

Research on Urban Community Food Supply Environment Oriented to Health Support

A case study of Yuzhong District, Chongqing

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Abstract

In recent years, chronic diseases related to nutritional intake, such as obesity and overweight, have become one of the most prevalent public health problems worldwide, and it is undeniable that the occurrence of obesity is associated with dietary intake factors. In cities, the food provided by the community food environment is an important source of energy and nutrient intake for residents, and its unreasonable spatial layout can affect the dietary health of residents. The study constructs a quantitative spatial model of health support in community food supply environments, and calculates the level of health support in community food environments through the Diversity Index, Health Index and Balance Index. Selecting Yuzhong District, Chongqing as a case study, the results showed that there was spatial variation in the level of health support in the community food supply environment. Future spatial planning needs to focus on the community food supply environment, we should stress the interaction between lifestyle and food environment, and combine systematic assessment and specific spatial control strategies to improve the multi-faceted optimization of special groups and areas to provide environmental support for residents to form a health-promoting dietary lifestyle.

Keywords

community food supply environment; food facilities; health support

1.Introduction

In recent years, chronic diseases related to nutritional intake, such as obesity and overweight, have become one of the most prevalent public health problems worldwide, and it is undeniable that the occurrence of obesity is associated with dietary intake factors. The changing food environment in urban areas has been paralleled by an increase in the frequency of eating out and buying fast food, which has led to a number of unhealthy eating habits that have already infiltrated people's lives and have had an impact on human health. In cities, the food provided by the community food environment is an important source of energy and nutrient intake for residents, and its unreasonable spatial layout can affect the dietary health of residents. Therefore, it is necessary to explore the community food supply environment as a research perspective on the built environment and population health, and provide a useful reference for the construction of a healthy and supportive community food environment.

Based on the observation records of community food supply environment in a large number of academic studies, the characteristics of the community food supply environment in China are analysed by relation to the actual situation in China. We attempted to quantify the health support benefits of community food supply environments through spatial measurement methods, and then used spatial statistical methods to quantify the health support of community food supply environments in the empirical study area. It is hoped that spatial interventions at the scale of living scenes can guide healthy eating and drinking, which will be of value and significance in further promoting the construction of healthy cities.

2.The methodology of analysis

2.1 Influence relationship theory

The interrelationship between environment and behavior is the basis for the study of environmental health support and is supported by two main theories. One is the behavioral intervention theory, which represents a direct intervention relationship between the environment and human behavior. The second is the theory of spatial interaction, that is, the process of spatial interaction in which human beings exist as mediators, eventually forming a dynamic environmental background that has an indirect impact on people. The influence of the built environment on residents' food choices emphasizes environmental interventions on behaviors in a broad sense, focusing on the environmental support of individuals in the process of behavioral change. The spatial layout of the built environment has the effect of either facilitating or hindering behavior, and acts as the underlying environmental support that guides the daily behavior of residents.

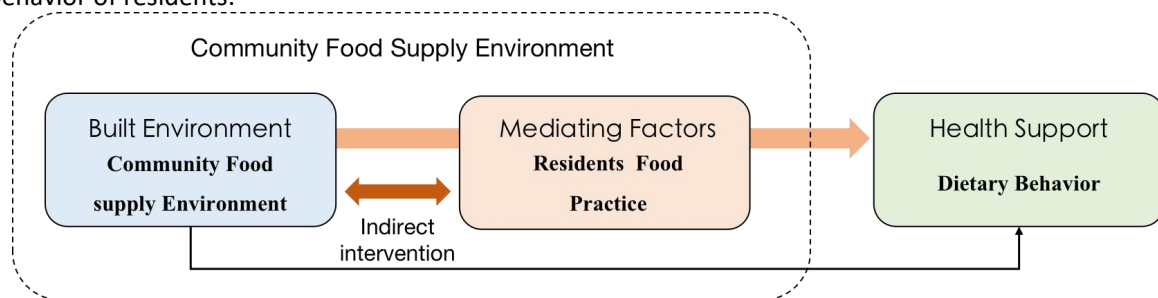


Fig.1 Intervention path of dietary behavior in community food supply environment

Source: Painted by author

According to the basic model of the interaction between environment and behavior, the process of forming residents' eating behaviors intentions in the community food environment can be described as "basic stimulus - directional response - motivational habit", forming a health influence pathway between the community food supply environment and residents' eating behaviors. On the basis of this understanding, a health support pathway of "facility supply - health attribute- spatial linkage" is established, which together form a dynamic and balanced health intervention process.

