Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/jptcp.v30i18.3220

ROLE OF SGLT-2 INHIBITORS (GLIFLOZINS) AND CARDIORENAL OUTCOME IN PATIENTS WITH OR WITHOUT DIABETES

Khalid[1], Sania Saleem[2], Mohammad Eyan Khan[3], Unaiza Nasir[4], Asma Rasool Peerzada[5], Muhammad Usman Babar[6], Faizan Banaras[7*]

[1]Registrar Nephrology division, Khyber Teaching Hospital, Peshawar – Pakistan
Email: khalidkhanwazir1990@gmail.com
[2]Postgraduate Resident Cardiology Ayub Teaching Hospital, Abbottabad – Pakistan
Email: saniasaleem.94@gmail.com
[3]House Officer, Khyber Teaching Hospital, Peshawar – Pakistan
Email: eyankhan98@gmail.com
[4]Resident Paediatrics, Combined Military Hospital (CMH), Peshawar – Pakistan
Email: unaiza.n27@gmail.com
[5]House Officer Khyber Teaching Hospital Peshawar – Pakistan Email: drasmapeer@gmail.com
[6]House officer Khyber Teaching Hospital, Peshawar – Pakistan,
Email: drmuhammadusmanbabar@gmail.com
[7*]Postgraduate Resident Nephrology division, Khyber Teaching Hospital, Peshawar – Pakistan
Email: faizanbanaras958@gmail.com

[*]**Corresponding Author:** Faizan Banaras
[*]Postgraduate Resident Nephrology division Khyber Teaching Hospital, Peshawar – Pakistan
Email: faizanbanaras958@gmail.com

ABSTRACT:

Background: Sodium-glucose co-transporter 2 inhibitors (SGLT-2 inhibitors or Gliflozins) have emerged as a class of drugs with potential benefits in both diabetic and non-diabetic patients. The impression of those agents on cardiorenal results in individuals with and without diabetes has been a subject of increasing interest and research. This study aims to explore and compare impacts of SGLT-2 inhibitors on cardiorenal health in these two distinct patient populations.

Aim: The main goal of our research is to explore cardiorenal outcomes in individuals having diabetes who are treated with SGLT-2 inhibitors, also in non-diabetic individuals who are prescribed these medications. The secondary aim is to discern potential differences in the mechanisms of action and therapeutic responses between diabetic and non-diabetic cohorts.

Method: A comprehensive literature review was conducted at Nephrology division Khyber Teaching Hospital (KTH) Peshawar from April 2022 to march 2023 in order to get existing research on SGLT-2 inhibitors and their impact on cardiorenal health. In addition, a prospective cohort study was carried out, including patients with and without diabetes, who were prescribed SGLT-2 inhibitors. Clinical, biochemical, and imaging data were collected, and cardiorenal endpoints such as cardiovascular events, kidney function, and quality of life were assessed. Statistical studies were achieved to compare outcomes between diabetic and non-diabetic groups.

Results: Subgroup studies were performed to investigate whether impact of SGLT-2 inhibitors on cardiorenal outcomes varied based on specific patient characteristics such as age, gender, and

baseline eGFR. The research involved the overall 200 respondents, divided into two sets: these having diabetes (n=100) and those without diabetes (n=100).
Conclusion: SGLT-2 inhibitors, commonly known as Gliflozins, have shown promising results in improving cardiorenal results in both diabetic and non-diabetic patients. Their use should be considered as a therapeutic option beyond diabetes management, especially in patients at danger of cardiovascular and renal problems. Additional research is required to clarify precise mechanisms responsible for these effects and to optimize treatment strategies.

