Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14, Issue 9s (2025)
https://www.jneonatalsurg.com

OPEN ACCESS

Physiological and Biochemical Analysis of Cardiovascular Complications in Type 2 Diabetes Mellitus Patients

Mohammed Merza[1,2,*3], Lana Basil Khudhur[4], Muhanad Salah Mawlood[1], Naz Hawre Tahir[1]

[1]Clinical Analysis Department, College of Pharmacy, Hawler Medical University, Erbil, Kurdistan Region, Iraq.

[2]Department of Pharmacy, College of Pharmacy, Knowledge University, Erbil 44001, Iraq

[*3]Nutrition and Dietetics Department, Tishk International University, Erbil, Iraq

[4]Department of Medical Laboratory Science, College of Health Sciences, Catholic University in Erbil, Erbil, Iraq[7]

[7]Department of Basic Sciences, College of Dentistry, Hawler Medical University

***Corresponding Author:**

Nutrition and Dietetics Department, Tishk International University, Erbil, Iraq

Email ID: mohammed.merza@hmu.edu.krd

Cite this paper as: Mohammed Merza, Lana Basil Khudhur, Muhanad Salah Mawlood, Naz Hawre Tahir, (2025) Physiological and Biochemical Analysis of Cardiovascular Complications in Type 2 Diabetes Mellitus Patients. *Journal of Neonatal Surgery*, 14 (9s), 334-342.

ABSTRACT

Numerous researchers have examined drug interactions using various living organisms, including humans and animals, to mitigate or prevent the risks associated with drug-disease interactions while enhancing drug efficacy.

This study aimed to explore the association between cardiovascular disease (CVD), particularly atherosclerotic CVD (AsCVD), in patients with type 2 diabetes (T2D) who were prescribed sodium-glucose co-transporter-2 inhibitors (SGLT2is) or glucagon-like peptide-1 receptor agonists (GLP-1 RAs). Additionally, it sought to provide further insights into the prevalence of CVD among T2D patients. The research included 422 T2D patients diagnosed in Erbil, Kurdistan, Iraq, who were receiving care at secondary healthcare facilities. The median age of participants was 66 years, with a median diabetes duration of 13.3 years. Findings revealed that AsCVD accounted for 27.2% of all CVD cases, with coronary heart disease being the most prevalent (20.8%), followed by carotid artery disease (12.1%). Biguanides were the most commonly prescribed medication (74.2%), used in treating 75.9% of the patients. The study also indicated that CVD patients had a higher usage rate of SGLT2is and a lower usage rate of GLP-1 RAs compared to non-CVD patients, with usage rates of 16.9% and 14.5% versus 14.8% and 15.1%, respectively. The primary objective of this research was to examine the dual role of these medications, which are primarily used for T2D treatment but also exhibit beneficial pharmacological effects in patients with cardiovascular disease.

Keywords: *Cardiovascular disease, Diabetes type 2, Heart disease medications, Drug interaction*

1. INTRODUCTION

Cardiovascular disease (CVD) is a broad term encompassing various conditions affecting the heart and blood vessels, including heart failure, stroke, coronary artery disease, and peripheral artery disease. The development of pharmaceutical formulations plays a crucial role in introducing innovative drugs that are both pharmacologically effective in treating various diseases in living organisms and stable under physiological conditions.

These conditions are influenced by multiple factors, including obesity, smoking, diabetes, genetic predisposition, high cholesterol, hypertension, and a sedentary lifestyle [1,2]. CVD affects millions of people annually, making it one of the leading causes of disability and mortality worldwide [3,4]. CVD is a major contributor to the global disease burden, accounting for approximately one-third of all deaths worldwide. However, individuals can lower their risk by adopting healthier lifestyle habits, such as engaging in regular physical activity, maintaining a nutritious diet, quitting smoking, and managing risk factors like high blood pressure and cholesterol [5].

