modern urban planning and health began in 1986 when the World Health Organization (WHO) first established the Healthy Cities Project, and then the Healthy Cities Engineering Network was established in Europe. After 30 years of development, Healthy City has become a worldwide movement (XU Congbao, *et al.* 2005). It has gone through four stages of development, and is now in the fifth stage (from 2009 to now). The core theme of this stage is supportive environment, healthy lifestyle and healthy urban design (XU Congbao, *et al.* 2005). At present, the change of life style has become one of the main reasons that endanger residents' health (MA Guansheng, *et al.* 2006). The traditional methods of urban planning to protect residents' health (such as functional zoning, sunshine spacing, green space rate, etc.) can no longer meet the growing health needs of people. Planning needs to re-recognize the direction and path of healthy city construction.

The static lifestyle formed by housework, work, commuting and leisure activities has a significant impact on residents' health, but also has a close relationship with urban spatial environment. Commuting and leisure activities are directly related to urban spatial environment (Lee C, et al. 2004). One of the most serious problems caused by static lifestyle is childhood obesity. In the Draft Final Report on Ending Child Obesity, WHO pointed out that the rapid increase of childhood obesity has become an urgent global public health problem, especially in cities of low- and middle-income countries (WHO. 2004). Existing studies generally believe that lack of adequate physical activity is an important cause of obesity and overweight in children (Fredriks A M, et al., 2005, Wang Wenyuan, et al., 2008). A large number of studies have proved that urban built-up environment has significant effects on children's outdoor physical activity, body mass index (BMI) and health perception. For example, barren open space can reduce children's outdoor activities and health evaluation value (Lestan K, Eržen I, Golobič M., 2014, Janssen I, Rosu A., 2015); low residential density and road density can increase children's obesity rate (Duncan D T, et al., 2014); neighbourhood safety has accumulated for children's outdoor activities. Extremely affect and reduce the incidence of obesity in children (Nogueira H, et al., 2013, Janssen I., 2014); leisure facilities such as parks have a positive impact on children's outdoor activities (Babey S H, et al., 2008), which will reduce the incidence of obesity in children (Wolch J, et al., 2011). In contrast, the relevant research in China focuses on the design of micro-activity sites, plant allocation, environmental construction and facilities arrangement, aiming at enhancing the safety, comfort and independence of children's outdoor activities (Zhan Yan., 2005, Xu Xuefang., 2010, Yan Tingting., 2013). It lacks the research on the relationship between built environment and children's outdoor activities from the perspective of larger-scale neighborhoods and even cities (Zhang Yi, Dai Shenzhi., 2011). Only Han Xili (2012) adopted the research on the relationship between built environment and children's outdoor activities. The perceptual map method qualitatively explores the factors affecting children's outdoor physical activity in neighborhood space environment (Wang Dong, Han Xili., 2012).

At present, the problems of high population density, land shortage, deterioration of traffic environment, prominent contradiction between supply and demand of facilities, and severe public security environment prevail in large cities in China. Additionally, the concept of children's education, such as "can't lose at the starting line", may become the cause of restraining children's outdoor activities and causing diseases. Taking Shanghai as an example, the problem of childhood obesity is particularly prominent. The detection rate of overweight and obesity among children is close to that of developed countries in the world (Zhu Meihong, et al., 2011). At the same time, the level of economic and social development in Shanghai is relatively developed, and people pay high attention to health issues. Therefore, the study of children in Shanghai is of great practical significance to solve this problem from the perspective of urban built environment. Shanghai is also a metropolis with high heterogeneity. Its built environment is rich and its population and social economic background are diverse. It provides an ideal sample space for exploring the material and social factors and mechanisms affecting children's outdoor activities. Therefore, this study takes Shanghai as a case study. The goal of this study is to grasp children's physical health and outdoor activities as a whole, to explore the characteristics of time and space, and to explore the relevant elements, so as to provide a basis for further exploring and understanding the mechanism of urban construction affecting children's health and outdoor activities, and to provide urban planning for promoting children's outdoor activities and reducing the incidence of childhood obesity. Provides the basis for the design.

