

ORIGINAL ARTICLE

**Characteristic Analysis Of Type 2 Diabetes Mellitus Based On HbA1c**

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**ABSTRACT**

**Introduction:** Type 2 Diabetes Mellitus (DM) is a group of metabolic diseases with hyperglycemia characteristic that occurs due to insulin resistance accompanied by relative insulin deficiency. Monitoring the metabolic status of DM patients is essential. One method that can be used to determine blood glucose control in people with DM is the measurement of hemoglobin-glycosylated (HbA1c). **Objective:** The purpose of this study is to determine the characteristics of DM patients based on HbA1c levels in Ponorogo Regency, East Java, Indonesia. **Method:** The study used a cross-sectional design and descriptive data presentation. The study took a sample of 180 people with type 2 diabetes in Ponorogo Regency. Respondent characteristic data in the form of age, sex, education, and duration of DM were obtained through interviews, and HbA1c values were obtained by blood tests in a standardized laboratory in Ponorogo Regency. **Results:** The results of the study show that 81.7% of 180 DM patients had 16.5% HbA1c values. Patients with HbA1c  $\geq 6.5\%$  are mostly women, old age, low education, and have had suffered DM less than five years. **Conclusion:** Glycemic control through routine and periodic HbA1c checks is required, to prevent further complications

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**1. Introduction**

Diabetes Mellitus (DM) is a DM group with insulin resistance accompanied by relative insulin deficiency. Diagnosis for DM needs to focus if there are classic DM complaints in the form of polyuria, polydipsia, polyphagia, and weight loss that cannot be explained (Soelistijo et al., 2015). Type 2 diabetes mellitus often cannot be felt at an early stage and remains undiagnosed for a long time until various complications occur (Juarez, Demaris, Goo, Mnatzaganian, & Smith, 2014).

Every year around 3.2 million deaths are caused by DM, meaning there is one person per 10 seconds or six people per minute who die from DM. The incidence of DM in 2012 in the world was 371 million people, with the proportion of type 2 DM events being 95% (Claesson, Ignell, Shaat, & Berntorp, 2017). The prevalence of DM in the world continues to increase, especially in developing countries, including Indonesia. According to WHO, the number of people who suffered from DM increased from 8.4 million in 2000 to 13.7 million in 2003; and this number is expected to increase by around 21.3 million in 2030. The high number of sufferers makes Indonesia ranked fourth in the world after China, India, and the United States (World Health Organization, 2014). In 2007, based on Riskesdas results, it is seen that the prevalence of DM in

Indonesia is 1.1%, and in 2013 there was an increase in DM prevalence to 2.1%. One of the regions with the highest number of people with diabetes is East Java Province, with a prevalence of DM sufferers of 2.1%, which ranked fifth in the top 10 of Diabetes mellitus prevalence in Indonesia (Kemenkes RI, 2013).

Factors that can be used in assessing DM control are HbA1c levels, fasting blood sugar test, 2-hour postprandial blood glucose, cholesterol, body mass index, and blood pressure (Soelistijo et al., 2015). DM control by examining HbA1c levels is also recommended by the American Diabetic Association (ADA) because it can describe the average blood sugar over the past 2-3 months so that it can be used as a reference for treatment planning (American Diabetes Association, 2017). HbA1c is a non-enzymatic binding of glucose molecules to hemoglobin through post-translational glycation (Chugh SN, 2011). Duplicated hemoglobin is seen in several HbA amino acids consisting of HbA1a, HbA1b, and HbA1c (Kovatchev, 2017). An essential component of hemoglobin glycation in Diabetes mellitus is HbA1c, used as the primary benchmark for DM disease control since HbA1c can describe blood sugar levels in the range of 1-3 months because the age of red blood cells bound by glucose molecules is 120 days (Chugh SN, 2011).

