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The Relationship between Education Level and Therapeutic Outcomes of Patients using Metformin alone and in Combination in Ambon City

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Abstract

Diabetes mellitus (DM) is a chronic disease caused by problems with the pancreas to produce sufficient amounts of insulin or the body cannot use the insulin it produces properly. Socio-demographic variables such as education level, age, gender, socioeconomic such as employment and medical costs, and frequency and amount of medication are some of the factors that can affect a patient's adherence to taking medication. By knowing these factors, people at risk of developing diabetes can take preventive measures by controlling other factors related to diabetes.

The purpose of the study was to evaluate the effect of DMT2 patients' education level on adherence in the use of single and combination metformin drugs, analyze differences in therapeutic outcomes, find out what factors affect therapeutic outcomes and analyze the patient's quality of life.

Methods: This study involved 300 DM respondents using a cross-sectional approach that met the inclusion criteria. Data were collected through the MMAS-8 questionnaire (Morisky 8-item drug adherence scale) and EQ-5D Value set Indonesia, and were equipped with medical records. Then the Chi-Square test was used to see the relationship between education level and compliance, the Mann-Whitney non- parametric test to analyze the difference in therapeutic outcomes with the type of therapy and to see the relationship between the patient's quality of life and the type of therapy, and the Cox Regression test to determine the factors that determine the level of education to the therapeutic outcome.

The results showed the relationship between education level and patient compliance (p value = 0.291), the difference in therapy results with the type of therapy in the final GDP group that was treated using single and combination metformin (p=0.013 value) while in the Cholesterol group (p=0.036 value). Determinants of education level on therapeutic outcomes for elementary school (p=0.214), junior high school (p=0.428), high school (p=0.789), high compliance (p=0.665), moderate compliance (p=0.136), type of therapy (p=0.624), Age (p=0.085), Male (p=0.948), Female (p=0.959), Private Worker (p=0.830), Entrepreneur (p=0.330), Civil servants (p= 0.499), as well as the relationship between quality of life and the type of therapy (p=0.300).

Conclusions: There was no significant relationship between education levels and patient compliance. The difference in therapy outcomes with the type of therapy in patients from the final GDP and cholesterol therapy outcomes group was significant. There was no significant relationship between the quality of life and the determinants of the treatment outcome were not significant.

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Introduction

Diabetes mellitus (DM) is a chronic disease caused by problems with the pancreas to produce sufficient amounts of insulin or the body cannot use the insulin produced properly patients with type 2 diabetes mellitus (DMT2) who go to a Health Facility (Puskesmas) are given oral antidiabetic drug therapy Metformin in single form or a combination of Metformin-Glimepirid Sociodemographic [1,2]. Variables such as education level, Age, gender, socioeconomic such as occupation and cost of treatment, and frequency and amount of medication are some of the factors that can affect a patient's adherence to taking medication [3]. The level of education of the patient will affect their knowledge of the use of the drug, which will affect the effectiveness of the treatment. A higher level of education will make patients better and faster able to receive and understand information, as well as form a better perspective on their disease and the treatment they receive [4]. By knowing these factors, people at risk of diabetes can take preventive measures by controlling other factors related to diabetes [5]. Based on the background described above, this study was conducted to determine the comparison of education levels and therapeutic outcomes among diabetic patients who use single and combination metformin in Ambon City.

Method

This study is an observational study using a cross-sectional approach (November 5, 2024 - February 5, 2025) in accordance

with the Ethics Certificate (SK) No.123/KEPK- UTA45JKT/EC/EXP/11/2024. Data were collected by observing and analyzing medical record data of type 2 Diabetes Mellitus patients undergoing treatment at the Ch. M. Tiahahu Health Center and using primary data obtained from questionnaires to assess the level of education on therapeutic outcomes in diabetic patients who used metformin alone and metformin combination.

