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Evaluating Human Needs: A Study on the Spatial Justice of Medical Facility Services in Social Housing Communities in Guangzhou

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Abstract: Mainstream empirical studies on the spatial justice of medical facilities focus on equal accessibility or resource availability based on population scale, overlooking critiques that emphasize the importance of assessing inequality and the multidimensionality of human needs. However, access to medical care, particularly for vulnerable groups in social housing, often demands a higher level of consideration. Evaluating whether people can access the facilities they demand and expect is crucial for improving living standards. This study categorizes medical facilities into primary healthcare and hospital facilities based on their service grade, and integrates survey-based satisfaction into a spatial analysis of cost–distance-based accessibility and gravity-2SFCA-based availability. Analysis reveals that satisfaction primarily correlates with two factors: the distance to primary healthcare and the ease of reaching hospital facilities. While low accessibility to primary healthcare contributes to the evident distribution injustice of medical resources, satisfaction with service quality and scope is more strongly associated with the ease of reaching hospitals. To reduce injustice in social housing, specific remedies are needed to improve the difficult conditions for accessing primary healthcare faced by communities such as Guangdan, Likang, and Jinshazhou. Moreover, improving the easiness of reaching hospital facilities may significantly enhance the resident satisfaction with the level of medical service provided. Findings obtained in this research may not only enlighten Guangzhou's urban planning, but may also be noteworthy for developing livable cities, which people anticipated.

Keywords: human needs; spatial justice; medical facilities; accessibility; social housing; urban planning

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1. Introduction

Access to medical care is a daily necessity, especially for residents in social housing, where medical facilities are crucial for maintaining well-being [1,2]. Social housing, also referred to as affordable housing in most western countries and designed for welfare purposes, aims to address the housing difficulties faced by vulnerable groups [3–5]. As a consequence, these communities often comprise a higher proportion of ageing individuals, people with disabilities, and those with some health issues [6,7]. They demonstrate a strong demand for easy access to medical services, including routine healthcare, treatment for illness, and emergency care. Thus, fulfilling medical needs has been considered to be essential for developing a healthy social housing community. Though many western scholars have presented extensive examinations of medical facility services starting in the early 1970s, it was not until the 1990s that studies began to emerge focusing on spatial equity, equal accessibility, and availability from spatial perspectives. Soon after, Chinese geographers became involved in related studies, and their rich empirical research made significant contributions to both methodologies and urban planning.

In Guangzhou, social housing provision has triggered the relocation of economically vulnerable groups to peripheral areas with inadequate facilities [8]. Despite housing condi-

tions improving significantly, certain inconvenient consequences have emerged, such as reduced accessibility to reliable medical facilities, quality education, and vibrant commercial environments. To address the primary medical needs of social housing residents, the local government has established some primary medical facilities physically attached to large and distant communities (referred to as Weishengzhan and Shequ Zhensuo). However, smaller communities lack dedicated healthcare facilities, forcing residents to seek medical services in the vicinity.

Many researchers recognize that the inferior location of these housings leads to locally unjust phenomena, including inadequate infrastructures, job–housing mismatch, residential segregation, and discrimination. Given that the spatial distribution of services is often determined by location [9], significant efforts have delved into measuring accessibility and availability levels and evaluating the rationality of spatial layout within a given geographical space. Frequently used models or indices include servicer-to-population ratio-based two-step floating catchment area (2SFCA) and enhanced-2SFCA or further 3SFCA, index of dissimilarity, location- and route-based service area, and personal travel time-based analyses. These analyses are based on some spatial factors such as location, distance, the transport system, territorial range, and some non-spatial factors like population and service counts [10,11].

Though measurements of proximity, accessibility, and availability based on these indicators have provided a foundation for spatial justice research, more efforts are still needed. Underestimating people's complex needs regarding the service level, quality, and price of medical treatment, relative to their socio-economic status, may result in dubious explanations concerning justice [12–14]. Inadequate attention has been paid to the real healthcare-related needs, which are not only easy access, but also the potential to reach facilities that meet people's expectations or needs. For instance, a shorter travel time may prove to grant easier access, fewer services per capita within a given geographical area denotes poor accessibility [15], and significant difficulty in reaching required medical care may signify a lack of justice. Ideally, people's demands for medical care may cover several aspects: physical proximity to facilities, sufficient physicians or beds, short wait times, compatible medical providers, reliable treatments, and affordable prices [16]. Therefore, this study aims to examine the spatial justice of medical facilities by using a combined method of availability and personal assessment, while addressing the factors of human needs.

The aim of addressing human needs in this study lies in efficient guidelines for urban planning with respect to health services, rather than providing any innovative methods as many spatial examinations engaged in. To effectively improve the quality of life for social housing residents, it is crucial to evaluate the level of medical services in terms of accessibility, quantity, and quality. Therefore, within the domain of spatial justice addressing human needs, this study employs a GIS-based approach and survey analysis to answer two research questions. (1) How should we gauge human needs in empirical studies of accessibility and availability? What aspects of human needs should be considered, and what indicators can be used to gauge justice in this study? (2) What level of justice do social housing residents in Guangzhou experience regarding the distribution of medical facilities? The results may be beneficial for identifying whether social housing residents truly experience injustices, and may suggest effective remedies for improving potential conditions of injustice. Primarily, the corresponding findings of these questions may contribute to positive effects on urban strategies regarding the spatial distribution of medical facilities within the city of Guangzhou. Additionally, emphasizing the notion of human needs may illuminate and foster more effective inquiries into achieving spatial justice.

2. Literature Review

The paradigm of spatial justice formulates a socio-spatial dialect perspective that encompasses a broader range of research scope including resource allocation inequality,

residential segregation, job–housing mismatch, and local discriminations. The theory addresses both unjust physical phenomena and active geographical practises in real society. This merit makes it particularly suitable for investigating the living quality of vulnerable groups, such as our targeted group of social housing inhabitants who have lower economic statuses. Furthermore, most spatial work is fragmentary with little attention given to internal logic, parameters, the accuracy of estimation, and the relevance of theory [17]. Therefore, this section starts by underscoring the concept of human needs as proposed by the theory of spatial justice. It then reviews the methods developed for solving justice problems and closes with improved operations suggestions considering the strengths and weaknesses of current studies.

2.1. The Definition of Spatial Justice

In comparison to refining the logical thinking of justice critiques in the fields of morality, philosophy, sociology, and legislation, the theory of spatial justice within a geographic context addresses more of what it actually is, clarifying the situation as being good or bad, right or wrong [18]. For spatial justice to be meaningful, its principles must be successfully applied [19].

The establishment of the nominative concept of spatial justice was principally inspired by the two notions of obtaining rights in urban space proposed by the right to the city [12,20,21], and the pursuit of the fair and equitable distribution of resources addressed by Marxist geographers in the spatiality of social justice [22,23]. Despite discussions appearing much earlier among British Geographers, explicit endeavours relating to spatial justice were unnoticed in the 1960s. However, geographical studies experienced a less active period from the 1970s to the 1990s, during which justice and spatial structure discussions were primarily moral-based [24–26].

To advance the pursuit of a better and just society, Harvey [27] and Lopes de Souza [28] first triggered broad discussions on surplus distribution in urbanization processes through a series of phenomena such as urban demolition, reconstruction, fragmentation, and space deprivation [29]. Concepts like local justice [30], distributive justice [23], and territorial justice [31] subsequently emerged, focusing on the allocation of material resources to a fixed number of receivers. Scholars from Chicago schools and planners in Los Angeles firstly used the term "spatial justice" to explore phenomena shown in urban spaces [32,33]. Second, Young [34] further established structural justice, underlining the importance of allocating institutional subjects such as power, rights, and opportunities, and doubting that distributive justice is restricted to the outcome of material goods. By identifying structural factors and their effects, spatial justice studies expanded to wider fields such as exploitation, marginalization, powerlessness, cultural imperialism, and violence [35]. Furthermore, researchers like Purcell [21], Ellis and Kessel [36], and Uitermark et al. [37] deliberated the forms of spatial justice at global and regional levels, considering the role of urban space in global capital flows and post-colonialism. Fainstein's "The Just City" [38] and Chatterton's "Urban Commons" [39] proposed the criteria of equality, diversity, and democracy. Ultimately, Soja [40] foundationally constructs the theoretical paradigm of spatial justice in his influential work "Seeking Spatial Justice".

