AVAILABILITY AND ACCESSIBILITY OF PUBLIC HEALTH CARE FACILITIES IN DELHI: A GEOSPATIAL ANALYSIS

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Abstract

The availability and accessibility of health care facilities play an important role in the development of human resource. In the absence of health care facilities even a minor illness may result into an epidemic like situation. Studies have shown that availability and accessibility of health care facilities positively affect health outcome indicators. In this context, the present study attempts to study the availability and accessibility of public health care facilities in Delhi. The study is based on the secondary sources of data obtained from the District Census Handbook of Delhi, 2011 and Annual Health Report of Delhi 2021-22. The spatial pattern in availability and accessibility of health care facilities has been studied at different levels vis-à-vis the norms of their provision. The study also reflects upon the vulnerable and best served areas of Delhi in availability and accessibility of health care facilities. The results of the study reveal that the districts of Shahdara, Central and New Delhi are better served, while the South West, South East and North West districts are poorly served. These findings underscore the need for targeted interventions to address the disparities and improve the overall well-being of the population in the study area.

Keywords: Health care facilities, Availability, Accessibility, Geospatial techniques.

Introduction

A well-developed health care infrastructure is regarded as an important determinant in the promotion of the general physical, mental, and social well-being of people around the world (Dinesha et al., 2010). The Indian public health care sector faces various issues such as inadequate financial resources, lack of accessibility to health care facilities, inadequate buildings and physical infrastructure, absence of optimum manpower, absence of good transport facilities and rural-urban imbalance in the availability and utilization of health care facilities (GOI, 2002; Kasthuri, 2018).

The availability of Health Care Facilities (HCFs) is defined as the ratio of health care facility with the spatial distribution of the population, while accessibility refers to the outreach of population to the HCFs. Medical geographers study accessibility under two heads: physical and realized. Physical accessibility is defined as the locational relationship between health care centers and the surrounding population, whereas realized accessibility refers to the actual utilization patterns of health care facilities by the population, considering the economic, social, and cultural aspects (Joseph and Phillips, 1984).

The availability, accessibility and

utilization of health care facilities have been extensively studied by the researchers. Studies have empirically shown that the unequal distribution of health care resources results in unequal availability of HCFs for a significant portion of the population (Balarajan et al., 2011; Nunes et al., 2014; Bhan et al., 2016). The disparity in the availability of HCFs leads to restricted access and disproportionately affects the population with lower income or financial resources. Consequently, the essential medical care remains inaccessible to many individuals and communities, exacerbating health inequalities and widening the gap between the privileged and the marginalized in the society. Despite the availability of health care services, significant disparities in its access persist, indicating a complex interplay between the geographic distribution of HCFs and the patterns of actual service utilization (Rajeshwari and Sinha, 2004; Hare and Barcus, 2007; Baru et al., 2010; Munjanja et al., 2012; Gusmano et al., 2017). Rajeshwari (1996) has observed that the level of ante natal care (ANC), girls' immunization level and curative care in case of illness are much better in villages with HCFs in Haryana.

Singh (2017) studied the distribution of HCFs in Delhi and found concentration of public hospitals in Central and New Delhi districts. Mukherjee (2022) has highlighted the disproportionate growth of public and private health care facilities in Delhi over two decades, indicating a pressing need for strategic planning and resource allocation to ensure comprehensive health care access, particularly for marginalized population. Similar observations on availability, quality, and functioning of Mohalla clinics in Delhi have been presented by Hazarika et al. (2016), Lahariya (2017) and Sah et al. (2019). Despite the extensive

research on the growth and distribution of HCFs, the existing literature lacks how the hierarchical structure of HCFs and their spatial location poses constraints in their access. Hence, this study is focused on the availability and accessibility of public HCFs in Delhi.

Objectives of the Study

Major objectives of the study are:
- to study the availability and accessibility of public health care facilities in Delhi and
- to identify the vulnerable areas in availability and accessibility of public HCFs.

Study Area

According to the 2011 Census, Delhi, the national capital of India has a population of 16.7 million; 97.50 per cent of it comprises of urban population, while only 2.50 per cent population is rural. The overall population density of Delhi is 11,320 persons/km², with the North East district registering the highest density of 36,155 persons/km², while the New Delhi district has the lowest density of 4,057 persons/km². The total working population of Delhi is 33.53 per cent, out of it nearly 85 per cent are male. In Delhi, health care services are provided by various agencies such as public (Central government, Delhi government, Municipal Corporation of Delhi (MCD), New Delhi Municipal Corporation (NDMC), Cantonment Board, Railways etc.), private and voluntary organisations (Lahariya 2017; Sood, 2017; Mukherjee, 2022).

