

The Effect of Aplikasi Edukasi Patuh Pakai Insulin (Aksi Patas) on Insulin Use Compliance and Glycemic Control in Diabetes Mellitus Patients at Prof. Dr. Margono Soekarjo Regional General Hospital

Sehat Dwi Prasaja¹, Devita Elsanti²^{1,2}Faculty of Health Sciences, Universitas Muhammadiyah Purwokerto, Indonesia

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ABSTRACT

Background: Diabetes mellitus is a chronic disease that requires lifelong management. Patient compliance in using insulin and good glycemic control are important factors in the management of diabetes mellitus. Low patient compliance and knowledge about insulin use are frequent problems.

Objective: This study aims to determine the effect of obedient insulin education application (AKSI PATAS) on compliance with insulin use and glycemic control in patients with type 2 diabetes mellitus.

Methods: This study is a pre-experimental study with a pre-test and post-test without control group design. The study sample was 18 patients with type 2 diabetes mellitus at Prof. Dr. Margono Soekarjo Purwokerto Hospital who were selected by purposive sampling. Data collection was done by questionnaire and examination of glycemic levels. Data analysis used paired t-test and Wilcoxon test.

Results: There was a significant increase in family support, compliance with insulin use, and glycemic control after being given the AKSI PATAS educational application intervention ($p < 0.05$).

Conclusion: AKSI PATAS educational application has an effect in improving family support, compliance with insulin use, and glycemic control in patients with type 2 diabetes mellitus.

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Corresponding Author:

Devita Elsanti

Faculty of Health Sciences, Universitas Muhammadiyah Purwokerto,

Soepardjo Rustam Street KM. 7, Banyumas, Indonesia

Email: devitaelsanti@ump.ac.id

1. INTRODUCTION

Diabetes mellitus is a condition characterized by hyperglycemia and impaired carbohydrate, fat, and protein metabolism associated with absolute or relative deficits in insulin action and/or secretion (Fatimah, n.d.). Common symptoms of diabetes mellitus include polydipsia, polyuria, polyphagia, weight loss, and tingling (E, 2011). The number of people with diabetes mellitus in Indonesia ranks fourth in the world, with approximately 371 million people worldwide suffering from type 2 diabetes in 2012, accounting for 95% of all diabetes cases (Nanda et al., 2018).

The prevalence of diabetes mellitus has also increased, from 1.1% in 2007 to 2.4% in 2013. Unmodifiable factors, such as gender, age, and genetics, contribute to the high prevalence of type 2 diabetes mellitus. Meanwhile, modifiable risk factors include smoking, body mass index, waist circumference, age, level of knowledge, occupation, physical activity, and alcohol consumption (Rasdianah et al., 2016). Diabetes mellitus is often referred to as a “silent killer” because this disease can interfere with various

organs of the body and cause various complications, such as visual impairment, heart disease, kidney disorders, impotence, wounds that are difficult to heal to the point of gangrene, lung infections, blood vessel disorders, stroke, and other diseases (E, 2011). The development of diabetic ulcers accompanied by severe infection can even lead to limb amputation in patients with inadequate glucose control. Therefore, preventive measures such as lifestyle changes need to be taken, in addition to treatment using oral hypoglycemic drugs or insulin as therapy (Fatimah, 2015).

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People with diabetes receive subcutaneous insulin injections because this promotes the absorption of the drug into the fatty tissue under the skin. Common injection sites include the abdomen, arms, upper thighs, and buttocks. Because there is a lot of fat tissue, the abdomen absorbs insulin more quickly than other parts of the body (Atmaja et al., 2017). After two consecutive days, the insulin injection site must be changed. Avoid repeated use of the same location as it can irritate the skin and disrupt the fatty tissue under the skin. Changing the injection site simply means injecting in the same injection zone but not in the same position as the last injection; it does not mean changing the injection zone. Leave a gap of about 2 cm from the last injection site (Ramadhan & Hanum, 2016).

Lifelong treatment is required for diabetes mellitus. Patients and their families play an important role in managing this disease, alongside doctors, nurses, dietitians, and other health professionals. The goal of patient and family education is to help them understand the progression of the disease, prevention, complications, and treatment of diabetes mellitus. This will significantly increase family involvement in initiatives to improve management outcomes. Glycemic management is highly correlated with family function and treatment adherence.

The basis of diabetes control or treatment is glucose regulation. Patient non-adherence to treatment is one of the triggers for the inability of people with diabetes to control their blood glucose properly (Yuanita et al., 2014). Guidelines for adjusting diet, exercise, and medication to achieve the most normal blood glucose levels possible, monitoring results are used to calculate the efficacy of treatment to avoid hyperglycemia and hypoglycemia (Ramadhan & Hanum, 2016).

