

Travel Times to Public Primary Healthcare and Hospitals in Jazan Region of Saudi Arabia

Mosa Ali Shubayr (✉ mshubayr@jazanu.edu.sa)

Jazan University

Estie Kruger

The University of Western Australia

Marc Tennant

The University of Western Australia

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Abstract

Background: It is impossible to attain good general health without maintaining oral health. This becomes difficult when dental services are located far from the population that needs to utilize them. The study aimed to assess the geographic accessibility of dental healthcare services and to estimate the served population by the dental services in Jazan of Saudi Arabia.

Methods: The location of health facilities, governates borders and road systems was obtained and to model accessibility to health facilities (PHCs and hospitals) using GIS. This study used two scenarios to measure the travel time by car driving and walking to the health facilities. The maximum travel time considered as a serviced area was set at 30 min and underserved area outside 30 min from the health facilities.

Results: The finding shows that most of the region's residents need a long time to reach the PHCs and hospital facilitates weather by walking or car driving. Only 30.73 % and 31.97 % of jazan population live on served area by car drinving. Most of the mountain governates such as Al Aridah, Al Aydabi, Al Harth, Ar Rayth, Baysh, Fayfa and Harub had the highest number of underserved populations. Regarding the walking scenario, only 40% of Jazan region residents need 30 minutes or less to reach PHCs and only 19% of the residents need 30 minutes or less to reach hospitals. The majority of Farasan and Damad residents was considered a served area of PHCs and hospitals.

Conclusion: The study shows that there is an accessibility issue due to many Jazan residents needing to drive or walk for a long time (> 30 min.) to reach a healthcare facility whether to PHCs or hospitals. This issue could cause many people to not receive proper health services when needed which could affect their oral health status. Further research is needed focusing in mapping MOH, private and other health facilities and the burden of oral disease in the region.

Introduction

Health is a universal need for all humans. However, it is impossible to attain good general health without maintaining oral health. This becomes difficult when dental services are located far from the population that needs to utilize them. Even a slight increase in the distance of healthcare facilities lowers the utilization of health services such as a comprehensive dental examination [1].

According to R Penchansky and JW Thomas [2], access means “that degree of fit between the system and the patient. There are different dimensions which help to provide an overview on access to healthcare. Accessibility, Availability, Accommodation, affordability and Acceptability are example of access dimension [2]. The relation between the location of health service and the location of a patient is a referee to accessibility. The World Health Organization [3] lists different forms of accessibility such as economic, informational and physical. Each spectrum of accessibility covers different health needs and challenges across the board. Having access to relevant information reinforces the right of an individual or group of people to seek and receive information about the health issue they are concerned about. Once

being informed of their need, there is still a cost implication as well as the proximity of the sought-after health services for those in need of them.

Factors such as seriousness, kernel density, and catchment area methods [4] have become acceptable methodological approaches for estimating health accessibility. However, the most utilized methods of calculating accessibility in public health research remain the Euclidean and network distance methods [5]. An area's relationship to a point or points of supply, based on the crow-flies distance, is the main impetus of the Euclidean distance methods. Networked distance is the actual road taken to arrive at the destination [6].

There is no generally accepted distance allowed for people to travel for medical care. This means that no standard parameter can be used to measure how far is far enough when it comes to healthcare services' accessibility. However, stakeholders like The World Health Organization (WHO) suggest the use of travel time, rather than travel distance, to determine the accessibility of healthcare services. This approach considers the state of the roads and means of transportation. [7]. Some authors recommend half an hour to access patient care [8]. Others suggest that people living more than three-quarters of an hour from healthcare facilities are more likely to be marginalized. Still others regard one hour as tolerable [9].

In Saudi Arabia, different studies have examined the topic, but they were mostly focused on the barriers to utilizing dental services. This research, which is a study of travel time to primary health care centres and hospitals, was conducted in the Jazan region (Fig. 1). Jazan is the southwestern region of Saudi Arabia. It has a population of approximately 1.7 million – 54.2% male and 45.8% female [10]. Jazan is rapidly developing as a large agricultural heartland and provides many economic opportunities for both domestic and foreign investments. This continued growth has led to health care challenges such as an increase in population resulting in high health care costs. Jazan is considered one of the regions with the lowest health care quality in the country [11].

It is postulated that proximity to health centres facilitates good health because it increases access to healthcare [12]. On the other hand, long travel times and greater distances inhibit access and discourage repeat visits to healthcare facilities [13].

To the researcher's knowledge, no similar published studies of distance to healthcare services in the same region (Jazan) exist. Therefore, this study examines the travel time to dental healthcare centres and services offered by the Ministry of Health (MOH) facilities in the Jazan region. By measuring geographical accessibility in the region, recommendations to enhance future dental healthcare services can be made

Material And Methods

This study calculates the travel time to the healthcare services and the healthcare facilities by car driving or walking scenarios. The study's focus is Primary Health Care and Hospitals in the Jazan region of Saudi Arabia. This region (also spelled Jizan, Gizan, or Gazan) consists of 17 governorates (*mohafadat*

in Arabic) with a total of 1,726,739 residents as of 2020. Data for the current study were obtained between Oct 1st, 2021 and Dec 31st, 2021. The researcher used freely available, anonymous data. Ethics approval was therefore not necessary.

