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Evaluating the Economic Impact of Diabetes Mellitus: A Hospital-Centric Cost Analysis in Hail, Saudi Arabia

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Background: Diabetes mellitus (DM) is a chronic non-communicable disease (NCD) that imposes a significant economic burden on healthcare systems and households. This study aimed to estimate the direct medical costs associated with diabetes care from a hospital perspective in Hail, Saudi Arabia.

Methods: A retrospective, hospital-based study was conducted using data from hospital records of diabetic patients treated at King Khalid Hospital (KKH) and King Salman Specialized Hospital (KSSH) in Hail. The study employed a top-down approach to estimate direct medical costs, including consultation, lab tests, medications, admissions, and annual check-ups. Costs were adjusted to US dollars (1 USD = 3.75 SAR). Ethical approval was obtained from the Hail Health Cluster (IRB Log Number: 2023–44).

Results: A total of 377 diabetic patients were included in the study. The mean age was 58.02 years (SD = 18.80), with 53.3% male and 46.7% female patients. The average total annual cost per patient was US$6689.1 (±3450.1), with admission costs being the highest contributor (US$2686.0 ± 3373.0). The total estimated cost for all patients combined was approximately US$2.52 million. Older age, female gender, DM complications, and treatment at KSSH were significantly associated with higher direct costs.

Conclusion: The economic burden of diabetes is substantial and continues to rise annually. Policymakers should prioritize cost-effective interventions and improve data collection across hospitals to better understand and mitigate the financial impact of diabetes.

Keywords: diabetes mellitus, economic burden, direct medical costs, Saudi Arabia, hospital perspective

Introduction

Diabetes mellitus (DM) is one of the most prevalent chronic non-communicable diseases (NCDs) globally, posing a major threat to public health and economic sustainability due to its increasing prevalence and complications.[1] The condition imposes substantial burdens on both healthcare systems and household economies, particularly in countries with high prevalence rates such as Saudi Arabia.[2] According to Alhowaish et. al,[3] the economic costs of diabetes in Saudi Arabia are significant, affecting not only direct medical care but also productivity and social wellbeing. The extensive treatments for diabetes and its complications account for much of these costs, making it one of the most expensive diseases to treat in many parts of the world.[4]

Saudi Arabia ranks among the top nations in DM prevalence, with recent studies indicating an upward trend due to rapid urbanization, aging populations, and lifestyle changes.[5–7] These factors are expected to exacerbate the burden of NCDs, including diabetes, by 2030.[6] Obesity, a major risk factor for type 2 DM, remains widespread in the Kingdom, further complicating diabetes prevention and management efforts.[8,9]

Despite the increasing disease burden, there is a notable gap in localized, cost-specific research on the economic impact of DM within Saudi Arabia. While national estimates exist,[3] region-specific data are sparse, especially regarding direct medical costs incurred by public healthcare systems. Moreover, many existing studies do not comprehensively include indirect costs, such as productivity loss, transportation, or long-term caregiving—elements that substantially contribute to the total burden of the disease.[10,11]

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King Khalid Hospital (KKH) and King Salman Specialist Hospital (KSSH) in Hail were selected for this study due to their central role in providing comprehensive diabetes care in the region and the availability of reliable cost-reporting systems and electronic health records, making them ideal sources for collecting reliable data.[12] Additionally, structural and service quality factors specific to the Hail region warrant focused investigation to inform tailored healthcare interventions.

Therefore, this study aims to estimate the direct medical costs associated with DM care in Hail, Saudi Arabia, using data from KKH and KSSH. It also seeks to identify demographic and clinical variables influencing these costs. By addressing gaps in regional cost data and incorporating both system-level and patient-level perspectives, this study contributes valuable evidence to support health policy, financing reforms, and the goals outlined in Saudi Vision 2030, particularly those related to cost-effectiveness and healthcare sustainability.[13–15]

Materials and Methods

Study Design

A retrospective, hospital-based study was conducted to estimate the direct medical costs associated with type 2 diabetes mellitus (T2DM) care in Hail, Saudi Arabia. The study utilized data from hospital records of diabetic patients treated at two major healthcare facilities in the region: King Khalid Hospital (KKH) and King Salman Specialized Hospital (KSSH). These hospitals were selected due to their central role in providing diabetes care and their representation of the healthcare infrastructure in Hail.

