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ORIGINAL RESEARCH

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## FACTORS ASSOCIATED WITH POOR GLYCEMIC CONTROL AMONG TYPE 2 DIABETES MELLITUS IN INDONESIA

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### ABSTRACT

**Background:** Type 2 Diabetes mellitus becomes the public health problem worldwide. Reasons for poor glycemic control in Type 2 diabetes are complex.

**Objectives:** To determine factors contributed to poor glycemic control among Indonesian patients with Type 2 Diabetes mellitus.

**Methods:** This was a cross sectional regression study. There were 70 respondents selected using purposive sampling. Pre-structured questionnaires were used to measure socio demographic, clinical characteristics, self-care management behaviors, medication adherence, barriers to adherence, and family support. Data were analyzed using chi-square and binary logistic regression.

**Results:** Poor glycemic control was defined as HbA1c  $\geq 7\%$  or FBG  $\geq 200$  mg/dl. Findings of this study reported that 83% patients had or FBG  $\geq 200$  mg/dl, which confirmed as poor glycemic control. Logistic regression showed that increasing duration of diabetes ( $> 5$  years), non-adherence to dietary behaviors recommendation through selecting healthy diet, arranging a meal plan, recognizing the amount calorie needs, managing dietary behaviors challenges, medication adherence, and family support were significantly influence poor glycemic control with increased odds ratio scores.

**Conclusion:** The proportion of patients with poor glycemic control was raised. Increasing duration of diabetes, non- adherence to medication and dietary behaviors management, and lack of family support were associated with poor glycemic control. Thus, integration of diabetes self-management program with social support is needed to deal with patients' need to achieve the great benefits in diabetes care.

**Keywords:** influencing factors, poor glycemic control, type 2 diabetes mellitus

### INTRODUCTION

Type 2 Diabetes mellitus becomes a public health problem globally. In Indonesia, prevalence of diabetes mellitus

in adults was 7.6 million adults.<sup>1</sup> The increase of diabetes incidence is observed in all ages, in both genders and the major ethnic groups.

The American Diabetes Association (ADA) designated a goal of optimal blood glucose level on <7% of HbA1c or than <130 mg/dl<sup>2</sup> of fasting blood glucose (FBG). The successful of blood glucose control significantly correlates with a reduction in the micro and macro-vascular complications of diabetes,<sup>3</sup> although the evidence revealed that controlling blood glucose level in the normal line has a positive impact to decrease the complications.<sup>2,4</sup> However, the high proportion of patients still remains a poor glycemic control of type 2 DM.<sup>5</sup>

In community setting, optimal glycemic control is difficult to achieve since a long term blood glucose monitoring is required for diabetic patients. In addition, complexity reason of caring among them is one of the barriers, followed by the factors of patients and health care provider that are associated with difficulties to achieve the optimal glycemic control. As the result, public health centers in Indonesia reported that most of patients with type 2 DM are developed to poor glycemic control. Therefore, this study was conducted to determine the factors associated with poor glycemic control among patients with type 2 diabetes mellitus in community setting, in Indonesia.

## METHODS

### *Design and Sample*

This was a cross sectional regression study conducted in 2015 at the Public Health Center of Kebunsari, Indonesia. There were seventy diabetic patients selected in this study based on the inclusion criteria, namely: 1) patients with poor glycemic control (fasting blood sugar level  $\geq 200$  mg/dl/HbA1c >7%), 2) stayed in a community setting, West Sulawesi Province, Indonesia, 3) aged 18-60 years old, 4) able to communicate in Indonesian language, and 5) had no vision and

hearing impairment during data collection processes.

### *Measure*

There were four parts of measures in this study, namely: demographic characteristics questionnaire, clinical characteristics, self-care management behavior, family support and medication adherence. All instruments have been translated into Indonesian language.

#### 1. Demographic characteristics questionnaire

The demographic characteristic questionnaire was developed by the researchers, which consisted of age, gender, level of education, income, occupation, cooking responsibility, current smoking and duration of diabetes.

