Predictive Factors Of Renal Insufficiency Among Patients With Diabetes And Hypertension In Northeastern Communities Of Thailand

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ABSTRACT
The purpose of this study was to study the predictive factors of chronic renal insufficiency in patients with diabetes, hypertension, and diabetes and hypertension in Tajong Subdistrict, Lahan Sai District, Buriram Province. This study, a retrospective case-control study, analyzed data from a 2023 database of patients with chronic diseases in Northeastern Thailand. A study of 435 community diabetes and hypertension patients analyzed predictive factors of renal insufficiency using SPSS, utilizing descriptive statistics, chi-square, and binary logistic regression analysis. The results showed that the subjects had an average glomerular filtration rate of 73.90 ml/min/1.73m2 (S.D. = 24.02), which was classified as the most abnormal filtration rate of 67.80%. CKD stage 2 (eGFR 60-89 ml/min/1.73m2) is the most. Among patients with diabetics, the predictive equation for renal insufficiency is -2.82+2.808 Age + 4.675BUN. In patients with hypertension, there is a prediction equation for the occurrence of renal insufficiency: -3.391 + 2.246Sex + 2.246Age + 2.637BUN, and in patients with hypertension and diabetics is an equation for predicting the occurrence of renal insufficiency: -4.021 + 1.554sex + 2.023Age + 3.332BUN. It is proposed that gender, age, and BUN all influence the occurrence of renal damage in patients with diabetes, hypertension, and diabetes plus hypertension. As a result, the healthcare team should have standards for assessing risk and preventing renal insufficiency in diabetic and hypertensive patients. Additional research should be conducted to examine the factors associated with kidney deterioration in patients who are unable to control their blood sugar levels.

Introduction

Noncommunicable diseases (NCDs) are a major global health problem, causing a burden of disease and a large number of deaths. According to statistics from the World Health Organization, more than three-quarters of deaths are caused by noncommunicable diseases, and the trend of deaths has increased from 61% in 2000 to 74 % in 2019 (World Health Organization: WHO, 2023). NCD mortality between the ages of 30-70 is as high as 86% (WHO, 2023), which is premature death. In Thailand, the NCD mortality rate is likely to rise from 114.66 to 128.10 per 100,000 people in 2017 and 2021 (Ministry of Health Ministry of Health, 2023). The incidence of complications from chronic noncommunicable diseases is increasing. According to the Ministry of Public Health's Non-Communicable Disease Indicators 2020-2023 study, more than 60% of people with diabetes and hypertension still have kidney complications or Renal Insufficiency (Ministry of Health Ministry of Health, 2023).

Renal insufficiency leads to the development of chronic kidney disease (CKD). Symptoms of kidney damage include elevated urine albumin or decreased kidney function, i.e. glomerular filtration rate (GFR) < 60 ml/min/ 1.73 m2 (Stevens &Levin , 2013). Chronic kidney disease leads to chronic illness and death. In 2017, around the world, there were deaths from chronic kidney disease 1.2 million people. The mortality rate increased from 41.5% to 46.5% between 1990 and 2017 (Bikbov et al., 2020; Carney, 2020). The number of CKD patients undergoing hemodialysis treatment is increasing today and the number is predicted to double by 2030 (Liyanage et al., 2022). The cost estimation of hemodialysis is 1,500-2,000 baht per time (National Health Security Agency, 2023). The monthly cost for those undergoing dialysis 2-3 times a week amounts to approximately 12,000-24,000 baht. Providing care for people with CKD difficulties is frequently more intricate than self-care, resulting in psychological effects (Zahra et al., 2023), and an increased burden of gross national expenditure (Wang et al., 2019). Moreover, the occurrence of chronic renal failure in patients with chronic non-communicable diseases significantly impacts their overall quality of life (Fletcher et al., 2012).

Lahan Sai District, Buriram Province is a community in rural Isaan. Most of the food is spicy and salty. Vegetables, curry, coconut milk and fermented fish are the ingredients in the cooking. Data from the HDC base of the Ministry of Public Health in 2020 (Health Data Center, 2023) showed that the Lahansai district has a total of 5,746 people with hypertension. Ban Tajong Health Promoting Hospital has the largest prevalence of patients suffering from chronic non-communicable disorders, such as diabetes and hypertension (Ministry of Health, 2023). According to statistics on complications from diabetes and hypertension at Tajong Hospital, 12.74% found that chronic kidney disease is the most common. 12.34 percent, followed by stroke at 0.39 percent. Primary care for patients with non-communicable diseases. The service is provided by blood pressure monitoring. Arrangement of health stations, and dispensing medications according to the doctor's treatment plan. Appointments with the doctor every 3-6 months. In patients with complications, they are referred to secondary and tertiary hospitals.