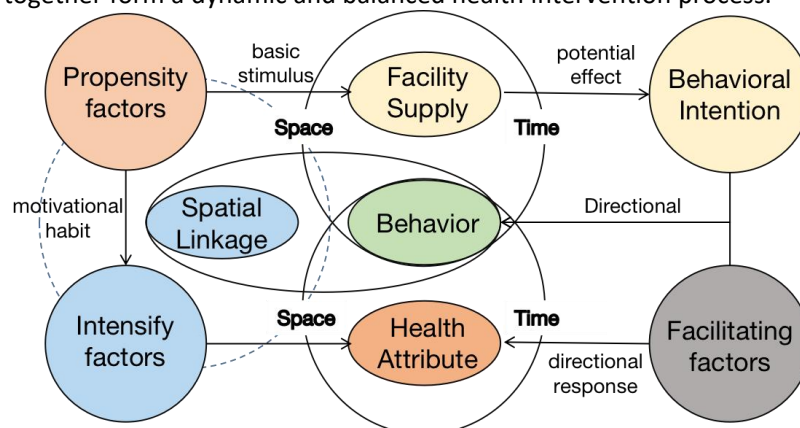


Fig.2 Community Food and Environmental attributes and their components of Health support

Source: Painted by author

(1) Supply of facilities

The lack of food facilities and limited choice in the community is the origin of the food supply environment study. When the area is unable to provide the food supply needed by the residents, the basic physical needs of the residents are not guaranteed, and in addition, it costs more time or money to meet the same food needs.

The number of food facilities within a community food environment is the bottom-line safeguard for food consumption, and the impact on eating behavior is mainly reflected in the availability of enough food to meet people's demands. When the number of food provisioning facilities in a community changes,

residents' access to food will also change and the community food environment will present different health supporting effects. The impact of the availability of facilities in the community food environment on residents' eating behavior is reflected in both the number of food facilities and the type of composition, with more choice in the food environment likely to be beneficial to the health of urban residents and some health disparities associated with the uneven spatial distribution of food facilities^{1,2}. And the more types and numbers of food facilities provided by the community food environment, the better it is for promoting stable eating behaviors among residents.

(2) Health attributes

The health attributes of food facility sites have a two-sided impact on the health support of residents' diets, and a study by Black C measured the health levels of food retail facilities and showed significant differences in overall health according to shop type ($p < 0.001$)³, comparing the ratio of the area of vegetables sold in the shop and unhealthy snacks sold, from the highest to lowest retail shop types were supermarkets (0.55-0.72), medium-sized food shops (0.40-0.61), small food shops (0.18-0.30), and convenience stores, pharmacies, and tobacco and alcohol retail shops (0.1 and below) in that order⁴.

The relationship between dining facilities and health effects is reflected in the accessibility of a balanced and varied range of healthy food at affordable prices. Schröder H used the Food Frequency Questionnaire to survey the fast food intake of 3054 adults in north-eastern Spain and evaluated the respondents by the Mediterranean Diet Score (MDS) and the Healthy Eating Index (HEI) indicators. The results showed that the frequency of fast food intake was inversely related to the dietary quality score ($p=0.001$)⁵. Accordingly, environments that support healthy food choices can be defined as healthier food supply environments, and environments that create health risks and discourage healthy food choices can be defined as unhealthy food supply environments⁶. Therefore, the health attributes attributed to formal food facilities (X_1), supermarket retail (X_4) and specialized retail (X_6) are positive impacts (+), and the health attributes attributed to fast food facilities (X_2), snack facilities (X_3) and convenience facilities (X_5) are negative impacts (-) (Table 1).

Table1. Health attributes of food facilities

| Name of facility | Definition | Health Attributes |
|------------------------------------|---|-------------------|
| Formal dining facilities (X_1) | Comprehensive restaurants serving a wide range of meals are associated with higher vegetable intake | (+) |
| Fast food facilities (X_2) | Fast food intake means higher energy, poorer nutrition, and higher risk of obesity | (-) |
| Snack facilities (X_3) | Higher intake of energy, fat, sugary drinks and lower intake of healthy foods and key nutrients | (-) |
| Supermarket retail (X_4) | Fresh vegetables and fruit are sold in much larger areas than other types of shops, unhealthy snacks sold in relatively low ratio | (+) |
| Convenience facilities (X_5) | High ratio of unhealthy snack selling area in shops | (-) |
| Specialist retail (X_6) | Selling mainly fresh vegetables, fruit, protein and dairy products | (+) |

Source: Compiled from literatures

(3) Spatial linkage

Some studies have shown that distance to fast food restaurants is positively associated with body weight⁵, while the relationship between distance to integrated restaurants and body weight is unclear, and distance from home to supermarket is negatively associated with vegetable and fruit intake^{7,8}. Cliona and Black C have conducted decades of research on the hypothesized relationship between community

food environments and individual eating patterns, yielding complex results, particularly when using proximity measures. More consistent results were obtained when using proximity measures, that a positive correlation was shown between proximity to fast food outlets and poor eating habits^{9,10}.

