Analysis Of The Relationship Between Type 2 Diabetes Mellitus And Chronic Kidney Failure Events At Royal Prima Hospital, Medan, In 2024

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Abstract.

Background: Type 2 diabetes mellitus (DMT2) is the leading cause of chronic renal failure (CCC) globally. Indonesia is projected to experience an increase in diabetes cases from 18.69 million in 2020 to 40.7 million in 2045. Objective: This research aims to analyze the relationship between type 2 diabetes mellitus and the incidence of chronic kidney failure at Royal Prima Hospital, Medan, in 2024. Methods: This cross-sectional study included 85 DMT2 patients selected using simple random sampling. Data collection used medical records, and statistical analysis using the Chi-Square test and prevalence ratio calculations at a 95% confidence level. Results: The study found a significant association between DMT2 and CKD (p = 0.018). The majority of female respondents (58.8%) were aged 45-60 (49.4%). Most cases of CKD in advanced stages: 23.5% stage 4 and 11.8% stage 5. DMT2 patients with complications of diabetic ketoacidosis and hyperosmolar hyperglycemic state had a 1.46 times higher risk of CKD. Conclusions: There is a significant association between type 2 diabetes mellitus and the incidence of chronic renal failure, so a systematic renal function screening program and comprehensive glycemic control education are needed.

Keywords: *Cross-sectional study; Type 2 Diabetes Mellitus; Chronic Kidney Failure; Prevalence Ratio and Medical Records.*

I. INTRODUCTION

Research Phenomenon

Diabetes mellitus represents a complex metabolic disorder characterized by persistent hyperglycemia. This chronic condition has emerged as one of the most pressing health challenges of the modern era. The global burden of diabetes continues to escalate at an alarming rate, positioning it as a critical public health crisis that demands immediate attention. Current epidemiological trends reveal a disturbing trajectory for diabetes prevalence worldwide. Indonesia, in particular, faces a dramatic surge in diabetes cases that threatens to overwhelm healthcare systems. Statistical projections paint a concerning picture of the disease's future impact on the Indonesian population.The prevalence of diabetes mellitus in Indonesia demonstrates an exponential growth pattern. In 2020, approximately 9.19% of the population was affected by this condition, translating to roughly 18.69 million documented cases. However, forecasting models predict a substantial escalation in these numbers over the coming decades. By 2045, experts anticipate that diabetes prevalence will reach 16.09% of the Indonesian population. This projection corresponds to an estimated 40.7 million affected individuals. The magnitude of this increase represents a staggering 75.1% rise over 25 years, highlighting the urgency of preventive measures. Recent data from the 2023 Indonesian Health Survey provides additional evidence of the growing diabetes epidemic. The survey utilized blood glucose testing to assess diabetes prevalence among adults.

Results indicated that 11.7% of individuals aged 15 years and older currently live with diabetes mellitus. Indonesia's position on the global diabetes landscape is particularly concerning. The country ranks among the top five nations worldwide with the highest absolute numbers of diabetes patients. This classification underscores the severity of the health crisis facing the Indonesian healthcare system.Multiple interconnected factors contribute to the rising diabetes prevalence observed in Indonesia. Lifestyle modifications associated with modernization play a pivotal role in disease development. Sedentary behaviors have become increasingly common as traditional physical activities decline. Urbanization processes have

fundamentally altered dietary patterns and physical activity levels. Rural-to-urban migration exposes populations to processed foods and reduced opportunities for physical exercise. These environmental changes create conditions conducive to diabetes development. Nutritional transitions represent another critical driver of the diabetes epidemic.