Taking into account the abundant discussions above, recent studies on geographies of justice emphasize two themes: seeing justice, and seeking justice. The concept of spatial justice presents in a socio-spatial dialectic perspective, serving as both a theoretical critique and a practical method, both a product and a producer, both stable and dynamic, and both a process and an outcome [41]. Contrasting with the view that space is an effective tool for social control, mastery, and dominance [42], and that unjust geographic phenomena are derivatives of social injustice [43], Soja [35] placed spatial force at the same position as social, political, and economic forces. Soja [44] explored six discourses—Flexcity, Cosmopolis, Exopolis, Metropolarities, and Carceral Archipelagos—to examine the results of spatial inequality and stratification based on class, race, or capital articulation. Samara et al. [45] analyzed urban injustice from a socio-spatial dialectic view through

urban space reconfiguration with political regimes and active actors. A discussion of Kipfer and Kanishka [46] addressed a search for spatial forms of political domination. Thus, the paradigm of spatial justice contains two primary research topics: (1) explaining the level of justice in socio-spatial outcomes, and (2) seeking out the spatial causality and formation processes of injustice. Combining Young's [34] five forms of spatial injustice—exploitation, marginalization, powerlessness, cultural imperialism, and violence—with Fainstein's [38] three dimensions of justice—territorial distribution justice, social spatial justice, and institutional power—this study summarizes the research dimensions into two parts: territorial distribution justice and local discrimination [47].

The prominent way to achieve spatial justice is through the territory-based distribution of opportunities, wealth, and goods [18,19]. Emphasizing visible space facts, territorial distribution justice remains the central topic, though it is often regarded as a narrow and sometimes doubtful explanation of spatial justice. The research embraces both the equity of physical distribution and the fairness of a broader range of social goods such as experiences, power, opportunities, and neighbourhood environments [48,49].

Structuring criteria for territorial distribution justice are established based on several aspects: respecting specific productive and consumptive functions of each good, meeting the basic needs of people in every territorial unit, taking account of rational needs and merits in special situations like earthquakes or floods, and maximizing the interregional multiplier effect of allocation [20,22,23,50]. Scholars have established two principles to clarify conditions for just distribution that should be complied with in sequence: proportional equality and meeting individuals' needs [31,51]. The first rule, proportional equality, applies to measuring resources representing a minimum standard of living. The outcome of just distribution can be understood as a geometrical equality, which maintains the idea of propositional service provision to needs in the real world [52]. More often, just allocation should comply with the second rule of meeting individuals' needs, which stands on unequal distribution. Consequences may be hierarchical, showing different levels of access experienced by territorially defined groups to common goods [53]. In other words, criteria are structured in terms of two types of human needs: basic needs and wider needs. Therefore, delineating the contents of human needs is essential work in the evaluation of territorial distribution justice.

2.2. The Human Needs

Identifying and assessing human needs in practise poses significant challenges [54]. The first issue concerns defining the threshold of basic needs, generally accepted as the right to freedom, the security of private property, and material resources that are minimum requirements for urban life, such as transportation, primary medical care, and primary education [11,12]. Since scholars consistently agree that basic needs essential for human survival should be equally addressed and met, evaluation should follow the first rule of proportional equality, and possibly be conducted through well-defined indicators such as equal access, or using the match ratio of services-to-population [55].

A greater challenge lies in establishing standards for assessing wider needs (such as needs as demands, needs based on desires) beyond the basic ones [56]. Just distribution does not eliminate differences between people but draws attention to those variations connected to individuals' needs [34]. Different to the easiness of measuring basic needs aligning with breadth (e.g., population, and the number of needs), identifying these multidimensional needs requires depth [11]. This produces difficulties in measuring as needs are more abstract to measure. Needs are unequal and differentiated because of linking to both emic and etic factors such as age, education, and income [57]. On the one hand, it is necessary to treat material or social goods differently in accordance with their characteristics, as specific social meanings are attached to them [58]. On the other hand, including personal perceptions of experiences, emotions, and senses of identity is indispensable [59,60], since needs in society also cover the range of expressed needs, felt needs, and some combination of them [52].

The multidimensional nature of needs causes significant challenges in defining the weight of each dimension. This intricate task lacks absolute criteria, particularly when evaluating the reasonableness of personal needs and assessing the demands of different social groups or individuals concerning social and material goods. Factors such as rational needs, merits, and contributions further complicate this assessment [61]. There is no absolute or linear correlation between people's needs and service provision. Even if there is, it cannot fully prove to be a just standard. For instance, Jesson et al. [62] found a "U-shaped" correlation between people's educational needs and social class, but there are significant differences in the quality and quantity requirements for primary and secondary education.

Furthermore, the spatial justice of healthcare does not an equality of all kinds of medical facilities in the distribution. It is a more complex concept encompassing the equal fulfilment of primary healthcare needs within a certain geographical area and accommodating rational differences aligned with wider needs of service levels of facilities. This includes adequate and reliable treatment, short travel and wait times, and affordable costs [16]. Daniels [63] has found there to be three conditions in seeking justice in medical facilities: (1) utilization for needs, referring to the potential effects caused by structural features of medical facilities, such as the available hospitals and physicians, and the service level of facilities; (2) process variables like travel or waiting times, reflecting the access people have; and (3) market constraints in catering to people's preferences.

2.3. The Rationale of Accessibility and Availability

Though enlightened by theoretical critiques concerning human needs in spatial justice, operationalizing these concepts demonstrates various challenges in delineating the criteria of distribution justice and human needs [64]. Due to the complexity inherent in estimating subjective, varied, and multidimensional human needs, most studies on facility distribution have opted for more easily measurable concepts such as equity or equality instead of justice [13]. Thus, researchers have predominantly developed two ways, namely accessibility and availability, to deal with relative issues.

2.3.1. What Is Accessibility and Availability?

Accessibility plays a crucial role in assessing the rationality of spatial facility layouts. While a normative definition of accessibility is not easily found, it is widely accepted to be a temporal-spatial matter related to physical proximity and ease of access [65]. Accessibility analysis typically involves either geometric distance-based or travel-based methods. Firstly, geometric distance measures, such as GIS-based network distance, road-based travel distance, Euclidean distance, and cost distance, are prevalently used to map service areas and assess spatial interaction between locations [15,66] through defining the maximal distance from a point of people in need to observe the potential weight of spatial interaction between two locations. For instance, Farhan and Murry [67] identified catchment areas of a park-and-ride facility within an acceptable travel time and travel direction.

Secondly, travel time is also widely adopted to define travel accessibility [6]. Some researchers advocate for an individual-based travel distance as it offers a more reliable database [68]. Individual travel behaviours and choices are influenced by intrinsic needs, which are reflected in their actions [69,70]. For instance, Niu et al. [71] manifested the impact of commercial facility distributions on walking-based consumption behaviours using travel distance and travel frequency. Rahman and Nahiduzzaman [72] have tested accessibility in Saudi cities through surveyed travel behaviours. More recently, researchers started to use mobile phone-based big data to inspect accessibility [73,74].

Availability is normally defined by the density of resources, representing the match ratio of services-to-population [75]. Early studies utilized various indices such as Kernel density [76,77], the index of dissimilarity [78,79], the Gini coefficient [80], and LISA [81] to assess the spatial match between opportunities and populations. More recently, increased attention has been directed towards a spatial quantitative method known as the two-step forward catchment area (2SFCA) to gauge the available number of facilities or opportunities

for the target population within the catchment area [82,83]. Essentially, it is a fact of proportional allocation in a defined space [52]. The catchment area is determined by the threshold of travel time, with locations reachable within a specified travel time being included in the calculation, while those outside the area are excluded [67].

