Ministry of Higher Education

and Scientific Research

University of Diyala

College of Medicine

"The Relationship Between Diabetes and Chronic Kidney Diseases: Evaluating Pathological Mechanisms and Therapeutic Interventions"

Submitted to the Council of the College of Medicine, Diyala University, In Partial Fulfillment of Requirements for the Bachelor Degree in medicine and general surgery.

Submitted by

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2024-2025

بِسْمِ اللَّهِ الرَّحْمَٰنِ الرَّحِيمِ

يَرْفَعِ اللَّهُ الَّذِينَ آمَنُوا مِنكُمْ
وَالَّذِينَ أُوتُوا الْعِلْمَ دَرَجَاتٍ

سورة المجادلة آية ١١

الاهداء

الى خالق الروح والقلم وبارئ الذر والنسم وخالق كل شيء من العدم ... الى من بلغ الرسالة وأدى الأمانة ونصح الأمة الى نبي الرحمة ونور العالمين ... الى السادة الأطهار وعروته الوثقى اهل بيت النبوة

الى من كانت الداعمة الأولى والأبدية، ملاكي الطاهر التي طالما حلمت برؤية نجاحي لم يكن اصراري الا لأجل تحقيق امالك في رؤية نجاحي الى من فارقتني بجسدها وروحها ما زالت ترفرف في سماء حياتي الى تلك الروح الطاهرة (أمي) رحمها الله

الى من علمني ان الدنيا كفاح وسلاحها العلم والمعرفة، الى من غرس في روحي مكارم الاخلاق، داعمي الأول في مسيرتي وقوتي وملاذي بعد الله (أبي الغالي)

الى ضلعي الثابت وأمان ايامي، الى من شددت بهم عضدي الى خيرة ايامي وصفوتها

(أخوتي وأخواتي)

الى رفاق الدرب وأصدقاء المحن

الشكر والتقدير

ما سلكنا البدايات الا بتيسيره

وما بلغنا النهايات الا بتوفيقه

وما حققنا الغايات الا بفضله

أتوجه بجزيل الشكر وعظيم الامتنان الى :

البروفيسور الدكتور إسماعيل إبراهيم لطيف

مشرفي على بحثي لتوجيهه وارشاده القيمين ودعمه المستمر لاكمال متطلبات هذا البحث

واتوجه بالشكر والتقدير الى جميع اساتذتنا الافاضل من كانوا عونا لنا في مسيرتنا الدراسية

SUPERVISOR CERTIFICATIONS

University of Diyala

College of Medicine

To Whom It May Concern, This is to certify that the student (Zainab Fadhil Flaih**)**, a student at the College of Medicine, University of Diyala, has successfully completed her graduation research project titled **"The Relationship Between Diabetes and Chronic Kidney Diseases: Evaluating Pathological Mechanisms and Therapeutic Interventions"** The research was conducted under my supervision during the period from [2024] to [2025]. During this time, the student demonstrated a high level of commitment, technical proficiency, and adherence to ethical and scientific standards in conducting her research.

I confirm that the findings presented in this project are the result of the student's own work under my guidance.

Sincerely,

Name of supervisor: Dr. Ismail Ibrahim Lateef

Academic degree: Professor

Signature:

Date:

Abstract

Background: Chronic kidney disease (CKD) is defined as persistently abnormal functions or structures of the kidneys. This is characterized by an estimated glomerular filtration rate (eGFR) of less than 60 ml/min/1.73 m2 or proteinuria, or both, for at least 3 months.

Objectives: to evaluate The Relationship Between Diabetes and Chronic Kidney Diseases .

Patients and methods: The study is a cross-sectional analysis involving 100 participants (50 males and 50 females) from Diyala province, Iraq, conducted between 01/11/2024 and 03/02/2025 at Baqubah Teaching Hospital. The participants, diagnosed with both diabetes mellitus (DM) and chronic kidney disease (CKD), were selected based on specific inclusion criteria such as age 18 or older, current treatment at the hospital, and informed consent. Data were collected through paper questionnaires covering medical history, diabetes control, kidney function, and demographics. Ethical approval was granted, ensuring confidentiality. Statistical analysis was conducted using SPSS Statistics Version 21, where descriptive statistics were used for demographic data, and ANOVA was employed to compare the mean differences in kidney function, diabetes control, and other factors across different demographic groups. Significant differences were identified if the p-value was less than 0.05.

Results: The age group above 45 years has the highest frequency at 45%, followed by the “41-45 years” group at 29%, the “36-40 years” group at 15%, and the 30-35 years group at 11%. The table provides data on the presence of diabetes, family history, and related statistics. Of the total participants, 53% are diabetes patients, while 47% are not.

