Barriers to Maternal Health Care Accessibility and Its Causal Determinants in Faisalabad, Pakistan: A Geospatial Assessment

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Access to maternal healthcare is a critical determinant of maternal and neonatal health outcomes, yet it remains a neglected issue in many developing regions, including Pakistan. This study investigates the spatial distribution and accessibility of maternal healthcare facilities in Faisalabad District using Geographic Information System (GIS) techniques, including point distance analysis and multiple ring buffer analysis. A total of 230 female respondents from six tehsils were surveyed using a structured questionnaire, with data gathered from two major public hospitals in the district. There are 155 Basic Health Units (BHUs) operating within Faisalabad District. 45.2% of respondents reported good accessibility to maternal health facilities, while 43% reported bad and 11.7% worse access. The highest concentration of cases (78 respondents) was within 6–10 km of a health facility. The findings reveal significant spatial disparities in access to healthcare facilities, particularly in rural and peripheral areas such as Tandlianwala, Chak Jhumra, and Samundri. Many women reside more than 20 kilometers from the nearest well-equipped hospital, and road conditions—ranging from poor to non-existent—further limit physical accessibility. The multiple ring buffer analysis demonstrates that several remote settlements fall outside the 12-mile buffer, indicating critical service gaps. Additionally, economic constraints and lack of public transportation exacerbate the situation, limiting women's ability to seek timely antenatal care. The overcrowding of urban public hospitals and the high cost and low quality of private healthcare further restrict options for low-income groups. The study underscores the urgent need for decentralized planning, infrastructure improvement, and equitable distribution of maternal health services, especially in underserved rural regions.

Keywords: Maternal Health Care, Geospatial Accessibility, Maternal Mortality, Determinants, Pakistan

Introduction:

Maternal healthcare facilities continue to be a critical and widely debated global concern. Although significant progress has been made, maternal mortality remains a serious challenge, particularly in developing nations. In 2020, an estimated 287,000 women lost their lives due to complications arising from pregnancy and childbirth [1]. Astonishingly, 830 women die every day from preventable maternal causes, with 99% of these deaths occurring in developing nations[2]. While developed countries have established effective mechanisms to ensure access to maternal healthcare facilities, developing countries continue to struggle to provide adequate accessibility. In developing countries, maternal and neonatal health risks remain considerably high. Despite the fact that over three-quarters of women utilize Antenatal Care (ANC) and Skilled Birth Attendant (SBA) services, wide disparities in access and quality continue to exist, especially within regions of Asia and Africa[3]. Pakistan was one of six countries that contributed to over half of all maternal deaths in 2008[4]. According to the Pakistan Demographic and Health Survey (PDHS) 2017–18, 70% of women face at least one problem in accessing health care[5]. Pakistan's maternal mortality ratio (MMR) was recorded at 276 deaths per 100,000 live births in 2006–07[6]. According to the Pakistan Maternal Mortality Survey (2019), the maternal mortality ratio (MMR) in Pakistan, excluding Azad Jammu and Kashmir (AJK) and Gilgit-Baltistan (GB), is 186 deaths per 100,000 live births[7]. In contrast, developed countries report an average MMR of just 12 deaths per 100,000 live births[8].

Physical accessibility represents one of the most critical barriers to maternal healthcare, as it directly shapes other dimensions of access, including financial and informational accessibility. In many developing countries, including Pakistan, health care centers are unevenly distributed, often concentrated in urban centers and sparse in rural areas. Poor transportation infrastructure further exacerbates the situation, leaving rural populations particularly vulnerable [9]. In fact, the U.S. government has invested over a billion dollars annually to mitigate problems related to health care access, highlighting the importance of physical proximity to health services[10]. In Pakistan, 30.7% of maternal deaths are attributed to lack of timely access due to transport issues, while 26.9% are linked to economic constraints[11]. It is concerning that, for nearly two decades, many countries have shown little progress, remaining locked in the same phase of maternal mortality transition[12]. Despite the seriousness of the issue, the Government of Pakistan allocates only about 1% of GDP to the health sector[13], and its percentage ranges from 1 to 1.4% from fiscal year 2017-18 to present[14]. Health budget should be increased to reduce maternal mortality in Pakistan, and more emphasis should be placed on improving the health sector[15]. Sustainable Development Goal 3 (SDG 3) focuses on ensuring healthy lives and promoting well-being for all at all ages. Specifically, SDG 3.1 is the sustainable development goal target focused on reducing mortality ratio while SDG 3.2 seeks to end preventable deaths of newborns and children under five. Maternal mortality and maternal health are critically neglected issues, particularly in developing countries. Access to health care facilities plays a vital role in improving human health, especially in terms of accessibility, distance, and availability of services.[16], [17]. This challenge is more pronounced in rural areas, where 61.12% of the population resides, often facing inadequate infrastructure, fewer health centers, and long travel times to receive basic maternal and child health services. [18][19] measured the Maternal Mortality Ratio (MMR) in Faisalabad from 2006 to 2010. During this period, a total of 168 maternal deaths were reported out of 24,667 live births. Their findings revealed an MMR of 6.81 per 1,000 live births, highlighting Faisalabad's significant contribution to Pakistan's overall maternal mortality burden[19].