Traditional Indonesian diets, rich in whole grains and vegetables, have been gradually replaced by Western-style eating patterns. These modern diets typically contain excessive calories, refined sugars, and saturated fats. The proliferation of fast food establishments and convenience foods has made high-calorie options more accessible to the general population. Simultaneously, opportunities for regular physical activity have diminished due to technological advances and changing work environments. This combination of increased caloric intake and decreased energy expenditure creates an ideal environment for diabetes development.Type 2 diabetes mellitus, which accounts for 90% of all DM cases, is characterized by chronic hyperglycemia due to insulin resistance and decreased insulin secretion by pancreatic beta cells. In Indonesia, the most common complications of DM that occur consecutively are neuropathy (17.65%), diabetic nephropathy (7.75%), coronary artery disease (5.4%), cerebrovascular disease (5.4%), heart failure (5.0%), retinopathy (2.7%), and peripheral artery disease (0.5%). However, diabetic nephropathy as a microvascular complication has a more serious impact because it can progress to end-stage renal failure requiring renal replacement therapy such as hemodialysis or kidney transplantation.

Research Problems

Chronic kidney failure (CKD) or chronic kidney disease (CKD) is the most life-threatening complication of type 2 DM, with prevalence continuing to increase as the number of people with diabetes increases. Based on recent studies in Southeast Asia, diabetic kidney disease (DKD) is the main cause of advanced CKD with a prevalence of 29.2% (95% CI 23.88-34.78), followed by glomerulonephritis (20.0%) and hypertension (16.8%). Indonesian Renal Registry (IRR) data for 2018 show that diabetic nephropathy is in second place after hypertension as the etiology of end-stage renal failure, with 14,998 people out of 53,940 total end-stage renal failure patients in Indonesia caused by diabetic nephropathy. The prevalence of CKD in patients with DM has been reported to vary from 25% to 53%, with approximately 20-30% of patients with type 2 DM developing diabetic nephropathy, which can progress to renal failure if not properly controlled.Various studies have shown a significant association between type 2 DM and the incidence of CKD, with complex and multifactorial risk factors. Studies at PKU Muhammadiyah Hospital, Yogyakarta, show a meaningful relationship between type 2 DM and GGK ($p = 0.000$, CI 2.3-7.8), while research at Dr. Soetomo Surabaya identified a history of hypertension (OR = 3,801) and low HDL levels (OR = 3,356) as the main risk factors for CKD in patients with type 2 DM.

The CITE study in India showed a prevalence of CKD in patients with type 2 DM of up to 32%, with the main risk factors including age over 50 years, duration of DM over 10 years, uncontrolled HbA1c, and hypertension. However, there are still variations in results between studies related to relationship strength and dominant risk factors, which may be due to differences in population characteristics, diagnostic criteria, and geographic factors.Projections show that CKD deaths in diabetics in Indonesia will increase from 29,061 in 2020 to 63,279 in 2045, reflecting a growing disease burden. At the regional level, the burden of CKD in Asia is estimated at 434 million people, with 65 million of them in advanced stages (stages 4-5). This condition is exacerbated by the limitations of population-based screening and surveillance systems for early detection and intervention of CKD, especially in low- and middle-income countries such as Indonesia. In addition, CKD is often asymptomatic in the early stages, so many patients are diagnosed late and are already at an advanced stage when first detected, which worsens the prognosis and increases the cost of care.

Research Objectives, Urgency, and Novelty

This research aims to analyze the relationship between type 2 DM and the incidence of CKD at Royal Prima Hospital Medan in 2024, with a focus on identifying the strength of associations and risk factors that contribute to disease progression. The urgency of this study is driven by the projected drastic increase in the prevalence of DM and CKD in Indonesia, where it is estimated that 28.6 million people will suffer from diabetes by 2045, with the consequence of an increase in CKD cases requiring expensive and complex kidney replacement therapy. The novelty of this research lies in the use of the latest 2024 data from referral

hospitals in North Sumatra, which can provide a contemporary epidemiological picture of the relationship between type 2-GGK DM in Indonesia's tertiary health service settings, as well as a contribution to the development of prevention strategies and more effective management based on the latest scientific evidence. The results of this study are expected to form the basis for the development of a more systematic renal function screening program in patients with type 2 DM, as well as provide recommendations for the optimization of glycemic control and cardiovascular risk factors to prevent progression to advanced CKD.