The study employed a top-down approach to estimate direct medical costs, which is a widely used methodology in health economics for assessing healthcare expenditures.[3,11] This approach aggregates costs at the hospital level and allocates them to specific services, such as consultations, laboratory tests, medications, hospital admissions, and annual check-ups. By focusing on the hospital perspective, the study aimed to provide a comprehensive assessment of the financial burden of diabetes care within the healthcare system.

Data Collection

Data were extracted from hospital records for the period June 2023 to June 2024. The study included adult patients (≥18 years) diagnosed with type 2 diabetes mellitus (T2DM) who received care at KKH or KSSH during the study period. Patients with incomplete medical records or those treated primarily for conditions other than diabetes (eg, cancer, cardiovascular diseases) were excluded to ensure the accuracy and relevance of the data. The presence of diabetes-related complications (eg, neuropathy, retinopathy, cardiovascular issues) was recorded and included in both subgroup and regression analyses to assess their impact on healthcare utilization and costs.

The data collection process involved reviewing electronic medical records (EMRs) and hospital billing systems to extract the following information:

- Demographic details: Age, gender, level of education, and period of diabetes.
- Clinical details: Duration of diabetes and presence of comorbidities (eg, hypertension, obesity).
- Healthcare utilization: Frequency of consultations, laboratory tests, medications prescribed, hospital admissions, and annual check-ups.
- Cost data: Itemized costs for each service category, including consultation fees, laboratory test charges, medication prices, hospitalization costs, and annual check-up expenses.

To ensure data accuracy, a standardized data extraction form was developed and pilot-tested on a subset of records. Any discrepancies or missing data were resolved through consultation with hospital administrators and clinical staff.

Cost Estimation

A top-down costing approach was applied to estimate direct medical costs from the hospital perspective, which includes all costs incurred by the healthcare facility in providing diabetes care. This method uses aggregate cost data reported in

hospital billing systems, rather than micro-costing each individual service or patient record. The key steps in this process are illustrated in Figure 1.

The following cost categories were included:

1. Consultation costs: Fees associated with outpatient visits to endocrinologists, diabetologists, and general practitioners.
2. Laboratory test costs: Expenses related to diagnostic tests, such as HbA1c, blood glucose levels, lipid profiles, and renal function tests.
3. Medication costs: Costs of antidiabetic medications (eg, insulin, oral hypoglycemic agents).
4. Hospital admission costs: Expenses associated with inpatient care, including room charges, nursing care, and specialized treatments.
5. Annual check-up costs: Costs of comprehensive diabetes evaluations, including eye exams, foot exams, and cardiovascular assessments.

All costs were initially recorded in Saudi Riyals (SAR) and subsequently converted to US dollars (USD) using the exchange rate of 1 USD = 3.75 SAR, as per the prevailing rate during the study period.[10,11] This conversion facilitates comparison with international studies and aligns with global health economic reporting standards. The top-down approach was selected over the bottom-up method—which requires detailed tracking of individual services and patient-level resource use—due to its practicality and suitability for hospital-based studies utilizing aggregate financial data.

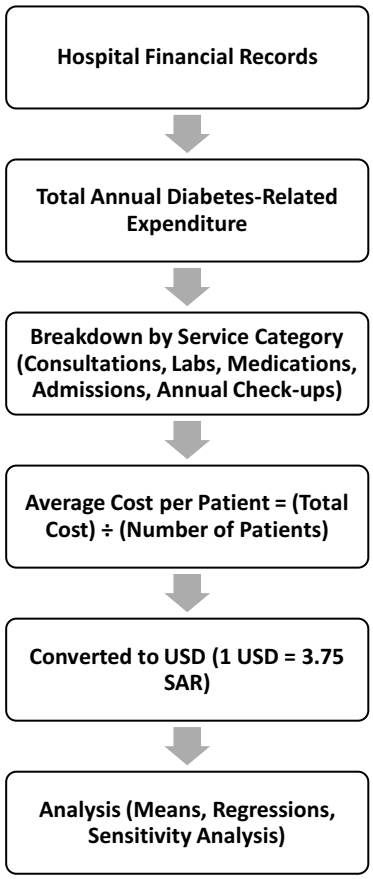

Figure 1 Top-Down Cost Estimation Flowchart.

