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Knowledge of Compliance in Taking Medication for Patients with Type 2 Diabetes Mellitus and Hypertension: A Review

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Abstract
Introduction: Type 2 diabetes mellitus (T2DM) and hypertension are leading contributors to global morbidity. One prevalent comorbidity among people with diabetes is hypertension. Patients with T2DM who have hypertension are at a 7.2 times higher risk of mortality and mortality to experience macrovascular and microvascular complications. Compliance with taking medication is one of the supporting factors for the success of pharmacological therapy which is the management and prevention of complications of type 2 Diabetes Mellitus and hypertension which should be accompanied by adequate knowledge.
Objectives: This study aims to systematically review the relationship between patient knowledge and medication adherence in individuals with type 2 Diabetes Mellitus and hypertension based on findings from peer-reviewed literature.
Method: The design of this research is a literature review with data sourced from PubMed, Wiley, Science Direct, Scopus, Sinta, and Google Scholar.
Results: Based on the literature review, there were 13 relevant articles from 1392 articles. The study found that knowledge is related to the compliance of patients with type 2 Diabetes Mellitus and hypertension.
Conclusion: High knowledge tends to be in line with high patient medication compliance and vice versa.

Keywords: Patient Knowledge; Medication Compliance; Type 2 Diabetes Mellitus; Hypertension.

Introduction

Globally, the prevalence of people suffering from Type 2 diabetes mellitus (T2DM) and hypertension has increased over the years. In 2019, around 9.3% of the global population (463 million people) had diabetes, based on regional and global diabetes prevalence statistics. It is estimated that the prevalence will increase to 10.2% (578 million) by 2030 and 10.9% (700 million) by 2045, contributing to 4.6 million deaths worldwide. Diabetes is linked to high rates of morbidity and death in the twenty-first century, which presents a considerable obstacle for the healthcare system. One prevalent comorbidity among people with diabetes is hypertension. Patients with T2DM who have hypertension are at a 7.2 times higher risk of mortality and are more likely to experience macrovascular and microvascular complications (Kefale *et al.*, 2020).

According to the International Diabetes Federation (IDF) in 2021, globally an estimated 537 million people suffer from DM, which is expected to increase to 643 million in 2030 and to 783 million in 2045, it is also estimated that more than 6.7 million people aged 20-79 years will die from DM and more than 1.2 million children and adolescents (up to 19 years) suffer from type 1 DM. Type 2 DM is the most common type of DM, accounting for more than 90% of all DM worldwide, globally the prevalence of Type 2 Diabetes Mellitus (T2DM) is high and continues to increase in all regions, this increase is influenced by population aging, economic development and increasing urbanization which tends to lead to unhealthy lifestyles such as sitting more and consuming less healthy foods and lifestyles that are widely associated with obesity, the incidence of T2DM is common in the Pima and Navajo Native Americans, Aboriginal and Torres Strait Islander people in Australia and indigenous Canadians, in Southeast Asia, it is estimated that 1 in 11 adults (90 million) suffer from Diabetes Mellitus (DM), and will increase to reach 113 million people in 2030 and to 151 million in 2045. DM causes 747,000 deaths in 2021 in Southeast Asia. Based on data from this source, it is also known that Indonesia is ranked 5th out of 10 countries worldwide with the largest number of adults (20-79 years) suffering from Diabetes Mellitus in 2021 and 2025, namely 19.5 million people with the number of undiagnosed cases of 14.3 million people (73.7%) and is estimated to increase in 2045 to 28.6 million cases of DM (International Diabetes Federation, 2021).

The risk of coronary heart disease, stroke, renal disease, and retinopathy is greatly increased in diabetic patients when hypertension coexists. Patients with chronic diseases, particularly those that are asymptomatic, such as hypertension and diabetes mellitus, are more likely to be non-compliant. One main significant factor in medication nonadherence is knowledge of the importance of adherence (Saraiva *et al.*, 2020).

The World Health Organization (WHO) defines DM as a chronic hyperglycemic condition that results in Fasting Blood Glucose (FBS) levels ≥ 7.0 mmol/l. This serious disease occurs when the pancreas does not produce enough insulin, or when the body cannot use insulin effectively. Insulin is a hormone that regulates blood glucose levels, which are used to produce energy (Kheriji *et al.*, 2023).