The community environment in which residents live typically serves as the sphere of daily life, so the possibility of spatially connected food facilities being selected is enhanced, and the possibility of selection of food facilities decays as it diminishes. The spatial linkage of the community food environment reflects the intensity of intervening effects of different types of food facilities on residents' eating behaviors, further enhancing the health impacts of proximity to facilities based on their supply and health attributes.

2.2 Quantification of spatial elements

From the above health intervention pathways of the food environment, it can be seen that three factors, facilities supply, health attributes and spatial linkages are key to the community food environment's health support for eating behavior, and the spatial connotations they represent can be used as spatial elements to explore the health support of the community food supply environment.

Based on the health intervention pathways of community food environment and the perceived health attributes of food facilities, study adopts a quantitative research method to conduct a spatial statistical analysis of community food supply environment. The health support of community food environment was measured from diversity index, balance index and health index, and then a superimposed analysis was used to reflect the current health support of community food environment by a comprehensive judgment.

Table 2. Quantitative Model of Spatial Elements of Community Food Environment

| Measurement factors | Computational models |
|---------------------|---|
| Diversity Index | Shannon-Wiener Index of the number of food facilities in the community context |
| Health Index | Number of healthy food facilities/unhealthy food facilities in the community context |
| Balance Index | Distance to the nearest unhealthy food facility / Distance to the nearest healthy food facility |

Source: Compiled from literature

3. Study area and data


3.1 Study Area

The study selected Yuzhong District as the demonstration area, which is the main urban area of Chongqing and the birthplace and core area of Chongqing's urban construction. Yuzhong District is also the financial, commercial and cultural center of Chongqing. It has 11 streets, including 79 community committees, and a resident population of 662,000 at the end of 2019. The overall land use structure of Yuzhong District is reasonable, the urban functions are complete, and Yuzhong District has a long history of urban construction is a typical example of a concentrated construction area in a mountainous city and an area of integrated development of the old and the new, therefore, it is very suitable to be studied as a typical case of community food supply environment.

3.2 Data

The research data in this paper consists of three main categories of statistical data, basic geographical data and open source web data.

Table3. Data types and sources

| Data name | Format | Time | Source |
|--|---|------|---|
| Demographic and socio-economic data | Excel | 2019 | China National Bureau of Statistics |
|  58TH ISOCARP WORLD PLANNING CONGRESS | FROM WEALTHY TO HEALTHY CITIES | | URBANISM AND PLANNING FOR THE WELL-BEING OF CITIZENS |
| | | | 3-6 OCTOBER 2022 BRUSSELS BELGIUM |

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|---|--------|------|-----------------|
| Chongqing Municipal Boundary and Water System | Vector | - | NFGIS |
| Road network in the main city of Chongqing | Vector | 2019 | Open Street Map |
| Chongqing POI Data | Excel | 2019 | Amap |
| Chongqing Main City Building | Vector | 2017 | Amap |
| Yuzhong District Community House Prices | Excel | 2019 | Lianjia.com |
| Satellite remote sensing map of Chongqing | Raster | 2019 | Google Earth |
| Chongqing Yuzhong District Elevation Map | DEM | 2019 | Google Earth |

The food facility POI data was classified according to the Amap POI classification code list as the basis for filtering. Filter out the eight medium categories of food and beverage related places(0500),Chinese restaurants(0501),foreign restaurants(0502), fast food restaurants(0503), casual dining places(0504), convenience stores(0602), supermarkets(0604), and general markets(0607). Then the categories such as Watson's(060411), Mannings Supermarket(060415), General Market(060700), Small Commodity Market, (060701) and Thrift Market(060702) which are not used as the main food supply facilities, were eliminated.

Invalid and incomplete data were manually eliminated according to type details and facility names, and a total of 55 items were deleted. The total number of food facility POI data in Yuzhong District after the final classification process was 11,779. Based on the previous results of organizing and reclassifying the food facility POI data, the study used the Arc GIS spatial analysis tool to establish a geographic database (GDB), and converted the food facility data of Yuzhong District into a shapefile file with spatial information to replace the facility points in the real space, so as to obtain the spatial distribution profile of community classified food facilities in Yuzhong District, Chongqing City(Fig. 3).

