Profile of Education Level and Understanding of Insulin Therapy in Type 2 Diabetes Mellitus Patients With Insulin Therapy at RSUD dr. M. Soewandhi Surabaya

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Abstract. This study examines the relationship between education level and understanding of insulin therapy among type 2 diabetes mellitus patients undergoing insulin therapy at RSUD dr. M. Soewandhi Surabaya. Using a descriptive observational method with a cross-sectional design, data were collected from interviews and medical record observations from 100 patients aged 15-64. The findings reveal that most patients had low educational backgrounds, with 27% never attending school and 39% only completing high school. Regarding insulin therapy comprehension, 10% demonstrated good understanding, 55% moderate, and 35% poor. The highest comprehension was insulin usage rules, while the lowest was injection techniques. The study underscores the need for tailored health education to improve patient understanding, particularly for low-education groups. Limitations of the study include the single-site setting and potential response biases from interviews. Future research should expand to include diverse populations and examine non-educational factors influencing therapy comprehension, such as cultural and economic conditions.

Keywords Education Level, Insulin Therapy, Type 2 Diabetes, Patient Understanding, Health Education.

1. INTRODUCTION

Diabetes mellitus (DM) is a metabolic disorder characterized by increased blood glucose levels that exceed normal limits or hyperglycemia. Increased blood glucose levels occur because the body cannot produce the hormone insulin, cannot use insulin effectively, or both (IDF, 2021; WHO, 2019). Hyperglycemia can be a serious problem if not treated immediately because it results in ketoacidosis, which can cause death (Gosmanov *et al.*, 2021). Therefore, "*Prevention is better than cure*" means it is better to prevent than treat.

Diabetes is a serious problem because the number of sufferers continues to increase from year to year. In 2014, there were 422 million adults with Diabetes (WHO, 2019). In 2021, Indonesia ranked 5th in the world with the most significant number of patients, reaching 19.5 million people, and it is even predicted that in 2024, it will continue to increase, reaching 28.6 million people (IDF, 2021). In 2018, the total prevalence of Diabetes in East Java was 98,566 people, and in Surabaya City reached 7,203 people (Riskesdas, 2018). The Diabetes Mellitus epidemic is driven by increasing obesity and increasingly poor lifestyles. Diabetes Mellitus is a significant cause of morbidity and mortality (Runge & Greganti, 2008).

Diabetes is a disease that will be suffered for life and requires changes in the lifestyle of the sufferer, so many patients are non-compliant and tend to despair because of the long and very complex treatment. According to the 2018 Riskesdas, the proportion of diabetes treatment in East Java is 76.35% of residents using anti-diabetes mellitus (DM)/anti-diabetes drugs (OAD) from medical personnel, 4.63% of residents using insulin injections, 11.28% of residents using anti-DM / OAD drugs from medical personnel and insulin injections, and the remaining 7.75% of residents are not treated. Then, it was also mentioned that 88.81% of East Java residents had complied with Diabetes Mellitus treatment according to doctor's instructions, and the remaining 11.19% of residents underwent treatment not according to doctor's instructions.

The general goal of DM management is to improve patients' quality of life. These goals include short-term goals that aim to eliminate or reduce complaints from people with Diabetes Mellitus and reduce the risk of acute complications. Long-term goals include preventing and inhibiting the progression of microangiopathic and macroangiopathic complications. The ultimate goal of management includes reducing the morbidity and mortality of Diabetes Mellitus. Achieving these goals requires controlling blood glucose, blood pressure, weight and lipid profile through comprehensive patient management. Diabetes treatment can be done with drug-based approaches (pharmacotherapy) and non-pharmacotherapy approaches. The first step is non-pharmacotherapy management in the form of diet and exercise. Suppose this first step still needs to meet the treatment objectives. In that case, it can be combined with pharmacotherapy in the form of insulin therapy, oral hypoglycemic drug therapy, or a combination of both. (Pamela *et al.,* 2019)

Some factors that often cause failure in the treatment of Diabetes Mellitus are forgetting to take/inject drugs, drugs are not available at health care facilities, preferring traditional medicines, cannot afford to buy drugs (due to poor economic conditions), do not routinely go to health care facilities (can be due to distant/remote homes), and education level (do not understand how to take/inject drugs) (Riskesdas, 2018).

