Study on the Evaluation System of Health-Oriented Street Design of Contemporary Beijing from the Perspective of Epidemiology

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Abstract
Focus on street, the most frequently used urban space in daily use, and put forward the topic of "how to design and improve street space to prevent residents from getting sick". Aiming at the characteristics of China's big cities, meta-analysis of results of interdisciplinary studies in public health and architecture in the past 20 years is conducted, a set of self-explanatory health street design research checklist and evaluation system have been initially compiled. On this basis, a preliminary study was conducted on 77 streets in Beijing's urban areas. The streets were analyzed in a quantified manner, conclusion the inadequacies and improvements in the street design.

1 Background and topics: from the treatment of "mega city disease" to the prevention of " Mega city epidemic "

The relationship between urban space and residents' health is an eternal topic in the history of urban development. In the 19th century, the industrial revolution brought about the rapid development of the city, but at the same time, the overcrowding of the city, especially the residential areas and the poor sanitation caused a series of "infectious diseases" such as cholera and yellow fever. These public health problems have promoted a series of urban space legislation, spawned the emergence of public health departments and urban planning departments, and become the origin of modern urban planning discipline.

Since the 1980s, "chronic diseases" have gradually replaced infectious diseases and become the main epidemic in the human disease spectrum. There are many epidemic diseases in the urban space of mega cities such as Beijing and New York. The problems of urban planning and urban design may affect the residents' psychology, life style and even directly cause pathogens. In this context, the field of public health began to pay attention to the relationship between "urban space" and human diseases from the perspective of "prevention". In the field of urban design, we began to reflect on the problems of "mega city epidemic" caused by large-scale urbanization.

2 Evaluation System: "healthy street survey" for Beijing urban area

The New York Active Design guidelines put forward a set of research methods for New York City Communities and streets, including a series of elements such as healthy community , healthy street , spatial interface and urban furniture. The research team has directly used the New York survey form to conduct several street surveys. However, through the site study, it is found that there are many differences between New York and Beijing's old city in terms of street scale, municipal road planning laws and regulations, building line withdrawal requirements and other actual situations, which makes many items of the original survey form seem unclear or unable to be filled in, and the content of the survey is not suitable The data obtained are not enough to make an objective and systematic judgment conclusion on the streets of the old city of Beijing.

Therefore, according to the characteristics of Beijing's old city and some research terms and project contents derived from the New York guidelines, the research team has made the survey form of Beijing's old city street health

design (Figure 1) and the survey checklist of Beijing's old city street. And based on this form, the selected streets are researched again.

The survey form includes 8 forms, including:

·**Survey of the neighborhood.** Describe the overall situation of related blocks, including location, mixed degree of land use planning, image map, etc.