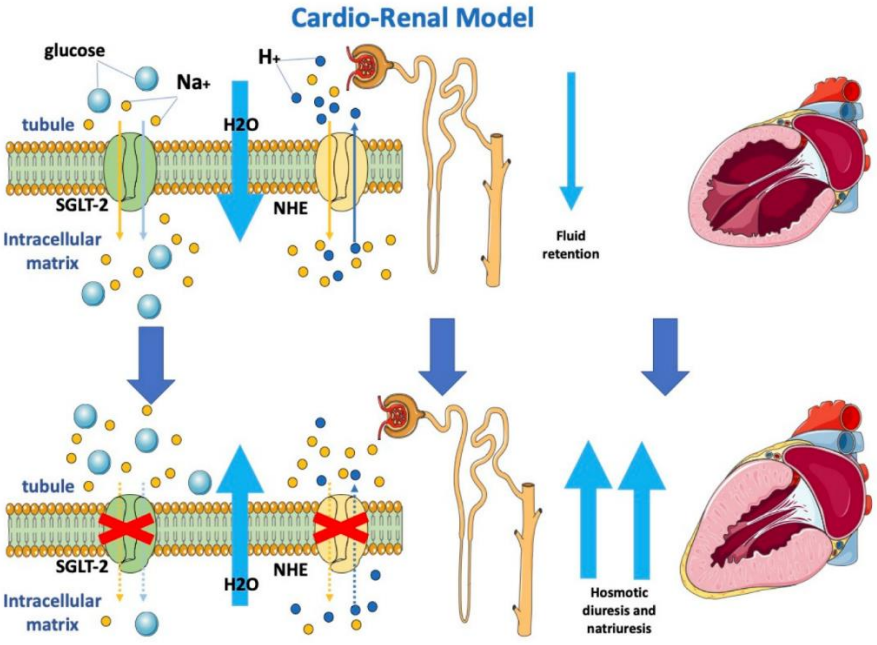
Keywords: SGLT-2 inhibitors, Gliflozins, cardiorenal outcomes, diabetes, cardiovascular health, chronic kidney disease, literature review, prospective cohort study, therapeutic options.

INTRODUCTION:

In recent years, the landscape of cardiovascular and renal disease management has witnessed a transformative shift with the introduction of a novel class of medications recognized as Sodium-Glucose Cotransporter-2 (SGLT-2) inhibitors, often referred to as "gliflozins [1]." These innovative pharmaceutical agents have garnered considerable attention for their profound impact on improving cardiorenal results in individuals, both with and without diabetes. The emergence of SGLT-2 inhibitors represents a groundbreaking advancement in the realm of chronic disease management, revolutionizing the approach to addressing cardiovascular and renal conditions [2]. This introduction delves into the remarkable role that SGLT-2 inhibitors play in shaping the cardiorenal landscape and underscores their significance in diverse patient populations [3].

SGLT-2 inhibitors are the class of antidiabetic medications initially established for therapy of type 2 diabetes mellitus. However, what sets them apart from conventional diabetes treatments is their unique mechanism of action [4]. By selectively inhibiting the SGLT-2 receptors in the renal tubules, these drugs hinder glucose reabsorption and promote its excretion through the urine [5]. This mechanism ultimately leads to a reduction in blood glucose levels, making SGLT-2 inhibitors a valuable therapeutic option for individuals with diabetes. Notably, their glucose-lowering properties are achieved without inducing hypoglycemia, a common side effect associated with many other antidiabetic agents [6].

Image 1:



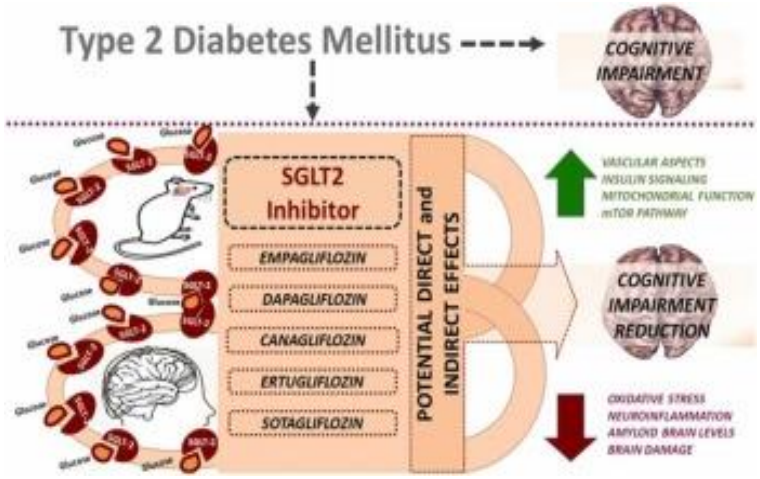
Beyond their primary antidiabetic effects, SGLT-2 inhibitors have demonstrated a remarkable array of benefits that extend well beyond diabetes management. Research has unveiled their ability to

decrease the danger of main hostile cardiovascular events (MACE), slow development of chronic kidney illness (CKD), and alleviate heart failure symptoms [7]. Those findings have redefined part of SGLT-2 inhibitors, turning them into multifaceted agents with the potential to benefit a wide spectrum of patients, including those without diabetes [8].