Patients may not routinely or do not comply with using drugs because they need to understand how to use these drugs; this can be due to a lack of education. This statement is supported by the results of research from Wahyuni *et al.* (2014) regarding the quality of life-based on the characteristics of patients with type 2 DM; this study illustrates that the higher the level of education, the higher the community's quality of life. Therefore, this study aims to determine the level of education and understanding of insulin therapy of Diabetes Mellitus patients who use insulin therapy.

2. LITERATURE REVIEW

A. Diabetes mellitus (DM)

1) Definition of Diabetes Mellitus

Diabetes mellitus (DM) is a complex metabolic disease with hyperglycemia as the main symptom. This condition occurs due to disturbances in insulin secretion or action, individually or in combination. In addition, DM is also often associated with abnormalities in lipid, protein, and electrolyte metabolism. The disease is caused by the interaction between genetic factors, the environment, and lifestyle choices, making it a heterogeneous metabolic disease (ADA, 2004; Solis-Herrera et al., 2018; Powers, 2011).

2) Classification of Diabetes Mellitus

Based on aetiology, DM is classified into five main groups. Type 1 DM (T1DM) is caused by pancreatic β-cell destruction resulting in absolute insulin deficiency, while type 2 DM (T2DM) involves insulin resistance with relatively impaired insulin secretion. Gestational diabetes (GDM) is a temporary form of diabetes that occurs during pregnancy, although it may increase the risk of future T2DM. Genetic factors, certain medications, or other medical conditions trigger other DMs. In addition, there are pre-diabetic conditions characterized by impaired fasting glucose (GDPT) and impaired glucose tolerance (TGT) (Muchid et al., 2005; Pamela et al., 2019).

3) Epidemiology of Diabetes Mellitus

DM is a global health problem that affects various walks of life in the world. The prevalence of DM continues to increase significantly, especially in developing countries. WHO data in 2014 showed 422 million adults with DM worldwide. In Indonesia, the prevalence of DM is also high, with 19.5 million sufferers in 2021, which is predicted to increase to 28.6 million in 2024. These prevalence rates represent a significant challenge to the national health system (IDF, 2021).

4) Aetiology of Diabetes Mellitus

The leading causes of hyperglycemia in DM are decreased insulin secretion, suboptimal glucose utilization, and increased glucose production in the body. This metabolic dysregulation has far-reaching effects on various organ systems, including the kidneys, eyes, and circulatory system. For example, in the United States, DM is the leading cause of end-stage renal disease, non-traumatic lower limb amputation, and blindness in adults (Powers, 2011).

5) *Risk Factors for Diabetes Mellitus*

DM is influenced by various risk factors that are categorized into three types. Non-modifiable risk factors include age, family history, ethnicity, and history of low birth weight. Modifiable risk factors include obesity, physical inactivity, hypertension, dyslipidemia, and unhealthy diet. In addition, there are other factors, such as polycystic ovary syndrome (PCOS), metabolic syndrome, and a history of cardiovascular disease (Soelistijo et al., 2021).

6) *Management of Diabetes Mellitus*

DM management aims to improve the quality of life of patients, both through preventing acute complications and delaying the development of chronic complications. The management approach involves integrated control of blood glucose, blood pressure, weight, and lipid profile. The main measures include patient education, medical nutrition therapy, physical exercise, and pharmacological therapy through oral or injectable medications. A combination of various therapies is often required to achieve optimal glycemic control (Soelistijo et al., 2021).

7) *Diabetes Mellitus Management Issues*

DM management faces various challenges, such as patients' lack of understanding of the relationship between diet and disease, social stigma towards insulin use, and obstacles in maintaining a healthy lifestyle. In addition, the social and psychological pressures experienced by people with DM, especially those with high-stress jobs, can affect the successful management of this disease (Wahyuningrum et al., 2020; Helgeson et al., 2019).