Each Jazan governate was given its own identifier and its borders were obtained from census data [10, 14]. The road system was obtained from the same source and was divided into two types – main roads and highways. Administrative governates were picked as the geographical region because this was the only available information source in the file format that matched the population information files. All population data were acquired from the most recent data on the General Authority and World Population's websites [15, 16].

The location of health facilities was obtained from the Ministry of Health Statistical Yearbook [17] and a Ministry of Health interactive map [18]. Only MOH primary healthcare facilities (PHCs) and hospitals were included in this study. Other facilities such as dental schools, mobile clinics, private medical centres, and duplicated addresses were left out. The location of the health facilities was converted to longitude and latitude with Google Maps with 90% at the building level.

For this study, the researcher used Quantum Geographic Information Systems (QGIS) (version 3.20, Essen, Germany) to carry out geographic mapping. To coordinate referencing, this study used World Geodetic System 1984 (WGS 84). The geographical data and linked population data obtained were captured and reviewed in Microsoft Excel (version 14.0; Microsoft, Redmond, WA, USA). The researcher used random points in the GISs to display the area of coverage for the identified clinics (PHCs and hospitals) concerning the target Jazan population. Population dots and locations of PHCs and hospitals were placed on the study map using Quantum GIS (QGIS).

This study used two scenarios to measure the travel time – both by car driving and on foot. This study did not measure travel time with the straight-line distance method because this does not consider physical barriers, such as expanses of water, rail tracks, buildings, and other obstacles [6, 19]. Thus, this study measures driving and walking time in minutes using the road system. The maximum travel time considered as a serviced area was set at 30 min. Areas that are located more than 30 min away from health facilities were considered underserved.

This study's data were analysed both descriptively and by calculation. Data were reviewed using Microsoft Excel (2016 version 14.0). Study data to be analysed were imported from the integrated database in QGIS into Microsoft Excel software.

Results

The study shows the driving time to primary healthcare centres (PHCs) in 7 time categories – 5, 10, 20, 30, 40, 50 and 60 minutes (Fig. 2). The findings show that most of the region's residents need a long time to reach the PHCs facilities. Only Al Darb and Al Tuwal have a short travel time to PHCs. At 30 minutes, these are the best-served areas in the region. However, residents in Al Dair, Al Aridah, Al Rayth, Fayfa and

Harub have the longest travel time to the PHCs since most of them require 60 minutes to reach the medical facilities. The results show that the majority (69.27%) of Jazan region residents live in underserved areas (Table 1). Al Darb, At Tuwal, Jazan, and Samtah are the governates with the highest number of people served by PHCs. (Fig. 3). Most of the mountain governates such as Al Aridah, Al Aydabi, Al Harth, Ar Rayth, Baysh, Fayfa and Harub had the highest number of underserved populations.

Table 1
Summary of the population distribution in the two scenarios

	Driving		Walking	
	PHCs	Hospitals	PHCs	Hospitals
Population Served (≤ 30 mn)	530566 (30.73%)	552019 (31.97%)	690,696 (39.69%)	328,080(18.72%)
Underserved Population (> 30 mn)	1196173 (69.27%)	1174720 (68.03%)	1,036,043(60.31%)	1,398,659 (81.82%)
Total	1,726,739 (100%)	1,726,739 (100%)	1,726,739 (100%)	1,726,739 (100%)

Regarding driving time to MOH hospitals, the findings show that the majority of Jazan region residents have a long driving time to receive health care hospitals in the region (Table 1 and Fig. 4). Farasan and Al Darb have the shortest travel time to PHCs at 5 and 20 minutes respectively. These are, therefore, the best-served areas in the region. Residents of Al Dair, Al Aydabi, Baysh and Fayfa have the longest travel time to the PHCs since most of them need 60 minutes to reach the services. The findings show that the majority (68.03%) of Jazan region residents live in underserved areas (Table 1). Al Darb and Farasan are the governates with the highest number of people living in the areas served by hospitals (Fig. 5). Ad Dair, Al Aridah, Al Aydabi, Al Harth, Ar Rayth, Baysh and Fayfa have the highest number of underserved people and no general hospital in the Harub governorate.

Regarding walking to primary healthcare facilities, the same time break in the driving scenario was used (Fig. 6). The study found that about 39.69% of Jazan region residents need 30 minutes or less to reach the services in PHCs (Table 1). The majority of residents who live in Ar Rayth, Damad, Farasan and Samitah can reach a PHC service if they walk 30 minutes or less. Fayfa, Al Aridah and Harub residents can reach PHCs only if they walk for longer than 60 minutes (Fig. 7).

Regarding walking to the hospital, the researcher used the same time break in the driving scenario (Fig. 8). The study found that about 18.72% of Jazan region residents need 30 minutes or less to reach the services in general hospitals (Table 1). The results show in Fig. 9 that more than half of Farasan and Damad residents need to walk for 20 minutes to reach general hospitals since 82.10% and 59.54% of their populations live in areas served by hospitals. Residents of Al Aydabi, Al Harth, Fayfa and Harub need a longer time to reach the health service at hospitals since these areas had the highest number of underserved populations and no general hospital in Harub governorate.