Database and Methodology

The present study is based on the secondary sources of data obtained from the District Census Handbook of Delhi, 2011 and

Annual Health Report of Delhi 2021-22. The availability of public health care facilities has been calculated as ratio of population to various health care facilities, whereas the accessibility has been calculated by area served per health care facility. The availability of HCFs in the study area has been assessed on the basis of population norms provided by the governments of India and Delhi (Table 1 and 2). Apart from these, a more realistic spatial pattern of concentration and dispersal of HCFs has been attempted in the present study with their actual geographical location. Hence, the locational analysis suggesting dispersal or concentration has been attempted. Concentration pattern is presented with dot density method. It is a non-parametric technique used to visualize and analyse spatial data for mapping and studying spatial pattern (Gatrell and Bailey, 1995). The catchment area demarcation has been attempted with Thiessen polygon method. A Thiessen polygon is a closed polygon which is created through the midpoint of the distance between each health care facility and the location of its closest facility. Such polygon encompasses the service area within it (Black et al., 2004). Thiessen polygon is valuable for the studies involving homogeneous topography, as it effectively partitions a given area based on proximity to a set of points (Vinothini and Saravanabavan, 2023). The larger catchment area shows that such a facility has to cater large population from that area in relation to its location. Euclidean distance is a measure of distance travelled by people in three-dimensional space. It is calculated as the linear distance among facilities. The smaller Euclidean distance implies that the patients have more choices within a small area and vice versa (Parvin et al., 2020). The proximity analysis has been carried out for calculating the per cent area served by each facility. It has been done by creating buffers to assess the accessibility of HCFs. In the present study, for the proximity analysis of mohalla clinics, 1 km buffer has been drawn, representing the distance that patients can easily cover on foot within 10 minutes. A 5 km buffer has been created for government hospitals assuming that patients can cover this distance with public transport. In order to demarcate best served and vulnerable areas, a composite index has been prepared by taking eight indicators. The indicators taken for availability are; persons served per mohalla clinic; per dispensary; per polyclinic and per

Table 1
India: Population Norms for Health Care Facilities, 1983

Health Care Facilities	Population/HCF*		Hierarchy
	Plain Areas	Tribal/Hilly/ Desert Areas	
Sub-Centres	5,000	3,000	Grassroot Level
Primary Health Centres	30,000	20,000	Primary Level, Referral unit for 6 Sub-Centres
Community Health Centres	1,20,000	80,000	Secondary Level, Referral unit for 4 PHCs
Hospitals	5,00,000		Tertiary Level, Specialized services

Source: National Health Policy, 1983. HCF*: Health Care Facility

Table 2

India: Population Norms for Health Care Facilities under National Urban Health Mission, 2013

Health Care Facilities	Population/HCF	Hierarchy
Community Outreach Services/ Mohalla Clinics	10,000-15,000	Grassroot Level
Urban Primary Health Centres (UPHCs)/Seed Primary Urban Health Centres (PUHCs) Dispensaries	50,000	Primary Level
Urban Community Health Centres (UCHCs) /Polyclinics	5,00,000	Secondary Level, Referral unit for 4-5 UPHCs
Hospitals	Specialized Care	Tertiary Level, Referral unit

Source: National Urban Health Mission, 2013.

government hospital. Similarly, the indicators taken for accessibility are area served by per mohalla clinic; per dispensary; per polyclinic and per government hospital. The normalisation method devised by Kundu (1992) has been used for calculating composite index.

Results and Discussion
Availability of Public Health Care Facilities

The mohalla clinics are the smallest unit of public HCFs in Delhi. These have been designed to cater the basic primary health care needs of 10,000 to 15,000 persons (Table 2). The Mohalla clinics provide curative care for common illnesses, free essential drugs, diagnostic tests, referral services, preventive care and health education etc. The availability of mohalla clinics shows that on an average one clinic is available to serve 37,333 persons (Table 3), which is more than double of its prescribed norms suggesting that almost equal number of more mohalla clinics are required. Its district level availability reveals that Shahdara and New Delhi districts are better served as these are serving less population less than the norms (Table 3). While, West, North West, East and North East districts are poorly served as there is one mohalla clinic for more

than 45,000 persons, suggesting the require-ment of mohalla clinics more than 3 times of existing numbers (Fig.1 a).

The dispensaries are second in the hierarchy of HCFs. It is mandated to cater the primary health care needs including curative, preventive, promotive health care and basic lab facilities for 50,000 persons (Table 2). Unlike Primary Health Centres (PHCs), as described in National Health Policy 1983 (GOI,1983), the dispensaries in Delhi does not provide in-patient and round the clock services. The average population to dispensary ratio has been 85,783 persons against the suggested norms of 50,000 persons (Table 3). The inter-district variation in the availability of dispensaries is also very sharp. Three districts namely, New Delhi, Shahdara and Central are better served as a dispensary is serving less than 50,000 persons, while, East, North East, West and North West districts are poorly served where one dispensary is serving more than one lakh persons (Fig. 1 b). However, North West dist-rict is very poorly served as there is one dispensary for 1,55,701 persons.

The polyclinics are third in hierarchy and envisaged to provide specialized OPD consultation and diagnostic services to about

Table 3
Delhi: Availability of Public Health Care Facilities, 2022

Districts	Population Served per Health Care Facility			
	Mohalla Clinics	Dispensaries	Polyclinics	Government Hospitals
Shahdara	6,875	20,626	1,23,758	75,256
New Delhi	10,884	12,559	1,63,262	1,63,262
Central	15,940	24,796	3,34,747	83,687
North	25,523	63,807	10,20,908	2,55,227
South	27,826	96,322	12,52,184	4,17,395
South East	37,034	99,406	18,88,715	18,88,715
South West	37,130	87,874	6,59,054	6,59,054
West	52,214	1,21,832	9,74,655	4,87,328
North West	53,214	1,55,701	6,00,560	22,05,921
East	63,395	1,03,433	19,65,235	9,82,618
North East	66,846	1,16,101	5,51,480	8,40,785
State Average	**37,333**	**85,783**	**6,89,325**	**4,82,527**
Norms	**10,000-15,000**	**50,000**	**5,00,000**	**Specialized Services**
C.V. (per cent)	**54.93**	**56.76**	**69.38**	**93.40**