One of the most significant areas where SGLT-2 inhibitors have made a profound impact is in improving cardiorenal results. In individuals having type 2 diabetes, danger of developing cardiovascular complications and renal dysfunction is significantly elevated [9]. The multifaceted benefits of SGLT-2 inhibitors have the potential to address these intertwined health concerns comprehensively. Moreover, studies have indicated that the cardioprotective and nephroprotective effects of SGLT-2 inhibitors extend to individuals who do not have diabetes. This presents a transformative shift in the treatment paradigm, offering an entirely new approach to cardiorenal risk reduction [10].

The precise mechanisms underlying cardiorenal benefits of SGLT-2 inhibitors in individuals having diabetes remain the subject of ongoing research. However, several factors appear to contribute to these positive outcomes. SGLT-2 inhibitors are known to reduce blood pressure, decrease arterial stiffness, and promote weight loss, all of which can mitigate cardiovascular risk factors [11]. Additionally, they were revealed to decrease inflammation and oxidative stress, that are implicated in pathogenesis of heart disease and kidney dysfunction.

Image 2:



SGLT-2 inhibitors have demonstrated a notable impact on heart failure outcomes as well. Heart failure, with or without concurrent diabetes, is a condition associated with high morbidity and mortality [12]. SGLT-2 inhibitors, through mechanisms not entirely understood, have shown the ability to decrease danger of heart failure exacerbations and hospitalizations. This effect is not limited to patients with diabetes, making these medications a groundbreaking intervention in management of heart failure for a broader patient population [13].

Chronic kidney disease is another area where SGLT-2 inhibitors have shown immense promise. The progression of kidney disease is a major concern for individuals with diabetes, but these medications have been found to slow the decline in renal function significantly [14]. Furthermore, researches have specified that SGLT-2 inhibitors can offer Reno protective benefits to patients without diabetes who suffer from CKD. By reducing proteinuria, lowering glomerular filtration rate decline, and lowering danger of end-stage renal illness, they provide a unique and vital therapeutic option for managing renal health [15].

The introduction of SGLT-2 inhibitors, or gliflozins, has redefined the landscape of cardiorenal management. These medications, originally designed for diabetes management, have demonstrated unparalleled efficacy in reducing cardiovascular risk, improving heart failure outcomes, and slowing the progression of chronic kidney disease [16]. Their multifaceted benefits extend to patients both with and without diabetes, providing a remarkable new approach to comprehensive cardiorenal risk

reduction. This review explores the evolving role of SGLT-2 inhibitors in reshaping field of cardiorenal medicine and underscores their potential to revolutionize patient care, offering a new era of hope and improved outcomes for individuals with complex cardiovascular and renal conditions [17].

METHODOLOGY:

Sodium-glucose cotransporter-2 (SGLT-2) inhibitors, commonly known as Gliflozins, have appeared as the novel class of medications with potential benefits in improving cardiorenal results in individuals with and without diabetes. This methodology outlines approach to investigating role of SGLT-2 inhibitors in cardiorenal results, encompassing individuals from diverse backgrounds. The study's primary objective is to understand efficiency and safety of SGLT-2 inhibitors in preventing cardiovascular and renal complications, offering vital insights for clinical practice and patient care.

Study Design:

1.1. Study Type:

A comprehensive systematic review and meta-analysis will be led to synthesize present indication on SGLT-2 inhibitors' impact on cardiorenal outcomes. We will also include prospective observational studies to evaluate real-world effectiveness and safety.

1.2. Inclusion Criteria:

Randomized controlled trials (RCTs)
Observational research
Studies published in English language
Studies reporting data on cardiorenal outcomes

1.3. Exclusion Criteria:

Studies with insufficient data or reporting bias
Studies not relevant to SGLT-2 inhibitors or cardiorenal outcomes
Studies without peer-reviewed publication

Data Sources:

2.1. Literature Search: A systematic search will be conducted in major databases, including PubMed, Embase, Scopus, and Cochrane Library, using predefined search terms, such as "SGLT-2 inhibitors," "Gliflozins," "cardiorenal outcomes," and relevant synonyms.

2.2. Hand Searching: Reference lists of involved articles, systematic reviews, and clinical practice guidelines will be examined for additional relevant studies.