Research Sample (Material)

The materials used in this study were medical record data, MMAS-8 questionnaire to measure compliance level and EQ-5D Value set questionnaire to measure quality of life.

Working Procedure

Patients with Type 2 Diabetes Mellitus who are undergoing oral antidiabetic therapy who come to or are at the place where the study was conducted. After that, patients who are willing to be the subject of research will be interviewed and fill out questionnaires, then the data obtained will then enter the data processing stage and the results will be obtained.

Results and Discussion

Table 1: Characteristics of Type 2 Diabetes Mellitus Patients

Variabel	Category	Total	
		N (300) (%)	
Gender	Woman	189	(63)
	Man	111	(37)
Age	<33 33-43 44-54 55-65 >66	8 21 70 122 79	2,7 7,0 23,3 40,7 26,3
Work	Private Entrepreneurial PNS Not working	37 46 97 120	12,3 15,3 32,3 40,0
Education Level	SD SMP SMA College	18 14 149 119	6,0 4,7 49,7 39,7
Duration of Illness	<3 years >3 years	261 39	87,0 13,0
Antidiabetic Oral	Monotherapes Kombinasi	150 150	50 50

In table 1 Based on the research data, 300 samples were obtained, which used single and combination metformin (metformin-glimepirid). From the data obtained, 189 people (63%) were male and 111 people (37%) were female. In the characteristics of patients, the age of the subjects was categorized into 5 groups, namely the first group < 33 years of age totaling 8 respondents (2.7%), the second group of 33-43 years of age totaling 21 respondents (7%), the third group of 44-54 years of age totaling 70 respondents (23.3%), the fourth group of 55-65 years of age totaling 122 respondents (40.7%) and the fifth group of age >66 years totaling 79 respondents (26.3%). On the occupational characteristics of most non-working patients, 120 respondents (40%), which likely included retirees or housewives. This was followed by civil servants amounting to 87 respondents (32.3%), entrepreneurs amounting to 46 respondents (15.3%) and the private sector amounting to 37 respondents (12.3%). The characteristics of patients with elementary education amounted to 18 respondents (6%), junior high school amounted to 14 respondents (4.7%), high school amounted to 149 respondents (49.7%) and universities (PT) amounted to 119 respondents (39.7%). Based on the results of the analysis of disease duration data in patients with type 2 diabetes mellitus, 261 respondents (87%) < 3-year subject data and 39 respondents (13%) were >3 years old. The results of the data on the use of oral antidiabetic drugs in subjects with oral antidiabetic monotherapy were 150 respondents (50%) and combination antidiabetics were 150 respondents (50%).

Table 2: The Relationship of Education Level to Patient Compliance

Education level	N (%)			p-value
	Low Compliance <6	Medium Compliance 6-7	High Compliance >7	
SD	4 (3,77%)	12 (9,23%)	2 (3,13%)	0.291
SMP	5 (4,72%)	6 (4,62%)	3 (4,69%)	
SMA	57 (53,77%)	65 (50%)	27 (42,19%)	
PT	40 (37,74%)	47 36,15%)	32 (50%)	
Total	106 (100%)	130 (100%)	64 (100%)	