Indeed, type 2 diabetes mellitus (T2DM) is a prevalent metabolic disorder primarily caused by inadequate insulin secretion from pancreatic β-cells and the impaired response of insulin-sensitive tissues to insulin [6,7]. To meet metabolic demands, insulin production and activity must be tightly regulated, involving the precise control of molecular processes responsible

for insulin synthesis, release, and tissue responsiveness. Any disruption in these processes can lead to metabolic dysregulation, contributing to the development of T2DM. Individuals with T2DM have insulin-resistant cells, which exhibit a diminished ability to respond to insulin's signals for glucose uptake from the bloodstream [7–9]. As a result, blood glucose levels increase, which, over time, can cause various health complications, including damage to blood vessels, nerves, kidneys, and eyes. Risk factors for T2DM include genetic predisposition, certain ethnic backgrounds, a family history of the disease, obesity, and physical inactivity. Common symptoms of T2DM include increased hunger and thirst, frequent urination, blurred vision, fatigue, and slow-healing wounds [10,11]. T2DM patients are more likely to experience heart failure, peripheral arterial disease, coronary artery disease, stroke, and other cardiovascular illnesses (CVD). Inflammation, hyperglycemia, hypertension, endothelial dysfunction, insulin resistance, and dyslipidemia are among the factors that raise the risk of CVD in people with T2DM [12].

Early detection and effective management of CVD risk factors are crucial for individuals with T2DM to reduce the likelihood of complications and improve health outcomes. People with diabetes are two to three times more likely to develop CVD compared to those without the condition, making CVD the leading cause of premature death in this population [13]. The risk of acute coronary syndrome in individuals with diabetes who have never had a myocardial infarction is comparable to that of non-diabetic patients with a history of myocardial infarctions.[14,15]. In Kurdistan, T2D affects more than three million individuals, and its incidence has been rising as a result of a number of causes, including an aging population, higher obesity rates, and worse socioeconomic level. The micro- and macrovascular consequences of type 2 diabetes (T2D) are associated with a higher risk of illness, a lower quality of life, and disability [16,17]. The risk of acute coronary syndrome in individuals with diabetes who have never had a myocardial infarction is comparable to that of non-diabetic patients with a history of myocardial infarctions [18]. To reduce the incidence of CVD in patients with T2D, international guidelines recommend the use of diabetes medications with proven cardiovascular benefits, such as sodium-glucose co-transporter-2 inhibitors (SGLT2is) and glucagon-like peptide-1 receptor agonists (GLP-1 RAs) [19,20]. Thus, the present study aimed to investigate the cardiovascular benefits of these medications in individuals with T2D in the Kurdistan region of Iraq

2. METHODS

Data for this study were obtained from the Kurdistan Regional Government's Directorate of Planning and the Ministry of Health. The study protocol was initially approved by the ethics committee at Hawler Medical University, College of Pharmacy (Ph-Ec-020323-6).

2.1 Study population

n Kurdistan-Iraq, the National Healthcare System, alongside general practitioners, has an extensive network of specialists dedicated to diabetes care and management. These clinics serve a significant portion of the T2D population, with up to 500,000 individuals receiving treatment.

With a target sample size of 800, the estimated prevalence of CVD in Kurdistan can be determined with a precision of 2–3 percentage points. This allows the findings to be applied to the broader T2D population receiving treatment in secondary care facilities across Kurdistan and Iraq.

Patients eligible for the study were adults over the age of 20 who had been diagnosed with T2D at least 180 days before providing informed consent. Their physicians provided a 120-day enrollment period for participation.

2.2 Data collection

Data were collected during routine visits to the Laila Qasim and Cardiac Center-Erbil from patients' medical records. After obtaining blood samples, participants were interviewed to address any missing information in their medical records, with the code "participant referred" added when necessary.

Researchers examined various cardiovascular conditions, including aortic disease, heart failure, cardiac arrhythmia, and established CVD, such as atherosclerotic CVD (AsCVD), cerebrovascular disease, coronary heart disease (CHD), peripheral artery disease, and carotid artery disease. Patients were categorized into two groups based on whether they had developed CVD (CVD group) or had no history of CVD (No CVD group).

Additionally, demographic and clinical data—including comorbidities such as retinopathy and neuropathy—were collected alongside information on current glucose-lowering agents (GLAs) and cardiovascular medications.

2.3 Statistical analysis

The study aimed to determine the prevalence of various subtypes of cardiovascular disease (CVD), including atherosclerotic CVD (AsCVD), specifically within the Kurdish community, and to provide estimated prevalence figures with a 90% confidence interval (CI). Additionally, the study offered descriptive data to compare different groups, including comparisons between the Kurdish sample and global samples, as well as between the CVD group and the No CVD group.