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Data Analysis

Descriptive statistics were used to summarize the demographic and clinical characteristics of the study population. Continuous variables (eg, age, cost) were presented as means and standard deviations (SD), while categorical variables (eg, gender, level of education) were expressed as frequencies and percentages.

To estimate the total direct medical costs, the frequency of each service (eg, consultations, lab tests) was multiplied by its unit cost, and the results were aggregated across all cost categories. Subgroup analyses were conducted to examine variations in costs based on demographic factors (eg, age, gender, level of education) and clinical characteristics (eg, duration of diabetes, presence of comorbidities).

Univariate and multivariate linear regression analyses were performed to identify predictors of direct medical costs. Independent variables included demographic and clinical characteristics. A p-value of <0.05 was considered statistically significant. Sensitivity analysis was performed by varying unit costs by ±10% to assess the robustness of the cost estimates, following recommended practices.[16] Additionally, the distribution of cost data was reviewed, and the presence of high standard deviations in several cost components suggested the influence of a few high-cost cases (outliers), which were noted and considered during interpretation. This study employed a retrospective census-based design, including all eligible patients within a 12-month period. As the sample size was determined by available patient records, a prospective power calculation was not feasible. However, the final sample size was sufficient to support multivariate regression analyses and detect statistically significant associations.

Ethical Considerations

The study protocol was reviewed and approved by the Institutional Review Board (IRB) of the Hail Health Cluster (approval number: 2023–44). Patient confidentiality was maintained by anonymizing all data, and only aggregated results were reported. The study adhered to the ethical guidelines outlined in the Declaration of Helsinki and local regulations governing health research in Saudi Arabia.

The need for informed consent was waived by the IRB due to the retrospective design of the study and the anonymization of all patient data.

Results

Demographic Overview of the Study Population

The study included a total of 377 diabetic patients, with a mean age of 58.02 years (SD=18.80). The gender distribution was nearly balanced, with 53.3% (n=201) of the patients being male and 46.7% (n=176) female. Most patients (87.3%, n=329) had uncomplicated diabetes mellitus, while 12.7% (n=48) presented with complicated cases, indicating the presence of diabetes-related complications such as neuropathy, retinopathy, or cardiovascular issues.

Educational levels among the patients varied significantly. Approximately 12.2% (n=46) of the patients were illiterate, 42.2% (n=159) had primary education, and 45.6% (n=172) held a bachelor's degree or higher. This distribution highlights the diverse educational backgrounds of the patient population, which may influence health literacy and diabetes management practices.

In terms of hospital distribution, the majority of patients (81.2%, n=306) received care at King Khalid Hospital (KKH), while 18.8% (n=71) were treated at King Salman Specialized Hospital (KSSH). This disparity in hospital utilization may reflect differences in patient referral patterns, hospital capacity, or accessibility.

Direct Medical Costs Associated with Diabetes Care

The study estimated the direct medical costs of diabetes care from the hospital perspective, focusing on key cost components. The results are summarized in Figure 1, which provides a detailed breakdown of the mean costs per patient.

- Consultation costs: The average consultation cost per patient was US$79.7 (±31.7), reflecting the expenses associated with outpatient visits to healthcare providers.

- Laboratory test costs: Laboratory tests, including HbA1c, blood glucose levels, and lipid profiles, averaged US$87.9 (±27.9) per patient.
- Medication costs: The cost of antidiabetic medications averaged US$73.9 (±35.8) per patient, with substantial variability observed due to differences in prescribed regimens and drug types.
- Hospital admission costs: Admission costs were significantly higher, averaging US$2686.0 (±3373.0) per patient. This high cost underscores the financial impact of inpatient care, particularly for patients with severe or complicated diabetes.
- Monthly expenses: The total monthly cost per patient averaged US$289.4 (±57.8), highlighting the ongoing financial burden of diabetes management.
- Annual check-up costs: Annual check-ups, which include comprehensive evaluations such as eye exams, foot exams, and cardiovascular assessments, averaged US$3472.3 (±694.1) per patient. These costs emphasize the importance of preventive care in reducing long-term complications.
- Total annual costs: The total annual cost per patient, encompassing all medical expenditures, averaged US$6689.1 (±3450.1). This figure illustrates the cumulative economic impact of diabetes treatment over a year, reflecting the substantial financial burden on both patients and healthcare systems.