This 2SFCA method contains two main steps: First, its calculates the ratio of the supply to its surrounding population within the catchment area. Second, it sums up all ratios at each demand location [84]. Moreover, recognizing that places closer to the supply may be more beneficial, some studies have enhanced this method with a gravity model to account for distance decay [85,86]. For instance, Salze et al. [14] used a gravity model to delineate declining accessibility along an increasing distance.

$$A_i^s = \sum_{j=1}^{n} O_j^s \cdot f(d_{ij}),\ f(d_{ij}) = d_{ij}^{-\beta}$$

A_i^s is the potential of point i for a given type of opportunity S, O_j^s refers to an opportunity at point j, and $f(d_{ij})$ is the function of the gravity model to define people's decaying willingness for a visit.

Ni et al. [87] examined access to elderly healthcare facilities in the city of Nanjing, considering the proximity to affordable housing. Enhanced models also include 3SFCA, which points out that the number of available resources is less than a sum due to the market competition existing among them [88]. In conclusion, research has recognized that accessibility is a multidimensional issue concerning temporal, social, and economic factors, and scholars are continually striving to enhance the accuracy and practicality of their studies [89]. However, most estimations are still limited to factors of location, service scale, travel time, and population, which may not fully capture the real needs of individuals. Despite methods of accessibility and availability having advantages in measuring spatial interaction, their evidenced questions are connected to, but not equivalent to the justice issue. As Lee [10] elucidated, indicators and criteria only offer a good first screen to identify types of injustice, shortages and underservices of medical facilities. More attention should be given to understanding the diverse needs in different areas, the kinds of staffing, mixed needs, or the priority settings among areas.

2.3.2. Combined Analysis of Satisfaction and Accessibility

Defining healthcare-related needs is essential work for estimating justice or the shortages of medical facilities across different areas. An accurate identification of human needs requires a consideration of various factors. Injustice in reaching medical facilities is not only a difficulty, but also a failure in satisfying the desired amount of access or the number, quality, and price of services. Evaluation should weigh individuals' mental conceptions and ontological imaginations. Formulating standard indicators for real needs seems ambiguous due to the unstable effects of factors such as income and education [54]. Consequently, studies often rely on residential satisfaction to capture individuals' needs and perceptions [16]. Many studies have manifested a positive relationship between the proximity to public facilities and housing satisfaction [90,91]. These examinations principally considered factors from three dimensions: the socio-economic backgrounds of individuals, the locations of facilities, and the scales of supply and demand. However, little attention has been paid to the features of facility services, such as their service grade, scope, quality, and cost. Yet, each of these elements may play a role in personal decision-making and satisfaction in choosing a matching facility [92–94]. Assessing detailed aspects of service quality and cost is obviously insufficient in current methods such as accessibility, availability, and satisfaction. The primary objective of this article is to estimate the justice of medical facilities from the perspective of human needs, and a combined analysis based on accessibility, availability, and multifaceted satisfaction may assist in achieving this goal. Rather than focusing on innovative methods, our study underscores ways of estimating human needs.

In the aims of testing spatial justice, approaches of availability may be more suitable than methods of accessibility, because more socio-economic factors have been involved.

But the consideration limited to the number of services and population amount falls short in finding the distribution justice of medical facilities, as multi-dimensional personal needs are still excluded. The combined analysis of satisfaction and availability may provide an efficient means in the current situation. Therefore, our estimation has adopted combined methods to underscore human needs, rather than developing any innovative techniques for spatial analysis.

3. Study Area, Methods, and Data

3.1. The Guangzhou City

Guangzhou, as a pilot city, has effectively explored a suitable scheme and undertook an intensive construction of social housing blocks over the past two decades [6]. The demand for housing has remained robust but affordability has become a pressing issue for citizens [95], especially after the housing commercialization in 1998 [96,97]. The intensification of land use and the rise in housing prices in urban areas exacerbated difficulties faced by citizens with relatively lower incomes in acquiring affordable housing on the market [7,98]. Consequently, the local government has taken steps to alleviate this issue by selling or leasing social housing units at more favourable prices, thereby relocating a significant number of middle- and low-income households to newly constructed neighbourhoods on the outskirts [3–5]. Since 1994, Guangzhou has witnessed three waves of social housing construction: initially, ANJU and JIEKUN housing was constructed before 2000, followed by low-rent housing (LRH) and economically affordable housing (EAH) between 2000 and 2014, and more recently, public rental housing (PRH) has been dominating the provision since 2015 [99,100]. Among them, LRH caters to the housing needs of the lowest- and low-income households, while EAH targets middle- and lower middle-income families by offering dwellings with restricted sizes and prices. In comparison, PRH aims to provide housing solutions for a wider range of individuals facing difficulties, such as young workers, migrant workers, and new urban residents. As of 2021, a total of 93,800 housing units have been completed, including nearly 50 newly built communities and scattered housing units, including dormitories and second-hand units. The majority of them are situated in the less-developed urban fringe with fewer numbers of facilities; only 2% lies in central districts (see Figure 1).

Depending on the locations and sizes of the land parcels, the local government has constructed communities of varying sizes and designed them to accommodate single-type housing or a mix of multiple housing types. In several peripherally located communities (with populations exceeding 3000, for example), specific primary medical facilities were built to meet very basic healthcare needs. These facilities are typically integrated within the community. Hospitals in close proximity are extremely rare. More often, residents in smaller communities rely on adjacent facilities such as clinics and physicians within other communities, or seek out physicians in their neighbourhood.

3.2. Methods and Data Processing

This study defined territorial distribution justice as a multifaceted issue embracing both socio-spatial and humanistic dimensions. Given the importance of considering human needs, our approach combines service area-based accessibility and availability using the gravity-based 2SFCA (two-step forward catchment area) method, along with survey-based satisfaction assessments. To identify differences in human needs, we classify medical facilities based on their grade of service, drawing inspiration from the central place theory [101]. Additionally, we measured personal assessments of facilities from aspects of accessibility, the quality of the healthcare service, and the scope of services [16]. The following sections will provide detailed insights into our data sources, processing techniques, and the methods employed to complete our analysis.