II. METHODS

Types and Methods of Research

This investigation employs a quantitative methodology characterized by an observational analytical framework. The study design specifically utilizes a cross-sectional approach to examine the research objectives. The methodological foundation draws upon established principles of empirical research to ensure scientific rigor and validity. Quantitative research methodology represents a systematic approach to scientific inquiry. This research paradigm is fundamentally grounded in positivist philosophical principles. The positivist framework emphasizes objective measurement and statistical analysis as the primary means of understanding phenomena.According to Sugiyono's methodological guidelines published in 2022, quantitative research serves multiple essential functions. This research approach facilitates the systematic examination of specific populations or carefully selected sample groups. The methodology relies heavily on randomized sampling procedures to ensure representative data collection. Data collection in quantitative studies depends on standardized research instruments. These tools are designed to gather measurable information that can be subjected to rigorous statistical analysis. The ultimate objective of this analytical process involves testing predetermined hypotheses through empirical evidence.Cross-sectional studies constitute a distinct category within observational research methodologies. These investigations are characterized by their unique temporal design, which captures both exposure variables and outcome measures simultaneously.

This concurrent measurement approach distinguishes cross-sectional studies from longitudinal research designs. The temporal framework of cross-sectional research provides a snapshot of population characteristics at a specific moment. Unlike longitudinal studies, this design does not incorporate extended follow-up periods or repeated measurements over time. This characteristic makes cross-sectional studies particularly suitable for certain research questions.Cross-sectional methodology offers several advantages for epidemiological investigations. This design proves exceptionally valuable for estimating disease prevalence within defined populations. The approach enables researchers to assess the frequency of health conditions across different demographic groups efficiently.Furthermore, cross-sectional studies excel in evaluating associations between various exposure factors and health outcomes. The simultaneous measurement of variables allows for the assessment of relationships without the temporal complexities inherent in longitudinal designs. This capability makes the approach particularly useful for hypothesis generation and preliminary investigations. The application of cross-sectional methodology to diabetes and kidney disease research offers specific benefits. This design enables efficient examination of the relationship between type 2 diabetes mellitus and chronic kidney failure incidents. The cost-effectiveness of this approach makes it particularly attractive for resource-limited research environments.The cross-sectional framework allows investigators to analyze complex disease relationships within predetermined population parameters. This capability proves essential when examining multifactorial health conditions such as diabetic nephropathy.

The methodology provides a practical means of generating evidence-based insights into disease associations while maintaining scientific validity and methodological rigor.The choice of cross-sectional design in this study was based on several methodological advantages relevant to the study objectives. First, this design allows direct and accurate measurement of the prevalence of chronic renal failure in patients with type 2 diabetes mellitus. Second, cross-sectional studies can be used to analyze the association between independent variables (type 2 diabetes mellitus) and dependent variables (chronic renal failure incidence) through measurement of association calculations such as prevalence ratio (PR) and prevalence odds ratio (POR). Thirdly, this design is relatively quick to implement and entails lower costs compared to longitudinal

studies, which corresponds to limited time and research resources. However, this study also noticed the limitations of a cross-sectional design, which could not establish definitive causal relationships because exposure and outcome measurements were taken simultaneously.

Population and Sample

The population targeted for this research encompassed every individual diagnosed with type 2 diabetes mellitus across the North Sumatra region. From this broad target group, the accessible population was defined as those patients who received treatment in the internal medicine department at Royal Prima Medan General Hospital between January and December 2024. This hospital, recognized as a tertiary referral center, routinely manages a diverse spectrum of diabetic cases, including those with complex complications, and thus offers an appropriate microcosm of the wider regional diabetes population.In accordance with Sugiyono's definition of population (2021), a population consists of all entities, be they people or objects, sharing specific attributes designated by the researcher for study purposes. Selecting Royal Prima Medan General Hospital as the research site was based on its comprehensive caseload of type 2 diabetes mellitus, ensuring that the findings would be representative of the condition's manifestations in North Sumatra. To extract a representative sample from this accessible group, a simple random sampling method was employed. This approach guarantees that every individual within the accessible population has an equal probability of selection, thereby minimizing selection bias.

