THE ASSOCIATION BETWEEN DIETARY SODIUM INTAKE, DIALYSIS ADEQUACY, NUTRITIONAL STATUS AND BLOOD PRESSURE AMONG HAEMODIALYSIS PATIENTS IN HOSPITAL PAKAR UNIVERSITI SAINS MALAYSIA (HPUSM)

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By

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Bachelor of Health Science (Honours) (Dietetics)

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DECLARATION

I hereby declare that this dissertation is the result of my own investigations, except where otherwise stated and duly acknowledged. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at Universiti Sains Malaysia or other institutions. I grant Universiti Sains Malaysia the right to use the dissertation for teaching, research and promotional purposes.

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NOOR AIN AMANI BINTI ABDUL RAHANI

Date: 1 JULY 2025

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LIST OF ABBREVIATIONS

CKD	Chronic Kidney Disease
eGFR	Estimated Glomerular Filtration Rate
ESRD	End Stage Renal Disease
CVD	Cardiovascular disease
GFR	Glomerular Filtration Rate
WHO	World Health Organization
DMS	Dialysis Malnutrition Score
HD	Haemodialysis
URR	Urea Reduction Ratio
DM	Diabetes Mellitus
BP	Blood Pressure

HUBUNGAN ANTARA PENGAMBILAN SODIUM DALAM PEMAKANAN, KECUKUPAN DIALISIS, STATUS PEMAKANAN DAN TEKANAN DARAH DALAM KALANGAN PESAKIT HEMODIALISIS DI HOSPITAL PAKAR UNIVERSITI SAINS MALAYSIA (HPUSM)

ABSTRAK

Kajian ini mengkaji hubungan antara pengambilan sodium dalam pemakanan, kecukupan dialisis, status pemakanan dan tekanan darah dalam kalangan pesakit hemodialisis di Hospital Pakar Universiti Sains Malaysia (HPUSM). Kajian keratan rentas ini melibatkan 73 orang pesakit berumur 18 tahun ke atas. Data dikumpulkan melalui soal selidik iaitu, 2 hari rekod diet 24 jam, kecukupan dialisis (Kt/V) dan Skor Malnutrisi Dialisis (DMS). Median pengambilan sodium bagi lelaki ialah 591 mg (IQR: 729 mg) dan bagi perempuan 400 mg (IQR: 526 mg). Median tekanan darah sistolik ialah 166 mmHg (IQR: 35 mmHg) bagi lelaki dan 158 mmHg (IQR: 44.75 mmHg) bagi perempuan. Manakala, median tekanan darah diastolik ialah 80 mmHg (IQR: 21 mmHg) bagi lelaki dan 78.5 mmHg (IQR: 17 mmHg) bagi perempuan. Sebahagian besar peserta mencapai kecukupan dialisis. Nilai median Kt/V ialah 1.3 (IQR: 0.25) bagi lelaki dan 1.4 (IQR: 0.4) bagi perempuan. Tiada perbezaan dalam median DMS antara perempuan (15, IQR: 5) dan lelaki (14, IQR: 5). Hasil kajian ini tidak menunjukkan hubungan yang signifikan secara statistik antara pengambilan sodium, kecukupan dialisis, status pemakanan dan tekanan darah dalam kalangan pesakit hemodialisis. Walau bagaimanapun, untuk lebih memahami faktor-faktor yang mempengaruhi tekanan darah, penyelidikan lanjut disyorkan untuk meneroka penyebab yang berpotensi mempengaruhi hubungan tersebut yang dapat meningkatkan pengurusan diet dalam kalangan pesakit hemodialis.

