

## Factors Related to Glycemic Control among Type 2 Diabetic Outpatients in North Okkalapa General Hospital

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Although a variety of factors influencing the glycemic control have been identified, little is known about these factors in Myanmar context. A cross-sectional study was carried out on type 2 diabetes patients attending the Diabetic Clinic at North Okkalapa General Hospital from January to May 2015. It was aimed to identify the demographic, anthropometric and clinical characteristics related to glycemic control. Personal interviews were conducted to collect data. Some data were obtained from patient records. The blood samples were also collected for measurement of HbA1C. Poor glycemic control was defined as HbA1C  $\geq 7\%$ . A total of 120 type 2 diabetes patients were included in the study. Of them, 76.7% were females. The mean age of participants was 56.69 (SD=9.83) years. The mean value of HbA1C was 8.26 (SD=1.92) and 66.7% had HbA1C  $\geq 7\%$ . In the multivariate analysis, disease duration more than 5 years, medication type consisting of insulin, and systolic blood pressure  $\geq 140$  mmHg were significant factors ( $p < 0.05$ ) related to poor glycemic control. Health care providers should pay special attention to type 2 diabetes patients with longer duration, elevated systolic blood pressure and those on insulin treatment.

*Key words:* Influencing factors, Glycemic control, Type 2 diabetes, HbA1C

### INTRODUCTION

Diabetes mellitus (DM) is an important public health problem worldwide. In a recent national survey in Myanmar, overall prevalence of raised blood glucose (fasting glucose or 2-hour glucose) or currently on medication for diabetes was 10.5% with 9.1% in the men and 11.8% in the women.<sup>1</sup>

Maintaining good glycemic control is a goal for all patients with diabetes. Several large clinical trials have demonstrated that tight blood glucose control correlates with a reduction in the microvascular complications of diabetes.<sup>2, 3</sup> Glycemic control remains the major therapeutic objective for prevention of target organ damage and other complications arising from diabetes.<sup>4</sup> The primary target of

glycemic control is glycosylated hemoglobin (HbA1C) and its desirable value is below 7%.<sup>5</sup> HbA1C is a gold standard in analysis of patient's status, and is essential to ensure the optimal care of diabetic patients.<sup>6</sup> A previous research has shown that the risk of microvascular complications could be reduced by 40 percent with each one percent reduction in HbA1C.<sup>7</sup>

Despite the evidence from large randomized controlled trials establishing the benefit of intensive diabetes management in reducing microvascular and macrovascular complications, high proportion of patients remain poorly controlled.<sup>8,9</sup> In clinical

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practice, it is difficult to obtain an optimal glycemic control on the long-term basis as the reasons for poor glycemic control are complex.<sup>10</sup> A variety of factors which influence the glycemic control have been identified. They include age, sex, education, marital status, body mass index (BMI), smoking, diabetes duration and type of medications among others.<sup>10-12</sup> However, the results are not consistent and little is known about these factors in Myanmar context. Thus, the present study was conducted to identify the demographic, anthropometric and clinical characteristics related to poor glycemic control in patients with type 2 DM in Myanmar.

## MATERIALS AND METHODS

A cross-sectional study was carried out on type 2 diabetes patients attending the Diabetic Clinic at North Okkalapa General Hospital in Yangon from January to May 2015. The inclusion criteria were: aged  $\geq 35$  years, duration of diabetes  $\geq 1$  year, minimum follow-up period of 6 months at study clinic, and the absence of serious complications (e.g. renal failure, heart failure). Face-to-face interviews were carried out by trained interviewers using pre-tested questionnaire. Some of the data were obtained from patient records. The following information was collected from each patient.

- Demographic information: age, sex, education, marital status, smoking, family history and duration of diabetes
- Anthropometrics data: body mass index (BMI), and waist circumference. Based on the BMI, subjects were grouped into different categories as recommended by the WHO: normal (18.5-24.9 kg/m<sup>2</sup>), overweight (25-29.9 kg/m<sup>2</sup>) and obese ( $\geq 30$  kg/m<sup>2</sup>). Waist circumference was measured in centimeters. It was considered as increased if more than 90 cm in males and 80 cm in females.
- Clinical measures: glycosylated hemoglobin (HbA1C), systolic and diastolic

blood pressure, and medication type. HbA1C was measured by using NycoCard Reader II. Blood pressure (BP) was measured using a mercury sphygmomanometer at the sitting position after the 10-minute rest.

- Other data: self-monitoring blood glucose (SMBG) and exercise. SMBG was defined as monitoring blood glucose at least once per week. Exercise was defined as a minimum of 30 minutes of aerobic exercise (e.g. walking, jogging, bicycling) performed long enough to sweat at least twice a week.