Inclusion criteria stipulated that participants must have a confirmed diagnosis of type 2 diabetes mellitus, be at least 25 years old, and possess complete medical records detailing kidney function assessments. These records were critical for evaluating renal outcomes alongside diabetic history.Conversely, patients were excluded if their medical records lacked necessary data, or if they had been diagnosed with other primary renal pathologies—such as glomerulonephritis, pyelonephritis, or interstitial nephritis—that could independently precipitate chronic kidney failure. Patients younger than 25 years were also omitted to maintain age homogeneity and focus on the adult-onset form of diabetes. To determine the optimal sample size, Slovin's formula was applied with a 95% confidence interval and a 5% allowable error margin. This calculation yielded a required sample size of 85 respondents, which provided sufficient statistical power to detect meaningful associations between type 2 diabetes mellitus and chronic kidney outcomes within the study cohort.

Data Analysis Instruments and Techniques

The research instrument used is patient medical record data at Royal Prima Hospital Medan for the period January to December 2024. Medical records are files containing records and documents about the patient's identity, examination, diagnosis, treatment, actions, and other services that have been provided to the patient, which serve as a valid and reliable secondary data source for retrospective research. According to Siswanto (2015), medical record instruments enable researchers to collect objective and standardized clinical data, including the results of laboratory tests, medical diagnoses, and demographic characteristics of patients required for epidemiological analysis. The data collected included variables diabetes mellitus type 2 (based on blood sugar levels ≥200 mg/dL, KAD >250 mg/dL, or HHS ≥600 mg/dL), incidence of chronic renal failure (based on eGFR stage), as well as demographic variables such as gender and age.

Data analysis techniques use a gradual approach with univariate and bivariate analysis using SPSS (Statistical Package for the Social Sciences) software. A univariate analysis was performed to describe the characteristics of the respondents in terms of frequency and percentage distribution for each study variable. Bivariate analysis used the Chi-Square test (χ^2) to identify the association between type 2 diabetes mellitus and the incidence of chronic renal failure at a confidence level of 95% ($\alpha = 0.05$). According to the hypothesis testing procedure, H_0 is accepted if $p > 0.05$ (no significant relationship) and Ha is accepted if $p \leq 0.05$ (there is a significant relationship between independent and dependent variables). In addition to the Chi-Square test, a prevalence ratio (PR) analysis will be performed to measure the strength of the association and the relative risk of chronic renal failure events in patients with type 2 diabetes mellitus. Prevalence ratio is a more suitable association measure for cross-sectional studies than odds ratio, especially when the prevalence outcome is ≥10%, because PR provides a more accurate interpretation and does not overestimate the strength of the relationship.

Research Procedures

The research procedure is carried out in several systematic stages in accordance with the rules of good research methodology. The research preparation stage includes preparing a research proposal, submitting ethical clearance, and processing a research permit to Royal Prima Hospital Medan. The planning stage includes identifying and formulating research problems, studying literature to develop a theoretical framework, determining appropriate research designs, and preparing data collection instruments in the form of data extraction sheets from medical records. According to Waruwu et al. (2025), quantitative research stages must be carried out systematically to ensure that the research process runs according to scientific methods and produces data that is valid, reliable, and can be analyzed statistically.