Discussion

This study identifies the variation in healthcare services in the Jazan region of Saudi Arabia by using pragmatic estimates of travel time for both driving and walking to health care facilities. This study will help researchers and health planners to explore travel time along road networks, considering the mode of transportation. Travel time provides a better indication of geographical accessibility issues than other measures [20]. This study was in line with studies that stated the travel distance to health service within 5 min and 60 minutes as maximum travel times [6, 20] with served areas of fewer than or equal to 30 minutes and underserved areas of more than 30 minutes [21].

This study's findings show that there is an issue regarding reaching health services in a reasonable time in the Jazan region. This result was similar to the finding in a similar study [6]. Many people in Jazan need to drive for a long time (> 30 min.) to reach a health facility, whether it's a PHC or hospital. Al Darb residents has a short time to reach health facilities compared to the other governates. This can be explained by the equal population distribution, since half of them live within the served area which means a shorter travel time to reach healthcare services. Also, Al Darb is located at the entrance to the Jazan region with other regions that allow Al Darb residents to move easily to other closed regions to receive healthcare. The study also found that most of the mountain governates such as Al Aridah, Al Aydabi, Al Harth, Ar Rayth, Baysh, Fayfa and Harub had the highest number of underserved residents. This could be because of the lower number of roads and difficult driving conditions in these areas.

Regarding the walking scenario, only 40% of Jazan region residents need 30 minutes or less to reach PHCs and only 19% of the residents need 30 minutes or less to reach hospitals. The majority of Farasan and Damad residents was considered a served area of PHCs and hospitals. This could be many people live close from the governates centres as well as has a good infrastructure for walking.

In terms of population distribution, the study showed that accessibility is mainly difficult when people need to walk to general hospitals; More than 80% of the Jazan region is in an underdeveloped area. The accessibility issue is almost like the scenario of driving to PHCs (69.27%) or hospitals (68.03%). Many people are using their own vehicles which is considered the main mode of transportation in Saudi Arabia [20]. This is possibly because of the small population size, because these governates' basic infrastructure is still under development, or due to prolonged driving time to the facility [22].

To combat the effects of poor dental service distribution, policy maker must consider increasing the number of healthcare facilities, particularly for the underserved areas. Also, the infrastructure of the public transport network must be improved by creating new roads or rehabilitating existing ones. More efforts are needed in mapping the travel time to MOH, private and other healthcare facilities in the region. More spatial and attribute variables should be included regarding oral health status, dental services and providers, private and other health facilities' locations.

To the researcher's knowledge, the current study was the first to describe travel time to public dental healthcare service in the Jazan region of Saudi Arabia by using QGIS. However, the study has several

limitations that should be considered. First, there is a lack of updated information regarding health facilities (PHCs and hospitals). This study only used openly accessible data and geographic divides. At the time of the study, there was an absence of data regarding oral health services and oral health providers in the Jazan region at the district level regarding the number of oral health providers (dentist, dental hygienists and assistants), type of service offered, waiting time, and characteristics of dental providers such as gender and type of specialty. Due to the rapid advancement of the dental health system and general healthcare system, previously collected data used in this study might not reflect recent developments. Also, the study didn't include other factors such as where patients seek treatment, public transportation, and considered factors like age and gender to measure realistic travel time for walking travel time. These factors should be explored for better estimates of travel times in future studies.

Despite these limitations, this study has several strengths. This study used the road network rather than straight lines to estimate the travel time to the health facility. Using road travel line is more accurate and is normally used among the population [6, 23]. In addition, the study used updated population data based on governorates levels, not administrative levels to avoid biased and aggregated population data. This study is particularly useful in informing the planning of health care facilities' distribution and the supply and disparities of service availability in the region.

Conclusion

This study used two different scenarios to measure the travel time from anywhere in the Jazan region to the nearest healthcare facility and imparts new information about the accessibility of healthcare facilities in the region. The study shows that there is an accessibility issue due to many Jazan residents needing to drive or walk for a long time (> 30 min.) to reach a healthcare facility – whether to PHCs or hospitals. This issue could cause many people to not receive proper health services when needed which could affect their oral health status.

Declarations

Ethics approval and consent to participate

Only openly accessible, non-identifiable data and information was used for this research, and therefore ethics approval was not necessary. All methods were carried out in accordance with the relevant guidelines and regulations.

Consent for publication

Not applicable.

Availability of data and materials

All population datasets analysed during the current study are available the General Authority [<https://www.stats.gov.sa/en/1007-0>] and World Population's [<https://www.worldpop.org/>] websites. The location of health facilities was obtained from the Ministry of Health Statistical Yearbook [<https://www.moh.gov.sa/en/Ministry/Statistics/book/Pages/default.aspx>] and a Ministry of Health interactive map [https://www.moh.gov.sa/en/eServices/interactive-maps/Pages/default.aspx#].

Competing interests

None

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Authors contribution

All authors designed and implemented the study, acquisition of data, drafting the article and revising it critically for important intellectual content. MS completed the data collection and data entry. M.S. completed the analyses and interpretation of data. M.S. writing and proofreading the manuscript. M.S. revising and final approval of the version to be published. All authors read and approved the final manuscript.