B. Insulin

1) *Insulin Synthesis*

Insulin is a small protein hormone with a molecular weight of approximately 5,808. Insulin consists of two amino acid chains (A and B) connected by a disulfide bond. If the two chains are separated, insulin loses its biological activity. The process of insulin synthesis takes place in pancreatic beta cells by a mechanism that resembles protein synthesis in general. The process begins with translating insulin RNA by ribosomes bound to the endoplasmic reticulum, producing a preproinsulin molecule with a molecular weight of about 11,500. This preproinsulin molecule is converted into proinsulin with a molecular weight of about 9,000. Proinsulin consists of three peptide chains: A, B, and C.

Next, in the Golgi apparatus, proinsulin is processed into active insulin, consisting of A and B chains connected by disulfide bonds and a C chain known as the linker peptide (C-peptide). Insulin and C-peptide are stored in secretory granules and released into the blood circulation in equal amounts. C-peptide has almost no insulin activity but is known to bind to specific membrane structures and affect the activity of enzymes such as sodium-potassium adenosine triphosphate (ATPase) and nitric oxide synthase.

Once secreted into the blood, insulin circulates in the free (unbound) form. The half-life of insulin in plasma is about six minutes, so within 10 to 15 minutes, almost no insulin remains in circulation. Unused insulin is immediately broken down by the enzyme insulinase in the liver, kidneys and other tissues (Guyton & Hall, 2021).

2) *Insulin Secretion*

Insulin is secreted by pancreatic beta cells both basally (in small amounts) and in response to various stimuli, especially glucose. Besides glucose, insulin can also be stimulated by other sugars such as mannose, some amino acids (e.g. leucine and arginine), and certain hormones such as glucagon-like peptide-1 (GLP-1) and glucose-dependent insulinotropic polypeptide (GIP). The mechanism of insulin secretion begins with hyperglycemia, which causes an increase in intracellular ATP in beta cells. The ATP closes ATP-dependent potassium channels, depolarising the beta cells. This depolarization opens voltage-gated calcium channels, increasing intracellular calcium and triggering insulin release (Katzung et al., 2014). Drugs such as sulfonylureas also use a similar mechanism to stimulate insulin secretion. In contrast, some agents, such as diazoxide and phenytoin, are known to inhibit insulin release.

3) *How Insulin Works*

Insulin regulates carbohydrate, lipid, protein, and mineral metabolism. The primary function of insulin is to aid the transport of glucose from the blood into cells. If insulin is insufficient, glucose cannot enter the cells, resulting in increased blood sugar levels (hyperglycemia) and energy deficiency at the cellular level. In addition, insulin increases lipogenesis (fat formation), suppresses lipolysis (fat breakdown), and increases amino acid transport into cells.

Impaired insulin function, such as in diabetes mellitus, can lead to various complications, including damage to blood vessels and nerves. Besides regulating

energy metabolism, insulin also affects DNA transcription, protein synthesis, and cell replication (Muchid et al., 2005).

4) *Insulin Therapy*

Insulin therapy is a mandatory step for people with type 1 diabetes mellitus (T1DM), where the pancreatic beta cells are damaged and unable to produce insulin. In type 2 diabetes mellitus (T2DM), most patients can control blood sugar with oral hypoglycemic drugs, but about 30% of patients require additional insulin therapy.

Indications for insulin use include severe hyperglycemia with ketosis, HbA1c levels $\geq 9\%$ without treatment, or $\geq 7.5\%$ after using oral medications, as well as specific conditions such as pregnancy, renal impairment, or hepatic impairment. Insulin types are classified based on their duration of action: rapid-, short-, intermediate-, long-, ultra-long-acting insulin, and mixed insulin. Individual responses to insulin vary, so the dose and schedule of administration must be adjusted to the needs of each patient (Soelistijo et al., 2021).

