

Regional Variation in Diabetes Clinic Utilisation in Saudi Arabia: An Analysis of Ministry of Health Statistical Yearbook Data

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Abstract

Background: Saudi Arabia has one of the highest diabetes burdens in the world, yet regional monitoring relies mainly on periodic surveys. The Ministry of Health (MOH) Statistical Yearbook reports annual encounters at hospital diabetes clinics by region, a routinely published but rarely analysed indicator.

Objective: To describe regional variation in MOH hospital diabetes clinic utilisation across Saudi Arabia's 13 administrative regions from 2022 to 2024, and to examine its association with health system supply and population composition.

Methods: Encounters at MOH hospital diabetes clinics by region, sex and nationality were extracted from the 2022 to 2024 Statistical Yearbooks and harmonised to the 13 administrative regions. Rates per 10,000 population used 2022 census denominators. Variation was summarised with the extremal quotient (EQ), coefficient of variation (CV) and Gini coefficient, rank stability with Spearman correlation, and associations with negative binomial regression (incidence rate ratios, IRRs).

Results: Encounters rose from 593,157 in 2022 to 620,742 in 2024, a national rate of 184.4 and 175.8 per 10,000. Saudi rates were about ten times non-Saudi rates, and women had higher rates than men. Regional rates varied 6.2-fold in 2022 and 9.3-fold in 2024, from 75.1 per 10,000 in Riyadh to 699.4 in Al-Baha (CV 64.5%, Gini 0.37), with highly stable rankings (Spearman rho 0.87 to 0.88). Utilisation correlated with MOH beds per 10,000 (rho 0.80) and inversely with the non-Saudi share (rho -0.81). Among Saudis, PHC centre density was associated with higher use (IRR 1.32 per SD, 95% CI 1.00 to 1.73).

Conclusions: Hospital diabetes clinic use varies widely and persistently between regions and tracks MOH service supply and population composition more closely than survey-based prevalence. The indicator measures where diabetes care is delivered, not disease burden, and would be more useful for monitoring health sector transformation if linked to prevalence, age structure and non-MOH providers.

Keywords: diabetes mellitus; health services utilisation; small-area variation; regional disparities; Saudi Arabia; Ministry of Health; health clusters; Vision 2030

1. Introduction

Diabetes mellitus is among the leading public health problems in Saudi Arabia. The International Diabetes Federation estimated an age-standardised prevalence of 23.1% among adults aged 20 to 79 years in 2024, about 5.3 million people, with 43.6% undiagnosed [1], [2]. The Global Burden of Disease study places North Africa and the Middle East as the super-region with the highest age-standardised diabetes prevalence and projects continued growth to 2050 [3]. National reviews describe a roughly tenfold rise over three decades, driven by urbanisation, obesity and physical inactivity [4], [5].

Population surveys show that this burden is not spread evenly across the Kingdom. A survey of 16,917 Saudis aged 30 to 70 years conducted between 1995 and 2000 found higher prevalence in urban than rural areas (25.5% versus 19.5%) [6]. The Saudi Health Interview Survey of 2013 reported a prevalence of 13.4% among Saudis aged 15 years and over, more than half of it undiagnosed [7]. The SAUDI-DM study, which sampled all 13 administrative regions, found abnormal glucose metabolism ranging up to 43.4% in Makkah and 41.7% in Al-Jouf [8]. More recently, analysis of the 2017 national household health survey found diabetes prevalence among people aged 15 and over ranging from 7.3% in Najran to 11.0% in Makkah [9]. Regional registries, such as that of Jazan, show rising registered case counts [10].

Surveys of this kind are infrequent and measure disease, not the care that follows diagnosis. How diabetes care is distributed across regions matters for planning under the Health Sector Transformation Program (HSTP) of Vision 2030, which is reorganising MOH services into integrated health clusters, each intended to serve about

one million people and to manage chronic conditions closer to home [11]-[14]. Routine administrative data offer a complementary, annually updated view of where diabetes care is delivered.

The MOH Statistical Yearbook is the most accessible such source. It publishes facility, workforce and activity indicators by region every year, and recent studies have used it to describe regional disparities in PHC centres, workforce and service use [15]-[17]. Each yearbook also includes a table of encounters at diabetes clinics in MOH hospitals by sex, nationality and region. To our knowledge, this table has not been analysed in the published literature.