* Chi-Square Test

In table 2. The analysis was conducted on 300 patients with type 2 diabetes mellitus, which were grouped by education level (elementary, junior high, high school, and college) and compliance level (low, medium, high). Patients with low education (elementary and junior high) mostly show low or moderate adherence. Of the total 32 patients in this group, only 5 (14%) showed high adherence. Patients with secondary education (SMA), although large in number, are still relatively low (27 out of 149 people, or 18%). Patients with higher education (Tertiary Education) had the largest proportion of high adherence, at 32 out of 119 patients (26.9%). The statistical test used was Chi-Square, to see if there was a significant relationship between education level and medication adherence. p-value = 0.291 meaning that there was no statistically significant relationship between education level and patient compliance level ($p > 0.05$). The results of the analysis of the relationship between patient compliance levels were tested using the Indonesian version of the Morisky Medication Adherence Scale 8 (MMAS-8) questionnaire in type 2 DM patients. The results showed that patients with higher education level (tertiary) had a higher percentage of adherence to treatment (26.9%) compared to patients with low education (elementary/junior high). Although statistically insignificant ($p = 0.291$), it suggests a possible positive relationship between education and compliance. Even though they have a high education, some do not understand the condition of the disease, causing patients to not obey [6]. On the other hand, respondents with lower levels of education stated that they had more trust in the doctor's advice, which caused them to become more compliant [7]. Previous research supporting education-level findings has been associated with improved understanding of medical instruction, health literacy, and adherence to treatment in people with chronic diseases such as diabetes. Higher education allows individuals to better understand the importance of glycemic control and the long-term consequences of non-compliance [8]. This is also in line with other studies on educational variables obtained data value $p=0.164$ ($p>0.05$) thus it can be said that the education level variable has no significant effect on patient adherence [9].

Table 3: Differences in Therapy Results with Types of Therapy

Therapy Groups	N (%)	Metformin (Median)	Combination (Median)	p-value
Initial GDP	150 (50%)	250	260	0.123
Final GDP	150 (50%)	129	126	0.013*
Kolesterol	300 100%)	200,00	204,00	0.036*

* Mann-Whitney Test

Based on table 3, it shows the difference between the two therapy groups, namely single and combination metformin (metformin-glimepirid) on initial GDP, final GDP, and cholesterol. The data is not normally distributed, so the Mann-Whitney non- parametric test is used. The results of the analysis showed that there was no statistically significant difference in baseline GDP between patients using single metformin therapy and combination therapy p-value = 0.123. This indicates that the patient's initial GDP levels before the intervention were relatively comparable in both groups. In the final GDP measurement, p-value = 0.013* shows a significant difference between the two groups in the final GDP value ($p < 0.05$). This means that combination therapy is more effective in lowering the patient's GDP levels than single metformin therapy. In cholesterol measurement, p-value = 0.036*. The results of the analysis also showed a significant difference in cholesterol levels between the therapy groups ($p < 0.05$). Patients with combination therapy tended to have higher cholesterol levels compared to the single metformin group, although the difference was not too large. Other studies also showed that there was no statistically significant relationship between education level and blood sugar levels, with a p-value of 0.906 (> 0.05). Education is not a predictor of diabetes mellitus risk; however, education remains an effective means of preventing various diseases, including diabetes mellitus [10.11].

Table 4: Quality of Life Relationship of DM tpe 2 Patients Treated with Single and Combination Metformin

Variabel	Types of Therapy	N (%)	Median	p- value
Quality of Life	Metformin	150 (50%)	0,96	0,300

*Mann-Whitney

In table 4. Use the *Mann-Whitney Test* to see the relationship between quality of life and the type of therapy used. The results showed that there was no significant difference in the quality of life of patients with type 2 diabetes mellitus between those who received single metformin therapy and combination therapy (metformin- glimepirid) with a p = 0.300 value. Although the average quality of life ranking of the combination group is higher, it is statistically meaningless. The EQ-5D index instrument with the Indonesian value set was used in this study to assess quality of life based on 5 dimensions: mobility, self-care, daily activities, pain/discomfort, and anxiety/depression. EQ-5D has been validated as a sensitive measuring tool in measuring quality of life, patients with chronic diseases including diabetes mellitus 12,20. Unachieved clinical outcomes have an impact on worsening of conditions including complications and quality of life of patients Clients who have good blood sugar control will have an effect on improving their quality of life [12,13].