C. **Education Level**

1) *Definition of Education*

Education is a conscious and planned effort to create a learning atmosphere and learning process that allows students to develop their potential actively. Learners are intended to have religious and spiritual strength, self-control, personality, intelligence, noble character, and skills needed for themselves, society, nation and state. This definition is contained in Law Number 20 of 2003 concerning the National Education System.

Syah (2007) states that education is a conscious effort made by parents to educate their children so that they have moral responsibility for their actions. Etymologically, education comes from the word "didik", which means providing training through teaching and guiding. Chandra (2009) adds that education is a knowledge transfer process that enables students to understand and master the subject. In addition, Langeveld (1980) argues that education is an effort to bring someone to maturity. Implementing education helps learners complete their life mission to become independent and ethically responsible individuals.

2) *Functions and Objectives of Education*

Education in Indonesia is essential to develop abilities, shape character, and build a dignified national civilization to educate the nation's life. Law No. 20 of 2003 also stipulates the purpose of education, which is to develop the potential of students

to become human beings who are faithful, pious, noble, healthy, knowledgeable, capable, creative, independent, democratic and responsible citizens.

3) *Education Pathway*

The education pathway refers to the vehicle through which students develop their potential through the learning process. Based on Law Number 20 of 2003, education pathways in Indonesia include formal, non-formal and informal education. Formal pathways include primary, secondary and higher education, while non-formal pathways, such as training or courses, are more flexible. Informal education, on the other hand, takes place within the family or community environment. These three pathways complement each other to meet the community's educational needs.

4) *Levels of Education*

The levels of education in Indonesia are arranged based on the stages of learner development, the goals to be achieved, and the abilities to be developed. Law No. 20/2003 explains that the formal education level consists of basic, secondary and higher education. Primary education includes elementary and junior high schools, while secondary education includes senior high schools or vocational high schools. Higher education consists of diploma, undergraduate, and postgraduate programs. Other types of education, such as vocational, vocational, academic, religious, and special education, are also designed to answer the needs of students in various fields.

5) *Education Level in Indonesia*

Data from the Central Statistics Agency (BPS) in 2021 shows that the education level of the Indonesian population aged 15 years and over is mainly at the secondary education level. Of every 100 residents, 29 have completed high school or equivalent education, while only nine have completed tertiary education.

The average years of schooling of the Indonesian population aged 15 years and over in 2021 reached 8.97 years, equivalent to the third grade of Junior High School (SMP). This data shows that most Indonesians still need better education despite the government's efforts to increase school enrollment rates (BPS, 2021).

6) *Linkages between Community Education Levels and Government Programs*

The level of public education significantly influences the success of government programs, especially in the health sector. Several studies have shown that low education levels often cause failure to achieve therapeutic goals in patients. Patients with higher education tend to have better knowledge about the disease and

its treatment methods. In contrast, patients with low education levels often experience barriers to understanding pharmacological and non-pharmacological therapies (Huri et al., 2013; Talman et al., 2016).

Patients with higher education are better able to think logically and understand health information well. This affects their mindset in making decisions and solving health-related problems. Therefore, delivering information in simple and easy-to-understand language is essential to improve patient understanding. Research has also shown that employed individuals tend to have better access to health education materials, as employment is usually associated with higher levels of education (Shrestha et al., 2015).