Data collection

Questionnaire Survey

Questionnaire survey was used to collect data. Because the cognitive and expressive aspects of young children are not enough to complete the survey alone, at the same time, similar studies abroad mostly use the method of investigating parents, and the credibility is also recognized (Tappe K A, et al., 2013). Therefore, the subjects of this study are parents of children and adolescents aged 6-18 (hereinafter referred to as children). The goal of this

study is to collect data on children's health and outdoor activities, built environment and family background from the perspective of parents. In terms of health, the self-assessment of children's overall health and BMI index were investigated; in outdoor activities, the frequency, time consuming, activity time and activity venue of children's moderate and vigorous activities were recorded; in the aspect of building environment, 15 types of built environment indicators affecting children's outdoor activities were collected by parents in the form of structure scale, including population density. Degree, land mixing, pavement facilities, traffic volume, environmental safety, accessibility of activity facilities, neighborhood relationship environment, etc. The background information of children's family includes two levels: children and family. Children collect information on gender, age and number of children. Family level collects monthly family income, education level of parents, household registration and location information of residential quarters.

The questionnaire was distributed to the resident residents of children aged 6-18 in Shanghai in November 2015 through the "Questionnaire Star" network survey platform. A total of nearly 700 questionnaires were collected, and 403 valid questionnaires were obtained after screening and screening. Screening conditions include excluding the answers other than the age of the target children, setting trap questions to exclude the randomly filled answers, excluding Shanghai users according to IP address, excluding the answers that are incomplete and invalid, etc.

Sample characteristics

Children aged 6-7, 8-10, 11-14 and 15-18 accounted for 44.9%, 29.1%, 13.9% and 12.1% respectively. The sex distribution of the sample children was fairly uniform, with boys accounting for 59% and girls 41% respectively. The highest educational background of parents is undergraduate, accounting for 65%; 15% and 20% respectively are below undergraduate and above undergraduate. The distribution of household monthly income is not very different. 43% of household monthly income ranges from 10,000 yuan to 20,000 yuan, 34% of household income is below 10,000 yuan and 23% of household income is above 20,000 yuan. Ninety percent of the households in the sample had only one child and 10 percent had more than one child. The sample families consist mainly of nuclear families, accounting for 54.6% of the sample; 42.2% of the families living together with three generations; and only 3.2% of the single-parent families.

The spatial distribution of sample residences at Shanghai regional level is shown in Figure 1. Except for 2.7% of the cases, the residences of the remaining samples are not located, accounting for 19.6%, 25.1%, 21.3% and 31.3% respectively within the inner ring, between the inner ring and the central ring, between the central ring and the outer ring, and outside the outer ring. The number of cases and the socio-economic attributes of children and families in the four circles are more balanced in space, which lays a foundation for comparative analysis.

Children's Health

The physical health of children is measured from both subjective and objective aspects. Subjectively, the children's parents'evaluation of their children's physical health was divided into five grades: very good - good - General - poor. The results showed that most parents rated the children's physical health highly: 34% of parents thought the children's health was very good, 36.7% thought it was good, 23.6% thought it was good, only 5.7% thought the children's health was normal, and No parents think their children are in poor health.

Objectively, the body mass index ($BMI = \text{weight divided by the square of height (kg/m}^2\text{)}$) is used to measure the obesity of children. Himes suggests defining obesity in the 95-point group with BMI greater than the same age and sex, and overweight in the 85-point group(Himes J H, Dietz W H., 1994). Because of the differences in race, level of economic development and lifestyle, different countries have used different BMI screening criteria for obesity (Ji Chengye., 2006). In this paper, we selected the WGOC standard for children and adolescents of China Obesity Working Group (Chen Chunming., 2008), which was proved to be the most suitable criterion for screening the incidence of overweight and obesity among children in China (Chen Lei, et al., 2010). According

to WGOC standard, children's overweight is defined as body mass index (BMI) between 85 and 95 in a specific age and sex group, obesity is defined as BMI greater than 95 in a specific age and sex group, and low body mass is defined as two standard deviations lower than the average BMI of the same age and sex group, and the rest is normal. The results showed that more than half (55.5%) of the children in the sample had normal BMI, 22.9% had obesity, 12.9% were overweight and 8.7% had low BMI.