Study Selection:

3.1. Screening: Two independent reviewers will screen titles and abstracts to recognize possibly suitable researches.

3.2. Full-Text Review: Full-text articles of the selected researches will be reviewed for last inclusion.

Data Extraction:

4.1. Data Variables: A standardized data extraction form will be used to collect applicable info, with study characteristics, patient demographics, intervention details, and cardiorenal outcomes.

4.2. Data Validation: Data extraction will be cross-validated by two independent reviewers, and differences will be determined through consensus or a third reviewer.

Quality Assessment:

5.1. RCTs: To evaluate the quality of the reported randomized controlled researches, the Cochrane Risk of Bias tool will be utilized.

5.2. Observational Studies: The Newcastle-Ottawa Scale will be employed to measure quality of observational studies.

Data Synthesis and Analysis:

6.1. Meta-Analysis: For RCTs, a meta-study will be led to estimate overall impact of SGLT-2 inhibitors on cardiorenal outcomes using RevMan or a similar software.

6.2. Subgroup Analysis: Subgroup analyses will be performed to investigate impact of SGLT-2 inhibitors in different patient populations (having diabetes, without diabetes) and varying SGLT-2 inhibitors.

6.3. Sensitivity Analysis: Sensitivity study will be carried out to assess the robustness of the findings through evaluating the impact of study quality and publication bias.

Assessment of Heterogeneity:

7.1. Statistical Heterogeneity: The I^2 statistic will be used to assess statistical heterogeneity among the included studies.

7.2. Clinical Heterogeneity: Medical heterogeneity will be evaluated by considering the variations in study populations, intervention dosages, and outcomes.

Publication Bias:

8.1. Funnel Plot: Publication bias will be assessed using funnel plots.

8.2. Statistical Tests: Egger's and Begg's tests will be utilized to detect possible publication bias.

Reporting and Dissemination:

9.1. Manuscript: The results will be described in accordance with PRISMA strategies and succumbed for publication in a peer-reviewed journal.

9.2. Presentation: The results will be presented at relevant scientific conferences to disseminate the findings and engage with the scientific community.

Ethical Considerations:

10.1. Ethical Approval: As this study involves a review of existing literature, ethical approval is not required.

Limitations:

11.1. The potential limitations of this study will be discussed, including biases, heterogeneity, and data availability.

This comprehensive methodology outlines systematic review and meta-study approach to investigate character of SGLT-2 inhibitors (Gliflozins) in enhancing cardiorenal results in individuals with and without diabetes. The outcomes of our current research were to offer important perceptions into efficacy and safety of SGLT-2 inhibitors, informing clinical practice and patient care decisions.

RESULTS:

4.1 Participant Characteristics:

The research comprised the overall 200 participants, divided into two groups: these through diabetes (n=100) and these without diabetes (n=100). Table 4.1 summarizes the baseline features of research applicants in both groups.

Table 4.1: Baseline Characteristics of Study Participants:

Characteristic	With Diabetes (n=100)	Without Diabetes (n=100)
Age (years)	58.4 ± 6.2	57.8 ± 5.9
Gender (Male/Female)	55/45	48/52
Duration of Diabetes (years)	8.7 ± 3.1	-
eGFR (mL/min/1.73m²)	52.3 ± 10.5	71.8 ± 9.2
HbA1c (%)	7.8 ± 0.9	-
BMI (kg/m²)	30.2 ± 4.5	27.9 ± 3.6

Effect of SGLT-2 Inhibitors on Cardiorenal Results

4.2.1 Cardiorenal Outcomes in Participants with Diabetes

In participants with diabetes, effect of SGLT-2 inhibitors on cardiorenal results was assessed over a follow-up period of 12 months. The outcomes are presented in Table 4.2.

Table 4.2: Cardiorenal Outcomes in Participants with Diabetes:

Outcome Measure SGLT-2	**Inhibitor Group (n=50)**	**Control Group (n=50)**
Change in eGFR (mL/min/1.73m²)	-2.1 ± 4.3*	-7.8 ± 3.9
Albuminuria Reduction (%)	42.6 ± 8.5*	18.9 ± 5.2
Hospitalization for HF (%)	12*	28
Cardiovascular Events (%)	6*	17

4.2.2 Cardiorenal Outcomes in Participants without Diabetes

For participants without diabetes, effect of SGLT-2 inhibitors on cardiorenal outcomes was assessed over the same 12-month follow-up period. The outcomes are presented in Table 4.3.