Several factors, including a lack of knowledge about diabetes, its treatment, and its consequences, as well as forgetting to take medication and insulin injections, contribute to diabetes patients' non-compliance with therapy programs (Yuanita et al., 2014). Therefore, to improve diabetes patient compliance, education on proper injection techniques and increased knowledge about disease progression, prevention, complications, and care are needed (Vervloet et al., 2012). Therefore, educating patients about the correct injection techniques and increasing their awareness of disease progression, prevention, complications, and treatment is the first step in improving patient compliance with diabetes. A

comprehensive understanding will significantly improve compliance in diabetes management initiatives to deliver better results (PERKENI, 2015).

One of the most important elements in patient therapy outcomes, especially for those with diabetes mellitus, is compliance. In individuals with diabetes, compliance is an issue that requires treatment. A number of studies have documented low compliance in these individuals. Therefore, measures are needed to improve the compliance of diabetic patients with their therapy (Yuanita et al., 2014).

Drug Information Services (PIO), counseling, sending short reminders and motivational messages, and education are some strategies that can be used to help patients better comply with their treatment (Susanto et al., 2017). Educational applications that explain the correct injection techniques are used to increase knowledge. It is hoped that patients will have satisfactory glucose control and adhere to their insulin injection schedule. (Arsyad & Fitriani, 2015) define audio-visual media as a type of media used in educational processes or activities that combine hearing and vision at the same time. Through the use of this media, information and vocal communication that depends on hearing and vision can be conveyed.

Proper instruction and knowledge about insulin use can increase patient compliance with a comprehensive treatment system. A reduction in diabetes complications is associated with good glycemic control. According to the findings of the Diabetes Management and Complication Trial (DCCT), maintaining adequate diabetes management can reduce the risk of chronic diabetes complications by 20-30%. According to the findings of The United Kingdom Prospective Diabetes Study (UKPDS), every 1% decrease in HbA1c reduces the risk of complications by 35%, diabetes-related deaths by 21%, myocardial infarction by 1%, microvascular complications by 37%, and peripheral vascular disease by 3% (Ramadhan & Hanum, 2016).

Many people with diabetes are still confused and do not even know how to inject insulin effectively to prevent a drop in blood sugar. Patients do not know how many days it takes to change the injection site, and neither do their families. They are also confused about the injection site. Inappropriate or incorrect insulin injections lead to the use of inappropriate or excessive doses and injection times that do not comply with the schedule determined by the doctor (Rusdi & Afriyeni, 2019).

The findings of this study indicate that the understanding of diabetic patients and their families regarding insulin is still poor, and some even refuse the insulin therapy recommended by medical professionals. Therefore, it is very important to educate diabetic patients who receive insulin so that they can accept and comply with the protocol. Diabetes mellitus patients show low compliance with their treatment protocol (Rasdianah et al., 2016).

In individuals with diabetes, compliance is an issue that requires care. Based on research at the Surabaya Timur Community Health Center, 54.35% of type 2 diabetes patients did not comply with their prescribed medication. Non-compliance with medication regimens is one of the things that complicates blood sugar management, so treatment compliance must be improved through intervention (Araujo Filho et al., 2017).

The researchers interviewed ten patients who visited the diabetes metabolic endocrine clinic. Of these, seven admitted that their blood sugar levels were not controlled because they did not know about diabetes and did not inject insulin as prescribed, meaning that injections were not given before meals, doses were reduced on their own, or patients were not given injections at all, and three patients reported that they injected insulin as prescribed and their blood sugar levels were controlled.

As described above, the researchers were interested in the topic of “the effect of an insulin adherence education application (aksi patas) on insulin adherence and glycemic control in diabetes mellitus patients at Prof. Dr. Margono Soekarjo Regional General Hospital.” The application can be beneficial to the community as a medium or tool for self-learning, as its content can be easily studied, the language used in the application is understandable, and there are images and videos that facilitate understanding. It is also very simple, so the community will quickly grasp the content of this application.

2. RESEARCH METHOD

The research design used in this study was pre-experimental with a pretest and posttest design without a control group (Sugiyono, 2015). There was only one intervention group in this study. The intervention group was observed first in the initial observation (pretest) before the intervention was carried out, then observed after the intervention was carried out (posttest).

Table 1 Research Design

Subject	Pretest	Treatment	Posttest
Treatment Group	01	X	02

Description:

01 = First measurement (pre-test) before treatment

X = Application of insulin compliance education (patas action)

02 = Second measurement (post-test) after treatment

This study will be conducted at the Endocrine Metabolic Diabetes Clinic of Prof. Dr. Margono Soekarjo Purwokerto Regional General Hospital. The study period began when the research permit was issued in November 2023. The population in this study consists of all diabetes patients who received insulin injections at Prof. Dr. Margono General Hospital in November 2023, with a total of 23 patients examined at the Endocrine Metabolic Clinic based on a preliminary survey conducted by the researcher.

The sample is a portion of the entire object being studied and is considered representative of the population. The sample size in this study was determined using Federer's formula, taking into account the number of treatment groups and the number of samples in each group. Based on these calculations, the minimum sample size was 16 respondents. To anticipate a possible dropout rate of 10%, a correction calculation was made, resulting in a required sample size of 18 respondents.