The risk of retinopathy, nephropathy, cerebrovascular incidents, and cardiovascular illness is greatly increased as diabetes and hypertension coexist. Worldwide, the number of people suffering from diabetes who also have high blood pressure is increasing. The results of cardiovascular disease can be significantly reduced by managing hypertension in diabetics. (Baiee & Makai, 2022). The co-occurrence of hypertension in diabetes individuals greatly raises their chances of developing renal disease, retinopathy, coronary heart disease, and stroke (Prasad & Kumar, 2021).

DM is associated with hypertension, DM sufferers are often accompanied by hypertension, and high blood pressure is closely related to increased circulating fluid volume and peripheral vascular resistance. Patients with diabetes mellitus experience increased peripheral arterial resistance caused by vascular remodeling and increased body fluid volume associated with hyperinsulinemia and hyperglycemia caused by insulin resistance (Ohishi, 2018).

The occurrence of hypertension in patients with diabetes mellitus is caused by hyperglycemia in patients with diabetes mellitus which can increase angiotensin II so that it can cause increased blood pressure or hypertension, the emergence of this hypertension can then cause further complications such as coronary heart disease, diabetic nephropathy, and diabetic retinopathy. Type 2 diabetes mellitus and hypertension are two chronic diseases that are quite common in society and are often found simultaneously in one patient because both diseases are degenerative diseases, namely diseases that arise due to a decrease in the function or structure of body tissues or organs that progressively over time due to age or lifestyle choices. Without good and accurate treatment, these two complications will end with the risk of death

due to cardiocerebrovascular and kidney failure (Husni *et al.*, 2022).
Hypertension (high blood pressure) occurs when the pressure in the blood vessels is too high (140/90 mmHg or higher). Diabetes mellitus and hypertension are the most common cardiovascular diseases and risk factors worldwide, and their frequency increases with age (Tsimihodimos *et al.*, 2018) The incidence of hypertension in the world in 2021 is estimated at 1.28 billion adults aged 30-79 years worldwide suffer from hypertension, most of whom (two-thirds) live in low- and middle-income countries (World Health Organization, 2023)
One of the treatments for T2DM and hypertension is through pharmacological therapy, the success of treatment is influenced by compliance with taking medication, Compliance with treatment is the success of patients in taking medication according to what is prescribed by the doctor (Mpila *et al.*, 2023).
Previous studies found that knowledge is associated with diabetes mellitus and hypertension diseases. Unfortunately, most of them revealed the general result and focus with each disease and still limited. The novelty of this study is that the authors tried to combine two diseases into one and find the result of the relationship between knowledge to compliance in taking medication. Some studies showed that knowledge increased compliance in taking medication, but it needs to be accompanied by adequate knowledge. Knowledge is a very important domain for the formation of actions. The elements needed include an understanding of what is being done, beliefs about the benefits and truth of what is being done, and the means needed to do it. Good knowledge about when and how to carry out therapy will help someone to always behave obediently towards the therapy (Sumantri, 2024). Therefore, this study aims to review the relationship between knowledge and medication adherence in patients with T2DM and hypertension.

Methodology

The design of this study is a literature review. It contains a study of the theoretical description of the results or findings of research that discusses the relationship between knowledge and medication adherence in patients with T2DM and hypertension. The data in this study were collected from various comprehensive databases, including PubMed, Wiley, Science Direct, Scopus, Sinta, and Google Scholar. The search used relevant keywords and Medical Subject Headings (MeSH) such as "knowledge of patients with type 2 Diabetes Mellitus and Hypertension", and "medication adherence in type 2 Diabetes Mellitus and Hypertension". The inclusion criteria were articles related to the topic, original or primer study, provided pdf file, and published between 2020-2025. In this study, the authors determined 13 articles that were following the topic to be studied from 1392 articles (Figure 1).
This narrative review synthesizes findings from existing studies to explore the relationship between knowledge and medication adherence in patients with T2DM and hypertension.