The small-area variation tradition, which began with Wennberg and Gittelsohn's study of neighbouring Vermont communities [18], holds that wide and persistent differences in service use between areas with similar need usually reflect the organisation and supply of care rather than differences in illness. Applying this lens to diabetes clinic data can show whether hospital-based diabetes care in Saudi Arabia is distributed in line with the known geography of the disease.

This study therefore had three aims: (1) to describe MOH hospital diabetes clinic utilisation nationally and by sex and nationality from 2022 to 2024; (2) to quantify the magnitude and stability of variation across the 13 administrative regions; and (3) to examine whether regional utilisation is associated with MOH bed and PHC supply and with population composition.

2. Methods

2.1 Design and data sources

This was a repeated cross-sectional ecological study of publicly available aggregate data, reported following the RECORD extension of the STROBE statement where applicable. All data came from the MOH Statistical Yearbooks for 2022, 2023 and 2024, downloaded in Excel format from the MOH website [19]-[21].

The outcome came from the yearbook table "Encounters to Diabetic Clinics, MOH Hospitals by Sex, Nationality and Health Region" (Table 4-13 in 2022 and 2023; Table 4-16 in 2024). It reports annual encounters (visits) by Saudi males, Saudi females, non-Saudi males and non-Saudi females. Total hospital outpatient encounters by region came from the companion outpatient tables (Table 4-4 in 2022 and 2023; Table 4-5 in 2024). Regional populations by nationality came from the 2022 Saudi Census as reproduced in the 2022 yearbook (Table 1-11; total 32,175,224) [22]. National populations by sex and nationality for 2022, 2023 and 2024 came from the yearbook population tables. MOH hospital beds and PHC centres by region for 2022 came from Tables 2-16 and 2-25 of the 2023 yearbook.

2.2 Geographic harmonisation

The 2022 and 2023 yearbooks report 20 former Health Affairs directorates, while the 2024 yearbook reports 23 health clusters and sub-clusters. Both were aggregated to the 13 administrative regions using the MOH correspondence between directorates, clusters and regions (Table 1). Cluster subtotal rows were excluded to avoid double counting, and aggregated totals were checked against each yearbook's national total.

Table 1. Correspondence between reporting units and administrative regions

Administrative region	2022 and 2023 health directorates	2024 health clusters
Riyadh	Riyadh	Riyadh First, Second and Third
Makkah	Holy Capital, Jeddah, Taif, Qunfudah	Makkah (Holy Capital), Makkah (Qunfudah), Jeddah First and Second, Taif
Madinah	Madinah	Madinah
Qassim	Qassim	Qassim
Eastern	Eastern, Al-Ahsa, Hafr Al-Batin	Eastern, Al-Ahsa, Hafr Al-Batin
Asir	Asir, Bishah	Asir (Asir), Asir (Bishah)
Tabuk	Tabuk	Tabuk
Hail	Hail	Hail
Northern Borders	Northern Borders	Northern Borders
Jazan	Jazan	Jazan
Najran	Najran	Najran

Administrative region	2022 and 2023 health directorates	2024 health clusters
Al-Baha	Al-Baha	Al-Baha
Al-Jouf	Al-Jouf, Qurayyat	Al-Jouf (Al-Jouf), Al-Jouf (Qurayyat)

2.3 Measures

The primary measure was the crude diabetes clinic encounter rate per 10,000 population for each region and year. Regional census counts for Saudi and non-Saudi residents were projected to 2023 and 2024 by the national growth of each nationality group (Saudi: 2.4% and 4.5% above 2022; non-Saudi: 8.0% and 17.1% above 2022). National rates by sex and nationality used the yearbook's exact national denominators.

Secondary measures were nationality-specific rates, the female-to-male ratio of encounters among Saudis, and the share of all MOH hospital outpatient encounters that took place in diabetes clinics. The last measure partly adjusts for regional differences in overall hospital outpatient activity and recording.

Explanatory variables were MOH hospital beds per 10,000 population, MOH PHC centres per 10,000 population and the percentage of the population that is non-Saudi, all for 2022. Non-Saudi share was included because the expatriate workforce is younger and more often covered by private insurance, so it is expected to use MOH hospital clinics less.