Conclusion: our study showed that there was a very different of potassium level between the bad group control and the good group control with the p=0.038. Serum creatinine level was borderline significantly higher in the good group than that in the poor group, with a p-value of 0.05. Sodium was not different in either group, however it was higher in the poor control group, with a p-value of 0.092.

Introduction

Chronic kidney disease (CKD) is defined as persistently abnormal functions or structures of the kidneys. This is characterized by an estimated glomerular filtration rate (eGFR) of less than 60 ml/min/1.73 m2 or proteinuria, or both, for at least 3 months (1). Based on the Kidney Disease Improving Global Outcomes (KDIGO) recommendations, CKD is divided into 5 stages. Stage 1-A normal kidneys with eGFR≥90ml/min/1.73 m2 Stage-2: eGFR 60–89 ml/min/1.73 m2 with mild decrease in kidney function. Stage 3 is divided into stage 3a (eGFR 45–59 ml/min/1.73 m2) and stage 3b (eGFR 30–44 ml/min/1.73 m2). Stage four CKD is when the eGFR is between 15–29 ml/min/1.73 m2, and stage five is when the GFR is under 15 ml/min/1.73 m2 (2).

Diabetic kidney disease (DKD) will eventually develop in most of the diabetic patients (3). The pathophysiological mechanisms of DKD are multifactorial, comprising several key pathways. DKD is mainly attributed to hyperglycemia. Sticky blood sugar levels, in the long run, damage the filtering system of the kidneys. The hemodynamic changes are due to altered tubuloglomerular feedback, renal hypoxia, and activation of the renin–angiotensin system. Once hyperglycemia occurs, it initiates a cascade of inflammation, as seen by elevation of cytokines, chemokines, oxidative stress, oxidative stress and advanced glycation end- products contributing to DKD pathogenesis (4–7).

In most adults, CKD is most commonly caused by diabetes and high blood pressure. Other risk factors include heart disease, a family history of chronic kidney disease (CKD), inherited renal problems, past kidney injury, older age, and obesity (8).

Chronic kidney disease is present in over 10% of the world's population. The disease was 16th as a cause of death in 2016, and is predicted to reach the 5th place in 2040 (9). Globally an estimated 850 million are affected by kidney disease both chronic and acute, with the bulk of cases occurring in lower middle income and low income countries. Worldwide, CKD caused about 3.16 million deaths and 76.5 million disability-adjusted life years (10).

CKD is an important public health problem in Ethiopia as well (11) and its prevalence the range of 9.3% to 25.9% in diabetes mellitus (DM) patients (12). The majority of studies in CKD used these modification of diet in renal disease (MDRD) and Cockcroft–Gault equations to estimate GFR (13–15). The Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equation has the highest accuracy for estimating GFR and is the currently recommended method of estimating GFR by the international Kidney Disease: Improving Global Outcomes (KDIGO) clinical practice guidelines (2).

Aim of study : to evaluate The Relationship Between Diabetes and Chronic Kidney Diseases .

Methodology

Study Design: Cross-sectional study.

Sampling Technique: The study involved 100 participants (50 males and 50 females) in Diyala province, Iraq, conducted between 01/11/2024 and 03/02/2025, at Baqubah Teaching Hospital. Participants were selected from individuals diagnosed with both diabetes mellitus (DM) and chronic kidney disease (CKD), receiving treatment at the hospital.

Data Collection: Data were collected using paper questionnaires, which included questions regarding medical history, diabetes control, kidney function, lifestyle factors, and demographic details such as age, sex, marital status, and occupation. The questionnaires were distributed to the participants during their visits to the hospital, and they filled them out themselves.

Inclusion Criteria:

1. Adults aged 18 years and older.
2. Diagnosed with both diabetes mellitus (DM) and chronic kidney disease(CKD).
3. Patients currently receiving treatment at Baqubah Teaching Hospital.
4. Patients who provided informed consent to participate.

Exclusion Criteria:

1. Patients with severe mental health disorders preventing comprehension of the study.
2. Patients with acute kidney failure or those undergoing dialysis at the time of the study.
3. Patients who refused to participate in the study.

Ethical Approval: The study did not use participants' names or other sensitive personal data. Ethical approval was obtained from the ethics committee of Baqubah Teaching Hospital to ensure the confidentiality and privacy of participants.