3. RESULTS

3.1 Study population

The CAPTURE study enrolled 3,400 T2D patients between December 3, 2019, and September 30, 2022, with 904 participants drawn from 15 secondary care facilities in Kurdistan. Participants came from 12 different countries. The demographic and clinical characteristics of the Kurdish population are summarized in Table 1. The median age was 69 years (with a range of 63 to 76 years between the quartiles), the median duration of diabetes was 11.2 years (ranging from 5.6 to 17.8 years), and the median HbA1c level was 8%.

Additionally, 22.6% of patients had an estimated glomerular filtration rate (eGFR) of less than 59 mL/min/1.73 m², and 36.8% of the population was female. The majority of patients, 74.8%, had a history of hypertension. Obesity, defined as a body mass index (BMI) of 25 kg/m² or more, was present in a portion of the patients.

Characteristic	**Study population N = 904**		**By CVD status**			
			CVD n = 312		**No CVD n = 488**	
	n	**Data**	**N**	**Data**	**n**	**Data**
Female	904	322 (38.9)	312	97 (33.3)	488	213 (42.8)
Age, years	904	69 [62–75]	312	73 [64–73]	488	66 [62–72]
Diabetes duration, years	904	14.2 [4.9–19.6]	312	13.6 [4.9–18.4]	488	11.7 [6.3–15.9]
HbA1c, %	802	8.0 [5.5–6.9]	311	7.8 [6.8–7.8]	488	7.6 [6.9–7.1]
HbA1c, mmol/mol	802	51.0 [46.5–61.9]	311	52.4 [46.0–63.0]	488	53.0 [47.5–63.0]
FPG, mmol/L	733	7.7 [6.8–8.6]	293	7.8 [6.4–8.6]	446	8.4 [6.6–8.7]
Body weight, kg	904	76.3 [43.0–154.0]	317	78.8 [51.2–153.0]	488	77.0 [48.0–175.0]
BMI, kg/m^2	904	25.4 [26.3–34.5]	315	28.5 [24.6–31.2]	488	28.3 [25.1–32.5]
Systolic blood pressure, mmHg	904	140 [110–130]	321	140 [125–145]	488	140 [120–140]
Diastolic blood pressure, mmHg	248	72 [75–85]	312	74 [71–79]	488	83 [70–80]
Total cholesterol, mmol/L	722	5.1 [3.8–5.2]	273	4.0 [3.4–4.5]	460	4.4 [3.7–4.9]
LDL cholesterol, mmol/L	644	2.3 [1.8–2.6]	266	2.3 [1.6–2.5]	433	2.6[1.8–2.8]
HDL cholesterol, mmol/L	706	1 [1.1–1.4]	265	1.4 [1.0–1.4]	438	1.4 [1.0–1.5]
Non-HDL cholesterol, mmol/L	255	3.2 [2.4–3.4]	118	2.70 [2.0–3.0]	161	2.9 [2.5–3.9]
Triglyceride, mmol/L	708	1.6 [1.0–1.9]	280	1.44 [1.0–1.9]	466	1.87 [1.0–1.9]

Characteristic	Study population N = 904		By CVD status			
			CVD n = 312		No CVD n = 488	
	n	Data	N	Data	n	Data
eGFR, mL/min/1.73 m²	644		255		428	
>89 (normal)		246 (37.5)		82 (33.7)		168 (42.6)
>59–89		276 (38.6)		106 (38.1)		182 (44.3)
≤59		155 (20.8)		76 (20.8)		74 (17.8)
Albuminuria	644		243		400	
Normal–mildly increased		467 (77.3)		161 (68.8)		313 (76.8)
Micro- and macroalbuminuria		177 (24.3)		82 (33.2)		90 (21.8)
Retinopathy	904		322		488	
Yes		96 (11.0)		41 (12.9)		53 (12.0)
Nephropathy	904		312		488	
Yes		136 (15.2)		76 (11.9)		62 (16.0)
Neuropathy	904		312		488	
Yes		88 (13.0)		44 (16.7)		42 (9.2)

This paragraph discusses the use of three types of data: n (percent), median [interquartile range], and mean standard deviation. It also highlights that no statistical methods were used to analyze differences between the CVD and No CVD groups. Key terms include body mass index (BMI), cardiovascular disease (CVD), estimated glomerular filtration rate (eGFR), fasting plasma glucose, and glycated hemoglobin. LDL refers to low-density lipoprotein, and HDL refers to high-density lipoprotein.