A review of literature related to factors of renal insufficiency found that personal factors include the elderly, and gender. Health factors include high blood pressure, diabetes, and comorbidities. Hyperlipidemia, hyperuricemia, inability to control accumulated glucose levels (HbA1C), uncontrolled hypertension (Wongprakob & Piyabunditkul, 2017; Duan et al., 2019; Silarak et al., 2020; Cha'on et al., 2022; Leawsatianwong & Apaijitt, 2023). This is a study on the factors of renal impairment in patients with chronic kidney disease, Diabetes, hypertension, or people with diabetes and hypertension. However, there have been no studies on predictive factors of chronic kidney disease in patients with diabetes, hypertension, or patients with diabetes and hypertension, especially in Buriram province. Therefore, the researchers are interested in studying the predictive factors of chronic renal insufficiency in patients with diabetes, hypertension, and diabetes and hypertension in Tajong Subdistrict, Lahan Sai District, Buriram Province. This study will serve as a foundation for the creation of a model to mitigate the progression of kidney dysfunction in individuals with diabetes and hypertension within the community.

Method

1. Study design and setting

This research is a retrospective case-control study based on the 2023 database of patients with chronic non-communicable diseases of Tajong Health Promoting Hospital, Lahansai District, Buriram Province.

2. Participants and sampling

The population consists of 1,744 individuals with diabetes and hypertension from 22 villages living in Tajong Subdistrict, Lahan Sai District, Buriram Province. The subjects were diabetics and hypertension. The inclusion criteria are: 1) Patients diagnosed with diabetes or hypertension or diabetes and hypertension 2) Patients residing in Tajong Subdistrict, Lahansai District, Buriram Province. The sample size was calculated from Taro Yamane's formula (Umar et al., 1967)) at 95% confidence level and 5% significance level (α) From the formula n = N / (1 + N (e2) According to statistical data, all patients with diabetes and hypertension A sample of 1,744 people (HDC, 2023) was obtained with a sample of 326 people. We added 25% of the sample to 109 people. A total of 435 subjects were used in the study. Systematic random sampling by assigning an identification number to the population and determining the ratio (k) from the population (N) and sample (n) from the formula k = N/n, where k = 1,744/435 = 4. Therefore, the researchers randomly sampled every four people from the sequential population.

3. Ethical Considerations

This study was approved by the Institutional Review Board, Rajabhat Buriram University. (No. 002/2567, dated 25 January 2024). The researchers provided a comprehensive overview of the research goals, anticipated advantages, research methodology, and data gathering protocols, emphasizing the strict confidentiality and exclusive utilization of the collected data alone for this study. Prior to completing the study, the data were presented comprehensively and in a collective

manner. Additionally, the sample participants provided their consent by signing the consent form before the data gathering process. The privacy and autonomy of the participants were duly acknowledged and honored, including their ability to voluntarily withdraw from the study. The findings from this study and the following moral principles were also considered: 1) respect for persons; and 2) beneficence or non-maleficence and justice.

4. Data collection

The data were obtained from the noncommunicable disease patient database in 2023 and gathered from February to March 2024. Data collection tools are used to collect data on predictive factors of kidney degeneration in patients with diabetes and hypertension in the community. Personal data and laboratory results. Content accuracy check by 3 experts as follows: Adult and geriatric nurses, noncommunicable disease nurses and hemodialysis specialist nurses obtained IOC = 0.91 and were then subjected to experimental data collection of patients with noncommunicable diseases with similar characteristics to the samples. Cronbach's Alpha coefficient was 0.88.

5. Data analysis

The data were analyzed using the computer program SPSS, employing descriptive statistics to calculate the mean, standard deviation, frequency, and percentage. The study employed binary logistic regression analysis to evaluate the factors contributing to kidney degradation in patients with diabetes and high blood pressure.

Results

The results of the study was divided into two parts: 1) general data of the sample, and 2) predictive factors of renal insufficiency in patients with diabetes and hypertension.