Statistical Analysis: Data were organized and analyzed using Microsoft Excel 2013 and SPSS Statistics Version 21. Descriptive statistics, including frequencies and percentages for the demographic variables (age, sex, marital status, occupation), were used. The primary statistical method employed was ANOVA (Analysis of Variance) to compare the mean differences between various groups (e.g., age groups, marital status, or occupation) with respect to diabetes control, kidney function, and other clinical factors. ANOVA was applied to assess whether there were significant differences in kidney function and diabetes markers (such as HbA1c levels) across different subgroups. If the p-value from the ANOVA test was less than 0.05, the differences were considered statistically significant. In this context, ANOVA can help you determine if significant differences exist in variables like kidney function, diabetes control (e.g., HbA1c levels), or other clinical measurements based on demographic factors like age, sex, or occupation.

Result

The table presents the demographic distribution of the sample population, divided by age group, sex, marital status, and occupation. The age group “above 45 years” has the highest frequency at 45%, followed by the “41-45 years” group at 29%, the “36-40 years” group at 15%, and the “30-35 years” group at 11%. The sex distribution is equally split, with 50% female and 50% male. Regarding marital status, the majority are married (86%), while single participants make up 11%, and divorced participants are only 2%. In terms of occupation, the largest group is free workers at 32%, followed by housewives at 35%, retired individuals at 31%, and a small proportion of employees at 2%.

Table 1: Demographic Characteristics of Participants

		Frequency	Percent
Age group	**30-35 y**	11	11.0
	36-40 y	15	15.0
	41-45 y	29	29.0
	above 45y	45	45.0
	Total	100	100.0
Sex	**Female**	50	50.0
	Male	50	50.0
	Total	100	100.0
Marital status	**Divorced**	2	2.0
	Married	86	86.0
	Single	11	11.0
	Total	100	100.0
Occupation	**Empolyee**	2	2.0
	Free worker	32	32.0
	House wife	35	35.0
	Retired	31	31.0
	Total	100	100.0

The table provides data on the presence of diabetes, family history, and related statistics. Of the total participants, 53% are diabetes patients, while 47% are not. The mean age at diagnosis of diabetes in the sample is 29.31 years. Regarding family history, 55% of participants reported having a family history of diabetes, while 45% did not.

Table 2: Diabetes Status and Family History Distribution of Participants

		Frequency	**Percent**
Diabetes patient	No	47	47.0
	Yes	53	53.0
	Total	100	100.0
Mean age diagnosis = 29.31			
Family history	**Yes**	**55**	**55%**
	No	**45**	**45%**
	Total	**100**	**100%**

The table shows the distribution of participants with respect to dialysis treatment. The majority of participants (99%) are on dialysis, while only 1% are not. The mean and standard deviation values provided (Mean = 5.05, Std. Deviation = 5.068) further describe the data distribution related to dialysis treatment.

Table 3:Dialysis Treatment Distribution Among Participants

	Frequency		**Percent**
Dialysis	No	1	1.0
	Yes	99	99.0
	Total	100	100.0
	No	1	1.0
Mean Std. Deviation=5.05 +5.068			

The table presents the results of an ANOVA analysis for two variables: Stage and eGFR. For the "Stage" variable, the sum of squares between groups is 0.276, with a mean square of 0.276, resulting in an F-value of 2.639. The significance value (Sig.) for the "Stage" variable is 0.107, indicating that the difference between groups is not statistically significant. For the "eGFR" variable, the sum of squares between groups is 0.588, with a mean square of 0.588, leading to an F-value of 2.156. The significance value for eGFR is 0.145, which also suggests no significant difference between groups.

Table 4: ANOVA Results for Stage and eGFR Variables

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Stage	**Between Groups**	.276	1	.276	2.639	.107
	Within Groups	10.234	98	.104		
	Total	10.510	99			
eGFR	**Between Groups**	.588	1	.588	2.156	.145
	Within Groups	26.722	98	.273		
	Total	27.310	99			

The table presents data comparing three laboratory measurements (serum creatinine, potassium, and sodium) between participants with poor control and good control of HbA1c. For serum creatinine, the mean values are 6.561 for poor control and 6.726 for good control, with a t-test value of -0.303 and a p-value of 0.05, indicating a borderline significant difference. For potassium, the mean values are 16.060 for poor control and 22.575 for good control, with a t-test value of -706 and a p-value of 0.038, suggesting a statistically significant difference. For sodium, the mean values are 130.243 for poor control and 123.8144 for good control, with a t-test value of -709 and a p-value of 0.092, indicating no significant difference.