D. Conceptual Framework

Management of type 2 diabetes mellitus can be done by education, diet, exercise, medication, and pancreas graft. Factors that influence understanding of education include education level, socioeconomics, age, and family history of the disease. The purpose of education is to achieve public understanding of the correct understanding of insulin therapy to achieve compliance with the correct use of insulin. It can normalize blood sugar (normoglycemia).
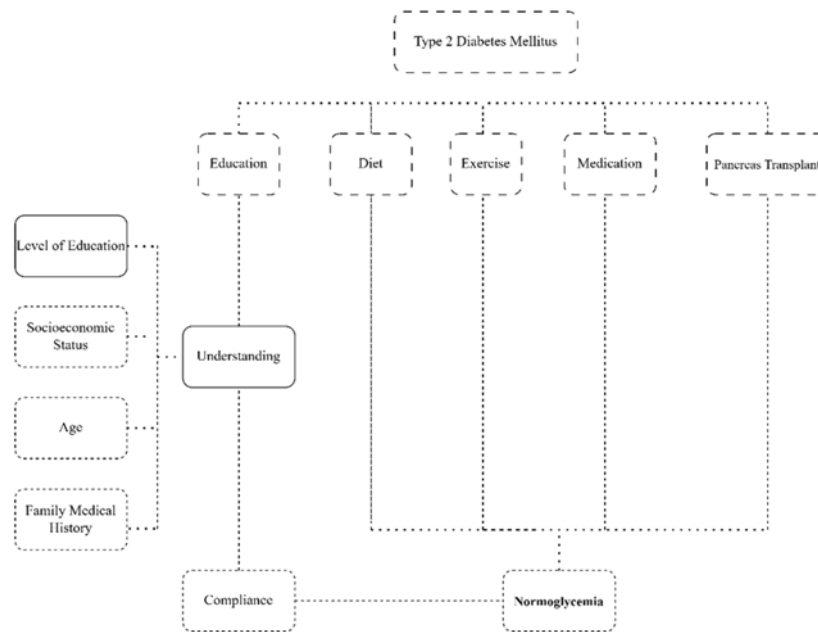

Figure 2. Conceptual framework

Description

☐ : The variable under study

┌┄┄┐
└┄┄┘ : Variables that were not studied

3. METHODS

This study used a descriptive observational method with a *cross-sectional* design to analyze the education level and understanding of insulin therapy in type 2 diabetes mellitus patients undergoing insulin therapy at RSUD dr. M. Soewandhi Surabaya in 2022. The study population was patients with type 2 diabetes mellitus who received insulin therapy, with the sample size determined using the Lemeshow formula, resulting in 100 samples. Samples were selected by *consecutive sampling* with inclusion criteria such as age 15-64 years, good communication skills, injecting insulin independently, and exclusion for patients with injection assistance or cognitive impairment.

The study variables included education level, understanding of insulin therapy, gender, age, family history, diabetes complications, and insurance membership, which were measured through interviews using questionnaires and observation of medical records. Data were collected at the Internal Medicine Clinic of Dr. M. Soewandhi Hospital in January 2023. Data processing included *editing*, *coding*, *entry*, and *cleaning*, with the level of education and understanding categorized based on specific criteria. Analysis was done descriptively, and the results were presented as diagrams. The study also paid attention to ethical aspects such as *confidentiality* and *anonymity*, with the confidentiality of patient data guaranteed through anonymous codes (Arikunto, 2012; Department of Health RI, 2009).

4. RESULTS

The study's results were obtained by observation of medical records and sampling using *consecutive sampling* methods from patients who came to the internal medicine clinic of RSUD dr. M. Soewandhi Surabaya. The number of patients interviewed during January 2023 was 100 patients. The data used were primary and secondary data. The necessary data were taken from interviews with research subjects and medical records. This study has obtained permission and ethical approval from RSUD dr. M. Soewandhi Surabaya.

Data Distribution Based on Patient Characteristics

Table 1. Data Distribution Based on Patient Characteristics

Characteristics	Category	Number of Patients	Percentage
Gender	Male	33	33%
	Female	67	67%
Age	26-35	4	4%
	36-45	9	9%
	46-55	34	34%
	56-64	53	53%
BPJS Class	Class I	15	15%
	Class II	6	6%

	Class III	79	79%
Complicated Diseases	No	60	60%
	Yes	40	40%
Family History	No	58	58%
	Yes	42	42%
TKOI Usage	Yes	70	70%
	No	30	30%
Last Education	Not in school	27	27%
	SD	15	15%
	SMP	15	15%
	SMA	39	39%
	University	4	4%

Table 2. Data Distribution Based on Level of Understanding of Insulin Therapy

Level of Understanding of Insulin Therapy	Distribution of the number of patients	Percentage
Good	10	10%
Simply	55	55%
Less	35	35%