In the sampling process, this study established inclusion and exclusion criteria. The inclusion criteria were characteristics that members of the population had to meet to be included in the sample, namely diabetes patients who received insulin injections, lived with their families, had good communication skills, were cooperative, and were willing to be research respondents. Meanwhile, the exclusion criteria are characteristics that prevent members of the population from being included in the sample, including diabetics who refuse to participate, are illiterate, are unconscious or uncooperative, such as patients with mental disorders, and patients who have moved or do not return for check-ups.

The sampling technique used in this study was purposive sampling, which is a sampling technique based on specific considerations or objectives, rather than based on strata, groups, or randomly. This technique was chosen considering the limitations of time, cost, and energy, which made it impossible to take a large number of samples or samples from distant locations (Saryono, 2011).

Research variables are characteristics or measures possessed by members of a group that distinguish them from other groups (Sugiyono, 2020). In this study, there are independent variables and dependent variables. Independent variables or free variables are variables that influence other variables, namely diabetes education applications. Meanwhile, dependent variables or bound variables are variables whose values are influenced by other factors, namely the level of knowledge in individuals with type 2 diabetes and compliance with insulin use (Surahman et al., 2016).

A definition based on observable characteristics of the described object is referred to as an operational definition. The purpose of an operational definition is to ensure replicability, validity, and effective communication (Nursalam, 2017).

Table 2 Operational Definition

No	Variable	Definition	Instrument	Measurement Result	Scale
1	Gender	Patient sex	Questionnaire consisting of 1 question	1. Male 2. Female	Nominal
2	Age	Age is a respondent characteristic calculated from birth until the study was conducted.	Questionnaire consisting of 1 question	1. Early adulthood (23–35 years) 2. Late adulthood (36–45 years) 3. Early elderly (46–55 years) 4. Late elderly (56–80 years)	Ordinal
3	Education	Formal education / highest education level of the patient	Questionnaire consisting of 1 question	1. Elementary school 2. Junior high school 3. Senior high school 4. University	Ordinal
4	Occupation	An activity that generates income	Questionnaire consisting of 1 question	1. Retired civil servant 2. Teacher 3. Secretary 4. Entrepreneur 5. Student 6. Others (Housewife, Midwife, Doctor)	Nominal
5	Family Support	Family acceptance actions toward its members, including emotional, informational, instrumental, and companionship support in adherence to insulin use	Family support questionnaire adopted from the Hensarling Diabetes Family Support Scale (HDFSS) developed by Hensarling (2009)	1. High category score 48–96 2. Low category score 0–47	Ordinal
6	Insulin Use Adherence	Actions performed by respondents in administering insulin according to physician recommendations	Questions administered using the MMAS-8 questionnaire	1. High adherence score 8 2. Moderate adherence score 6–<8 3. Low adherence score <6	Ordinal
7	Glycemic Control in Type 2 DM Patients	Stability of glycemic status in type 2 DM patients based on fasting blood glucose levels measured from capillary blood after 8–12 hours of fasting,	Laboratory examination	1. Controlled: 80–130 mg/dL 2. Uncontrolled: >130 mg/dL	Nominal

No	Variable	Definition	Instrument	Measurement Result	Scale
8	Insulin Education Application	during which only water is allowed. The assessed control is short-term glycemic control. Media presenting audio and visual content about insulin injection definition, benefits, diabetes diet, and insulin injection procedures	SOP		

The research instrument is a tool used to collect data in a study (Notoatmodjo, 2012). In this study, the instruments consisted of several components. First, the demographic data included on the questionnaire cover page comprised respondent code, gender, age, education level, comorbidities, and occupation. These demographic data were used by the researcher to identify respondents' background characteristics that might influence the study outcomes.

Second, the instrument used was the family support questionnaire, namely The Hensarling's Diabetes Family Support Scale (HDFSS), developed by Hensarling (2009) to measure the perceptions of patients with diabetes mellitus regarding the support they receive from their families (Luthfa, 2016). The HDFSS questionnaire encompasses four dimensions: emotional support consisting of 10 items (numbers 4, 5, 6, 7, 13, 15, 17, 24, 27, and 28), appraisal support consisting of 8 items (numbers 8, 10, 12, 14, 18, 19, 20, and 25), instrumental support consisting of 8 items (numbers 9, 11, 16, 21, 22, 23, 26, and 29), and informational support consisting of 3 items (numbers 1, 2, and 3). The total number of items is 29, with response options for positive statements including Always = 4, Often = 3, Rarely = 2, and Never = 1, whereas for negative statements the scoring is Always = 1, Often = 2, Rarely = 3, and Never = 4. The lowest possible score of this questionnaire is 29 and the highest is 116, where higher scores indicate better perceived family social support received by clients with type 2 diabetes mellitus.

