



## The Affecting Factors of Compliance Diabetes Mellitus Treatment of Type 2 in Pandemic Era

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### Abstract

Diabetes mellitus (DM) is one of the non-communicable diseases that cause serious health problems. This chronic disease requires lifelong treatment to prevent complications and death. In the pandemic era, DM became comorbid that contributed to the death rate in Covid-19 cases, so that patients with type 2 DM become important to comply with the treatment underway. Aim: This study aimed to evaluate the treatment compliance in patients with DM type 2 at the Purwodiningratan primary health care, Surakarta. Method: This study was conducted in 2020 used an analytical method with crosssectional design. Populations were all of the patients who experience DM type 2, sampling techniques used total sampling with 108 respondents. Univariate, bivariate analysis, and logistic regression were used in this study. Compliance levels measured used the MMAS-8 questionnaire. Result: The results of this study were obtained from several independent variables that related to compliance with DM type 2 treatment. The descriptive analysis result of patient compliance showed that 70.4% of patients were obedient. The significant variable was the side effects on DM drugs with (OR = -0.44; 95% CI = -0.74 - 0.15; p = 0.003). Conclusion: Most of the patients were adherent to the treatment and the most influencing factor was the side effect of the drug.

### Introduction

Diabetes mellitus (DM) is one of the global health threats with a tendency to increase the number of sufferers every year. Based on the International Diabetes Federation in 2019, 9.3% (463 million) of the world's population suffer from DM and it is estimated that it will reach 10.9% (700.2 million) in 2045. Indonesia ranks of 7th with the largest number of sufferers in the world, which is 10.7 million people and is projected to increase to 16.6 million by 2045 (International Diabetes Federation, 2019). The 2018 Basic Health Research (RISKEDAS) report also shows that the national DM prevalence is 10.9%. In addition, based on the 2018 RISKEDAS, the city of Surakarta has a fairly high prevalence compared to other

cities in Central Java, which is 2.97% (Health Research and Development Agency, 2019)

During the Covid-19 pandemic, the prevalence of DM sufferers is also increasing. The results of the report from the Chinese Center for Disease Control found that the case fatality rate due to Covid-19 in patients with DM was much higher when compared to patients without DM, which was 7.3% compared to 2.3%. (American Diabetes Association, 2019). Diabetes mellitus is classified into type 1 DM, type 2 DM, gestational diabetes, and other types of diabetes. Type 2 DM patients make up 90% of the total population with DM. WHO predicts that there will be an increase in the number of type 2 DM patients in Indonesia from 8.5 million to 21.3 million in 2045 (International

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Diabetes Federation, 2019). Covid-19 patients with type 2 diabetes are more likely to receive treatment in the ICU compared to patients without type 2 diabetes. It is proven that people with comorbid DM are at risk for more severe Covid-19, especially if they have other comorbidities (Michalakakis et al., 2021).

The prevalence of DM in Covid-19 patients in China was 5.3% among the 44,672 confirmed cases of Covid-19 until February 11, 2020. This is different from the study from Italy which showed that among 146 Covid-19 patients, the DM prevalence rate was 8.9%. In addition, a study from Milan reported a DM prevalence of 14.9% out of 410 people hospitalized with Covid-19 (Pugliese et al., 2020). This shows that patients with DM are a risk factor for COVID-19. The impact of Covid-19 on DM patients has an increased risk of more severe infections and contributes to poorer DM clinical outcomes due to stress, changes in routine care and medication, diet and physical activity. A meta-regression study reported that Covid-19 patients with DM were at risk of death by 2.12 times compared to Covid-19 patients without comorbid DM and at risk of experiencing more severe Covid-19 by 2.45 times compared to Covid-19 patients without comorbid DM (Hartmann-Boyce et al., 2020; Huang et al., 2020).

Monitoring treatment for DM patients during the Covid-19 pandemic is an important thing to do. A systematic review and meta-analysis found that patients with DM had shown a substantial effect on the mortality rate of Covid-19 patients. DM sufferers are shown to be more susceptible to infectious diseases, especially those caused by bacteria and viruses that affect the lower respiratory tract, high glucose levels are responsible for impaired neutrophil function. Microangiopathic occurs in the respiratory tract of DM patients, thereby inhibiting gas exchange in the lungs. Several reports have also shown a higher susceptibility to lower respiratory tract infections caused by atypical microorganisms and episodes of severe pneumonia in DM patients (Mukona, 2020; Ali, 2021)

The pneumonia pathogen that is currently feared by many people is SARS CoV-2 which causes the disease Covid-19. Diabetes mellitus is

one of the most common comorbidities found in patients with Covid-19. There is evidence of an increased incidence and severity of COVID-19 in patients with DM which results in increased complications in sufferers. These complications can be in the form of disorders of the blood vessels or nervous system (neuropathy) that can affect the heart (coronary heart disease), brain (stroke), eyes (diabetic retinopathy), and kidneys (diabetic nephropathy). Neuropathy can affect motor, sensory, or autonomic nerves. In addition, neuropathy can also cause acute complications that can cause permanent damage to the nervous system, coma, and even death (Mukona, 2020).

