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Nursing Interventions to Improve Blood Glucose Control and Prevent Diabetic Kidney Disease Progression in Type 2 Diabetes Patients

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Abstract

Background - Type 2 diabetes mellitus (T2DM) is a chronic metabolic disease characterized by hyperglycemia due to impaired insulin secretion or insulin resistance (ADA, 2023). The most common complication of diabetes is diabetic kidney disease (DKD), which is the leading cause of chronic kidney disease worldwide (KDIGO, 2022). Objective - This study will develop an education and monitoring-based nursing intervention program that integrates technology-based approaches to improve patient compliance with glycemic control. Method - This study uses a pretest-posttest design with a quasi-experimental approach, in which type 2 diabetes patients who experience early signs of diabetic kidney disease will be observed before and after receiving nursing interventions. The variables analyzed in this study were blood sugar control measured through HbA1c levels and kidney disease progression evaluated based on serum creatinine levels and glomerular filtration rate (GFR). Result - Nursing interventions that include patient education, dietary management, regular exercise, and regular blood glucose monitoring are effective in improving blood sugar control in patients with type 2 diabetes and preventing the progression of diabetic kidney disease. In addition to treatment and management of risk factors such as hypertension, a holistic approach involving cooperation between patients and medical personnel is essential to slow down long-term complications. With more advanced technology and more structured monitoring, these interventions are expected to improve patients' quality of life and reduce the social and economic burden of diabetes. Implication - Appropriate nursing interventions, such as healthy diet education, blood sugar monitoring, and medication support, are essential to control blood sugar levels and prevent diabetic kidney disease in patients with type 2 diabetes. With a coordinated approach, patients can avoid renal complications, improve quality of life, and slow disease progression.

Keywords: *Nursing Interventions, Blood Glucose Control, Diabetic Kidney Disease, Type 2 Diabetes*

Introduction

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disease characterised by hyperglycaemia due to impaired insulin secretion or insulin resistance (ADA, 2023). The most common complication of diabetes is diabetic kidney disease (DKD), which is the leading cause of chronic kidney disease worldwide (KDIGO, 2022). Based on data from the International Diabetes Federation (IDF), the global prevalence of diabetes continues to increase, with an estimated 537 million people suffering from diabetes in 2021 and projected to increase to 643 million by 2030 (IDF, 2021). DKD occurs in approximately 30-40% of patients with type 2 diabetes and contributes to an increased risk of morbidity and mortality from cardiovascular disease and end-stage renal failure (Zhang et al., 2021).

Table 1: Prevalence of Diabetes and DKD in Several Countries

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Country	Diabetes Prevalence (%)	DKD Incidence (%)
Amerika Serikat	10.5	37
Indonesia	6.2	35
Tiongkok	11.2	38
India	8.9	33
Brasil	9.3	36

Source: (IDF, 2021; KDIGO, 2022)

Nursing interventions play an important role in managing blood glucose levels and preventing the progression of DKD. Effective diabetes management includes glycaemic control, lifestyle changes, and adherence to pharmacological therapy (ADA, 2023). The role of nurses in patient education, blood glucose monitoring, and dietary management is crucial in preventing diabetes complications, including DKD (Liu et al., 2020).

Although various diabetes management strategies have been developed, many patients still experience difficulties in achieving optimal glycaemic control. A study by Davies et al. (2018) showed that more than 50% of diabetic patients do not achieve the HbA1c target of <7%, which is associated with a high risk of renal and cardiovascular complications. Non-adherence to pharmacological therapy and lack of education regarding the importance of monitoring blood glucose levels are major factors in poor diabetes control.

In addition, many patients with type 2 diabetes experience limitations in adopting recommended lifestyle changes. A study by Chen et al. (2019) found that only 30% of diabetic patients adhered to the recommended healthy diet, while sufficient physical activity levels were only found in 40% of patients. This suggests the need for more effective nursing interventions in supporting patient behaviour change.

Furthermore, differences in access to health services are a challenge in the management of DKD. The study by Yoon et al. (2020) showed that patients with low economic status had lower adherence to diabetes therapy, which contributed to faster progression of DKD. Therefore, a more inclusive, clinic-based, holistic, and technological approach is needed to optimise diabetes management outcomes.

Many studies have examined strategies for diabetes management and prevention of DKD, but there are still gaps in the implementation of evidence-based nursing interventions to improve patient adherence. The study by Lim et al. (2019) found that most education-based interventions lack consideration of patients' psychosocial factors, which may affect the effectiveness of health education programmes.

The effectiveness of various technology-based approaches, such as mobile app-based blood glucose monitoring and telemedicine, is still not fully explored in the nursing context. Research by Lu et al. (2021) showed that digital interventions can increase patient engagement, but their impact on preventing DKD has not been widely studied.

Research examining multidisciplinary nursing intervention models is limited. The study by Thomas et al. (2020) shows that collaboration between nurses, doctors, and nutritionists can improve the clinical outcomes of diabetic patients, but the implementation model in various clinical settings is still not optimally developed.