Demographic Factors Influencing Direct Medical Costs

The study identified several demographic factors that significantly influence the direct medical costs of diabetes care, as shown in Table 1. Both univariate and multivariate linear regression analyses were conducted to assess the impact of these factors.

- Age: Age showed a significant positive association with direct costs in both univariate (Beta=0.147, P=0.004) and multivariate (Beta=0.153, P=0.001) analyses. This indicates that older patients tend to incur higher healthcare costs, likely due to increased susceptibility to complications and comorbidities.
- Gender: Female patients incurred significantly higher direct costs compared to male patients, as evidenced by Beta values of 0.170 (P=0.001) in univariate and 0.123 (P=0.008) in multivariate analyses. This gender disparity may be attributed to differences in healthcare utilization patterns or the prevalence of comorbid conditions among female patients.

Table 1 Demographic Data of the Diabetes Patients

Variable	Category	Count	(%)
Age	Mean (SD): 58.02 (18.80)		
Gender	Male	201	(53.3)
	Female	176	(46.7)
DM complication	Uncomplicated	329	(87.3)
	Complicated	48	(12.7)
Educational level	Illiterate	46	(12.2)
	Primary	159	(42.2)
	Bachelor and above	172	(45.6)
Hospital	KKUH	306	(81.2)
	KSSH	71	(18.8)

Abbreviations: KSSH, King Salman Specialized Hospital; KSSH, King Khalid University Hospital; DM, diabetes mellitus; SD, standard deviation.

- Diabetes complications: The presence of diabetes complications had a profound impact on direct costs, with Beta values of 0.418 (P<0.001) in univariate and 0.399 (P<0.001) in multivariate analyses. Patients with complications incurred significantly higher costs, reflecting the additional resources required for managing complex cases.
- Educational level: Educational level was inversely related to direct costs. Patients with a bachelor's degree or higher had significantly lower costs compared to those with primary education or below, with Beta values of −0.126 (P=0.015) in univariate and −0.098 (P=0.034) in multivariate analyses. This suggests that higher education may be associated with better diabetes self-management and reduced healthcare utilization.
- Hospital type: Patients treated at King Salman Specialized Hospital (KSSH) incurred higher costs than those treated at King Khalid Hospital (KKH), with a significant Beta value of 0.097 (P=0.038) in multivariate analysis. This difference may be due to variations in service provision, patient case mix, or resource allocation between the two hospitals.

The regression model explained 22.9% of the variance in direct costs (Table 2), highlighting the importance of demographic factors in understanding the economic burden of diabetes care. These findings underscore the need for targeted interventions to address cost drivers, particularly among high-risk groups such as older patients, females, and those with complications.

Sensitivity Analysis

To assess the robustness of the total annual direct medical cost estimates, a one-way sensitivity analysis was conducted by varying unit costs of key healthcare components — including medical consultations, laboratory investigations, medications, hospitalizations, and annual check-ups — individually by ±10%, following recommended practices in economic evaluations.[16]

The results, presented in Table 3, show that variations in hospitalization and annual check-up costs had the greatest impact on the total cost per patient. A 10% increase in annual check-up costs raised the total annual cost by 5.19%, while a 10% increase in hospitalization costs raised it by 4.02%. In contrast, varying consultation, laboratory, and medication costs by ±10% resulted in minimal changes (less than ±0.2%). These findings suggest that inpatient care and preventive services are the primary drivers of cost variability.

Table 2 Linear Regression Analysis of Factors Influencing Direct Medical Costs (n=377)

Variables		**Univariate Linear Regression**		**Multivariate Linear Regression**	
		Beta (95.0% CI)	**P value**		**P value**
Age		0.147(8.51, 45.37)	**0.004***	0.153 (11.28, 44.87)	**0.001***
Gender	Male	Reference		Reference	
	Female	0.170(48.90, 1863.09)	**0.001***	0.123(225.97, 1476.42)	**0.008***
DM complication	Uncomplicated	Reference		Reference	
	Complicated	0.418(3364.74, 5271.95)	**<0.001***	0.399(3185.0, 5053.81)	**<0.001***
Educational level	Primary and below	Reference		Reference	
	Bachelor and above	−0.126(−1567.07, −173.39)	**0.015***	−0.098(−1298.45, −1.66)	**0.034***
Hospital	KKUH	Reference		Reference	
	KSSH	0.066(−61.87, 295.279)	0.200	0.097 (9.92, 333.06)	**0.038***

Notes: Variable with a p value of less 0.25 of univariate was included in multivariate regression. R^2 = 22.9%, Bold values indicate statistically significant results at p < 0.05.
Abbreviations: KSSH, King Salman Specialized Hospital; KSSH, King Khalid University Hospital; DM, diabetes mellitus.