THE ASSOCIATION BETWEEN DIETARY SODIUM INTAKE, DIALYSIS ADEQUACY, NUTRITIONAL STATUS AND BLOOD PRESSURE AMONG HAEMODIALYSIS PATIENTS IN HOSPITAL PAKAR UNIVERSITI SAINS MALAYSIA (HPUSM)

ABSTRACT

This study investigates the association between dietary sodium intake, dialysis adequacy, nutritional status, and blood pressure among haemodialysis patients in Hospital Pakar Universiti Sains Malaysia (HPUSM). A cross-sectional study was conducted involving 73 patients aged 18 and above. Data were collected through standardised questionnaires, 2-day 24-hour dietary recalls, dialysis adequacy (Kt/V), and Dialysis Malnutrition Score (DMS). The median dietary sodium intake was 591 mg (IQR: 729 mg) in males and 400 mg (IQR: 526 mg) in females. Median systolic blood pressure was 166 mmHg (IQR: 35 mmHg) for males and 158 mmHg (IQR: 44.75 mmHg) for females. Diastolic blood pressure medians were 80 mmHg (IQR: 21 mmHg) for males and 78.5 mmHg (IQR: 17 mmHg) for females. Most participants achieved adequate dialysis. There was no difference in the median DMS between females (15, IQR: 5) and males (14, IQR: 5). The study found no statistically significant association between dietary sodium intake, dialysis adequacy, nutritional status, and blood pressure among the haemodialysis patients. However, to better understand the factors influencing blood pressure and improve patient outcomes, further research is recommended to explore potential causal relationships that can optimise dietary management among haemodialysis patients.

CHAPTER 1

INTRODUCTION

1.1 Background study

The term "chronic kidney disease" (CKD) refers to structural or functional abnormalities of the kidneys that have been present for more than three months and have health implications. CKD is classified based on the cause, estimated glomerular filtration rate (eGFR), and albuminuria category (De Boer et al., 2020). According to the Clinical Practices Guidelines: Management of Chronic Kidney Disease, there are 5 categories of CKD. The first category involves persistent albuminuria and an eGFR of ≥ 90 ml/min/1.73 m^2. The second category involves an eGFR of 60–89 ml/min/1.73 m^2. In the meantime, the third category was split into two groups, known as category 3a and category 3b. Category 3a involves an eGFR of 45-59 ml/min/1.73 m^2, while category 3b involves an eGFR of 30-44 ml/min/1.73 m^2. Category 4 involves an eGFR of 15–29 ml/min/1.73 m^2, and category 5 involves eGFR ≤15 ml/min/1.73 m^2 (CPG: Management of Chronic Kidney Disease, 2018). Although it is commonly understood that CKD can result in end-stage renal disease (ESRD), people with CKD are also more likely to experience mortality from cardiovascular disease (CVD) and other causes (Lim et al., 2014). According to the National Action Plan for Healthy Kidneys (ACT-KID) 2018-2025, CKD is a significant public health concern with an ever-increasing prevalence of CKD and ESRD in Malaysia. In the 2018 National Health and Morbidity Survey, the prevalence of CKD increased from 9.1% in 2011 to 15.5% in 2018 (Ministry of Health Malaysia. 2018. National Action Plan for Healthy Kidneys (ACT-KID) 2018-2025). The past 25 years have also seen a significant increase in the incidence and prevalence of treated ESRD.

Dialysis comes from the Greek words “dia”, which means "through," and lysis, which means "loosening or splitting." It is a type of renal replacement therapy in which artificial machinery is used to remove excess water, solutes, and toxins from the blood, replacing the kidney's filtration function. Dialysis helps individuals whose kidney function is failing quickly to maintain homeostasis, or a stable internal environment or a prolonged, gradual loss that is CKD (Murdeshwar & Anjum, 2023). For the past 20 years, Malaysia has seen an increase in both the incidence and prevalence of ESRD patients. The number of people receiving dialysis is rising due to the increase in haemodialysis treatment facilities and the accessibility with which public or subsidized funding can be obtained, particularly in the nongovernmental sector (Bujang et al., 2017).

The kidney is an important organ for preserving serum sodium level and normal tissue hydration. In haemodialysis patients with impaired or absent kidney function, fluid status is managed by removing excess fluid using ultrafiltration and by restricting dietary sodium intake (Canaud et al., 2019). When kidney function declines, fluids accumulate in the blood and body tissues. The accumulation of fluids causes problems in the patients, such as hypertension related to fluid overloads, increased interdialytic weight gain, and eventually adverse cardiovascular events (Chazot & Jean, 2018). One major clinical issue with ESRD patients is fluid overload. In normal people, excessive fluid will be removed from the body by the increase in urinary excretion (Ipema et al., 2016). Despite this, the glomerular filtration rate (GFR) falls to less than 15 millilitres per minute in ESRD patients. Reduced GFR causes the fluid to be retained in the body as fluid is overloaded (Kamaruzaman & Yee, 2024).