The objective indicators reflect the serious physical health problems of children in Shanghai at present. However, the health status of children reported by parents is generally good. This shows that parents have not paid attention to the hidden dangers of children's obesity, overweight and low physique, which are harmful to children's health. It also highlights the importance of correctly recognizing children's physical health and the necessity of promoting children's physical health by building an environment.

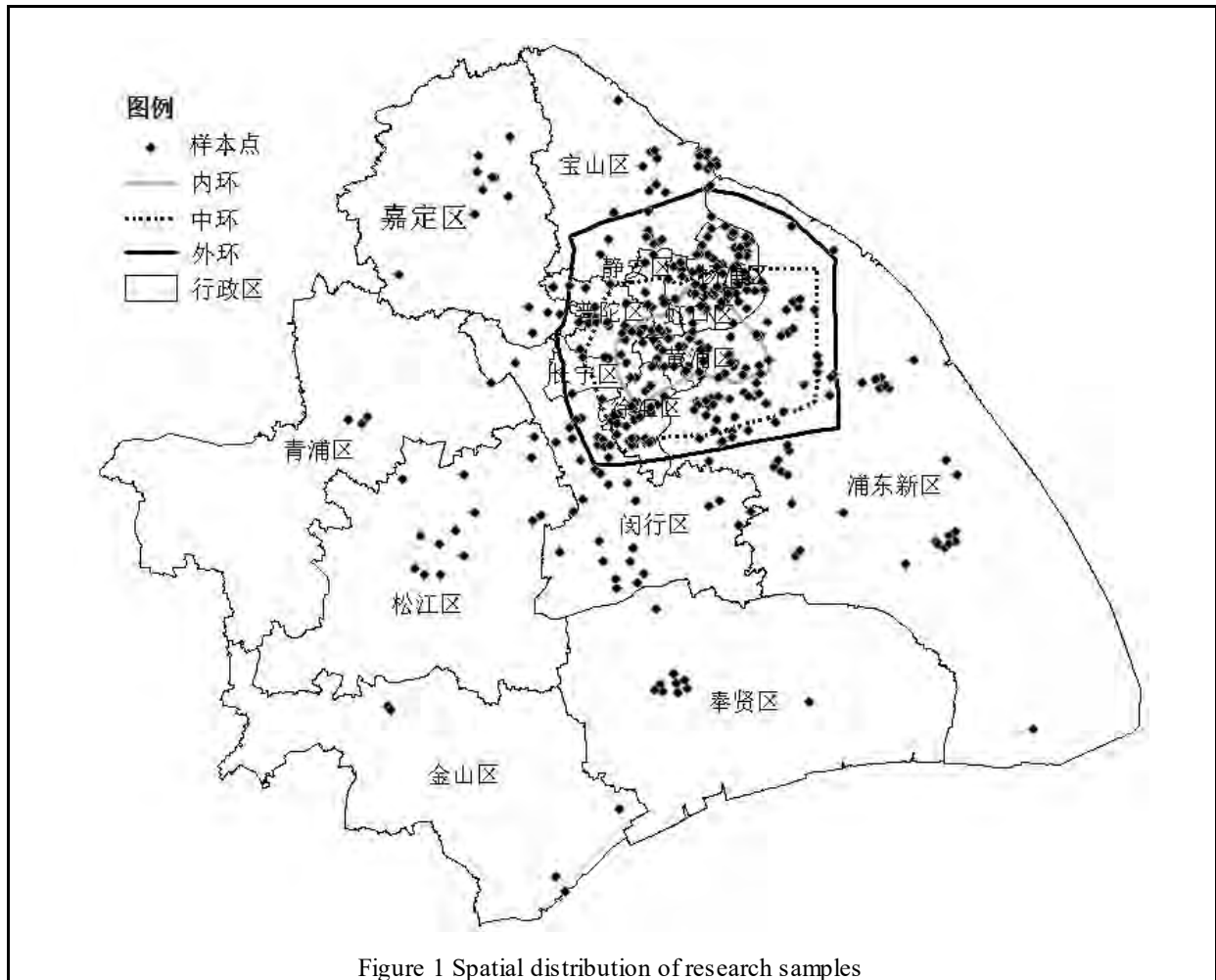


Figure 1 Spatial distribution of research samples

Children's Outdoor Activities

Existing studies have shown that children's physical health is closely related to the amount of activity (Xue Hongmei, et al., 2015). In this paper, the frequency, time consumption and intensity of children's outdoor activities are used to measure the amount of activity. According to the degree of energy consumption, children's outdoor activities can be divided into moderate activities and vigorous activities. Moderate activities refer to physical activities that require moderate exercise but do not cause shortness of breath and significant acceleration of cardiac rhythm. Vigorous activities refer to physical activities that require a lot of exercise and cause shortness of breath and significant acceleration of cardiac rhythm(WHO, 2017).

Most of the children in the sample had outdoor activities. The time and frequency distribution of activities were shown in Figure 2 and Figure 3. Among them, only 5% of children do not engage in moderate outdoor activities, and 15% do not engage in vigorous outdoor activities. The frequency distribution of moderate and intense activities is similar to that of time-consuming activities. The frequency of activities mainly concentrates on 2-5 times per week, and the time consumption of a single activity concentrates on 10-30 minutes. The frequency of moderate activity of children is slightly higher than that of vigorous activity, and the time spent within 40 minutes is also longer.