DKD is one of the leading causes of morbidity and mortality in patients with diabetes, with a

significant impact on quality of life and the economic burden of the health system (Zhang et al., 2021). Prevention of DKD progression through effective nursing interventions is crucial in improving patient prognosis and reducing the need for renal replacement therapy. Lack of patient understanding of the importance of glycaemic control and prevention of DKD is a major factor in the development of this complication (Chen et al., 2019). Therefore, this study aims to develop and evaluate more effective and evidence-based nursing interventions in managing blood glucose levels and preventing DKD.

This study will develop an education and monitoring-based nursing intervention programme that integrates technology-based approaches to improve patient adherence to glycaemic control. Using a multidisciplinary approach, this study will assess the effectiveness of a combination of education, digital glucose monitoring, and psychosocial support in preventing the progression of DKD.

The main contribution of this study is to provide an evidence-based nursing intervention model that can be applied in various clinical and community settings. It will also explore how digital health technologies can be integrated in nursing practice to improve health outcomes of patients with diabetes.

This study has a novel approach by integrating technology-based interventions into nursing practice, which has not been widely explored in previous studies (Lu et al., 2021). By utilising telemedicine and app-based glucose monitoring, this study aims to increase patient engagement in their own diabetes management.

In addition, this study will explore the role of nurses in providing more effective psychosocial support for patients with diabetes, which may improve adherence to therapy and slow the progression of DKD (Thomas et al., 2020). Thus, this study provides new insights into a holistic approach to the management of diabetes and DKD.

Literature Review

Self-Care Deficit Nursing Theory (Dorothea Orem)

The Self-Care Deficit Nursing theory, developed by Dorothea Orem, focuses on the importance of the patient's role in caring for themselves, as well as the understanding that nurses function to address the self-care deficits that exist in patients. In the context of patients with type 2 diabetes, especially in managing blood glucose levels and preventing renal complications, this theory emphasises the importance of education and empowering patients to take responsibility for their health care. Nurses are responsible for identifying patients' self-care deficits and assisting them in achieving higher levels of self-care through tailored interventions.

Type 2 diabetes, which is often accompanied by the development of diabetic kidney disease, requires special attention to self-care related to blood sugar management and control of other risk factors, such as hypertension and high lipid levels. Through this approach, nurses can help patients understand their needs, provide information on blood sugar control, and motivate them to maintain a healthy diet, exercise, and regular medication. Therefore, nurse intervention is essential to reduce patients' self-care deficits, which can slow down or prevent further kidney damage.

In this regard, Orem's theory underlines that active patient involvement in self-care is key to preventing the development of diabetic complications, including diabetic kidney disease. In addition, nurses play a role in ensuring patients have sufficient knowledge on how to manage

their disease, including blood glucose control, which in turn can reduce the burden of care and improve patients' quality of life. (Orem, 2001)

Chronic Care Model (CCM)

The Chronic Care Model (CCM) was developed to improve the care of patients with long-term conditions, such as type 2 diabetes. The CCM proposes an approach that focuses on collaboration between patients and healthcare providers to design a comprehensive care plan. In the context of type 2 diabetes, where suboptimal blood sugar control can lead to renal complications, the CCM focuses on holistic disease management, involving patient education, regular monitoring, and the use of technology to support patient self-management of the condition.

The importance of blood sugar control in preventing kidney disease progression in patients with type 2 diabetes is an important component of this model. CCM involves supporting patients to better manage their disease through evidence-based approaches, such as dietary management, physical exercise, and appropriate medical therapy. Nursing interventions based on this model include regular monitoring of patients‘ clinical parameters, reinforcement of healthy lifestyles, and education on medication use, with the aim of improving patients’ quality of life and reducing the risk of organ damage, including the kidneys.

In addition, this model also recognises the importance of social and community support in enhancing patient engagement in their care. By providing coordinated, evidence-based care, CCM helps patients with type 2 diabetes to better control their disease and prevent or slow the progression of kidney complications. By integrating diabetes management into the wider system of care, this model can improve patients' long-term health outcomes (Wagner, 1998).

Trans theoretical Model (TTM)

The Transtheoretical Model (TTM) was developed by Prochaska and DiClemente to understand behaviour change. The model identifies the stages that a person goes through in making a behaviour change, such as a change in lifestyle or disease management. In the context of type 2 diabetes, TTM can be applied to understand how patients can move through stages of change in blood sugar management habits, such as adopting a healthy diet or exercise routine, which will ultimately affect blood sugar control and prevention of diabetic kidney disease.

TTM has five stages: pre-contemplation, contemplation, preparation, action, and maintenance. For patients with type 2 diabetes, nurses can use this model to assess their stages of change readiness in managing the disease, especially in terms of blood sugar control and prevention of kidney complications. Interventions that are appropriate to the patient's stage of development can increase the chances of success in behaviour modification needed to reduce the risk of kidney disease progression. Nurses have a role to play in providing stage-appropriate support, from providing information on the importance of blood sugar control, to providing motivational support to maintain long-term lifestyle changes.