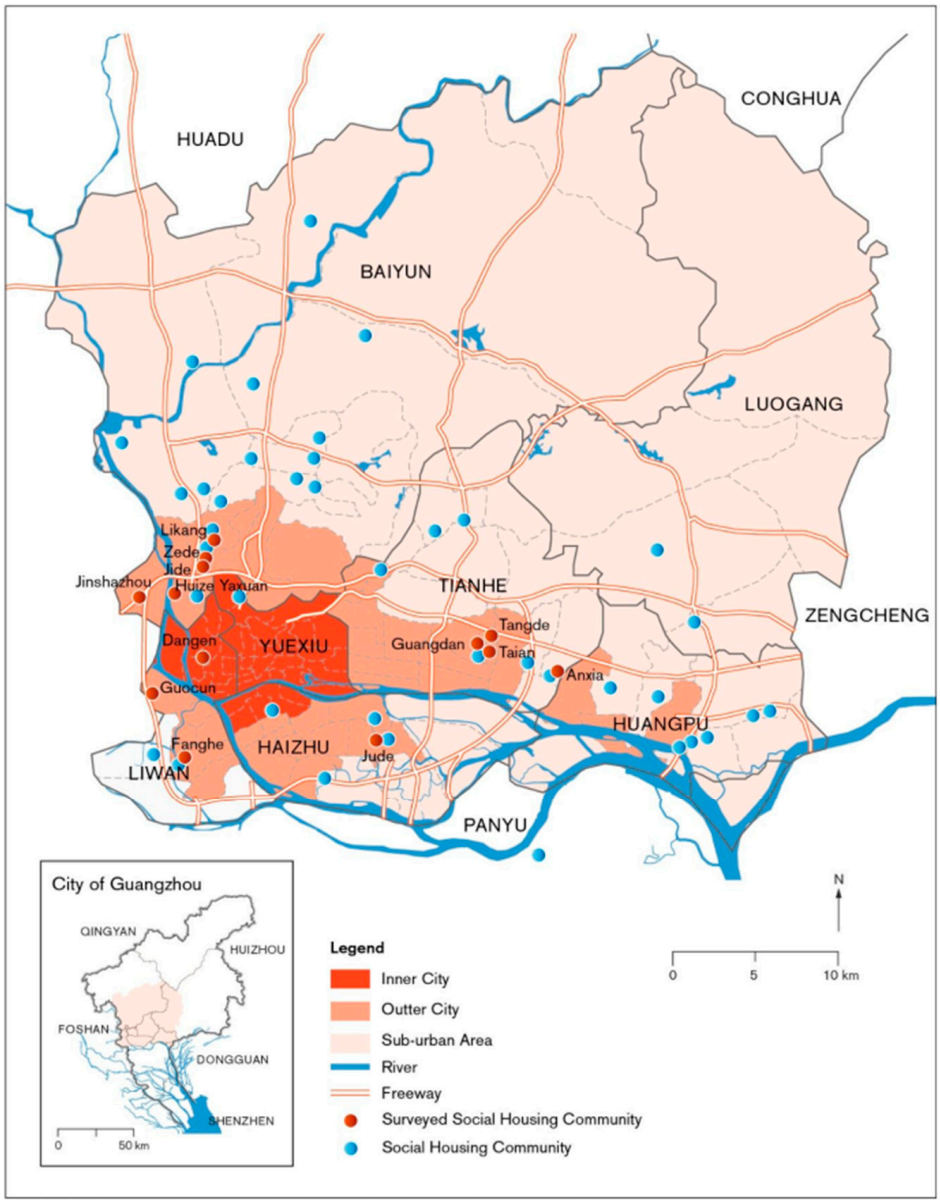


Figure 1. Spatial layout of social housing communities in the main urban area of Guangzhou.

Data collection: The data source for this study comprises map data, statistical data, website data and survey data. Initially, a base map was constructed using ArcGIS, which included the locations of medical facilities, road networks, and administrative boundaries of central urban areas such as Liwan, Yuexiu, Haizhu, Tianhe, Baiyun, Huangptu, and Luogang districts. The smallest geographic unit utilized in this study was the sub-district (*Shequ*), consistent with census data, comprising a total of 116 sub-districts. Socio-economic data, such as population figures, were assigned to the centroids of sub-districts. Additionally, socio-economic attributes were derived from both statistical data and the website of "99yiyuanku". The number of healthcare professionals, patient beds and the grade of service were given for 1309 medical service points in Guangzhou city. Furthermore, the socio-spatial information of 13 surveyed communities, demographic data, and individual satisfaction assessments were collected during the fieldtrips and through two rounds of questionnaire surveys in 2014, involving a total of 660 respondents (see Table 1).

Table 1. The details of 13 surveyed social housing communities.

Name	Location	Time Built	Scale (Number of Houses)	Housing Type	Sampling Quantity (Person)
Fanghe	Liwan District	9/2010	5935	LRH and EAH	100
Guocun	Liwan District	1/2009	929	LRH and EAH	20
Dang'en	Liwan District	1/2009	512	EAH	20
Jude	Haizhu District	1998; 2008; 2009	2691	ANJU, JIEKUN, LRH and EAH	100
Tangde	Tianhe District	1998; 11/2008; 2016	2649	ANJU, JIEKUN, LRH, EAH, and PRH	100
Guangdan	Tianhe District	9/2011; 7/2012; 2016	4446	LRH, EAH, and PRH	20
Tai'an	Tianhe District	1/2009	675	LRH and EAH	20
Anxia	Tianhe District	9/2011	2113	EAH	20
Zede	Baiyun District	1998; 2008; 2010; 2012	5758	ANJU, JIEKUN, LRH, and EAH	100
Jinshazhou	Baiyun District	1/2008; 2018	5227	LRH, EAH, and PRH	100
Jide	Baiyun District	1998	1747	ANJU, JIEKUN, LRH and EAH	20
Huize Yaxuan	Baiyun District	1/2011	426	EAH	20
Likang	Baiyun District	1/2008	166	EAH	20

Note: LRH is low-rent housing, EAH is economic affordable housing, PRH is public rental housing.

Regrouping medical facilities: The real demands and expectations largely relate to the characteristics of the medical facilities. Also, drawing insights from the central place theory, it is evident that hospitals are not as easily accessible as primary healthcare facilities. This is because hospitals serve larger areas that contain several smaller-size service areas of primary healthcare facilities [102]. This study decided to identify medical facilities by groups of primary medical facilities and key hospitals (see Figure 2). Primary medical facilities, such as clinics and medical care stations, offer limited physicians and basic treatments. Key hospitals operate at a higher level catering to a larger population; they are classified into AAA-hospitals, AA-hospitals, and A-hospitals in terms of scale, service quality, and complexity.

Measuring service area—method of cost distance: The analysis of service areas employed the cost distance approach. While network analysis could potentially offer a more precise assessment by considering vectoral factors such as traffic flows, connectivity, and velocity, our resources did not allow us to meet the high database requirements necessary for such an approach. Hence, we opted to include the effect of the road system and employ the cost distance method instead. We first created a polyline-feature layer to represent the road system, then converted the feature layer to a raster form. Next, we constructed the cost surface by revaluing each grid using the "Reclassify" and "Weighted overlay" tools. In this process, areas corresponding to roads were assigned a value of "1", while non-road areas were assigned a value of "10". That means that crossing a non-road cell incurs a tenfold higher cost than travelling along a road cell. Referring to the average velocity in Guangzhou, we set the walking speed at 4.2 km/h and the bus speed at 21 km/h. Finally, we generated six buffered rings around each medical service point, representing travel times of 20 min, 40 min, and 60 min by both walking and using bus transportation.