Table. 3 Distribution of Understanding Score Based on the Relationship between Level of Education and Level of Understanding of Insulin Therapy

Education Level	Basic Insulin Knowledge	Insulin Injection Method	How to store insulin	Insulin Usage Rules
Not in School	64,35	44,44	70,37	79,62
SD	65,83	49,33	80,00	78,33
SMP	67,5	49,33	76,66	88,33
SMA	70,19	45,12	83,33	87,17
University	68,75	40,00	75,00	75,00

5. DISCUSSION

A. Discussion of Data Distribution Based on Gender

Referring to Table 1, this study shows that in patients with type 2 diabetes mellitus who received insulin therapy at RSUD Dr. M. Soewandhi Surabaya in the January 2023 period, the majority were experienced by women, with 67 patients (67%). Based on gender, the prevalence of type 2 diabetes mellitus is mainly experienced by female patients (Riskesdas, 2018; IDF, 2022) with a percentage of 1.78% of the total Indonesian population compared to men who are only 1.21% (Riskesdas, 2018). These results are also in line with other studies, which show that most people with type 2 diabetes mellitus are women, with a percentage of 51.7% of the total sample (Gunawan & Rahmawati, 2021). In addition, the results of another study revealed that 58% of the total sample of patients with type 2 diabetes mellitus were women (Vonna et al., 2021). From research conducted in Depok, West Java, it was found that women with type 2 diabetes mellitus were 81 (60.4%) compared to 53 (39.6%) male patients (Komariah &

Rahayu, 2020). However, research from Pakistan revealed that men with type 2 diabetes mellitus were slightly more than women, with 112 people (51.4%) and 106 women (48.6%) from a total sample of 218 people (Bukhsh et al., 2019). The same results were also found in a study in Brazil. Most people with type 2 diabetes mellitus were male, with 226 people (58.7%) of a total sample of 385 people (Alves & Laporta, 2020). This difference in results may be due to differences in lifestyle behaviours or activities between women in Indonesia and other countries because lifestyle is a risk factor for type 2 diabetes mellitus (PERKENI, 2019; Powers, 2020).

B. Discussion of Age Data Distribution

Referring to Table 1, this study shows that patients with type 2 diabetes mellitus who received insulin therapy at RSUD dr. M. Soewandhi Surabaya, in January 2023, was found in the age range of 26-35 years in as many as four patients (4%), 36-45 years of age as many as nine patients (9%), 46-55 years of age as many as 34 patients (34%), and 56-64 years of age as many as 53 patients (53%) of the total sample. These data show that the largest group of patients with type 2 diabetes mellitus who received insulin therapy at RSUD, dr M. Soewandhi Surabaya, during January 2023 was in the age range of 56-64 years. These results are in line with research conducted in Sidoarjo, which found that most people with type 2 diabetes mellitus were in the age range 51-60 years, namely 81 people (69.2%) of the total sample, 41-50 years of age as many as 30 people (25.6%) of the total sample, and in the age range 31-40 years as many as six people (5.1%) (Wahyuni et al., 2019). This is based on the fact that age can increase the incidence of type 2 diabetes mellitus, because age can reduce insulin sensitivity so that it can affect blood sugar levels (Laquatra, 2014). A study in Pakistan found that most patients with type 2 diabetes mellitus were 41-50 years old, with a total of 1033 (32.37%) people from a total sample of 3201 people (Aamir et al., 2019). This is by research conducted in Tabanan, Bali, which found that people after 40 generally experience a drastic physiological decline. One of the impacts is the reduced ability of pancreatic β cells to produce insulin. In addition, mitochondrial activity in muscle cells decreases by 35% in older people. This is associated with a 30% increase in muscle fat content and triggers insulin resistance (Sujaya, 2009).