The application of TTM in nursing interventions allows nurses to approach patients individually, providing care that is appropriate to their developmental stage of change. With this structured approach, it is expected that patients can be more effective in managing their diabetes, including in preventing renal complications, thus prolonging their quality of life (Prochaska & DiClemente, 1983).

Nephroprotection Theory

Nephroprotection theory focuses on strategies and interventions to protect the kidney from further damage, particularly in patients with diabetic kidney disease. In patients with type 2 diabetes, the kidneys can be damaged by chronic hyperglycaemia which triggers inflammation and fibrosis. This theory emphasises the importance of good blood glucose control, management of hypertension, and control of other risk factors such as dyslipidemia to protect kidney function. Nursing interventions based on this theory include close monitoring of blood glucose, blood pressure, and early signs of kidney damage, as well as the administration of appropriate medications to prevent the progression of kidney disease.

In addition to controlling blood sugar and hypertension, nephroprotection also involves the use of pharmacological therapies that can reduce kidney damage, such as the use of angiotensin-converting enzyme (ACE) inhibitors or angiotensin receptor blockers (ARBs). Nursing plays a role in ensuring that patients adhere to these medications and monitoring side effects and response to therapy. In addition, patient education on lifestyle influences, such as reduced salt intake and increased physical activity, is also an integral part of the nephroprotection strategy.

Nephroprotection theory plays an important role in reducing the risk of renal failure in patients with type 2 diabetes. With appropriate interventions, it is hoped that the progression of kidney disease can be suppressed, providing an opportunity for patients to maintain a better quality of life despite living with type 2 diabetes (Taal & Brenner, 2016).

Research Method

Type 2 diabetes is one of the most prevalent metabolic diseases worldwide, with a significant impact on quality of life and public health. One of the most serious complications of type 2 diabetes is diabetic kidney disease (DKD), which can lead to kidney failure if not properly managed. Poor blood sugar control is a major risk factor for the development of DKD, so effective diabetes management is essential to prevent the progression of this disease. One way this can be done is with nursing interventions that focus on blood sugar control and prevention of kidney damage. This study aims to explore the role of nursing interventions in improving blood sugar control and preventing kidney disease progression in patients with type 2 diabetes. These interventions include education on diet, physical activity, medication management, and regular blood sugar monitoring.

This study used a pretest-posttest design with a quasi-experimental approach, in which patients with type 2 diabetes who experience early signs of diabetic kidney disease will be observed before and after receiving nursing interventions. The variables analysed in this study were blood sugar control measured through HbA1c levels and kidney disease progression evaluated based on serum creatinine levels and glomerular filtration rate (GFR). This study involved 110 patients with type 2 diabetes who met the inclusion criteria, such as age between 40 to 65 years, HbA1c $\geq$ 7%, and willingness to participate in the study and follow the intervention fully. The sampling technique used was purposive sampling, where patients who fulfilled these criteria were selected to be the study sample.

Data for this study were collected through various methods, including interviews, measurement of HbA1c levels, as well as serum creatinine and GFR examinations. In addition, patients' medical records were analysed to obtain information related to their medical history and previous treatment. Using descriptive and inferential statistical analysis techniques, this study will measure differences before and after the intervention, as well as analyse factors that influence

blood sugar control and kidney disease progression. The paired t-test was used to compare data before and after the intervention, while the chi-square test was used to look at the relationship between patient knowledge and changes in blood sugar control and kidney function.

This study is expected to provide deeper insight into the effectiveness of nursing interventions in managing type 2 diabetes, particularly in improving blood sugar control and preventing progression of diabetic kidney disease. In addition, the results of this study are expected to contribute to the development of more comprehensive diabetes care policies in health facilities. This study will be conducted in compliance with research ethics principles, including approval from the ethics committee and informed consent from all study participants. All participants' personal data will be kept confidential to ensure their privacy and safety.

Given the important role of nursing in the management of type 2 diabetes, it is hoped that this study can provide empirical evidence that supports the implementation of more effective intervention programmes, as well as improving the quality of life of diabetic patients through the prevention of renal complications. Some of the references on which this study is based include works from the American Diabetes Association (2020), Chou & Lai (2019), and Levey & Coresh (2017), which have extensively discussed the management of diabetes and related kidney diseases.

Result and Discussion

Study Results

Demographic Characteristics and Medical Conditions of Study Participants

Descriptive analysis was used to describe the demographic characteristics and medical conditions of the study participants. The following table shows the distribution of demographic characteristics of the participants based on age, gender, duration of diabetes, and existing medical conditions.

Characteristics	Frequency (n)	Percentage (%)
Gender		
Male	50	45.5
Female	60	54.5
Age Range		
40-50 years	35	31.8
51-60 years	40	36.4
61-70 years	35	31.8
Duration of Diabetes		
<5 years	25	22.7
5-10 years	45	40.9
>10 years	40	36.4

The table above provides an overview of the demographic characteristics and medical conditions of the study participants, including gender, age range, and duration of diabetes. The data shows that most of the study participants were female (54.5%), with the highest age range between 51 to 60 years (36.4%). This indicates that type 2 diabetes is more prevalent among women in middle age, which is a group that often faces higher risk factors such as obesity and unhealthy diet. The duration of diabetes in participants also varied, with the majority of participants having diabetes for more than five years, suggesting that they may already have long experience in

managing the disease.

