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# Regional Variations in Diabetes Clinic Utilization and Health Resource Distribution in Saudi Arabia: An Analysis of 2024 National Data

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## Abstract

Diabetes mellitus is a major public health challenge in Saudi Arabia. Understanding regional variation in diabetes clinic utilisation and its relationship to health resource availability is essential for equitable planning under Vision 2030. This cross-sectional study analysed 2024 Ministry of Health diabetes clinic visits, obtained via the Saudi Data and Artificial Intelligence Authority (SDAIA) Open Data Platform, across all 13 administrative regions. Visit counts were aggregated by region, nationality and sex. Population-adjusted visit rates per 1,000 with exact Poisson 95% confidence intervals were derived using 2024 General Authority for Statistics estimates. Pearson and Spearman correlations, with Shapiro–Wilk assumption checks and bootstrap 95% confidence intervals, assessed associations between five resource indicators (hospitals per million; beds, physicians and nurses per 10,000; dedicated diabetes/endocrine centres per million) and visit rates. Overall, 620,742 visits were recorded; Saudis accounted for 94.0% and females 53.9%. Regional rates ranged from 7.6 to 68.7 per 1,000 (coefficient of variation: 64.0%). Al Baha, Asir and Northern Borders had the highest rates; Riyadh and Eastern the lowest. Visit rates were positively correlated with hospitals per million ($r = 0.733$, $p = 0.004$), beds per 10,000 ($r = 0.640$, $p = 0.018$) and physicians per 10,000 ($r = 0.561$, $p = 0.046$) and strongly rank-correlated with diabetes/endocrine centres per million (Spearman $\rho = 0.868$, $p < 0.001$). Substantial regional disparities in diabetes clinic utilisation exist and are strongly associated with the spatial availability of physician-led and specialty-focused services, supporting equity-oriented planning under Vision 2030.

**Keywords:** Diabetes Mellitus, Healthcare Utilization, Health Resources, Regional Disparities, Saudi Arabia.

## Introduction

Diabetes mellitus has emerged as one of the most significant public health challenges globally, with the World Health Organization (1) estimating that over 422 million people worldwide are living with the condition. The Middle East and North Africa region has been particularly affected, with some of the highest prevalence rates globally, driven by rapid urbanization, lifestyle changes and genetic predispositions (1, 2). The economic burden of diabetes is substantial, with healthcare costs associated with diabetes complications consuming significant portions of national healthcare budgets across the region (1). Saudi Arabia, in particular, has experienced a substantial burden of diabetes, with prevalence estimates ranging from 15% to 25% among the adult population (2, 3). Recent comparative work indicates that approximately 25% of Saudi adults are affected by diabetes, with type 2 diabetes accounting for the vast majority of cases and highlights persistent gaps in glycaemic control, late diagnosis and uneven service delivery across the Kingdom (4). The Saudi Abnormal Glucose Metabolism and Diabetes Impact Study (SAUDI-DM) revealed that diabetes and impaired fasting glucose are highly prevalent in Saudi society, with the majority of patients being unaware of their disease, which warrants urgent adoption of early detection, treatment and prevention programs (5). The economic impact of diabetes on the Saudi healthcare system is considerable. In 2014 alone, approximately 25 billion Saudi Arabian Riyal (SAR) was spent on diabetic individuals from the allocated healthcare budget of SAR 180 billion, representing 14% of total healthcare expenditures (2). Healthcare expendi-tures related to diabetes have increased by approximately five folds over the past two decades, underscoring the urgent need for effective prevention and management strategies (2). The Saudi Ministry of Health (MoH) has implemented comprehensive strategies to address the diabetes epidemic, including the establishment



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of specialised diabetes clinics across the Kingdom's health clusters. These clinics provide essential services such as screening, diagnosis, treatment and ongoing management for patients with diabetes, alongside structured population-health management approaches developed under Saudi Vision 2030 (6).

Saudi Arabia's Vision 2030 represents a transformative agenda that includes significant healthcare sector reforms aimed at improving the quality and accessibility of healthcare services across the Kingdom. The Health Sector Transformation Program, a key component of Vision 2030, emphasises the adoption of population health management approaches to improve health outcomes and ensure equitable access to care (6). Understanding the current patterns of diabetes clinic utilisation is essential for informing these transformation initiatives and ensuring that resources are allocated effectively to meet population health needs.

Regional variations in healthcare utilisation are well-documented in the literature, with factors such as geographic accessibility, socioeconomic status, cultural factors and health resource availability influencing service utilisation patterns (7, 8). Research in Saudi Arabia has identified significant regional disparities in physician distribution, with urban centres such as Riyadh and Jeddah attracting more healthcare professionals due to better resources and infrastructure, while rural and underserved regions face shortages of medical professionals (9). These disparities not only affect access to healthcare but also impact the quality of care delivered across different regions.

Studies have demonstrated that geographic accessibility is a critical determinant of healthcare utilisation. The spatial distribution of healthcare facilities and the proximity of services to populations influence whether individuals seek and receive appropriate care (10). In Saudi Arabia, the uneven distribution of health services between regions has been documented, with higher availability of services in Riyadh, Makkah and Eastern regions compared to regions such as Al Baha and Najran (11). Understanding how these geographic factors relate to diabetes clinic utilisation is essential for developing targeted interventions.

Gender differences in healthcare utilisation have also been well established, with females generally demonstrating higher rates of healthcare seeking behaviour compared to males (12). These patterns may be influenced by cultural factors, differences in disease prevalence and varying health literacy levels across populations. In the Saudi context, understanding gender-specific utilisation patterns are important for designing culturally appropriate interventions that address the needs of all population groups.