References

1. Wehby GL, Shane DM, Joshi A, Momany E, Chi DL, Kuthy RA, Damiano PC: **The effects of distance to dentists and dentist supply on children's use of dental care.** Health services research 2017, **52**(5):1817–1834.
2. Penchansky R, Thomas JW: **The concept of access: definition and relationship to consumer satisfaction.** Medical care 1981:127–140.
3. World Health Organization: **Gender, Equity and Human Rights. Making a Difference: Visions, Goals and Strategy.** World Health Organization 2015.
4. Langford M, Higgs G: **Measuring potential access to primary healthcare services: the influence of alternative spatial representations of population.** The Professional Geographer 2006, **58**(3):294–306.
5. Mizen A, Fry R, Grinnell D, Rodgers SE: **Quantifying the error associated with alternative gis-based techniques to measure access to health care services.** AIMS public health 2015, **2**(4):746.

6. dos Anjos Luis A, Cabral P: **Geographic accessibility to primary healthcare centers in Mozambique.** *International Journal for equity in Health* 2016, **15**(1):1–13.
7. World Health Organization: **Background paper for the technical consultation on effective coverage of health systems.** *Geneva: World Health Organization* 2001.
8. Rooväli L, Kiivet RA: **Geographical variations in hospital use in Estonia.** *Health & place* 2006, **12**(2):195–202.
9. Fatih K, EGRESI IO: **Accessibility of health care institutions: a case study by using GIS.** *Int J* 2013, **3**(4):2305–2493.
10. Population indicators database [<https://www.stats.gov.sa/en/indicators>]
11. Gosadi IM: **Case report of patient experience influenced by inadequate interactions between primary, secondary, and tertiary healthcare services in the south of Saudi Arabia.** *Clinical Case Reports* 2020, **8**(2):299–304.
12. Graham JE, Fisher SR, Bergés I-M, Kuo Y-F, Ostir GV: **Walking speed threshold for classifying walking independence in hospitalized older adults.** *Physical therapy* 2010, **90**(11):1591–1597.
13. Awoyemi T, Obayelu O, Opaluwa H: **Effect of distance on utilization of health care services in rural Kogi State, Nigeria.** *Journal of human Ecology* 2011, **35**(1):1–9.
14. Geographic Information Systems, [<https://www.my.gov.sa/wps/portal/snp/main>]
15. General Authority of Statistics: Chap. 1: **Population and biological Characteristics.** In. Edited by General Authority of Statistics, vol. 2019. Riyadh; 2019.
16. Open spatial demographic data and research [<https://www.worldpop.org/>]
17. Ministry of Health: **Health Statistical Year Book.** In. Riyadh; 2020.
18. Interactive map [<https://www.moh.gov.sa/en/eServices/interactive-maps/Pages/default.aspx#/>]
19. Modelling walkability [<https://www.esri.com/news/arcuser/0112/modeling-walkability.html>]
20. Murad AA: **Using geographical information systems for defining the accessibility to health care facilities in Jeddah City, Saudi Arabia.** *Geospatial Health* 2014, **8**(3):S661-S669.
21. Murad A: **Using GIS for Determining Variations in Health Access in Jeddah City, Saudi Arabia.** *ISPRS international journal of geo-information* 2018, **7**(7):254.
22. Mansour S: **Spatial analysis of public health facilities in Riyadh Governorate, Saudi Arabia: a GIS-based study to assess geographic variations of service provision and accessibility.** *Geo-spatial Information Science* 2016, **19**(1):26–38.
23. Brabyn L, Skelly C: **Modeling population access to New Zealand public hospitals.** *International journal of health geographics* 2002, **1**(1):1–9.