Several programs have been carried out to suppress and reduce the incidence of type 2 DM. Such as the Joint Asia Diabetes Evaluation Program (JADE) which is a web-based program that combines comprehensive risk management, treatment guidelines, and clinical decision support to improve outpatient diabetes care. (Welch et al., 2011). Unlike the Indonesian government, the government has made efforts to control the increase in DM and its complications, including issuing Guidelines for the Management and Prevention of Type 2 DM, but cases of patients experiencing complications with varying incidence rates are still found. In contrast to Singapore that a pilot study reported good satisfaction of patients receiving telemedicine monitoring for type 1 and 2 DM, patients were referred to a DM center only for blood collection and HbA1c monitoring. While the provision of counseling, therapy and blood test results were informed through telemedicine devices and 80% of the interviewed patients reported no difference between in-person visits and telemedicine, the remaining 20% were more satisfied with telemedicine facilities compared to face-to-face meetings (Umano et al., 2021).

With the morbidity and mortality rates that are still increasing, efforts are needed to identify the factors that cause DM complications to appear even though treatment management has been carried out. One of the factors that influence the increase in morbidity and mortality is poor medication adherence, causing failure of pharmacological therapy. In a study also showed that there are still many type

2 DM patients who are not disciplined in self-management such as non-adherence in taking medication, routine blood glucose checks, diet, knowledge and physical activity (Sofiana et al., 2019). World Health Organization (WHO) defines compliance as an active and voluntary behavioral change including taking medication, following a diet, and changing lifestyles in accordance with the recommendations of health workers. The level of compliance of DM patients during the Covid-19 pandemic is very important to be able to suppress complications in DM patients, to prevent DM morbidity and mortality (International Diabetes Federation, 2019).

The level of adherence to treatment of type 2 DM is poor, which can result in uncontrolled blood glucose control. Non-adherence in the treatment of type 2 DM is usually associated with low socioeconomic factors, non-routine blood sugar monitoring, and inadequate information from health facilities, treatment only when symptoms occur, and lack of support from family. (Polonsky et al., 2016). Therefore, this study aims to identify the factors that influence adherence to type 2 DM at the Purwodiningratan Public Health Center, Surakarta. These data are expected to assist in providing appropriate interventions so that the success of type 2 DM therapy can be achieved which can prevent complications and reduce mortality and morbidity rates.

## Method

This study is an analytic study with a cross-sectional approach. This design is used to determine whether there is a relationship between the independent variable and the dependent variable observed at the same time. In this study, the independent variables were the characteristics of the respondents (gender, education, occupation, age, duration of suffering from type 2 DM, family history, smoking, eating patterns and side effects of type 2 DM drugs), while the dependent variable was the level of adherence. The sampling technique uses non-probability sampling, namely total sampling. The study population is patients diagnosed with type 2 DM and undergoing treatment therapy for type 2 DM at the Purwodiningratan Public Health Center for at least 1 month

(August-October) 2020. This study has received approval from the ethics committee. Data collection was carried out using a google form accompanied by electronic informed consent which was distributed to type 2 DM patients in the working area of the Purwodiningratan Health Center through puskesmas officers. The sample of this study amounted to 108 people.

The level of compliance was measured using the MMAS-8 questionnaire, consisting of 8 questions whose results were categorized into high compliance if the score 8, moderate adherence if the score was 6-7 and low compliance if the score < 6. Changed into two categories with a mean 7 is compliant category and < 7 is a non-compliant category. The analysis test in this study used univariate, bivariate and multivariate tests with multiple logistic regressions.