·**Sidewalk survey.** Investigate and evaluate the elements of the street sidewalk and the overall and partial evaluation of the pedestrian experience.
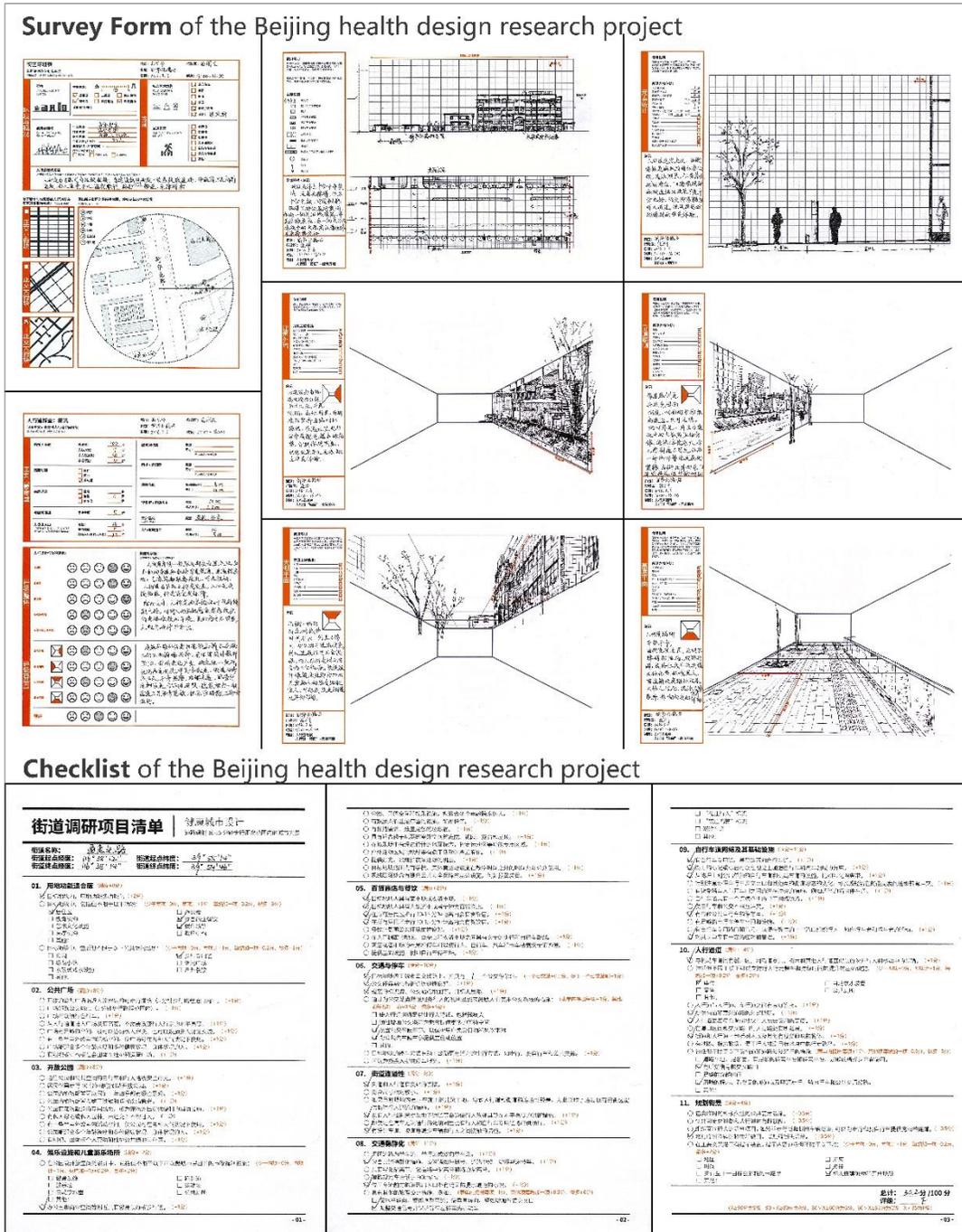

Figure 1. Survey form and Checklist of the Beijing health design research project. Source. Redesigned from Active Design Guidelines: Promoting Physical Activity and Health in Design

·**Full length street survey.** Survey the whole main street in the battery limit, including street elevation and plan, etc.

· **Survey form of Street building section.** Survey and survey or speculate on the structure of street buildings, and sort out the relationship between indoor level and street level.

·**Street four interface questionnaire.** Detailed investigation of elements of the Ground Plane, Roadside, Building Wall and Canopy , and detailed description of the four interface perspective drawings.

Combined with the characteristics of architecture and urban design, each form not only includes the "description data part" to investigate relevant elements and collect data, but also includes the "freehand drawing part" to draw relevant intention drawings and mapping drawings. This research project starts from the actual walking experience of the investigator, so the measurement unit in the research form is "step (unit length of each step is equivalent to $600 \pm 60mm$)".