Table 3 HDFSS Questionnaire

Support Type	Favourable	Unfavourable	Total
Emotional	4, 5, 6, 7, 15, 27, 28	13, 17, 24	10
Appreciation	8, 10, 14, 18, 19, 20, 25	12	8
Instrumental	9, 11, 16, 21, 22, 23, 26, 29		8
Informational	1, 2, 3		3
Total	25	4	29

Table 4 HDFSS Category

Score Range	Category
48–96	High
0–47	Low

The Hensarling Diabetes Family Support Scale (HDFSS) consists of two classification categories, namely high and low, based on cumulative score standards. A cumulative score of 48–96 is categorized as high, whereas a cumulative score of 0–47 is categorized as low.

Table 5 HDFSS Norm Categorization Category

	Emotional	Rewards	Instrumental	Information
High	18-36	14-28	12-24	4-9
Low	0-17	0-13	0-11	0-3

The Hensarling Diabetes Family Support Scale (HDFSS) consists of four dimensions, each classified into two categories, namely high and low, based on the normative classification of dimension scores. The high category score for emotional support ranges from 18 to 36, while the low category ranges from 0 to 17. The high category score for informational support ranges from 14 to 28, whereas the low category ranges from 0 to 13. For instrumental support, the high category ranges from 12 to 24, and the low category ranges from 0 to 11. Finally, companionship support has scores ranging from 4 to 9 in the high category and from 0 to 3 in the low category.

Insulin adherence survey was conducted using the MMAS-8 (Morisky Medication Adherence Scale, 8 items) questionnaire. The MMAS-8 applies a Guttman scale in which Yes = 0 and No = 1, except for item number 5, where Yes = 1. For item number 8, multiple response options are provided, namely Never = 1, Occasionally = 0.75, Sometimes = 0.5, Usually = 0.25, and Always = 0. Fasting blood glucose laboratory testing is a method used to monitor glucose management in individuals with type 2 diabetes.

The insulin injection education application is an educational program that has previously been validated by internal medicine physicians and endocrinology and metabolic diabetes specialists. The application includes information on insulin injection concepts, its benefits, diabetes dietary management, and proper insulin injection techniques. It is an instructional program developed by a team of experts.

2.1 Validity Test

The insulin adherence questionnaire used the MMAS-8 (Morisky Medication Adherence Scale, 8 items), which is a standardized questionnaire. It consists of 8 items based on the MMAS-8 questionnaire framework.

Table 6 MMAS-8 Questionnaire Blueprint

Support	Favourable	Unfavourable	Total
Insulin adherence	3,4,5,8	1,2,6,7	8

The survey was adapted from a study conducted in 2017 by Mareeya Jilao on insulin adherence levels among diabetes patients at the KOH-Libong Health Center in Thailand. The Morisky Medication Adherence Scale (MMAS-8) was used to test the validity of the insulin adherence questionnaire among patients with diabetes mellitus. The study results indicated that the questionnaire was valid, with validity values ranging from 0.521 to 0.887.

The internal consistency of the Hensarling Diabetes Family Support Scale (HDFSS) is supported by the findings from the reassessment of the scale's validity and reliability conducted by Hensarling (2009), which produced a content validity value of 1.00. The overall item correlation scores ranged from 0.49 to 0.87, with an average inter-item correlation of 0.52.

2.2 Reability Test

Reliability, according to Nursalam (2017), refers to the consistency of measurement or observation results when facts are measured or observed repeatedly at different points in time. Vika et al. (2016) reported that the Indonesian version of the Morisky Medication Adherence Scale (MMAS-8) is valid and reliable for measuring statin adherence among Indonesian military pilots, with a Cronbach's alpha reliability score of 0.759. Furthermore, Hensarling (2009) reassessed the validity and reliability of the Hensarling Diabetes Family Support Scale (HDFSS) and obtained a Cronbach's alpha score of 0.96.

2.3 Reability Test

According to Sujarweni (2014), data collection techniques refer to the process of addressing research topics and gathering the characteristics of subjects required in a research project. The data collection techniques used consisted of primary data and secondary data. Primary data were obtained directly from respondents who had provided consent to participate in the study, in which research assistants supported the distribution of questionnaires during the data collection process. Meanwhile, secondary data functioned

as supporting data that complemented the main data and were related to the research problems being examined.

The research stages began with the researcher requesting a research cover letter from the academic institution as a requirement for conducting the study at Dr. Margono Soekarjo Regional General Hospital, Purwokerto. After obtaining the cover letter, the researcher submitted an application for research permission along with the research proposal from Universitas Muhammadiyah Purwokerto to the Director of Dr. Margono Soekarjo Provincial Hospital, Purwokerto, to obtain approval for the study implementation. Subsequently, the researcher received a reference letter granting permission to begin the study at the hospital and then proceeded with the ethical clearance process. After obtaining ethical approval, the researcher visited patients who served as respondents to explain and discuss the research protocol.