The research implementation stage includes collecting secondary data through tracing the medical records of type 2 diabetes mellitus patients for the January-December 2024 period, by recording registration number, age, gender, main and secondary diagnosis, results of kidney function tests (serum creatinine and eGFR), as well as other relevant clinical data. Data processing and analysis are carried out using the SPSS application with data cleaning stages, variable coding, descriptive analysis (univariate), and inferential analysis (bivariate) using the Chi-Square test and prevalence ratio calculation. The final phase of the study included the interpretation of the results of statistical analysis, the preparation of a research report, and the drawing of conclusions based on the research findings, taking into account the methodological limitations and clinical implications of the research results. All stages of research are carried out by paying attention to ethical aspects of research and maintaining the confidentiality of patient data in accordance with the principles of good clinical research practice.

III. RESULTS AND DISCUSSIONS

Result

Table 1. Respondent Characteristics

Variable	Amount	%
Gender		
Female	50	58,8
Man	35	41,2
Total	85	100
Age		
25-44 years	15	17,6
45-60 years	42	49,4
61-75 years	27	31,8
>75 years	1	1,2
Total	85	100
History of Type 2 DM		
DM: ≥ 200 mg/dL	28	32,9
CAD: > 250 mg/dL	29	34,1
HHS: ≥ 600 mg/dL	28	32,9
Total	85	100
Chronic Renal Failure Event		
Stadium 1	13	15,3
Stadium 2	14	16,5
Stage 3a	12	14,1
Stage 3b	16	18,8
Stage 4	20	23,5
Stadium 5	10	11,8
Total	85	100

The demographic analysis of study participants at Royal Prima Hospital Medan during 2024 revealed significant gender disparities in the patient population. Female participants constituted the majority of the study cohort, representing 50 individuals from the total sample. This figure translates to approximately 58.88% of all respondents included in the research. In contrast, male participants numbered 35 individuals,

accounting for 41.2% of the study population. These gender distribution patterns align closely with findings reported by Napitupulu and colleagues in their 2022 research publication. Their study provided comprehensive explanations for the higher prevalence of type 2 diabetes mellitus among women. Several physiological and lifestyle factors contribute to this increased susceptibility in the female population. Hormonal fluctuations throughout a woman's lifespan significantly influence glucose metabolism and insulin sensitivity. These endocrine changes, particularly during menopause, can predispose women to developing insulin resistance. Additionally, patterns of body fat distribution differ between genders, with women typically accumulating adipose tissue in areas that may contribute to metabolic dysfunction. The prevalence of obesity among elderly women represents another critical risk factor. Age-related changes in metabolism, combined with reduced physical activity levels, create conditions favorable for diabetes development. These interconnected factors explain why women demonstrate higher rates of type 2 diabetes mellitus in clinical populations.Age distribution analysis revealed distinct patterns among study participants.

The predominant age category encompassed individuals between 45 and 60 years, representing 49.4% of the total sample. This substantial proportion highlights the significance of middle age as a critical period for diabetes development and progression. The second-largest demographic group included participants aged 61 to 75 years, comprising 31.8% of the study population. Younger adults, specifically those aged 25 to 44 years, represented 17.6% of respondents. The smallest cohort consisted of individuals over 75 years of age, accounting for merely 1.2% of participants.The concentration of diabetes cases within the 45-60 year age range reflects well-established pathophysiological processes. During this life stage, individuals commonly experience declining insulin sensitivity, a phenomenon that predisposes them to glucose intolerance. Simultaneously, the risk of developing metabolic syndrome increases substantially, creating a cascade of metabolic abnormalities. These age-related findings corroborate earlier research conducted by Fitriani Nasution and Andilala in 2021. Their investigation demonstrated that 91.3% of diabetes patients were over 45 years of age, specifically 21 individuals from their study cohort. This remarkable consistency across different research populations strengthens the evidence regarding age-related diabetes risk.Examination of diabetes-related complications revealed concerning patterns among the 85 study participants. The distribution of severe diabetic conditions was relatively uniform across different complication types. Twenty-eight patients, representing 32.9% of the cohort, presented with standard diabetes mellitus without acute complications.