The checklist consists of 3 pages, including 11 categories, 82 items, and 100 points of research content and evaluation items on healthy street design. Based on the three aspects of land use, traffic and street evaluation, the contents involved detailed items, and assign scores to them to try to score standards. The applicable research scope of the entry is the urban street block involved in the 10-15 minute walking distance from the street selected in the research form. The items are mainly "Yes or No" judgment items, that is, items that meet the description of the items are scored according to the assigned value, otherwise, they are not scored; in addition, there are some "other" categories of expansion items for the investigators to fill in, so that the investigators can flexibly add points according to the site conditions, but there is a ceiling control of bonus points. The list items mainly include:

① **land use mix,** full score of 8 points. It mainly describes the mixing degree and complexity of the functional composition of the target plot.

·② **public square,** full score 9 points. Objective description is made around the public squares that may exist in the target plot. In addition to

Article 6, "there is enough space in the square, which can not only help private secret talks, but also encourage multiple people to discuss and exchange." Except for the subjective judgment of investigators, the rest are based on objective facts.

·③ **open park,** full score 8 points. Objective description is made around the possible open parks in the target plot. Among them, the items describing the allocation of plant species in the park need to be trained in the identification of specific plants before investigation.

·④ **entertainment facilities and children's playground,** Full Score: 13 points. In essence, it is an objective description of the current situation of municipal facilities and street furniture in the target plot, but researchers should strictly consider whether the research objectives are suitable for children's play when judging.

·⑤ **department stores and catering,** full score of 8 points. Describe the commercial functions and traffic structure of the target plot, focusing on catering and general merchandise.

·⑥ **traffic and parking,** 10 points in total. The description of the municipal public transport system in the target plot is based on objective facts, except that article 5 "the parking mode of the target plot helps to encourage more dynamic travel modes, such as walking, cycling and public transport" requires the subjective judgment of the investigator.

·⑦ **street connectivity,** full score 6 points. Objective description of the contact and isolation between the pedestrians and roads in the target plot.

·⑧ **traffic calming,** full score is 12 points. Objective description of the composition of vehicle roads in the target plot.

·⑨ **bicycle lane and infrastructure,** full score 11 points. Objectively describe the composition of bicycle roads and related facilities in the target plot.

·⑩ **pedestrian passage,** full score 11 points. Objective description of the composition of pedestrian roads and related facilities in the target plot.
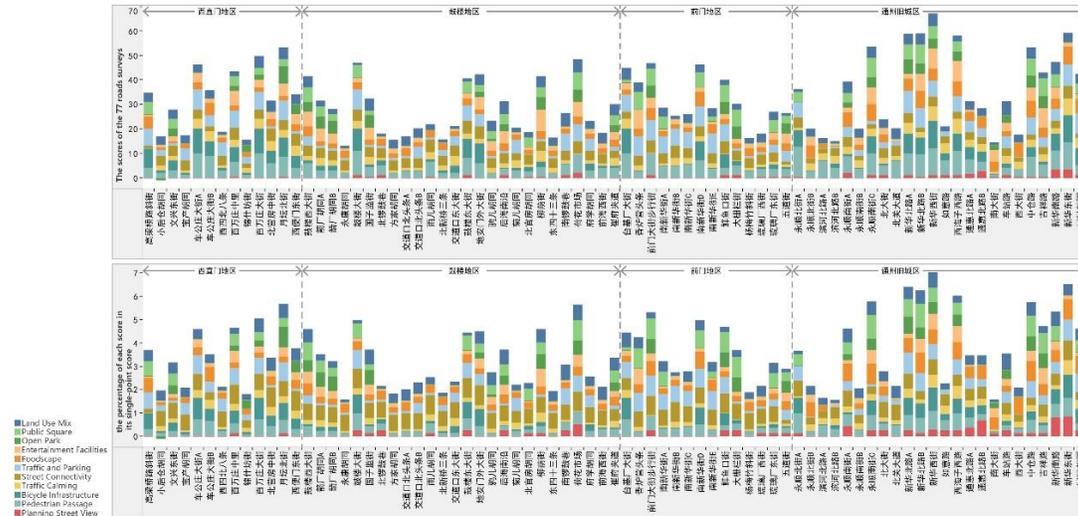
Figure 2. The scores of the 77 roads surveys (above), the percentage of each score in its single-point score (below)

·⑪planning street view. Full score of 4 points, Mainly for possible bonus items.