## Results and Discussion

In this study, it was found that 76 respondents (70.4%) adhered to the treatment of type 2 DM and 32 respondents (29.6%) did not comply, even though the treatment was carried out during the Covid-19 pandemic. Based on data in the field, the rate of patient visits decreased during the Covid-19 pandemic. This is evident from the results of the study which found that there was a decrease in visits to health facilities, especially hospitals, from 66.4% before the pandemic to 37.4% (Chou et al., 2020). Despite maintaining health protocols, the fact is that people are still afraid to come to health facilities for examination and treatment. However, even so, the level of compliance of type 2 DM patients at the Purwadiningratan Health Center was classified as obedient. This is because the measurement of Type 2 DM treatment adherence is based on indicators of adherence or not taking medication, not whether or not the patient is diligent in checking himself into a health facility.

It was found in a meta-analysis, the prevalence of DM in Covid-19 patients was 9%, with the prevalence of DM in severe patients with Covid-19 the mean age of 56.5 years was 17% and in moderate patients with Covid-19 the mean age was 17%. average 46.4 years is 7% (Mukona, 2020). Many factors cause DM disease does not go away and even

cause various complications in sufferers. One of the factors is due to non-compliance in carrying out treatment. In this study, the characteristics of respondents related to type 2 diabetes treatment adherences. A total of 89 respondents (82.4%) aged 26-65 years. Most of them have higher education as many as 84 respondents (77.8%). DM sufferers work as many as 86 respondents (79.6%). Type 2 DM patients with DM 10 years were 87 respondents (89.6%). A total of 61 respondents (56.5%) in their families did not have a history of DM. A total of 98 respondents (90.7%) carried out the diet. A total of 102 respondents (94.4%) did not smoke and as many as 98 respondents (90.7%) did not experience side effects from the DM drugs of type 2 consumed.

A good level of medication adherence, if balanced with good self-care activities such as diet control, physical activity and routine check-ups will have an impact on glycemic control so that it will reduce complications in DM patients of type 2 (Sayeed et al., 2020). From the results of the study, the age of the respondents did not significantly affect compliance ( $p = 0.37$ ). However, based on the age range classified according to WHO, the prevalence of type 2 DM shows that it occurs more in adulthood and the late elderly (26-65 years) than the elderly ( $> 65$  years). In line with the research of Jeremiah (2019), as many as 61% of type 2 DM are more susceptible to being affected at the age of 56-65 years, namely in the late elderly group. The increase in cases of type 2 diabetes in the elderly is due to decreased insulin sensitivity and glucose metabolism in the body.

People who do not work or IRT tend to be more focused on undergoing treatment because they do not have a lot of busyness at work so that it will affect the level of adherence to DM treatment of type 2. DM will tend to be more aware of himself. So it has high adherence in treatment. Respondents will learn to maintain their diet, lifestyle and activity patterns (Aminde et al., 2019). However, the results of this study indicate that a family history of DM has no significant effect ( $p = 0.65$ ). Based on the results of the analysis, although there is no family history of DM, respondents are obedient in carrying out treatment due to the education and knowledge that has been conveyed by

health workers, so that respondents are also more concerned with the therapy they are undergoing.

The results of the chi square test show that the relationship between compliance and education has a  $p$  value of 0.05. Furthermore, the chi square test between the relationship between the implementation of eating patterns and adherence to taking medication also has a significant relationship value, namely the value of  $p = 0.03$ . The results of the chi square test the relationship between drug side effects and medication adherence have a  $p$  value = 0.003. In addition, the results of the study show that almost most of the respondents are highly educated. In theory, education will have an impact on health. The higher the level of education will increase awareness in maintaining health, while lower education will affect the lack of knowledge so that it can increase the risk of DM of type 2 (Saheb Kashaf, 2017).

However, in this study the increase in educational knowledge about DM of type 2 was carried out by health workers at the Purwodiningratan Health Center through audio visuals, in this case education was carried out in the form of video playback with the aim of increasing respondents' knowledge. Previous research has also shown that education using this video can improve medication adherence in DM of type 2 patients. Good knowledge of patients will help improve type 2 DM treatment adherence from management, monitoring, medication, physical activity and diet to things that needs to be controlled. Lack of medication adherence often occurs, and this will affect glycemic levels resulting in complications and death in DM of type 2 patients. Uncontrolled glycemic control can lead to an increased risk of cardiovascular disease, neuropathy, retinopathy, and nephropathy so that patients require intensive care in hospital. In addition, according to other studies, diabetes mellitus that is not well controlled can increase the risk or complications of stroke (Mulyawati, 2015).