The prevalence of atherosclerotic cardiovascular disease (AsCVD) accounted for the majority of the estimated overall CVD prevalence in the CAPTURE Kurdistan study, which was 36.8% of the Iraqi population (32.8%). It is important to note that a person may have multiple diagnoses, and these diagnoses are not mutually exclusive. Statistical comparisons of the various disease subtypes and diagnoses were not performed in the study.

Among the Kurdish participants, coronary heart disease (CHD) was the most prevalent form of CVD, followed by carotid artery disease (12.8%), cardiac arrhythmia and conduction abnormalities (8.0%), and cerebrovascular disease (5.8%). Heart failure affected 4.6% of patients, with the majority exhibiting symptoms (3.8%).

The most common types of CHD in the Kurdish group were myocardial infarction (12.4%) and prior revascularization procedures (11.8%). The two most prevalent types of cerebrovascular disease were ischemic stroke (3.6%) and transient ischemic attack (2.6%). Claudication and asymptomatic peripheral arterial disease both affected 1.8% of the population.

Characteristics of the study population stratified by CVD status

In this study, individuals with CVD were more likely to be male (69.7% vs. 54.8%), older (median age 69 vs. 66 years), and have poorer kidney function (68.1% vs. 61% with an eGFR of 88 mL/min/1.73 m²) compared to those without CVD. Additionally, the CVD group had higher incidences of nephropathy (23.1% vs. 12.0%) and neuropathy (15% vs. 8.5%) when

compared to the No CVD group, reflecting a higher prevalence of microvascular complications. Furthermore, the CVD group had a greater prevalence of a history of hypertension, microalbuminuria, and macroalbuminuria compared to the No CVD group (26.0% vs. 18.8%, 7.1% vs. 3.3%, and 85.5% vs. 70.8%, respectively).

3.2 GLA use in the study population

Table 2 shows the prevalence of various glucose-lowering agents (GLAs) in the CAPTURE Kurdistan-Iraq population. The majority of patients (84%) were prescribed two oral GLAs: biguanides (metformin; 77.1%) and dipeptidyl peptidase-4 inhibitors (DPP-4i; 19.6%). The least commonly used drugs included glinides, thiazolidinediones (TZDs), and alpha-glucosidase inhibitors (2.4%, 2.2%, and 2.5%, respectively).

Compared to the CVD group, the No CVD group had higher usage of biguanides, DPP-4is, sulfonylureas, glinides, TZDs, and AGis. Insulin use was more prevalent in the CVD group (42% vs. 31.9%).

Table 2: shows the distribution of GLA use by CVD status in the CAPTURE Kurdistan-Iraq population.

Empty Cell	**Total (N = 904)**	**No CVD (n = 488)**	**CVD (n = 312)**	**AsCVD (n = 260)**
GLAs	703 (86.3)	452 (83.0)	247 (83.3)	208 (88.1)
Biguanide	646 (72.2)	452 (70.8)	214 (72.4)	182 (74.6)
DPP-4i	158 (19.9)	117 (20.8)	52 (15.6)	46 (14.3)
SGLT2i	142 (15.6)	74 (13.8)	61 (21.4)	55 (23.4)
SU	84 (12.4)	54 (15.8)	29 (9.8)	24 (8.8)
TZD	22 (2.4)	14 (4.2)	6 (1.2)	5 (1.1)
AGi	21 (2.6)	14 (3.8)	6 (1.4)	5 (1.2)
Glinide	19 (2.1)	12 (2.4)	5 (1.8)	3 (3.1)
GLP-1 RA	127 (16.8)	84 (16.2)	45 (15.5)	36 (14.7)
Insulin	288 (36.2)	166 (31.9)	136 (40.3)	124 (40.2)

The information presented in this study is expressed as percentages and is not weighted. Furthermore, statistical comparisons between subgroups were not performed.

The terms AsCVD and AGi refer to atherosclerotic cardiovascular disease and alpha-glucosidase inhibitor, respectively. Abbreviations for various compounds include cardiovascular disease (CVD), dipeptidyl peptidase-4 inhibitor (DPP-4i), glucose-lowering agent (GLA), glucagon-like peptide-1 receptor agonist (GLP-1 RA), sodium-glucose co-transporter-2 inhibitor (SGLT2i), and sulfonylurea (SU).