Figures

Figure 1

Jazan Region Map

Figure 2

Driving time to primary healthcare canters in different time categories

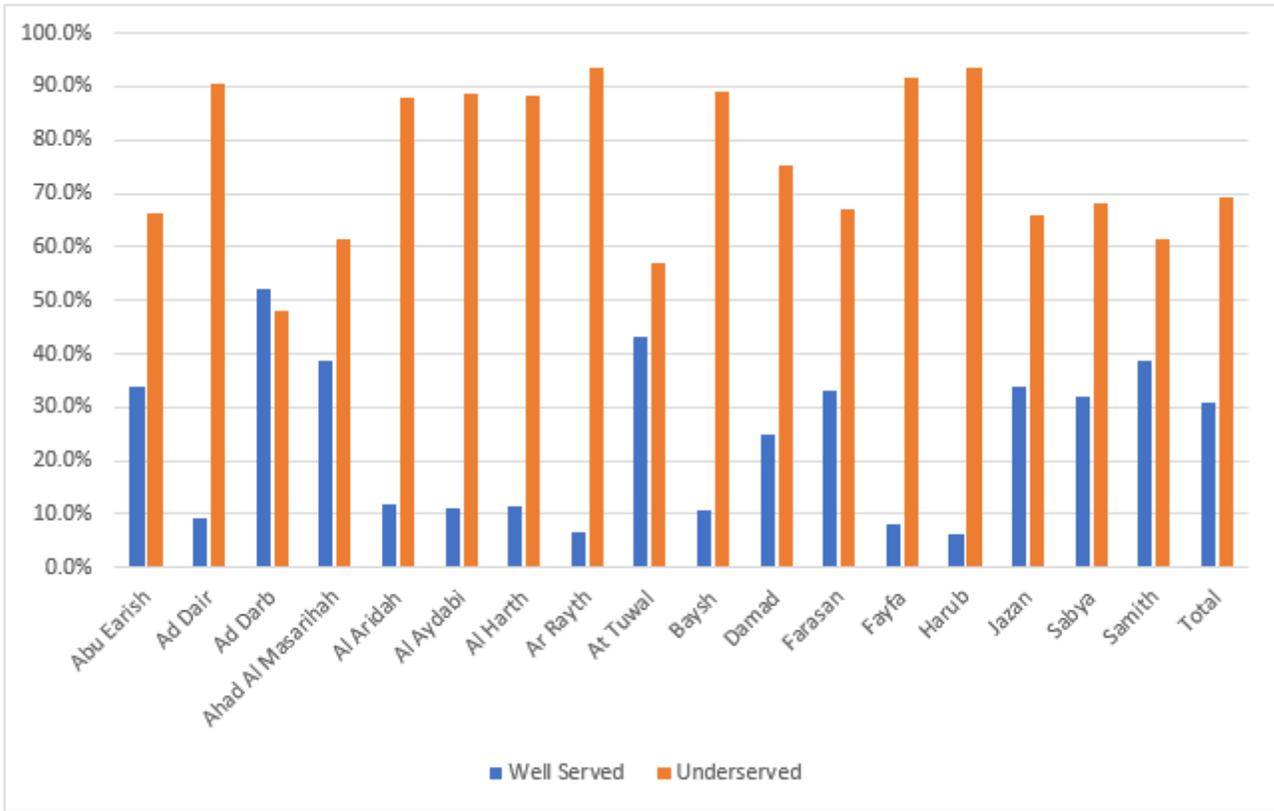


Figure 3

Population in served and underserved areas by Primary Healthcare Centers in the Driving times in Jazan cities, Saudi Arabia

Figure 4

Driving time to General Hospitals in different time categories

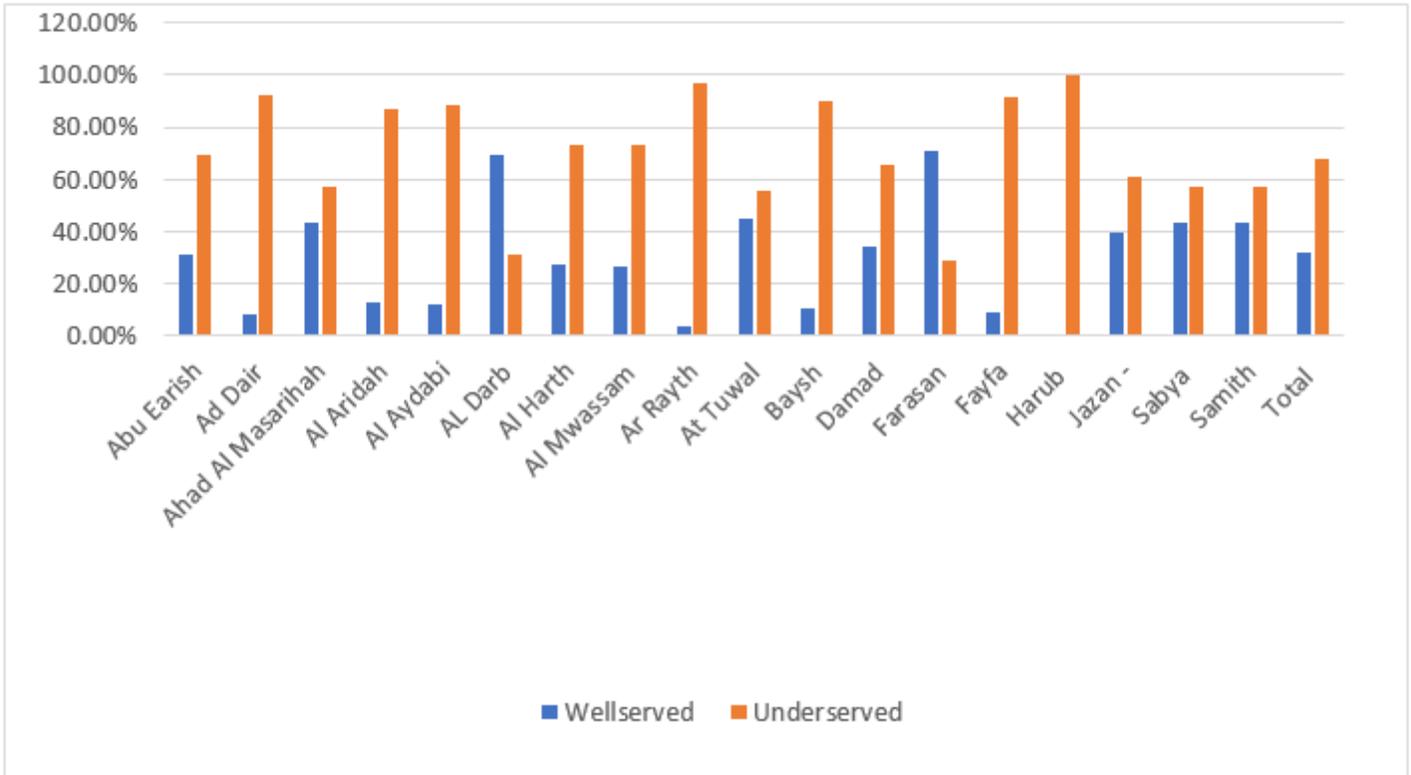


Figure 5

Population in served and underserved areas by Hospitals in the Driving times in Jazan cities, Saudi Arabia

