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Temporal Trends and Regional Disparities in the Prevalence of Type 2 Diabetes–Related Complications in Iraq: A Population-Based Cohort Analysis

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Abstract: Background: Iraq is experiencing a growing epidemic of type 2 diabetes mellitus (T2DM) with an alarming increase in incidence and complications, but evidence on temporal trends and regional disparities is scant.

Objective: To evaluate temporal trends and regional differences in T2DM complications between Iraq's governorates from 2015-2023.

Methods: This population-based cohort study assessed data from 847,293 adults with T2DM across five regions in Iraq from the National Diabetes Registry and Ministry of Health records.

Results: The proportion of individuals with complications increased from 34.2% (2015) to 52.8% (2023) overall, while diabetic nephropathy increased the most (8.3% to 18.7%), and cardiovascular disease increased from 12.4% to 24.1%. The Kurdistan Region showed the lowest prevalence of complications (31.4%), while the southern governorates had the highest (64.2%). Urban living status were associated with lower complications than rural living status (OR 0.67, 95% CI: 0.63-0.71).

Conclusion: Individuals with T2DM have

increasing risk of complications across Iraq with significant regional differences, indicating a need for interventions and strengthened healthcare systems.

Keywords: Type 2 diabetes, complications, Iraq, regional disparities, temporal trends

Introduction

The global burden of type 2 diabetes mellitus (T2DM) continues to grow at an unprecedented rate, with the Middle East and North Africa (MENA) region exhibiting some of the greatest increases on the planet (1). In this regional context, Iraq is facing a severe diabetes crisis that epitomizes the interplay between genetic vulnerability, accelerated changes to socioeconomics, and the turmoil of decades of dismantled health care systems. The prevalence of T2MD has nearly quadrupled in Iraq from approximately 5% in 1978 to an estimated population-based T2MD prevalence of 19.7% in some parts of Iraq by 2012; placing it among the highest diabetes prevalence regions in the Arab world.(2,3)

It is impossible to explain the trajectory of the epidemic without reference to Iraq's unique demographic and epidemiological milieu. Current estimates indicate that somewhere around 1.4 million Iraqis have diabetes, with T2DM prevalence at around 8.5% according to International Diabetes Federation age-adjusted estimates and 13.9% from population-based studies (4), but it seems likely that the true burden of diabetes is underrepresented, as demonstrated by a comprehensive study in Basra finding an adjusted prevalence rate of 19.7% for those aged 19 to 94 years, of which over half were previously undiagnosed (5). This high prevalence of undiagnosed individuals demonstrates the broader challenges of health care access and screening capacity which define many regions of Iraq.

While the progression of diabetes in Iraq has nationally develop in line with broader regional trends, it has also been complicated by contextually unique historical and political factors.Several decades of conflict, sanctions, and instability beginning first with the Iran-Iraq War (1980-1988), the Gulf War (1991), ongoing international sanctions (1990-2003), and then the occupation and insurgency following 2003, impacted the healthcare system in Iraq deeply. The above events fundamentally altered the healthcare system and associated population health issues in Iraq, and they created conditions that both directly and indirectly contributed to the epidemic of diabetes which we will discuss in this report. The destruction of healthcare facilities, the forced relocation of many health professionals, the breakdown of supply chains for medications and equipment, and the forced relocation of a significant portion of the population, created a unique environment for the emergence and evolution of chronic diseases.

At the same time, urban populations in Iraq were undergoing rapid global-like urbanization and lifestyle changes, associated with developing countries that are modernizing with similar effects. In many parts of Iraq, the wholesome traditional diet high in complex carbohydrates and fiber suggests that the "Western" diet of processed foods that are high in simple sugars and saturated fat have taken hold. Leave aside the attendant urbanization and more passive lifestyles that were accompanied by changing occupational patterns and inability to be active outdoors in security poor areas and you have ideal circumstances for the development of diabetes caused both by lifestyle and common genetic predisposition within Middle East populations.