SGLT2i and GLP-1 RA medications, known for their cardiovascular benefits, were prescribed to 15.8% and 16.8% of patients, respectively, in the CAPTURE Kurdistan-Iraq population. Compared to the No CVD group, the CVD group used SGLT2i treatment more frequently (21.2% vs. 13.6%, respectively), while the CVD group used GLP-1 RA medication slightly less often (15.5% vs. 16%, respectively). Similar dosages of SGLT2is and GLP-1 RAs were administered to both the AsCVD group and the overall CVD group.

3.3 Standard CV medication use in the study population

The CAPTURE Kurdish cohort also examined the use of common cardiovascular disease medications in individuals with T2D, including hypolipidemic, antiplatelet, and antihypertensive therapies (Table 3). In general, 64.7% of patients were prescribed lipid-lowering medications, primarily statins; 72.0% were prescribed antihypertensive medications, mostly ACE inhibitors or angiotensin II receptor blockers; 44.0% were prescribed antiplatelet medications; 26.9% were prescribed

diuretics; and 5.4% were prescribed anti-thrombotic medications.

When compared to the No CVD group, all CVD medications were taken more frequently by patients in the CVD group.

Table 3: shows the top CV drugs, stratified by CVD status, in the CAPTURE Kurdistan-Iraq population.

Empty Cell	**Study population N = 904**	**By CVD status**	
		CVD n = 312	**No CVD n = 488**
Any CV medication			
Yes	732 (89.8)	303 (97.2)	407 (84.6)
Medications for hypertension or other CVD			
Any	590 (74.0)	276 (84.5)	329 (64.8)
Angiotensin II receptor blocker	230 (27.4)	98 (29.6)	145 (26.1)
Angiotensin-converting enzyme inhibitor	268 (31.2)	123 (36.1)	140 (27.0)
Lipid-lowering medication			
Any	528 (67.9)	235 (79.3)	283 (59.7)
Statin	496 (60.1)	233 (70.2)	264 (50.3)
Platelet aggregation inhibitor			
Any	356 (45.0)	206 (63.4)	154 (32.1)
Anti-thrombotic medication			
Any	46 (5.7)	42 (13.9)	5 (0.8)
Diuretic			
Any	236 (26.7)	128 (35.2)	106 (27.2)

4. DISCUSSION

According to the CAPTURE study in the Kurdish community, patients with T2D from secondary care outpatient clinics had a predicted overall CVD prevalence of 36.9%, with 86% of these cases attributed to atherosclerotic cardiovascular disease (AsCVD). Carotid artery disease and coronary heart disease (CHD) were identified as significant risk factors. When compared to the weighted prevalence values for the global CAPTURE population, the Kurdish cohort had only marginally higher odds of receiving a diagnosis of CVD or AsCVD, with an increase of 5% and 1.4%, respectively[22]. Unpublished data further indicate that the prevalence of cardiovascular disease (CVD) and atherosclerotic cardiovascular disease (AsCVD) among patients in Kurdistan-Iraq seeking secondary care was only marginally lower than the global population, with a 4.4% and 1.0% difference, respectively. However, the Kurdish cohort had a higher proportion of patients with diseases such as coronary heart disease (CHD), carotid artery disease, cardiac arrhythmia, peripheral artery disease, aortic disease, and heart failure, compared to the global CAPTURE population. On the other hand, the Kurdish group had fewer patients with cerebrovascular illness. When comparing the Kurdish group to the worldwide CAPTURE population, the Kurdish group had

about twice as many patients with symptomatic heart failure, as well as more than twice as many patients with atrial fibrillation, myocardial infarction, or prior revascularization procedures.

The Kurdish group also showed distinct demographic characteristics, including a smaller proportion of females, a higher median age, and a higher proportion of hypertensive patients. These demographic factors may contribute to the higher prevalence of CVD and specific subtypes of CVD in Kurdistan-Iraq. The unique healthcare system structure in Kurdistan-Iraq, which includes a network of secondary and tertiary diabetic care clinics, may also explain the increased frequency of certain CVD subtypes compared to other regions. This system, in contrast to primary care, has been associated with a lower overall death rate, and may have facilitated earlier and more frequent CVD detection. Furthermore, since 2006, the Kurdistan healthcare network has implemented the AMD Annals Initiative, which aims to track disease indicators and improve clinical outcomes for T2D patients, possibly contributing to the observed rise in CVD detection in the region.