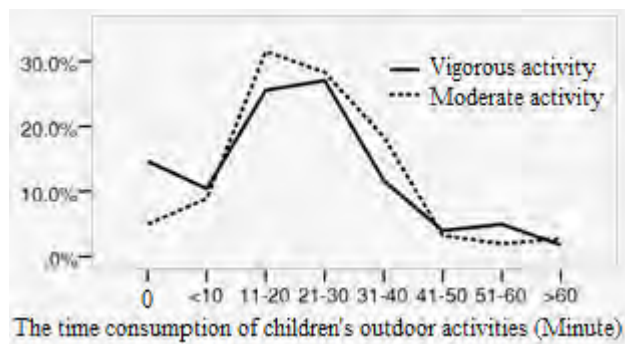


Figure 2 The distribution of time consumption of children's outdoor activities

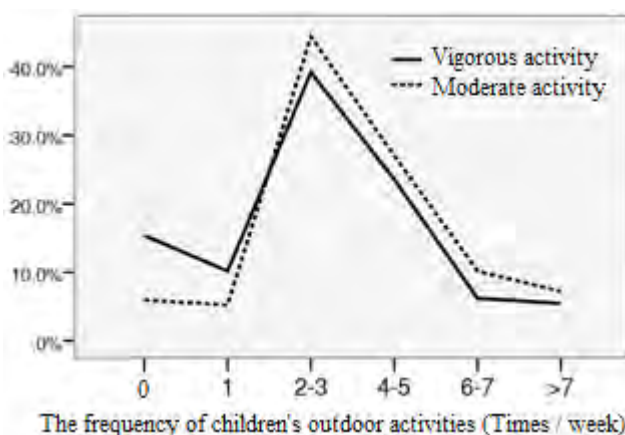


Figure 3 The frequency distribution of children's outdoor activities

By synthesizing the frequency and time of activities, the intensity index of children's outdoor activities is constructed, which is the total time consumption of children's outdoor activities every week. Because the energy consumption of vigorous activity is different from that of moderate activity, the intensity of vigorous activity is equal to about twice that of moderate activity by using the conversion method of WHO (WHO, 2017). Finally, the intensity of children's outdoor activities is calculated as Figure 4, showing an obvious exponential distribution. With the increase of activity intensity, the number of children's cases decreases; the average intensity of children's outdoor activities is 238 minutes/week, mainly within 250 minutes/week, and the number of children whose activity intensity exceeds 250 minutes/week decreases sharply; the standard deviation is 210 minutes/week, which indicates that the intensity of children's outdoor activities decreases dramatically. There are a few cases with high activity intensity. The physical activity of children and adolescents aged 5-17 recommended by the World Health Organization is greater than 420 minutes/week (WHO, 2017). Only 9.4% of the children in the sample had more than 420 minutes of outdoor activities per week, which indicated that the intensity of outdoor activities of Shanghai children was far from meeting the requirements of WHO.