### *Statistical analysis*

Both univariate and multiple logistic regression analyses were used to find out the association between outcome variable (good vs. poor glycemic control) and exposure variables (age, sex, education, marital status, smoking, BMI, duration of disease, family history, SMBG, medication type, systolic BP, diastolic BP and exercise). HbA1C values less than 7% were regarded as good glycemic control and values  $\geq 7\%$  as poor glycemic control.<sup>5</sup>

### *Ethical consideration*

This study was approved by the Ethics Review Committee, Department of Medical Research under letter No. 77/ Ethics 2014 on 25 November 2014. Written informed consent was obtained from participants after explaining the procedures involved.

## RESULTS

### *Participant's characteristics*

Of a total of 120 type 2 diabetes patients, 76.7% were females. Their mean age was  $56.69 \pm 9.83$  years (range, 35-77 years), 60.8% were married, and 48.3% had BMI within normal range (18.5 to 24.9). Median duration of diabetes was 5 years (range, 1-24 years). Family history of diabetes was reported by 31.7%.

### *Glycemic control*

The mean value of HbA1C was  $8.26 \pm 1.92$  and 66.7% had HbA1C  $\geq 7\%$ . The results

Table 1. Univariate analysis of factors associated with poor glycemic control among type 2 diabetes patients

	Good control (n=40, HbA1C <7%)	Poor control (n=80, HbA1C ≥7%)	OR (95% Confidence interval)	p value
	No (%)	No (%)		
<i>Age (year)</i>				
35-54	17(42.5)	36(45.0)	1(ref.)	0.79
≥55	23(57.5)	44(55.0)	0.9(0.39-2.10)	
<i>Sex</i>				
Male	8(20.0)	20(25.0)	1(ref.)	0.54
Female	32(80.0)	60(75.0)	0.75(0.30-1.89)	
<i>Education</i>				
Primary	13(32.5)	22(27.4)	1(ref.)	0.66
Secondary	23(57.5)	47(58.8)	1.21(0.52-2.82)	
Higher	4(10.0)	11(13.8)	1.63(0.43-6.17)	
<i>Marital status</i>				
Married	24(60.0)	49(61.2)	1(ref.)	0.98
Single	4(10.0)	8(10.0)	0.98(0.27-3.58)	
Widowed/Divorced	12(30.0)	23(28.8)	0.94(0.40-2.20)	
<i>Smoking</i>				
No	34(85.0)	74(92.5)	1(ref.)	0.21
Yes	6(15.0)	6(7.5)	0.46(0.14-1.53)	
<i>Family history</i>				
No	29(72.5)	53(66.2)	1(ref.)	0.49
Yes	11(27.5)	27(33.8)	1.34(0.55-3.44)	
<i>Duration of diabetes (year)</i>				
≤5 years	26(66.6)	36(46.7)	1(ref.)	0.04
>5 years	13(33.3)	41(53.2)	2.28(1.15-5.56)	
<i>Medication type</i>				
Oral monotherapy	17(42.5)	17(21.25)	1(ref.)	0.12
Oral combined	19(47.5)	38(47.5)	2(0.84- 4.77)	
Insulin alone	1(2.5)	12(15.0)	12(1.4-22.8)	
Insulin and oral drugs	3(7.5)	13(16.25)	4.33(1.04-18)	
<i>SMBG</i>				
Yes	32(80.0)	68(85.0)	1(ref.)	0.49
No	8(20.0)	12(15.0)	0.71(0.26-1.89)	
<i>Systolic Blood Pressure (mmHg)</i>				
<140	35(89.7)	54(69.2)	1(ref.)	0.01
≥140	4(10.3)	24(30.8)	3.89(1.18-16.57)	
<i>Diastolic Blood Pressure (mmHg)</i>				
<90	37(94.9)	64(82.0)	1(ref.)	0.057
≥90	2(5.1)	14(17.9)	4.05(0.85-18.28)	
<i>BMI</i>				
<25 (normal)	20(55.6)	38(50.7)	1(ref.)	0.48
25-29.9 (overweight)	9(25.0)	24(32.0)	1.4(0.55-3.59)	
≥30 (obese)	7(19.4)	13(17.3)	0.98(0.34-2.84)	
<i>Waist circumference</i>				
Normal	7(17.5)	18(22.5)	1(ref.)	0.53
Increased	33(82.5)	62(77.5)	0.73(0.28-1.93)	
<i>Exercise</i>				
Yes	17(42.5)	38(47.5)	1(ref.)	0.61
No	23(57.5)	42(52.5)	0.82(0.38-1.76)	

SMBG=Self-monitoring blood glucose

BMI=Body mass index

obtained from univariate analysis are shown in Table 1. It shows that duration of diabetes more than 5 years (p=0.04), medication type consisting of either insulin alone (p=0.02) or combination with oral drugs (p=0.04), and systolic blood pressure ≥140 mmHg (p=0.01) were

factors significantly related to poor glycemic control in patients with type 2 DM in this study. Increased diastolic blood pressure (≥90 mmHg) was also found to have marginally significant association with poorly controlled diabetes (p=0.057).