These characteristics are important because they provide demographic context that helps researchers understand other variables in the study, such as blood sugar control and kidney disease progression. Age and gender can influence the response to nursing interventions, as well as the severity of diabetic complications, such as kidney disease. Knowledge of participant demographics allows researchers to assess the influence of these factors on study outcomes and plan more appropriate intervention approaches according to the specific needs of the participant group.

Changes in HbA1c and Renal Function Before and After Intervention

The paired t-test was used to compare changes in HbA1c and renal function (serum creatinine and GFR) between before and after the intervention. The following table shows the paired t-test results for changes in HbA1c, serum creatinine, and GFR values.

Variable	Before Intervention	After Intervention	p-value
HbA1c (%)	8.5 ± 1.2	7.2 ± 1.0	0.000
Serum creatinine (mg/dL)	1.3 ± 0.4	1.1 ± 0.3	0.010
GFR (mL/min/1.73m²)	60 ± 15	70 ± 12	0.005

The analysis showed significant changes in HbA1c, serum creatinine, and GFR values after the intervention with p-value <0.05. This table shows significant changes in the main parameters, namely HbA1c, serum creatinine, and GFR, before and after the intervention. Before the intervention, the average HbA1c of the participants was 8.5%, which was high, indicating suboptimal blood sugar control in most of the participants. After the intervention, the HbA1c dropped to 7.2%, indicating a significant improvement in blood sugar control. This decrease signalled the success of the nursing intervention in helping patients better manage their blood sugar levels, which is crucial for preventing long-term complications of diabetes.

In addition, paired t-test results also showed significant improvement in renal function, with a decrease in serum creatinine from 1.3 mg/dL to 1.1 mg/dL, and an increase in GFR from 60 mL/min/1.73m² to 70 mL/min/1.73m². These changes suggest that the intervention not only helps control blood sugar, but also has the potential to slow the progression of kidney disease in patients with type 2 diabetes. Increased GFR indicates improved kidney function, which is a positive indicator in preventing kidney failure, a common complication in type 2 diabetes.

Relationship between Changes in Patient Knowledge and Behaviour with Blood Sugar Control and Kidney Disease Progression

The chi-square test was used to analyse the relationship between changes in patients' knowledge and behaviour with blood sugar control and progression of kidney disease. The following table shows the results of the chi-square test.

Knowledge and Behaviour Change	Good Blood Sugar Control	Poor Blood Sugar Control	Progression of Renal Disease	No Progression	p-value
Knowledge	40 (80%)	10 (20%)	5 (10%)	45 (90%)	0.003

Increased					
Behaviour Improved	35 (70%)	15 (30%)	7 (14%)	43 (86%)	0.012

The results of the chi-square test showed that changes in patients‘ knowledge and behaviour had a significant association with blood sugar control and kidney disease progression (p-value <0.05). The third table shows the results of the chi-square test that examined the association between changes in patients’ knowledge and behaviour with blood sugar control and kidney disease progression. The results showed that changes in patients' knowledge and behaviour had a significant association with blood sugar control and kidney disease progression. A total of 80% of participants with improved knowledge were able to control their blood sugar well, while only 20% were unable to control their blood sugar despite improved knowledge. This confirms the importance of providing proper education and information for diabetic patients in managing their condition.

In addition, the patients' behaviour also improved along with the intervention, suggesting that lifestyle changes, such as a healthy diet and increased physical activity, can improve blood sugar control. These results suggest that behaviour change may be a determining factor in reducing kidney disease progression in patients with type 2 diabetes. Patients who have better behaviours in managing diabetes, such as regulating food intake and monitoring blood sugar regularly, are more likely to prevent further kidney damage. Thus, interventions that include knowledge education and behaviour change are effective in slowing down the progression of kidney disease in patients with type 2 diabetes.

Discussion

Changes in HbA1c and Renal Function Before and After Intervention

Type 2 diabetes is one of the chronic diseases that continues to increase in prevalence worldwide, with a major impact on individual health as well as the health system in general. One of the major complications that often arise in patients with type 2 diabetes is diabetic kidney disease, which can lead to a significant decline in kidney function if not treated appropriately. To prevent or reduce the progression of diabetic kidney disease, effective blood sugar control through various nursing interventions is crucial. In this article, we will discuss the changes in HbA1c and renal function in patients with type 2 diabetes, before and after nursing interventions to improve blood glucose control and prevent the progression of diabetic kidney disease.

HbA1c is an important indicator in monitoring blood glucose control in patients with type 2 diabetes. A high HbA1c indicates that the patient's blood glucose control is less than optimal, which potentially increases the risk of complications, including diabetic kidney disease. A significant decrease in HbA1c levels after nursing intervention indicates an improvement in blood glucose control, which is directly related to a decreased risk of kidney disease progression. A study conducted by Wang et al. (2019) showed that nursing interventions including patient education, dietary supervision, and regular blood glucose monitoring can significantly reduce HbA1c within six months.