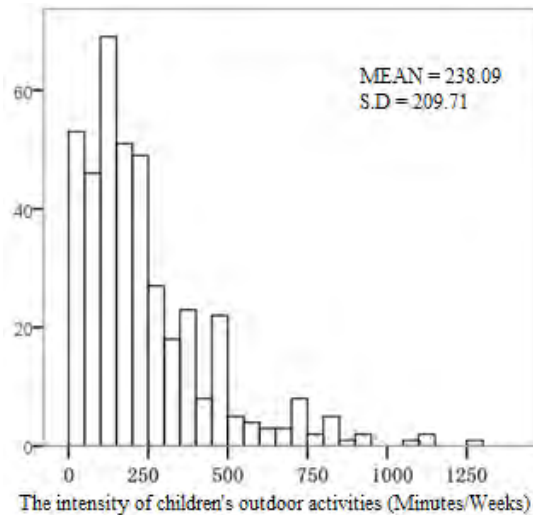


Figure 4 The intensity distribution of children's outdoor activities

The influence of built environment on children's outdoor activities

The survey asked parents to evaluate the built environment near their residence. The questions were expressed positively in terms of environmental factors affecting children's outdoor activities. The answers were divided into four levels: very disagreement - disagreement - agreement - very agreement. The statistical evaluation mean is shown in Figure 5. The higher the evaluation mean is, the more reasonable or perfect parents think the present situation of environmental factors is. It shows that the evaluation of road connectivity, traffic accessibility and neighborhood relationship around residential areas is higher. The current situation of environmental factors such as traffic volume, facilities accessibility, roadside parking and driving speed is worse.

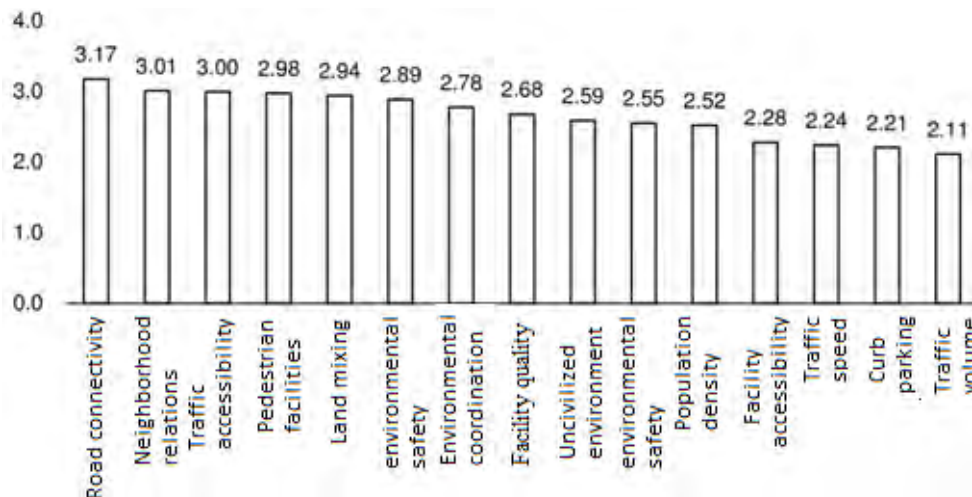


Figure 5 The mean value of parents' evaluation of the built environment affecting children's outdoor activities

Non-parametric tests were used to verify the relationship between 15 built environment factors and children's outdoor activities and health (Table 1). It is found that most of the environmental factors are closely related to children's health assessed by parents. Specifically, in the built environment with mixed land functions, harmonious neighborhood relations, perfect pavement facilities, high road accessibility, low road speed, less roadside parking, traffic safety, convenient activities and good quality, children's health assessed by parents is obviously better. In contrast, the correlation between these environmental factors and BMI health index is weak. Only road speed and traffic accessibility are significantly correlated, but interestingly, they are all traffic factors.