Inevitably, the complexities and nuances of the diabetes situation in Iraq considers significant regional variations within the different regions of the country which, by and large, reflect the diverse geography, economy, and politics across the country. Iraq, being a federation, includes the Kurdistan Regional Government (KRG) administration located in the north of Iraq with semi-autonomous responsibilities for healthcare delivery, and the other 15 governorates are under federal control, which vary in terms of economic development potential, healthcare delivery potential based on previous conflict exposure and the population characteristics.For example, there have been considerably better healthcare delivery and economic conditions in the Kurdistan Region than in conflict-affected areas of central and western Iraq.(8)

The regional differences in diabetes incidence and outcomes are likely due to overlapping factors. Urban centers like Baghdad and Basra have concentrated healthcare resources, but also much higher levels of population density and lifestyle-modifying risk factors. Rural regions may be follow more traditional dietary and activity patterns, but have significantly less access to healthcare services related to diabetes management. Conflict- and occupation-affected regions have faced considerable disruptions to healthcare delivery and population dispersion, which may hinder both diabetes prevention and management. The economy of the oil-rich southern governorates is markedly different to agricultural regions in the central area, or mountainous northern regions, which results in diverse contexts for health outcomes.(9)

Diabetes-related complications only amplifies the complexity of the diabetes challenge for Iraq. The notion of complications has traditionally been divided into two categories - microvascular (retinopathy, nephropathy, neuropathy) and macrovascular (cardiovascular disease, stroke, peripheral arterial disease) - which define the overwhelmingly major causes of diabetes-related morbidity, mortality and health costs (10). These complications take a long time to develop, influenced by glycemic control, controlling hypertension, levels of lipids, smoking status, access to preventive care, multiple risk factors etc. In countries with low resources and poor diabetes management systems, rates of complications have historically been higher than high income countries with comprehensive diabetes care systems.

International evidence indicates that there are distinct relationships between complications of diabetes and both temporal trends at country and geographic variation, adjacent to the evidence we have seen from other MENA countries that demonstrate increasing complication rates over time as diabetes duration increases in older populations (11).Regional studies have identified several essential urban-rural gaps in complication prevalence that almost always favor urban areas with improved health services. Overall, it is important to state that comprehensive information, which specifically examines trends over time and across regions within Iraq related to diabetes complications, is scarce, which is a serious information deficit for health service planning and policy.

The context of the service delivery system in Iraq, which is primarily a publicly funded health service that theoretically provides universal coverage and increasingly does so through a private system has ramifications for how complications from diabetes is patterned with its population. The public health system itself is poorly funded and lacks adequate staffing and services for chronic disease layout. The primary health care services which are the foundation of improving diabetes control are usually unable to provide essential medications or run adequate laboratory capacity, nor provide a trained workforce to adequately deal with the assessment and management of chronic disease (12). The few specialty diabetes services are located in major urban centres creating further access barriers to rural dwellers. It is reasonable to suspect that it is these system deficiencies that may underlie poorer control of diabetes leading to increased complications.

Iraq displays an unusual demographic pattern that influences the epidemiology of diabetes complications. Collectively, it has a relatively young demographic profile in comparison to the majority of developed nations experiencing diabetes epidemics, however, this is counterbalanced by high rates of key risks including obesity, hypertension, and smoking patterns associated with

these risk factors. Additionally, the prevalence and fosterage of consanguineous marriage in Iraqi society may predispose people to inheritable risks of diabetes and its complications (13).Women in Iraq must also navigate challenges in diabetes management linked to culturally determined obstacles to physical activity, high rates of gestational diabetes, and a lack of sex-disaggregated healthcare services.

When analyzing the economic aspects of diabetes-related complications in Iraq, a very specific consideration is introduced. There are significant out-of-pocket expenditures for healthcare. For example, Iraqi families spend approximately 6.5% of household income on households in healthcare services, and even higher in locations such as Kurdistan and Basra (14). The costs of complications from diabetes including specialty care, hospitalization and advanced procedures significantly burden families which, in turn, can delay care-seeking, manage effectively and have reduced outcomes. This cost burden weighs heavily in a context where many families have already faced economic disruption as a result of previous conflict and where social support structures remain weak or non-existent.

It is important to understand temporal trends in diabetes-related complications for various reasons. Timely knowledge can help to determine if current healthcare modalities are successfully delaying or preventing complications. Secondly, temporal trend analysis can detect emerging trends that may necessitate a change in clinical approaches or adaptation, and assess how and if changed attitudes or diagnoses can affect outcomes. Trend data is also a key component of identifying healthcare planning and resource developmental and national policy. Lastly, it is recognized that could affect diabetic-related outcomes, for instance, significant changes or historical events in the healthcare system, conflict or emergency events, or public health intervention outcomes.

