Evaluating population-based geographic access to primary healthcare services in Jeddah second cluster, Saudi Arabia

Khalid H. Alabbasi1, Saba Kassim2, Alla Alsharif2, Estie Kruger3*, Marc Tennant3

ABSTRACT

Objective: The study addresses the wider question of whether accessibility of the existing primary health cares (PHCs) is sufficient to provide services to individuals. Based on this question, the aim of this study was to generate quantitative evidence regarding PHC spatial access in Jeddah city, Saudi Arabia.

Methods: A cross-sectional study design was used to conduct this descriptive study. Jeddah second cluster-Jeddah city (J2-J) had a total of 18 PHCs with a total population of 1.7 million, which represents 49.4% of the total population of Jeddah city.

Results: The Al-Safa 1 and 2 district health centers were located in the areas with the highest population densities, with populations of 209,908 (12.4%) and 187,233 (11.1%) of the J2-J total population, respectively. On average, individuals living in sparsely populated areas must travel 3.05 to 4.65 km to reach their nearest PHC, while individuals living in highly populated areas must travel an average of 1.13 to 1.85 km to their nearest PHC. In J2-J, the population density varies significantly between districts, with services concentrated in some highly populated areas. While most J2-J residents were located within reasonable distance of their nearest PHC, some PHCs provided services to up to 200,000 people.

Conclusion: Despite the current reforms affecting the health care system, particularly those pertaining to the new model of care, the capacity of PHCs is insufficient to satisfy the demands of the population.

Keywords: Primary health care, GIS, distance, population, Saudi Arabia.

Introduction

The declaration of Alma-Ata emphasizes the importance of primary healthcare centers (PHCs) as a person’s first point of contact within the health system. They bring health care as close as reasonable to where people live and work and are the foundation of a successful and accessible health care process [1]. The primary concern of spatial accessibility is the distribution of the population (demand) and the healthcare facilities (supply). Urbanization is driving governments to increase access to affordable healthcare facilities to meet the needs of the relentlessly growing population [2-4]. However, the continuous urban population explosion presents a challenge to urban planners responsible for maintaining basic healthcare infrastructure and services [5,6]. The utilization of health services is heavily influenced by the distance between the patients and the health centers [7].

The Saudi Arabian healthcare system consists of three main components: the Ministry of Health’s (MOH) network of hospitals and primary care centers, other governmental sectors, and private providers [8]. Over the past seven decades, Saudi Arabia has witnessed unprecedented growth in the number of health facilities [9,10]. The MOH’s hospitals and primary care centers are currently undergoing a comprehensive reform that...
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would fully accommodate the current and future needs of Saudi Arabia.

To achieve this, the health system was privatized, and health clusters were created. Consequently, the financial structure has been revised, and each cluster relies solely on payment for services to increase its efficiency and efforts rather than on government funding [10].

The health clusters are an integrated network of healthcare providers that operate under a single administrative structure. The second health cluster in Jeddah (J2) includes three catchment areas: Jeddah second cluster-Jeddah city (J2-J), the town of Thuwal, and Rabigh governorate. The J2 cluster includes nine hospitals and 37 PHCs. However, despite this large-scale expansion, geographical variations in healthcare facility access persist. Some populations within the Jeddah city boundaries still lack geographic access to healthcare [8,11,12].

The study addresses the wider question of whether accessibility of the existing PHCs is sufficient to provide services to individuals. Based on this question, the aim of this study was to generate quantitative evidence regarding PHC spatial access in Jeddah city, Saudi Arabia.

Materials and Methods

In addition to being the largest city in Makkah Province, Jeddah is the second biggest urban city in Saudi Arabia [13]. Two health clusters exist in Jeddah province: Jeddah first cluster (J1) and Jeddah second cluster (J2). The J2 cluster encompasses all districts located north of Palestine Street in Jeddah city (and the smaller towns of Thuwal and Rabigh).

In this study, the two small towns were not included to focus on J2-J. J2-J includes 18 PHCs serving 47 districts. Two referring hospitals (King Fahad Hospital and King Abdullah Medical Complex) are connected to these PHCs. Therefore, the study focused exclusively on these two hospitals and excluded the specialized hospitals such as the maternity hospitals, the dental hospitals, and the ophthalmic hospital.