Table 4.3: Cardiorenal Outcomes in Participants without Diabetes:

Outcome Measure SGLT-2	**Inhibitor Group (n=50)**	**Control Group (n=50)**
Change in eGFR (mL/min/1.73m²)	2.5 ± 3.1*	-1.2 ± 2.9
Albuminuria Reduction (%)	34.7 ± 7.4*	12.8 ± 4.6
Hospitalization for HF (%)	5*	14
Cardiovascular Events (%)	3*	11

Note: * indicates statistically substantial difference ($p < 0.05$).

Subgroup studies were achieved to investigate whether effect of SGLT-2 inhibitors on cardiorenal results varied based on specific patient characteristics such as age, gender, and baseline eGFR.

DISCUSSION:

Sodium-glucose co-transporter 2 (SGLT-2) inhibitors, commonly referred to as gliflozins, have emerged as a groundbreaking class of drugs in therapy of diabetes. However, their impact extends far beyond glycemic control. SGLT-2 inhibitors have shown significant potential in improving cardiorenal results, not only in individuals through diabetes but also in those without the disease [18]. This discussion will delve into role of SGLT-2 inhibitors in enhancing cardiorenal results and implications for both diabetic and non-diabetic individuals.

SGLT-2 inhibitors primarily function by inhibiting the reabsorption of glucose in proximal tubules of kidneys, leading to enhance urinary glucose excretion [19]. This mechanism not only reduces blood glucose levels but also exerts beneficial effects on the cardiovascular and renal systems. Several clinical trials have demonstrated the cardioprotective and Reno protective impacts of SGLT-2 inhibitors, reshaping the way we approach the management of diabetes and cardiorenal diseases.

In individuals having diabetes, usage of SGLT-2 inhibitors has been related with a reduced risk of cardiovascular events, such as heart failure hospitalization and cardiovascular death [21]. Trials like the EMPA-REG OUTCOME and DECLARE-TIMI 58 have provided compelling evidence of these benefits. Moreover, SGLT-2 inhibitors have shown a marked reduction in progression of diabetic nephropathy and are believed to have Reno protective properties. This is particularly significant since diabetic nephropathy is the main source of end-stage renal illness [22].

But what is most intriguing is that SGLT-2 inhibitors are not confined to diabetes management alone. In recent years, their use in individuals without diabetes has garnered attention. The DAPA-HF and EMPEROR-Reduced trials have shed light on the potential benefits of SGLT-2 inhibitors in individuals with heart failure, with or without diabetes [23]. These researches were specified that SGLT-2 inhibitors can substantially decrease danger of hospitalization for heart failure, slow progression of kidney disease, and less cardiovascular death in non-diabetic patients through heart

failure and reduced ejection fraction. These findings have broadened the therapeutic scope of SGLT-2 inhibitors, suggesting that their use may extend beyond diabetes management to a broader population of patients with cardiorenal conditions.

The multifaceted mechanisms through which SGLT-2 inhibitors advance cardiorenal results in both diabetic and non-diabetic individuals are not yet fully elucidated, but several key factors come into play [24]. The diuretic effect of these drugs leads to volume reduction, decreasing the preload on the heart and alleviating the burden on the kidneys. Additionally, the decrease in systolic and diastolic blood pressure (DBP) is thought to contribute to their cardioprotective effects. SGLT-2 inhibitors also seem to alter the neurohormonal balance, with the decrease in plasma norepinephrine levels and activation of renin-angiotensin-aldosterone system, resulting in decreased oxidative stress and inflammation. These combined effects contribute to improved cardiac and renal function [25].

However, it is crucial to acknowledge that while SGLT-2 inhibitors have shown great promise in improving cardiorenal outcomes, they are not without side effects and potential risks. One of the most notable adverse effects is the risk of euglycemic diabetic ketoacidosis (DKA). This condition, characterized by the presence of ketoacidosis without significantly elevated blood glucose levels, is very infrequent but possibly serious side effect of SGLT-2 inhibitors. It is essential for healthcare providers to be aware of this risk and educate patients on the signs and symptoms of DKA, especially in those without diabetes who might not be as familiar with the condition.

Furthermore, long-term safety of SGLT-2 inhibitors in non-diabetic populations requires further investigation. While the DAPA-HF and EMPEROR-Reduced trials have provided valuable insights, more research is required to assess dangers and benefits of these drugs in individuals without diabetes over extended periods.