This study aims to provide a comprehensive analysis of diabetes clinic visits across all administrative regions of Saudi Arabia during 2024, examining demographic patterns, regional variations in visit rates and the relationship between health resource availability and diabetes service utilisation. In contrast to national surveillance reports, which typically aggregate diabetes indicators at the country level and emphasise prevalence or programme outputs, this analysis links 2024 facility-level visit counts from the Saudi Data and Artificial Intelligence Authority (SDAIA) open-data platform with Ministry of Health Statistical Yearbook resource indicators and General Authority for Statistics population estimates to derive population-adjusted, region-specific utilisation rates and to quantify their association with multiple categories of health resources, including hospitals, beds, physicians, nurses and dedicated diabetes and endocrine centres. To our knowledge, this is the first nationwide study to integrate these data sources to examine regional variation in diabetes clinic utilisation under Vision 2030, providing an evidence base that complements existing surveillance products and directly supports equity-oriented resource-allocation decisions. The findings will inform healthcare planning and policy development to ensure equitable access to diabetes care across the Kingdom, supporting the objectives of Vision 2030 and the Health Sector Transformation Program.

# Methodology

## Data Sources

This comprehensive analysis utilised data from multiple authoritative sources. This study examined diabetes clinic visits and health resource distribution across all 13 administrative regions of Saudi Arabia. Diabetes clinic visit data for 2024 were obtained from the Ministry of Health (MoH) via the Saudi Data and Artificial Intelligence Authority (SDAIA) National Open Data Platform, which forms part of the Saudi e-government health-data infrastructure (13). The dataset included visit counts by health cluster, nationality (Saudi and non-Saudi) and gender (male and female) across all administrative regions of Saudi Arabia. Health resource data, including hospital and bed counts by sector and region as well as regional health-workforce counts (physicians, nurses, pharmacists, allied health personnel) and the number of dedicated diabetes and endocrine centres per cluster, were extracted from the Statistical Yearbook 2024 published by the Ministry of Health, consistent with prior peer-reviewed analyses of Saudi healthcare workforce and resource indicators (14). Population data for 2024 were obtained from the General Authority for Statistics (GAS) (15), based on the 2024 national population estimate of 35,300,280. The MoH health-cluster framework reorganises the former directorate structure into integrated clusters that map onto the 13 official administrative regions. Several regions are served by more than one cluster (Riyadh by three; Makkah by five, including Holy Capital, Qunfudah, Jeddah First, Jeddah Second and Taif; Eastern by three, including Eastern, Al Ahsa and Hafr Al Batin; Asir by two, including Asir and Bishah; and Al Jouf by two, including Al Jouf and Qurayyat). Cluster-level visit counts and resource indicators were aggregated to administrative regions using the official MoH cluster-to-region mapping published in the Statistical Yearbook 2024, which is unambiguous and stable; no boundary changes between 2023 and 2024 affected this assignment.

## Data Analysis

Health cluster-level data were aggregated to administrative regions based on the mapping provided by the Ministry of Health. Population-adjusted diabetes clinic visit rates were calculated per 1,000 population for each administrative region. The coefficient of variation (CV) was computed as ((sample SD/mean) x 100) to quantify regional heterogeneity in visit rates. Exact Poisson 95 percent confidence intervals (Garwood method) were calculated for each regional rate to convey statistical uncertainty given the count structure of the data. The analytical framework was anchored in Andersen's Behavioural Model of Healthcare Utilisation, which conceptualises service use as a function of predisposing, enabling and need factors and in Penchansky and Thomas's access framework, which emphasises availability, accessibility and accommodation as core dimensions of access (7, 8). Within this framework, regional differences in hospital and workforce density were treated as enabling factors, while demographic composition (sex, nationality) and underlying diabetes burden were treated as predisposing and need factors. The study was designed as an ecological analysis, with administrative region as the unit of observation; this design supports population-level inference but does not permit conclusions about individual patients and we therefore avoided causal interpretations of region-level associations.

Pearson product-moment correlation coefficients were calculated to examine relationships between five health resource indicators and diabetes clinic visit rates: hospital beds per 10,000 population, hospitals per million population, physicians per 10,000 population, nurses per 10,000 population and dedicated diabetes and endocrine centres per million population. The Pearson assumptions of approximate bivariate normality and linearity were assessed by Shapiro-Wilk tests for each variable and by visual inspection of scatterplots; given the small number of regions ($n = 13$), Spearman's rank correlation was reported alongside Pearson r as a non-parametric sensitivity analysis robust to outliers and to departures from normality. Bootstrap 95 percent confidence intervals for Pearson r were derived from 5,000 resamples. All statistical analyses were conducted using Stata V16.1 (StataCorp LLC, College Station, TX, USA). Statistical significance was set at $p < 0.05$.

## Ethical Considerations

The study used publicly available, de-identified and aggregated data from the Saudi Data and Artificial Intelligence Authority (SDAIA) via the National Open Data Platform, the Ministry of Health Statistical Yearbook and the General Authority for Statistics. Under Saudi data governance regulations, including the Personal Data Protection Law (PDPL) and National Data Management Office (NDMO) guidelines, the datasets are classified as public and fully anonymised, with all personal identifiers removed. Because the data pose minimal risk and contain no identifiable information, the study does not require individual consent or Institutional Review Board (IRB) approval, consistent with National Committee of Bioethics (NCBE) standards. All analyses were conducted in accordance with the Saudi Open Data License, which authorises reuse for research purposes.

# Results

## Overall Diabetes Clinic Visits

In 2024, a total of 620,742 diabetes clinic visits were recorded across all 13 administrative regions in Saudi Arabia. The demographic distribution of visits revealed that Saudi patients accounted for 583,527 visits (94.0%), while non-Saudi patients represented 37,215 visits (6.0%). This distribution notably differs from the general population composition, where Saudis represent approximately 55.6% and non-Saudis 44.4% of the total population (15), indicating disproportionately higher utilisation of MoH diabetes clinics by Saudi nationals. Nationality-specific visit rates per 1,000 population (computed using the estimated regional Saudi and non-Saudi denominators derived from GAS 2024 totals and 2022 census regional shares) confirmed substantially higher utilisation among Saudi residents in every region, with the Saudi-to-non-Saudi rate ratio exceeding 5 in most regions.