For children's outdoor activities, the relationship between built environment and intense activities is more closely than moderate activities, and the relationship between frequency and time is more closely. In terms of activity time consumption, in the urban environment with uncivilized phenomena (such as garbage, dog dung, graffiti) and poor road connectivity, moderate activity time consumption is significantly lower. In terms of activity frequency, children are more likely to engage in outdoor vigorous activities in urban environments with low road speed, less parking on the roadside, beautiful and harmonious built environment, civilized outdoor environment, harmonious neighborhood relationship, convenient children's activities facilities and high quality; in urban environments with less traffic, harmonious neighborhood relationship and high quality children's activities facilities, children's outdoor activities are moderate. The activity frequency is high. In terms of total activity intensity, the urban environment with less parking, beautiful and harmonious built environment, civilized outdoor environment, harmonious neighborhood relationship and high quality of children's activity facilities corresponds to children's high-intensity outdoor activities.

Table 1 Cross analysis of children's outdoor activities and health and social economic attributes

Built environment	Health rated	BMI health	vigorous activity			moderate activity			Total activity intensity (minutes / week)
			Time consumption (minutes / times)	frequency (times / week)	intensity (minutes / week)	Time consumption (minutes / times)	frequency (times / week)	intensity (minutes / week)	
Pedestrian facilities	0.000***	0.221	0.920	0.973	0.779	0.236	0.577	0.314	0.855
Road connectivity	0.009***	0.666	0.198	0.834	0.483	0.063*	0.319	0.141	0.286
Traffic volume	0.289	0.392	0.298	0.133	0.191	0.774	0.015*	0.187	0.114
Traffic speed	0.014**	0.040**	0.845	0.032**	0.190	0.526	0.433	0.296	0.105
Curbside parking	0.008***	0.273	0.525	0.096*	0.080*	0.418	0.436	0.273	0.077*
Environmental coordination	0.391	0.983	0.124	0.008***	0.068*	0.238	0.789	0.638	0.070*
Uncivilized environment	0.189	0.810	0.217	0.015**	0.025**	0.036**	0.637	0.173	0.032**
Traffic accessibility	0.325	0.049**	0.784	0.673	0.792	0.608	0.544	0.577	0.611
Land mixing	0.001***	0.682	0.714	0.230	0.642	0.909	0.153	0.714	0.518
Population density	0.196	0.638	0.603	0.292	0.225	0.926	0.654	0.974	0.290
environmental safety	0.140	0.654	0.372	0.517	0.588	0.421	0.668	0.100*	0.796
trafficsafety	0.001***	0.463	0.380	0.161	0.219	0.338	0.418	0.350	0.157
Neighborhood relations	0.001***	0.123	0.132	0.039**	0.036**	0.617	0.056*	0.184	0.046**
Facility accessibility	0.005***	0.528	0.641	0.078*	0.244	0.723	0.318	0.764	0.264
Facility quality	0.012**	0.620	0.907	0.037**	0.340	0.619	0.002**	0.619	0.086*

Note: * 0.1 significant level; ** 0.05 significant level; *** 0.01 significant level.

Conclusion

With the prominence of children's health problems and the enhancement of social health awareness, children's outdoor activities will be paid more attention. Urban planning and space design for promoting children's outdoor activities are of great significance to improve children's health. Taking Shanghai as an example, this study summarizes the characteristics and related factors of children's outdoor activities in big cities from the dimensions of time, space and family attributes, which can provide a basis for relevant planning, design, decision-making and in-depth research. The study found that the incidence of obesity among children in Shanghai is high. Most children's outdoor activities are not up to the World Health Organization standard.

However, parents do not know enough about children's health, which indicates the urgency of measures to promote children's outdoor activities, including urban planning. The analysis shows that children's outdoor activities are highly heterogeneous. Although this study has obtained the overall impact direction of significant related factors to children's health and outdoor activities, more precise impact mechanism must be further explored in order to provide a clearer theoretical basis and methodological means for planning. The analysis at the municipal level finds out the hot spots of children's health and outdoor activities, which provides clues for in-depth regional case studies or interregional comparative studies to find out reasonable explanations. Some findings also prompt reflection on traditional planning concepts and methods. For example, although children's outdoor activities mainly focus on community green space, exercise venues and parks, high frequency and long time-consuming activities mainly occur in some "informal" activities such as sidewalks and street empty spaces on both sides of the road; the reasons for this phenomenon need to be more systematically examined. If space forms do have an impact, then the focus of planning and design may need to tilt towards creating safer, continuous and comfortable street children's activity space.

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