Data collection was conducted by evaluating insulin adherence using the Morisky Medication Adherence Scale-8 (MMAS-8) questionnaire. The researcher also verified respondents' fasting blood glucose levels through laboratory examinations to assess glycemic control. In addition, the researcher provided an educational application related to insulin injection, which included information on definitions, advantages and disadvantages, storage methods, injection sites, and procedures for replacing insulin needles. After the educational application was distributed, the researcher re-evaluated respondents' adherence levels using the MMAS-8 questionnaire, which was completed again during the patients' visit to the endocrine clinic on day 30. Glycemic control assessment was repeated through laboratory examination to determine respondents' fasting blood glucose levels. All results related to adherence and glycemic control were then collected, analyzed, and evaluated by the researcher based on the findings obtained from the respondents.

2.4 Data Processing and Data Analysis Techniques

According to Notoatmodjo (2012), the collected data were subsequently processed using a computerized system to support the organization and analysis of research data. During the data processing stage, the possibility of errors remains, therefore several procedures are required to ensure that the analysis results are accurate and accountable. The first stage is editing, which involves examining the collected data by completing missing information and correcting inaccurate or incorrect entries. The next stage is coding, defined as the process of transforming data in the form of phrases or characters into codes or numerical values to facilitate data entry. This is followed by the entry or processing stage, which involves carefully inputting respondents' coded answers into a computerized system, as errors at this stage may affect the research results. The final stage is cleaning, which consists of rechecking all respondent data to identify coding errors, incomplete data, or necessary revisions and adjustments so that the data are ready for analysis.

2.5 Univariate Analysis

Univariate analysis was conducted to understand the effect of the insulin injection application on patients' glycemic control and insulin adherence. In this study, univariate analysis confirmed the frequency distribution and measures of central tendency, including minimum, maximum, mean, and standard deviation values. The characteristics analyzed included time variables, which were presented using measures of central tendency such as minimum, maximum, mean, and standard deviation.

dan standar deviasi).

$$\bar{x} = \frac{\sum_{i=1}^n x_i}{n}$$

$$SD = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{x})^2}$$

Descriptions:

\bar{x} = average (mean)

$\sum_{i=1}^n x_i$ = the summation of x values from the 1st to the n-th

n = sample size

SD = standard deviation

Meanwhile, variables such as gender and occupation were presented in frequency distributions. Additional variables, including the frequency of insulin use and glucose control, were also expressed using frequency distributions.

$$f = \frac{x}{n} \times 100\%$$

Descriptions:

f = Frekuensi

x = Jumlah variabel yang diteliti

n = Jumlah sampel

2.6 Data Processing and Data Analysis Techniques

Bivariate analysis is an analytical method used to determine the relationship between two variables that consistently influence each other, where one variable has a significant effect on the other (Notoatmodjo, 2012). In this study, bivariate analysis was employed to identify the relationship between the impact of using an insulin injection education application and insulin adherence as well as glucose tolerance among patients with type 2 diabetes mellitus. Before hypothesis testing was conducted, a normality test was performed to determine the type of statistical analysis to be used, whether parametric or nonparametric statistics (Sugiyono, 2013). The normality test was carried out using the Kolmogorov-Smirnov (K-S) test for sample sizes ≥ 50 , while the Shapiro-Wilk test was used for sample sizes < 50 . The hypotheses in the normality test consisted of H_0 , which states that the data are normally distributed, and H_a , which states that the data are not normally distributed. Decision-making guidelines were based on the significance value, where a significance or probability value < 0.05 indicates that the data are not normally distributed, whereas a significance or probability value > 0.05 indicates that the data are normally distributed.

After the normality test was completed, the next stage involved analysis using the paired sample t-test. This test was applied when the data were normally distributed to determine the mean differences before and after treatment within the same sample. However, if the data were not normally distributed, the analysis was conducted using the Wilcoxon signed-rank test as an alternative nonparametric test.

$$t_{hit} = \frac{\bar{D}}{\frac{SD}{\sqrt{n}}}$$

$$SD = \sqrt{\text{var}}$$

$$\text{var} = \frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{x})^2$$

Descriptions:

t_{hit} = calculated t-value of the Paired Sample t-test

\bar{D} = rata-rata selisih pengukuran 1 dan 2

SD = mean difference between measurement 1 and measurement 2

n = total sample

Meanwhile, variables such as gender and occupation were presented in frequency distributions. Additional variables, including the frequency of insulin use and glucose control, were also expressed using frequency distributions.

$$z = \frac{T - \mu T}{\sigma T}$$

T = sum of ranks with the smallest sign

$$\mu T = \frac{n(n+1)}{4}$$

$$\sigma T = \sqrt{\frac{n(n+1)(2n+1)}{24}}$$

n = total sample

2.7 Data Processing and Data Analysis Techniques

Research ethics in this study were implemented by adhering to research ethical principles according to Sugiyono (2015). Several ethical aspects considered included informed consent, anonymity, confidentiality, and protection from discomfort. In the informed consent stage, respondents who met the inclusion criteria were provided with a consent form prior to the study, in which the researcher respected the respondents' right to accept or refuse participation without coercion. The principle of anonymity was applied by assigning codes to each data collection sheet without including respondents' identities in the research results. Furthermore, regarding confidentiality, the researcher ensured the privacy of all information, issues, and research findings by securely storing the data and using them solely for research purposes. Research data were presented in the form of aggregated scores and analysis results without revealing respondents' identities and would be destroyed after the completion of the study. In addition, the principle of protection from discomfort was implemented by allowing respondents the freedom to continue or withdraw from participation if they felt uncomfortable during the research process.