Regarding gender distribution, female patients accounted for 334,425 visits (53.9%) compared to 286,317 visits (46.1%) for male patients, resulting in a female-to-male ratio of 1.17. Sex-specific visit rates per 1,000 population were higher among females in every region, with the female-to-male rate ratio ranging from approximately 1.0 in the Northern Borders to 1.9 in Hail, indicating both consistent female predominance and meaningful regional heterogeneity in the magnitude of the sex gap. Figure 1 presents the demographic distribution of diabetes clinic visits by nationality and gender. This pattern of higher female utilisation is consistent with global trends in healthcare seeking behaviour (12).

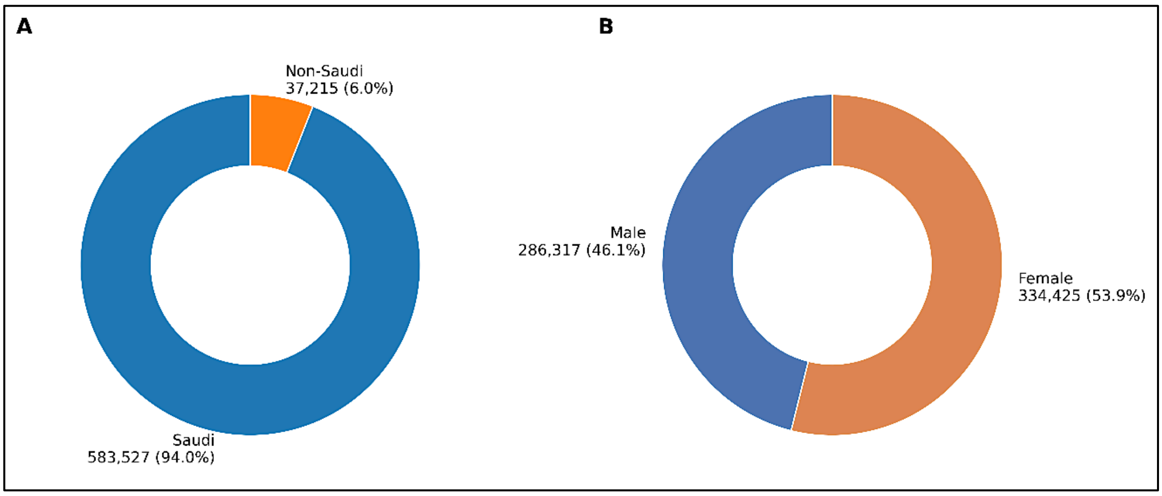


**Figure 1:** Demographic Distribution of Diabetes Clinic Visits in Saudi Arabia, 2024.
(A) Distribution By Nationality (Saudi Vs. Non-Saudi), (B) Distribution by Gender (Male Vs. Female)

**Table 1:** Diabetes Clinic Visits by Region with Population-adjusted Rates Per 1,000 Population (With Exact Poisson 95% Confidence Intervals) and Demographic Distribution, Saudi Arabia, 2024

| Region | GPS Coordinates | Visits | Population | Rate per 1,000 | 95% CI | Saudi % | Female % |
|---|---|---|---|---|---|---|---|
| Al Baha | 20.0129° N, 41.4677° E | 25,558 | 372,117 | 68.7 | 67.8–69.5 | 98.6 | 52.5 |
| Asir | 18.2161° N, 42.5053° E | 107,200 | 2,220,896 | 48.3 | 48.0–48.6 | 97.5 | 52.3 |
| Northern Borders | 30.9833° N, 41.0166° E | 19,567 | 409,861 | 47.7 | 47.1–48.4 | 95.1 | 50.7 |
| Qassim | 26.0940° N, 43.9734° E | 56,290 | 1,465,957 | 38.4 | 38.1–38.7 | 96.3 | 62.3 |
| Jazan | 16.9096° N, 42.5679° E | 53,855 | 1,541,459 | 34.9 | 34.6–35.2 | 95.3 | 52.3 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Najran | 17.4933° N, 44.1277° E | 21,420 | 649,828 | 33.0 | 32.5–33.4 | 80.5% | 52.0 |
| Al Jouf | 29.9538° N, 40.1970° E | 17,237 | 653,692 | 26.4 | 26.0–26.8 | 97.6 | 58.8 |
| Tabuk | 28.3835° N, 36.5662° E | 16,241 | 972,093 | 16.7 | 16.5–17.0 | 90.8 | 52.0 |
| Hail | 27.5236° N, 41.6966° E | 13,555 | 818,902 | 16.6 | 16.3–16.8 | 96.6 | 65.5 |
| Makkah | 21.4225° N, 39.8261° E | 142,771 | 8,800,557 | 16.2 | 16.1–16.3 | 92.8 | 51.0 |
| Madinah | 24.4709° N, 39.6122° E | 27,510 | 2,345,637 | 11.7 | 11.6–11.9 | 93.3 | 51.8 |
| Eastern | 26.4256° N, 50.0551° E | 48,205 | 5,623,050 | 8.6 | 8.5–8.6 | 95.3 | 55.4 |
| Riyadh | 24.7742° N, 46.7385° E | 71,333 | 9,426,231 | 7.6 | 7.5–7.6 | 89.3 | 55.3 |

Note: CI- confidence interval; GPS- Global Positioning System. Visit rates are calculated as visits per 1,000 population using 2024 General Authority for Statistics population estimates. 95% confidence intervals are computed using the exact Poisson (Garwood) method. Saudi % = proportion of visits made by Saudi nationals; Female % = proportion of visits made by female patients. *GPS coordinates refer to the administrative centre (capital city) of each region.

## Regional Variation in Diabetes Clinic Visit Rates

Analysis of diabetes clinic visits by administrative region revealed substantial geographic variation in service utilisation. When adjusted for population size, visit rates ranged from 7.6 to 68.7 visits per 1,000 population, representing an approximately nine-fold difference between the highest and lowest regions. The coefficient of variation for visit rates was 64.0%, indicating substantial heterogeneity across regions. Exact Poisson 95 percent confidence intervals for these rates were narrow because of the very large number of visits in each region, confirming that the observed regional differences are highly unlikely to reflect random variation alone. Table 1 presents the diabetes clinic visit rates by region, ranked from highest to lowest, together with the 95 percent confidence intervals. The geographic pattern is visualised in Figure 2, which maps population-adjusted visit rates across the 13 administrative regions and the corresponding bar chart with confidence intervals is shown in Figure 3.