2.4 Statistical analysis

Regional variation in each year was summarised with the range, median, extremal quotient (EQ, highest rate divided by lowest), unweighted and population-weighted coefficient of variation (CV) and the population-weighted Gini coefficient [23], [24]. A chi-square test compared observed regional counts with those expected under the national rate. Stability of regional rankings was assessed with Spearman's rank correlation between years, and change in the distribution of regional rates with the Friedman test. Spearman correlations related each region's mean rate over the three years to the explanatory variables.

Region-year counts (13 regions by 3 years, $n = 39$) were modelled with negative binomial regression because the Poisson model was heavily overdispersed (Pearson dispersion statistic 6,534). Models included year as a categorical term and standardised explanatory variables, with standard errors clustered by region. Results are IRRs per one standard deviation (SD) increase. Four models were fitted: all encounters with a population offset (Model 1); Saudi encounters with a Saudi population offset (Model 2); all encounters with total outpatient encounters as the offset (Model 3); and a beds-only model (Model 4). Because the explanatory variables were strongly correlated (Spearman rho for beds and non-Saudi share -0.83), Model 4 and the bivariate correlations are reported alongside the adjusted models.

A sensitivity analysis repeated the variation statistics using unprojected 2022 census denominators for all years. Analyses used Python 3 with pandas, SciPy and statsmodels. Two-sided $p < 0.05$ was taken as statistically significant.

2.5 Ethics

The study used publicly available, aggregate, anonymised government statistics with no individual-level data, so ethical approval and consent were not required.

3. Results

3.1 National profile

MOH hospital diabetes clinics recorded 593,157 encounters in 2022, 617,377 in 2023 and 620,742 in 2024, an increase of 4.7% over two years (Table 2). Because the population grew faster, the national rate fell slightly, from 184.4 to 175.8 encounters per 10,000. Total hospital outpatient encounters grew by 30.5% over the same period, so the share of outpatient activity taking place in diabetes clinics fell from 4.6% to 3.7%.

Saudi nationals accounted for 93.0% to 94.0% of encounters, and their rate (293.4 to 298.6 per 10,000) was about ten times that of non-Saudis (31.2 in 2022, falling to 23.8 in 2024). Women accounted for 53.9% to 55.3% of encounters. Among Saudis, the female rate exceeded the male rate by 21% to 29%. Among non-Saudis, the female rate was about 2.4 times the male rate, reflecting a non-Saudi population that is 77% male.

Table 2. National diabetes clinic encounters and rates in MOH hospitals, 2022 to 2024

Indicator	2022	2023	2024
Diabetes clinic encounters	593,157	617,377	620,742
Rate per 10,000, total population	184.4	183.2	175.8