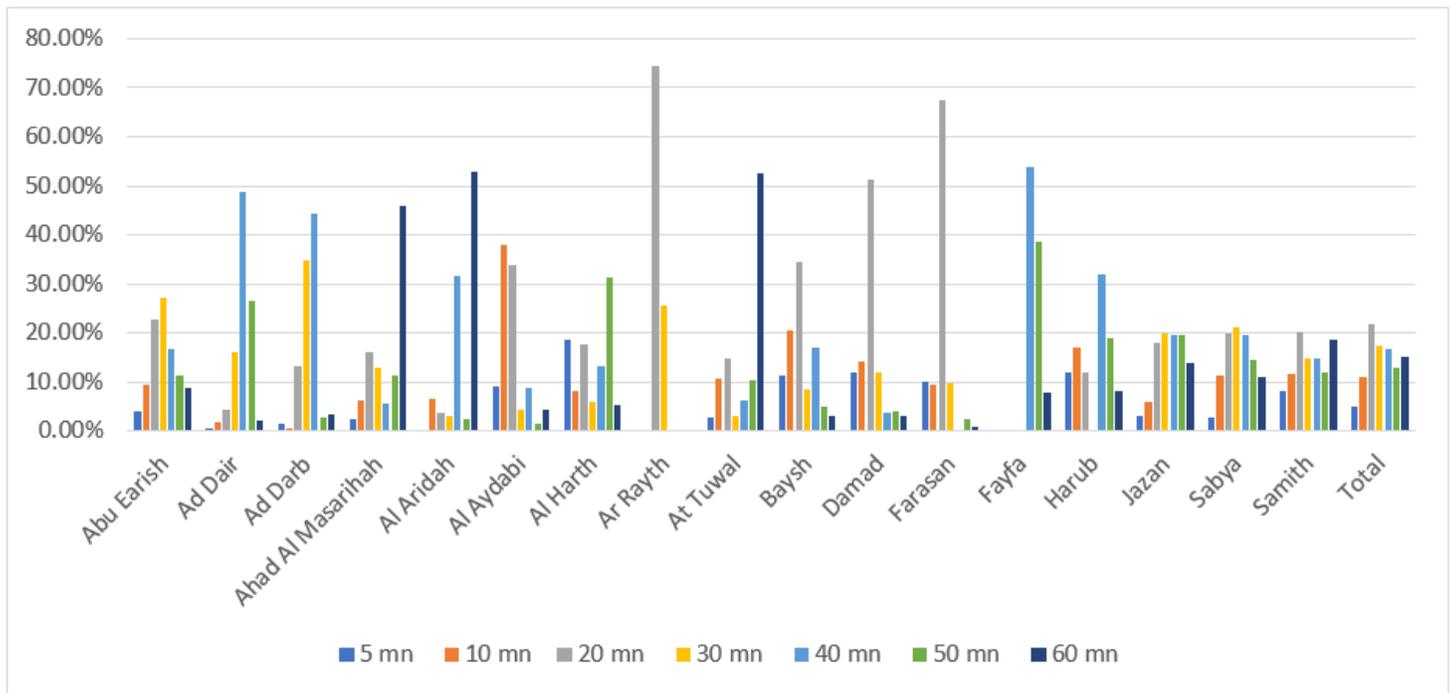


Figure 6

Distribution of Walking times to Primary Healthcare Centres in Jazan Regions cities, Saudi Arabia