Therefore, the importance of adherence to treatment for therapeutic success is increasing the effectiveness of treatment for DM of type 2 patients, so that glucose levels are well controlled. (Nogueira et al., 2020). Almost

all respondents at the level of medication adherence made arrangements for eating patterns, exercising regularly and not smoking because in addition to being obedient to taking medication, patients compensate by adjusting their diet to control sugar levels. In controlling eating patterns, respondents who are more obedient avoid consuming excess sugar. In addition, obedient respondents will better prevent complications, reduce DM morbidity

and mortality of type 2. If complications can be prevented, the respondent can carry out daily activities more healthily and consistently. Thus, in compliant patients, HbA1c was lower than in non-adherent patients. Respondents who do not comply can be given an evaluation related to the results of the analysis of the factors that can affect the complications of type 2 DM. It is hoped that in this way respondents can further improve adherence to treatment.

**Table 1.** Characteristics Associated with DM Compliance Level of Type 2

Independent Variable	Number (n)	Percentage (%)
<b>Age</b>		
26-65 years old	89	82.4
>65 years old	19	17.6
<b>Education</b>		
Low education	24	22.2
High education	84	77.8
<b>Occupation</b>		
Not working	22	20.8
Working	86	79.6
<b>Gender</b>		
Male	29	26.9
Female	79	73.1
<b>Long time suffering from DM2</b>		
≤ 10 years	87	89.6
>10 years	21	19.4
<b>Family History</b>		
No	61	56.5
Yes	47	43.5
<b>Implement eating patterns</b>		
No	10	9.3
Yes	98	90.7
<b>Smoking</b>		
No	102	94.4
Yes	6	5.6
<b>Side effects of DM drugs</b>		
No	98	90.7
Yes	10	9.3

Source: Primary Data 2020

The results of the bivariate analysis showed that the three variables that were significantly related to type 2 diabetes mellitus adherence were education, dietary practices, and side effects of DM drugs (table 2). In contrast to the other six variables, which were not significantly related, namely age, gender, occupation, duration of suffering from type 2 diabetes, family history, and smoking. Significantly related variables are explained

as follows, namely DM . patients of type 2 with higher education 2.5 times adhered to DM treatment compared with those with low education (OR = 2.5; 95% CI = 0.87-7.18; p = 0.05), while DM patients of type 2 who had a good diet had 4.2 times medication adherence than those who did not (OR = 4.2; 95% CI = 0.88-21.34; p = 0.03), and patients with type 2 diabetes who did not experience drug side effects have treatment adherence 0.2 times than

those who experience side effects when taking DM of type 2 (OR = 0.2; CI 95% = 0.02-0.72; p = 0.003).

Because the variables of education, occupation, diet and side effects of DM drugs have a p value of <0.25, this variable is included in the first modeling stage of multiple logistic regression analysis with DM drug side effects as the main variable. The results of statistical tests

with logistic regression showed that the side effect variable had a p value of <0.05, meaning that the side effects of DM drugs had a significant relationship with medication adherence. The variables of education, occupation, and diet have their respective values (p = 0.14, p = 0.96 and p = 0.25) so that these variables do not have a significant relationship and are excluded from the next stage of the logistic regression test.

**Table 2.** Factors Affecting Compliance with DM of Type 2

Independent Variable	DM Compliance Rate of Type 2				OR 95% (CI)	p
	Disobedient		Obedient			
	n	%	n	%		
<b>Age</b>						
26-65 years old	28	31.5	61	68.5	1.72 (0.48-7.73)	0.367
>65 years old	4	21.1	15	78.9		
<b>Education</b>						
Low education	11	45.8	13	54.2	2.53 (0.87-7.18)	0.048
High education	21	25	63	75		
<b>Occupation</b>						
Not working	9	40.9	13	59.1	0.53 (0.18-1.60)	0.194
working	23	26.7	63	73.3		
<b>Gender</b>						
Male	8	27.6	21	72.4	0.87 (0.29-2.42)	0.778
Female	24	30.4	55	69.6		
<b>Long time suffering from DM2</b>						
≤ 10 year	26	29.9	61	70.1	1.06 (0.34-3.73)	0.905
>10 year	6	28.6	15	71.4		
<b>Family History</b>						
No	17	27.9	44	72.1	0.82 (0.33-2.06)	0.648
Yes	15	31.9	32	68.1		
<b>Implement eating patterns</b>						
No	6	60	4	40	4.15 (0.88-21.34)	0.027
Yes	26	26.5	72	73.5		
<b>Smoking</b>						
No	30	29.4	72	70.6	0.83 (0.11-9.69)	0.838
Yes	2	33.3	4	66.7		
<b>Side effects of DM drugs</b>						
No	25	25.5	73	74.5	0.15 (0.02-0.72)	0.003
Yes	7	70	3	30		

Source: Primary Data 2020

In multivariate analysis using multiple logistic regression between independent variables that have a p value > 0.25 in bivariate analysis as the main variables, namely education, occupation, diet and side effects of DM drugs

of type 2 it was found that the independent variable with a p value < 0.05 was a side effect of the drug, then the side effect of the drug would be included in the next modeling stage (Table 3).