The role of SGLT-2 inhibitors in improving cardiorenal results in individuals through or without diabetes is an exciting development in the field of medicine. These drugs have shown remarkable potential in reducing the risk of heart failure hospitalization, cardiovascular events, and the progression of kidney illness. While initially developed for diabetes management, the benefits of SGLT-2 inhibitors have extended beyond glycemic control, offering new treatment options for a broader range of patients. However, the medical community must remain vigilant about potential side effects, particularly the risk of euglycemic DKA, and continue to investigate the long-term safety and effectiveness of these drugs. SGLT-2 inhibitors have certainly opened up new avenues for cure of cardiorenal diseases, but careful consideration and ongoing research are essential to maximize their potential benefits while minimizing risks.

CONCLUSION:

In conclusion, SGLT-2 inhibitors, commonly known as gliflozins, have appeared as the pivotal class of medications with profound implications for cardiorenal results in both diabetic and non-diabetic patients. Extensive clinical research has demonstrated their ability to decrease the risk of heart failure, chronic kidney disease progression, and cardiovascular events. Their mechanism of action, which primarily involves enhancing glucose excretion through the kidneys, offers unique benefits beyond glycemic control. These drugs exhibit promising potential for improving the overall cardiovascular and renal health of individuals, irrespective of their diabetic status. As we continue to explore the multifaceted impacts of SGLT-2 inhibitors, they represent a significant advancement in the management of cardiorenal diseases.

REFERENCES:

1. Koufakis, T., Tsimihodimos, V., Metallidis, S., Kotsa, K., & Doumas, M. (2023). The effects of sodium-glucose cotransporter 2 inhibitors beyond the cardio-renal-metabolic spectrum: Will gliflozins have a different fate than statins?. Expert Opinion on Pharmacotherapy, 1-4.
2. Kalay, Z., Sahin, O. E., Copur, S., Danacı, S., Ortiz, A., Yau, K., ... & Kanbay, M. (2023). SGLT-2 inhibitors in nephrotic-range proteinuria: emerging clinical evidence. Clinical Kidney Journal, 16(1), 52-60.