An equal number of patients, 28 individuals (32.9%), experienced hyperosmolar hyperglycemic syndrome (HHS), a life-threatening complication characterized by severe hyperglycemia and dehydration. The remaining 29 patients, constituting 34.1% of the sample, suffered from diabetic ketoacidosis, another serious acute complication requiring immediate medical intervention.Analysis of chronic kidney disease progression among diabetic patients revealed alarming trends. The majority of type 2 diabetes patients who developed chronic kidney disease presented at advanced stages of renal dysfunction. Stage 4 chronic kidney disease was the most common presentation, affecting 20 patients from the diabetic cohort. This stage 4 predominance indicates substantial deterioration of kidney function before clinical recognition or referral. Such an advanced presentation suggests delayed diagnosis or inadequate monitoring of renal function in diabetic patients. The finding aligns with established medical literature demonstrating diabetes mellitus as the leading cause of chronic kidney disease, particularly in advanced stages.Additionally, 10 patients presented with stage 5 chronic kidney disease, representing end-stage renal failure requiring immediate renal replacement therapy. The concentration of patients in these advanced stages underscores the critical importance of early detection and intervention in diabetic nephropathy to prevent progression to irreversible kidney damage.

Relationship between Dependent Variables and Independent Variables

Table 2. Chi-Square Test Results

	Value	**Asymptotic Significance (2-sided)**
Pearson Chi-Square	5,559	0.018

The analysis of the Chi-Square test results, as presented in Table 2, revealed a p-value of 0.018, which is below the conventional threshold of 0.05. This statistically significant finding indicates a robust association between type 2 diabetes mellitus and the development of chronic kidney failure among the studied cohort at Royal Prima Hospital Medan in 2024. In practical terms, the p-value of 0.018 confirms that the observed disparity in chronic kidney disease prevalence between patients with type 2 diabetes and those without the condition is unlikely to be due to random chance. Consequently, the null hypothesis—which posits the absence of any relationship between these variables—was rejected. Instead, the alternative hypothesis (Ha) was supported, signifying that type 2 diabetes mellitus and chronic kidney failure are indeed correlated within this patient population.It is important to consider potential confounding influences on these results. The relatively modest sample size may limit the precision of the association estimates.

Additionally, individual variability in glycemic control could have affected the likelihood of renal complications. Fluctuations in blood glucose levels, ranging from well-managed to poorly controlled states, contribute to heterogeneity in disease progression. Furthermore, the co-occurrence of other comorbid conditions likely played a role in renal outcomes. Hypertension, dyslipidemia, and lifestyle factors such as diet and physical activity patterns are well-established contributors to chronic kidney damage. These additional risk elements may have amplified the impact of diabetes on renal function, thereby reinforcing the observed association. These results are consistent with the findings of Sari and Hisyam (2014) at PKU Muhammadiyah Hospital in Yogyakarta. Their study, conducted between January 2011 and October 2012, also demonstrated a significant relationship between type II diabetes mellitus and chronic kidney failure, yielding a p-value of 0.000 ($p < 0.05$) and a confidence interval ranging from 2.3 to 7.8. The congruence between these independent investigations strengthens the evidence that diabetes is a primary driver of renal impairment in diverse clinical settings.

Table 3. Prevalence Ratio Test Results

Risk	**Disease**	
	Light CKD	**CKD Heavy**
DM	23	5
KAD&HHS	32	25
Amount	55	30
Total Respondents	85	
Risk Value	1.46	

Table 3 summarizes the results of the prevalence ratio analysis, revealing a value of 1.46 for the association between diabetic history and chronic kidney failure. Specifically, among the 85 study participants, those with type 2 diabetes who additionally experienced acute complications—namely diabetic ketoacidosis (KAD) and hyperosmolar hyperglycemic state (HHS)—demonstrated a substantially elevated risk of developing chronic kidney disease compared to diabetic individuals without these complications. A prevalence ratio of 1.46 indicates that the subgroup of patients with KAD or HHS complications has a 46% higher likelihood of chronic renal impairment relative to their counterparts with uncomplicated diabetes. This elevated risk underscores the critical impact of acute glycemic crises on the kidneys' long-term structural and functional integrity.