Source: Compiled by Authors
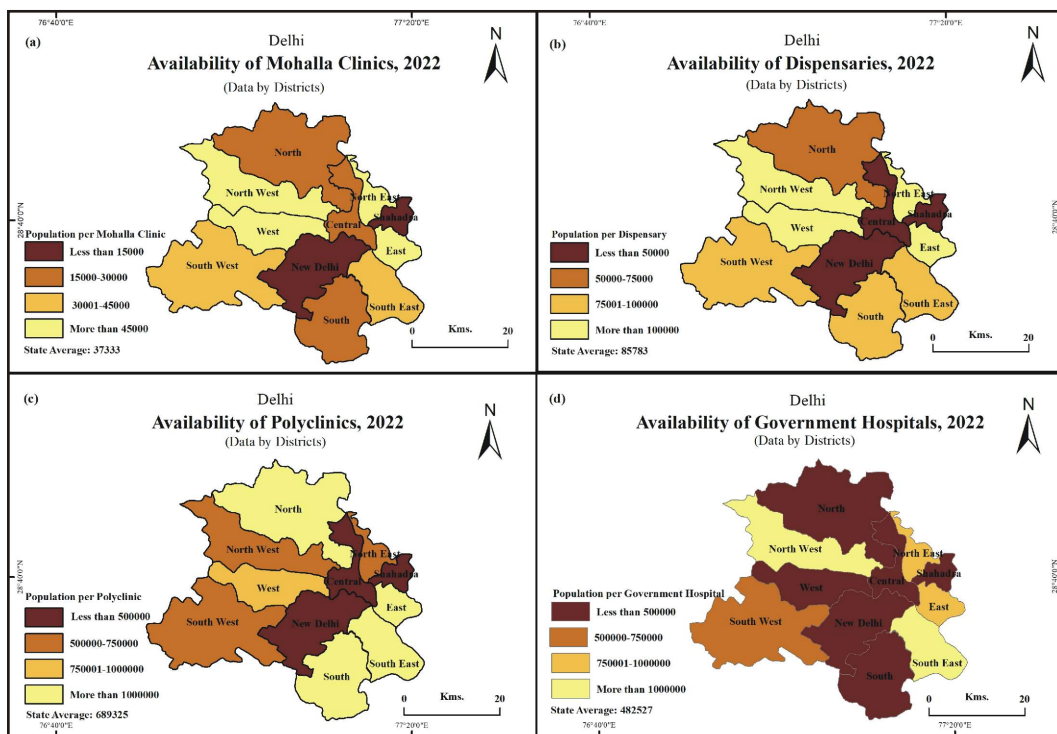
Fig. 1

five lakh persons. The services include general medicine, gynaecology, paediatrics, orthopaedics, dermatology and ENT (Ear, Nose and Throat). The availability of polyclinics in Delhi reveals that on an average, there is one polyclinic for approximately 6,90,000 persons (Table 3). The coefficient of variation is 69.38 per cent revealing a large inter-district variation. Three districts namely Shahdara, New Delhi and Central are better served as availability of polyclinic is within the suggested norms of population, while four districts, namely North, South, South East and East are very poorly served as there is only one polyclinic available for more than 10,00,000 persons (Fig.1 c).

Hospitals are at the apex of public HCFs hierarchy. As per norms, hospitals are supposed to provide specialised care. Hospitals also act as referral points for polyclinics, dispensaries and mohalla clinics. In Delhi one hospital is available for 4,83,000 persons (Table 3). Delhi being the capital of the country hospitals provide referral services at all India level and not exclusively for Delhi. Hence, their availability just for Delhi population may be misleading. Yet an attempt has been made to study the inter-district variations in their availability. It reveals that six districts, namely, Shahdara, Central, New Delhi, North, South and West are better served (less than 5,00,000 persons/hospital). While South East and North West districts are poorly served where one hospital is available for more than 10,00,000 persons (Fig. 1 d).

Accessibility of Public Health Care Facilities

The accessibility to public health care facilities shows areal coverage and it has been calculated as area served per health care facility. The results show that there are huge inter-district variations in accessibility of all types of HCFs, especially in case of dispensaries/seed PUHCs and government hospitals (Table 4). The Mohalla clinics are the basic unit of public HCFs and act as the first point of contact. If mohalla clinics are properly distributed, these can be very effective in preventing disease outbreaks on large scale. The accessibility of mohalla clinics however shows that on an average it serves approximately 3 km² area. The district-wise analysis shows variations and in four districts namely Shahdara, Central, North East and North, the area served by one mohalla clinic is less than 1.5 km² suggesting that the population of these districts have better access as compared to the North West and South West districts where it has to cater more than 4.5 km² area (Fig. 2 a).

The pattern is more or less same in case of accessibility of dispensaries. Their concentration in Central, Shahdara and North East districts where it serves less than 2.5 km² area for every unit is less burdensome. In case of South, South West and North West districts, dispensaries have to cater more than 7.5 km² of area (Fig. 2 b). Polyclinics are a step higher to dispensaries in hierarchy and provide the secondary level of health care. The physical access of polyclinics is quite poor in Delhi, as there has been only one polyclinic for approximately 53 km² of area. The district-wise pattern demonstrates that Shahdara, Central and North East districts are better placed with one polyclinic serving less than 25 km² of area, while, the South East, South West and South districts are very poorly served as one Polyclinic is serving more than 75 km² of area (Fig. 2 c).