Objectives:

The primary objective of this research is to examine the spatial distribution of maternal health care facilities and to evaluate their physical accessibility within the Faisalabad District.

The study aims to identify disparities in access based on distance and location, highlighting underserved areas that may require targeted policy intervention or infrastructural development.

Novelty of the Study:

This study brings a novel contribution by specifically focusing on maternal health care facilities in the Faisalabad District and employing Geographic Information System (GIS) tools to assess physical accessibility. Unlike previous studies that rely solely on demographic or statistical data, this research integrates spatial analysis to offer a more precise and visual understanding of how distance affects access to maternal health services. The approach provides actionable insights for urban planners, health administrators, and policymakers.

Materials and Methods:

Study Area-Faisalabad-Punjab:

The study was conducted in Faisalabad District, which is located approximately at latitude 31.4181° N and longitude 73.0892° E. The 2023 Population Census reports that the district spans 5,857 square kilometers and is home to 9,075,819 people, comprising 52.1% males and 47.9% females[18].

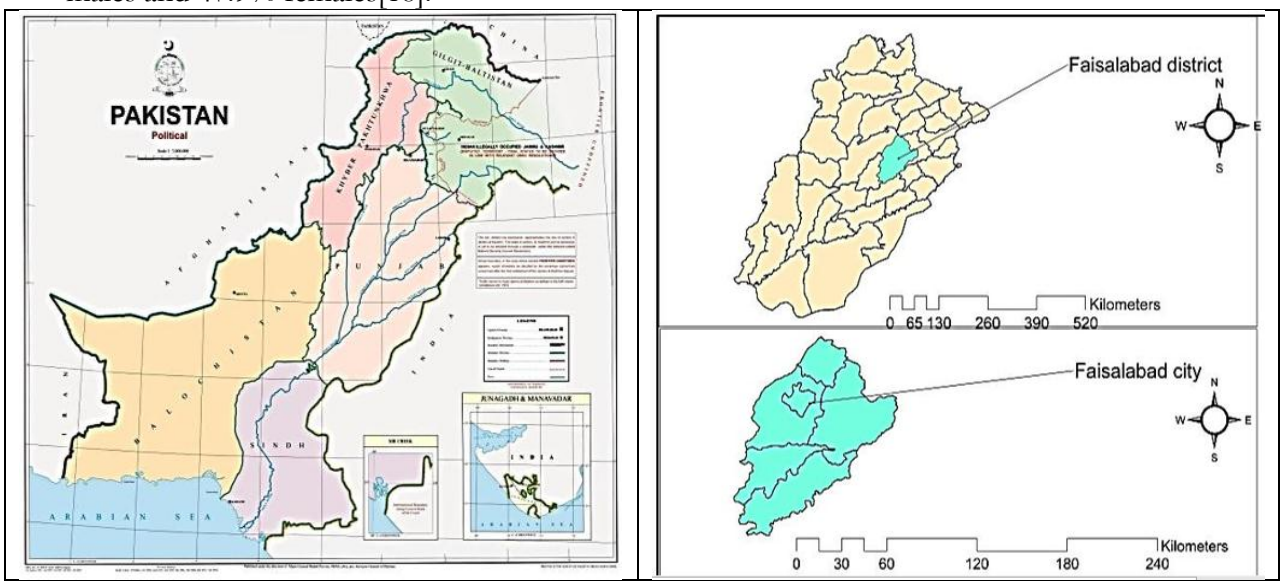


Figure 1. Study Area

To examine the spatial distribution of healthcare services, Google Earth was employed to map the locations of respondents' residences alongside nearby public and private hospitals and health facilities within Faisalabad District.