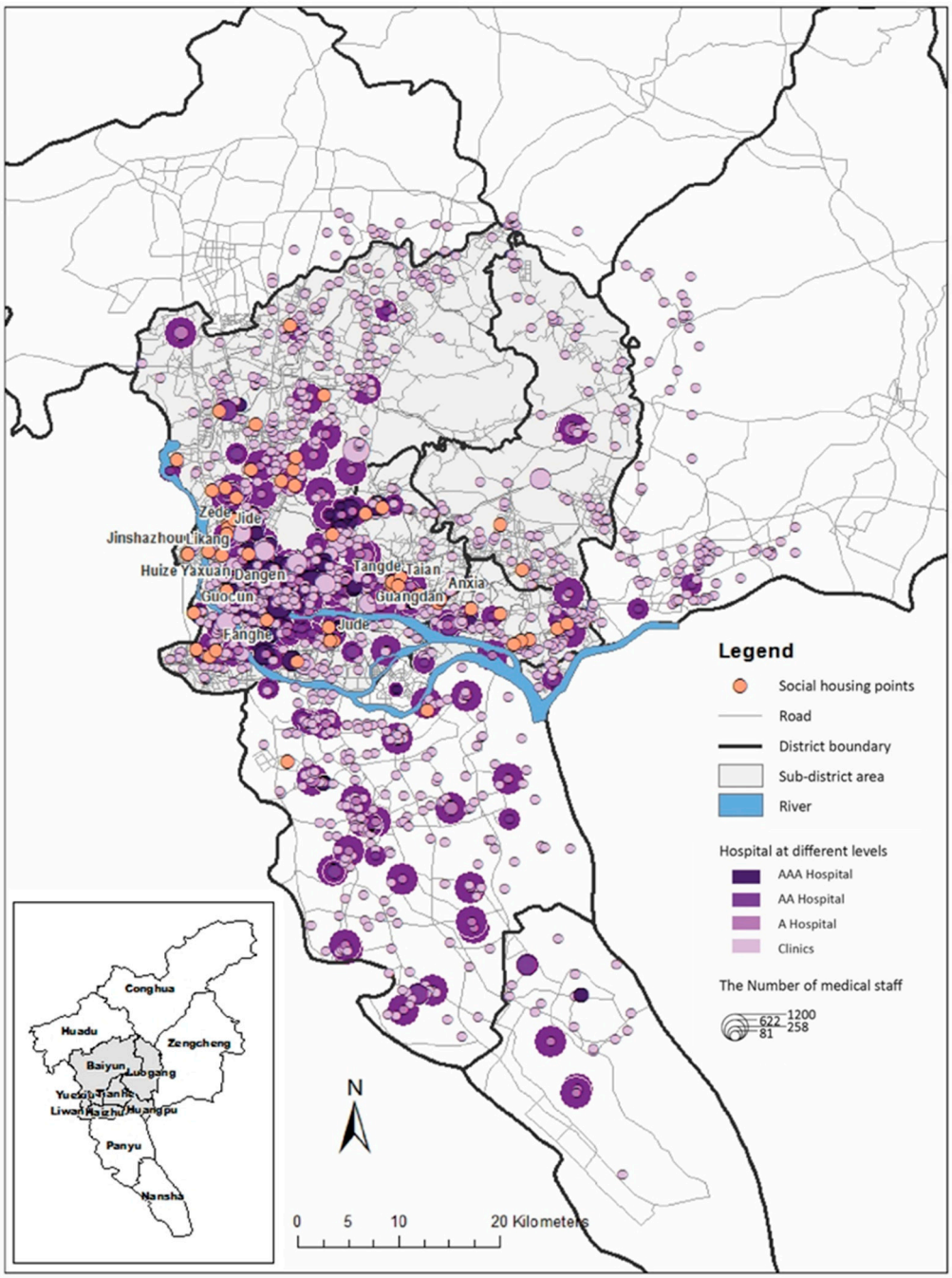


Figure 2. Distribution of medical facilities in Guangzhou city, 2017.

Measuring availability—the method of gravity-based 2SFCA: This section utilized an enhanced 2SFCA method using a gravity model (the distance decay parameter ß set to "1") as the way to elucidate the availability score of every demand point in the study area. The score represents the ratio of the supply of medical facilities (measured by the number of healthcare professionals) to the population in need. Considering facility services benefit nearby locations more than those farther away [75,103], we employed a gravity-based model to simulate this distance decay. The formula is as follows:

$$A_i^G = \sum_{j=1}^{n} \frac{S_j f(d_{ij})}{\sum_{k=1}^{m} D_k f\left(d_{kj}\right)}, \; f(d_{ij}) = d_{ij}^{-\beta}, d_{ij} \leq d_o$$

A_i^G is the availability of demand location i, S_j is the supply potential of the service location j, D_k is the demand scale (population) of the point k, and $f(d_{ij})$ is the distance decay function between demand point i and supply point j.

In this step, we used the inverse distance weighting (IDW) tool in ArcGIS to assign values from the centroids to their neighbouring grids, with each grid cell representing an area of 1 square metre. This assignment gives higher weights to locations lying nearby and lower weights to distant locations, allowing for a smooth interpolation of values across the study area [104].

As recommended by previous studies [78,105], our analysis set the power of inverse distance decay as "1". Additionally, we defined the catchment area using a threshold d0 travel time of 20 min by walking and 20 min by bus, which corresponds to approximate Euclidean distances of 1400 m and 7000 m, respectively. Finally, we calculated the match ratio of physicians-to-population in the given catchment area. A higher score means that the population at the demand point has better access to more physicians within a threshold travel time, while a lower ratio suggests less access.

Measuring satisfaction—a survey-based assessment: The investigation was conducted in thirteen social housing communities in Guangzhou city. A total of 660 respondents provided their answers in line with three questions concerning service levels: the near–far distance, the comprehensive–simple scope of services, and reliable–unreliable service quality. Each of these questions were structured in a five-point Likert scale, consisting of five categories: very dissatisfied, satisfied, normal, satisfied, and very satisfied. To ensure the reliability of the responses, a reliability test was conducted on the five-point scale of satisfaction. The coefficient obtained from this test was 0.904, indicating a very high level of reliability in the responses provided by the participants.

4. Results

4.1. Accessibility Based on Service Area Analysis

Accessibility of primary healthcare facilities: Figure 3a illustrates the service areas within 20 min of walking, 20–40 min of walking, 40–60 min of walking, 20 min by bus, 20–40 min by bus, and 40–60 min by bus.

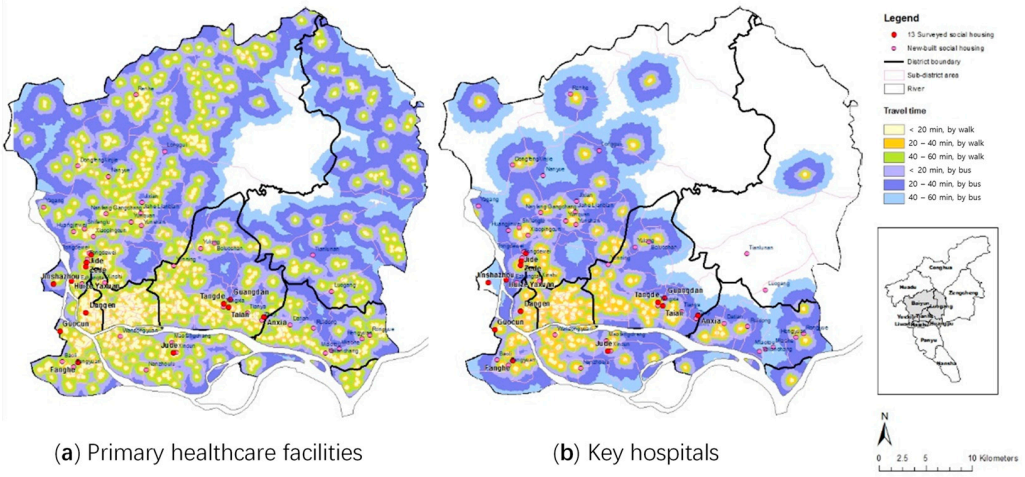


Figure 3. Service areas of medical facilities, by the grade of facility service, Guangzhou.

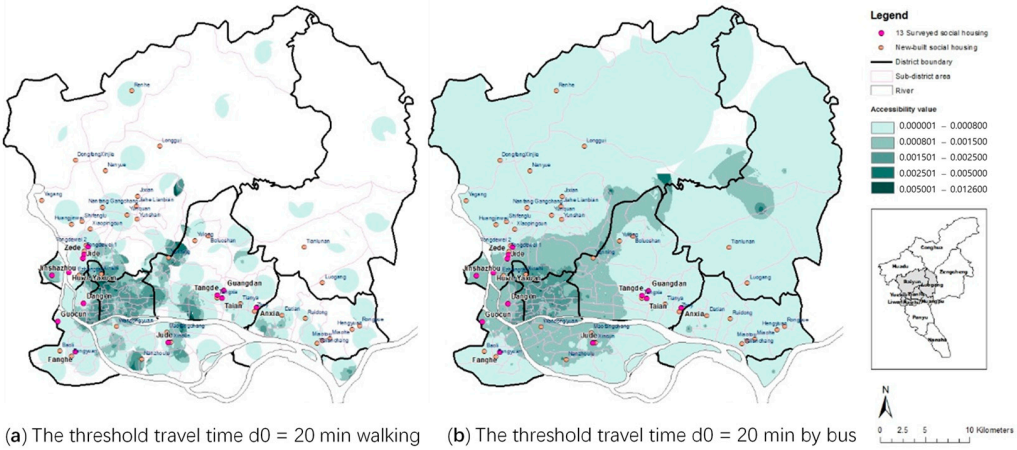
The bulk of social housing communities were positioned within a 40 min walking radius of primary healthcare facilities. This result indicates that most inhabitants can access primary physicians within a reasonable 40 min walk. Nonetheless, accessibility imbalances are evident across the 13 communities surveyed. Inhabitants, particularly in Anxia, Jinshazhou, and Guangdan, may not find it as easy as people in other communities to access primary healthcare. Seven communities, namely Dang'en, Fanghe, Jude, Tongde, Tai'an, Zede, and Huize Yaxuan, are situated within 20 min of walking to a service area.Of

the remaining six communities, Guocun, Jide, and Anxia are within a 40–60 min walking radius, while Guangdan, Likang, and Jinshazhou are even farther away, requiring a 20 min bus ride. Of 38 growing communities, most are dispersed in regions where accessing basic health services necessitates a 20–40 min walk. A handful of them, such as Longgui, Tianlunan, and Miaohe, exhibit low accessibility as they lie within service areas where a minimum 20 min bus ride is essential. From a spatial distance perspective, except for a few communities (e.g., Guangdan, Jinshazhou, Longgui), most inhabitants of social housing may encounter no significant difficulties in reaching primary physicians, as they are able to access them within a 40 min walk or a 20 min bus ride.