The accessibility of government hospitals is better as compared to polyclinics

Table 4
Delhi: Availability of Public Health Care Facilities, 2022

Districts	Area Served per Health Care Facility (km²)			
	Mohalla Clinics	Dispensaries	Polyclinics	Government Hospitals
Central	0.55	0.86	11.68	2.92
Shahdara	0.55	1.66	10.00	6.00
North East	1.31	2.27	10.8	43.23
North	1.47	3.68	58.92	14.73
East	1.57	2.57	48.9	24.45
South East	2.00	5.36	102.00	102.00
New Delhi	2.33	2.68	34.95	34.95
West	2.33	5.44	43.52	21.76
South	3.27	11.34	147.44	49.14
North West	5.60	16.40	63.26	88.56
South West	5.92	14.02	105.20	105.20
State Average	**2.86**	**6.59**	**52.96**	**37.07**
C.V. (per cent)	**70.95**	**85.07**	**73.10**	**79.78**

Source: Compiled by Authors
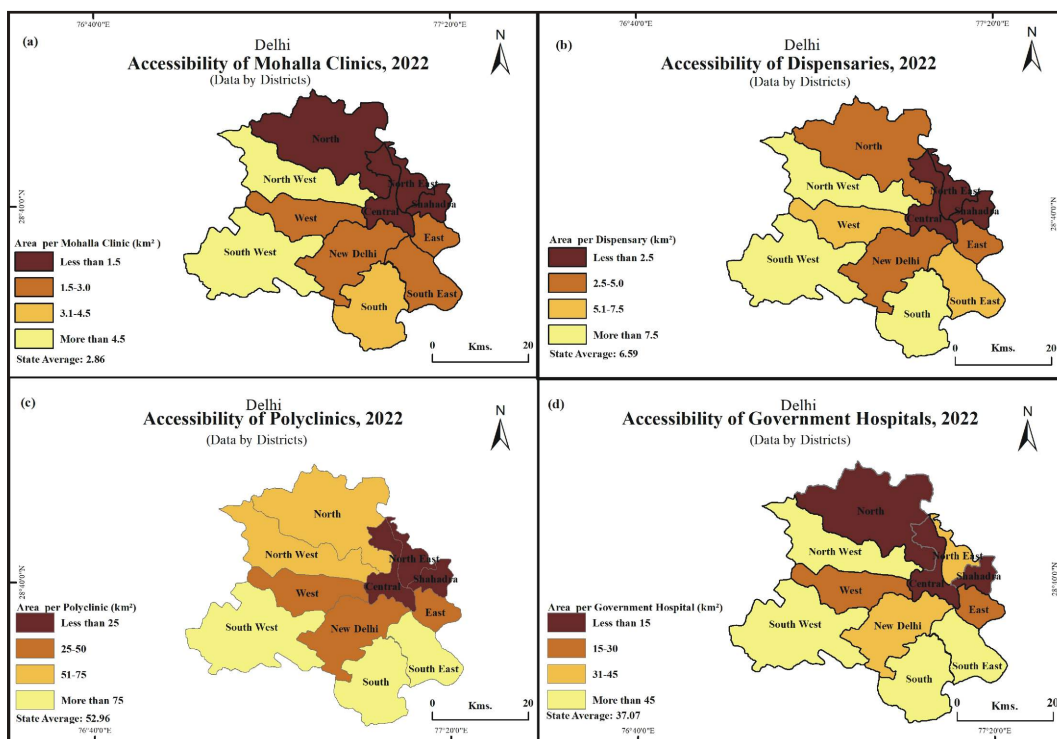
Fig. 2

(Table 4). It may however be noted that, there is a huge inter-district disparity in the accessibility of government hospitals. The Central, Shahdara, and North districts are better in terms of accessibility as a hospital serves less than 15 km² of area. While, four districts namely, South, North West, South East and South West have very poor accessibility with one government hospital serving more than 45 km² of area (Fig. 2 d).

Location of Public Health Care Facilities

The geographical location of a facility discloses a pattern of dispersal, concentration and uniformity which is crucial in determining the optimum use or under-utilization of HCFs. The location and the pattern of concentration and dispersal of various levels of HCFs in Delhi has been mapped in Fig. 3. It has been observed that mohalla clinics and dispensaries are highly concentrated in Shahdara and North East districts of Delhi, while in the districts of North, South West and New Delhi, these are sparsely distributed (Fig. 3 a and 3 b).