3. Research objects and results analysis: Problems and suggestions on Health Oriented Street Design in Beijing

3.1 research object: 4 areas, 77 streets

Four typical areas were selected in this survey, namely Xizhimen area, Gulou area, Qianmen area and TongZhou old city area. Cut 100 × 100m street blocks in the area for targeted survey, mapping and scoring, and conduct in-depth research on the health design issues within the scope. There are 77 typical streets in total. After the completion of the field survey, 77 sets of survey tables are drawn. Check the scoring items against the project list, calculate the score of the target plot and conduct rating.

In addition, the successful cases of urban design are selected for horizontal comparison. Bartley park is located in the lower part of Manhattan Island, New York City, the United States. In this study, the street collector Pi is taken as an example for analysis.

3.2 result analysis

During the investigation of each community and street space, the team members investigated the daily life style and health of the community residents and the citizens working here as much as possible through random interviews and a small number of household interviews, made qualitative statistics, and listed the scores of each street for comparison (Figure 2). It can be seen that the streets of Hutong type are difficult to get high scores due to the lack of public places around them. The streets with wide motorways but complete peripheral functions show the high scores of counter intuitive results. Among them, compared with other three districts, the Old City District of Tongzhou shows more obvious differentiation of scores. After the close classification is combined and counted, the score distribution of each street is obtained (Figure 3), in which 0 sub item has been removed.

Issues of community and street space design:

·**Low land use mix:** low mixing degree of land use function is the most important space factor leading to unhealthy lifestyle of citizens. Land use planning is the core of urban planning, which determines the location, shape, scale and function of each plot. Mixed use refers to the horizontal and vertical mixed degree of different urban land functions such as "residence", "office", "business" and "green space" in a certain urban block. The mixed degree of land use directly determines the life trajectory, travel mode, social frequency and eating habits of citizens. This survey shows that most of the blocks are completely filled by one or two land use functions, such as the lack of business and office in residential areas, while commercial
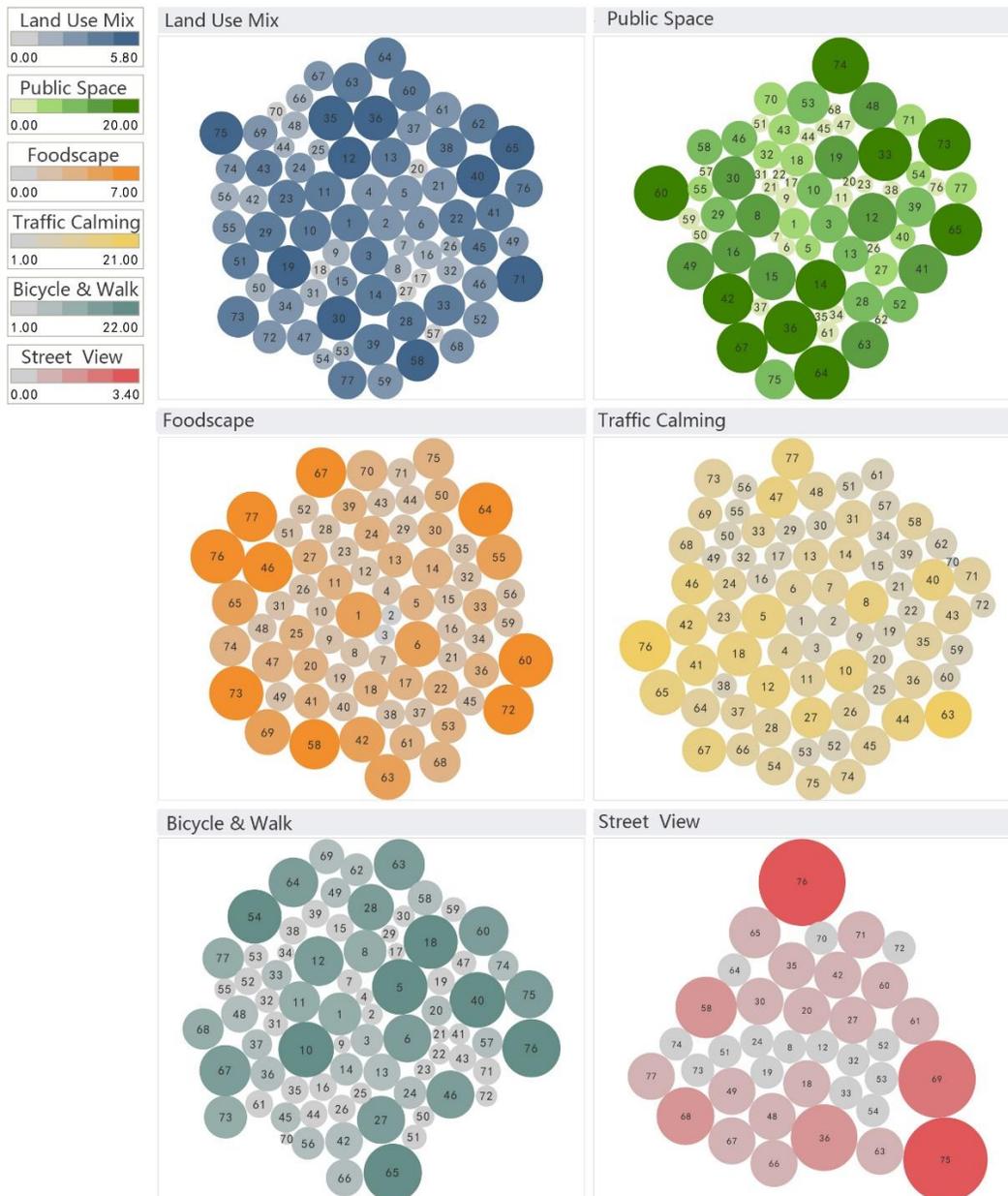
Figure 3. Distribution of scores

areas, office areas and even public squares and parks are far away from concentrated residential areas. Most of the 2-minute walking circles contain only one urban function, which is quite different from the situation that New York and other cities can achieve the mixing of various urban functions in both plan and height (Figure 4).

·**Walking index is seriously insufficient:** "low walking index" is another main spatial factor