These location points were then converted into shapefiles using an online KML-to-SHP converter http://www.zonums.com/online/kml2shp.php Following data collection, ArcGIS 10 was employed for spatial analysis, including point distance analysis and multiple buffer analysis. The point distance proximity analysis was used to measure the direct distance between respondents' residential locations and the nearest hospital, while multiple buffer zones were applied to identify accessibility challenges, particularly in underprivileged and underserved areas.

In addition to spatial analysis, a structured questionnaire was administered to assess issues related to the physical accessibility of healthcare facilities. The study utilized a convenience sampling technique, with a total sample size of 230 female respondents. All respondents were patients from the gynecology wards of two major public health institutions in Faisalabad: Allied Hospital Faisalabad and District Headquarters (DHQ) Hospital Faisalabad.

Results:

Table 1 presents the regional disparities in maternal mortality across Pakistan, expressed in terms of the Maternal Mortality Ratio (MMR) per 100,000 live births. Balochistan reports the highest MMR at 298, indicating a severe lack of maternal health services, infrastructure, and access to skilled healthcare professionals, particularly in rural and remote areas. Sindh reports a high MMR of 224, followed by Khyber Pakhtunkhwa at 165 and Punjab at 157. Although comparatively lower, these figures remain concerning and underscore persistent gaps in the accessibility and quality of maternal healthcare. Interestingly, Gilgit-Baltistan shares the same MMR as Punjab (157), but with a much wider confidence interval (53–261), indicating data variability and possibly smaller sample sizes. Azad Jammu and Kashmir records the lowest MMR at 104; however, the wide confidence interval (23–185) warrants caution in interpreting the precision of this estimate. The national average MMR stands at 186, which remains alarmingly high compared to the Sustainable Development Goal (SDG) 3.1 target of reducing maternal mortality to fewer than 70 deaths per 100,000 live births by 2030. These figures underscore the urgent need for targeted health interventions, improved access to maternal care—especially in underserved provinces like Balochistan and Sindh—and better data collection mechanisms to inform policy and ensure equitable healthcare outcomes for women across the country.

Table 1. Maternal Mortality Ratios (MMR) by Region in Pakistan
(Per 100,000 live births)

Region	MMR	95% Confidence Interval (Lower)	95% Confidence Interval (Upper)
Punjab	157	79	235
Sindh	224	148	299
Khyber Pakhtunkhwa	165	84	246
Balochistan	298	130	298
Total (Pakistan)	186	138	234
Azad Jammu & Kashmir	104	23	185
Gilgit-Baltistan	157	53	261

Data Source: Pakistan Maternal Mortality Survey (PMMS), 2019:

Maternal mortality ratios are alarmingly high in Baluchistan, primarily due to a combination of healthcare system limitations and socio-cultural challenges. Key contributing factors include low frequencies of antenatal visits, limited utilization of family planning services, an inadequate referral system, and delays in accessing emergency obstetric care, all of which are common underlying causes of maternal deaths in the province [20]. In addition to these healthcare-related issues, socio-cultural barriers such as traditional norms, gender inequality, and lack of education further exacerbate maternal health outcomes in Balochistan[17]. Similar conditions are evident across other provinces, although the situation becomes particularly severe in rural areas, where maternal mortality ratios are consistently higher than in urban regions. Several systemic and social determinants contribute to this disparity, including a lack of awareness about family planning, poverty, unemployment, malnutrition, early age pregnancies, violence against women, restricted female mobility, and the low social status of women. Medically, the most common direct causes of maternal deaths in Pakistan are postpartum hemorrhage, sepsis, eclampsia, uterine rupture, unsafe abortions, and preeclampsia [21],[22],[23],[24],[25],[26],[27],[28],[29],[30],[31]. Many of these deaths occur either directly due to medical complications or indirectly due to societal barriers, particularly those that hinder women's access to timely and adequate maternal healthcare services [32].

The survey results indicate that there are 155 Basic Health Units (BHUs) operating within Faisalabad District. While these facilities are geographically dispersed, their distribution

is uneven, with certain areas—particularly the eastern side of Tandlianwala-being severely underserved. This lack of coverage leaves large portions of the rural population without adequate access to primary healthcare. Respondents frequently expressed that they are unable to afford treatment in private hospitals, and that existing public health facilities are outdated and not being upgraded. While public hospitals are somewhat accessible, they are often criticized for delivering poor-quality healthcare services.