Al Baha (68.7 visits per 1,000 population), Asir (48.3) and Northern Borders (47.7) regions showed the highest diabetes clinic visit rates. These regions are characterized by smaller populations and potentially higher disease prevalence or better healthcare access. The high visit rates in these regions may reflect several factors, including higher diabetes prevalence in southern regions, better geographic accessibility to healthcare facilities, or more effective diabetes screening and referral programs.

## Gender Distribution by Region

The gender distribution of diabetes clinic visits varied across regions. While females consistently showed higher visit rates overall, notable regional variations were observed. Hail showed the highest female proportion (65.5%), followed by Qassim (62.3%). The Northern Borders region demonstrated the most balanced gender distribution (50.7% female), while Makkah also showed relatively balanced utilization (51.0% female). These regional differences in female utilisation are summarised in the regional breakdown of visits.

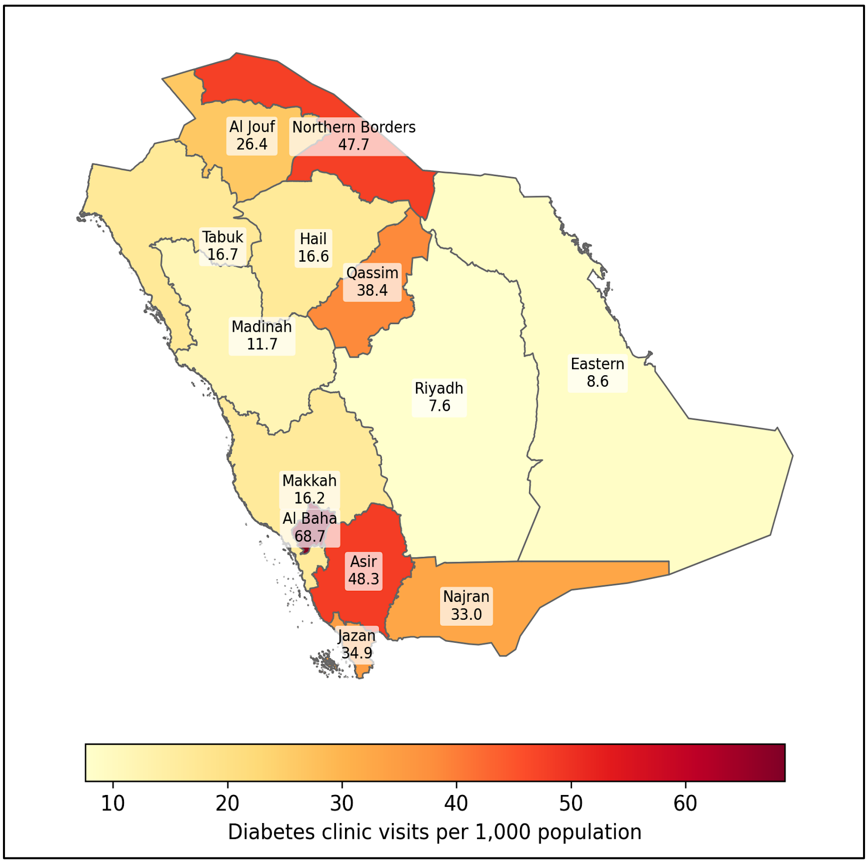


**Figure 2:** Regional Variation in Diabetes Clinic Visit Rates Per 1,000 Population Across The 13 Administrative Regions of Saudi Arabia, 2024. Higher Rates are Observed in Al Baha, Asir, Northern Borders, Qassim and Jazan and Lower Rates in Riyadh, Eastern, Madinah and Makkah

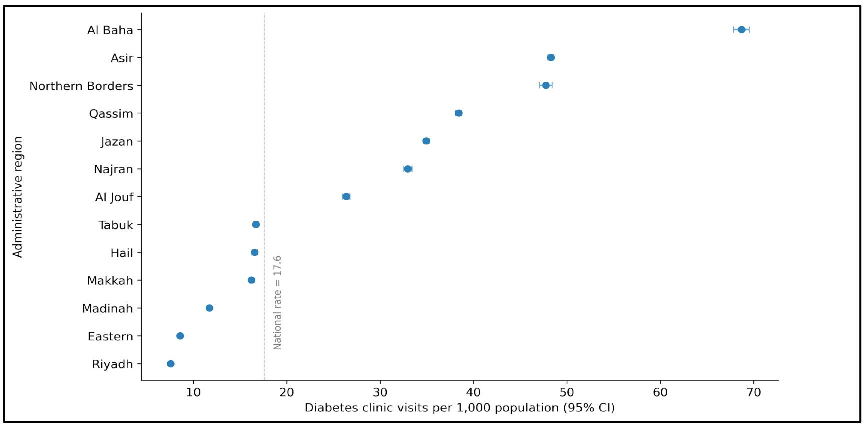


**Figure 3:** Population-adjusted Diabetes Clinic Visit Rates by Administrative Region with Exact Poisson 95% Confidence Intervals, Saudi Arabia, 2024. The Dashed Line Indicates the National Rate Of 17.6 Visits Per 1,000 Population

## Health Resources Distribution

As of 2024, Saudi Arabia's healthcare infrastructure comprised 516 hospitals with a total capacity of 82,721 beds, reflecting continued expansion from the 487 hospitals and 72,981 beds reported for the Kingdom in 2017 (14). The distribution across sectors reflects the Kingdom's mixed public-private healthcare system. The Ministry of Health maintained the largest share with 290 hospitals (56.2%) and 46,905 beds (56.7%). The private sector contributed 166 hospitals (32.2%) and 20,624 beds (24.9%), while other governmental sectors operated 60 hospitals (11.6%) with 15,192 beds (18.4%). Figure 4 summarises the distribution of hospitals and beds across these sectors.