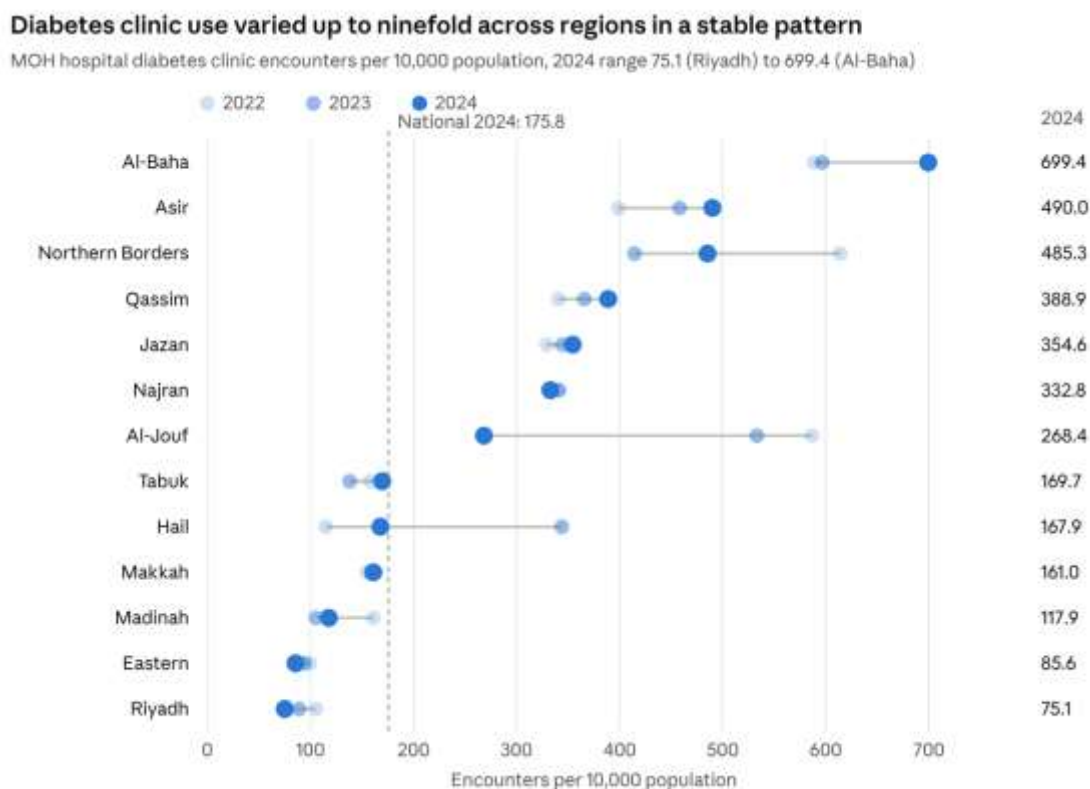
Indicator	2022	2023	2024
Rate per 10,000, Saudi males	256.1	263.9	269.1
Rate per 10,000, Saudi females	331.1	333.5	325.3
Rate per 10,000, non-Saudi males	23.1	22.4	18.1
Rate per 10,000, non-Saudi females	57.8	53.4	43.0
Encounters by females (%)	55.3	54.7	53.9
Encounters by Saudi nationals (%)	93.0	93.1	94.0
All MOH hospital outpatient encounters	12,875,411	15,109,368	16,796,225
Diabetes clinic share of outpatient encounters (%)	4.6	4.1	3.7

Source: MOH Statistical Yearbooks 2022 to 2024 [19]-[21]; national population denominators from the yearbook population tables.

3.2 Magnitude of regional variation

Regional rates varied six- to nine-fold in every year (Figure 1, Table 3). In 2024, the rate ranged from 75.1 per 10,000 in Riyadh to 699.4 in Al-Baha, with a median of 268.4. The two largest regions, Riyadh and Makkah, together hold 52% of the population but recorded 34% of encounters. The variation was far greater than chance: observed counts departed sharply from those expected at the national rate in every year (chi-square 267,834 to 365,274 on 12 df, all $p < 0.001$).

Figure 1. Diabetes clinic encounter rate per 10,000 population by administrative region, 2022 to 2024



MOH Statistical Yearbooks 2022 to 2024 (diabetes clinic tables 4-13 and 4-16); 2022 census denominators projected by nationality-specific growth · 13 regions

Regions are ordered by their 2024 rate; the grey bar spans each region's three annual values.

Variation among Saudi nationals alone was somewhat smaller but still large (EQ 5.1 to 7.0, CV 52.6% to 60.3%), so it is not explained by nationality mix alone (Table 3). Rates for non-Saudis were extremely dispersed, ranging from under 10 to over 600 per 10,000 in 2022, a pattern that partly reflects small counts and inconsistent recording (Section 3.5). The diabetes clinic share of hospital outpatient activity varied four- to six-fold, from

1.5% in Eastern to 9.1% in Asir in 2024. All dispersion measures for the total rate rose between 2022 and 2024 (EQ 6.2 to 9.3; population-weighted CV 67.2% to 76.7%; Gini 0.31 to 0.37). Using unprojected 2022 denominators changed the results little (CV 56.3% to 64.0%; EQ 6.2 to 9.1).