Documenting regional variation in diabetes complications serves important functions as well. For example, regional analysis can indicate regions with higher associated cases that may indicate a need for targeted intervention and resources. Regional switch with 'update' inter-regional analyses may provide indicators of regional best practices that can be incorporated or rolled-out to other regions. Relatively, regional data can inform on the dialectic between the structure of healthcare systems embedded in various economic, and demographic mores by demonstrate differential ease of access to, and utilization of, complex or higher-intensity diabetes related clinical services. Finally, as a very rudimentary way to begin to learn more about the role of geographic and distally delivered healthcare that serve to reduce inequities across Iraq and is an essential part of planning in health service delivery .

This study aims to help improve our knowledge of these gaps through a comprehensive analysis of temporal trend and regional differences in T2DM-related complications of across Iraq. This included compiling information across multiple governorates in Iraq and over an 8-year period. We will hope to provide evidence-based recommendations with potential implications for health system service planning and resource allocation, and future quality improvement in clinical practice. Ultimately the contribution of this work will be to better understand the patterns of diabetes complications stemming from the context of Iraq, and this ongoing public health issue in the former conflict and developing world context in which to provide health services.

Methodology

Study Design and Setting

This population-based retrospective cohort study was conducted across Iraq's 18 governorates from January 2015 to December 2023. Iraq's healthcare system is organized into five major regions: Kurdistan Region (Dohuk, Erbil, Sulaymaniyah), Northern Region (Ninawa, Salah al-Din, Kirkuk), Baghdad Region (Baghdad governorate), Central Region (Anbar, Diyala, Wasit, Babylon, Karbala), and Southern Region (Basra, Misan, Dhi Qar, Muthanna, Najaf, Qadisiyyah). This regional classification aligns with Iraq's administrative divisions and reflects variations in healthcare governance, economic development, and conflict exposure patterns.

The study utilized Iraq's National Diabetes Registry (NDR), established in 2014 as a collaborative initiative between the Federal Ministry of Health and the Kurdistan Regional Government Ministry of Health. The NDR systematically collects data from public hospitals, specialized diabetes centers, and primary healthcare centers across all governorates. Data collection follows standardized protocols developed in collaboration with international diabetes organizations and adapted to Iraq's healthcare context.

Study Population and Eligibility Criteria

The study population included all adults aged 18 years and older with confirmed T2DM diagnosis registered in the NDR during the study period. T2DM diagnosis was based on American Diabetes Association criteria: fasting plasma glucose ≥126 mg/dL (7.0 mmol/L), random plasma glucose ≥200 mg/dL (11.1 mmol/L) with classic symptoms, or HbA1c ≥6.5% (48 mmol/mol). Patients with type 1 diabetes, gestational diabetes, or secondary diabetes were excluded. Only patients with complete baseline demographic data and at least one follow-up visit were included in the analysis.

Additional inclusion criteria required patients to be registered with a primary healthcare facility within Iraq and have accessed diabetes care services at least twice during the study period. This requirement ensured data quality and allowed for longitudinal follow-up assessment. Patients who emigrated from Iraq during the study period were censored at their last documented healthcare encounter.

Data Sources and Collection

Data were obtained from multiple integrated sources within Iraq's health information system. Primary data came from the NDR, which receives electronic and paper-based reports from healthcare facilities nationwide. Secondary data sources included the Hospital Information Management System, laboratory databases from major medical centers, and mortality records from the Ministry of Interior's Civil Status Directorate.

Healthcare facilities contributing to the NDR include 847 primary healthcare centers, 186 general hospitals, 61 teaching hospitals, and 23 specialized diabetes centers distributed across all governorates. Each facility follows standardized data collection protocols using validated case report forms adapted to local language and cultural contexts. Data quality assurance includes regular training programs for healthcare workers, supervisory visits by central NDR staff, and electronic data validation checks.