The healthcare workforce in 2024 totaled 681,914 personnel across all sectors. Nurses constituted the largest category (243,336;35.7%), followed by allied health personnel (222,060;32.6%), physicians (129,772;19.0%), pharmacists (46,856; 6.9%), dentists (33,751;4.9%) and midwives (6,139;0.9%).

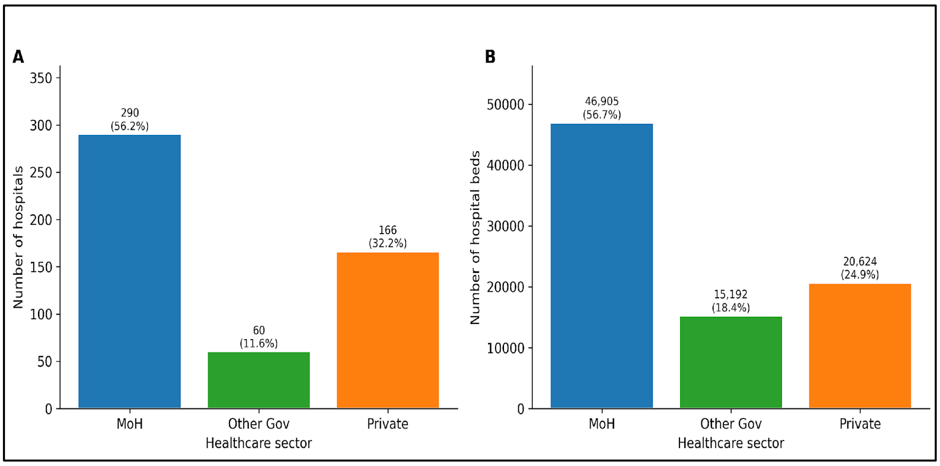


**Figure 4:** Distribution of Healthcare Resources Across Sectors in Saudi Arabia, 2024. (A) Number of Hospitals by Sector, (B) Number of Hospital Beds by Sector

## Correlation Analysis

Correlation analyses were performed to examine relationships between health resource availability and diabetes clinic utilisation. Five health resource indicators were analysed: hospital beds per 10,000 population, hospitals per million population, physicians per 10,000 population, nurses per 10,000 population and dedicated diabetes and endocrine centres per million population.

A moderate-to-strong positive correlation was observed between hospital bed capacity per population and diabetes clinic visit rates (Pearson $r = 0.640$, $p = 0.018$). Regions with higher hospital bed capacity per population tended to have higher diabetes clinic visit rates, suggesting that overall healthcare infrastructure capacity is associated with diabetes service utilisation.

A strong positive correlation was found between hospital density and diabetes visit rates (Pearson $r = 0.733$, $p = 0.004$; Spearman rho $= 0.764$, $p = 0.002$). The number of hospitals per million population showed a stronger correlation with visit rates than bed capacity alone, suggesting that geographic accessibility (the number of facilities) may be more important than total capacity for diabetes clinic utilisation. Table 2 presents the regional distribution of all five resource indicators.

Beyond hospital and bed indicators, regional health-workforce density and access to specialised diabetes services were examined as additional resource indicators. The density of physicians per 10,000 population was significantly correlated with diabetes clinic visit rates (Pearson $r = 0.561$, $p = 0.046$; Spearman rho $= 0.319$, $p = 0.289$), supporting the interpretation that broader workforce availability is associated with greater chronic-disease service use, while the discrepancy between Pearson and Spearman estimates indicates sensitivity to one or two high-leverage regions.

The density of dedicated diabetes and endocrine centres per million population was strongly rank-correlated with visit rates (Spearman rho $= 0.868$, $p < 0.001$), although the Pearson coefficient was weaker ($r = 0.499$, $p = 0.083$), reflecting marked skewness in the specialty-centre distribution; this discrepancy underscores the value of non-parametric sensitivity analysis when assessing access to specialised diabetes care. Nurse density per 10,000 population was not significantly associated with visit rates ($r = 0.185$, $p = 0.545$), suggesting that the primary structural driver of diabetes clinic utilisation is the spatial availability of physician-staffed facilities and dedicated diabetes services rather than overall nursing capacity. Shapiro-Wilk tests showed that the visit-rate distribution was consistent with normality ($p = 0.250$) and most resource variables also satisfied the assumption (all $p > 0.05$) except the diabetes-centre density ($p = 0.001$) and pharmacist density ($p = 0.008$), justifying the additional Spearman analyses.

**Table 2:** Distribution of Healthcare Resources (Hospitals, Beds, Physicians, Nurses and Dedicated Diabetes and Endocrine Centres) Across The 13 Administrative Regions of Saudi Arabia, 2024

| Region | Hospitals Per Million | Beds Per 10,000 | Physicians Per 10,000 | Nurses Per 10,000 | Diabetes/Endocrine Centres Per Million |
|---|---|---|---|---|---|
| Al Baha | 26.9 | 34.8 | 51.2 | 73.3 | 2.69 |
| Asir | 19.4 | 24.2 | 34.9 | 62.3 | 2.70 |
| Northern Borders | 26.8 | 35.6 | 47.5 | 96.9 | 7.32 |
| Qassim | 17.1 | 27.9 | 38.1 | 69.8 | 2.05 |
| Jazan | 18.2 | 21.0 | 28.1 | 53.3 | 1.30 |
| Najran | 26.2 | 29.3 | 35.6 | 80.5 | 1.54 |
| Al Jouf | 22.9 | 30.1 | 37.7 | 88.6 | 6.12 |
| Tabuk | 16.5 | 27.3 | 34.7 | 67.1 | 1.03 |
| Hail | 20.8 | 26.9 | 33.9 | 60.8 | 1.22 |
| Makkah | 11.2 | 20.0 | 34.4 | 51.7 | 1.02 |
| Madinah | 14.1 | 21.1 | 33.2 | 57.1 | 0.85 |
| Eastern | 15.5 | 24.7 | 36.2 | 69.8 | 0.53 |
| Riyadh | 12.2 | 23.4 | 41.3 | 88.8 | 0.85 |

Note: Hospital, bed and workforce counts include all sectors. Workforce densities (physicians and nurses per 10,000 population) and specialty-centre densities (diabetes and endocrine centres per million population) were derived by aggregating cluster-level counts to the 13 administrative regions using the official Ministry of Health cluster-to-region mapping.