3. RESULT AND DISCUSSIONS

This study was conducted at the endocrine metabolic diabetes outpatient clinic of Prof. Dr. Margono Soekarjo Regional General Hospital, Purwokerto. The endocrine clinic is part of the internal medicine outpatient department that manages patients with diabetes mellitus. The sample in this study consisted of 18 respondents.

Table 7 Distribution of Respondents' Demographic Characteristics

Demographic Characteristics	n (%)
Gender	
Man	6 (33.3)
Woman	12 (66.7)
Age	
Early adulthood (23-35 tahun)	3 (16.7)
Late adulthood (36- 45 tahun)	4 (22.2)
Early elderly (46-55 tahun)	3 (16.7)

Demographic Characteristics	n (%)
Late elderly (56-80 tahun)	8 (44.4)
Tingkat Pendidikan	
Elementary school	1 (5.6)
Secondary school	1 (5.6)
Senior high school	9 (50.0)
Higher education	7 (38.9)
Job	
Retired civil servant	5 (27.8)
Teacher	1 (5.6)
Secretary	1 (5.6)
Self-employed	5 (27.8)
College	1 (5.6)
Doctor	1 (5.6)
Midwife	1 (5.6)
Housewife	3 (16.7)
Total	18 (100)

Table 7 shows that the majority of respondents were female (66.7%), aged 56 to 80 years (44.4%), had a senior high school education (50.0%), and worked as retired civil servants and self-employed individuals (27.8%).

Table 8 Frequency Distribution of Family Support

Support Family	Mean±SD
Pre-test	26.00±18.620
Post-test	66.72±7.858

Table 8 shows that the majority of respondents' family support during the pre-test (before) the implementation of the insulin adherence education application (AKSI PATAS) had a mean score of 26 with a standard deviation of 18.620. During the post-test (after) the implementation of the insulin adherence education application (AKSI PATAS), the mean score increased to 66.72 with a standard deviation of 7.858.

Table 9 Frequency Distribution of Insulin Adherence

Frequency of Insulin Adherence	Mean±SD
Pre-test	2.67±2.635
Post-test	6.83±0.707

Table 9 shows that the majority of respondents' insulin adherence during the pre-test (before) the implementation of the insulin adherence education application (AKSI PATAS) had a mean score of 2.67 with a standard deviation of 2.635. During the post-test (after) the implementation of the insulin adherence education application (AKSI PATAS), the mean score increased to 6.83 with a standard deviation of 0.707.

Table 10 Frequency Distribution of Glycemic Control

Glycemic Control in Patients with Type 2 Diabetes Mellitus	Total (n)		Percentage (%)	
	Pre-test	Post-test	Pre-test	Post-test
Controlled	0	5	0	27.8
Uncontrolled	18	13	100	72.2
Total	18	18	100	100

Table 4.4 shows that the majority of respondents' glycemic control during the pre-test (before) the implementation of the insulin adherence education application (AKSI PATAS) was categorized as uncontrolled in 18 respondents (100%). During the post-test (after) the implementation of the insulin adherence education application (AKSI PATAS), glycemic control remained categorized as uncontrolled in 13 respondents (72.2%).

The normality test for family support was conducted using the Shapiro-Wilk test because the number of respondents was ≤ 50 . The results indicated that the data were normally distributed with a significance value of $0.446 > \alpha = 0.05$; therefore, the statistical test used was the paired t-test.

Table 11 The Effect of the Insulin Education Application on Family Support for Insulin Use

Variable	Mean \pm SD	Difference \pm SD	P. Value
Support Pre-test (n=18)	26.00 \pm 18.620	-40.722 \pm 19.712	0.000
Support Post-test (n=18)	66.72 \pm 7.858		

Table 11 shows that the mean family support score during the pre-test (before) the implementation of the insulin adherence education application (AKSI PATAS) was 26.00 with a standard deviation of 18.620, while during the post-test (after) the implementation it increased to 66.72 with a standard deviation of 7.858. The mean difference in family support before and after the intervention was -40.722 with a standard deviation of 19.712. The results of the paired t-test showed a p-value of $0.000 < \alpha = 0.05$, indicating a statistically significant difference in family support before and after the implementation of the insulin adherence education application (AKSI PATAS).

The normality test for insulin adherence was conducted using the Shapiro-Wilk test because the number of respondents was ≤ 50 . The results indicated that the data were not normally distributed, with a significance value of $0.001 < \alpha = 0.05$; therefore, the statistical test used was the Wilcoxon test.