As CKD progresses, hypertension plays a role in both its cause and effect. Hypertension becomes more common and more severe when eGFR decreases. Additionally, hypertension and CKD are both independent risk factors for CVD (Pugh et

al., 2019). High dietary sodium (salt) intake is associated with increased blood pressure (BP) and risk of CVDs, stroke, and kidney disease in adults (Soh et al., 2022). The World Health Organization (WHO) states that less than 2 grams (g/day) of sodium or less than 5 grams (g/day) of salt should be consumed daily. According to a study of hypertensive patients on primary care follow-up over 10 years, the incidence of new CKD was 30.9% (n = 142) with an annual rate of 3% and the BP control rate improved from 15.2% at baseline to 18.9% at 5 years and 41.1% at 10 years (Chia & Ching, 2012).

Patients on dialysis frequently have malnutrition, which gets worse with age. In mild to severe cases, malnutrition affects almost one-third of dialysis patients (Shahrin et al., 2019). Malnutrition is widespread even though haemodialysis extends patients' lives (Goh BL et al., 2015). To give early nutrition management to those who are at risk of malnutrition, nutritional status assessment is a crucial component of care for patients with CKD (Ho & Chan, 2018). The European Best Practice Guidelines (EBPG) on Nutrition and Kidney Disease Outcomes Quality Initiative (K/DOQI) (2000) has suggested that a tool that can be used to detect malnutrition among haemodialysis patients is the Dialysis Malnutrition Score (DMS), also known as the modified Subjective Global Assessment (SGA) (Ling et al., 2018).

1.2 Problem statement

Due to the global pandemic of chronic noncommunicable diseases, including diabetes mellitus and hypertension, as well as the aging of the population, the number of ESRD patients is rising quickly in both developed and industrialized countries (Bujang et al., 2017). As stated by End-Stage Renal Disease: Medical Management (2021), primary care professionals are essential in the diagnosis, monitoring, treatment, and identification of complications associated with chronic kidney disease, as well as in managing modifiable risk factors. According to Levey et al. (2020), most patients choose to treat their ESRD with dialysis.

Since a diet heavy in salt (NaCl) is unhealthy, sodium (Na) is often viewed as being antagonistic to health. However, it seems that the desire for NaCl is an intrinsic mechanism, and consuming more NaCl could help prevent dehydration (Leshem, 2020). There are many risk factors for CVD, and the development of CKD is associated with excessive salt (sodium) intake (Nerbass et al., 2018). Because of that, it is important to maintain the sodium at a proper level for hydromineral homeostasis (Na and fluid balances) along with adaptive mechanisms also required for survival (Bernal et al., 2023). Reduced salt filtration and improper tubular reabsorption suppression are the results of progressive loss of renal function, which eventually contribute to volume expansion (Hung et al., 2014). Edema, hypertension, congestive heart failure (CHF), and left ventricular hypertrophy (LVH) have all been linked to fluid overload, which typically appears in individuals with intermediate to extremely late stages of CKD (Khan et al., 2016). A major issue that this patient group faces aside from that is malnutrition, which has a 28–54% global prevalence (Carrero et al., 2018). In order to provide early nutrition management to those who are at risk of malnutrition, nutritional status assessment is a

crucial component of therapy for patients with chronic kidney disease (CKD) (Ling et al., 2018).

Therefore, we would like to investigate the association between dietary sodium intake, dialysis adequacy, nutritional status, and blood pressure among haemodialysis patients at Hospital Pakar Universiti Sains Malaysia (HPUSM). In addition, the findings of this study may be beneficial in helping the community of haemodialysis patients in Kelantan as well as with family support and community-based health management initiatives.