# Discussion

This national analysis of diabetes clinic utilisation and health resource distribution in Saudi Arabia identified pronounced regional and demographic inequities with direct implications for health policy and service planning. Interpreted within Andersen's Behavioural Model and the Penchansky-Thomas access framework, regional differences in hospital, workforce and specialty-centre density represent enabling factors, while demographic composition (sex, nationality) and underlying diabetes burden act as predisposing and need factors that jointly shape observed utilisation patterns (7, 8). Visit rates varied by approximately nine-fold between regions, indicating substantial geographic heterogeneity in access to and use of diabetes care. Such variation underscores the influence of geographic, demographic and health system factors on the utilisation of publicly funded diabetes services and motivates an equity-oriented interpretation of the findings, rather than viewing utilisation as a direct measure of unmet need.

The high coefficient of variation (64.0%) confirms marked regional heterogeneity in diabetes clinic utilisation. Elevated visit rates in Al Baha, Asir and the Northern Borders are consistent with evidence of a heavier diabetes burden and poorer glycaemic control in southern regions. Recent national evidence indicates that the Southern region, including Asir, has one of the highest proportions of uncontrolled diabetes in the Kingdom, with fewer than 20% of patients achieving glycaemic control, substantially lower than in Western and Eastern regions (16). This poor control likely necessitates more frequent follow-up and contributes to increased reliance on public diabetes clinics. Similarly, rising diabetes prevalence and persistent challenges in glycaemic control have been documented in Jazan between 2021 and 2023, reflecting a substantial chronic-disease burden that may extend to adjacent regions such as Asir and Al Baha (17). Recent national survey data have further shown that regional diabetes prevalence ranges from 7.3% in Najran to 11% in Makkah, confirming that differences in disease burden are genuine rather than uniform across the Kingdom and plausibly translate into higher service utilisation where prevalence is greater (18). The association of high utilisation in regions with documented unmet need cautions against equating high diabetes clinic visit rates with adequate care; in these regions, utilisation may instead reflect more intensive follow-up demand in the context of poorer disease control, rather than universally well-served populations.

In contrast, Riyadh, Eastern and Madinah, among the most populous regions, exhibited the lowest visit rates. These findings may reflect a combination of healthcare system capacity constraints within Ministry of Health facilities, greater reliance on an extensive private healthcare sector and substantial expatriate populations who are more likely to access employer-sponsored or private services rather than MoH diabetes clinics. Understanding the balance between public and private sector utilization in these regions is essential to ensure that healthcare planning incorporates the full spectrum of diabetes care provision.

The marked overrepresentation of Saudi nationals in diabetes clinic visits (94.0% of visits versus 55.6% of the population) suggests important inequities in service use that warrant further investigation. Potential explanations include differences in underlying disease prevalence, eligibility and insurance coverage and structural or cultural barriers limiting non-Saudi access to public services, such as language barriers, limited awareness, or preference for private care (19). Higher utilisation among females (53.9% of visits) aligns with global evidence that women more frequently seek healthcare (12) and with Saudi data indicating higher diabetes prevalence among women than men (2). These patterns highlight the need for targeted strategies to improve access and engagement among non-Saudi residents and male patients. Crucially, utilisation as measured here should be distinguished from need: lower utilisation in a region or subgroup may reflect lower disease burden, greater reliance on private or employer-sponsored care, or barriers to access and higher utilisation may indicate either better access or greater follow-up burden among inadequately controlled patients. Disentangling these mechanisms requires linkage of utilisation data to prevalence estimates, private-sector activity and patient-level clinical outcomes.

The strong positive correlation between hospital density and diabetes visit rates (Pearson $r = 0.733$, $p = 0.004$; Spearman $\rho = 0.764$, $p = 0.002$) indicates that geographic accessibility of facilities is a key determinant of diabetes clinic utilisation. The expanded resource analysis further showed that physician density per 10,000 population was positively associated with visit rates ($r = 0.561$, $p = 0.046$) and that the density of dedicated diabetes and endocrine centres was strongly rank-correlated with utilisation (Spearman $\rho = 0.868$, $p < 0.001$), while nurse density was not ($r = 0.185$, $p = 0.545$). Together, these findings suggest that the primary structural driver of diabetes clinic utilisation is the spatial availability of physician-led and specialty-focused services rather than overall workforce capacity. This is consistent with previous work demonstrating that proximity to healthcare facilities strongly influences service use (10). At the same time, prior research in Saudi Arabia has documented unequal distribution of health services and physicians, with more favourable coverage in major urban centres such as Riyadh and Makkah compared with regions like Al Baha and Najran (9, 11). The patterns observed here echo evidence from the wider Gulf region and from universal-healthcare systems internationally. National population-based data from Kuwait have shown substantial governorate-level variation in diabetes and prediabetes prevalence (20) and primary-care studies from Qatar and Oman have documented concentrated chronic-disease utilisation among specific geographic and demographic subgroups (21, 22). A recent comparative analysis of diabetes care in Saudi Arabia and the United Kingdom similarly underscored the role of geographic accessibility, regional resource allocation and integrated digital health platforms in shaping diabetes outcomes across both health systems (4). In universal-healthcare systems, both the English NHS Diabetes Prevention Programme and Australian Medicare data have shown that regional access to primary care substantially shapes diabetes-related service uptake (23, 24). Addressing the structural and geographic disparities identified in the present study, in line with these international experiences, is essential to achieving the equity and access objectives of the Health Sector Transformation Program under Vision 2030.

The observed regional and demographic disparities in diabetes clinic utilisation have several implications for health system planning and resource allocation in Saudi Arabia. Regions with low visit rates relative to their population size warrant targeted strategies to strengthen access to diabetes care, including expanding clinic capacity, optimising referral pathways and improving transportation and outreach in underserved areas. These priorities are consistent with the Health Sector Transformation Program under Vision 2030, which emphasises equitable access to essential health services across all regions (6).