The geographical location of Polyclinics reveal that their concentration is more in Shahdara, North East, Central and somewhat in North West districts of Delhi. In all other districts, their location is quite sparse (Fig. 3 c). The location pattern of hospitals divulge that these are highly concentrated in the Shahdara and Central districts.   These are sparsely located in the North, North West and South East districts (Fig. 3 d). Hence, one can understand that the population in Central and Eastern districts have more easy access as these
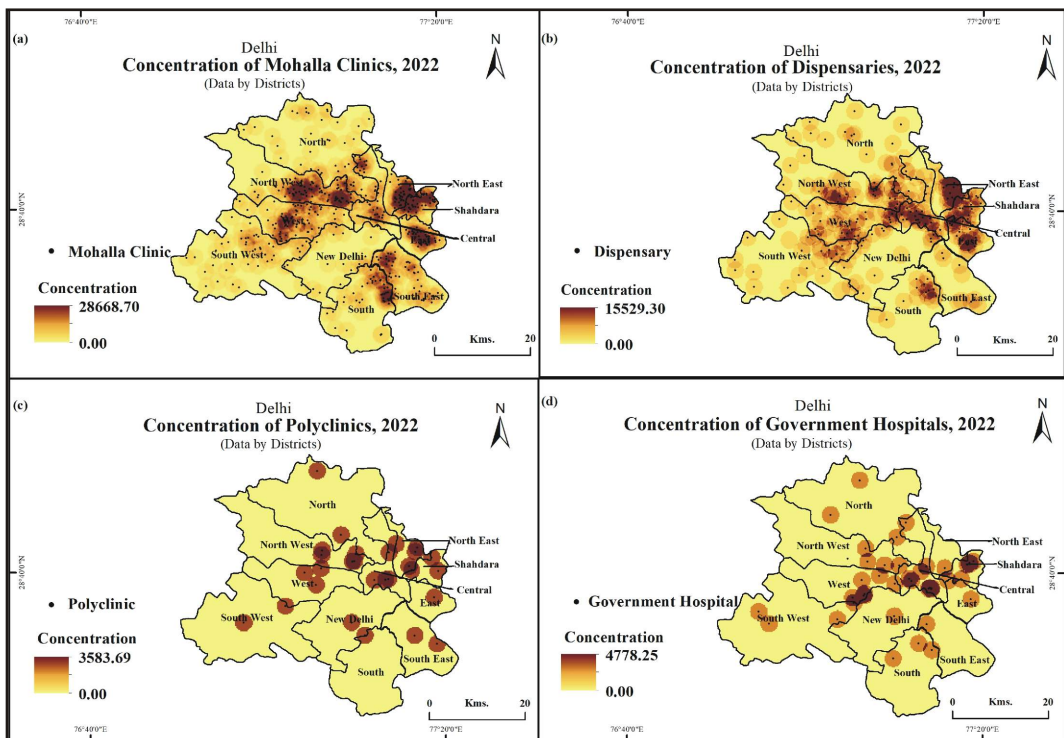

Fig. 3

districts have a clustered pattern of all levels of HCFs.

Catchment Area of Public Health Care Facilities

The catchment area of mohalla clinics is large in North West district as compared to the Central, North East, Shahdara, West and South East districts of Delhi (Fig. 4 a). It has been observed that the districts with smaller catchment of mohalla clinics are also densely populated. It has also been found that the mohalla clinics of North West district are serving larger area in absence of other HCFs. Similarly, the government hospitals located in North, North West, South West, South and South East are having much larger catchment as compared to the hospitals of Central and Shahdara districts (Fig. 4 b).

Euclidean Distance of Public Health Care Facilities

The low Euclidian distance of mohalla clinics shows that the population of Shahdara, Central, East and South East districts have more choices to avail HCFs. The Euclidean distance in the outer Delhi particularly in North West and South districts is much larger showing less choices are available to the population to avail HCFs (Fig. 5 a). A large part of New Delhi district also show high Euclidean distance suggesting that the population in these areas have low choices of HCFs in case of ailment or health care needs.