1.3 Research question

The following questions are look to be answered at the end of the study:

i. What is the mean blood pressure haemodialysis patients in Hospital Pakar Universiti Sains Malaysia (HPUSM)?

ii. What is the mean dietary sodium intake among haemodialysis patients in Hospital Pakar Universiti Sains Malaysia (HPUSM)?

iii. What is the mean dialysis adequacy among haemodialysis patients in Hospital Pakar Universiti Sains Malaysia (HPUSM)?

iv. What is the nutritional status among haemodialysis patients in Hospital Pakar Universiti Sains Malaysia (HPUSM)?

v. Is there a significant association between the dietary sodium intake with blood pressure among haemodialysis patients in Hospital Pakar Universiti Sains Malaysia (HPUSM)?

vi. Is there a significant association between the dialysis adequacy with blood pressure among haemodialysis patients in Hospital Pakar Universiti Sains Malaysia (HPUSM)?

vii. Is there a significant association between nutritional status with blood pressure among haemodialysis patients in Hospital Pakar Universiti Sains Malaysia (HPUSM)?

1.4 Research Objectives

1.4.1 General Objective

To determine the correlation between dietary sodium intake, dialysis adequacy, nutritional status and blood pressure among haemodialysis patients in Hospital Pakar Universiti Sains Malaysia (HPUSM).

1.4.2 Specific Objectives

i. To determine the blood pressure among haemodialysis patients in Hospital Pakar Universiti Sains Malaysia (HPUSM).

ii. To assess the dietary sodium intake among haemodialysis patients in Hospital Pakar Universiti Sains Malaysia (HPUSM).

iii. To determine the dialysis adequacy among haemodialysis patients in Hospital Pakar Universiti Sains Malaysia (HPUSM).

iv. To assess the nutritional status among haemodialysis patients in Hospital Pakar Universiti Sains Malaysia (HPUSM).

v. To determine the correlation between the dietary sodium intake with blood pressure among haemodialysis patients in Hospital Pakar Universiti Sains Malaysia (HPUSM).

vi. To determine the correlation between the dialysis adequacy with blood pressure among haemodialysis patients in Hospital Pakar Universiti Sains Malaysia (HPUSM).

vii. To determine the correlation between nutritional status with blood pressure among haemodialysis patients in Hospital Pakar Universiti Sains Malaysia (HPUSM).

1.5 Research Hypothesis

1.5.1 Hypothesis

Null hypothesis (H_0)

1. There is no correlation between the dietary sodium intake with blood pressure among haemodialysis patients in Hospital Pakar Universiti Sains Malaysia (HPUSM).
2. There is no correlation between the dialysis adequacy with blood pressure among haemodialysis patients in Hospital Pakar Universiti Sains Malaysia (HPUSM).
3. There is no correlation between nutritional status with blood pressure among haemodialysis patients in Hospital Pakar Universiti Sains Malaysia (HPSUM).

Alternative hypothesis (H_A)

1. There is correlation between the dietary sodium intake with blood pressure among haemodialysis patients in Hospital Pakar Universiti Sains Malaysia (HPUSM).
2. There is correlation between the dialysis adequacy with blood pressure among haemodialysis patients in Hospital Pakar Universiti Sains Malaysia (HPUSM).
3. There is correlation between nutritional status with blood pressure among haemodialysis patients in Hospital Pakar Universiti Sains Malaysia (HPUSM).

1.6 Justification of study

The findings of this study will provide information about haemodialysis patients at Hospital Pakar Universiti Sains Malaysia (HPUSM) about their dietary sodium intake, dialysis adequacy, nutritional status, and blood pressure. The focus of this study is to investigate whether the blood pressure can be affected by the dietary sodium intake, dialysis adequacy, and nutritional status of the patients. This study can be important to the community because the prevalence of hypertension among haemodialysis patients is high. This prevalence is also closely related to sodium intake. Excessive sodium intake among haemodialysis patients can lead to fluid overload and elevated blood pressure, thus worsening the health outcome. By investigating the relationship between dietary sodium intake, dialysis adequacy, nutritional status, and blood pressure at HPUSM, we will be able to give beneficial information to patient care, which can help them with more effective dietary intervention and how to balance the fluid status and improve blood pressure control.