Table 3. Regional variation in diabetes clinic 1770urbanized1770n, 13 administrative regions

Measure	Year	Lowest (region)	Highest (region)	EQ	CV (%)	Weighted CV (%)	Gini
Rate per 10,000, total	2022	99.4 (Eastern)	614.2 (Northern Borders)	6.2	63.1	67.2	0.31
Rate per 10,000, total	2023	89.1 (Riyadh)	596.6 (Al-Baha)	6.7	56.6	71.5	0.35
Rate per 10,000, total	2024	75.1 (Riyadh)	699.4 (Al-Baha)	9.3	64.5	76.7	0.37
Rate per 10,000, Saudi	2022	156.3 (Hail)	792.5 (Al-Baha)	5.1	54.4	51.5	0.25
Rate per 10,000, Saudi	2023	157.0 (Riyadh)	811.9 (Al-Baha)	5.2	52.6	58.6	0.29
Rate per 10,000, Saudi	2024	137.3 (Riyadh)	960.1 (Al-Baha)	7.0	60.3	63.7	0.32
Rate per 10,000, non-Saudi	2022	7.2 (Al-Baha)	614.0 (Northern Borders)	85.7	174.0	197.6	0.47
Rate per 10,000, non-Saudi	2024	9.0 (Eastern)	180.8 (Najran)	20.2	99.1	96.3	0.36
Share of outpatient encounters (%)	2022	2.4 (Eastern)	9.7 (Asir)	4.0	44.3	40.1	0.20
Share of outpatient encounters (%)	2024	1.5 (Eastern)	9.1 (Asir)	5.9	46.6	52.4	0.27

EQ, extremal quotient; CV, coefficient of variation; weighted CV and Gini are population-weighted. Non-Saudi and share figures for 2023 are omitted for brevity (non-Saudi EQ 34.0, CV 140.5%; share EQ 5.2, CV 47.9%).

3.3 Regional profile and stability over time

The highest rates were consistently found in the smaller southern and northern regions: Al-Baha, Asir, Northern Borders, Qassim, Jazan and Najran (Table 4). The lowest were in the three most 1770urbanized regions, Riyadh, Eastern and Madinah. Makkah had a low total rate but a mid-ranking Saudi rate (305.3 per 10,000 in 2024), because nearly half its population is non-Saudi.

Regional rankings were highly stable. Spearman correlations between regional rates were 0.87 for 2022 to 2023, 0.88 for 2023 to 2024 and 0.87 for 2022 to 2024 (all $p < 0.001$), and the Friedman test found no systematic shift in the distribution of regional rates across years (chi-square 0.46, $p = 0.79$). Change in encounter counts from 2022 to 2024 nonetheless differed widely by region, from +58.0% in Hail, +32.8% in Asir and +27.9% in Al-Baha to -21.2% in Riyadh, -20.2% in Madinah and -50.7% in Al-Jouf.

Table 4. Regional characteristics and diabetes clinic utilisation, 2024, ordered by total rate

Region	Population (2022 census)	Non-Saudi (%)	MOH beds per 10,000	PHC centres per 10,000	Encounters, 2024	Saudi rate per 10,000	Outpatient share (%)	Female to male ratio, Saudi
Al-Baha	339,174	25.9	38.2	2.74	25,558	960.1	5.2	1.12
Asir	2,024,285	28.6	16.1	1.35	107,200	692.2	9.1	1.11
Northern Borders	373,577	27.4	39.1	1.10	19,567	656.7	5.1	1.03
Qassim	1,336,179	30.7	21.8	1.14	56,290	559.7	5.0	1.69
Jazan	1,404,997	28.6	17.2	1.17	53,855	489.8	5.6	1.12
Najran	592,300	33.3	22.0	1.15	21,420	417.8	3.4	1.23
Al-Jouf	595,822	26.1	30.6	0.94	17,237	365.8	3.3	1.44
Tabuk	886,036	28.0	21.7	0.96	16,241	221.2	4.2	1.15