Currently, there are nine government hospitals across Faisalabad District. Of these, the facilities located in Jaranwala, Tandlianwala, Samundri, and Chak Jhumra are reportedly under-equipped and inadequately staffed, compelling patients to travel to Faisalabad city for treatment. Within the city, only two hospitals-District Headquarters Hospital and Allied Hospital—are adequately equipped, yet both are severely overburdened. Due to high patient influx, especially in the gynecology wards, it is common to see two to three patients sharing a single bed, reflecting an acute shortage of space and resources.

Overall, public hospitals in Faisalabad are overcrowded, and the issue of physical accessibility was largely overlooked in the planning and location of these facilities. This has led to a mismatch between healthcare supply and community needs, particularly affecting marginalized and low-income populations in rural and peri-urban areas.

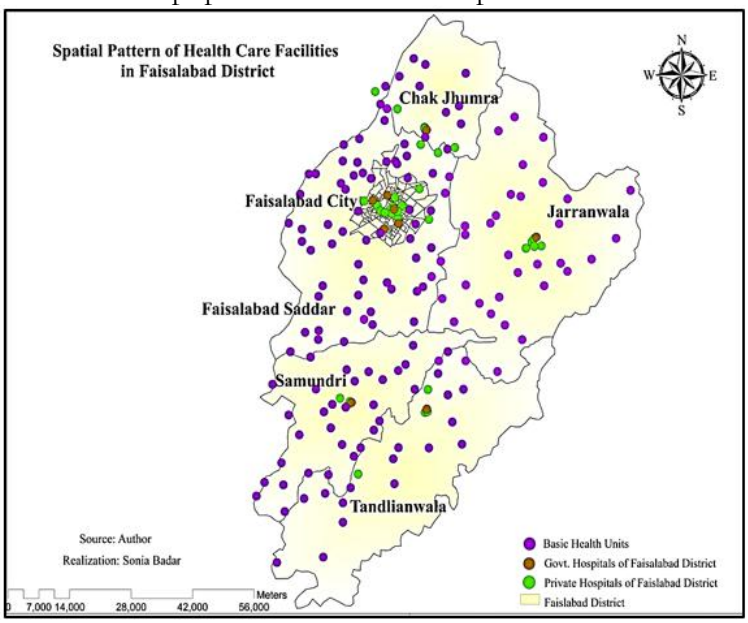


Figure 2. Spatial distribution of health care facilities in Faisalabad District

Figure 2 illustrates the spatial distribution of public and private health care facilities across Faisalabad District. The map was developed using Google Earth and ArcGIS 10, based on geospatial data collected from field surveys and secondary sources. Locations of health centers, hospitals, and respondents' residential areas were marked using Google Earth and converted into shapefiles through an online KML-to-SHP converter. The visual analysis reveals an uneven distribution of health services, with a marked concentration of facilities in urban centers like central Faisalabad, whereas peripheral and rural regions remain significantly underserved. This spatial disparity is crucial for understanding barriers to physical accessibility, especially for maternal healthcare services. Buffer and point distance analyses were conducted to measure the proximity of healthcare centers to respondents' residences, revealing that many underprivileged areas fall outside of a reasonable distance from essential health services. The findings underscore the urgent need for a more equitable distribution of healthcare infrastructure to enhance access in marginalized and rural communities. In Faisalabad District alone, 54 private hospitals are currently in operation. As illustrated in Figure 2, the spatial distribution of these facilities reveals a noticeable clustering of hospitals across all tehsils,

particularly in urban and semi-urban centers. This overlapping of points on the map signifies a high concentration of private health services in certain areas, while leaving other regions, such as Faisalabad Saddar and its surrounding localities, relatively deprived of basic healthcare access. Despite the availability of these facilities, a significant segment of the population, particularly in Faisalabad Saddar, remains without adequate access to private healthcare services.

A major barrier to accessing private hospitals is their high cost, which is prohibitive for lower- and middle-income groups. Furthermore, concerns were raised during the survey regarding the quality of care in private institutions. Many of these hospitals reportedly lack qualified medical staff, and nurses or pharmaceutical workers are often found treating patients, prioritizing profit over patient care. This situation undermines trust in the private health sector and contributes to the growing burden on already overwhelmed public hospitals.