Accessibility of hospital facilities: The results of the service area analysis reveal that most communities are positioned at a significant distance from hospitals. Only those communities near the central area, such as Dang'en, Guocun, and Jude, have a strategic advantage in hospital accessibility (see Figure 3b). Fanghe, Tai'an, and Guangdan are located within a 20 min bus ride radius, while Anxia, Huize Yaxuan, and Likang are situated in a 20–40 min bus travel zone, and Jinshazhou lies on the outer ring, requiring a 40 to 60 min bus journey. Uncompleted projects primarily occupy areas accessible within a 20 min bus ride. It is evident that longer travel durations or a faster mode of transport are increasingly necessary to reach hospital facilities compared to basic healthcare services. Aside from residents in centrally located communities, the majority of social housing inhabitants would take over 20 min by bus to access key hospitals.

4.2. Availability Based on the Accessible Physicians-to-Population Ratio

Availability of primary healthcare facilities: Looking at Figure 4a,b, within 20 min, the accessibility of medical staff for residents at the site of social housing is less than that for people located in central areas. The highest scores are clustered in the central area, with values gradually decreasing along the centre–periphery continuum. The rate of decline depicted in Figure 4a is much steeper than that observed in Figure 4b. This result reveals that the advantage of the central area regarding the available number of physicians is more significant when people travel on foot rather than by bus.



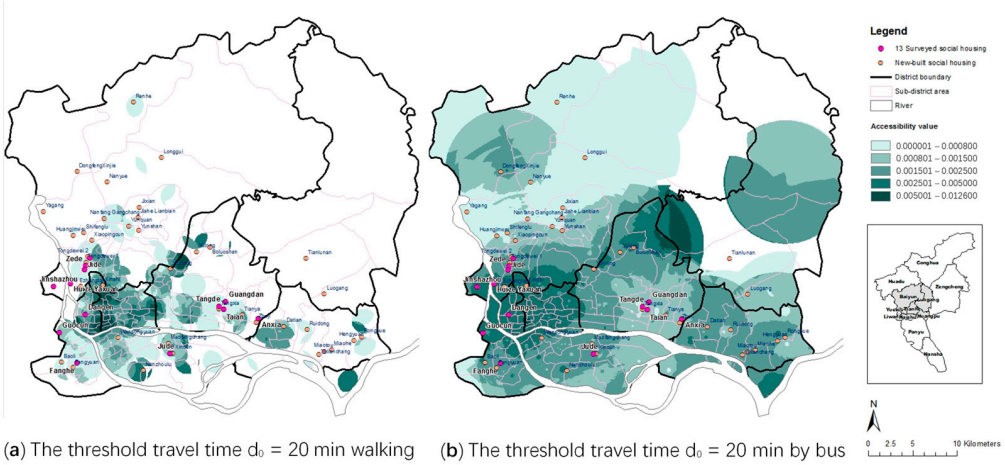
(**a**) The threshold travel time d0 = 20 min walking (**b**) The threshold travel time d0 = 20 min by bus

Figure 4. Availability scores of medical staff in primary healthcare facilities, Guangzhou.

Subsequently, most social housing communities lie in areas characterized by notably low availability scores. Within a 20 min walking radius, nine out of thirteen surveyed communities are located at regions with the lowest scale, ranging from [0.000001, 0.0008]. Jude and Jinshazhou remain at the second-lowest level, while the value of Huize Yaxuan and Anxia is minimal, approaching zero. The situation is even worse for the 38 communities under construction, as hardly any of them fall within regions where healthcare physicians are available within a 20 min walk. In summary, residents in social housing may be able to access basic healthcare within a 20 min walk, but the available number of physicians may be limited.

When identifying the threshold time as 20 min by bus, the availability scores for social housing areas show a slight improvement. When six surveyed communities and another 38 growing communities still fall within the lowest range [0.000001–0.000800], seven communities—including Tangde, Guangdan, Tai'an, Anxia, Fanghe, and Likang—ascend to the second-lowest level [0.000801–0.001500]. These results indicate that the availability of medical staff for residents in social housing areas within a 20 min bus ride radius remains lower than that in the city centre. However, the disparity between them narrows somewhat compared to access within a 20 min walk.

Availability of hospital facilities: As depicted in Figure 5a, within the travel time of 20 min of walking, the availability scores of most social housing communities are situated at a remarkably low grade within the city area. High values are concentrated in the central city regions, particularly in the connecting area of the northeast Liwan district, Yuexiu and the northwest edge of Haizhu district. Only two communities, Dang'en in Liwan and Jude in Haizhu, present significantly higher intermediate levels of availability scores, with values of 0.002308 and 0.001169, respectively, because of their proximity to these areas. The overwhelming majority of communities are positioned away from these areas, with their scores falling into the lowest range [0.000001–0.000800] or even approaching zero. Similarly, many of 38 ongoing projects exhibit scores of zero. The patient disparities illustrated by social housing communities imply that barely any of these communities can access healthcare professionals of hospitals by walking 20 min.



(**a**) The threshold travel time d_0 = 20 min walking (**b**) The threshold travel time d_0 = 20 min by bus

Figure 5. Availability scores of medical staff in key hospital facilities, Guangzhou.

When the threshold is defined as a 20 min bus ride, the availability scores of social housing locations attain a moderate level across the entire city (see Figure 5b). Nine surveyed communities are positioned in the second upper range [0.002501–0.005000] and in the medium range [0.001501–0.002500]. The remaining four communities in Tianhe district fall into the second-lower range [0.000801–0.001500]. The diminished disparities between social housing areas and the city centre may indicate that the availability of medical staff at key hospitals would be significantly improved if social housing residents opted for bus transportation.

4.3. Satisfaction with the Service Level of Medical Facilities

Assessment of the distance to medical facilities being "near–far": From the percentages of Table 2, we perceive that most respondents in the surveyed social housing communities are fairly satisfied with the distance to a healthcare facility. However, notable exceptions are observed in the communities of Guangdan and Likang, where respondents express significant dissatisfaction. Overall, approximately 60% of the surveyed individuals provided positive responses, indicating they were either very satisfied or satisfied. Remarkably, communities such as Dang'en and Jude stand out with satisfaction rates reaching as high as 90%. In

contrast, 20.0% of respondents in Guangdan expressed dissatisfaction with the distance to healthcare facilities, with an alarming 70.0% indicating they were very dissatisfied. Similarly, in Likang, only 4.8% of respondents were satisfied with the distance, while 33.3% expressed dissatisfaction, and a staggering 38.1% reported feeling very dissatisfied. Despite the majority of respondents perceiving the distance to facilities as satisfactory, notable disparities persist among communities.

Table 2. Satisfaction with the distance to medical facilities being "near–far".