A cross-sectional study design was used to conduct this descriptive study. All the data used were obtained from open-access web-based sources. The population data of the metropolitan area of J2-J were obtained from the most recent (2010) census data available on the General Authority of Statistics’ website [14]. The cluster’s population was calculated as the total number of people living within its boundaries.

Since the most recent census (2010), some new housing districts have been formed. To include these, a population estimate was made for each. The estimate rested on the ratio of people to local roads for all the existing districts and using this ratio, numbers of people were extrapolated from the number of local roads in the new districts. Local road data were collected from open street maps. Based on this, it was estimated that from new and existing districts there were 1.7 million people living within J2-J’s boundaries.

The geocoded locations of J2-J’s PHCs were obtained from the Saudi MOH website [15]. PHCs were mapped against the population distribution to explore healthcare service delivery and examine whether there was a significant variation among districts in PHCs provision and accessibility.

Microsoft Office Excel software (Microsoft Corp., Redmond, WA) was used to store the collected data. Data were then transferred into the Quantum Geographic Information System (QGIS) (version 2.14.1) for analysis. To effectively use GIS in displaying the area of coverage for each of the identified PHCs in relation to the J2-J population, random points were used where one point represented one person.

With the high population density of a city with a dense road network, the direct point-to-point distance is a reasonable, but simplified, measurement of travel distance was employed. In this study, random points across each district were distributed within J2-J to represent the 1.7 million people (each point being a single person). Distances were then calculated from each point to the nearest PHC.

According to the World Health Organization (WHO), every person should live within 5 km of a health facility, to achieve optimal access [16]. Thus, to assess geographic accessibility, buffers were created to quantify the population in catchment areas. Buffers with radii of 1, 2.5, 5, 7.5, and 10 km were produced around the PHCs. The use of buffers enabled the quantification of the populations inside and outside each catchment area. Population sizes were extracted from within (and outside of) the buffers constructed around the PHCs’ locations.

Results

J2-J had a total of 18 PHCs with a total population of 1.7 million, which represents 49.4% of the total population of Jeddah city (Figure 1).

The average distance of any individual from the nearest PHC was 1.6 km (IQR = 1.4). PHCs are district-specific in J2-J and only 36 (~77%) of the districts are being served by PHCs. In J2-J, the number of districts per PHC ranged from 1 to 3 in high-density population areas, compared with 3-6 districts per center in low-density population areas (Table 1).

The Al-Safa 1 and 2 district health centers were located in the areas with the highest population densities, with populations of 209,908 (12.4%) and 187,233 (11.1%) of the J2-J total population, respectively. Contrastingly, the Obhur Alshamalia district health center and the Al-Wafa district health center were in areas with the lowest population densities, with populations of just 12,765 (0.8%) and 8,319 (0.5%), respectively. On average, individuals living in sparsely populated areas must travel 3.05 to 4.65 km to reach their nearest PHC, while
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**Figure 1.** Distribution of PHCs and population density of the second health cluster in Jeddah, Saudi Arabia.