1.7 Conceptual Framework

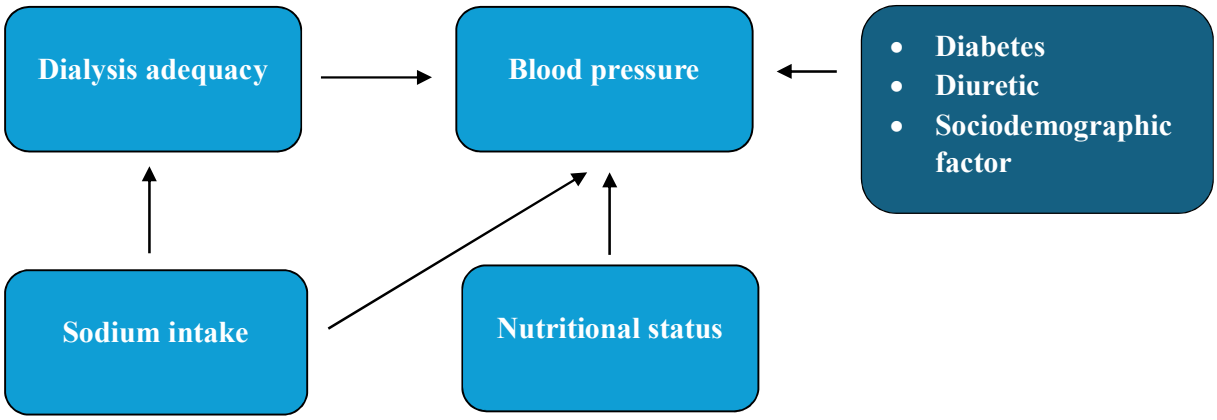

Figure 1: Conceptual framework of cause and effect related to dietary sodium intake, dialysis adequacy, nutritional status and blood pressure among haemodialysis patients.

This study is shown by the conceptual framework in figure 1. It shows the correlation between three independent variables which are sodium intake, dialysis adequacy, and nutritional status, together with blood pressure as the dependent variable. Hypertension is one of the changeable risk factors for heart failure, cardiovascular disease, kidney problems, and stroke (Md Yasin et al., 2023). According to NHMS 2019, the prevalence in people living in rural areas is higher compared to people living in urban counterparts, which is 32.8% vs. 29.2%. It also reported that the prevalence of the lowest socioeconomic class (B40 or Bottom 40%) is higher (30.8%) compared to the higher economic class (T20 or Top 20%), which is only 22.7%. Other than that, the prevalence is also different between ethnic groups in Malaysia, where Bumiputera (indigenous) Sarawak (46.8%), Malays (32.2%), Bumiputera Sabah (31.0%), Indians (30.6%), and Chinese (28.1%). The prevalence of overall raised blood pressure among age groups between 20-24 years old is reported at 5.7%. (95% CI: 4.09, 7.82) Meanwhile, it shows the highest prevalence of overall blood pressure among the age group 75 years old and

above, which is 81.7% (95% CI: 77.03, 85.55). This shows prevalence of overall raised blood pressure increased with age. This prevalence shows that sociodemographic factors can be the risk factors of elevated blood pressure in Malaysia. These results also indicate that sociodemographic characteristics are significant risk variables that cannot be changed and may interact with other clinical factors that may be affecting blood pressure in this investigation.

The second factor influence the changes of blood pressure is sodium intake. Sodium enhances the flavours of food and is beneficial to human health. However, due to their busy lifestyles, people often consume excessive amounts of sodium. Adult Malaysians continue to consume a remarkably high proportion of high-sodium foods despite the negative impacts of excessive salt intake on health (National Health and Morbidity Survey, 2019). An adult Malaysian consumes 3.17 grams of sodium on average per day, 1.17 grams more than the World Health Organization's recommended intake (National Health and Morbidity Survey, 2019). A low-salt diet has been demonstrated to lower blood pressure, and a study by Tan, (2018) indicates that essential hypertension is largely observed in countries where salt intake is above 100 mmol/day (2.3 g sodium). The most recent KDIGO clinical practice guidelines, published in 2021, recommended that patients with high blood pressure and CKD aim for a sodium consumption of less than 2 grammes per day or less than 90 mmol of sodium per day, or less than 5 grammes of sodium chloride per day (Mann et al., 2021). There has been much discussion over the pathophysiological relationship between salt consumption and elevated blood pressure. Consuming more salt may cause water retention, which would result in increased arterial artery flow. It has been suggested that the mechanism of pressure natriuresis is a physiological phenomenon in which elevated blood pressure in the renal arteries leads to increased excretion of salt and water. (Grillo et al, 2019). Therefore, sodium intake is

considered a key dietary factor that may affect blood pressure among haemodialysis patients in this study.