Categories / Community	Evaluation (%)					Total
	Very Satisfied	Satisfied	Normal	Dissatisfied	Very Dissatisfied	%
Fanghe	59.0	16.0	15.0	5.0	5.0	100
Guocun	50.0	15.0	25.0	5.0	5.0	100
Dang'en	80.0	15.0	5.0	0.0	0.0	100
Jude	27.0	63.0	5.0	3.0	0.0	100
Tangde	32.0	22.0	36.0	8.0	2.0	100
Guangdan	0.0	0.0	5.0	20.0	70.0	100
Tai'an	15.0	35.0	40.0	10.0	0.0	100
Anxia	0.0	70.0	20.0	5.0	0.0	100
Zede	31.3	24.2	23.2	15.2	6.1	100
Jinshazhou	11.0	21.0	33.0	13.0	22.0	100
Jide	15.0	60.0	25.0	0.0	0.0	100
Huize Yaxuan	50.0	20.0	10.0	15.0	5.0	100
Likang	4.8	0.0	23.8	33.3	38.1	100

Database: Questionnaire reposnses in 13 social housing communities of Guangzhou (n = 660), surveyed by Chao. R in September 2014, with the support of Sun Yat-sen University, Department of geography and urban planning.

Assessment of the scope of medical services as "comprehensive-simple": Table 3 illustrates that the percentages of respondents in each community follow a normal distribution. Regarding the scope of medical services, respondents generally exhibit a moderate attitude. Around 50% of respondents perceive the complexity of healthcare services as normal. On average, approximately 20–30% of respondents in most communities select the category of "Normal". However, notable disparities are observed in three communities: Guangdan, Likang, and Jinshazhou, which demonstrate distinctly low satisfaction results. In the Guangdan community, as much as 40% of surveyed individuals consider the services unsatisfactory, with an additional 30% expressing that they are very dissatisfied. In contrast, communities such as Dang'en, Jude, and Fanghe exhibit significantly lower percentages of dissatisfaction. Only 5.0% and 11% of respondents in Jude and Fanghe, respectively, express dissatisfaction, while none of the interviewees in Dang'en indicate any dissatisfaction.

Assessment of the medical service quality as "reliable–unreliable": Similarly, the proportion values form a bell curve in each community, with higher percentages concentrating on the category of "Normal," indicating that overall satisfaction with service quality remains at a medium level (see Table 4). However, a notable gap exists in this assessment. While respondents in Guangdan, Likang, and Jinshazhou express strong negative satisfaction, respondents in Dang'en, Jude, and Fanghe tend to respond with percentages leaning towards positive evaluations. As shown in Table 4, only a small percentage of interviewees in Dang'en, Jude, and Fanghe—0%, 6%, and 11%, respectively—feel dissatisfied with the service quality. In contrast, a significant proportion of respondents—65%, 51%, and 51%, respectively—in these communities express satisfaction. Conversely, a comparatively high percentage of respondents—55% in Guangdan, 42.9% in Likang, and 43% in Jinshazhou—provide answers indicating unsatisfactory service quality in medical facilities.

Table 3. Satisfaction with the scope of medical services being "comprehensive–simple".

Categories / Community	Evaluation (%)					Total
	Very Satisfied	Satisfied	Normal	Dissatisfied	Very Dissatisfied	%
Fanghe	12.0	26.0	41.0	5.0	6.0	100
Guocun	5.0	15.0	65.0	15.0	0.0	100
Dang'en	15.0	20.0	65.0	0.0	0.0	100
Jude	2.0	51.0	42.0	5.0	0.0	100
Tangde	9.0	22.0	43.0	24.0	2.0	100
Guangdan	0.0	5.0	25.0	40.0	30.0	100
Tai'an	5.0	20.0	45.0	25.0	5.0	100
Anxia	0.0	10.0	75.0	15.0	0.0	100
Zede	3.0	15.2	56.6	23.2	2.0	100
Jinshazhou	4.0	8.0	47.0	30.0	11.0	100
Jide	0.0	0.0	65.0	30.0	5.0	100
Huize Yaxuan	5.0	35.0	55.0	5.0	0.0	100
Likang	4.8	14.3	38.1	33.3	9.5	100

Database: Questionnaire responses in 13 social housing communities of Guangzhou (n = 660), surveyed by Chao. R in September 2014, with the support of Sun Yat-sen University, Department of geography and urban planning.

Table 4. Satisfaction with the medical service quality being "reliable–unreliable".

Categories / Community	Evaluation (%)					Total
	Very Satisfied	Satisfied	Normal	Dissatisfied	Very Dissatisfied	%
Fanghe	15.0	36.0	34.0	9.0	6.0	100
Guocun	5.0	15.0	60.0	15.0	5.0	100
Dang'en	15.0	50.0	35.0	0.0	0.0	100
Jude	3.0	49.0	42.0	6.0	0.0	100
Tangde	2.0	23.0	45.0	28.0	2.0	100
Guangdan	0.0	10.0	35.0	30.0	25.0	100
Tai'an	0.0	35.0	30.0	30.0	5.0	100
Anxia	0.0	5.0	80.0	15.0	0.0	100
Zede	5.1	17.2	52.5	22.2	3.0	100
Jinshazhou	6.0	7.0	44.0	29.0	14.0	100
Jide	0.0	10.0	55.0	30.0	5.0	100
Huize Yaxuan	15.0	20.0	55.0	10.0	0.0	100
Likang	4.8	14.3	38.1	28.6	14.3	100

Database: Questionnaire responses in 13 social housing communities of Guangzhou (n = 660), surveyed by Chao. R in September 2014, with the support of Sun Yat-sen University, Department of geography and urban planning.

5. Discussions

By combining the results obtained from the above analysis of accessibility, availability, and satisfaction evaluations, this study uncovered several strong and intriguing correlations between location-based spatial analysis and person-based assessments. This section will primarily discuss these correlations from the following three aspects:

5.1. A Match between the Low Accessibility to Primary Healthcare Facilities and Low Satisfaction

The service area-based accessibility of primary healthcare shows a strong correlation with satisfaction assessments. Most surveyed residents live within service areas accessible within 40 min by foot, and their satisfaction with the distance to medical facilities is significantly high (see Section 4.1). At least 60% of respondents report being satisfied, with satisfaction levels reaching 80–95% in communities like Dang'en, Jude, and Fanghe (see Section 4.3). In contrast, communities such as Guangdan, Likang, and Jinshazhou face a

distinct disadvantage in accessibility to primary medical facilities. Residents in these areas cannot access any primary healthcare facilities within an hour on foot. Correspondingly, satisfaction levels in these communities are noticeably lower, with 0.0% and 4.8% of residents in Guangdan and Likang, respectively, expressing satisfaction, while 90% and 71.4% report dissatisfaction.

This disparity is closely linked to the central location factor. Dang'en and Jude, located in Haizhu district, and Fanghe, situated in Liwan district, are physically near the city centre, with access to primary healthcare within a 20 min walk. Conversely, Guangdan and Likang are in remote regions of the Tianhe and Baiyun districts, far from the central area of Guangzhou. Communities with moderately high levels of both accessibility and satisfaction are located at the fringes of the central area but are not too distant.

5.2. A Correlation between the High Accessibility of Hospital Facilities and High Satisfaction

The results of the accessibility of key hospitals and satisfaction assessments indicate a correlation: communities with discernible advantages in accessing hospital facilities show high satisfaction, particularly regarding the quality and scope of medical services. Dang'en, Guocun, and Fanghe in the Liwan district, and Jude in the Haizhu district, are within service areas that can be accessed by foot or by a short bus ride. Respondents in these communities express higher levels of satisfaction compared to other communities, especially concerning the quality and scope of medical care.

For the remaining communities, a hierarchy of accessibility is apparent. However, their satisfaction assessments do not strictly adhere to this hierarchy. For instance, despite being within the second-upper tier of accessibility with a 20 min bus service radius, Guangdan shows the lowest level of satisfaction. This suggests that only residents living in close proximity to hospitals may feel satisfied with the quality of medical services. High satisfaction with medical service levels appears to be more closely associated with increased accessibility to hospitals rather than primary medical care. Social housing communities near the central city in Guangzhou exhibit high levels of both accessibility and satisfaction.