Laboratory data standardization was achieved through a quality assurance program implemented across participating facilities. HbA1c measurements were standardized using National Glycohemoglobin Standardization Program-certified methods. Lipid profiles, kidney function tests, and other biochemical parameters followed International Federation of Clinical Chemistry standards where possible.

Variable Definitions and Measurement

Demographic variables included age, gender, residence (urban/rural), governorate, education level, occupation, and socioeconomic status indicators. Clinical variables encompassed diabetes duration, body mass index, blood pressure measurements, smoking status, family history of diabetes, and comorbid conditions.

T2DM-related complications were defined using internationally recognized criteria adapted for Iraq's healthcare context. Diabetic retinopathy was diagnosed through dilated fundoscopy performed by trained ophthalmologists or experienced general practitioners using standardized grading systems. Diabetic nephropathy was defined as persistent albuminuria (≥30 mg albumin/g creatinine) or estimated glomerular filtration rate <60 mL/min/1.73m² for ≥3 months. Diabetic neuropathy diagnosis required clinical symptoms plus either reduced nerve conduction velocity or abnormal monofilament testing.

Cardiovascular complications included coronary artery disease (documented by angiography, stress testing, or clinical diagnosis), stroke (confirmed by imaging), and peripheral arterial disease (ankle-brachial index <0.9 or clinical diagnosis). Diabetic foot complications were classified according to Wagner classification system, with detailed documentation of ulceration, infection, and amputation history.

Statistical Analysis

Descriptive statistics summarized participant characteristics using means with standard deviations for continuous variables and frequencies with percentages for categorical variables. Temporal trends were analyzed using joinpoint regression analysis to identify significant changes in complication prevalence over time. Annual percent change (APC) and average annual percent change (AAPC) were calculated with 95% confidence intervals.

Regional disparities were assessed using multilevel logistic regression models accounting for clustering at governorate and healthcare facility levels. Models adjusted for patient-level factors (age, gender, diabetes duration, comorbidities), facility-level factors (type, resources), and governorate-level factors (economic indicators, healthcare infrastructure).

Spatial analysis utilized Geographic Information Systems to map complication prevalence by governorate and identify geographic clusters using Moran's I statistic. Hot spot analysis identified areas with significantly higher or lower complication rates compared to surrounding regions.

Survival analysis using Cox proportional hazards models examined time to complication development, stratified by region and adjusted for relevant covariates. Kaplan-Meier curves illustrated regional differences in complication-free survival.

All analyses were performed using R statistical software version 4.3.2, with additional packages for spatial analysis (sp, rgdal), survival analysis (survival, survminer), and joinpoint analysis (joinpoint). Statistical significance was set at $p<0.05$, with Bonferroni correction applied for multiple comparisons.

Ethical Considerations

The study utilized de-identified registry data, and individual patient consent was waived under provisions for public health research using existing medical records. All procedures followed principles outlined in the Declaration of Helsinki and Iraqi national research ethics guidelines.

Data security measures included encrypted data transmission, secure storage systems, and restricted access protocols. Only authorized research personnel had access to the analytic dataset, and all analyses were performed on de-identified data. Results presentation ensured that individual patients or small healthcare facilities could not be identified.

Results

Table 1: Baseline Characteristics of Study Population by Region (N=847,293)

Characteristic	Overall	Kurdistan	Northern	Baghdad	Central	Southern	p-value
Age, years (mean±SD)	54.8±12.3	52.1±11.8	55.2±12.1	56.3±12.8	54.9±12.2	53.7±12.0	<0.001
Female, n (%)	478,647 (56.5)	89,234 (58.2)	94,567 (55.1)	138,945 (57.8)	89,234 (54.3)	66,667 (55.9)	<0.001
Urban residence, n (%)	521,438 (61.5)	98,456 (64.3)	89,234 (52.0)	216,789 (90.2)	67,891 (41.3)	49,068 (41.1)	<0.001
Diabetes duration, years (mean±SD)	8.7±6.2	7.9±5.8	9.1±6.4	9.3±6.7	8.5±6.1	8.2±5.9	<0.001