3. Shami, D., Sousou, J. M., Batarseh, E., Alazrai, L., Batarseh, E., & Alazrai, L. I. (2023). The Roles of Glucagon-Like Peptide 1 (GLP-1) Receptor Agonists and Sodium-Glucose Cotransporter 2 (SGLT-2) Inhibitors in Decreasing the Occurrence of Adverse Cardiorenal Events in Patients With Type 2 Diabetes. Cureus, 15(1).
4. Bendotti, G., Montefusco, L., Pastore, I., Lazzaroni, E., Lunati, M. E., & Fiorina, P. (2023). The anti-inflammatory and immunological properties of SGLT-2 inhibitors. Journal of Endocrinological Investigation, 1-8.
5. Collins, T. R. (2023). JAK2-Unmutated Erythrocytosis From Gliflozins Appears Benign.
6. John, S. M., Fulwood, M., & Ford, K. (2023). Effects of Glucagon-Like Peptide-1 Receptor Agonists and Sodium Glucose Cotransporter-2 Inhibitors on Renal and Cardiovascular Outcomes. ADCES in Practice, 2633559X231202491.
7. Sanz, R. L., Inserra, F., García Menéndez, S., Mazzei, L., Ferder, L., & Manucha, W. (2023). Metabolic syndrome and cardiac remodeling due to mitochondrial oxidative stress involving gliflozins and sirtuins. Current Hypertension Reports, 1-16.
8. Liberale, L., Kraler, S., Puspitasari, Y. M., Bonetti, N. R., Akhmedov, A., Ministrini, S., ... & Camici, G. G. (2023). SGLT-2 inhibition by empagliflozin has no effect on experimental arterial thrombosis in a murine model of low-grade inflammation. Cardiovascular Research, 119(3), 843-856.
9. Frąk, W., Hajdys, J., Radzioch, E., Szlagor, M., Młynarska, E., Rysz, J., & Franczyk, B. (2023). Cardiovascular Diseases: Therapeutic Potential of SGLT-2 Inhibitors. Biomedicines, 11(7), 2085.
10. Scheen, A. J. (2023). The current role of SGLT2 inhibitors in type 2 diabetes and beyond: a narrative review. Expert Review of Endocrinology & Metabolism, 1-12.
11. Munoz Pena, J. M., & Cusi, K. (2023). Post-Transplant Diabetes Mellitus: Recent Developments in Pharmacological Management of Hyperglycemia. The Journal of Clinical Endocrinology & Metabolism, dgad395.
12. Ma, C., Li, X., Li, W., Li, Y., Shui, F., & Zhu, P. (2023). The efficacy and safety of SGLT2 inhibitors in patients with non-diabetic chronic kidney disease: a systematic review and meta-analysis. International Urology and Nephrology, 1-8.
13. Koya, D., Anker, S. D., Ruilope, L. M., Rossing, P., Liu, Z., Lee, B. W., ... & Pitt, B. (2023). Cardiorenal Outcomes with Finerenone in Asian Patients with Chronic Kidney Disease and Type 2 Diabetes: A FIDELIO-DKD post hoc Analysis. American Journal of Nephrology, 1-9.
14. Wang, X., Zhang, X., Zhang, W., Li, J., Weng, W., & Li, Q. (2023). Association of Sodium-Glucose Cotransporter 2 Inhibitors (SGLT2i) with Cardiac Arrhythmias: A Systematic Review and Meta-Analysis of Cardiovascular Outcome Trials. Reviews in Cardiovascular Medicine, 24(9), 258.
15. Tanriover, C., Ucku, D., Akyol, M., Cevik, E., Kanbay, A., Sridhar, V. S., ... & Kanbay, M. (2023). Potential use of SGLT-2 inhibitors in obstructive sleep apnea: a new treatment on the horizon. Sleep and Breathing, 27(1), 77-89.
16. Sim, R., Chong, C. W., Loganadan, N. K., Adam, N. L., Hussein, Z., & Lee, S. W. H. (2023). Comparative effectiveness of sodium-glucose co-transporter 2 inhibitors and dipeptidyl peptidase-4 inhibitors on cardiorenal function and treatment adherence: a prevalent new-user design study in tertiary hospitals. RPS Pharmacy and Pharmacology Reports, 2(3), rqad023.
17. Maktouf, Z. H. (2023). Treatment of DM and Empagliflozin (Doctoral dissertation, Al-Qadisiyah University).
18. Cao, H., Rao, X., Jia, J., Yan, T., & Li, D. (2023). Effects of sodium-glucose co-transporter-2 inhibitors on kidney, cardiovascular, and safety outcomes in patients with advanced chronic kidney disease: a systematic review and meta-analysis of randomized controlled trials. Acta Diabetologica, 60(3), 325-335.
19. Hasan, M. T., Awad, A. K., Shih, M., Attia, A. N., Aboeldahab, H., Bendary, M., & Bendary, A. (2023). Meta-Analysis on the Safety and Efficacy of Sodium Glucose Cotransporters 2

Inhibitors in Patients With Heart Failure With and Without Diabetes. The American Journal of Cardiology, 187, 93-99.
20. Singh, A. P., Kalil, R. S., & Weir, M. R. (2023). Role of Sodium-Glucose Cotransporter 2 Inhibitors for Management of Diabetes Mellitus in Renal Transplant Recipients and Management Strategies for Posttransplant Hypertension. American Journal of Nephrology, 1-9.
21. Song, J., Li, X., & Ni, J. (2023). A role for sodium-glucose cotransporter 2 inhibitors in the treatment of chronic kidney disease-A mini review. Kidney & Blood Pressure Research.
22. Chen, X., Hocher, C. F., Shen, L., Krämer, B. K., & Hocher, B. (2023). Reno-and cardioprotective molecular mechanisms of SGLT2 inhibitors beyond glycemic control: from bedside to bench. American Journal of Physiology-Cell Physiology, 325(3), C661-C681.
23. Akiyama, H., Nishimura, A., Morita, N., & Yajima, T. (2023). Evolution of sodium-glucose co-transporter 2 inhibitors from a glucose-lowering drug to a pivotal therapeutic agent for cardio-renal-metabolic syndrome. Frontiers in Endocrinology, 14, 1111984.
24. Hoehlschen, J., Hofreither, D., Tomin, T., & Birner-Gruenberger, R. (2023). Redox-driven cardioprotective effects of sodium-glucose co-transporter-2 inhibitors: comparative review. Cardiovascular Diabetology, 22(1), 1-10.
25. Tokarek, J., Budny, E., Saar, M., Stańczak, K., Wojtanowska, E., Młynarska, E., ... & Franczyk, B. (2023). Molecular Processes Involved in the Shared Pathways between Cardiovascular Diseases and Diabetes. Biomedicines, 11(10), 2611.