**Table 3.** Results of Multivariate Analysis Modeling 1 Factors of Patient Compliance with DM of type 2 with Double Regression Logistics

Independent Variable	OR	95% CI		p
		Lower limit	Upper Limit	
Education	0.16	-0.07	0.39	0.175
Occupation	0.01	-0.23	0.24	0.970
Implement eating patterns	0.18	-0.13	0.49	0.246
Side effects of DM drugs	-0.39	-0.68	-0.08	0.012

Source: Primary Data 2020

The medical history of the obedient respondents, most of them took more than one type of DM drug, namely metformin and glimepiride or what is called a combination drug. Metformin is more effective when combined with glimepiride or glibenclamide. Treatment with combination drugs (metformin and glimepiride) can reduce HbA1c by 0.8% - 1.5% with fewer hypoglycemic side effects. There are almost no side effects felt by respondents, thereby increasing adherence to DM treatment of this type 2. In line with previous studies, it was found that the effectiveness of DM therapy of type 2 were metformin and glimepiride (7.47%). Therapy that is carried out only by taking the drug metformin or this so-called monotherapy, will reduce the level of treatment adherence. This is because separate drug therapy has more side effects, but also has a higher cost, causing discomfort for people with DM of type 2. The potential side effects of metformin are nausea, diarrhea and hypoglycemia. In line with Raden's research, it was found that there was a potential side effect of nausea with the use of metformin (18.5%) and glimepiride (13.3%) and glibenclamide caused a side effect of hypoglycemia (15.8%) so that patients stopped taking DM drugs of type 2 to reduce the side effects he feels (Putra et al., 2017). In addition, the patient's lack of confidence in the benefits of the drug causes a less than optimal level of adherence.

In a meta-analysis study by Marcel et al. (2020) it was found that knowledge and care based on pharmaceutical care or adherence to medication had a significant impact on DM of

Type 2. Adherence to this treatment will be useful in monitoring the recovery of patients with DM of type 2 (Nogueira et al., 2020). In carrying out treatment compliance for DM patients of Type 2 requires collaboration between patients and health workers, agreement and decisions to work together considering clinical factors and patient preferences that are agreed by both parties. According to Charles, there is a need for construction such as involvement between patients and health workers, mutual support for contributions to treatment deliberation, exchange of information and mutual agreement. Recent guidelines from the American Diabetes Association (ADA) and European Association Study for Diabetes (EASD) recognize and support the existence of a patient-centred approach to treatment to improve medication adherence in DM patients of type 2 (Saheb Kashaf et al., 2017).

In addition, factors that influence medication adherence in DM patients of type 2 include socio-economic factors, information from health facilities, family support, treatment when symptoms appear, routine checks of blood sugar levels, complexity of pharmacotherapy and patient beliefs about drugs. Respondents who do not comply need to intervene by providing education to both individuals and families about the importance of controlling blood sugar, taking medication, doing physical activity and how to improve medication adherence. Education and information related to DM treatment adherence of type 2 during this pandemic, an alternative solution that can be done is to provide education through digital

media, educational videos or telemedicine. In addition, interventions need to be carried out to monitor medication adherence in DM patients of type 2 who has not complied. In the study, the results of the multivariate analysis test in the final model showed that the presence of side effects of DM drugs felt by the respondents had an effect on reducing 0.44 times the medication adherence of type 2 DM patients compared to respondents who did not experience side effects of DM drugs (OR = -0.44; 95% CI = -0.74 to -0.15; p = 0.003).

### Conclusion

Based on the results of research conducted at the Public Health Center of Purwodiningratan, it showed that there was a relationship between medication adherences of patients with DM of type 2 with side effects of DM drugs consumed. The level of adherence to treatment of DM patients of type 2 is at Public Health Center of Purwodiningratan mostly fall into the obedient category. The most influential factor is the side effects of DM drugs of type 2. From this study, it was found that patients who did not experience side effects of DM drugs were more compliant by 0.44 times than patients who experienced side effects of DM drugs. In future research, it is expected to conduct research related to other risks related to factors that influence DM treatment adherence of type 2 such as knowledge, motivation, and attitudes of DM patients of Type 2.

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