Table 3 Sensitivity Analysis of Total Annual Direct Medical Costs per Patient

Parameter Varied	Adjusted Total Cost (USD)	% Change from Base Case
Base case (no change)	6689.1	–
Consultation cost +10%	6697.1	+0.12%
Consultation cost −10%	6681.1	–0.12%
Lab test cost +10%	6697.9	+0.13%
Lab test cost −10%	6680.3	–0.13%
Medication cost +10%	6696.5	+0.11%
Medication cost −10%	6681.7	–0.11%
Hospitalization cost +10%	6957.7	+4.02%
Hospitalization cost −10%	6420.5	–4.02%
Annual check-up cost +10%	7036.3	+5.19%
Annual check-up cost −10%	6341.9	–5.19%

Notes: Sensitivity analysis showing the effect of ±10% changes in individual unit costs on the estimated total annual direct medical cost per patient.

Additionally, a review of the cost data distribution revealed high standard deviations in several cost components, indicating the influence of a few high-cost cases (outliers), which were considered during the interpretation of results.

Interpretation and Implications

The results of this study provide valuable insights into the economic burden of diabetes care in Hail, Saudi Arabia. The high costs associated with hospital admissions and annual check-ups emphasize the need for effective preventive measures to reduce complications and hospitalizations. Additionally, the significant impact of demographic factors such as age, gender, and education on healthcare costs highlights the importance of tailored interventions to address the specific needs of different patient groups. As shown in Table 4, these demographic factors significantly influence the total healthcare costs among patients.

Table 4 Direct Medical Costs of Diabetes Care (USD)

Cost Category	Mean Cost per Patient (SD)	SD (±)	Cost Category
Consultations	79.7	(±31.7)	1.2%
Laboratory Tests	87.9	(±27.9)	1.3%
Medications	73.9	(±35.8)	1.1%
Hospital Admissions	2686.0	(±3373.0)	40.1%
Monthly Expenses	289.4	(±57.8)	4.3%
Annual Check-ups	3472.3	(±694.1)	51.9%
Total Annual Cost	**6689.1**	**(±3450.1)**	**100%**

Note: 1 US dollar = 3.75 Saudi Riyals.
Abbreviations: SD, standard deviation; US$, United state dollar.

Table 5 Comparison of Direct Medical Costs by Patient Subgroups (N = 377)

Subgroup	n	Mean Cost (USD)	SD (±)	p-value
Gender				0.001***
Male	201	$5800	3100	
Female	176	$7500	3800	
Age Group				0.003**
< 50 years	112	$5200	2800	
50–70 years	198	$6900	3500	
> 70 years	67	$8100	4200	
Hospital				0.038*
King Khalid Hospital (KKH)	306	$6200	3300	
King Salman Hospital (KSSH)	71	$7900	4100	
DM Complications				<0.001***
Uncomplicated	329	$5500	2900	
Complicated	48	$12,800	4500	

Notes: p-values were derived from ANOVA (for age) and independent t-tests (for gender, hospital, and complications). Significance levels: *p < 0.05; **p < 0.01; ***p < 0.001.
Abbreviations: SD, Standard deviation; USD, United State Dollar.

From a policy perspective, these findings underscore the need for enhanced diabetes management programs, particularly for high-risk populations. Strategies such as patient education, early detection of complications, and improved access to specialized care could help reduce the financial burden of diabetes on both patients and healthcare systems. Furthermore, the observed differences in costs between hospitals (Table 5) suggest the need for standardized care protocols and resource allocation to ensure equitable access to quality diabetes care across healthcare facilities.