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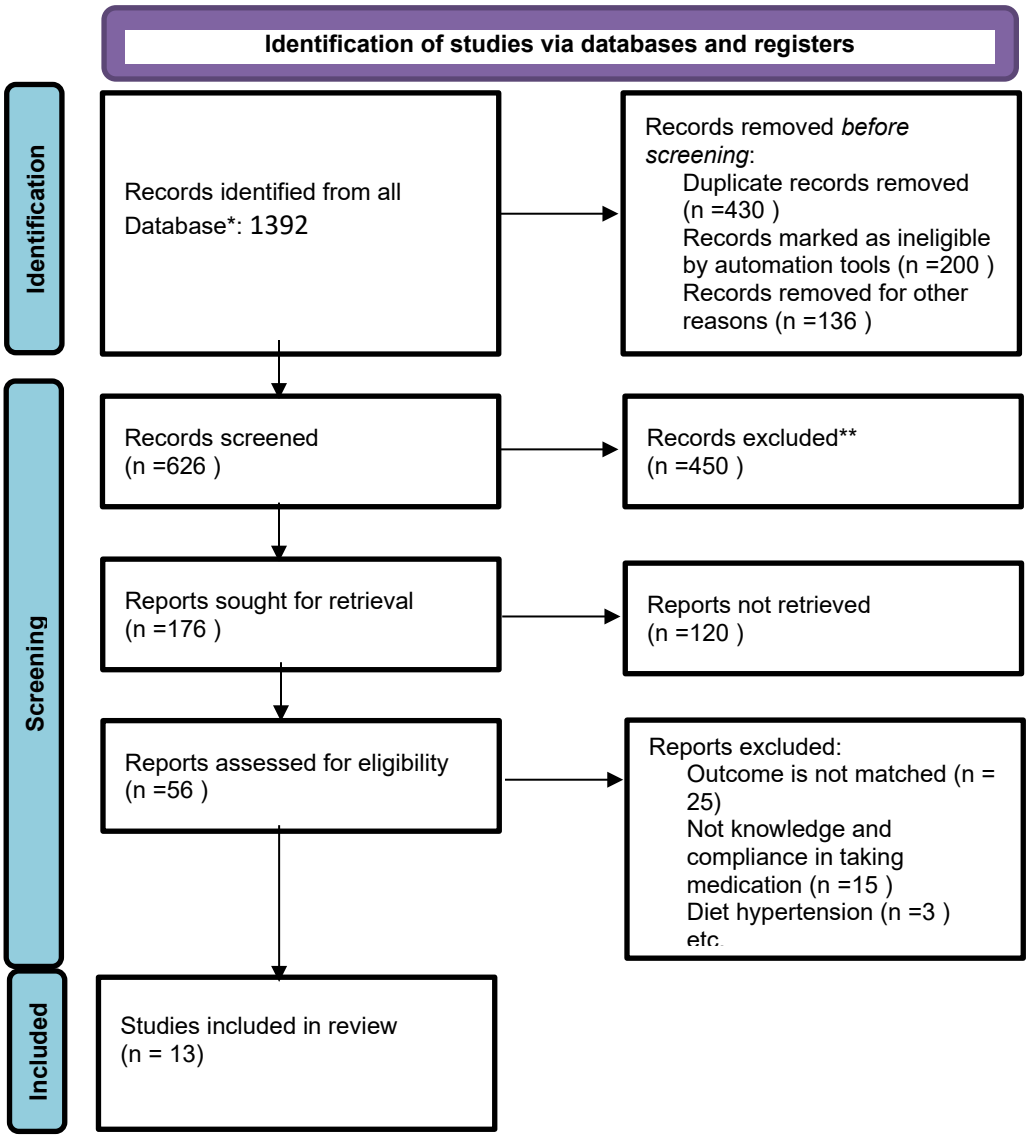

Figure 1. PRISMA flow diagram

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Results

Knowledge is related to medication adherence in patients with T2DM and hypertension (Table 1).