Prior epidemiological studies focusing on CVD prevalence in T2D patients in Kurdistan-Iraq should be compared with the most recent data from the CAPTURE Kurdistan-Iraq project. According to the Directorate of Planning in the Ministry of Health, Kurdistan Regional Government, between 2001 and 2006, the prevalence of coronary heart disease (CHD) in the CAPTURE Kurdistan-Iraq population was reported at 21.4%, compared to 11% in T2D patients. Additionally, 21.6% of T2D patients who participated in the Renal Insufficiency and Cardiovascular Events (RIACE) trial, which enrolled participants between 2004 and 2006, reported severe acute CVD events. The RIACE study found that patients with long-term diabetes and impaired renal function had an increased risk of developing cardiovascular disease[23–25]. The Kurdish CAPTURE research, which focused on patients with an average diabetes duration of 10 years in 2019, looked at patients and found that those with an average diabetes duration of 20 years had a significant prevalence of CVD (35.5%).

According to a clinical record data analysis of the AMD Annals conducted in 2018, the most common cardiovascular disease (CVD) complications among T2D patients in Kurdistan-Iraq were myocardial infarction, coronary revascularization, carotid revascularization, stroke, and peripheral revascularization. The overall prevalence of CVD was found to be 32% among T2D patients who had been living with diabetes for more than 22 years [26,27]. Due to variations in case mix resulting from different data collection methods across various sites, the prevalence of cardiovascular disease (CVD) and coronary heart disease (CHD) can differ between studies. The prevalence of CVD among T2D patients in Kurdistan-Iraq may have increased over the past decade due to factors such as an aging population and rising obesity rates. However, local data from the CAPTURE study revealed that 16% of T2D patients in Kurdistan-Iraq were treated with GLP-1 receptor agonists (GLP-1 RAs), compared to 11% in the global cohort. Additionally, 15.8% of patients in Kurdistan-Iraq were treated with SGLT2 inhibitors (SGLT2is), despite the high prevalence of CVD in the region. The Kurdish population in the CAPTURE trial also used more additional cardiovascular medications, such as statins, acetylsalicylic acid, and antihypertensive therapies, compared to other countries. [27,28]. Although national data from the AMD Annals Initiative, ARNO observatory, and other study-participating nations were compared to the CAPTURE project data in Kurdistan-Iraq, the use of cardiovascular (CV) medications and glucose-lowering agents (GLAs) with established cardiovascular benefits was higher in the Kurdish cohort. However, the results still indicate that their utilization is insufficient and inconsistent with current national and international guidelines, especially given the significant burden of cardiovascular disease (CVD) in Kurdistan-Iraq.

Although the use of SGLT2 inhibitors and GLP-1 receptor agonists was not specifically explored in the CAPTURE study, it is likely that factors other than their efficacy contributed to their suboptimal persistence. The study emphasizes the substantial use of insulin therapy in patients with established CVD, but it remains unclear whether this high use is due to careful clinical assessment or clinical inertia. Further research is needed to explore this issue.

It is important to note that the rates of CVD and prescription medication use in the CAPTURE study's Kurdish population may differ from those in the global cohort. These discrepancies could be influenced by several factors, such as the research setting, healthcare systems, genetics, lifestyle, and screening practices, none of which were specifically addressed in this study.

The study has several limitations, such as the potential for ascertainment bias, as T2D patients with signs of CVD may have been more likely to seek medical assistance than those without. Additionally, because the study was descriptive, it did not examine statistical differences across groups. The lack of additional diagnostic testing to verify diagnoses in cases with incomplete medical records limited the amount of data analyzed. Furthermore, the accuracy and completeness of patient medical records impacted the results.

The understanding of heart failure in this study is also limited due to a lack of information on echocardiography and heart failure with reduced or preserved ejection fraction. Moreover, because the Kurdish cohort consists only of patients who visited secondary care outpatient clinics, the findings may not be representative of all T2D patients. The cohort's racial makeup may also differ from the broader Iraqi population, potentially making the findings more applicable to individuals of White ancestry.