A study conducted by the United Kingdom Prospective DM Study (UKPDS) revealed, the higher the HbA1c value in patients with DM, the more potential for complications (d'Emden et al., 2012). Every 1% reduction will reduce the risk of vascular (microvascular) disorders by 35%; other DM complications by 21% will reduce the risk of death by 21%. Normal HbA1c can be sought by keeping blood sugar levels normal at all times (Chugh SN, 2011). DM control that is not optimal can increase the number of sufferers and complications in various body organs such as eyes, kidneys, heart, and blood vessels (Renz, Cavagnoli, Weinert, Silveiro, & Camargo, 2015). However, research conducted in Indonesia regarding the characteristics of type 2 DM patients based on HbA1c levels is still lacking. Therefore this study was conducted to determine the characteristics of type 2 Diabetes Mellitus patients based on HbA1c levels in the Prolanis (Chronic Disease Management Program) group in primary care facilities in Ponorogo Regency, East Java Province, Indonesia.

## 2. Method

The design of this study was a cross-sectional study. The study was conducted from 15 April 2019 to 30 May 2019. The study population was the Prolanis (Chronic Disease Management Program) in the primary service facilities in Ponorogo Regency. The sample size in this study obtained 180 respondents identified through secondary data in Ponorogo Regency. Inclusion criteria were a Type 2 DM patients in the Prolanis group (Chronic Disease Management Program) at the primary service facility in Ponorogo Regency, aged 18-65 years, and willing to participate in the research.

Data collection was carried out by interview to obtain data on age, sex, and the length of DM suffering, while the HbA1c value was obtained from standardized laboratory examination results in Ponorogo Regency. The data is processed and analyzed descriptively and presented in the form of a frequency distribution with a level of significance 0,05. The HbA1c value refers to PERKENI, namely the DM criteria, with the cut-off value of HbA1c  $\geq$  6.5% (Soelistijo et al., 2015). The data were collected after obtaining patient approval from the Human Research Ethics Committee (UHREC) Sultan Zainal Abidin University Malaysia with Number: UnISZA.C/2 /UHREC/628-2 (85) on 8 April 2019 with UHREC code number: UnISZA/UHREC/ 2018/46.

## 3. Results And Discussion

From Table 1, it was found that most patients with type 2 DM in the Prolanis (Chronic Disease Management Program) group in primary care facilities in Ponorogo Regency with HbA1c level  $\geq$ 6.5% are; elderly patients (68.9%), female (73,8%), patients with low education (78.8%), and patients who have suffered from type 2 DM for less than five years (61.1%).

Table 1 The characteristics of respondents (n=180).

Characteristics	HbA1c				Total	
	≥ 6.5		<6.5		Frequency	Percentage (%)
	Frequency	Percentage (%)	Frequency	Percentage (%)		
Age						
Adult	23	12.8	20	11.1	43	23.9
Elderly	124	68.9	13	7.2	137	76.1
Type of sex						
Male	14	7.8	18	10	32	17.8
Female	133	73.8	15	8.4	148	82.2
Education						
Primary	142	78.8	28	15.6	170	94.4
Secondary	5	2.8	5	2,8	10	5.6
Suffering Time						
≤ 5 years	110	61.1	12	6.7	122	67.8
> 5 years	37	20.5	21	11.7	58	32.2

HbA1c assessment in patients with DM is used to determine complications earlier and assess compliance with DM control by patients. HbA1c is one of the hemoglobin fractions in the human body that binds enzymatically to glucose (Tc, Needleman, Sh, & Ej, 2010). Because red blood cells survive for 8-12 weeks before regeneration occurs, measuring glycosylated hemoglobin (HbA1c) can reflect average blood glucose levels during that period (Soranzo et al., 2010). HbA1c concentration depends on blood glucose concentration and the age of erythrocytes (Qaseem et al., 2018). Several studies have shown a close relationship between HbA1c concentrations and average blood glucose levels. A Cohort Study in Australia revealed that the median HbA1c increases with worsening glycemic levels (Begley, 2012).

From the results of the study, it is found that the value of ≥6.5% HbA1c in patients was 84.7%. This result illustrates the lack of patient attention to DM. An HbA1c value of <6.5% indicates reasonable diabetes control, a value of ≥6.5% indicates poor diabetes control. From the results of HbA1c, it can be known the average value of glucose in the last 1-3 months. Thus it is recommended that patients get a regular HbA1c check every 3-6 months, at least two times a year (Larose et al., 2011).