Discussion

This study highlights the substantial economic burden of diabetes mellitus in Hail, Saudi Arabia, with an average total annual cost per patient of US$6689.1 (±3450.1). The highest contributing factor was hospital admission costs (US $2686.0 ± 3373.0), followed by annual check-up costs (US$3472.3 ± 694.1). These findings align with broader national and international trends, where inpatient care and complications management drive the largest portion of diabetes-related expenditures.

Studies have reported similar trends, such as the economic burden of diabetes in Saudi Arabia, which was estimated at USD 870 million, primarily driven by inpatient costs.[13] Our findings are also consistent with regional studies from Gulf countries, where hospital admissions and complications are the primary cost drivers due to the growing prevalence of type 2 diabetes and increased healthcare utilization. Aljulifi[17] reported a significant rise in type 2 diabetes across Gulf Cooperation Council (GCC) countries, attributed to factors such as obesity, sedentary lifestyle, and urbanization. Furthermore, a recent predictive model study demonstrated that implementing a multidisciplinary team approach in diabetes care could result in substantial cost savings. The average incremental cost savings per diabetic patient in Saudi Arabia were estimated at $38,878, including $11,108 in the year of complication onset and $27,770 over the following 10 years. Additionally, adjusted savings reached $22,869 per 1% reduction in HbA1c and $27,770 for every 10mmHg reduction in systolic blood pressure.[18]

The growing prevalence of diabetes globally further contextualizes the rising healthcare burden. For instance, in the United States, it was estimated that 25.5 million people had diagnosed diabetes in 2022, representing 7.6% of the total population—a 3% increase from 2017 and a 14% increase from 2012. Additionally, 9.6% of the adult population had diabetes.[19] Similarly, a study in Brazil reported that, based on a national self-reported diabetes prevalence of 6.2%, the total cost of diabetes in 2014 was Int$15.67 billion. Of this, Int$6.89 billion (44%) was attributed to direct medical costs, Int$3.69 billion (23.6%) to non-medical costs, and Int$5.07 billion (32.4%) to indirect costs.[20] These findings further demonstrate how diabetes imposes significant financial burdens on both healthcare systems and national economies worldwide.

Additionally, studies in lower-middle-income countries have indicated comparable direct medical costs.[11] Our results further emphasize that female patients, older age groups, and patients with complications incur significantly higher costs, which is consistent with global studies.[6]

Variations in cost across hospitals in our study also merit attention. Patients treated at King Salman Specialized Hospital (KSSH) had significantly higher costs compared to those at King Khalid Hospital (KKH) (Table 6). This discrepancy may be due to several factors, including hospital infrastructure, service availability, treatment protocols, and patient case complexity. KSSH may handle a higher proportion of complicated cases or provide more specialized services, contributing to increased expenditures. Similar hospital-related cost variations have been reported in other national studies,[10] highlighting the need for harmonized care protocols to reduce inefficiencies.

Expanding on these observations, a study conducted in Saudi Arabia found that out-of-pocket (OOP) expenses for diabetic patients are substantial, often leading to financial strain on households.[21] Our study did not incorporate OOP costs but focused on direct medical costs from the hospital perspective. Nevertheless, the burden on public hospitals indirectly reflects broader system-level expenditures. In particular, complications such as nephropathy and cardiovascular diseases significantly escalated costs in our study, aligning with international findings that identify complications as key cost drivers.[22]

Table 6 Direct Medical Costs by Patient Subgroups (USD)

Subgroup	Mean (SD)	Median (IQR)	n	p-value
Age Group				0.003**
<50 years	$5200 (±2800)	4800(4800(3100–$6900)	112	
50–70 years	$6900 (±3500)	6200(6200(4500–$8700)	198	
>70 years	$8100 (±4200)	7300(7300(5600–$9800)	67	
Gender				0.001***
Male	$5800 (±3100)	5200(5200(3800–$7400)	201	
Female	$7500 (±3800)	6900(6900(5100–$9200)	176	
Hospital				0.038*
KKH	$6200 (±3300)	5800(5800(4200–$7900)	306	
KSSH	$7900 (±4100)	7100(7100(5300–$9600)	71	
DM Complications				<0.001***
Uncomplicated	$5500 (±2900)	5000(5000(3500–$6800)	329	
Complicated	$12,800 (±4500)	11,900(11,900(9200–$15,100)	48	

Notes: p-values from ANOVA (age) and t-tests (gender, hospital, complications); Significant differences: ***p<0.001; **p<0.01; *p<0.05.