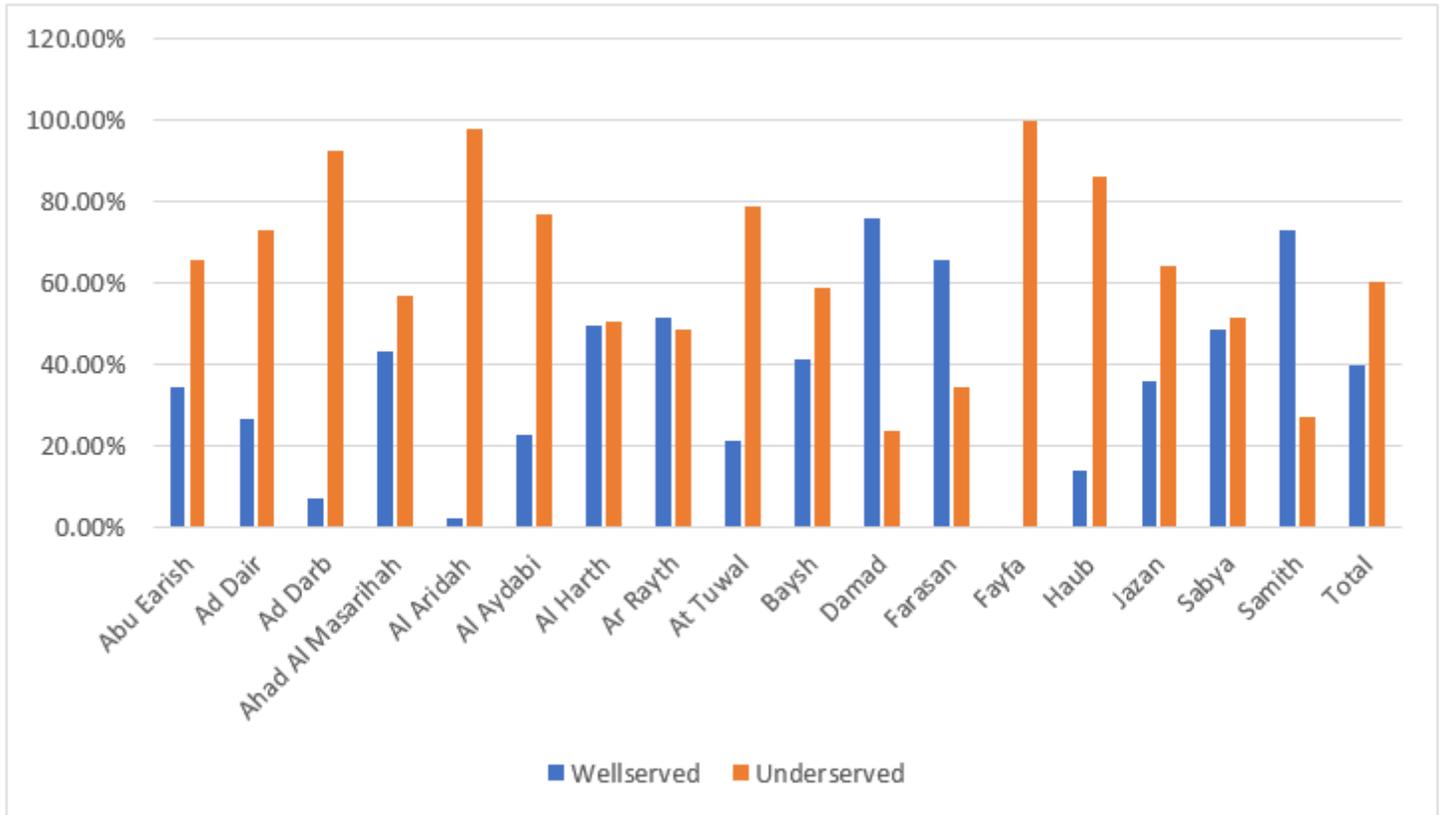


Figure 7

Population in served and underserved areas by Primary Healthcare Centers in the Walking times in Jazan cities, Saudi Arabia