The increasing number of incidence of DM is closely related to the increase in age because more than 50% of people with DM occurs in the age group of more than 60 years. This can be seen from the results of studies that show that the majority of people with DM are elderly (46-65 years). Other research states that in the age group of 41-64 years is 3.3 times more comfortable to have a risk for suffering from Diabetes mellitus than the age group of 25-40 years (Rahajeng, 2010). The results also show that the elderly group with HbA1c ≥6.5% also dominates as many as 124 people. This is in line with the research proposed by Yerizel (2010) in Ramadhan & Marissa, (2015), the highest increase in HbA1c in type 2 DM with peripheral vascular abnormalities is found in patients with age group 60-64 years (Ramadhan & Marissa, 2015).

From the results of the study, it is found that the majority of DM sufferers are female (133 people) with an HbA1c value ≥6.5. The results of this study are consistent with Chen et al. study, from the results of a study in Taiwan also found that the percentage of HbA1c value ≥6.5 in women (66.7%) was higher than men (Chen et al., 2015). The incidence of type 2 DM varies between men and women. They have the same chance of getting DM. However, seen from risk factors, women have a higher chance due to an increase in body mass index (BMI). Besides, monthly cycle syndrome (premenstrual syndrome), postmenopausal, which makes body fat distribution quickly accumulated due to these hormonal processes, put women at risk of

suffering from DM (Irawan, 2010). Riskesdas 2007 also stated that DM prevalence was higher in women by 6.4% compared to men by 4.9% (Kemeskes RI, 2013).

The education of patients with diabetes mellitus in the study is mostly low because it was dominated by the elderly. From the research results, it is obtained that HbA1c value  $\geq 6.5$  in low education is 142 respondents. The increase in the incidence of diabetes is also driven by factors of education level and influences the incidence of DM (Seino et al., 2010). People with higher education will usually have much health knowledge, have awareness in maintaining health, which influences physical activities they will carry out (Irawan, 2010). Lack of public knowledge about diabetes mellitus causes the less aware of DM to seek diagnosis after some time suffering symptoms (Currie, 2010). Based on Riskesdas 2013 data, the highest incidence of DM occurred among respondents with a level of education not completing Sekolah Dasar (SD) or Elementary School and graduating DI-DIII (college)/University is equal to 2.8%, at the level of non-school education of 2.7%, completing elementary school 2.3%, completing Middle School Above (high school) by 1.8% and completed junior high school (SMP) by 1.5% (Kemeskes RI, 2013).

Long-suffering from DM will further increase the occurrence of complications in the form of damage to blood vessels throughout the body so that it aggravates the malfunctioning of vital organs. As a study by Samberka (2010), revealed that of 30 male respondents who had long suffered from diabetes mellitus  $>5$  years, 70% had erectile dysfunction (Samberka, 2010), and another study by (Firdaus, 2013), there was a relationship between the length of suffering from diabetes mellitus and the occurrence of depression.

The research stated above is a case of complications due to diabetes mellitus found in the hospital. This situation reduces the quality of life of DM sufferers. This result showed that diabetes is often not detected, or the onset of diabetes is seven years before the diagnosis is established so that morbidity and mortality rates occur early in cases that are not detected (Higgins, 2013). The results of research conducted on the Prolanis (Chronic Disease Management Program) in primary service facilities in Ponorogo Regency show 110 respondents had long suffered from DM  $<5$  years and an HbA1c value of  $\geq 6.5\%$ . Judging from the history of the disease, the patients just recently had diabetes, so it is still possible to prevent further complications with routine glycemic control, one of which is by examining HbA1c.

#### 4. Conclusions

HbA1c levels in patients with type 2 diabetes mellitus in the Prolanis (Chronic Disease Management Program) group in primary care facilities in Ponorogo Regency, East Java Province, Indonesia are mostly  $\geq 6.5\%$ , which indicates that glycemic control is not reasonable. Characteristics of respondents are mostly women, elderly, low educated, and have suffered from type 2 diabetes less than five years. It is recommended for patients with type 2 diabetes and families to increase knowledge about the management and control of blood sugar levels, and increase preventive efforts so as not to experience further complications.

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