In case of government hospitals, the pattern remains more or less same. The high Euclidean distance in the peripheral areas of North, North West, West, South and South East districts indicates towards less choices of
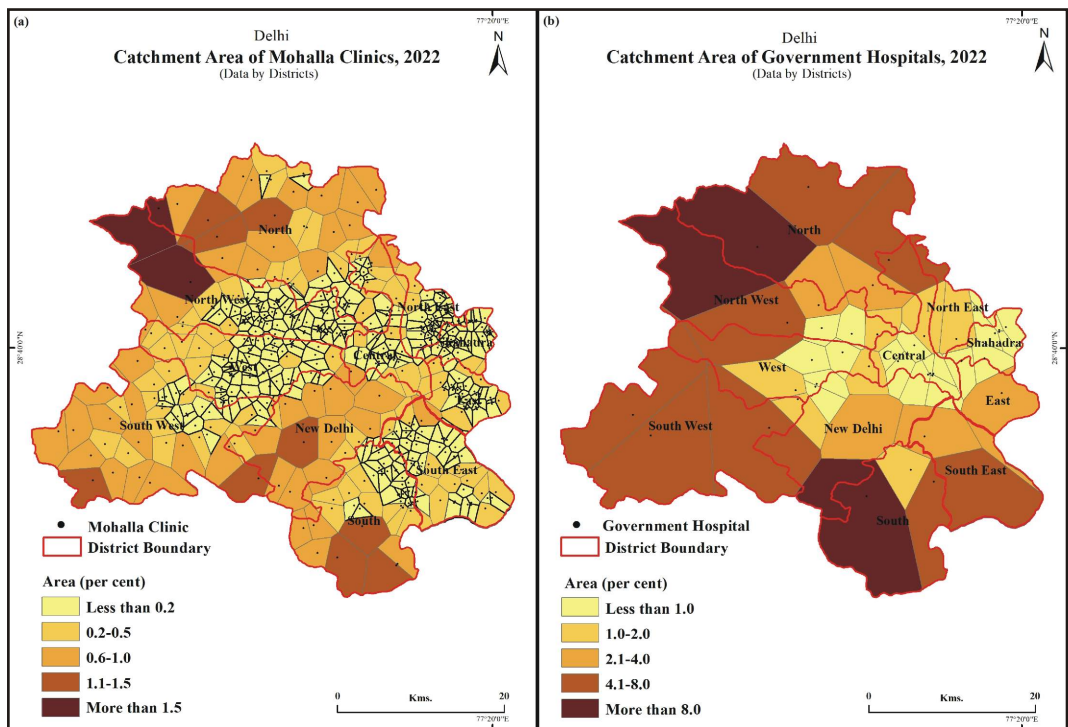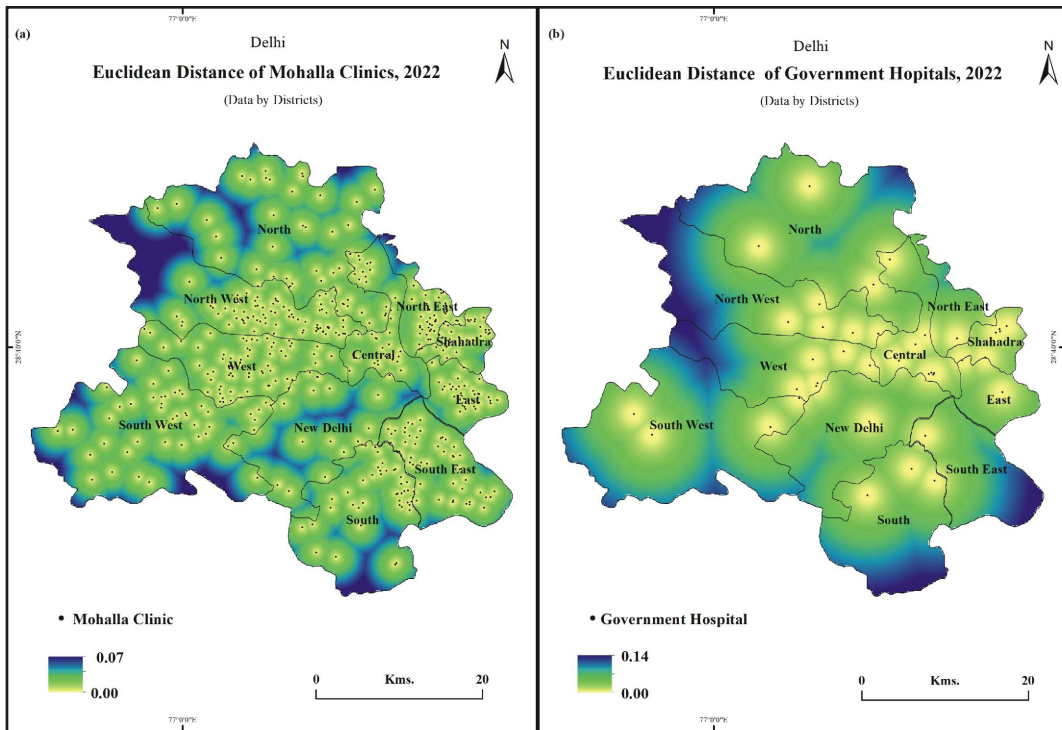

Fig. 4

Fig. 5

HCFs in case of medical exigencies. Euclidean distance is low in case of Central, Shahdara, New Delhi, East and North East districts indicating multiple choices available in health care needs (Fig. 5 b).

Proximity of Public Health Care Facilities with Buffers

Delhi is densely populated (11,500 persons per km²) and population seeking primary health care can easily cover one kilometer distance on foot in less than 10 minutes, therefore, 1 km buffer of mohalla clinic has been drawn (Fig. 6 a). As population living within one kilometer of mohalla clinic cannot be estimated, therefore, area within one kilometer buffer has been estimated. This estimation is performed for the whole of Delhi and the superimposition of district boundaries

revealed interesting findings. Further, 60.17 per cent area in Delhi is such where no mohalla clinic may be accessed within 1 kilometer distance (Table 5). The remaining area has either one or more than one mohalla clinic within one kilometer distance. The district-wise analysis shows that in Shahdara 64.42 per cent area is served by multiple mohalla clinics, while such area is less than 10 per cent in South West, North and New Delhi districts. However, in North West district of Delhi 77.69 per cent area is lying outside the 1 km buffer of mohalla clinics (Table 5).