#### 2. Clinical characteristic of patients

Clinical characteristic of the patients includes body mass index (BMI), fasting blood glucose, and total cholesterol level. In this study, BMI is calculated as a patient's weight in kilograms, divided by height in meters squared (kg/m<sup>2</sup>). Fasting blood glucose was measured using a glucose meter (one touch basic monitor) after 8 hours of fasting, while total cholesterol level was measured using an automatic lipid pro-meter by inserting blood from peripheral into strips of a blood cholesterol test.

#### 3. Self-care management behaviors

The self-care management behaviors were collected to assess the adherence to diabetes regimens, which included dietary behavior, exercise behavior, and self-monitoring blood glucose (SMBG). In this study, Dietary Behavior Questionnaire (DBQ) and Exercise Behavior Questionnaire (EBQ) adopted from Pamungkas<sup>6</sup> were used to assess dietary and exercise behaviors. Content validity of the instrument was examined by three experts and the reliability test had been conducted by 20 patients with Cronbach's alpha coefficient

0.85 and 0.80 respectively. The scale consisted of 30 items. Each item was rated on a five-point Likert scale (1=never, 2=seldom, 3=occasionally, 4=often, and 5=repeatedly). The total score ranged from a minimum score of 0 to a maximum score of 120. A higher score on the scale indicates of regularly dietary and exercise behaviors.

#### 4. Family support and medication adherence

Family support questionnaire was adopted from Tardy CH<sup>7</sup>, consisting of 15 items of questions, while medication adherence was assessed using medication adherence questionnaire developed by the researchers. Validity and reliability have been examined together with self-care management behavior.

#### Data Analysis

Statistical Package for Social Sciences (SPSS, version 16) was carried out for processing the data. Data were presented using mean for describing the proportions of categorical variables. The significance of the difference in the percentages of poor glycemic control was analyzed using

Chi-square test. Binary logistic regression was also performed to determine factors associated with poor glycemic control with p-value 0.05, considered as a statistically significant.

#### Ethical Consideration

The study permission was obtained from the Public Health Center of Kebunsari, Indonesia. Each respondent involved in this research has obtained an appropriate informed consent.

## RESULTS

### Demographic Characteristics

As shown in the Table 1, total of 70 patients with type 2 diabetes mellitus were selected in this study aged between 26 and 70 years with mean 51.80. The majority of the patients with type 2 diabetes mellitus were female (77.14%) with elementary school background (68.58%). More than half of the patients (58.57%) had more 1,000,000 IDR (> 84 USD) monthly income. With regard to cook responsibility, 78.57% of patients prepared the food by themselves; and 12.867% of patients were current smoker.

**Table 1** Proportion of patients with poor glycemic control based on the demographic characteristic

Variables	n	%	p
Age (Min-Max = 26-70)			
Young age (20-33 years old)	7	10	.000
Middle age (34-59 years old)	40	57.14	
Elderly (60-80 years old)	23	32.86	
Gender			
Male	16	22.86	.000
Female	54	77.14	
Educational level			
Elementary school	48	68.58	.000
Junior high school	4	5.71	
Senior high school	13	18.57	
Diploma/Bachelor	5	7.14	

Monthly income			
< 1,000,000 IDR (< 84 USD)	29	41.43	.151
> 1,000,000 IDR (> 84 USD)	41	58.57	
Cooking responsibility			
Cooking by oneself	55	78.57	.000
Family cooking	12	17.14	
Combination of cooking for oneself & family cooking	3	4.29	
Experience of previous education program			
Yes	11	15.71	.000
No	59	84.29	
Current smoking status			
Never	61	87.14	.000
Smokes	9	12.86	

### Clinical Characteristic

Table 2 shows the proportion of patients with poor glycemic control based on clinical characteristics among diabetes patients with increased duration of illness, higher BMI, hypercholesterolemia, and higher blood glucose were more likely in patients with type 2 diabetes mellitus. The total of 70 patients reported that most of

patients have been suffered from type 2 diabetes mellitus for more than five years (87.14%). Of the total of respondents, 64.29% of them had normal line BMI, and 30% of them was categorized as overweight line. For the total cholesterol level, more than half patients was hypercholesterolemia (52.86%) (see Table 2).