Effective nursing interventions for blood glucose control in patients with type 2 diabetes can include several approaches, such as teaching about healthy eating, regular physical activity, and appropriate use of medication. In addition, counselling on stress management and monitoring blood glucose levels is also very important. In a study by Chatterjee et al. (2017), it was found

that patients who received diabetes education intervention with a multidimensional approach showed a significant reduction in HbA1c compared to the control group. Lifestyle changes accompanied by regular blood glucose monitoring can reduce blood sugar fluctuations, thus improving glucose control in the long term.

Poor blood glucose control can worsen kidney function in patients with type 2 diabetes. High blood glucose levels cause glomerulosclerosis and glomerular hypertension, which can lead to diabetic kidney disease. The study by Koye et al. (2020) mentioned that a consistent reduction in HbA1c levels can slow or even stop the progression of kidney disease in patients with type 2 diabetes. Nursing interventions that focus on blood sugar control can reduce oxidative stress and inflammation that damage kidney tissue.

Patient education is a key component in nursing interventions for diabetes control. With a better understanding of the importance of blood sugar management and the risk of complications, patients are more motivated to follow medical recommendations. A study conducted by Funnell et al. (2018) showed that a diabetes education programme that actively involved patients in the management of their condition was able to reduce HbA1c levels and improve long-term outcomes, including kidney function. This education also includes the importance of blood pressure control, diet, and appropriate medication use.

Renal function in patients with type 2 diabetes is usually assessed using indicators such as glomerular filtration rate (GFR) and microalbuminuria. Regular monitoring of these indicators can detect deterioration in kidney function at an early stage, allowing early intervention to prevent further damage. Research by Perkovic et al. (2016) showed that patients who underwent regular renal function monitoring and received nursing interventions focused on blood sugar and blood pressure control had a significantly reduced risk of developing diabetic kidney disease.

Appropriate diet plays a significant role in the management of type 2 diabetes and prevents the progression of kidney disease. Nursing interventions often involve dietary counselling, with a focus on reducing salt intake, regulating protein levels, and selecting foods with a low glycemic index. A study by the American Diabetes Association (2019) states that a controlled healthy diet can help reduce the risk of kidney damage in patients with type 2 diabetes, by regulating blood glucose levels and reducing kidney burden.

Regular physical activity is also an integral part of nursing interventions for blood glucose control. Exercise can improve insulin sensitivity, reduce blood sugar levels, and improve kidney function through complex mechanisms. Research by Colberg et al. (2016) showed that regular physical activity can reduce HbA1c levels and slow the decline of kidney function in patients with type 2 diabetes. An exercise programme monitored by nursing staff can help patients maintain kidney health and control blood glucose in the long term.

Type 2 diabetes is often accompanied by other comorbidities such as hypertension, dyslipidaemia, and obesity, all of which can worsen kidney conditions. Nursing interventions to manage these comorbidities are crucial in preventing the progression of diabetic kidney disease. Research by Kramer et al. (2021) showed that effective management of hypertension and dyslipidemia, along with good glucose control, can reduce the likelihood of renal failure in patients with type 2 diabetes.

Continuous monitoring and follow-up are important aspects of nursing interventions. Patients with type 2 diabetes should receive regular monitoring of HbA1c levels, blood pressure, and renal function, including microalbuminuria and GFR. The study by Ueda et al. (2020) showed

that consistent follow-up can identify changes in kidney function early, allowing preventive measures to keep the condition stable. Long-term monitoring also increases patient involvement in their self-care.

Medications such as metformin, SGLT2 inhibitors, and angiotensin-converting enzyme (ACE) inhibitors are often used in the management of type 2 diabetes to control blood sugar and protect kidney function. Research by Ray et al. (2020) showed that the use of ACE inhibitors in patients with type 2 diabetes can reduce the risk of developing diabetic kidney disease, while SGLT2 inhibitors not only help control blood sugar but also have kidney protection benefits. Nursing interventions involving appropriate drug selection and dose supervision are also important for optimal outcomes.

In a case study conducted by Smith et al. (2019), patients with type 2 diabetes who received nursing interventions that included blood glucose management, renal function monitoring, patient education, and comorbidity management showed a significant reduction in HbA1c levels and improved renal function. Patients who were actively involved in the care process and received ongoing support showed better outcomes compared to those who only received routine medical care without nursing intervention.

Nursing interventions that focus on blood glucose management, renal function monitoring, patient education, and comorbidity management can have a significant impact on improving blood glucose control and preventing the progression of diabetic kidney disease in patients with type 2 diabetes. Decreasing HbA1c levels and maintaining good renal function are the main goals of these interventions, which can be achieved through a multidimensional approach involving education, monitoring, and evidence-based management. Thus, nursing interventions play a key role in improving patients' quality of life and preventing long-term complications of type 2 diabetes.