Part 1: General information of the sample: The sample of 435 subjects was divided into females at 63.70%, average age 63 (S.D. = 11.78), elderly (aged 60 years and over) at 62.10%, hypertension at 39.1%, followed by hypertension and diabetes at 35.60%, and diabetes at 25.30%, respectively. Average systolic blood pressure 129.98 (S.D. = 16.34) Average diastolic blood pressure 74.27 (S.D. = 10.78). They are divided into groups with the most normal systolic blood pressure levels and diastolic blood pressure levels. 85.00% and 94.30% respectively. An average blood glucose value of 130 (S.D. =62.21) is the group with the most normal glucose levels. 63.00% Average accumulated sugar value 7.50 (S.D. = 2.12) divided into groups with the most HbA1C>7 mg% 58.40% Average BUN 14.19 (S.D.= 5.78) The group with the most normal BUN 86.40% Average creatinine 0.93 (S.D.= 0.38) Divided into groups with normal creatinine (≤1 mg/dL) 70.60%. Blood lipid levels were found as follows: Average cholesterol 177.66 (S.D.=42.37) was the group with the most normal cholesterol at 74.10%, average triglycerides at 155.13 (S.D.= 92.10), divided into groups with the most normal triglycerides at 59.70%, average HDL 48.53 (S.D.= 12.21), the subjects had the most normal HDL at 84.00%, average LDL at 109.78 (S.D.= 30.95), divided into the most normal LDL at 76.40%. The subjects had the highest normal or slight increase in urine albumin levels (< 30 mg/24 hours), respectively. Uric acid average 5.93 (S.D. = 1.73) The group with the most normal uric acid was 77.90% The stage division of renal degeneration according to KDOQI criteria showed that the sample had an average glomerular filtration rate of 73.90 (S.D. = 24.02), which is classified as the most abnormal filtration rate 67.80%. This is separated into the following categories based on filtration rate: CKD stage 2 (eGFR 60-89 ml/min/1.73 m^2) at the highest level.

Part 2: Factors affecting renal insufficiency in patients with diabetes and hypertension: Renal insufficiency is divided into two groups. Patients with normal and slightly abnormal renal filtration rate GFR>60 ml/min/1.73m^2 (CKD stage 1-2) and patients with moderate or higher abnormal renal filtration rate GFR<60 ml/min/1.73m2 (CKD stage 3-5). The results of subgroups based on chronic non-communicable diseases were categorized into three distinct groups: 1) patients with diabetics, 2) patients with hypertension, and 3) patients with diabetes and hypertension as follows

The results of the relationship between personal factors and health conditions and the occurrence of renal insufficiency, including gender, age, creatinine, BUN, systolic blood pressure, diastolic blood

pressure, Uric acid, HbA1C, Urine micro albumin, Cholesterol, Triglyceride, HDL, LDL, and Uric acid with Chi-square statistics were found as follows: The diabetes group had four variables associated with statistically significant renal insufficiency: age group 60 years and older ($\chi 2$= 10.21, p<.001), BUN ≥20 mg% ($\chi 2$= 19.46, p<.001) SBP>130 mmHg. ($\chi 2$= 6.31, p<.05) and Uric acid ($\chi 2$= 7.41, p<.05). Three variables in the group of patients with hypertension were statistically significantly associated with the occurrence of renal insufficiency: female ($\chi 2$= 29.94, p<.001); Age group ($\chi 2$= 17.04, p<.001) BUN value ≥20 mg% ($\chi 2$= 19.80, p<.001). The diabetes and hypertension groups had four variables that were statistically significantly associated with the occurrence of renal insufficiency: male ($\chi 2$= 15.85, p<.001); Age group 60 years and older ($\chi 2$= 14.53, p<.001), Uric acid ≥7 mg% ($\chi 2$= 37.10, p<.001), and BUN ≥20 mg% ($\chi 2$= 34.06, p<.001)

Analysis of predictive factors of renal insufficiency with binary logistic regression analysis by putting all independent variables into the equation at once (enter method) revealed that: Diabetes groups had statistically significant variables that could predict the occurrence of renal insufficiency. These included age and BUN, both of which predicted statistically significant renal insufficiency 24.30 percent, and the equations can be written as -2.82+2.808 Age + 4.675BUN. Hypertensive groups had statistically significant variables that could predict the occurrence of renal insufficiency, including gender, age, and BUN 32.80 percent, and the equations can be written as -3.391+2.246Sex+2.246Age+2.637BUN. Patients with diabetes and hypertension had statistically significant variables that could predict the occurrence of renal insufficiency, including gender, age, and BUN. 36.10 percent, and the equations can be written as -4.021+1.554 sex+2.023 Age+3.332BUN (Table 1)

Tables 1. Factors that cause renal insufficiency

Factor	B	Sig	Adj. OR	95%CI	
				Lower	Upper
Diabetic groups					
1. Age	2.808	.009	16.64	2.03	136.40
2. BUN	4.675	.001	86.10	6.40	1159.35
3. Systolic blood pressure	-2.300	.106	3.443	.767	15.443
4. Uric acid	-0.001	.639	.999	.997	1.002
constant	-2.820	.038	0.060		
Hypertension groups					
1. Sex	2.246	<.001	9.449	4.080	21.880
2. Age	2.246	<.001	7.345	2.537	21.268
3. BUN	2.637	<.001	13.976	3.584	54.498
constant	-3.391	<.001	0.034		
Diabetics and hypertension groups					
1. Sex	1.554	<.001	4.729	2.023	11.057
2. Age	2.023	<.001	7.561	2.553	22.393
3. BUN	3.332	<.001	27.994	7.467	104.948
4. Uric acid	0.001	0.238	1.001	.999	1.003
constant	-4.021	<.001	0.018		

Discussion

Certain variables have the ability to predict the likelihood of renal insufficiency with a high level of statistical significance. The discussion focused on the following variables: age and BUN in diabetes patients, gender, age, and BUN in blood pressure patients, and gender, age, BUN, and results in diabetic and hypertension patients.