**Table 2** Proportion of patients with poor glycemic control based on the clinical characteristic

Variables	n	%	p
Duration of Illness			
< 5 years	9	12.86	.000
> 5 years	61	87.14	
BMI Level			
Normal	35	64.29	.057
Overweight	31	30.00	
Obesity	4	5.71	
Total Cholesterol Level			
< 200 mg/dl	37	52.86	.003
>= 200 mg/dl	33	47.14	
Systolic Blood Pressure			
< 140 mmHg	20	28.57	.000
>= 140 mmHg	50	71.43	
Diastolic Blood Pressure			
< 90 mmHg	24	34.29	.000
>= 90 mmHg	46	65.71	

### Self-Care Behaviors

With regard to self-care management behaviors, the majority of the poor glycemic control patients did not follow diabetic meal plan regarded to selecting a healthy diet (62.86%), arranging a meal plan (85.71%), recognizing amount food calories (64.29%), and managing dietary behavior (71.43%). However, more than half of patients (61.43%) participated in

physical exercise by walking 30 minutes regularly, and 38.57% of patients did not participate in physical exercise. Regarding to self-monitoring blood glucose, only 35.71% of patients confirmed to test their blood glucose at home regularly, while 64.29% patients had a difficulty to check their blood glucose. Most of the patients (62.86%) were not highly adherent to their medication (see Table 3).

**Table 3** Proportion of diabetes self-care behaviors among patients with poor glycemic control

Variables	n	%	p
<b>Dietary Behaviors</b>			
<i>Selecting healthy diet</i>			
Yes	26	37.14	.031
No	44	62.86	
<i>Arranging meal plan</i>			
Yes	10	14.29	.000
No	60	85.71	
<i>Recognizing the amount food calories</i>			
Yes	25	35.71	.017
No	45	64.29	
<i>Managing dietary behavior challenges</i>			
Yes	20	28.57	.000
No	50	71.43	
<b>Exercise Behaviors</b>			
<i>Walking 30 minutes</i>			
Yes	43	61.43	.056
No	27	38.57	
<i>Self-monitoring blood glucose</i>			
Yes	25	35.71	.017
No	45	64.29	
<i>Medication adherence</i>			
Yes	26	37.14	.009
No	44	62.86	

### Analysis of Regression Logistic of Factors Associated with Poor Glycemic Control

Table 4 shows the analysis of regression logistic regarding to predictive factors associated with poor glycemic control,

which indicated that increased duration of diabetes (OR=1.78, p=.000), not following eating plan through selecting a healthy food (OR=1.33, p=.031), arranging meal plan (OR=2.89, p=.000),

recognizing the amount food calories need (OR=1.58, p=.017), and not managing dietary behavior challenges (OR=1.69, p=.000) were significantly increased the odds ratio scores of being poor glycemic

control. Increased of medication barriers also were associated with poorly controlled type 2 diabetes mellitus (OR=2.44, p=.009).

**Table 4** Analysis of regression logistic of predictive factors with poor glycemic control among patients with Type 2 diabetes

Variable	OR (95% confidence interval)	p
Duration		
> 5 years	2.78 (1.32-2.78)	.000
Dietary Behaviors		
<i>Selecting healthy diet</i>	2.33 (.16-2.94)	.031
<i>Arranging meal plan</i>	2.89 (.07-5.59)	.000
<i>Recognizing the amount food calories</i>	1.58 (.31-4.88)	.017
<i>Managing dietary behavior challenges</i>	1.69 (.11-3.02)	.000
Barriers of the adherence	1.03 (1.02-1.05)	.003
Medication adherence	2.04 (.60-9.06)	.009
Family support	2.80 (1.3-6.23)	.001