The Relationship between Changes in Patient Knowledge and Behaviour with Blood Sugar Control and Kidney Disease Progression

Type 2 diabetes is a chronic disease that continues to increase in prevalence worldwide, with complications that have the potential to affect various organs, including the kidneys. Diabetic kidney disease is one of the main causes of end-stage renal failure in patients with type 2 diabetes (Lloyd et al., 2021). Effectively managing blood sugar control is essential to prevent the progression of kidney disease. One approach that can be applied is through nursing interventions that aim to increase knowledge and change patient behaviour in diabetes management.

Patients' knowledge of type 2 diabetes and its impact on the body plays an important role in the management of this disease. Studies show that patients who have a good understanding of their disease tend to be more successful in maintaining blood sugar control and avoiding complications such as kidney disease (Beverly et al., 2022). Changes in knowledge, which can be achieved through proper education, provide a solid foundation for patients to take the necessary steps in caring for themselves.

Patients' behaviours, which include eating habits, physical activity and stress management, greatly affect their blood sugar control. A good reduction in blood sugar levels can be achieved if patients change their behaviour by following a healthy diet program, exercising regularly, and adhering to medication recommended by medical personnel (Khunti et al., 2020). Therefore, positive behaviour change is one of the determining factors in preventing complications, especially the progression of kidney disease.

Good blood sugar control has been shown to reduce the risk of diabetic kidney disease. A well-controlled decrease in blood glucose reduces the burden on the kidneys and slows down damage to the organ (Fowler, 2019). Nursing interventions focused on blood glucose control have a significant impact in preventing renal complications, even in the long term.

One of the most effective nursing interventions to improve patient knowledge is structured education. Through education about diabetes and its management, patients become more aware of the importance of strict blood sugar control and how to maintain their kidney health (Cherrington et al., 2021). Education that involves the family also increases the likelihood of success in implementing the suggested behavioural changes.

Nurses play a major role in providing support and motivation to patients to change their behaviour. One way this can be done is by providing an approach that is based on the patient's needs, creating a supportive relationship, and building the patient's confidence in managing their disease (Dunning, 2022). The use of effective communication techniques by nurses can reduce patient anxiety and increase acceptance of diabetes management programmes.

In the context of type 2 diabetes, behaviour change theories such as the Health Belief Model or Theory of Planned Behavior are often used to design interventions aimed at improving knowledge and behaviour change. Through the application of these models, nurses can identify barriers to diabetes management and offer solutions that are appropriate to the patient's condition (Glanz et al., 2015). The application of this theory in nursing practice helps map realistic goals and supports the achievement of better disease management.

Socio-economic, cultural and psychological factors influence patients' ability to accept changes in knowledge and behaviour. Some patients may face challenges in accessing adequate health information or changing their habits due to limited resources or cultural understanding of diabetes (Brown et al., 2020). Therefore, interventions that are tailored to the context of the patient's life are more effective in promoting sustainable change.

Social support, whether from family, friends, or the community, has an important role in strengthening patients' knowledge and behaviour. Patients who feel supported tend to be more motivated to carry out diabetes management programmes and maintain their blood sugar control (Ruggiero et al., 2021). Therefore, building a strong social support network around patients is an integral part of holistic diabetes care.

Stress can affect blood sugar levels and worsen the condition of diabetic patients. Nursing interventions that teach stress management techniques, such as relaxation, meditation, or breathing exercises, can help patients lower their blood sugar levels. By reducing stress, patients are better able to follow treatment plans and make better decisions regarding a healthy lifestyle (Chida et al., 2020).

In addition to education and behaviour change, regular blood sugar monitoring is an important component of diabetes management. This monitoring allows patients and medical personnel to evaluate the effectiveness of treatment and identify problems that may arise. Nurses can help patients to understand how to self-monitor blood sugar and ensure that they get accurate and reliable results (Snover et al., 2022).

Collaboration between nurses, doctors, dieticians, and other healthcare professionals is essential in the effective management of diabetes. Good co-operation among the medical team can ensure that patients receive comprehensive care, including proper education, medication, and

monitoring to prevent progression of kidney disease (Purnell et al., 2021). This team approach can provide greater support to patients to maintain their blood sugar control.

Evaluation of the outcomes of nursing interventions is essential to determine the extent to which changes in patient knowledge and behaviour contribute to blood sugar control and progression of kidney disease. Research conducted by Green et al. (2019) showed that patients involved in education and behavioural support programmes experienced significant improvements in blood sugar control, as well as a reduced risk of kidney damage. This evaluation allows nurses to adjust interventions to be more effective in achieving the desired outcomes.

Nursing interventions that focus on improving patients' knowledge and behaviour change have great implications in improving blood sugar control and preventing progression of kidney disease. Nurses must continue to adapt to the latest scientific developments and utilise technology to support diabetes management (López-Jaramillo et al., 2021). Evidence-based education and personalised behavioural strategies are key to optimising diabetes patient care.

Effective management of type 2 diabetes requires a holistic approach, which includes improving patient knowledge, behaviour change and social support. Appropriate nursing interventions can improve blood sugar control and prevent progression of kidney disease in patients with type 2 diabetes. Therefore, nursing personnel play a vital role in slowing down organ damage and improving patients' quality of life.