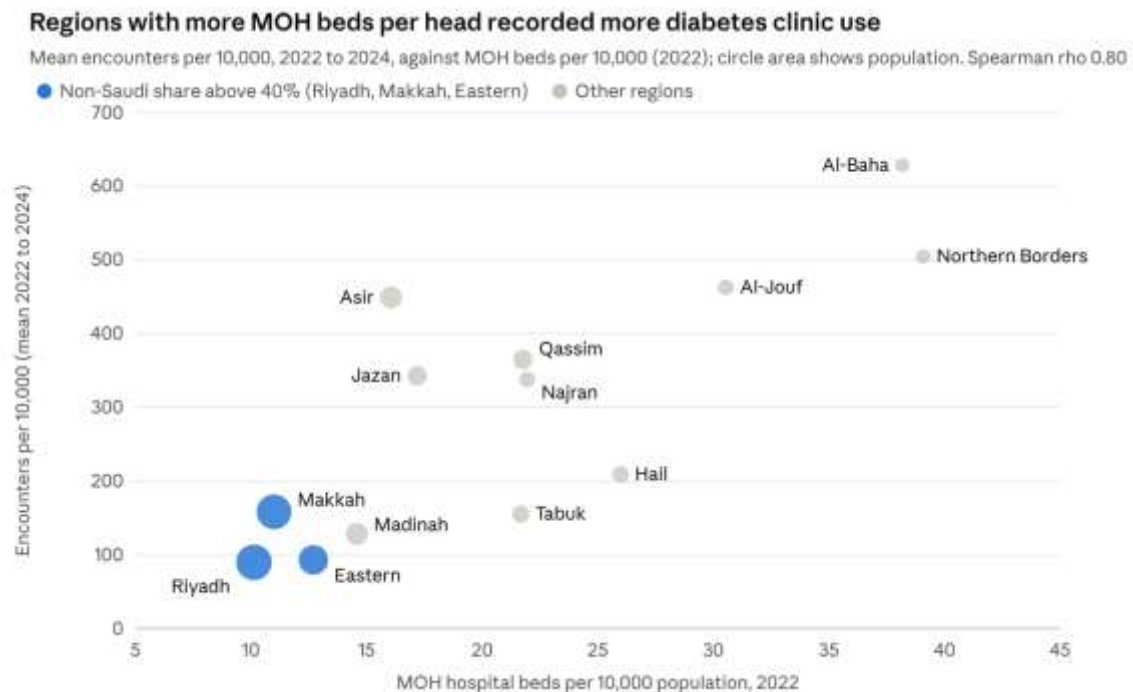
Region	Population (2022 census)	Non-Saudi (%)	MOH beds per 10,000	PHC centres per 10,000	Encounters, 2024	Saudi rate per 10,000	Outpatient share (%)	Female to male ratio, Saudi
Hail	746,406	29.3	26.0	1.46	13,555	237.3	2.9	1.95
Makkah	8,021,463	48.2	11.0	0.40	142,771	305.3	4.2	1.08
Madinah	2,137,983	36.8	14.6	0.68	27,510	181.8	2.3	1.11
Eastern	5,125,254	42.4	12.7	0.43	48,205	149.0	1.5	1.28
Riyadh	8,591,748	48.3	10.1	0.45	71,333	137.3	2.5	1.29

Beds and PHC centres are for 2022. Total rates by region and year are shown in Figure 1.

3.4 Association with service supply and population composition

Regions with more MOH capacity per head had higher utilisation (Figure 2). Across regions, the mean rate correlated with MOH beds per 10,000 ($\rho = 0.80$, $p = 0.001$), PHC centres per 10,000 ($\rho = 0.64$, $p = 0.019$) and overall hospital outpatient encounters per person ($\rho = 0.73$, $p = 0.005$), and inversely with the non-Saudi share ($\rho = -0.81$, $p < 0.001$).

Figure 2. Mean diabetes clinic encounter rate against MOH hospital beds per 10,000, by region



MOH Statistical Yearbooks 2022 to 2024; beds from 2023 yearbook Table 2-16 (2022 values); 2022 census populations · 13 regions

The three most urbanised regions, where non-Saudis make up more than 40% of residents, combine the lowest bed supply with the lowest utilisation.

In the beds-only model, each 1 SD increase in beds (9.3 per 10,000) was associated with 56% more encounters (IRR 1.56, 95% CI 1.26 to 1.93; Table 5). When beds, PHC density and non-Saudi share were entered together, all three estimates kept their direction but widened, consistent with strong collinearity among them. Among Saudis only, PHC centre density remained independently associated with utilisation (IRR 1.32 per 1 SD, 95% CI 1.00 to 1.73, $p = 0.048$). With total outpatient encounters as the offset, the year 2024 showed a 20% lower diabetes clinic share than 2022 (IRR 0.80, 95% CI 0.66 to 0.96), while supply measures were no longer associated, indicating that supply mainly shapes overall hospital activity rather than the diabetes share within it.