that affects the daily exercise and leads to unhealthy lifestyle. It is not necessary for citizens to use special equipment or have relevant ability to take "walking" as a daily exercise, and due to the requirements of travel, it is easy to develop into a daily repeated daily exercise mode. Therefore, before the popularization of private cars, walking was a necessary daily exercise activity for most citizens. This survey shows that there are quite
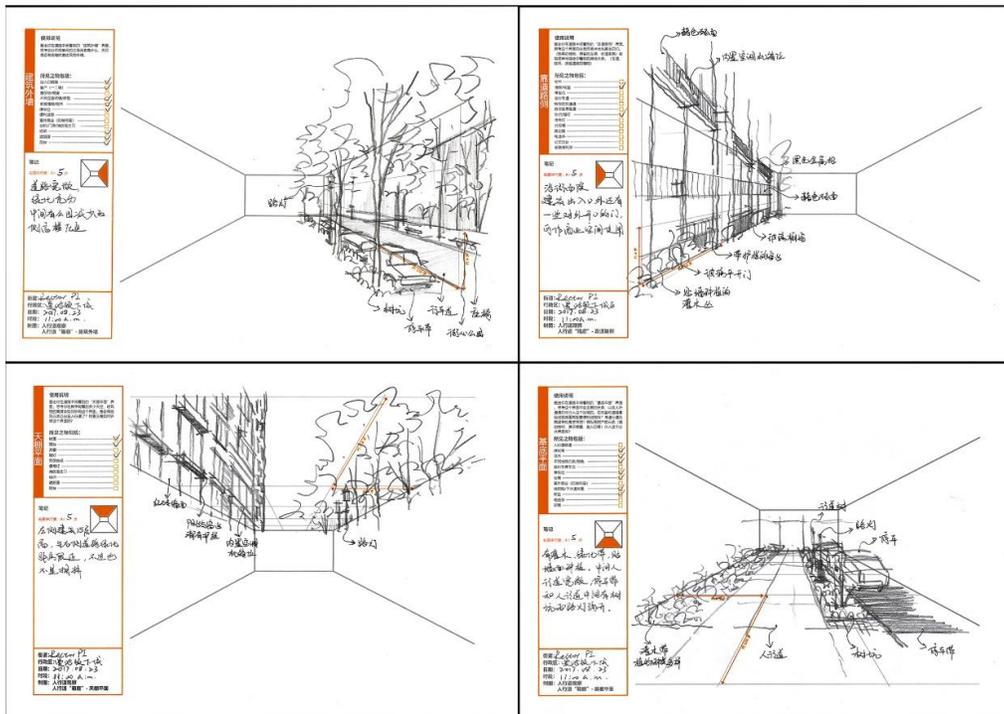
Scores comparison

Xiaohoucang Hutong (Road No. 2) Xiangluyingtoutiao (Road No. 41) Rector PI (NYC,US)
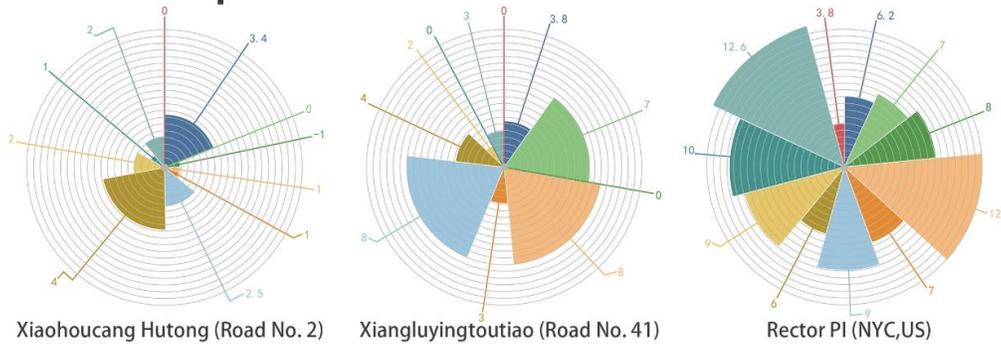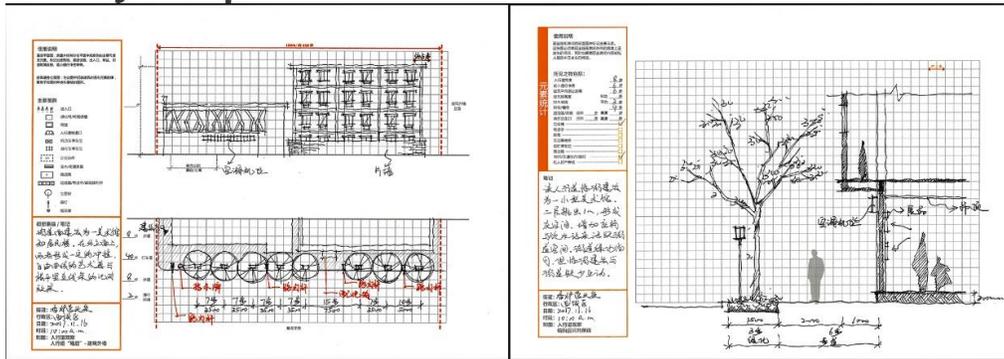
Survey comparison