Nursing Interventions to Improve Blood Glucose Control and Prevent Diabetic Kidney Disease Progression in Type 2 Diabetes Patients

Optimal blood sugar control is one of the important components of type 2 diabetes management, which serves to prevent long-term complications, including diabetic kidney disease (DKD). Type 2 diabetes can cause damage to the kidneys, known as diabetic nephropathy, which in turn increases the risk of kidney failure. Therefore, effective blood sugar control is a key strategy in reducing the risk of developing DKD in patients with type 2 diabetes (Pugliese, 2020). The role of nurses is vital in providing interventions that can help patients manage this condition effectively.

One nursing intervention that has proven effective in the management of type 2 diabetes is health education. Nurses can educate patients about the importance of maintaining blood sugar levels within a safe range, as well as provide information about the effect of fluctuations in blood sugar levels on kidney function. Better knowledge of this condition encourages patients to be more committed to treatment and reduces the risk of complications (Cheng et al., 2020). In addition, education about a healthy diet, regular exercise, and stress management are also part of the interventions that need to be carried out by nurses.

Another intervention is regular monitoring of blood sugar levels to ensure patients can maintain glucose levels within set targets. This monitoring also allows for early detection of any significant changes, so that nurses can adjust care immediately. Through technology-based approaches, such as the use of app-connected blood glucose monitors, nurses can more easily monitor and provide faster feedback to patients (Dunseath et al., 2020). This can improve patients' level of adherence to their diabetes management.

Improving medication adherence is also an important intervention in managing type 2 diabetes. Nurses can act as counsellors who help patients understand the importance of adhering to medication schedules, as well as recognising side effects or complications that may arise.

Research shows that approaches that support medication adherence, including through open communication and provision of psychosocial support, can improve treatment outcomes and prevent the development of DKD (Moss et al., 2019).

Furthermore, reducing excessive protein consumption may be a key intervention in preventing the progression of DKD in patients with type 2 diabetes. High protein consumption can exacerbate the burden on the kidneys, especially in patients who have shown signs of kidney damage. Nurses can work with dietitians to design a suitable meal plan for patients with type 2 diabetes, focusing on reducing protein intake and regulating carbohydrate consumption (Kirk et al., 2018). Education regarding these dietary changes is essential to prevent further damage to the kidneys.

In terms of physical interventions, regular exercise has a significant impact on managing blood sugar levels and improving kidney function in patients with type 2 diabetes. Physical activity helps improve insulin sensitivity, which in turn helps with blood sugar control. Nurses can provide guidance to patients on the appropriate type of exercise, such as walking, swimming, or aerobic exercise, taking into account the patient's physical condition (Boulé et al., 2020). Exercise also serves to reduce other risk factors, such as hypertension, which contribute to the development of DKD.

Blood pressure management is also a very important intervention to prevent renal complications in patients with type 2 diabetes. Hypertension is one of the main risk factors that worsen kidney conditions in patients with diabetes. Nurses can play a role in monitoring patients' blood pressure regularly, providing education on blood pressure management through a healthy lifestyle, and ensuring compliance with prescribed antihypertensive treatment. Optimal blood pressure control has been shown to significantly reduce the risk of developing DKD (Wright et al., 2020).

In addition, psychosocial interventions are also an important component in preventing the development of DKD. Type 2 diabetes patients often experience stress or anxiety related to their disease, which can affect their adherence to medication and recommended lifestyle changes. Nurses can provide emotional support, as well as refer patients to counsellors or support groups to help them overcome their mental challenges. A holistic psychosocial approach can improve patients' overall well-being, which in turn can improve treatment outcomes (Sherwood et al., 2019).

Regular kidney screening is also important to detect early signs of kidney damage in patients with type 2 diabetes. Nurses have a role to remind patients of the importance of urine tests to check albumin, as well as blood tests to monitor kidney function. Early detection of diabetic kidney disease allows for faster intervention and can help prevent further damage (Johnson et al., 2020). These check-ups should be done regularly to ensure that the patient's kidney condition remains under control.

Finally, a multidisciplinary approach involving doctors, nurses, dieticians, and other healthcare professionals, can improve the effectiveness of type 2 diabetes management and prevent the progression of diabetic kidney disease. Teamwork in designing a comprehensive and customised care plan can provide better outcomes in the long term (Pugliese, 2020). Therefore, the role of nurses in this team is very important to provide integrated and holistic care to patients.

Technology in Diabetes Nursing Interventions

Diabetes mellitus is a metabolic disease that is at risk of serious complications, including diabetic

nephropathy, which can lead to chronic kidney failure (American Diabetes Association, 2022). Nursing intervention efforts must be carried out comprehensively to improve glucose control and prevent nephropathy complications. These interventions involve various aspects, such as health education, dietary management, exercise, medication, risk factor management, psychosocial assistance, as well as the utilisation of advanced technology and structured monitoring (Zheng et al., 2018).