## DISCUSSION

The proportions of 70 patients with poor glycemic control were estimated in this study. Eighty percent of patients presented poor glycemic control with fasting blood glucose (FBG) level >200 mg/dl (Hb1c>7%). In Jordan, 65.1% of populations were remarked as poor glycemic control ( $\geq 7\%$ ).<sup>8</sup> In addition, 59% of diabetes patients was indicated as an undesirable diabetic control status.<sup>9</sup> In UK, 69% respondent also had HbA1c  $\geq 7.5\%$ ,<sup>9</sup> while in Malaysia (85.7%) had HbA1c  $\geq 7\%$  respectively.<sup>10</sup> Furthermore, HbA1c was reported from Singapore was 40% (below 45 years) to 10% (85 years and above).<sup>11</sup>

The finding in this study revealed that the majority of patients were middle age (34-59 years old), which have been diagnosed with diabetes mellitus for more than one year and had poor glycemic controlled (FBG  $\geq 200$  mg/dl) after 6 months of taking diabetic medication. It

was indicated that the demographic and clinical characteristics of the patients in this study were representations of patients with type 2 DM in Indonesia. The association between age and poor glycemic control is consistent with previous study reported that most of respondents who have been diagnosed diabetes mellitus was in the middle age group.<sup>11</sup>

In present study, patients with poor glycemic control were significantly increased in longer duration of diabetes. This result was consistent with previous studies which found that the length of duration of diabetes associated with poor glycemic control.<sup>12</sup> Other studies also reported that longer duration of disease, resistance to medication, and the need for higher doses or additional medications increased of poor glycemic control over time.<sup>13,14</sup> Furthermore, the longer duration of diabetes increased with poor glycemic control which possibly because of

progressive impairment of insulin secretion with time due to  $\beta$ -cell failure.<sup>15</sup>

Prior history of medication adherence, the finding of this study confirmed that non-adherence of medication was more likely to be a poor glycemic control. The increasing evidence to be prescribed combination of oral anti diabetic agents and insulin and poor glycemic control were consistent to previous studies.<sup>8,16,17</sup> The findings may be indicated that consuming diabetes medication for long term would impact to delay in applying insulin in the treatment of patients with diabetes, which was strongest predictor of poor glycemic control.

On the other hand, family is a key person to prepare a food for meal to support whether patients have time for physical activity among other competing time demands, and influence whether fit in the hierarchy of family priorities.<sup>18</sup> This finding is consistent with the present study reported that supporting from family was significantly influence the adherence to medication and the eating behaviors.

With regard to following of dietary behaviors, this study found that only a small percentage of type 2 DM patients were adherent to dietary behaviors. Most of patients had difficulties to select a healthy food, arrange a meal plan, recognize the amount food calorie needs, and manage the dietary behavior challenges. This finding was consistent with the previous finding.<sup>18</sup> However, the lack of a relationship between exercise behavior/physical activity and poor glycemic control confirmed that exercise behavior/physical activity was not significantly associated with poor glycemic control. This finding was not in line with previous study reported that physical activity was significantly decrease the blood glucose.<sup>19</sup> A systematic of education programs with follow-up strategy from health care

provider are recommended to encourage the physical activity regimen adherence. In addition, to confirm the findings, a study with more sample size needs to be conducted in Indonesia.

## CONCLUSION

In conclusion, the high proportion of patients with poor glycemic control was noted in this study. Longer duration of diabetes, non-adherence to diabetes self-care behaviors, and lack of support were associated with glycemic uncontrolled type 2 DM. Integration of diabetes self-management program with social support is needed to deal with patients' need to achieve the great benefits in diabetes care.

## Declaration of Conflicting Interest

None declared.

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## Authorship Contribution

Authors equally contributed in this study.

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