The third factor is dialysis adequacy, measured by Kt/V. Patients are required to maintain optimal BP and fluid volume control in their dialysis adequacy. The involvement of small molecular weight compounds such as urea and electrolytes will result in a greater blood flow rate in the diffusion mechanism during HD. The concentration gradients for diffusion are further reduced by the quick clearance of these materials. Furthermore, they have an impact on dialysis adequacy because they directly affect the dialysis machine pump speed, which indicates the volume available for material exchange with dialysis fluid. The amount of blood available for exchange with the dialysate is reflected in the blood flow, which is directly impacted by the dialysis machine pump speed (TAYYEBI et al., 2012). In addition, chronic fluid overload can trigger the hypertension and left ventricular hypertrophy (Pinter et al., 2020). According to Mamat et al. (2012), it is essential to eliminate excess fluid for regulating BP and protecting the heart among HD patients. According to this conceptual framework, adequate dialysis adequacy is seen as an important treatment-related aspect that affects blood pressure control.

The fourth factor is nutritional status. According to the American Heart Association (2017), malnutrition is characterized as both overnutrition and undernutrition, or an excess of nutrients. A study conducted in Malaysia also shows haemodialysis patients had an equal prevalence of moderate malnutrition; moreover, about 73% of dialysis patients suffered from moderate malnutrition (Harvinder et al., 2013). Hypertension is linked to deteriorating cardiovascular parameters and damage to target organs in haemodialysis patients. Furthermore, there were several pieces of evidence showing that malnutrition also influences the development of left ventricular hypertrophy (LVH). In ESRD patients, volume excess and malnutrition are commonly

associated. According to a study by Kürşat et al. (2007), increased left ventricular mass index and hypervolemic cardiovascular markers (increased left atrial volume and decreased vena cava inferior collapsibility index) are related to a decline in nutritional status in HD patients (Tekçe et al., 2013).

In conclusion, dietary sodium intake, dialysis adequacy, and nutritional status are important aspects that are related and also affect BP control among HD patients. Sodium consumption also directly affects the fluid retention, which can further alter the nutritional status and BP. Since sodium consumption and BP are related, controlling the intake of sodium levels is important for managing hypertension. Even if each component has the potential to be important, it is yet unclear how much of an impact they will have overall and in relation to one another, especially in the Malaysian haemodialysis community. Thus, the aim of this research is to examine the relationship between blood pressure, nutritional condition, dialysis adequacy, and dietary sodium intake in haemodialysis patients.

CHAPTER 2

LITERATURE REVIEW

2.1 Prevalence of chronic kidney disease in Malaysia

The Kidney Disease Outcomes Quality Initiative (KDOQI) defines CKD as kidney damage or a GFR less than 60 mL/min/1.73 m^2 for a duration of three months or longer, regardless of the underlying cause. Albuminuria, which is defined as an albumin-to-creatinine ratio of greater than 30 mg/g in two out of three spot urine specimens, is a sign of kidney impairment in many renal disorders (Levey et al., 2005). As reported by Goh et al. (2014), the prevalence of CKD increased in Malaysia from 13,479 per million people in 2004 to 20,589 per million people in 2008. Malaysia had 37,183 dialysis patients in 2015, which was a two-and-a-half-fold increase from 15,087 in 2006. In 2006, there were only 3,710 new dialysis patients who were admitted. This number has increased to 7,597 in 2014. The equivalent incidence and prevalence of patients on dialysis were 249 and 1,220 per million population in 2015 (Wong et al., 2018). With a prevalence of 1059 patients per million population (pmp) in 2016, HD is the most prevalent form of renal replacement therapy (RRT) in Malaysia. Peritoneal dialysis (PD) and renal transplantation (RT) are the next most common types, with 127 and 59 patients per million population (pmp), respectively (Malaysian Society of Nephrology, 2015). In 2016, there were 1814 patients with functional renal transplanted grafts, 35,781 patients receiving haemodialysis, and 3930 receiving peritoneal dialysis. In Malaysia, the prevalence of haemodialysis and peritoneal dialysis between 2007 and 2016 has increased by 2.3 and 2.5 times, respectively. However, there has been no change in the prevalence of renal transplantation (Malaysian Society of Nephrology, 2015).