The strong association between health resource availability and diabetes clinic utilisation indicates that investments in healthcare infrastructure can directly influence access to diabetes services. Ongoing infrastructure expansion under Vision 2030 should therefore be explicitly guided by population health needs and documented regional disparities, rather than aggregate national indicators alone. Implementing population health management approaches, as demonstrated in the Qassim Health Cluster, offers a promising model for aligning resource distribution with disease burden and for improving the organisation and outcomes of diabetes care (6).

The demographic patterns identified in this study further highlight the need for culturally and linguistically tailored interventions to improve engagement of non-Saudi residents and male patients in diabetes care (25). Strategies may include enhancing health literacy, reducing language barriers and implementing targeted community-based outreach to underrepresented groups. Concurrently, the development of national, context-specific guidelines for diabetes management provides an essential foundation for standardising care processes and improving quality and consistency across regions (26).

The evidence from quality improvement initiatives in Saudi Arabia demonstrates that structured, multilevel interventions can substantially enhance diabetes outcomes. A large-scale quality improvement project across 18 governmental hospitals showed that implementing evidence-based change packages, such as clinical practice guidelines, multidisciplinary care teams and diabetes registries, was associated with improved glycaemic control among patients with uncontrolled type 2 diabetes (2). Scaling and adapting such initiatives nationwide could help reduce regional disparities in care quality and support the broader goals of the Vision 2030 health transformation agenda (6).

## Conclusion

This national assessment demonstrates pronounced regional disparities in diabetes clinic utilisation in Saudi Arabia, with visit rates differing markedly across administrative regions. The strong positive association between health resource availability—particularly hospital density, physician density and the availability of dedicated diabetes and endocrine centres — and diabetes clinic use underscores the central role of healthcare infrastructure in enabling access to diabetes services and provides evidence to guide planning and resource allocation within the Vision 2030 transformation agenda. The results highlight the need for targeted interventions in regions with low utilisation to promote equitable access to diabetes care across the Kingdom, with strategic investments in infrastructure, streamlined referral pathways and culturally tailored outreach to help mitigate observed disparities in underserved areas.

Several limitations should be considered when interpreting these findings. As an ecological study with administrative region as the unit of observation, the analysis is subject to ecological inference and aggregation bias; associations observed at the region level do not necessarily reflect individual-level relationships and unmeasured within-region heterogeneity may obscure important sub-regional patterns. The dataset reports diabetes clinic visits by region, nationality and sex but not by age, so direct age-adjustment of regional visit rates was not feasible; sex- and nationality-stratified rates and transparent demographic comparisons are presented instead. Regional population estimates for 2024 were extrapolated from the 2022 census and may not fully capture differential growth across regions. The analysis is restricted to Ministry of Health diabetes clinics and does not include utilisation of private-sector services, which may be substantial in major urban areas, nor does it incorporate regional variation in diabetes prevalence, which would influence expected visit rates. Critically, the dataset lacks clinical outcome indicators, including HbA1c control, diabetes-related hospitalisation, complication and mortality rates; utilisation data alone cannot fully capture the quality, appropriateness or effectiveness of diabetes care.

Future research should integrate prevalence data, private-sector activity and clinical outcome indicators to provide a more comprehensive picture of diabetes care in Saudi Arabia. In particular, longitudinal analyses that track regional visit trends over multiple years, patient-level utilisation studies that link diabetes clinic visits to individual sociodemographic and clinical characteristics and studies that incorporate diabetes outcome indicators such as HbA1c control, hospitalisation and complication rates would substantially extend the present findings. Scaling population health management models and quality improvement initiatives pioneered in leading health clusters offers a practical pathway to strengthen diabetes care delivery and improve outcomes nationwide.

## Abbreviations

CV: Coefficient of Variation, GAS: General Authority for Statistics, MoH: Ministry of Health, NCBE: National Committee of Bioethics, NDMO: National Data Management Office, PDPL: Personal Data Protection Law, SAR: Saudi Arabian Riyal, SAUDI-DM: Saudi Abnormal Glucose Metabolism and Diabetes Impact Study, SDAIA: Saudi Data and Artificial Intelligence Authority, WHO: World Health Organization.

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## Author Contributions

Mohammed A Alsuliman: Conceptualization, Data Curation, Formal Analysis, Writing of Original Draft, Mohammed Alkharaiji: Conceptualization, Methodology, Formal Analysis, Writing of Original Draft, Review and Editing, Supervision. Both authors critically reviewed and approved the final draft of the manuscript.

## Conflict of Interest

The authors declare no conflict of interest.

## Data Availability

All data used in this study are publicly available through the Saudi Data and Artificial Intelligence Authority (SDAIA) National Open Data Platform (https://open.data.gov.sa), the Ministry of Health Statistical Yearbook 2024 and the General Authority for Statistics.

## Declaration of Artificial Intelligence (AI) Assistance

The authors declare that artificial intelligence (AI)-assisted tools were used solely for language refinement, grammatical editing and structural organization of the manuscript. All scientific content, data interpretation, analysis and conclusions were developed and verified by the authors. The authors take full responsibility for the accuracy and integrity of the manuscript.

## Ethics Approval

The study used publicly available, fully anonymized and aggregated data from the SDAIA National Open Data Platform. As the data were classified as public and contained no personal identifiers, individual consent and Institutional Review Board approval were not required, consistent with National Committee of Bioethics standards.