C. Discussion of BPJS Class Data Distribution

Referring to Table 1, this study shows that patients with type 2 diabetes mellitus who received insulin therapy at RSUD dr M. Soewandhi Surabaya during the January 2023 period based on BPJS class, namely class 1 as many as 15 patients (15%), class 2

as many as six patients (6%), and class 3 as many as 79 patients (79%) of the total sample. So from, these results, the largest group of patients with type 2 diabetes mellitus who received insulin therapy at RSUD dr. M. Soewandhi Surabaya, during the January 2023 period, used BPJS class 3. These results are in line with research conducted at one of the government-owned type A hospitals in Jakarta, which found that the largest group of BPJS users were in class 3, as many as 1,118 (55.7%) people (Optisari & Rif'ati, 2021). However, research at Meuraxa Hospital in Banda Aceh City found that the largest group of BPJS users were in class 1 with 101 (40.7%) people, followed by class 3, with 76 (30.6%) people, and finally, class 2, with 71 (28.6%) people (Natasya & Yusuf, 2021).

D. Discussion of Complicated Disease Data Distribution

Referring to Table 1, this study shows that patients with type 2 diabetes mellitus who received insulin therapy at RSUD dr. M. Soewandhi Surabaya, during January 2023, based on complication diseases, 40 patients (40%) of the total sample had complication diseases, and 60 patients (60%) did not have complication diseases. Complicated diseases suffered by 40 patients (40%) include heart, lung, nerve, eye, ear, kidney, stomach, gallstones, thyroid gland, and prostate diseases. Complications of diabetes mellitus can be acute or chronic. Acute complications of diabetes mellitus include diabetic ketoacidosis (DKA), hypoglycemia, and hyperglycemic hyperosmolar nonketotic (HHNK) coma (Powers et al., 2022). Chronic complications can be divided into vascular and non-vascular. Vascular complications are divided into microvascular (neuropathy, nephropathy, and retinopathy) and macrovascular (coronary artery disease and cerebrovascular disease). At the same time, non-vascular complications can occur in gastroparesis, infection, and skin changes (Powers et al., 2022; Setiati et al., 2014). A study in Lampung found that most patients with type 2 diabetes mellitus at the Pasir Sakti Health Center experienced complications of diabetes mellitus, namely 41 people (51.25%) (Ramdini et al., 2020).

E. Discussion of History Data Distribution in the Family

Referring to Table 1, this study shows that patients with type 2 diabetes mellitus who received insulin therapy at RSUD Dr. M. Soewandhi Surabaya in the January 2023 period, the majority with a total of 58 patients (58%) did not have a family history of type 2 diabetes mellitus. These results align with previous research in Purwokerto, which also found that most patients with type 2 diabetes mellitus did not have a family history of the same disease, namely 61 patients (64%) (Gumilas, 2019). However,

family history is the leading risk factor for a person developing diabetes mellitus. Patients with diabetes mellitus genetically affect their offspring (Mallongi, 2018; Soelistjo et al., 2021). The most assertive genetic inheritance is in diabetes mellitus. If the parents have diabetes, then 90% are sure to carry diabetes from their parents, which is characterized by abnormalities in insulin secretion (Price and Wilson, 2006). Research conducted in Amman, Jordan, found that most patients with type 2 diabetes mellitus have a family history of the same disease, with a total of 869 patients (86.6%) (Khawaja et al., 2018).

Discussion of Data Distribution on the Use of Oral Insulin Combination Therapy (TKOI)

Referring to Table 1, this study shows that patients with type 2 diabetes mellitus who received insulin therapy at RSUD dr. M. Soewandhi Surabaya during the period January 2023, based on the use of Oral Insulin Combination Therapy (TKOI), 70 patients (70%) of the total sample used TKOI and 30 patients (30%) of the total sample did not use TKOI. This result aligns with research in Kedungmundu, Semarang, which found that 84 (80%) people used TKOI (Ningrum, 2020). In Indonesia, most people only use oral therapy, in 2018 as many as 11,183 (74.8%) people used oral therapy, 763 (5.1%) people used insulin therapy, and 1,615 (10.8%) people used TKOI (Riskesdas, 2018).