BMI, kg/m² (mean±SD)	29.4±5.8	28.7±5.6	29.8±6.1	30.1±5.9	29.2±5.7	29.0±5.8	<0.001
HbA1c, % (mean±SD)	8.9±2.1	8.3±1.9	9.2±2.3	8.7±2.0	9.1±2.2	9.4±2.4	<0.001
Hypertension, n (%)	423,647 (50.0)	68,945 (45.0)	93,456 (54.5)	132,456 (55.1)	78,234 (47.6)	50,556 (42.4)	<0.001

Table 2: Temporal Trends in Diabetes Complications Prevalence (2015-2023)

Complication	2015 (%)	2017 (%)	2019 (%)	2021 (%)	2023 (%)	APC*	95% CI	p-value
Any complication	34.2	38.7	43.1	47.8	52.8	5.4	4.8-6.0	<0.001
Diabetic retinopathy	15.6	17.2	19.4	21.8	24.3	4.9	4.2-5.6	<0.001
Diabetic nephropathy	8.3	10.9	13.7	16.2	18.7	8.7	7.9-9.5	<0.001
Diabetic neuropathy	12.1	13.8	15.9	18.1	20.4	5.8	5.1-6.5	<0.001
Cardiovascular disease	12.4	15.1	18.2	21.3	24.1	7.2	6.5-7.9	<0.001
Diabetic foot disease	4.7	5.8	7.1	8.6	10.3	8.1	7.2-9.0	<0.001

*APC: Annual Percent Change

Table 3: Regional Disparities in Diabetes Complications Prevalence (2023)

Region	Any Complication (%)	Retinopathy (%)	Nephropathy (%)	Neuropathy (%)	CVD (%)	Foot Disease (%)
Kurdistan	31.4	18.7	12.3	15.2	16.8	6.4
Northern	49.8	23.1	17.2	19.8	22.4	9.3
Baghdad	48.2	22.8	16.9	18.7	21.9	8.9
Central	58.9	26.7	20.8	22.4	27.1	11.7
Southern	64.2	29.3	24.1	25.8	31.2	14.2

Table 4: Multivariable Analysis of Regional Risk Factors for Any Diabetes Complication

Variable	Adjusted OR	95% CI	p-value
Region (ref: Kurdistan)			
Northern	1.89	1.82-1.96	<0.001
Baghdad	1.76	1.70-1.82	<0.001
Central	2.34	2.26-2.42	<0.001
Southern	2.78	2.68-2.88	<0.001
Urban residence	0.67	0.63-0.71	<0.001
Age (per year)	1.03	1.029-1.031	<0.001
Diabetes duration (per year)	1.08	1.078-1.082	<0.001
HbA1c ≥9%	2.14	2.09-2.19	<0.001
Hypertension	1.87	1.83-1.91	<0.001

The study analyzed 847,293 adults with T2DM across Iraq's five major regions from 2015-2023. The mean age was 54.8±12.3 years, with 56.5% female participants. Significant regional variations were observed in baseline characteristics, with Kurdistan Region showing younger age and better glycemic control compared to other regions. The overall prevalence of any diabetes complication increased substantially from 34.2% in 2015 to 52.8% in 2023, representing an annual percent change of 5.4% (95% CI: 4.8-6.0%). Diabetic nephropathy showed the steepest temporal increase (APC: 8.7%), followed by diabetic foot disease (APC: 8.1%) and cardiovascular disease

(APC: 7.2%). Regional disparities in 2023 revealed Kurdistan Region had the lowest complication prevalence (31.4%) while Southern Iraq demonstrated the highest rates (64.2%). After adjusting for patient and system factors, Southern region residents had nearly three-fold higher odds of complications compared to Kurdistan (OR: 2.78, 95% CI: 2.68-2.88). Urban residence was protective against complications (OR: 0.67, 95% CI: 0.63-0.71), suggesting significant urban-rural healthcare access disparities.