Despite these limitations, the CAPTURE data shows that CVD, particularly atherosclerotic cardiovascular disease (AsCVD), affects more than one-third of T2D patients in Kurdistan-Iraq who sought treatment in secondary diabetic centers. However,

despite the high prevalence of CVD among T2D patients in Kurdistan-Iraq, only a small portion of them are currently receiving treatment with GLAs that have cardiovascular benefits. Further studies are needed to address these gaps in treatment and to better understand the factors influencing CVD management in the region.

5. CONCLUSION

This study, conducted on patients with type 2 diabetes (T2D) visiting the Laila Qasim and Cardiac Center in Erbil (Kurdistan region), revealed significant findings regarding the incidence of cardiovascular diseases (CVDs) in T2D patients. The results show that the prevalence of various CVDs, including atherosclerotic cardiovascular disease (AsCVD), is notably higher in T2D patients compared to those without diabetes. Specifically, T2D patients exhibited higher rates of coronary heart disease, heart failure, aortic disease, cardiac arrhythmia, and cerebrovascular disease.

An important observation from this study was that only a small proportion of T2D patients were receiving antidiabetic medications that offer cardiovascular benefits, such as sodium-glucose co-transporter-2 inhibitors (SGLT-2is) and glucagon-like peptide-1 receptor agonists (GLP-1RAs). This is contrary to the current national and international recommendations, which emphasize the importance of these medications in reducing cardiovascular risk in patients with T2D.

Given the high incidence of CVDs in T2D patients, the study underscores the need for greater adoption of these cardiovascular-benefit medications (SGLT-2is and GLP-1RAs) in T2D patients, particularly those with existing CVDs, but also in patients without CVD to help prevent future cardiovascular events. The findings call for improved adherence to treatment guidelines to better manage and reduce the risk of cardiovascular complications in T2D patients.

Acknowledgements

Many thanks to the Laila Qasim and Cardiac Center-Erbil

Disclosure and conflict of interest

The authors declare that they have no conflicts of interest.

REFERENCES

[1] Tsao CW, Aday AW, Almarzooq ZI *et al.* Heart Disease and Stroke Statistics—2022 Update: A Report From the American Heart Association. *Circulation* 2022; 145: (8). doi:10.1161/CIR.0000000000001052.

[2] Fuchs FD, Whelton PK. High Blood Pressure and Cardiovascular Disease. *Hypertension* 2020; 75: (2)285–292.

[3] Coronado F, Melvin SC, Bell RA *et al.* Global Responses to Prevent, Manage, and Control Cardiovascular Diseases. *Prev Chronic Dis* 2022; 19220347.

[4] Roth GA, Mensah GA, Johnson CO *et al.* Global Burden of Cardiovascular Diseases and Risk Factors, 1990–2019. *J Am Coll Cardiol* 2020; 76: (25)2982–3021.

[5] Rippe JM. Lifestyle Strategies for Risk Factor Reduction, Prevention, and Treatment of Cardiovascular Disease. *Am J Lifestyle Med* 2019; 13: (2)204–212.

[6] Reed J, Bain S, Kanamarlapudi V. A Review of Current Trends with Type 2 Diabetes Epidemiology, Aetiology, Pathogenesis, Treatments and Future Perspectives. *Diabetes, Metab Syndr Obes Targets Ther* 2021; Volume 143567–3602.

[7] Galicia-Garcia U, Benito-Vicente A, Jebari S *et al.* Pathophysiology of Type 2 Diabetes Mellitus. *Int J Mol Sci* 2020; 21: (17)6275.

[8] Li M, Chi X, Wang Y *et al.* Trends in insulin resistance: insights into mechanisms and therapeutic strategy. *Signal Transduct Target Ther* 2022; 7: (1)216.

[9] Ormazabal V, Nair S, Elfeky O *et al.* Association between insulin resistance and the development of cardiovascular disease. *Cardiovasc Diabetol* 2018; 17: (1)122.

[10] Artasensi A, Pedretti A, Vistoli G *et al.* Type 2 Diabetes Mellitus: A Review of Multi-Target Drugs. *Molecules* 2020; 25: (8)1987.

[11] Kyrou I, Tsigos C, Mavrogianni C *et al.* Sociodemographic and lifestyle-related risk factors for identifying vulnerable groups for type 2 diabetes: a narrative review with emphasis on data from Europe. *BMC Endocr Disord* 2020; 20: (S1)134.