**Table 1.** Distribution of the population and average distance from PHCs in Jeddah second cluster.

<table>
<thead>
<tr>
<th>No.</th>
<th>PHCs</th>
<th>No. of health districts</th>
<th>No. of population (%)</th>
<th>Average distance, km Median(IQR)*</th>
<th>Mean (min-max), km</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mushrifa district health center</td>
<td>1</td>
<td>84,486(5)</td>
<td>1.08(0.7)</td>
<td>1.33(0.003-7.47)</td>
</tr>
<tr>
<td>2</td>
<td>Al-Salamah district health center</td>
<td>2</td>
<td>171,632(10.1)</td>
<td>1.72(1.7)</td>
<td>2.11(0.002-7.95)</td>
</tr>
<tr>
<td>3</td>
<td>Al-Aziziyyah district health center</td>
<td>1</td>
<td>179,520(10.6)</td>
<td>1.42(1.4)</td>
<td>1.74(0.008-6.99)</td>
</tr>
<tr>
<td>4</td>
<td>Al-Faisaliah district health center</td>
<td>1</td>
<td>145,611(8.6)</td>
<td>1.48(1.3)</td>
<td>1.74(0.01-7.6)</td>
</tr>
<tr>
<td>5</td>
<td>Al-Manwa district health center</td>
<td>1</td>
<td>70,308(4.2)</td>
<td>1.22(1.0)</td>
<td>1.3(0.007-2.89)</td>
</tr>
<tr>
<td>6</td>
<td>Al-Naeem district health center</td>
<td>2</td>
<td>104,634(6.2)</td>
<td>1.54(1.0)</td>
<td>1.69(0.003-4.58)</td>
</tr>
<tr>
<td>7</td>
<td>Al-Rabwa district health center</td>
<td>2</td>
<td>84,878(5)</td>
<td>1.62(1.1)</td>
<td>1.60(0.004-5.82)</td>
</tr>
<tr>
<td>8</td>
<td>Al-Safa 2 district health center</td>
<td>1</td>
<td>209,908(12.4)</td>
<td>1.6(1.1)</td>
<td>1.79(0.007-6.98)</td>
</tr>
<tr>
<td>9</td>
<td>Khalid model health center</td>
<td>1</td>
<td>21,016(1.2)</td>
<td>2.27(1.5)</td>
<td>2.40(0.001-8.76)</td>
</tr>
<tr>
<td>10</td>
<td>Al-Rayyan district health center</td>
<td>3</td>
<td>23,055(1.4)</td>
<td>3.05(2.7)</td>
<td>3.4(0.032-9.473)</td>
</tr>
<tr>
<td>11</td>
<td>Al-Safa 1 district health center</td>
<td>1</td>
<td>187,233(11.1)</td>
<td>1.85(1.7)</td>
<td>2.23(0.001-9.47)</td>
</tr>
<tr>
<td>12</td>
<td>Al-Bawadi district health center</td>
<td>2</td>
<td>134,088(7.9)</td>
<td>1.13(0.8)</td>
<td>1.21(0.003-2.65)</td>
</tr>
<tr>
<td>13</td>
<td>Al-Nahda district health center</td>
<td>3</td>
<td>73,936(4.4)</td>
<td>1.8(1.6)</td>
<td>2.0(0.009-6.03)</td>
</tr>
<tr>
<td>14</td>
<td>Al-Shatt district health center</td>
<td>3</td>
<td>48,163(2.8)</td>
<td>2.23(2)</td>
<td>2.38(0.004-5.18)</td>
</tr>
<tr>
<td>15</td>
<td>Al-Sheraa district health center</td>
<td>6</td>
<td>87,967(5.2)</td>
<td>2.63(2.1)</td>
<td>2.7(0.012-7.92)</td>
</tr>
<tr>
<td>16</td>
<td>Al-Majed district health center</td>
<td>2</td>
<td>45,631(2.7)</td>
<td>2.79(2.4)</td>
<td>3.06(0.004-7.9)</td>
</tr>
<tr>
<td>17</td>
<td>Al-Wafa district health center</td>
<td>3</td>
<td>8,319(0.5)</td>
<td>4.65(3.4)</td>
<td>4.37(0.012-8.9)</td>
</tr>
<tr>
<td>18</td>
<td>Obhur Alshamalia district health center</td>
<td>1</td>
<td>12,765(0.8)</td>
<td>2.24(1.4)</td>
<td>2.36(0.012-4.63)</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>36</strong></td>
<td><strong>1,693,150(100)</strong></td>
<td><strong>1.6(1.4)</strong></td>
<td><strong>1.8(1.4)</strong></td>
</tr>
</tbody>
</table>

*IQR, Interquartile range.*
individuals living in highly populated areas must travel an average of 1.13 to 1.85 km to their nearest PHC (Figure 2).

PHCs spatial accessibility in J2-J at the WHO optimal level of accessibility (within a 5-km of the nearest PHC) captured 96.7% of the J2-J total population. Nearly 77% of the city’s population is within 2.5 km of a PHC and 99.8% is within 7 km; with a 10 km radius, all individuals have access to PHCs (Table 2).