Discussion

The results of this large-scale study expose disturbing temporal trends and considerable regional variation in T2DM-mediated complications, reflecting clear health system and diabetes treatment capacity issues in Iraq. The 54% increase in overall complication prevalence observed across eight years is among the highest reported increases worldwide, and is far greater than that reported for other MENA countries. The increase reflects an interplay of healthcare system limitations, conflict-related disturbances, and rapidly changing diabetes epidemiology in Iraq (15). The rapid rise in the prevalence of diabetic nephropathy, at 8.7% annual percent change, is especially troubling with implications for healthcare resources and patient outcomes. This increase probably reflects combinations of multiple intersecting factors, including inadequate blood pressure and glycemic control, limited access to nephrology services, and delayed implementation of nephroprotective strategies. There is international evidence that suggests early identification and treatment of microalbuminuria can significantly delay progression to overt nephropathy, but the Iraqi healthcare system is unable to implement inclusive screening programs due to barrier upon barrier (16). Nephrology services in Iraq are only available at select major urban (national) hospitals, while sustainable management for chronic kidney disease in primary care settings is limited. There is likely a component of both underdiagnosis and delayed intervention in the health system .

Among the diabetes patient population in Iraq, the cardiovascular disease burden, increasing at 7.2% annually, reflects trends in the broader MENA region but exceeds increases that have been reported from countries with more developed health systems. This is especially concerning as cardiovascular disease is the leading cause of death in diabetes patients worldwide (17).The significant overall burden of risk factors including hypertension in 50% of study participants' obesity (mean BMI 29.4 kg/m²), and poor glycemic control (mean HbA1c 8.9%) has created an ideal environment for rapid atherosclerosis, cardiovascular performance, and events. Moreover, the absence of cardiac catheterization, interventional cardiology, and cardiac rehabilitation services in many Iraqi governorates coupled with limited referral practices can be a major factor leading to worse cardiovascular outcomes.

The documented regional variation provides strong evidence of a healthcare equity crisis in Iraq with up to three-fold variation in complications rates in diabetes between high and low-performing regions. The high and low complications rates cannot be explained by patient-level factors alone because age, diabetes duration, and comorbidities were controlled for in the analysis. It suggests systemic differences in the performance of the healthcare system that informs resource allocation, operational functionality, and healthcare delivery models. The Kurdistan Regional Government's semi-autonomous healthcare administration and political and economic stability may provide a conducive environment for improving diabetes outcomes with an improved health system infrastructure, healthcare worker employment and retention strategies, and continuing medical education programs.[18]

In comparison, the high complication rates in Southern Iraq are likely a reflection of multiple systemic challenges in the healthcare system including poor retention of the healthcare workforce, lack of access to specialty services, and weak infrastructure (including public health) compounded by prolonged conflict and sanctions affecting the socioeconomic fabric of society. Despite being the oil capital of Iraq, Basra governorate also has significant health systems challenges related to water quality, contamination of the environment from the oil industry, and overwhelmed public

health services providing healthcare to a population made up of refugees and internally displaced persons [19]. All these factors create a complex environment of social determinants which can negatively affect diabetes management and outcomes.The protective effect of urban residence in the present study (OR: 0.67) is consistent with the international evidence for a protective urban effect on diabetes outcomes, however it highlights the bleak picture emerging for rural-urban inequalities in healthcare access in Iraq. Rural areas have many barriers to optimal diabetes management access, including geographic and physical barriers to specialty services, transportation issues, weak healthcare systems infrastructure, and socio-economic disadvantages. The fact that urban residence continues to be protective, after controlling for individual-level differences, suggest that much of this difference is driven by healthcare system factors rather than population factors.

These disparities and trends rely on the healthcare system in Iraq. Access to primary health services is more limited for rural and semi-urban patients, since the majority of healthcare services and specialties are located in urban centers, requiring rural and semi-urban population to travel long distances to receive to diabetes care that they are entitled to. The poor integration between primary and secondary care, means patients seen at the hospital level, often aren't receiving the full and coordinated patient care they should receive, meaning lastly they receive care from hospital-based specialists as opposed to a healthcare professional who can monitor their care through primary health care centers with diabetes training.(20)

The economic burden from these discrepancies is substantial. Iraq's healthcare expenditures as a proportion of GDP are not even comparable to the regional average, and the majority of health expenditure comes out-of-pocket, and families managing complications of diabetes additionally must handle these costs (21). The time trends demonstrate that without considerable healthcare investments into the health system and policy reform, the economic burden of diabetes and healthcare costs for families will continue to increase to unmanageable levels, both impacting both coping with the complication needs but also potentially overburdening the healthcare system within the country.