Table 2. Physical Distance (Km) from a Public Hospital with Respect to the Condition of the Road in Faisalabad District

Distance (Km)	Good	Bad	Worse	Total	Good (%)	Bad (%)	Worse (%)
1–5	19	7	0	26	73.1	26.9	0.0
6–10	37	30	11	78	47.4	38.5	14.1
11–15	11	13	2	26	42.3	50.0	7.7
16–20	7	8	0	15	46.7	53.3	0.0
21–25	7	4	5	16	43.8	25.0	31.2
26–30	1	10	2	13	7.7	76.9	15.4
31–35	6	3	1	10	60.0	30.0	10.0
36–40	3	4	3	10	30.0	40.0	30.0
41–45	1	1	0	2	50.0	50.0	0.0
46–50	3	7	1	11	27.3	63.6	9.1
51–55	4	4	0	8	50.0	50.0	0.0
56–60	2	0	1	3	66.7	0.0	33.3
61–65	0	0	0	0	_	_	6
66–70	3	3	0	6	50.0	50.0	0.0
71–75	0	3	0	3	0.0	100.0	0.0
76–80	0	1	0	1	0.0	100.0	0.0
81–85	0	1	1	2	0.0	50.0	50.0
Total	104	99	27	230	45.2	43.0	11.7

Table 2 reveals a clear pattern in healthcare accessibility relative to distance. The highest concentration of respondents (78) falls within the 6–10 km range, where 47.4% reported good accessibility, 38.5% bad, and 14.1% worse — indicating a mixed but somewhat favorable access situation. Within 1–5 km, accessibility is significantly better, with 73.1% rating it as good and only 26.9% as bad, with no reports of worse access. However, accessibility declines sharply beyond the 10 km mark. For instance, in the 26–30 km range, only 7.7% found access to be good, while 76.9% rated it bad and 15.4% worse. A similar trend continues through 31–40 km, where bad and worse ratings dominate.

Beyond 40 km, the sample size drops, but poor accessibility remains evident. In the 46–50 km range, only 27.3% reported good access, while 63.6% found it bad. Some distances, like 71–80 km, show 100% of respondents reporting bad access. Interestingly, the 81–85 km range includes both bad and worse ratings equally (50% each), with no reports of good accessibility. The 61–65 km range had no data, which may suggest an unpopulated or unmeasured zone.

Overall, of the 230 total responses, 45.2% rated accessibility as good, 43% as bad, and 11.7% as worse. This indicates that less than half the population has good access to healthcare

facilities, with a considerable portion (nearly 55%) facing challenges — especially in more remote areas. The data highlights a critical need to enhance healthcare infrastructure and services in areas beyond 10 km, where accessibility starts to significantly deteriorate.

Table 2 presents a breakdown of 230 female respondents based on the distance they live from a public hospital and the condition of the roads connecting them to these facilities. It offers critical insights into how physical accessibility and infrastructure quality impact maternal healthcare access in Faisalabad District. The majority of respondents (78 out of 230) live 6–10 km away from a public hospital, with road conditions split among good (37), bad (30), and worse (11). This suggests that, even within a moderate distance, nearly 53% of the population encounters poor or inadequate road conditions, potentially delaying emergency care, especially in maternal health cases. Similarly, in the 1–5 km range, 26 respondents were recorded, with 19 enjoying good roads, and only 7 experiencing bad roads. This suggests relatively better accessibility in close-proximity areas. Between 11 and 30 km, road conditions progressively deteriorate, with an increasing number of respondents reporting "bad" or "worse" roads. This issue is most pronounced in the 26–30 km range, where 12 out of 13 respondents rely on poorly maintained routes. A critical concern arises beyond 30 km, where road conditions continue to decline. In the 46–50 km range, for example, 8 out of 11 respondents face bad or worse road infrastructure. This trend continues with fewer respondents but consistently poor access to public health facilities, which poses serious risks during obstetric emergencies. The data also shows that 27 respondents (11.7%) overall face the worst road conditions, most of whom are located more than 10 km away from a hospital. The cumulative figures indicate that only 104 respondents (45%) have access to hospitals via good roads, while 126 (55%) face either bad or worse road conditions.