In case of government hospitals providing specialized and refferal services, 5 km buffer is drawn as it is easy to cover the distance in 10 to 15 minutes by using public transport (Fig. 6 b). Overall, 33.81 per cent area of Delhi is lying outside it, suggesting that
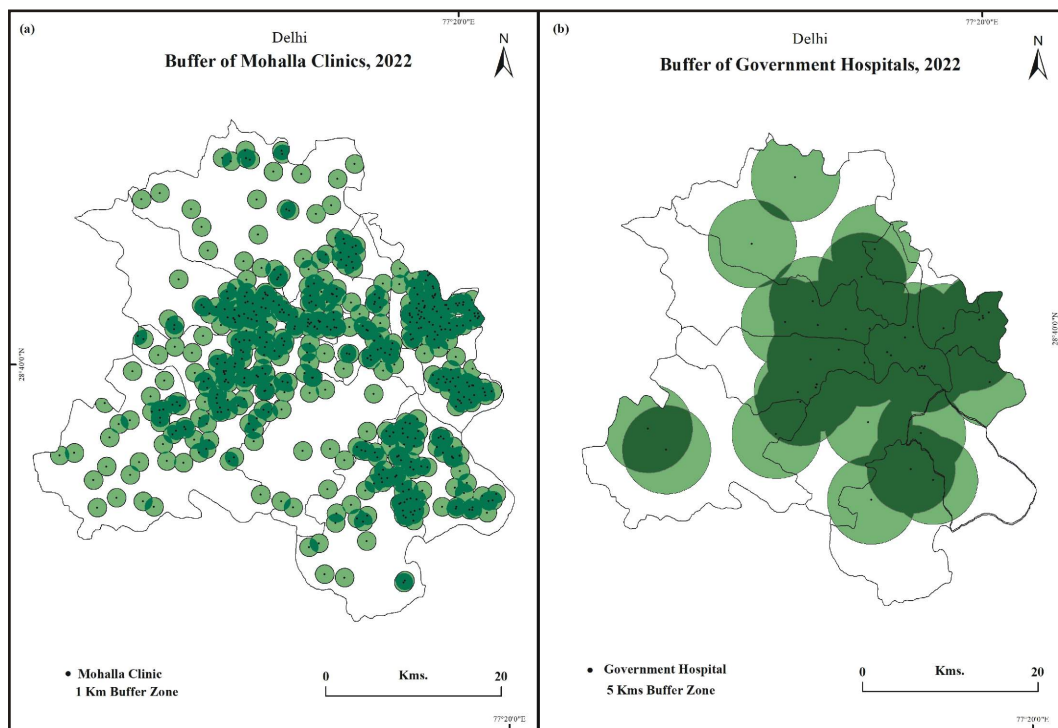
Fig. 6

Table 5
Delhi: Mohalla Clinics and Buffer (1 km), 2022

Districts	Percentage of Area having Mohalla Clinics		
	Nil	**One**	**Multiple**
Shahdara	18.83	16.75	64.42
West	26.99	30.02	42.99
East	33.70	24.84	41.46
North East	46.17	13.94	39.89
Central	37.79	23.12	39.09
South East	37.02	25.01	37.97
South	62.94	18.49	18.57
North West	77.69	5.94	16.37
South West	63.57	26.97	9.46
North	66.73	24.89	8.38
New Delhi	71.58	23.54	4.88
State Average	**60.17**	**20.2**	**19.63**

Source: Compiled by Authors

about one-third area and population living in these areas, have to travel more than 5 km for accessing the specialised care facilities. The study reveals that 38.85 per cent area of Delhi and its population has access to and choice of more than 1 hospital within 5 km radius (Table 6). The district wise access to hospitals with 5 km buffer shows that the total population of Shahadra district has the choice of more than one hospital within 5 km radius, while this choice is available to 19.86 to 22.25 per cent area of North, South East and South West districts. Further, 51 per cent area in South West district and 48.33 per cent area in South East district is lying beyond 5 km buffer of hospitals as a result, about half of area and population of these districts have to travel more than 5 km to access hospital services (Table 6).

Availability and Accessibility of Public Health Care Facilities

A composite picture of availability and accessibility of HCFs has been obtained by taking four indicators of availability (persons served per mohalla clinic, dispensary, poly-clinic and government hospital) and four of accessibility indicators (area served per mohalla clinic, dispensary, polyclinic and government hospital). The study reveals that Shahdara, Central and New Delhi districts have better availability and accessibility, whereas South West, South East and North West districts are having poor availability and accessibility of HCFs (Fig. 7).

It implies that the disparities in the availability and accessibility of HCFs in Delhi are rooted in a complex interplay of socio-political factors. Various studies have cited that the land availability and political will are the major constraints in uniform distribution of health care facilities in Delhi (Sethi et al., 2020; Patel and Pant, 2020). These findings, however, need to be corroborated with further empirical investigations. The study reveals that the locational/geographical disparities have a profound impact on the health outcomes of

Table 6
Delhi: Government Hospitals and Buffer (5 km), 2022

| Districts	Percentage of Area having Government Hospital		
	Nil	**One**	**Multiple**
Shahdara	0	0	100
Central	3.10	10.07	86.81
North East	14.94	26.49	58.56
West	36.81	7.98	55.20
New Delhi	13.72	34.40	51.86
East	0.13	50.02	49.84
North West	38.42	12.78	48.78
South	46.63	23.46	29.89
South West	51.10	26.63	22.25
South East	48.33	29.71	21.95
North	31.26	48.86	19.86
State Average	**33.81**	**27.32**	**38.85**