Table 5. Negative binomial regression of diabetes clinic encounters, region-years 2022 to 2024 (n = 39)

Term	Model 1: all, population offset	Model 2: Saudi, Saudi population offset	Model 3: all, outpatient offset	Model 4: all, beds only
Year 2023 vs 2022	0.99 (0.86 to 1.15)	1.02 (0.88 to 1.17)	0.94 (0.77 to 1.13)	1.02 (0.88 to 1.17)
Year 2024 vs 2022	0.94 (0.80 to 1.11)	1.00 (0.84 to 1.18)	0.80 (0.66 to 0.96)*	0.97 (0.83 to 1.15)
MOH beds per 10,000	1.16 (0.92 to 1.45)	1.19 (0.96 to 1.49)	0.92 (0.68 to 1.24)	1.56 (1.26 to 1.93)***
PHC centres per 10,000	1.17 (0.97 to 1.40)	1.32 (1.00 to 1.73)*	1.05 (0.88 to 1.26)	-
Non-Saudi share	0.74 (0.55 to 1.01)	-	0.77 (0.58 to 1.03)	-
Dispersion (alpha)	0.14	0.15	0.13	0.21

Values are IRRs (95% CI) with region-clustered standard errors; supply and population terms are per 1 SD increase. 1 SD = 9.3 beds, 0.59 PHC centres per 10,000 and 7.8 percentage points of non-Saudi share. * $p < 0.05$; *** $p < 0.001$.

3.5 Data consistency

Several regional series moved in ways that are unlikely to reflect real changes in care. Hail recorded 8,579 encounters in 2022, 26,700 in 2023 and 13,555 in 2024. Qurayyat, part of Al-Jouf, fell from 25,228 to 18,468 and then to 3,934, which accounts for most of Al-Jouf's 50.7% decline. Non-Saudi encounters in Northern Borders fell from 6,276 to 949, and Al-Jouf reported no non-Saudi encounters in 2023. Qassim reported an identical total of outpatient encounters in 2023 and 2024 (1,123,505). Finally, the Jeddah directorate reported 7,826 diabetes clinic encounters in 2022, whereas the two Jeddah clusters reported 42,466 in 2024, suggesting that the move to cluster reporting changed which facilities were counted. These issues affect individual estimates but not the overall regional gradient, which was stable in every year.

4. Discussion

4.1 Principal findings

This is, to our knowledge, the first analysis of the diabetes clinic encounter tables in the MOH Statistical Yearbook. Three findings stand out. First, hospital diabetes clinic use varied six- to nine-fold across regions, and the variation widened between 2022 and 2024. Second, the regional ranking was almost unchanged from year to year, which points to structural rather than random causes. Third, utilisation was highest where MOH supply per head was greatest and the expatriate share smallest, and lowest in the large urban regions of Riyadh, Eastern and Madinah.

4.2 Utilisation does not mirror prevalence

The geography of clinic use does not match the geography of disease. Survey estimates place Makkah, Al-Jouf and the Eastern region at or near the top for diabetes or abnormal glucose metabolism, and Najran at the bottom [8], [9]. In our data, Eastern and Makkah were among the lowest users of MOH diabetes clinics, while Najran sat in the upper half. Earlier surveys also found higher prevalence in urban than rural areas [6], the reverse of the urban-rural gradient in clinic use seen here.

The most likely explanation is that the yearbook table captures only one setting of care. In Riyadh, Makkah and the Eastern region, people with diabetes can also attend specialised diabetes centres, military, university and other government hospitals, and a large private sector. These providers are absent from MOH hospital statistics. In smaller regions such as Al-Baha, Asir, Jazan and Northern Borders, the MOH hospital network carries a much larger share of all specialist care, so the same disease burden produces more recorded MOH encounters. The strong correlation with MOH beds per head and with total outpatient activity per person supports this reading.

The classic small-area variation literature describes this as supply-sensitive care, in which use rises with the capacity available rather than with need [18]. Our models suggest a nuance: supply measures explained regional differences in MOH outpatient activity in general, but not in the share of that activity devoted to diabetes (Model 3). Regions with more MOH capacity appear to deliver more of all hospital outpatient care, diabetes included.

4.3 Nationality and sex

The tenfold difference between Saudi and non-Saudi rates is consistent with the structure of entitlement and financing. Most expatriate workers are covered by mandatory employer-funded private insurance and are younger than the Saudi population, both of which reduce their use of MOH hospital clinics. The inverse association between non-Saudi share and utilisation therefore reflects population composition and insurance coverage, not lower diabetes risk among expatriates.