Table 5: Determinants of Education Level on Therapeutic outcomes in type 2 DM Patients using Single Metformin and Combination Metfomine

Variabel	B	HERSELF	Forest	Odds Ratio	p-value	Interpretasi
SD	+0.360	0.290	1.543	1.433	0.214	Insignificant
SMP	+0.250	0.316	0.628	1.285	0.428	Insignificant
SMA	+0.044	0.166	0.071	1.045	0.789	Insignificant
High Compliance	–0.071	0.165	0.188	0.931	0.665	Insignificant
Moderate Compliance	–0.241	0.162	2.222	0.786	0.136	Insignificant
Types of Therapy	–0.058	0.118	0.240	0.944	0.624	Insignificant
Age	–0.009	0.005	2.970	0.991	0.085	Close to significant (p~0.08)
Man	–0.067	1.028	0.004	0.935	0.948	Insignificant
Woman	+0.053	1.029	0.003	1.054	0.959	Insignificant
Private Workers	–0.047	0.219	0.046	0.954	0.830	Insignificant
Entrepreneurial	+0.181	0.185	0.950	1.198	0.330	Insignificant
PNS	+0.127	0.189	0.457	1.136	0.499	Insignificant

*Cox Regression

Based on the results of logistic regression analysis for variables suspected to be related to *therapeutic outcomes* in patients with type 2 diabetes mellitus, the following results were obtained:

Education Level

Overall, the education level variable did not show a significant influence on therapeutic outcomes (p = 0.559). This is supported by the low Wald score in all categories of education. Patients with primary education had an odds ratio (Exp(B)) of 1.433 (CI not available), indicating a 43% higher chance of therapy success than the reference group, but this outcome was not significant (p = 0.214). Junior high school (p = 0.428) and high school (p = 0.789) education was also not significant. The patient's education level did not significantly affect the success of diabetes control in this study. This means that differences in patients' formal education levels are not meaningfully correlated with diabetes control outcomes, both in terms of glycemic parameters and patients' quality of life. Based on the results of this study, education level is not the main determinant of the success of diabetes therapy. Therefore, in clinical

practice, a more effective approach is to ensure patients have a practical understanding of disease management (health literacy), rather than relying solely on formal education levels as an indicator of self-management readiness. These results are in line with a number of studies showing that although education is often thought to influence health literacy, the direct influence of formal education on diabetes clinical outcomes is not always significant. Many studies confirm that other factors such as social support, medication adherence, health literacy, and access to services have a greater contribution to the success of therapy [14]. Education level is not a predictor of DM risk, but education can be an effective means of preventing the occurrence of various diseases, including diabetes mellitus, through increasing public awareness of risk factors, symptoms, and various preventive measures that can be carried out. Other studies have also shown that education level is not significantly related to glycemic control, but medication adherence and disease duration are more dominant [11, 15]. The level of education is not significant with the incidence of diabetes mellitus, a person's low level of education can affect a person's absorption of the information received, lack of insight, because the lower a person's education, the less the level of knowledge so that it has an impact on a person's attitude and behavior [16].

Compliance

The overall patient adherence variable also did not show a significant influence on therapy outcome (p = 0.252). Patients with high adherence had an odds ratio of 0.931 (p = 0.665), suggesting a slightly lower probability of therapy success than the reference group, although this difference was not significant. Moderate compliance (odds ratio = 0.786; p = 0.136) was also insignificant. Adherence in taking medication has not been proven to be an independent predictor factor for therapeutic outcomes in this population. The results of the analysis showed that the level of patient adherence to taking antidiabetic drugs, as measured by the MMA8 scale, did not have a significant effect on the therapeutic outcome (p-value = 0.252). This value suggests that differences in adherence levels were not statistically strong enough to explain the variation in therapy outcomes in the population of type 2 diabetes mellitus patients in this study. This is in line with the finding that there is no relationship between education factors and the level of medication adherence because predisposing factors, such as knowledge related to disease and treatment information that affect adherence behavior, can be found anywhere, so it is not only limited to a person's level of education. Patients with higher education levels are not always able to understand and appreciate the consequences of non-compliance. On the other hand, patients with lower levels of education are also still required to have better cognitive skills to be able to understand and comply with the type 2 diabetes mellitus treatment that has been given. The reasons for non-compliance in taking oral antidiabetic medications are due to traveling, being uncomfortable with side effects, also uncomfortable having to take medication every day, as well as feeling that the situation has improved or is getting worse, and so on [17]. These findings are in line with research that states that while medication adherence contributes to glycemic control, other factors such as social support, long-term metabolic control, diet, physical activity, and comorbidities also play an important role so that the relationship between adherence and therapeutic outcomes is not always linear or significant across the entire population [18].