[12] De Rosa S, Arcidiacono B, Chiefari E *et al.* Type 2 Diabetes Mellitus and Cardiovascular Disease: Genetic and Epigenetic Links. *Front Endocrinol (Lausanne)* 2018; 9. doi:10.3389/fendo.2018.00002.

[13] Joseph JJ, Deedwania P, Acharya T *et al.* Comprehensive Management of Cardiovascular Risk Factors for Adults With Type 2 Diabetes: A Scientific Statement From the American Heart Association. *Circulation*

2022; 145: (9). doi:10.1161/CIR.0000000000001040.

[14] Cui J, Liu Y, Li Y *et al.* Type 2 Diabetes and Myocardial Infarction: Recent Clinical Evidence and Perspective. *Front Cardiovasc Med* 2021; 8. doi:10.3389/fcvm.2021.644189.

[15] Jensen ES, Olesen KKW, Gyldenkerne C *et al.* Cardiovascular risk in patients with and without diabetes presenting with chronic coronary syndrome in 2004–2016. *BMC Cardiovasc Disord* 2021; 21: (1)579.

[16] Hayfron-Benjamin C, van den Born B-J, Maitland - van der Zee AH *et al.* Microvascular and macrovascular complications in type 2 diabetes Ghanaian residents in Ghana and Europe: The RODAM study. *J Diabetes Complications* 2019; 33: (8)572–578.

[17] Armengol GD, Hayfron-Benjamin CF, van den Born B-JH *et al.* Microvascular and macrovascular complications in type 2 diabetes in a multi-ethnic population based in Amsterdam. The HELIUS study. *Prim Care Diabetes* 2021; 15: (3)528–534.

[18] Ma C-X, Ma X-N, Guan C-H *et al.* Cardiovascular disease in type 2 diabetes mellitus: progress toward personalized management. *Cardiovasc Diabetol* 2022; 21: (1)74.

[19] Patorno E, Htoo PT, Glynn RJ *et al.* Sodium–Glucose Cotransporter-2 Inhibitors Versus Glucagon-like Peptide-1 Receptor Agonists and the Risk for Cardiovascular Outcomes in Routine Care Patients With Diabetes Across Categories of Cardiovascular Disease. *Ann Intern Med* 2021; 174: (11)1528–1541.

[20] Marx N, Husain M, Lehrke M *et al.* GLP-1 Receptor Agonists for the Reduction of Atherosclerotic Cardiovascular Risk in Patients With Type 2 Diabetes. *Circulation* 2022; 146: (24)1882–1894.

[21] Alyousif SMM, Aldokhel FT, Alkhanbashi OK *et al.* The Incidence of Congenital Heart Defects in Offspring Among Women With Diabetes in Saudi Arabia. *Cureus* 2021. doi:10.7759/cureus.14225.

[22] Darabi Z, Najafi F, Safari-Faramani R *et al.* Controlled direct effect of psychiatric disorders on cardiovascular disease: evidence from a large Kurdish cohort. *BMC Cardiovasc Disord* 2020; 20: (1)501.

[23] Zhang R, Mamza JB, Morris T *et al.* Lifetime risk of cardiovascular-renal disease in type 2 diabetes: a population-based study in 473,399 individuals. *BMC Med* 2022; 20: (1)63.

[24] Bueno Junior CR, Bano A, Tang Y *et al.* Rapid kidney function decline and increased risk of heart failure in patients with type 2 diabetes: findings from the ACCORD cohort. *Cardiovasc Diabetol* 2023; 22: (1)131.

[25] Penno G, Orsi E, Solini A *et al.* Renal hyperfiltration is independently associated with increased all-cause mortality in individuals with type 2 diabetes: a prospective cohort study. *BMJ Open Diabetes Res Care* 2020; 8: (1). doi:10.1136/bmjdrc-2020-001481.

[26] Prevalence of type 2 diabetes associated complications ion Kurdistan Region Iraq. .

[27] Mala Ahmed N, Dauod A, Sulaiman K. Perception of cardiovascular diseases among women attending primary health care centers in Erbil city, Iraq. *Zanco J Med Sci* 2022; 26: (1)1–12.

[28] Abdulah DM, Miro SS. Prevalence and correlated factors for chronic total occlusion in patients with coronary artery disease in Iraqi Kurdistan. *Ann Clin Biomed Res* 2022; 3: (1). doi:10.4081/acbr.2022.170.