These findings reinforce the concept that diabetes mellitus itself constitutes a primary contributor to chronic kidney failure. However, the presence of severe glycemic disturbances exacerbates renal vulnerability, accelerating the transition from early-stage nephropathy to advanced renal dysfunction. Consequently, the data highlight the importance of intensified clinical management for diabetic patients—particularly those with acute metabolic complications.To mitigate this increased risk, rigorous glycemic control should be combined with systematic monitoring of renal parameters such as serum creatinine and estimated glomerular filtration rate (eGFR). Early detection of renal function decline allows for timely therapeutic interventions, which may include pharmacologic agents with nephroprotective properties, dietary modifications, and patient education on maintaining optimal blood glucose levels. In conclusion, the prevalence ratio test result of 1.46 not only confirms diabetes as a significant predictor of chronic kidney failure but also emphasizes the need for integrated care strategies targeting both glycemic stability and renal health preservation in diabetic populations.

Discussion

The findings of this study show a significant association between type II diabetes mellitus and the incidence of chronic renal failure at Royal Prima Hospital Medan in 2024. This indicates that patients with type II DM have a greater risk of developing CKD than patients without DM. This is the same as the epidemiological fact that DM is the main cause of CGK throughout the world, including Indonesia, where DM prevalence continues to increase every year.This research also strengthens previous findings (Oktaviani, 2021) that type 2 DM is a major independent risk factor for CKD, noting that approximately 35–45% of type 2 DM patients will experience diabetic nephropathy, which in advanced stages becomes CKD. Chronic hyperglycemia triggers oxidative stress as well as the formation of *advanced glycation end products* (AGEs) that can damage the glomerular capillary endothelium. Additionally, DM is often accompanied by hypertension, dyslipidemia, and obesity, all of which accelerate the progression of kidney damage. Research at DR Soedarso Hospital, Pontianak City, shows that hypertension may be the main predictor for people with chronic kidney failure. Data analysis showed that patients with a history of hypertension of more than 5 years had a higher risk of terminal CKD, with an OR value = 10.89 (95% CI = 3.08–38.59) (Sulistio Rini, Suharyo Hadisaputro, 2018). Similar results were also found in a study (Shabrina et al., 2023) where hypertension was shown to have an association with the severity of kidney failure, indicated by a p-value of 0.010 and a value of *exponent B* of 7,236.

This means that patients with hypertension are at 7,236 times higher risk of End-Stage Renal Disease (ESRD) than patients with renal failure without hypertension.In addition to these comorbid factors, the duration of DM disease and the degree of blood glucose control have significant contributions. Research in Bekasi shows that patients with blood glucose levels >500 mg/dL have a greater risk of developing CKD than patients whose glucose levels are controlled (Napitupulu et al., 2022). Another study in Pontianak found that family history/DM, lack of physical activity, and low family support also play a role in accelerating the occurrence of kidney complications. These conditions illustrate the importance of multifactor control in type 2 DM patients to prevent CKD (Sulistio Rini, Suharyo Hadisaputro, 2018).In this study, the majority of patients with Type 2 DM who developed CKD were in stages 3 and 4. This suggests that many patients present with conditions that already have moderate to severe renal damage. This discovery is in accordance with a report from PERNEFRI (2023), which states that delayed diagnosis and poor blood glucose control are the main causes that accelerate the progression of CKD in diabetes patients. According to the International Diabetes Federation (2023), almost 40% of patients with Type 2 DM will experience kidney damage within 10–15 years of diagnosis if strict glycemic control is not carried out (Pavkov & Miyamoto, 2023). The findings in this study are consistent with global and national data, where type 2 DM is reported as the main cause of approximately 40% of CKD cases.