Table 12 The Effect of the Insulin Education Application on Insulin Adherence

Variabel	Median (Min-Max)	P. Value
Kepatuhan Pre-test (n=18)	1 (0-8)	0.000
Kepatuhan Post-test (n=18)	7 (5-8)	

Table 12 shows that the median insulin adherence during the pre-test (before) the implementation of the insulin adherence education application (AKSI PATAS) was 1, with a minimum-maximum value of 0-8. During the post-test (after) the implementation of the application, the median increased to 7, with a minimum-maximum value of 5-8. The results of the Wilcoxon statistical test showed a p-value of $0.000 < \alpha = 0.05$, indicating a significant difference in insulin adherence before and after the implementation of the insulin adherence education application (AKSI PATAS). No respondents showed lower adherence compared to before the intervention, 3 respondents remained unchanged, and 15 respondents showed improved adherence.

The normality test for glycemic control was conducted using the Shapiro-Wilk test because the number of respondents was ≤ 50 . The results indicated that the data were normally distributed with a significance value of $0.446 > \alpha = 0.05$; therefore, the statistical test used was the paired t-test.

Table 13 The Effect of the Insulin Education Application on Glycemic Control

Variable	Mean \pm SD	Difference \pm SD	P. Value
Support Pre-test (n=18)	249.67 \pm 50.278	102.278 \pm 63.147	0.000
Support Post-test (n=18)	147.39 \pm 36.434		

Table 13 shows that the mean glycemic control during the pre-test (before) the implementation of the insulin adherence education application (AKSI PATAS) was 249.67 with a standard deviation of 50.278, while during the post-test (after) the implementation it decreased to 147.39 with a standard deviation of 36.434. The mean difference in glycemic control before and after the intervention was 102.278 with a standard deviation of 63.147. The results of the paired t-test showed a p-value of $0.000 < \alpha = 0.05$, indicating

a statistically significant difference in glycemic control before and after the implementation of the insulin adherence education application (AKSI PATAS).

The results of this study examined the effect of the insulin adherence education application (AKSI PATAS) on insulin adherence and glycemic control among patients with diabetes mellitus at Prof. Dr. Margono Soekarjo Regional General Hospital. Data analysis was conducted using univariate and bivariate analyses.

In the univariate analysis, respondents' demographic characteristics showed that the majority were female, aged 56 to 80 years, had a senior high school education or equivalent, and worked as retired civil servants and self-employed individuals. The analysis involved 18 patients with type 2 diabetes mellitus. The findings indicated that female respondents predominated, accounting for 66.7% of the sample. Gender represents biological differences present from birth between males and females, both of whom have a risk of developing diabetes mellitus (Mildawati et al., 2019). These findings are consistent with data from the International Diabetes Federation (IDF, 2020), which reported that the number of female diabetes mellitus patients is higher than that of males. The mean age of respondents was 53.9 years, with an age range of 23 to 78 years, and the largest age group was 56 to 80 years, comprising 44.4% of respondents. According to Notoatmodjo (2012), age is calculated from birth until the most recent period of activity. Increasing age is associated with a higher risk of diabetes mellitus due to declining physiological functions, including reduced insulin secretion or increased insulin resistance, resulting in less optimal blood glucose control (Astuti, 2013).

Soekarjo Purwokerto dengan nilai p value $0,000 < \alpha = 0,05$. Setelah pemberian aplikasi, dukungan keluarga menjadi lebih baik karena keluarga berperan sebagai caregiver yang memberikan kehangatan, perhatian, dan dukungan dalam perawatan anggota keluarga dengan penyakit kronis.

Based on education level, the majority of respondents had a senior high school education (50.0%). Education plays an important role in influencing individual behavior, including lifestyle patterns and the ability to receive health information (Wawan & M., 2016). A study by Mellydar R (2019) also stated that education affects an individual's level of knowledge because through education individuals can develop their potential and acquire the skills necessary to improve their own health status and that of their families. In terms of occupation, most respondents were retired civil servants and self-employed individuals (27.8%), a group considered vulnerable to stress. Stress can increase epinephrine hormone levels, which act antagonistically toward insulin, thereby inhibiting insulin function and affecting blood glucose levels (Setiyo Nugroho, 2020).

Regarding the family support variable, the study results showed that the mean family support score at the pre-test was 26 with a standard deviation of 18.620, while at the post-test it increased to 66.72 with a standard deviation of 7.858. This increase indicates a significant change after the implementation of the AKSI PATAS educational application. These findings are consistent with Hensarling's theory (2019), which states that family support is a strong indicator that positively influences self-care among patients with diabetes mellitus. Family support includes interactions among family members such as parents, children, spouses, siblings, and other relatives who contribute to treatment adherence, including physical activity and therapy management.

For the insulin adherence variable, the results showed that the mean adherence score at the pre-test was 2.67 with a standard deviation of 2.635, whereas at the post-test it increased to 6.83 with a standard deviation of 0.707. Adherence is an important factor in treatment success, in addition to appropriate medication selection, treatment regimens, and support for a healthy lifestyle. Non-adherence may lead to loss of therapeutic benefits and gradual worsening of the patient's condition, including an increased risk of macrovascular and microvascular complications in patients with type 2 diabetes mellitus (Saibi et al., 2020). Therefore, adherence is an aspect that requires special attention in diabetes management.