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# References

1. International Diabetes Federation. IDF Diabetes Atlas. 10th ed. Brussels: International Diabetes Federation; 2021. ISBN: 978-2-930229-98-0. https://diabetesatlas.org/atlas/tenth-edition/
2. Al-Rubeaan K, Al-Manaa HA, Khoja TA, *et al.* Epidemiology of abnormal glucose metabolism in a country facing its epidemic: SAUDI-DM study. Journal of Diabetes. 2015;7(5):622-32. doi: 10.1111/1753-0407.12224
3. Al Dawish MA, Robert AA, Braham R, *et al.* Diabetes mellitus in Saudi Arabia: A review of the recent literature. Current Diabetes Reviews. 2016;12(4):359-68. doi: 10.2174/1573399811666150724095130
4. Almakrami M, Al Githan A, Aldawsari RA, *et al.* Comparative analysis of diagnosis, treatment and prevention strategies relating to diabetes in the United Kingdom and Saudi Arabia. The Review of Diabetic Studies. 2025;21(S10):159-69. doi:10.70082/a60qew37
5. Al-Rubeaan K. National surveillance for type 1, type 2 diabetes and prediabetes among children and adolescents: a population-based study (SAUDI-DM). Journal of Epidemiology and Community Health. 2015;69(11):1045-51. doi: 10.1136/jech-2015-205710
6. Alharbi MS, Osagiede EF, Idris YAA, *et al.* Healthcare transformation through the implementation of a new population health management approach to achieve Saudi Arabia's Vision 2030. Saudi Medical Journal. 2025;46(10):1223-31. doi: 10.15537/smj.2025.46.10.20250174
7. Penchansky R, Thomas JW. The concept of access: Definition and relationship to consumer satisfaction. Medical Care. 1981;19(2):127-40.

doi: 10.1097/00005650-198102000-00001

8. Andersen RM. Revisiting the behavioral model and access to medical care: Does it matter? Journal of Health and Social Behavior. 1995;36(1):1-10. doi: 10.2307/2137284
9. Kattan WM, Alshahrani A. Navigating the 2022 physician workforce dynamics in Saudi Arabia: A study of regional distribution. Open Public Health Journal. 2025;18:e18749445418574. doi:10.2174/011874944541857425100711758
10. Guagliardo MF. Spatial accessibility of primary care: Concepts, methods and challenges. International Journal of Health Geographics. 2004;3(1):3. doi: 10.1186/1476-072X-3-3
11. Elgawad MAA, Hashem AF, Shawki AW. Disparities in access to healthcare services for people with disabilities in the Kingdom of Saudi Arabia. Journal of Disability Research. 2025;4(3):JDR-2025-0636. doi: 10.57197/JDR-2025-0636
12. Bertakis KD, Azari R, Helms LJ, *et al*. Gender differences in the utilization of health care services. Journal of Family Practice. 2000;49(2):147-52. https://pubmed.ncbi.nlm.nih.gov/10718692/
13. Almalki M, FitzGerald G, Clark M. Health care system in Saudi Arabia: an overview. Eastern Mediterranean Health Journal. 2011;17(10):784-793. doi: 10.26719/2011.17.10.784
14. Al-Hanawi MK, Khan SA, Al-Borie HM. Healthcare human resource development in Saudi Arabia: emerging challenges and opportunities — a critical review. Public Health Reviews. 2019;40:1. doi: 10.1186/s40985-019-0112-4
15. General Authority for Statistics (Saudi Arabia). Population estimates 2024. Riyadh: General Authority for Statistics; 2024. https://www.stats.gov.sa/en/latest-publications
16. Al-Rasheedi M, Alhazmi Y, AlDaiji LA, *et al.* Status of diabetes mellitus in different regions of KSA and update on its management. Frontiers in Clinical Diabetes and Healthcare. 2024;5:1482090. doi: 10.3389/fcdhc.2024.1482090
17. Jeraiby MA, Moshi JM, Maashi SM, *et al.* Trends in diabetes mellitus prevalence and gender disparities in Jazan, Saudi Arabia. Saudi Medical Journal. 2025;46(6):617-23. doi: 10.15537/smj.2025.46.6.202501212
18. Alqahtani B, Elnaggar RK, Alshehri MM *et al*. National and regional prevalence rates of diabetes in Saudi Arabia: analysis of national survey data. International Journal of Diabetes in Developing Countries. 2023;43(3):392-7. doi: 10.1007/s13410-022-01092-1
19. Hobani MA, Khusheim LH, Fadel BA, *et al*. Barriers to access and utilization of diabetes care among patients with severe mental illness in Saudi Arabia: A qualitative interpretive study. Healthcare. 2025;13(5):543. doi: 10.3390/healthcare13050543
20. Alkandari A, Alarouj M, Elkum N, *et al*. Adult diabetes and prediabetes prevalence in Kuwait: data from the cross-sectional Kuwait Diabetes Epidemiology Program. Journal of Clinical Medicine. 2020;9(11):3420. doi: 10.3390/jcm9113420
21. Jaam M, Mohamed Ibrahim MI, Kheir N, *et al*. Assessing prevalence of and barriers to medication adherence in patients with uncontrolled diabetes attending primary healthcare clinics in Qatar. Primary Care Diabetes. 2018;12(2):116-25. doi: 10.1016/j.pcd.2017.11.001
22. Al-Abadi B, Al-Abadi J, Al-Fannah W, *et al*. The prevalence and characteristics of frequent attenders in primary health care in A'Dakhiliyah Governorate of Oman. Oman Medical Journal. 2018;33(4):331-6. doi: 10.5001/omj.2018.60
23. McManus E, Meacock R, Parkinson B, *et al*. Population level impact of the NHS Diabetes Prevention Programme on incidence of type 2 diabetes in England: an observational study. The Lancet Regional Health - Europe. 2022;19:100420. doi: 10.1016/j.lanepe.2022.100420
24. Mazumdar S, Bagheri N, Chong S, *et al*. Diabetes and the use of primary care provider services in rural, remote and metropolitan Australia. Rural and Remote Health. 2021;21(3):5844. doi: 10.22605/rrh5844
25. Aldahash R, Batais MA, El-Metwally A, *et al.* Guidelines for the management of complications of diabetes in Saudi Arabia using Delphi

technique for consensus among national experts. Clinics and Practice. 2025;15(1):9. doi: 10.3390/clinpract15010009
26. World Health Organization. Global Report on Diabetes. Geneva: World Health Organization; 2016. ISBN:978-92-4-156525-7. https://www.who.int/publications/i/item/9789241565257

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