In Indonesia, the incidence of DM continues to increase, and as a consequence, the prevalence of CKD also increases. The increased prevalence of this disease not only affects the quality of life of patients but also adds to the burden of national health costs, because CKD requires kidney replacement therapy, such as hemodialysis or kidney transplantation. Thus, the results of this study provide local evidence supporting the urgency of early detection and aggressive control of type 2 DM to prevent more severe renal complications.The clinical implications of this study are very important, especially for the management of type 2 DM patients at Royal Prima Hospital Medan. Routine examination of renal function, including estimation of glomerular filtration rate (eGFR), serum creatinine levels, and microalbuminuria, should be an integral part of DM patient management. Close control of blood glucose through lifestyle modifications, insulin therapy, or oral antidiabetic drugs, as well as management of other risk factors such as hypertension and dyslipidemia, can slow the progression of kidney damage. Modern pharmacological therapies, especially SGLT2 inhibitors, are now recommended by a panel of Indonesian experts because they have been proven to provide kidney and cardiovascular protection in type 2 DM patients (Liew et al., 2023). Apart from the medical approach, non-medical factors also play an important role. The education of patients and their families on the importance of blood glucose control, a healthy diet low in salt and adjusted protein, and increased physical activity should continue. Family support is a protective factor against chronic complications of DM, including CKD.

Implementation of hospital and community-based chronic disease management programs is urgently needed to encourage patients to be more adherent to therapy and long-term monitoring.With the results that Ha was accepted, this research provides a strong basis for strengthening strategies for preventing and managing type 2 DM as an effort to reduce the incidence of CKD at Royal Prima Hospital, Medan. Comprehensive management, from initial screening to pharmacological interventions and lifestyle education, is expected to reduce the incidence of CKD and improve the quality of life of patients. This research also makes an important contribution to local scientific evidence regarding the impact of type 2 DM on the kidneys, so that it can become a reference in preparing more effective health policies in the future.

IV. CONCLUSION

Based on the research results, it can be concluded that there is a statistically significant relationship between type 2 diabetes mellitus and the incidence of chronic kidney failure at Royal Prima Hospital Medan in 2024, as evidenced by a p-value = 0.018 ($p < 0.05$) in the Chi-Square test. These findings suggest that patients with a history of type 2 diabetes mellitus accompanied by complications of diabetic ketoacidosis (CAD) and hyperosmolar hyperglycemic state (HHS) have a 1.46 times higher risk of chronic renal failure than patients with diabetes without these complications. The majority of respondents were female (58.8%) with a predominant age group of 45-60 years (49.4%), and most cases of chronic renal failure were at advanced stages, namely stage 4 (23.5%) and stage 5 (11.8%). The results of this study reinforce the epidemiological evidence that type 2 diabetes mellitus is a major risk factor for the occurrence of chronic kidney disease, in line with various previous studies showing the prevalence of diabetic nephropathy as a major cause of end-stage renal failure.

Limitations of this study included a cross-sectional design that could not definitively show a causal relationship, a relatively small sample size (85 respondents), and the lack of analysis of other confounding factors such as hypertension, dyslipidemia, and duration of diabetes. Subsequent studies were suggested to use a prospective cohort design with a larger sample and analyze multivariate risk factors for independent determinants of chronic renal failure in diabetic patients. The practical implications of this study are the need for routine implementation of a renal function screening program in patients with type 2 diabetes mellitus, strict glycemic control, as well as comprehensive education on the prevention of renal complications. The results of this study could form the basis for the development of an integrated clinical protocol for the early detection and management of diabetic nephropathy in the referral hospital, so as to prevent progression to the stage of terminal renal failure requiring renal replacement therapy.

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