Table 3. Point Distance Analysis for Accessibility of Health Care Facilities in Faisalabad District

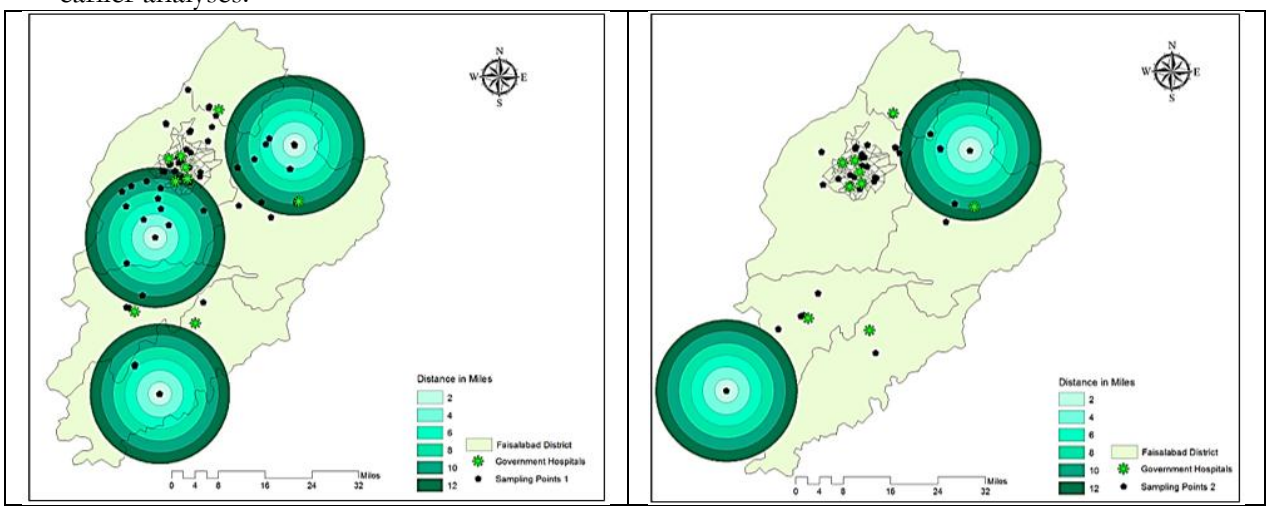
Area	Hospital	Distance (km)
Malkhan Wala	Government General Hospital Haseeb Wala Faisalabad	4.2
	District Head Quarters Hospital Faisalabad	7.3
	Government General Hospital Ghulam Muhammad Abad	11.9
Khurianwala	Government General Hospital Haseeb Wala Faisalabad	1.5
	Government General Hospital Samnabad	1.9
	District Head Quarters Hospital Faisalabad	3.9
Jwai Pura Muhalla Chak Jhumra	District Head Quarters Hospital Faisalabad	18.8
	Government General Hospital Ghulam Muhammad Abad	19.4
	Tehsil Head Quarters Hospital Chak Jhumra	0.9
39 GB Satiana Bangla	District Head Quarters Hospital Tandlianwala	10.5
	Tehsil Head Quarters Hospital Chak Jhumra	21.6
	Government General Hospital Haseeb Wala Faisalabad	30.9
Akalgrah	Government General Hospital Samnabad	17.1
	Government General Hospital Haseeb Wala Faisalabad	7.7
	District Head Quarters Hospital Faisalabad	7.9
244 GB Kalan	Tehsil Head Quarters Samundri	21
	District Head Quarters Hospital Tandlianwala	37
	Government General Hospital Samnabad	51

Ghona West	Government Civil Hospital Jaranwala	15.1
	Government General Hospital Haseeb Wala Faisalabad	16.4
	District Head Quarters Hospital Faisalabad	16.4

Discussion:

Table 3 presents a spatial accessibility analysis of healthcare services based on the physical distance (in kilometers) between various residential areas in Faisalabad District and the nearest public hospitals. It reveals critical insights into how far patients must travel to reach essential healthcare—particularly maternal care services—and highlights disparities in access across rural and semi-urban areas. The analysis shows that some areas, such as Khurianwala, are relatively well-served, with hospitals located within a 3.9 km radius, which can be considered acceptable for emergency access. Similarly, Jwai Pura Muhalla Chak Jhumra benefits from the proximity of a Tehsil Headquarter Hospital just 0.9 km away, though distances to other hospitals (18.8 km and 19.4 km) are significantly greater, showing dependency on a single local facility.