Table 1. Summary of Article Search

Author	Results	Study Type
(AlShayban *et al.*, 2020) Saudi Arabia	There is a significant relationship between knowledge and compliance in taking medication in type 2 diabetes mellitus patients with a positive and weak to moderate correlation (p <0.001; r = 0.0221)	Cross- Sectional Study
(Marito & Lestari, 2021) Indonesia	There is a relationship between the level of knowledge and compliance with type 2 Diabetes Mellitus treatment (p = 0.002; r = 0.0468)	Cross- Sectional Study
(Septyadina & Gunawan, 2021) Indonesia	There is a relationship between knowledge and compliance with type 2 diabetes mellitus treatment (p = 0.04)	Cross- Sectional Study
(Pristianty *et al.*, 2023) Indonesia	Patient knowledge is related to compliance with the treatment of patients with hypertension (p = 0.007; r = -0.331).	Cross- Sectional Study
(Oktadiana *et al.*, 2023) Indonesia	There is a very strong and unidirectional significant relationship between the level of knowledge about hypertension and the level of compliance with taking medication (p = 0.004; r = 0.900).	Cross- Sectional Study
(Dhrik et al., 2023) Indonesia	There is a significant relationship between knowledge and compliance in taking medication in hypertension patients (p= 0.004; r = 0.321).	Cross- Sectional Study
(Sevani et al., 2024) Indonesia	The results of this study showed that there was a significant relationship between knowledge about diabetes mellitus and treatment compliance in patients with type 2 diabetes mellitus (p = 0.001).	Cross-Sectional Study
(Sumantri, 2024) Indonesia	There is a relationship between knowledge and compliance in taking medication in type 2 Diabetes Mellitus patients (p = 0.001).	Cross-Sectional Study
(Piran *et al.*, 2024) Indonesia	There is a relationship between the level of knowledge and compliance in taking medication for Diabetes Mellitus patients (p = 0.000)	Cross- Sectional Study
(Ramadhani & Heart, 2024) Indonesia	There is a relationship between the level of knowledge and compliance in taking medication in type 2 Diabetes Mellitus patients (p = 0.000, r= 0.562)	Cross Sectional Study

(Selvia Yolanda Dalimunthe & Daulay, 2024) Indonesia	The results of this study indicate that there is a relationship between knowledge factors and medication compliance in type 2 Diabetes Mellitus patients (p = 0.047).	Cross-Sectional Study
(Aditya et al., 2024) Indonesia	There is a relationship between knowledge and compliance in taking medication for type 2 Diabetes Mellitus patients (p = 0.017) and an Odds Ratio (OR) of 0.010 indicating that respondents who have high knowledge tend to be more compliant with treatment compared to respondents who have low knowledge.	Cross-Sectional Study
(ALruwaili, 2024) Saudi Arabia	The results of this study showed that there was a positive correlation between knowledge and medication compliance in patients with hypertension (Spearman's rho = 0.312, ρ value = 0.002).	CrossSectional Study

Discussion

Research conducted by AlShayban *et al.* (2020) evaluated the relationship between knowledge about diabetes mellitus disease and compliance with treatment for outpatients in 3 community pharmacies located in the city of Khobar, Saudi Arabia for 3 months. Knowledge was measured using the Arabic version of the Revised Diabetes Knowledge Questionnaire (DKT-2) and measurement of medication compliance using The General Medication Adherence Scale (GMAS), knowledge about the disease is a determinant of medication compliance because patients who have more than average knowledge are 4-5 times more likely to be compliant with treatment, the knowledge score and compliance with treatment of the disease reported in Saudi Arabia were not satisfactory because only less than 60 percent had a high compliance and the majority of knowledge levels are only average, increasing health literacy is still a challenge for the Saudi Arabian population.

Research conducted by Marito & Lestari (2021) analyzed the relationship between the level of knowledge with compliance with taking medication for type 2 Diabetes Mellitus patients at the Sibabangun Health Center, Central Tapanuli Regency, North Sumatra Province, Indonesia with a sample of 58 people. From the study, it was obtained that the level of knowledge is in line with compliance with type 2 Diabetes Mellitus treatment, patients with low knowledge also have a low level of treatment compliance, namely 11 people, patients who have moderate knowledge have a moderate level of treatment compliance, namely 12 people, patients who have a high level of knowledge have a high level of knowledge, namely 8 people and there are no patients who have low knowledge but have a high level of treatment compliance. In the study, patients with type 2 diabetes mellitus who have good knowledge are able to identify the factors that cause diabetes mellitus, namely lack of rest, obesity, and eating sweet foods, while patients with poor knowledge are characterized by not knowing what things can increase blood sugar levels, symptoms of diabetes mellitus, about diabetes mellitus and signs of diabetes mellitus. Diabetes mellitus patients need to get the information provided including basic knowledge about diabetes mellitus, complications, management during illness, physical activity, meal planning, foot care, and the causes of high blood glucose levels.