Source: Compiled by Authors
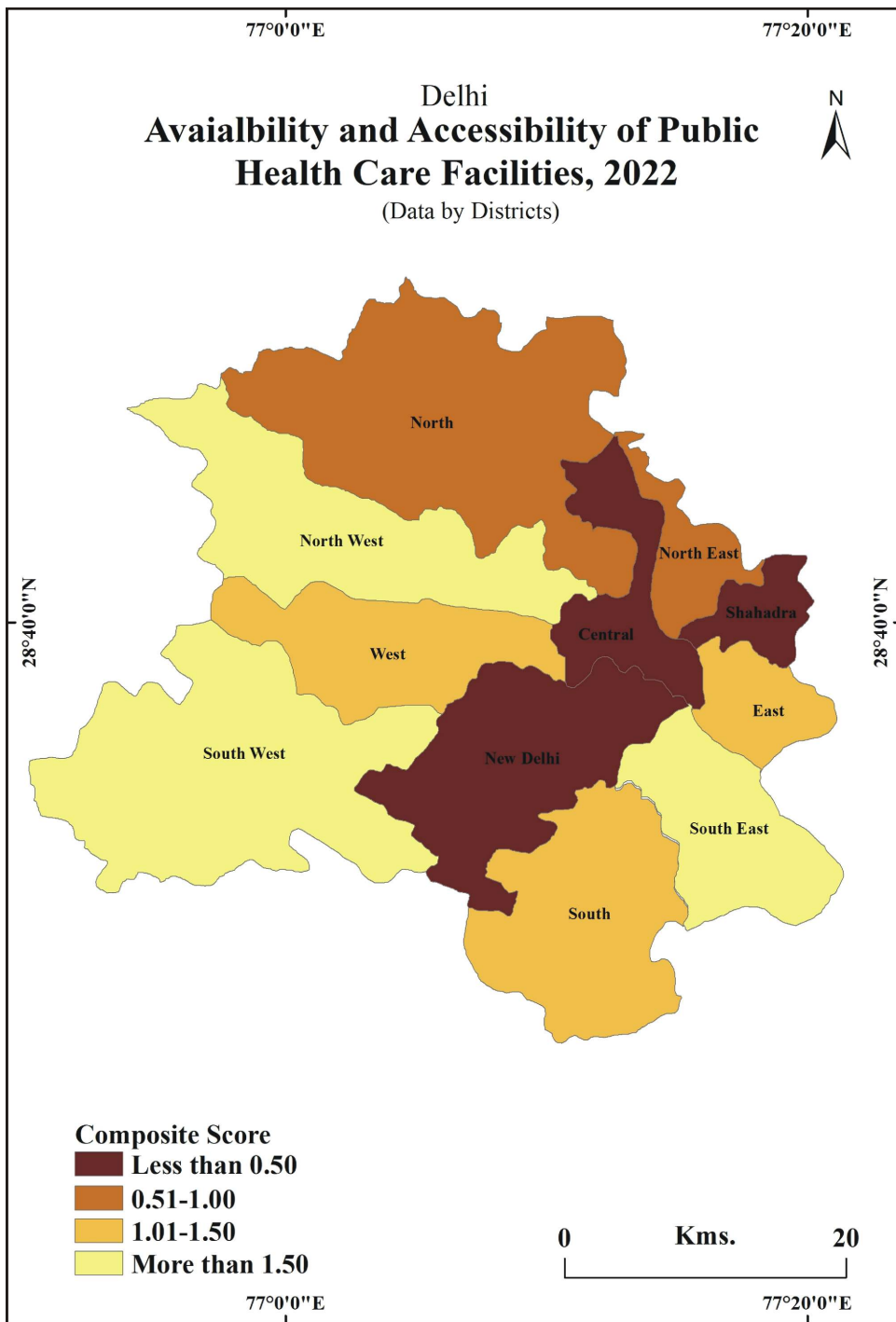
Fig. 7

vulnerable and underserved communities, particularly in the South West, South East, and North West districts. The population living in these districts face restricted access to essential medical care, which exacerbates health inequalities and widens the gap between the privileged and marginalized sections of the society.

Conclusions

The HCFs in Delhi are of different order where Mohalla clinics are the basic primary health care units, while hospitals are at the apex providing specialised curative care. The availability, measured as population facility ratio, reveals that all these facilities have wide inter district variations. The coefficient of inter-district variation in availability of mohalla clinics and dispensaries is 55 and 57 per cent. While in case of polyclinics it is 69 per cent and for hospitals the variation is 93 per cent. It shows that inter-district variation is more in availability of higher level of facilities. The study shows that Shahdara district is best served, while North East district is poorly served by mohalla clinics. In case of dispensa-ries, New Delhi district is better served, while North West district is poorly served. The Shadara district is also best served by the polyclinics, while the East district is poorly served. In case of government hospitals, Shahdara district is best served, while North West district is poorly served.

The accessibility of HCFs has been measured as area-facility ratio as well as with location density, catchment area, Euclidean distance and proximity of the facilities. Geographic location and density reveal that Shahdara district has higher concentration of all types of health care facilities. The catch-ment area of the Mohalla clinics of Shahdara district is smaller indicating better access, while the catchment areas are bigger in North West district making access poor. In case of higher order facility, i.e., hospitals, the pattern remains more or less the same demonstrating the district of Shahdara with better access. The Euclidean distance among the facilities is lesser in Shahdara and Central district, suggesting that people have more choices of HCFs in these districts. The proximity analysis reveals that in Shahdara district, large area lies within 1 km and 5 km buffers of mohalla clinics and government hospitals repectively. In North West and New Delhi districts, proportionately more area remains outside the easy physical access of mohalla clinics. Similarly, in the case of government hospitals, South district has low physical accessibilty.

The study further reveals that, three districts, namely, Shahdara, Central and New Delhi are best served, while of South West, South East and North West districts are poorly served in terms of availability and accessibility of public HCFs. These findings underscore the need for targeted interventions by the policymakers to address these disparities and improve the overall well-being of the popula-tion, especially in vulnerable and underserved communities of Delhi.

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