In contrast, areas like 244 GB Kalan face serious accessibility challenges, with the nearest hospital (Tehsil Headquarter Samundri) being 21 km away, and others located 37 km and 51 km away, respectively. This indicates severe spatial isolation, particularly dangerous in emergency maternal situations, where time is critical. Similarly, residents of 39 GB Satiana Bangla are required to travel distances ranging from 10.5 km to 30.9 km to access public hospitals, highlighting the shortage of nearby healthcare facilities in this area. Even in areas like Akalgrah, although two hospitals are within 8 km, the main gynecology-equipped hospital (Samnabad) is 17.1 km away, which could be a barrier for low-income, transport-constrained populations. In Ghona West, while the three nearest hospitals are all located within approximately 15–16 km, this still presents a burden, especially in cases of limited public transport or emergency needs. The situation is particularly severe for rural women, where long travel distances are further compounded by inadequate road infrastructure, as highlighted in earlier analyses.



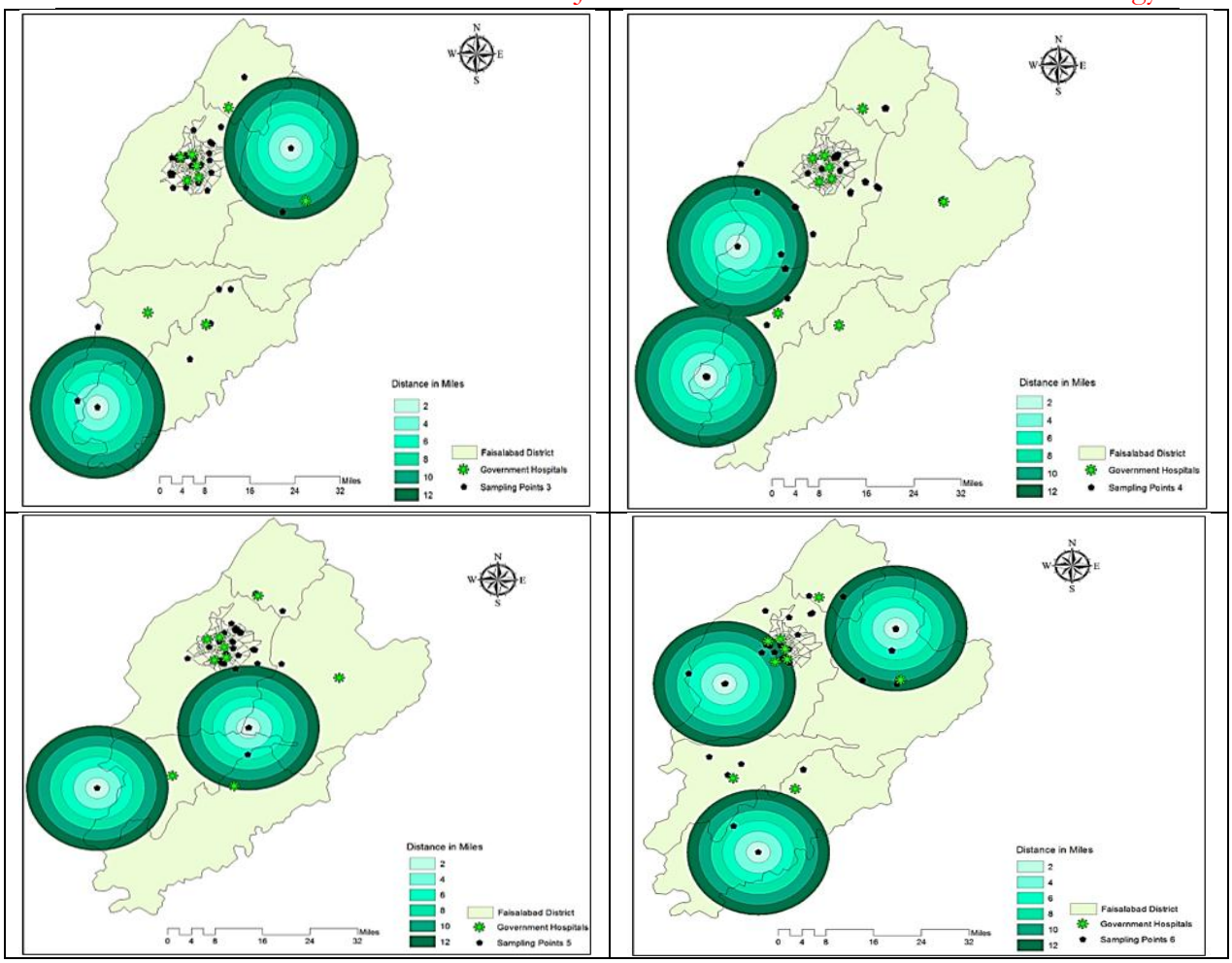


Figure 3. Multiple Ring Buffer analysis of health care centers in District Faisalabad

Figure 3 presents the spatial pattern of health care accessibility using a multiple-ring buffer analysis of public and private health care centers in Faisalabad District. The concentric rings represent incremental distances from health care centers, highlighting the spatial extent of service accessibility.