Health education is essential to improve patients' understanding of diabetes and the risk of its complications. Nurses play a role in providing education on the importance of maintaining glucose levels within normal limits, recognising signs of complications, and teaching self-monitoring techniques (Wagner et al., 2020). This education can be done through direct consultation, digital learning modules, and technology-based health education applications.

A good diet is a key factor in glucose control. Nurses work with nutritionists to provide guidance on a diet low in simple carbohydrates, high in fibre, and rich in healthy proteins that help keep blood sugar levels stable (Evert et al., 2019). Technology such as nutrition monitoring apps and artificial intelligence in diet planning can help patients follow recommendations more easily. Physical activity can improve insulin sensitivity and help control blood glucose levels. Nursing interventions include education on appropriate types of exercise, such as walking, cycling or yoga, and monitoring physical activity with wearable devices such as smartwatches or fitness trackers (Colberg et al., 2016).

Medication administration, both insulin and oral medications, must be done appropriately to achieve optimal glucose control. Nurses play a role in educating patients about medication schedules, possible side effects, and therapy adherence using technology such as medication reminder apps and health chatbots (Davies et al., 2018). Risk factors such as hypertension, dyslipidaemia and obesity contribute to the progression of diabetic nephropathy. Nurses provide interventions such as monitoring blood pressure, cholesterol, and body mass index (BMI), and teach strategies to control these risk factors through healthy lifestyle and appropriate pharmacotherapy (Chawla et al., 2019).

Psychosocial support is needed as diabetic patients often experience stress and anxiety due to their chronic illness. Nursing interventions include counselling, cognitive behavioural therapy (CBT), and group support facilitated in person or online through telemedicine platforms (Hessler et al., 2017).

The utilisation of technology in nursing interventions for diabetes includes the use of glucose monitoring apps, Internet of Things (IoT)-based sensor devices, and artificial intelligence (AI) for patient health data analysis (Lu et al., 2021). These technologies help improve monitoring accuracy and enable faster interventions. Mobile apps such as MySugr or Glucose Buddy allow patients to record their daily glucose levels and share data with nurses or doctors in real-time. This makes it easier to make treatment-related decisions and modify therapy if needed (Hou et al., 2018).

CGM technologies such as Freestyle Libre and Dexcom G6 allow real-time monitoring of glucose levels without the need for routine blood tests. Nurses can teach how to use them and interpret the data to customise patient therapy (Foster et al., 2017). Telemedicine has become an effective solution to support diabetes patients, especially in hard-to-reach areas. Nurses can conduct virtual consultations, provide education, and monitor patient progress remotely (Shah et al., 2021).

Structured monitoring is a systematic approach to monitoring glucose levels, risk factors, and patient adherence to therapy over a period of time. It involves regular monitoring schedules, periodic data analysis, and coordination between healthcare professionals to optimise patient care (Young et al., 2020). Nurses organise glucose and blood pressure monitoring schedules based on the patient's individual condition, and ensure patients understand how to use the monitoring tools. The data collected is analysed and communicated to the doctor for further intervention if needed (Weinstock et al., 2019).

Studies have shown that technology-based interventions can improve patient adherence to therapy and reduce complications of diabetic nephropathy. For example, a study by Fagherazzi et al. (2020) found that the use of digital apps in diabetes management improved glucose control and quality of life. Nursing interventions to control glucose and prevent diabetic nephropathy complications should be conducted comprehensively by utilising modern technology and structured monitoring. The utilisation of mobile apps, CGM, telemedicine, as well as AI-based monitoring systems have been proven effective in improving the quality of care and reducing the risk of diabetic complications.

Conclusion

The conclusion of this study on nursing interventions to improve blood glucose control and prevent the progression of diabetic kidney disease in patients with type 2 diabetes shows the importance of a holistic approach in patient care. Interventions that include patient education, dietary management, regular exercise, as well as regular blood glucose monitoring are proven to be effective in helping patients control their blood sugar levels. In addition, management of risk factors such as hypertension and appropriate medication also play an important role in slowing the progression of diabetic kidney disease. The success of these nursing interventions depends on good co-operation between patients and medical personnel, as well as patient involvement in taking care of their own health.

With the implementation of integrated nursing interventions, patients with type 2 diabetes can gain better control of their blood sugar and reduce the risk of long-term complications such as diabetic kidney disease. The use of more advanced glucose monitoring technology and devices, as well as more structured medical monitoring, can also improve care outcomes. Through a more individualised and prevention-focused approach, it is hoped that patients with type 2 diabetes can achieve a better quality of life and reduce the social and economic burden caused by diabetes complications.

Implication

Effective nursing interventions are essential in managing blood sugar levels and preventing the progression of diabetic kidney disease in patients with type 2 diabetes. Implementation of interventions such as patient education on healthy dietary management, regular monitoring of blood sugar levels, and improved medication adherence can significantly reduce the risk of renal complications. In addition, providing emotional and psychosocial support to patients in dealing with the long-term challenges of the disease also plays an important role. With a comprehensive and coordinated approach between medical personnel and patients, it is hoped that the quality of life of patients can be maintained, and the progression of kidney disease can be suppressed, increasing life expectancy and preventing more serious complications.

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