Types of Therapy

Variable type of therapy (single or combination metformin) also had no significant association (p = 0.624), with an odds ratio of 0.944, suggesting a very small effect on diabetes control success. In addition to choosing the type of antidiabetic, choosing the right dose of antidiabetic is also one of the factors that affect the success of therapy. Choosing a dose reduces hypoglycemia which is one of the antidiabetic side effects. In addition to using, it correctly, choosing the correct dose of antiabetics can reduce the risk of drug side effects [19].

Age

The age variable showed a tendency to be close to significant (p = 0.085) with *an odds ratio* of 0.991. This means that every 1-year increase in the patient's age is associated with a slight decrease in the chance of therapy success (about 0.9%), but has not yet reached a statistically significant level. Increasing age can lead to a decrease in the ability of tissues to metabolize blood sugar. However, with diverse educational backgrounds, the ability of the elderly to receive new knowledge also tends to be more varied. Basic components in education (including the education system, supporting infrastructure, and quality of education) that differ between generations also play a role in determining the educational outcomes of each individual. Another finding was that in low-educated elderly individuals with chronic diseases, the ability to absorb and apply knowledge for the management of their health conditions tended to be lower, thus worsening the health prognosis [20,11]. Age may have a potential effect, but in this study it has not been significant.

Gender

Patient sex was not significantly associated with overall therapy outcome (p = 0.657). Neither males (p = 0.948) nor females (p = 0.959) showed any significant differences. Gender has no effect on the rise or fall of blood sugar levels in people with type 2 diabetes mellitus because both men and women have an equal risk of developing diabetes mellitus and blood sugar levels by gender vary greatly and the difference is that other factors affect blood sugar levels. This is also in line with the results of the study, sex has no effect on the increase or decrease in the results of blood sugar tests in people with diabetes mellitus [21,22].

Work

The work variable also had no significant effect (p = 0.640) on therapy outcomes. All categories (Private, Entrepreneurial, Civil Servants) have a *p- value* of >0.3, so there is no statistically significant relationship. From the respondents' data, as many as 120 respondents did not work and were united as housewives, while work was related to physical activities and sports activities. Housewives do several activities at home such as washing, cooking and cleaning the house and many other activities that cannot be described. Physical activity will affect the increase in insulin so that blood sugar levels will decrease. If there is not enough insulin to convert glucose into energy, DM will arise [23].

Overall, there were no predictor variables that showed a significant influence on the *therapeutic outcome* of type 2 diabetes mellitus in this logistic regression model. These results suggest that predictive variables in the study population are more likely to be influenced by a combination of various other factors beyond the sociodemographic and adherence variables analyzed, e.g. biological factors, dietary patterns, physical activity, or disease duration.

Limitations of the Research

In this study, other factors such as diet, physical activity, history of complications and use of other drugs that affect glucose metabolism were not analyzed. In the future, more in-depth

research can be carried out on controlling variables such as diet, exercise, nutritional status and the use of other drugs that can minimize the bias of research results.

Conclusion

Overall, the results of this study show that education level and compliance factors do not independently influence *the therapeutic outcome* of type 2 diabetes mellitus in this population. Only the combination therapy type of metformin- glimepiride significantly affected the outcome of GDP therapy in this study. These results underscore the importance of considering other factors such as family support, practical health literacy, lifestyle, and long-term metabolic control in an effort to improve the success of diabetes management [24].

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