Completely survey form of Xiangluyingtoutiao (Road No. 41)

Completely survey form of Rector PI (NYC,US)

Figure 4. Scores comparison of Xiaohoucang Hutong (Road No. 2), Xiangluyingtoutiao (Road No. 41) and Rector PI (NYC,US)

Figure 5. Photos of Beijing old town streets (above) and photos of NYC streets (below)

a lot of problems in the pedestrian space of urban streets, which leads most interviewees to say that walking is definitely not their way of daily commuting. At the same time, within the range of 3km, most of the respondents choose to drive or other means of transportation. There are several reasons why the sidewalk space in the old city of Beijing is not suitable for people to walk: first, the poor trafficability of the sidewalk. The sidewalk is too narrow, which is a problem with the characteristics of urban space in the old city of Beijing. Most of the Hutong space, even no formed sidewalk space, but motor vehicles, non motor vehicles and street furniture completely occupy the walking space. Beside the normal streets, sidewalks are often occupied by irregular parking, bicycles, tree pools, etc. The second is the hidden danger of sidewalk safety. In 77 streets, there are many sidewalks and motorways that do not have obvious height difference, and even are occupied by motor vehicle parking, express electric vehicles and other non motor vehicles often pass on the sidewalk. Third, the walking experience is very poor. The sidewalk lacks walking attraction. The first floor buildings beside the sidewalk often do not have public functions, but private houses or office buildings. The building interface beside the sidewalk is often low transparency, high introversion and low pedestrian safety. However, these building interfaces can be used as mobile open shops or other functions.

·**Lack of communication space and natural contact:** in community planning and urban design, the addition of public communication space and landscape plants and the contact with nature play an active role in promoting and restoring the mental health of residents. Ulrich RS research is the first to prove the beneficial effect of natural landscape on the rehabilitation of patients. After that, more breakthroughs have been made in the research of natural landscape for rehabilitation in the public health field, and the research and design of "Healing Garden" has appeared in the landscape design. On the contrary, the public space in the design will affect the frequency and quality of social interaction of residents, while the lack of green natural contact will easily lead to psychological fatigue, mental concentration and other psychological problems of users. Compared with other peripheral urban spaces in Beijing, the old city of Beijing has more excellent public space and more park greening system. However, most of the respondents who work and live in the old city think that they are seriously lack of social interaction and contact with nature. According to the field survey, there are several problems in the open space of Beijing's old city: first, although the park and open space are large in area, they are not very public, and lack of free and accessible community level open space. Second, a large number of community level open spaces are not open to the public, and even private gardens are not accessible. Third, the tree species allocation of green space and park did not consider the patients with allergic and asthma diseases. In the tree species selection, a large number of poplar and other highly allergic "sensitizing plants" of oglen plants were planted. In spring, a large number of poplar and pollen allergens are produced. Figure 5)

4 Conclusion

The list of research projects and the design of evaluation system described in this paper have the following characteristics:

① the content and purpose of the research come from the theory and research investigation of related disciplines with foreign experience, and the research items are designed according to the actual situation of the old city of Beijing, which makes the data collection have a clearer goal;

② the research form is clear in diagram and self-evident in content, so that the latecomers of any academic background can quickly join in the research project, which has a very good sustainability;

③ try to evaluate the current situation of the research content, so that the analysis of the research data from the actual walking experience can be quantified;

④ the grading of research projects is derived from the actual urban design cases that have been well evaluated. It has certain progressiveness and can be used as a direction for improving the existing urban design problems.

In this survey, we also found some problems, such as the density of public transportation, the insufficient use of urban furniture and service facilities, which need more detailed data analysis. I hope that the results of this research can find a series of problems from the perspective of healthy urban design, and contribute to healthy Beijing and livable Beijing.

Endnotes

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