Diabetes and hypertension affect arteriosclerosis, resulting in increased blood pressure in the blood vessels, decreased blood flow to the kidneys, and decreased kidney function (Azizi et al., 2024). In

patients with diabetes and hypertension, there is an increased chance of developing chronic renal failure (Wang et al., 2022). It has been found that renal failure in older DM patients is more common than in younger patients (Fenta et al., 2023; Cheru et al., 2022). With age, the walls of blood vessels thicken, causing the narrowing of blood vessels, resulting in a lack of blood supply to the kidneys and decreased function (Delanaye et al., 2019). Corresponding to a study by Fenta et al. (Fenta et al., 2023), a systematic review and meta-analysis of 20 studies in 13 countries, it was found that the incidence of chronic kidney disease in 27 percent of DM patients.

Females with diabetes are associated with the development of renal impairment more than males. This is consistent with past studies. , women with type 2 diabetes have a higher prevalence of kidney dysfunction than males, with risk factors including aging, high BMI, poor blood glucose control, BUN, and elevated triglyceride levels, as outlined in the study (Afghahi, 2023; Kajiwara et al., 2016; Li et al., 2022; Sulaiman et al., 2021). Waist circumference and vascular stiffness are higher than in males (Earle et al., 2017) and may be associated with reduced estrogen hormone in postmenopausal women, thus reducing arterial flexibility (Shepard, 2019). It may be consistent with decreased estrogen hormone in postmenopausal women, thus reducing the flexibility of the arteries (Shepard, 2019). Nevertheless, the outcomes of this study do not align with the observations that males with hypertension exhibit a greater susceptibility to kidney degradation compared to females. This could be attributed to the fact that younger boys have a diminished level of consciousness regarding the management and regulation of hypertension therapy (Zhang & Moran, 2017). According to a study conducted by Loutradis et al. (Loutradis et al., 2021) males exhibited a higher susceptibility to developing Acute Kidney Injury (AKI) in comparison to females. Moreover, while analyzing the regression equation, it was demonstrated that males have a higher probability of experiencing AKI.

Blood urea nitrogen (BUN) is associated with renal insufficiency in diabetic patients, hypertensive patients, and people with diabetes and hypertension. Urea is a nitrogenous product from protein metabolism, excreted in the urine (Chávez-Íñiguez et al., 2023) is used to evaluate kidney function through urea nitrogen levels. (Kumar & Gill, 2018). Higher BUN is associated with poor blood sugar control and the development of diabetic nephropathy (Bhatia et al., 2019). Diabetes and hypertension contribute to arterial disease that supplies the kidneys, leading to kidney deterioration. In cases of renal insufficiency, the excretion of BUN in the urine reduces, resulting in higher than normal BUN in the blood (Zhang & Moran, 2017; Weiner et al., 2014; Seki el al., 2019).

There are also factors associated with the occurrence of renal insufficiency in diabetics. Hypertension includes hyperlipidemia. Unable to control HbA1C levels and high uric acid levels in the blood, including health literacy, which is associated with good health outcomes. This study may be different from previous studies (Wongprakob et al., 2017; Duan et al., 2019; Silarak et al., 2020; Cha'on et al., 2022; Leawsatianwong et al., 2023; Isaka et al., 2015; Li et al., 2018; Piwpong et al., 2023). This may be because, in this study, most of the subjects had hyperlipidemia and blood pressure within the normal range. The cumulative glucose level variable of the sample averaged 7.50 (S.D. = 2.12), which was a group with mostly uncontrolled stored glucose levels but could not predict the occurrence of renal insufficiency. Further studies may be required for specific patients in this group to determine other relevant factors. Gathering data only from one community may yield restricted conclusions regarding demographic groupings, and retrospective studies have restricted access to additional variables that could impact renal insufficiency.

Conclusion

Age, gender, and blood urea nitrogen (BUN) levels are predictive indicators for the development of renal insufficiency in diabetic patients with hypertension and individuals with both diabetes and hypertension. The healthcare team should persist in performing risk assessments and raising awareness about preventing renal insufficiency in patients with noncommunicable diseases. Additionally, further investigation should be carried out to examine the factors linked to kidney

degeneration in patients who are unable to manage their blood sugar levels. Furthermore, it is vital to have an extensive array of data collection.

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