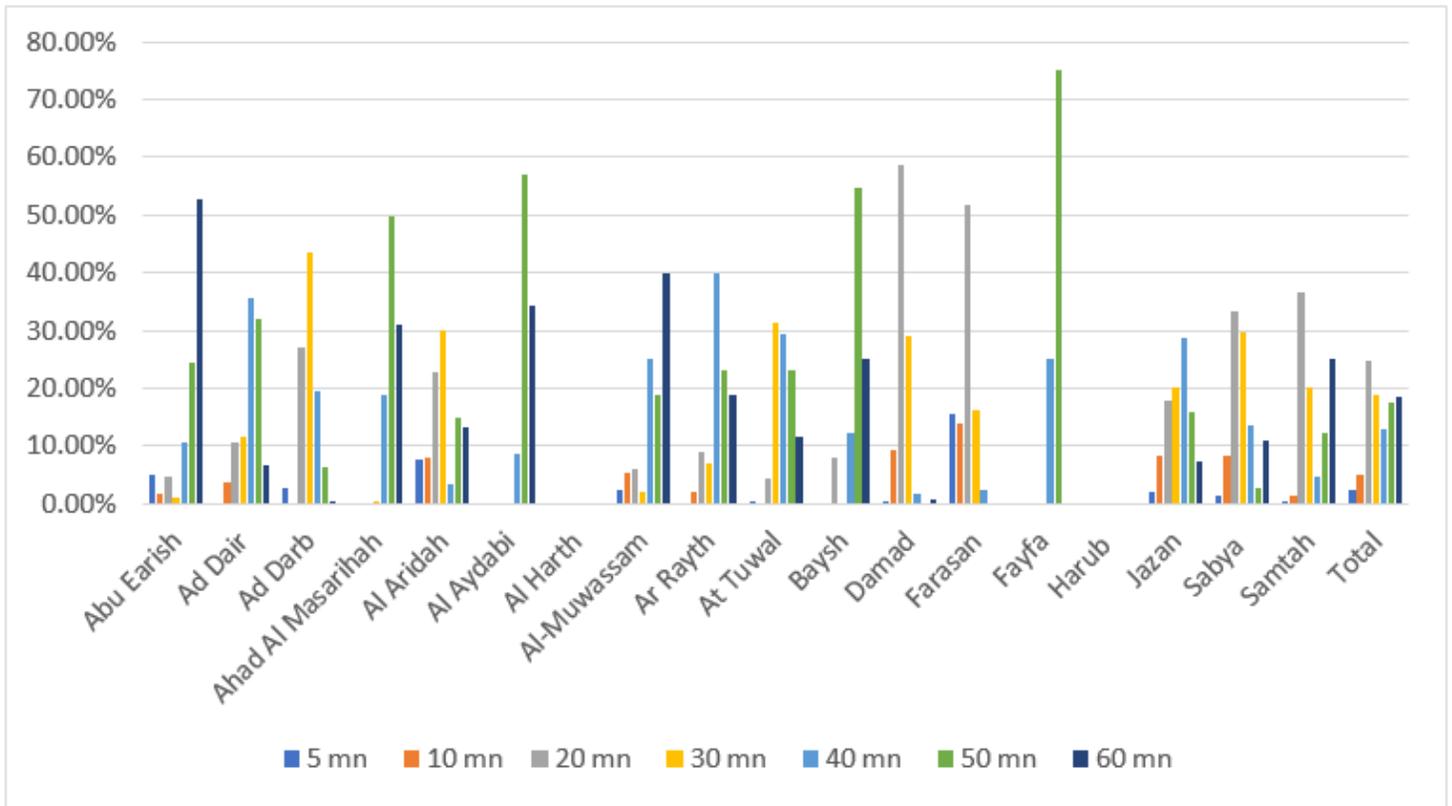


Figure 8

Distribution of Walking times to General Hospitals in Jazan Regions cities, Saudi Arabia

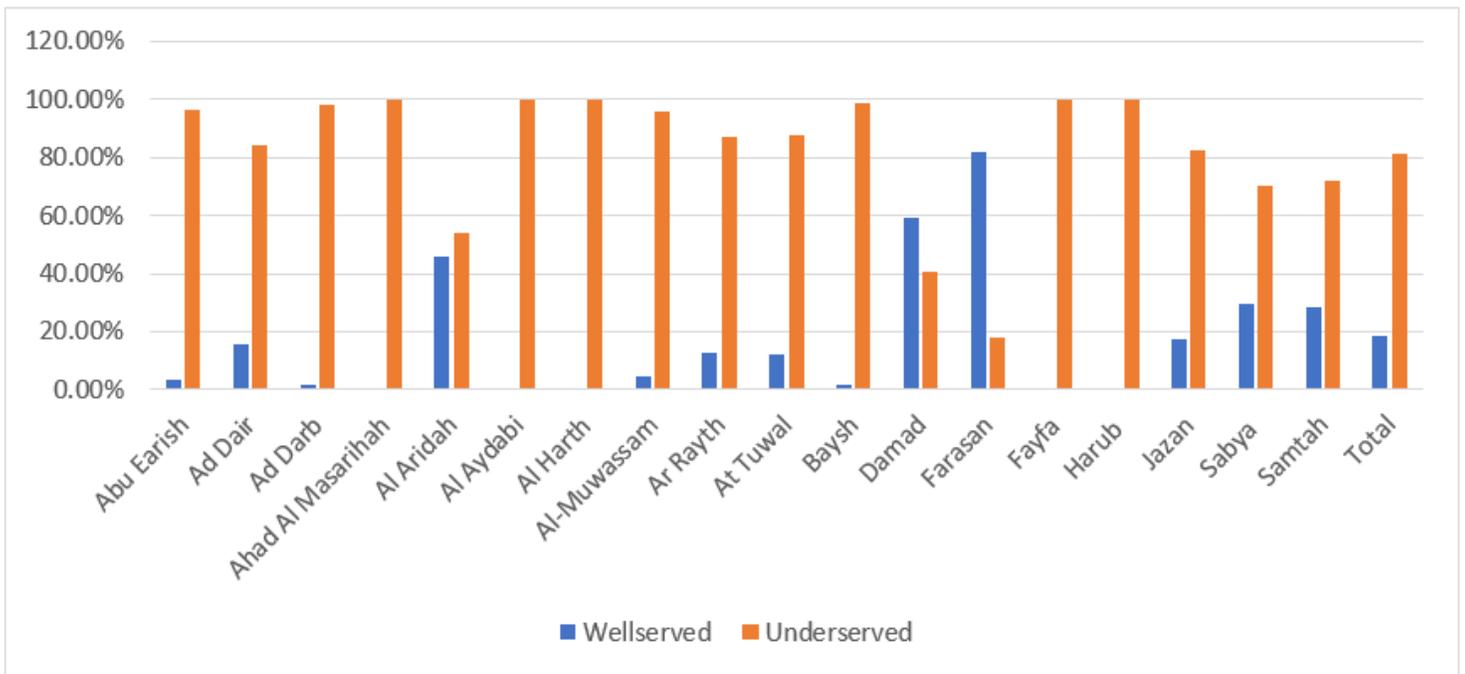


Figure 9

Population in served and underserved areas by Hospitals in the walking times in Jazan cities, Saudi Arabia