According to research by Saminathan et al. (2020), major related factors to CKD were diabetes mellitus, hypertension, BMI, and advancing age. The 24th Report of the Malaysian Dialysis and Transplant Registry 2016 also stated the incidence of new dialysis patients with diabetes mellitus in Malaysia has risen from 44% in 2000 to 65% in 2016. In medical settings, CKD screening initiatives should give priority to these high-risk populations. As per the Ministry of Health (2016) and the National Strategic Plan for Non-Communicable Disease (NSPNCD) 2016–2025, early detection and the implementation of suitable measures can potentially stop or slow the progression of CKD to the next stage and minimise its potential cardiovascular complications.

2.2 Risk factor of chronic kidney disease

CKD is a prevalent, quiet, and frequently misdiagnosed illness. In 2011, the Malaysian National Health and Morbidity Survey found that 9.07% of people had chronic CKD; however, only 4% of participants were aware they had the condition (Hooi, L. et al., 2013). A significant risk factor for coronary events and death is CKD (Briasoulis & Bakris, 2013). According to Johnson et al. (2013), kidney function declines less quickly by up to 50% with early detection and proper therapy. Meanwhile, excess sodium causes extracellular volume in patients with advanced CKD, which can result in heart failure and hypertension. According to Garofalo et al. (2018), a low-sodium diet is essential for maintaining hydro-saline homeostasis, which lowers both systolic and diastolic blood pressure and proteinuria. This is showing that a high sodium diet is another risk factor. The CPG: Management of Chronic Kidney Disease (2018) presents a comprehensive list of risk factors that may contribute to the development of CKD. CKD has been linked to diabetes mellitus (DM). Additionally, hypertension may contribute to or result from CKD and promote the development of renal disease, leading to ESRD. For this reason, those who have both hypertension and diabetes mellitus should get a CKD screening at least

once a year. People over 65 have a higher chance of developing CKD; thus, screening is crucial, at least once a year. People who have atherosclerosis may easily be exposed to CKD. Throughout a 2-year follow-up, patients with atherosclerotic vascular disease had a 1.4-fold increased chance of developing chronic kidney disease (CKD) compared to those without the condition. Patients also have a 40% increased risk of chronic kidney disease (CKD) over a 25-year follow-up if they have a family history of renal disease in first-degree relatives. (CPG: Management of Chronic Kidney Disease, 2018).

In Malaysia, several sociodemographic factors influence CKD. Age is one of the sociodemographic characteristics that has a major impact on CKD in Malaysia. Older persons are more vulnerable to CKD since its prevalence rises with age. Hooi et al. (2013) found that the prevalence of CKD increases with age. For instance, the risk of CKD is increased in older persons, especially those over 65. Additional research by Saminathan et al. (2020) demonstrates that the risk of CKD rises with every passing year. According to research, getting older is an important factor that is linked to an increased risk of developing CKD. In this study, which included people who were 18 years of age and older, it suggests that CKD is more common in later age groups. Thus, showing CKD was significantly more common in older persons than in younger people.

2.3 Sign and symptoms of chronic kidney disease

People with CKD may be varied from others depending on the stages that they develop. Some people might remain in stable condition with CKD, but some might be getting worse, which can lead to end-stage renal disease (ESRD) (Cheo et al., 2022). According to Vassalotti et al. (2015), signs such as ESRD, cardiovascular disease, and mortality are some of the long-term effects of chronic kidney disease. The incidence and prevalence of CKD and ESRD have been increasing over the past two decades in