F. Discussion of Data Distribution Based on Last Education

Referring to Table 1, this study shows that the last education of patients with type 2 diabetes mellitus who received insulin therapy at RSUD Dr. M. Soewandhi Surabaya during the January 2023 period was 27 patients (27%) who did not go to school or dropped out of school, 15 patients (15%) graduated from elementary school, 15 patients (15%) graduated from junior high school, 39 patients (39%) graduated from high school, and four patients (4%) graduated from college. From these results, it can be concluded that the largest group of patients with type 2 diabetes mellitus who received insulin therapy at RSUD, Dr M. Soewandhi Surabaya, during the January 2023 period, had a low level of education, namely 57 patients (57%). These results are from the 2018 Riskesdas report that the last education of patients with type 2 diabetes mellitus in East Java is mostly low education, namely 64,750 (72.16%) people. This is based on Indonesia, a developing country; of course, it can become a developed country if education runs well and correctly. However, in reality, education in Indonesia is in decline, so the quality of education in Indonesia is at the lowest level compared to other

countries. The level of education is one of the predisposing factors that influence the utilization of individual health services because the level of education affects awareness and knowledge about health (Handayani, 2012). Education level influences the incidence of diabetes mellitus. People with a high level of education usually have much health knowledge. By knowing this, a person will have the awareness to maintain their health. A study in Samarinda, East Kalimantan, found that most patients with type 2 diabetes mellitus had a low education level, as many as 31 (83.8%) people (Pahlawati & Nugroho, 2019).

G. Discussion of Data Distribution Based on Level of Understanding of Insulin Therapy

Referring to Table 2, this study shows that patients with type 2 diabetes mellitus who received insulin therapy at RSUD dr. M. Soewandhi Surabaya during the January 2023 period, based on the level of patient understanding, namely, ten patients (10%) had a good understanding (the subject answered 76%-100% of the questions correctly), 55 patients (55%) had sufficient understanding (the subject answered 56%-75% of the questions correctly), and 35 patients (35%) had a poor understanding (the subject answered <56% of the questions correctly). In this study, the largest group of patients with type 2 diabetes mellitus had a sufficient understanding of the use of insulin therapy. These results are from previous research conducted in Samarinda, where the patient's understanding of the use of insulin was sufficient in this study, namely 31 patients (72.09%) (Utami et al., 2017).

H. Discussion of the Relationship between Level of Education and Level of Understanding of Insulin Therapy

Referring to Table 3, this study shows that patients with type 2 diabetes mellitus who received insulin therapy at RSUD dr. M. Soewandhi Surabaya, during the period January 2023, based on the relationship between education level and level of understanding of insulin therapy, namely at the level of no school, elementary school, junior high school, high school, and college, scored the least in the category of understanding how to inject insulin with a score of no school 44.44% answered correctly, elementary school 49.33% answered correctly, junior high school 49.33% answered correctly, high school 45.12 answered correctly, college 40% answered correctly, likewise, with the order of understanding that all levels of education have the same level of understanding. The best understanding is understanding the rules for using insulin, how to store insulin, basic knowledge of insulin, and how to inject insulin.

Thus, it can be concluded that patients with type 2 diabetes mellitus who received insulin therapy at RSUD dr. M. Soewandhi Surabaya needed help understanding how to inject needed to gain during the January 2023 period.

6. CONCLUSION

This study shows the level of education and understanding of insulin therapy in patients with type 2 diabetes mellitus at RSUD dr. M. Soewandhi Surabaya are interrelated. However, a higher level of education only sometimes means a better understanding of how to inject insulin. Most patients have a low level of education and moderate to poor understanding of therapy, so health education is needed that is more effective and easy to understand. This study has several shortcomings, such as the sample size being limited to one hospital within a certain period, making it difficult for the results to represent the wider population. In addition, the interview method used risks generating biased answers from patients, which may affect the accuracy of the data. Future studies should include more sites and patients and use more diverse methods to ensure more accurate results. Other factors such as culture, economics and access to health care should also be investigated further to understand what influences patients' understanding of insulin therapy.

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