Abbreviations: KSSH, King Salman Specialized Hospital; KSSH, King Khalid University Hospital; DM, diabetes mellitus.

A nationwide cost-of-illness study in Saudi Arabia also projected that diabetes-related costs will continue rising sharply by 2030, emphasizing the need for enhanced prevention programs and cost-effective treatment interventions.[8] Regional projections from Qatar further support these concerns. Awad et al[23] forecast that the prevalence of type 2 diabetes will rise from 16.7% in 2012 to as high as 37.7% by 2050, with health expenditure related to T2DM expected to increase by 200–600%, potentially accounting for up to 32% of total national health expenditure. The study also highlighted increasing trends in obesity, smoking, and physical inactivity—key modifiable risk factors driving the diabetes burden across the Gulf region. Such forecasts emphasize the urgency of preventive strategies across GCC countries, including digital health interventions, telemedicine, and structured diabetes self-management education, which have shown potential to reduce hospital admissions and long-term complications.[9,17]

Additionally, findings from a study on healthcare transformation in Saudi Arabia indicated that indirect costs, including lost productivity and absenteeism, account for nearly 40% of total diabetes-related expenses.[15] While our study did not assess indirect costs, this highlights the importance of incorporating productivity loss analysis in future research to provide a more comprehensive understanding of the economic impact of diabetes.

By adopting integrated diabetes management strategies that include early screening, improved access to medication, and lifestyle interventions, policymakers can significantly reduce both direct and indirect costs associated with diabetes care. Cost-effective approaches such as telemedicine, mobile health platforms, and community-based diabetes management programs have shown promise in improving access and reducing complications. Our findings reinforce the importance of tailored cost-containment strategies, improved hospital resource utilization, and comprehensive diabetes prevention programs to alleviate the growing economic burden of this chronic disease in Saudi Arabia and across the Gulf region.

Limitations

This study has several limitations. First, the data were limited to two hospitals in Hail, which may not fully represent the broader population or healthcare system across Saudi Arabia. Second, not all hospitals maintain comprehensive or standardized records, which may affect the generalizability of the findings. Third, the study focused exclusively on direct medical costs and did not capture indirect costs such as productivity loss, transportation, or caregiving time—factors that significantly contribute to the overall economic burden of diabetes.

Additionally, socio-economic variables such as income or employment status were not included in the analysis due to data unavailability and the retrospective nature of the study. However, educational level was included as a proxy indicator. Furthermore, seasonal variations (eg, holidays or peak periods such as Hajj and Ramadan) may have influenced healthcare availability and patient access, potentially impacting cost estimates.

Finally, substantial variability in some cost categories—reflected by high standard deviations—was observed. This may be due to a small number of high-cost outliers that skewed the average costs, and should be considered when interpreting the results. Future prospective studies should incorporate broader socio-economic factors and indirect cost components to provide a more comprehensive assessment of the financial impact of diabetes care.

Conclusions

The economic burden of diabetes mellitus in Saudi Arabia is substantial and continues to grow, placing significant pressure on healthcare systems and households. This study highlights the high direct medical costs associated with diabetes care, particularly for hospital admissions and annual check-ups, which contribute significantly to the overall financial burden.

To mitigate these challenges, policymakers should prioritize targeted budget allocations toward preventive care, diabetes education, and early screening initiatives. Allocating a defined percentage of healthcare budgets specifically for chronic disease management, including diabetes, and integrating diabetes cost tracking into national health financing frameworks could improve resource planning and efficiency. Investing in standardized treatment protocols and expanding access to primary care services can help reduce costly hospital admissions and complications. Additionally, improving inter-hospital data collection systems and resource tracking will support more accurate budgeting and cost monitoring across healthcare institutions.

There is also a pressing need for longitudinal studies to evaluate cost trends over time, assess the long-term impact of policy changes, and guide resource planning under dynamic population health conditions. Such studies can offer deeper insight into the evolving economic impact of diabetes and inform sustainable national strategies.

Addressing these priorities is essential to reduce the economic burden of diabetes, improve patient outcomes, and align with Saudi Arabia's broader healthcare goals under Vision 2030.

Disclosure

The authors report no conflicts of interest in this work.

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