Women accounted for more than half of encounters, and Saudi women had 21% to 29% higher rates than Saudi men. National surveys have reported equal or higher diabetes prevalence among men [6], [7], and Jazan's registry recorded 54.4% of its cases among men [10]. Higher female use may reflect greater health service contact by women in general, and some gestational diabetes care delivered through hospital diabetes clinics [25]. Men with diabetes may be more often managed in PHC, private or workplace settings, or not at all, which matters given the high proportion of undiagnosed and uncontrolled cases reported nationally [2], [7].

4.4 Change during health cluster reform

The study period covers the transition from regional directorates to health clusters, a core element of the HSTP model of care [11]-[14]. National diabetes clinic encounters grew by only 4.7% while all hospital outpatient encounters grew by 30.5%, so the diabetes share of outpatient activity fell from 4.6% to 3.7%. This is consistent with a planned shift of stable chronic disease management towards primary care, including large-scale early testing for diabetes reported in 2023 [12]. However, it may also reflect changes in how clinics are classified under cluster reporting. Recent work using the same yearbooks has shown that recorded PHC encounters fell while hospital outpatient visits rose between 2016 and 2024 [17], so the movement of diabetes care between settings deserves direct study.

The widening of regional dispersion between 2022 and 2024 is driven mainly by falls in Riyadh, Madinah and Al-Jouf and rises in Hail, Asir and Al-Baha. Some of these shifts coincide with the reporting changes described in Section 3.5 and should not be read as real changes in access until they are confirmed.

4.5 Implications

For policy, the main implication is that MOH hospital diabetes clinic counts should not be used as a proxy for diabetes burden or unmet need. A low rate in Riyadh or the Eastern region more likely signals care delivered elsewhere than an absence of disease. Equitable planning of diabetes services across clusters needs a combined view of all providers, prevalence and control.

For statistics, three improvements would make the yearbook table far more useful: reporting encounters by age group; reporting unique patients as well as visits; and publishing diabetes care activity from PHC centres and non-MOH government hospitals on the same regional basis. A stable reporting geography, or a published concordance when it changes, would protect time series during reform. Linking regional activity data to the next national health survey would allow utilisation to be compared directly with prevalence.

4.6 Strengths and limitations

The study uses complete, official, nationally comparable data that are freely available and updated each year, and it harmonises a reporting change that would otherwise break the time series. Results were consistent across alternative denominators and model specifications.

The limitations are substantial and largely inherent to aggregate administrative data. The outcome is encounters, not patients, so a region where patients are seen more often will appear to have higher use. Rates are crude: regional age and sex structures were not available, and older populations in smaller regions may explain part of their higher rates. The data cover MOH hospitals only and exclude PHC centres, other government sectors and private providers. Regional denominators for 2023 and 2024 were projected from the 2022 census using national growth, which may misstate growth in fast-growing urban regions. With 13 regions and three years, the regression models have limited power and the explanatory variables are highly correlated, so adjusted estimates should be read as exploratory. The supply variables refer to MOH facilities as a whole rather than diabetes-specific capacity such as endocrinologists or diabetes educators. Finally, as an ecological study, it cannot support inferences about individuals, and the recording inconsistencies identified mean that individual regional estimates carry uncertainty that confidence intervals do not capture.

5. Conclusions

Use of MOH hospital diabetes clinics in Saudi Arabia varied up to ninefold between regions from 2022 to 2024, and the regional ranking barely changed. Utilisation was highest in smaller regions with more MOH capacity per head and fewer expatriate residents, and lowest in Riyadh, the Eastern region and Madinah. The pattern

does not follow survey-based diabetes prevalence. The yearbook indicator is therefore best read as a measure of where diabetes care is delivered within the MOH system, not of disease burden. Adding age, unique-patient and primary care detail to routine reporting, and linking it with prevalence surveys, would make this freely available source a stronger tool for monitoring equity as health clusters mature.

Declarations

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Conflicts of interest: The author declares no conflicts of interest.

Ethics approval: Not required; the study used publicly available aggregate government statistics.

Author contributions: Asia Abdullah M Alharbi is the sole author and was responsible for conceptualisation, data curation, formal analysis, methodology, visualisation, and writing (original draft, review and editing).

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