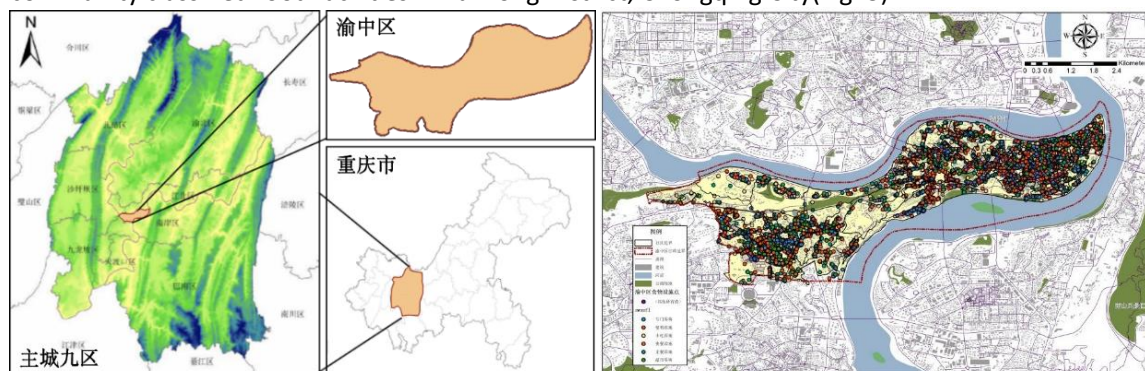


Fig.3 Spatial distribution of classified food facilities in Yuzhong District

Source: Painted by author

4.Results

Based on the theoretical construction basis of community food supply environmental attributes and their components of Health support. The quantitative analysis of the community food environment in Yuzhong District was conducted through big data collection and spatial statistical analysis to obtain the quantitative results of health support for the community food environment in Yuzhong District.

(1)Diversity Index

The distribution of diversity index levels in Yuzhong District can be visualized that the diversity of community food environments in Yuzhong District is generally low, with the distribution area basically

covering 80% of the area, and the spatial structure shows a gradual increase in diversity from the east to the west to the center (Fig.4-a).

(2)Health Index

The distribution of health index levels in Yuzhong District can be seen directly that the health levels of community food environment in Yuzhong District are relatively average, with negative and average types basically covering 80% of the area in spatial distribution, and the same spatial structure shows a gradual increase in diversity from the east to the west to the middle (Fig.4-b).

(3)Balance index

The distribution of the balance index levels in Yuzhong District can be intuitively seen from the graphical representation of the community food environment in Yuzhong District. The facilitating communities are scattered along the east-west axis of Yuzhong District, the spatial areas of the average and hindering communities are basically equal, and the hindering communities are clustered in the southeast side (Fig.4-c).

(4)Combined effect

It can be intuitively seen from the graphical representation of the distribution of comprehensive health grades in Yuzhong District that the overall food environment in Yuzhong District is weakly supported by health, with weakly supported communities and below covering about 50% of the area in spatial distribution. The spatial structure shows an overall trend of weak core areas in the east and west, while stronger health support in the central part (Fig.4-c).