5.3. A Match between the Easiness of Reaching Available Professionals of Hospitals and High Satisfaction with Medical Service Levels

Combining the results from availability and satisfaction assessment reveals that high satisfaction with the service level largely depends on the ease of accessing hospital professionals. Within a 20 min walking radius, social housing residents in the Liwan and Haizhu districts can access a greater number of hospital professionals at an intermediate level city-wide. In contrast, residents in other communities can only reach a minimal number of available doctors or none at all. This clear disparity is reflected in the levels of satisfaction with service quality and scope (see Section 4.3). When the threshold is set to a 20 min bus ride, the disparities in the availability of hospital professionals among the 13 surveyed communities significantly decrease. Most social housing locations can access a medium number of doctors. However, the gap in satisfaction levels among the communities does not narrow significantly.

To clarify, ranked satisfaction with the medical service level is more consistently associated with the hierarchical availability results defined by 20 min of walking rather than by 20 min bus rides. The primary factor affecting satisfaction with the medical service level is the ease of access to hospital professionals, which includes both short travel times and convenient travel modes. The communities of Dang'en, Jude, and Fanghe possess an overwhelming advantage in this regard.

5.4. Sub Conclusion

In conclusion, our findings indicate that personal assessments of medical facilities are primarily influenced by two factors: the distance to primary healthcare facilities and the ease of reaching major hospital facilities. Specifically, low accessibility to primary healthcare directly correlates with extreme dissatisfaction with the overall services pro-

vided by medical facilities. However, a longer distance to higher-level hospitals does not significantly reduce satisfaction with medical services. In other words, social housing residents' satisfaction with medical services is predominantly related to the accessibility of primary healthcare rather than hospital accessibility.

Furthermore, while difficulties or below-average ease in reaching hospitals may not necessarily result in dissatisfaction, easy accessibility to higher-grade hospital facilities (characterized by short travel times and convenient travel modes) can significantly enhance residents' experiences with the quality and scope of medical services. In the context of Guangzhou, these two principles are evident in the distance to the central city area. Communities located near the central area experience high accessibility to all types of medical facilities and report overwhelmingly high satisfaction levels, whereas those farther away do not.

Compared to the research results of previous studies, which found that most social housing residents or people from marginalized groups were suffering from injustice or difficulties with reaching medical facilities. Our study has unearthed some new findings. Although social housing residents do show certain disparities in accessing medical facilities, this does not fully prove injustice. This study demonstrated that a long distance to primary healthcare is evidence of injustice, as people express clear dissatisfaction. Conversely, certain difficulties in reaching hospitals may not significantly impact justice. Nevertheless, ensuring easy access and improving the quality of medical services for both primary healthcare and hospitals can contribute positively to spatial justice.

6. Conclusions: Findings and Implications

Access to medical facilities is indispensable for daily life [12], and easy access to medical facilities may intensely impact the living quality of residents in social housing. Given that the targeted demographic of social housing in Guangzhou consists primarily of vulnerable groups, such as the elderly, physically disabled, or health-impaired individuals, accessibility to medical care is even more crucial. Low accessibility to required medical facilities may bring about challenges in maintaining personal health conditions, potentially disrupting the daily lives of social housing residents. In tandem with losing interactive opportunities for individuals' sociality, this difficulty has the potential to increase the heterogeneity within social housing communities compared to neighbouring areas. To avoid the risk of socio-spatial problems of neighbourhood separation and marginalization, it is essential to investigate the physical service level of nearby medical facilities and examine whether people's medical demands have been fulfilled successfully.

Many studies in geographic contexts have explored the accessibility (distance- or mobility-based) and the availability (the service-to-population ratio) of public facilities in the domain of spatial justice, which concerns what it actually is [19,40]. However, recent studies often overlook the contents of real needs due to challenges in establishing clear criteria. By conducting a theoretical review elaborating on the key connotations of spatial justice (see Sections 2.1 and 2.2), we are guided by its focus on addressing the complexity of human needs rather than merely ensuring simple equality [106]. We attempt to evaluate the distribution of medical facilities by considering both emic and etic aspects of human needs, which ultimately manifest in the features of facility services and in personal assessments [50,53]. To achieve this, we employed methods of cost distance, gravity-based 2SFCA, and cross-tab analyses, respectively, to delineate the accessibility of, availability of, and satisfaction with medical facilities. Through integrating the results of these analyses, we identified several matches between them. We will elaborate on the main findings in following paragraphs. (1) The low accessibility of primary healthcare facilities is the predominant factor leading to the distribution injustice of medical facilities near social housing. This finding is manifested by the definite match between the accessibility to medical facilities and the satisfaction of communities (see Section 5.1). When the accessibility level of hospital facilities does not show significant relations with the satisfaction results of the surveyed communities, the accessibility to primary healthcare does.

The communities of Dang'en, Jude, and Fanghe ranked highest in both accessibility to primary healthcare (within a 20 min walking distance) and satisfaction (ranging from 80 to 95%). Another seven communities fall into the middle range, maintaining accessibility within a 40 min walking distance and an average satisfaction rate of 60%. Conversely, respondents in Guangdan, Likang, and Jinshazhou demonstrate a clear decrease in satisfaction, with it even dropping to zero when residents are unable to reach any basic medical facilities within an hour. This ranking verifies the critical importance of easy access to primary healthcare facilities. Once accessibility diminishes to the extent that over 40 min of walking is required, significant negative effects and potential injustices emerge. Additionally, we found that 40 min of walking to reach primary healthcare basically satisfies social housing residents, while 20 min of walking is considered ideal. This aligns with the results published by the United States, which recommend a maximum travel time of 30 min [10].

(2) Easy access to hospital facilities, characterized by short travel times and convenient travel modes, can significantly enhance residents' satisfaction with service quality and service scope. Apart from a few communities having notably high accessibility to hospitals (e.g., Dang'en, Jude, and Guocun), others maintain a certain distance from hospitals without showing significant dissatisfaction. While the higher level of availability and the notable advantage of hospital professionals correlate with higher satisfaction, lower availability does not strictly relate to lower satisfaction. Combined with satisfaction results, there is no evidence that social housing residents endure significant injustice in accessing hospital facilities. Residents in most social housing can tolerate the distance disadvantages to some extent, and this situation would affect their satisfaction with the service levels of medical facilities.

Finally, we attained some suggestions for practises pursuing spatial justice. Despite most communities seeming to be free from injustice in access to medical facilities, a few of the remotely located social housing communities in the margin are certainly suffering injustice in accessing medical care. This fact turns out to be an issue of central location in the context of Guangzhou. Special attention must be given to ongoing communities that are distant from the central area. Ensuring justice in access to medical facilities requires that primary healthcare be accessible within 40 min of walking. This study suggests that providing specific and intense remedies to primary medical facilities near the affected communities is necessary. Prioritizing the improvement of medical services in Guangdan, Likang, Jinshazhou, and other communities under construction is crucial. In addition, improving hospital facilities' provision in the surrounding areas to social housing is another significant effort which contributes to equitable service levels in medical care.

This study offers valuable insights for future research aiming to establish reasonable criteria for spatial justice. Addressing human needs in this study lies in efficient guidelines for urban planning with respect to health services, instead of providing any of the innovative methods that many spatial examinations engaged in. The suggestions derived from this research may prove instrumental in enhancing practises to achieve spatial justice in medical facilities. The incorporation of human needs in this study is a preliminary attempt. Given that determining justice requires meticulous consideration, our combined analysis of accessibility, availability, and personal satisfaction aims to make comparative evaluations. To reinforce the credibility of the final judgement of justice, future research should consider leveraging more comprehensive databases related to human needs, such as those utilizing big data regarding personal mobility, or developing appropriate methods and criteria to elucidate the dimensions of human needs. Nevertheless, this study offers limited implications for any innovative methods, as the developed method here is essentially a combination of existing approaches. Even the cost distance approach has been rarely noticed for its usability in relative examinations.

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