Similarly, the research conducted by Septyadina & Gunawan (2021) determined the relationship between knowledge and medication adherence in type 2 Diabetes Mellitus patients at the Regional General Hospital of South Bangka Regency, Indonesia, with a total of 102

respondents undergoing treatment, knowledge measurement was carried out using the DKQ-24 questionnaire and medication adherence based on the Morisky 8-item medication adherence scale (MMAS) based on the study, the results obtained were patients with a poor level of knowledge of 27 people (26.5%), a sufficient level of knowledge of 28 people (27.5%), a good level of knowledge of 47 people (46%), the level of medication adherence, namely non-compliant 73 people (71.6%) and compliant 29 people (28.4%). One of the causes of non-compliance with medication is low socioeconomic status because it can affect the opportunity to get the right treatment, this is due to the cost of treatment and transportation costs, in addition, patient visits to healthcare facilities are also indirectly related to exposure to health education that can be provided by health workers which results in a lack of knowledge and motivation for patients to seek treatment so that compliance with treatment such as taking antidiabetic drugs is low.

Patients can understand when someone has hypertension and experiences symptoms of high blood pressure. Compliance is an important factor in determining the results of patient therapy, delays in early detection and inadequate treatment can cause complications of hypertension (Pristianty *et al.*, 2023).

Health workers have an important role in helping patients learn more about drugs, by providing information to patients about drugs and non-drugs (lifestyle). For instance, a pharmacist can improve patient understanding of the drugs consumed by patients (Oktadiana *et al.*, 2023). Patients who have knowledge related to symptoms, development, disease control and the process of hypertension treatment can control themselves and increase awareness to be more compliant with the treatment they are undergoing (Dhrik *et al.*, 2023).

The work of Sevani *et al.* (2024) also analyzed the relationship between knowledge and medication adherence in patients with type 2 diabetes mellitus in the Antang Health Center Work Area, Makassar City, Indonesia on July 10 - August 10, 2023, with a sample of 62 patients. To measure patient knowledge, a questionnaire about DKQ-24 knowledge was used which contains 24 dichotomous scale question items and to measure the level of patient medication adherence, MMAS-8 was used with 8 dichotomous scale questions and one Likert scale question. Based on this study, it was also found that knowledge is in line with the level of medication adherence. Patients with good knowledge tend to have a high level of medication adherence and patients with less knowledge tend to have a low level of medication adherence. Patient non-compliance with medication can be caused by many factors or reasons such as forgetting to take medication due to decreased memory, patients feeling healthy so they don't take medication anymore, fear of experiencing kidney problems due to taking a lot of medication and feeling bored with the routine of taking medication.

Other studies have shown that the level of knowledge possessed by patients will encourage patients to comply with treatment and listen to instructions from health workers (Aditya *et al.*, 2024; Dalimunthe & Daulay, 2024; Piran *et al.*, 2024; Ramadhani & Heart, 2024; Sumantri, 2024)

People who work in the private sector and live in urban areas had a higher level of compliance than others. People in the private sector had continuous health monitoring, the availability of additional incentives, and more commitment to maintaining health for a better position while those living in urban areas have a higher level of compliance due to the availability and accessibility of health information sources (ALruwaili, 2024)

Behavior that can reduce the risk of complications in diabetes sufferers can be determined by knowledge. If the patient's knowledge is good regarding diabetes mellitus, then the patient's behavior toward the management of diabetes mellitus will also be good, as will compliance with taking medication which determines the success of diabetes mellitus treatment (Marito & Lestari, 2021).

T2DM and hypertension are global health problems that are one of the main causes of death in various cases of health problems. The importance of prevention and management efforts is something that needs to be prioritized, one of the efforts that can be done is to increase knowledge and compliance in taking medication for patients with diabetes mellitus type 2 and hypertension. Knowledge and compliance in taking medication have a parallel relationship, Knowledge is the basis for the emergence of action, a person's knowledge of something is the beginning of decision-making in acting, when individuals know it will provide a policy impetus to take action, but if individuals do not know it can cause mistakes in decision making or action and even neglect because they do not consider something necessary or unnecessary to do. The higher a person's knowledge about something is generally in line with the accuracy of the actions taken, and vice versa, the lower a person's knowledge will be in line with errors in a person's actions, so health education to increase the knowledge of patients with T2DM and hypertension which is in line with treatment compliance needs to be prioritized.

Conclusions

Knowledge is related to medication compliance in T2DM and hypertension patients, knowledge is in line with medication compliance, patients who have sufficient to high knowledge generally have a high level of medication compliance and conversely patients who have low or insufficient knowledge also have a low level of medication compliance.

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