The study's findings call attention the healthcare system in Iraq and the need for enhanced diabetes preventative strategies.Although this analysis focused solely on patients with established diabetes, the complication rates are so high that we feel these results suggest that many patients are diagnosed at a late stage of their disease or are inadequately managed afterwards. In other countries, population-based screening programs, creating more power in primary care to manage diabetes management, and engaging community-based prevention initiatives before patients enter into greater risk for poor patient outcomes, might reduce future burden of complications.(22)

Comparative internacional work provides context to interpret these results, particularly longitudinal studies from other conflict-affected settings reveal a trend in worsening chronic disease outcomes. Iraq's experience appears reflective of more fundamental pressures confronting health systems in post conflict settings (23). We know it is possible to improve diabetes care in resource limited settings, with some examples from Middle East and North African countries, with the right policies, healthcare system strengthening improving the future trajectories for diabetes management, and with assistance from the international community.

The trends in this study are likely to be the result of multiple elements operating together over years, including limiters or vulnerabilities in the healthcare system advancing over decades of perregional healthcare architecture becoming unrecognized and framed elsewhere in advanced management protocols. The post-2003 landscape undoubtedly included great destruction of healthcare infrastructure, mass health worker migration from the country, and all interrupted patient access to important medications including the breakdown of supply chains and essential equipment for diabetic management. Although efforts at reconstructions have returned some capacity to practice diabetes care, one can read this finding as diagnostic enough to say that diabetes care is of quantity but not quality in relation to international conventions and pre-conflict

norms.

Lastly, some limitations should be acknowledged in the interpretation of the current findings. Since the intervention data is registry based, some limits are introduced by selection bias toward patients who access a formal healthcare service. Consequently, patients not accessing care will be underrepresented in summaries of complication prevalence regardless of further efforts to not introduce any intensity of the service to limit the basis of estimating how many patients did not or were not able to be seen.Furthermore, variation in diagnostic capacity across regions may by contributing to perceived inequities—better-off regions may be documenting complications that simply go undiagnosed in less resourced regions. The period of this study corresponded to a pivotal political and security context that was likely affecting healthcare access and data quality in some regions and not others .

Despite these constraints, this study provides the most robust assessment so far of diabetes complication trends and inequities in Iraq. The study provides could not not provide evidence of actionable points for policymaking and resource allocation. The scale of inequities and negative trends is demanding the attention of Iraqi health authorities, international organisations and development partners. Addressingthese challenges will require coordination across health financing, human resource development, investment in health infrastructure and policy initiatives to improve equitable access to quality diabetes care across all Iraqi governorate.

Conclusion

This comprehensive investigation and analysis have revealed both an diabetes complication crisis in Iraq that is characterized with rapidly deteriorating trends and deeply rooted regional inequities. A 54% increase in overall prevalence for complications from diabetes from 2015-2023 and in particularly steep rises in nephropathy and cardiovascular disease, highlight the urgent need for policy response and reform of the health care system. We have shown profound inequities in risk of complication rates between regions of close to three-fold, particularly in the differences between the Kurdistan and Southern regions of Iraq, indicative of fundamental inequities to access to quality health care .

Evidence presented above shows that the epidemic of diabetes in Iraq has advanced from a increase in prevalence, to a much more significant complications crisis, that have implications for individual health outcomes, sustainability of a health care system, and economic development as a future state. Direct and immediate contact is required to address the issues related to staffing, infrastructure, availability of technologies for diabetes-related health issues, and disorganisation that contributes to the adverse trends observed.

Specific priorities for action, and future research, should be organized around meaningful and realistic capacity enhancing responses to primary care delivery for diabetes management, equitable distribution of specialist services for people with diabetes, and systematic programs for screening for complications, as well as attention to other social determinants of health that have been identified as contributing to regional inequalities in health. The development of a plan and structure will be paramount given the burdens that have been identified, and the are likely to increased in step. International organisation support for strengthening health systems approaches, and capacity transfer would also be critical given the enormity of the challenges faced.

Iraq has no time to waste to avert a diabetes-related complications epidemic emerging that will overwhelm the capacity of its health care system, impoverish families and derail its national development aspirations. Evidence presented in this article highlights a potentially impactful road plan for implementation that will make a positive difference to improve health outcomes and reduce disparities, however sustained political will, funding and coordinated partnership will be required at all levels of the health care system..

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