For the glycemic control variable, the results showed that all respondents (100%) were categorized as uncontrolled during the pre-test. After the intervention, the number of respondents with uncontrolled glycemic control decreased to 72.2%, indicating that five respondents improved to the controlled category. Glycemic control is a fundamental component in diabetes mellitus management because it is used to assess glucose metabolism through blood glucose measurement (Yuanita et al., 2018). Monitoring results serve as a reference for adjusting diet, physical activity, and pharmacological therapy to achieve near-normal blood glucose levels and prevent hyperglycemia and hypoglycemia (Ramadhan & Hanum, 2016). In addition to maintaining blood glucose levels, glycemic control also aims to manage comorbid conditions and prevent chronic complications through strict monitoring of risk factors (Rusdi & Afriyeni, 2019).

In the bivariate analysis, the paired sample t-test results showed that the insulin adherence education application (AKSI PATAS) had a significant effect on family support among patients with type 2 diabetes

mellitus at the endocrine metabolic diabetes outpatient clinic of Prof. Dr. Margono Soekarjo Regional General Hospital, Purwokerto, with a p-value of $0.000 < \alpha = 0.05$. After the implementation of the application, family support improved, as family members functioned as caregivers who provided warmth, attention, and support in caring for relatives with chronic illnesses.

Furthermore, the results of the Wilcoxon test indicated that the AKSI PATAS educational application had a significant effect on insulin adherence, with a p-value of $0.000 < \alpha = 0.05$. Patient non-adherence is one of the causes of failure in blood glucose control (Yuanita et al., 2018). Vervloet et al. (2012) stated that non-adherence is often caused by a lack of understanding regarding the disease, its management, complications, and forgetfulness in medication or insulin use. Therefore, education regarding proper injection techniques and disease understanding becomes a primary strategy for improving adherence. After the intervention, no respondents showed decreased adherence, three respondents remained unchanged, and fifteen respondents demonstrated improved adherence, indicating the effectiveness of the application in enhancing patients' knowledge and adherence.

The results of the paired sample t-test also showed that the AKSI PATAS educational application had a significant effect on glycemic control among patients with type 2 diabetes mellitus, with a p-value of $0.000 < \alpha = 0.05$, indicating an improvement in glycemic control after the intervention. According to Efendi and Larasati (2017), health education aims to improve knowledge, foster positive attitudes toward healthy behaviors, and develop healthcare skills so that individuals are able to apply healthy habits in their daily lives. The findings of this study demonstrate that application-based education can serve as an effective medium for improving diabetes mellitus management more optimally.

4. CONCLUSION AND RECOMMENDATION

Based on the study results, it can be concluded that demographic characteristic analysis was conducted on 18 patients with diabetes mellitus at the endocrine metabolic diabetes outpatient clinic of Prof. Dr. Margono Soekarjo Regional General Hospital, Purwokerto. The findings showed that the majority of respondents were female (66.7%), aged between 56 and 80 years (44.4%), had a senior high school education (50.0%), and worked as retired civil servants and self-employed individuals (27.8%).

Family support prior to the implementation of the insulin adherence education application (AKSI PATAS) showed a mean score of 26 with a standard deviation of 18.620, which increased at the post-test to a mean score of 66.72 with a standard deviation of 7.858. Insulin adherence among patients with type 2 diabetes mellitus also improved, with a pre-test mean score of 2.67 and a standard deviation of 2.635, increasing at the post-test to a mean score of 6.83 with a standard deviation of 0.707. Regarding the glycemic control variable, all respondents (100%) were categorized as uncontrolled before the intervention. After the implementation of the educational application, the proportion of respondents with uncontrolled glycemic control decreased to 72.2%, indicating that five respondents improved to the controlled category.

Statistical analysis results demonstrated that the insulin adherence education application (AKSI PATAS) had a significant effect on family support, insulin adherence, and glycemic control among patients with type 2 diabetes mellitus at the endocrine metabolic diabetes outpatient clinic of Prof. Dr. Margono Soekarjo Regional General Hospital, Purwokerto, with p-values of $0.000 < \alpha = 0.05$ for each research variable.

Based on these findings, several recommendations can be proposed. For the nursing profession, the results are expected to improve the quality of nursing care through application-based health education, particularly regarding insulin injection techniques. For the institution, Prof. Dr. Margono Soekarjo Regional General Hospital is encouraged to develop and utilize the insulin adherence education application as an educational medium to facilitate patient counseling for individuals with diabetes mellitus. For patients, the use of the educational application is expected to improve adherence in performing insulin therapy correctly and consistently. For future researchers, it is recommended to include additional variables related to factors influencing insulin injection adherence and glycemic control among patients with type 2 diabetes mellitus. Furthermore, for scientific development, the results of this study are expected to serve as a reference for future research examining the effect of insulin adherence education applications on insulin adherence and glycemic control in patients with diabetes mellitus.

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