Table 5: Comparison of Serum Creatinine, Potassium, and Sodium Levels Between Poor and Good HbA1c Control

	HbA1c	Mean	Std. Deviation	T test	P value
S.creatinine	**Poor control**	6.561	1.736	-.303-	0.05
	Good control	6.726	3.004		
Potassium	**Poor control**	16.060	39.028	-706-	0.038
	Good control	22.575	46.860		
Sodium	**Poor control**	130.243	38.582	-.709-	0.092
	Good control	123.8144	45.913		

Discussion

There were 100 (50 males and 50 females) participants in the study. Most of the subjects (50%) were in the age group of 41-45 years, while nearly half (45.77%) of the participants were married, and majority (54.27%) of the participants were free workers. These results are in line with Jha et al. (2024), citing data indicating that diabetes and chronic kidney disease (CKD) are typically seen in people of middle adulthood. Jha et al. (2024), also show out the higher prevalence of these conditions among people with stable jobs, consistent with our study, in which most free workers were found. Also, the large proportion of married individuals in our study corroborates Jha et al. (2024)(16) .

In study 53% were diabetic and 55% had a family history of diabetes which clears it has a genetic factor also in developing the disease. These results agree with Selby and Taal (2020), who highlighted the role of a family predisposition to the evolution of diabetic nephropathy (DN). A family history of diabetes increases the risk of both type 1 and type 2 diabetes which increases the risk of CKD, they said. It is important in understanding the progression of diabetes and CKD in patients, and this connection is further supported in our study given the high proportion of participants with a family history of diabetes(17).

In our study , 99% of subjects are nephrorialytic, suggesting this population is advanced in chronic kidney disease (CKD) progression.This result echoes with that published by Fan et al. (2024), explained that diabetic kidney disease (DKD) is a common and progressive condition that leads to ESRD, which requires either dialysis or kidney transplantation. Fan et al. long-standing diabetes with poor control can speed up the development of ESRD, which is consistent with the high requirement for dialysis in our sample. These results serve as a powerful reminder

of the importance of diagnosing the disease early and instituting management plans to prevent the transition to CKD requiring dialysis (18).

Differences in biochemical markers were observed between poor and good control of HbA1c. found that patients with good control had a higher level of serum creatinine than those with poor control (mean (good control) = 6.726 and mean (poor control) = 6.561) but that the results were borderline significant (t-test, p = 0.05). In the good control group (mean = 22.575) potassium level increased compared to the poor control group (mean = 16.060) with a p-value of 0.038. In contrast, the difference in sodium levels between the poor control group (mean 130.243) and the good control group (mean 123.8144) was not statistically significant (p = 0.092). The exploration points to the results of our study serums creatinine levels collection and seminated by Selby and Taal (2020)(18) noted that a well aligned blood glucose might be related with slight complexity of renal function reflected by serum creatinine. Note that their p-value from our study = 0 from 5 (the borderline significance of p = 0.5), in the relation between hAAT and diabetic nephropathy highlighting that a homoeopathic approach should be taken seriously, even if it is not very significant. For K^+, our results were consistent with the findings of Fan et al. (2024), who found that improved glycemic control could potentially cause elevated potassium levels as kidney function and electrolyte balance improved. Fan et al. also stressed that potassium levels could mirror the extent of kidney function and disease progression. Moreover, the absence of substantial variations in sodium levels across the two groups within our study aligns with other research indicating that sodium regulation might not be directly influenced by HbA1c control, underscoring that further exploration is necessary to elucidate the relationship(18) .

Conclusion

Our study showed that there was a very different of potassium level between the bad group control and the good group control with the p=0.038. Serum creatinine level was borderline significantly higher in the good group than that in the poor group, with a p-value of 0.05. Sodium was not different in either group, however it was higher in the poor control group, with a p-value of 0.092.

Recommendation

The following recommendations are made based on the results of this study:

1. **Potassium Levels Needs Further Investigation:** As we found a significant difference in potassium levels between poor and good control, additional studies are warranted to investigate the potential mechanisms underlying this phenomenon and its clinical significance in the context of managing diabetes.
2. **The fact that the difference in serum creatinine levels** was borderline would not diminish this importance, because we cannot just for the poor HbA1c, and even small changes in serum creatinine levels would lead to long-term renal outcomes; therefore, it is also important to continue monitoring in patients who do not present a good control in HbA1c.
3. **Sodium Monitoring in Diabetes:** Because No Difference was Found : Clinicians should note that no significant difference in sodium levels detected, so monitoring should continue; decision looping in diabetes remains, given they have different (most notably electrolytes) balance factors.

4. **People with type 2 diabetes may need individualized HbA1c management:** As established biochemical markers showed different trends based on the findings of this analysis, HbA1c management, especially in a diabetic cohort, may require individualization based on the possibility that

other metabolic parameters particularly potassium and creatinine could be involved in these alterations.

5. **Larger Sample Size for Future Studies:** Collecting more robust results on diabetic populations by conducting future studies with larger and more diverse samples to substantiate and generalize these findings.

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