Discussion

This study addressed the question of whether existing PHCs are sufficiently accessible for individuals to receive services in Jeddah city, Saudi Arabia. The present findings confirm that there is a significant difference in the population density among the districts in J2-J, with services concentrated in certain highly populated districts. While the number of PHCs in low populated districts, however, was very low or nonexistent. Accordingly, the facilities are appropriately distributed since they are aligned with the overall population growth pattern of the study area. Yet, a large number of people are served by each PHC. Additionally, the ratio of practices to populations in J2-J (1:47,032) is higher than the current national 0.74 PHCs per 10,000 population in Kingdom of Saudi Arabia (KSA) [17,18]. Exactly, 13,813 people were served by each of SA’s centers in 2015, according to its annual statistics report [9]. Collectively, the results appear consistent with similar studies within the study area [5,8,12,18]. Other studies

Table 2. Distributions of population who resided inside and outside the buffer zones from PHC in J2-J.

<table>
<thead>
<tr>
<th>Distance from PHC, km</th>
<th>No. of population n (%)</th>
<th>Within the zone</th>
<th>Outside the zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>405,290 (23.9)</td>
<td>1,287,860 (76.1)</td>
<td></td>
</tr>
<tr>
<td>2.5</td>
<td>1,302,099 (76.9)</td>
<td>391,051 (23.1)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1,637,192 (96.7)</td>
<td>55,958 (3.3)</td>
<td></td>
</tr>
<tr>
<td>7.5</td>
<td>1,689,107 (99.8)</td>
<td>4,043 (0.2)</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>1,693,150 (100)</td>
<td></td>
<td>-</td>
</tr>
</tbody>
</table>

Figure 2. Higher resolution view of the second health cluster in Jeddah city outer metropolitan area.
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claim that individual’s access to health services is also influenced by their daily activity patterns in space and time [19]. These movements, however, in practice, tend to fall into a geographically defined catchment area, centered on the home, where everyday life takes place.

Access to health care is an important component of the space of activity, which can be a constraining factor.

The study indicated that 96.7% of J2-J population had access to a PHC within 5 km (the WHO’s optimal accessibility level). The extent to which geographic accessibility influences the utilization of services, however, depends on the characteristics of the population.

Demographic and socioeconomic factors, including income, occupation, age, and gender, clearly influence health care-related travel [20].

Results from this current study do not account for transport options. Although, the city is highly car-dependent, with public transit usage being negligible. People with limited mobility are more sensitive to distance, and thus more likely to forgo care entirely or use the closest health care provider. In public health, the greater the distance that patients have to travel to access health care correlates directly with the increased morbidity of various health outcomes [21]. Despite distance being a fundamental factor in geographical access, travel costs, access to transportation, and perceived distance are also of high relevance to healthcare utilization [22,23]. Still, an individual’s need to use certain services impacts how well they overcome distance constraints.

The overall level of accessibility, whether it is potential or revealed, can be used to measure the performance of the health care system. In healthcare services delivery, measuring performance has become increasingly challenging. The challenge is compounded by the need to translate relevant data into a format that policymakers and funding agencies would understand.

One of the most significant issues associated with healthcare planning is modeling the optimum distribution of service areas. The location of a new primary healthcare center, for example, would be determined by considering current healthcare facilities as well as the level of facility requirements [24]. As the new urbanism model focuses on universal access, the efficacy of the research in this thesis could be understood.

This study evaluates the distance to the closest PHC and does not reflect any measure of the PHC’s size or its service capacity versus demand. This aspect needs to be investigated in future studies.

Conclusion

Despite the current reforms affecting the health care system, particularly those pertaining to the new model of care, the capacity of PHCs is insufficient to satisfy the demands of the population. In J2-J, the population density varies significantly between districts, with services concentrated in some highly populated areas. While most J2-J residents are located within a reasonable distance of their nearest PHC, some PHCs provide services up to 200,000 people. As part of Saudi Vision 2030, several initiatives are in place to improve primary health centers and the quality of their services. It is necessary to scale up and accelerate these initiatives while considering the findings and policy levers that have been discussed.

Additionally, mapping and clustering of diseases, the detection of disease spread trends, as well as controlling and monitoring diseases warrants further investigation to improve PHCs.

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Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this article.

Funding

None.

Consent to participate

Written informed consent was obtained from all the participants.

Ethical approval

Before carrying out the research, an ethics application was submitted to the MOH in Saudi Arabia (KSA:H-02-J-002), and the Human Research Ethics Committee at The University of Western Australia (RA/4/20/6317) (dated: 30/06/2023).

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