Figure 3 illustrates the Multiple Ring Buffer Analysis of health care facilities in Faisalabad District, a GIS-based technique used to visualize and quantify spatial accessibility. This method involves drawing concentric rings around health care centers at set distance intervals—such as 5 km, 10 km, 15 km, and so on—which helps to assess how far different populations live from the nearest health facility.

The analysis reveals a significant clustering of health care services in urban centers, particularly around Faisalabad city, where multiple buffers overlap, indicating dense and overlapping healthcare coverage. However, as distance from the city center increases, the buffer rings become more dispersed and isolated, revealing that peripheral and rural areas fall outside the optimal accessibility zones (typically considered within 5–10 km of a health facility).

Large portions of rural Faisalabad, including tehsils like Chak Jhumra, Tandlianwala, and Samundri, fall beyond the outer buffer rings, meaning they are more than 15–20 km away from a major health facility. This spatial inequality reflects the urban-rural divide in health infrastructure, where urban populations enjoy better coverage while rural residents face long travel distances and transport challenges. This analysis is critical for healthcare planning, as it identifies geographic gaps in service delivery and helps inform where new facilities should be

located to improve equity and emergency response times, particularly for maternal and child healthcare.

Figure 3 presents the accessibility of six selected sampling sites to the nearest government hospitals in Faisalabad District, using multiple ring buffer analysis. The analysis reveals that many areas-particularly in remote and rural locations—fall outside the 12-mile (approximately 19.3 km) buffer zones, indicating a severe lack of nearby, well-equipped health care facilities. These underserved areas lack access not only to maternal healthcare centers but also to basic emergency services, which poses a serious risk for women during pregnancy and childbirth.

The spatial gaps are most pronounced in remote regions, where residents cannot afford private transportation and must rely on infrequent or unreliable public conveyance, further delaying access to care during emergencies. As a result, women in these regions are often unable to receive timely antenatal care, which is essential for reducing maternal and neonatal mortality.

This analysis aligns with the findings of the Pakistan Demographic and Health Survey (PDHS) 2012–13 [33], which noted that neonatal mortality in Pakistan had remained largely unchanged over the past two decades[5]. The ring buffer zones, therefore, not only map physical accessibility but also highlight the structural inequities in healthcare distribution, emphasizing the urgent need for targeted health infrastructure development in marginalized areas.

Conclusion:

This study highlights the critical issue of spatial inequality in maternal healthcare accessibility within Faisalabad District, Pakistan. Using GIS-based analyses—including point distance and multiple ring buffer techniques- the research identified significant geographic and infrastructural barriers that limit timely access to maternal health services, especially for women in rural and underserved areas. Many localities fall outside a 12-mile radius of any well-equipped public hospital, and even where facilities exist, poor road conditions, long travel distances, and lack of affordable transport further restrict access.

The findings reveal a heavy concentration of health services in urban centers, leading to overcrowding in a few hospitals and leaving peripheral regions deprived of essential maternal care. This situation is particularly concerning in emergencies, where delays in accessing care can directly contribute to maternal and neonatal mortality. The results align with national health surveys that show stagnant neonatal and maternal health indicators over the past two decades.

To address these disparities, there is an urgent need for decentralized health planning, infrastructure development, and the equitable distribution of healthcare resources. Establishing well-equipped maternal health centers closer to rural populations, improving road connectivity, and strengthening the referral system can significantly improve maternal health outcomes. Without targeted intervention, the existing urban-rural divide in health access will continue to hinder progress toward achieving SDG Targets 3.1 and 3.2, which aim to reduce maternal and child mortality in Pakistan and beyond.

Declaration of Conflict of Interest:

Authors declare no conflict of interest. The submission is purely for this journal and not submitted anywhere else. The approval of all the authors has been obtained.

Ethics and Permission

Prior verbal consents have been taken from the respondents.

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