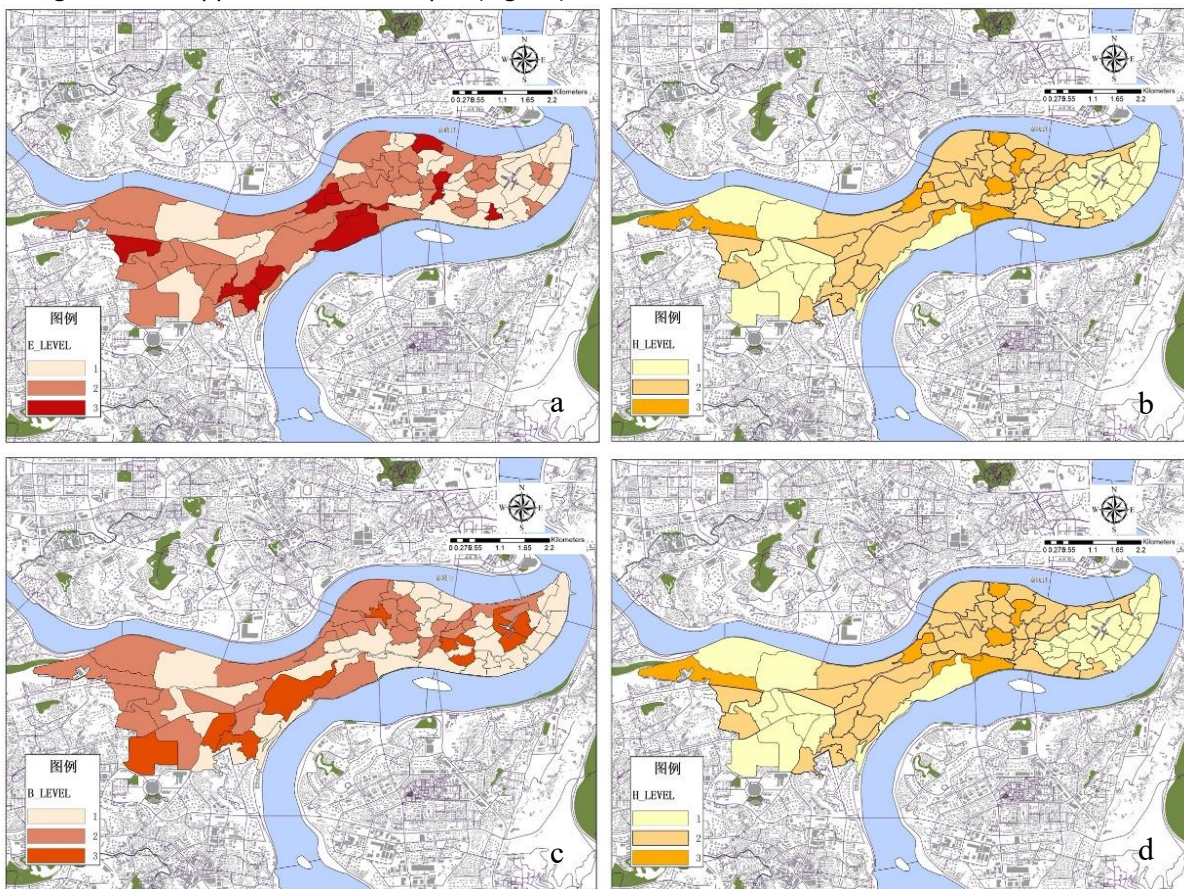


Fig.4 Quantitative results of health support for community food supply environment in Yuzhong District

Source: Painted by author

The spatial autocorrelation analysis tool was used in ArcGIS software to analyze the spatial autocorrelation of the health support results of the community food environment in Yuzhong District.

The results of the comprehensive evaluation of health support of the environment in Yuzhong District showed positive spatial correlation.

Table 4 Spatial autocorrelation analysis of health support

| Moran's I | Expected Index | Variance | Z Score | P-value |
|-----------|----------------|----------|---------|---------|
| 0.27085 | -0.012821 | 0.004166 | 4.3948 | 0.00001 |

According to the results of the comprehensive evaluation of health support, there is a more obvious spatial variation in the health support of the community food supply environment, and to a certain extent, there is a mutual influence between neighboring communities, leading to a convergence of the health impact of the food environment within the street scale. At the same time, the influence of community dominant functions is significant, and the environmental factors that cause its spatial differentiation need to be considered comprehensively when judging the health support of community food environment.

5. Discussion

The spatial layout of the community food environment is a complex process in which spatial planning and market economy work together. In a comprehensive assessment of community food environment health support in Yuzhong District, 60% (48 communities) were at low levels of health support. From the three measured indexes, the negative type of health index exists in three levels from very weak to moderate health support, while the percentage of low diversity index decreases from 69% of very weak support to 54% of weak support and exists only in low level of health support, proving that the influence of health attributes of food facilities is more significant when the diversity index of food facilities in the community food environment is low.

In contrast, the hindrance type of the balance index runs through four levels from very weak to stronger, respectively 92% in very weak support, 40.9% in weak support, 19% in moderate support, and 12% in stronger support, proving that the problem of balance in the food environment is commonly found. It also means that most residents in Yuzhong District are closer to unhealthy food facilities such as fast food, snacks and convenience stores in their daily lives and further away from healthy food facilities such as formal restaurants, supermarkets and fresh markets in terms of spatial distance, which, together with the poorly developed road network in mountainous communities, makes the community food supply environment present a lower level of health support.

The spatial layout of the community food environment is formed in two stages. In the preliminary stage, it is mainly based on the regulation of land use types by urban planning, while the specific type and quantity of food facilities is a process of dynamic change in the market, and the community food environment gradually forms the spatial layout status quo under the guidance of the market. Thus, the singleness and unbalanced spatial distribution of the community food supply environment reflects the joint action of the market and the plan, it is necessary to give attention to community food environment construction at different stages. Starting from the adjustment of consciousness, we should stress the interaction between lifestyle and food environment, and combine systematic assessment and specific spatial control strategies to improve the multi-faceted optimization of special groups and areas to provide environmental support for residents to form a health-promoting dietary lifestyle.

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