Table 2. Multivariate analysis of factors associated with poorly controlled diabetes among type 2 diabetes patients (Reduced model)

Variable	OR (95%Confidence Interval)	p value
<i>Age (year)</i>		
35-54	1	
≥55	0.45(0.16-1.29)	0.14
<i>Duration of diabetes (year)</i>		
≤5	1	
>5	3.33(1.18-9.38)	0.02
<i>Medication type</i>		
Oral monotherapy	1	
Oral combined	1.98(0.69-5.73)	0.2
Insulin	11.42(1.78-17.1)	0.01
Insulin and oral drugs	4.79(0.81-18.48)	0.08
<i>Systolic BP (mmHg)</i>		
<140	1	
≥140	4.43(1.48-19.9)	0.01
<i>BMI</i>		
<25	1	
25-29.9	0.67(0.21-2.07)	0.49
≥30	0.63(0.18-2.25)	0.48
<i>Exercise</i>		
Yes	1	
No	0.71(0.27-1.87)	0.48

*Multivariate analysis of factors associated with poorly controlled diabetes*

Reduced model was used with variables significant at 0.05 by univariate analysis and some clinically important confounding variables (age, BMI, physical activity). In the multivariate analysis, longer duration of diabetes (>5 years vs. ≤5 years) (OR=3.33, p=0.02), medication type consisting of insulin (OR=11.42, p=0.01), and elevated systolic blood pressure (OR=4.43, p=0.01) were significantly associated with poorly controlled diabetes (Table 2).

**DISCUSSION**

The proportion of patients with poor glycemic control was high (66.7%) which was more or less comparable to the reports from other countries; 67% in Thailand, 65% in Jordan and 66.7% in Kuwait.<sup>13-15</sup> In the present study, good glycemic control was defined as HbA1C level <7% following the guidelines by the America Diabetes Association (2011).<sup>5</sup> However, the American Association of Clinical Endocrinologists/ American College of

Endocrinology (AACE/ACE) Guidelines (2015) recommended a goal HbA1C level ≤6.5%.<sup>16</sup> The more strict goal of 6.5% would have resulted in a higher prevalence of poor glycemic control.

Because of the progressive decline of β-cell function with time, longer duration of diabetes was known to be associated with poor control. Most patients in the long run require a combination therapy for controlling their blood glucose. The UK Prospective Diabetes Study (UKPDS) Group revealed that HbA1C level in both conventional and intensive groups decreased in the first study year but subsequently increased with each following year.<sup>3</sup> The result was consistent with the UKPDS which reported that the longer a patient has DM, the poorer the glycemic control will be. It was also in agreement with that reported by other studies.<sup>14, 17, 18</sup>

Medication type consisting of insulin, alone or in combination with oral hypoglycemic agents (OHAs), was found to be related to poor glycemic control in the study. It was in agreement with that reported by Harris and co-workers.<sup>19</sup> Poor glycemic control is most common among insulin-treated patients because the majority of them are patients with secondary failure of OHAs or patients presenting with chronic complications of DM. As they have more aggressive disease, they require more aggressive treatment to get their blood glucose controlled.<sup>17</sup> Patients with high systolic BP were found to have uncontrolled diabetes in this study. Basit and co-workers also reported the significant association of hypertension with poor glycemic control in type 2 diabetic patients.<sup>20</sup> Hypertension may be due to renal damage as a result of poorly controlled diabetes. However, it was also possible that the increased blood pressure might be a direct consequence of poor glycemic control very early in diabetes contributing to the onset of the renal damage.<sup>21</sup>

An association between age and poor glycemic control was not observed in this study which is contrary to the reports that

younger age was related to poor glycemic control.<sup>22-24</sup> Regarding BMI, Nichols and co-workers found that lower BMI was the strongest and most consistent factor related to poor glycemic control.<sup>23</sup> It was consistent with UKPDS in which the intensive group gained weight (2-5 kg) compared to the conventional group.<sup>3</sup> In the present study, BMI as well as waist circumference did not turn out to be related to glycemic control. Harris and co-workers also reported that BMI was not related to glycemic control, but waist circumference emerged as a determinant of poor glycemic control in a study by Ghazanfari, *et al.*<sup>9, 19</sup>

This study explored the factors associated with poor glycemic control in Myanmar context. However, causal relationship between the independent variables and outcome cannot be established as it was a cross-sectional study. At the same time, information on physical activity and blood glucose self-monitoring were obtained by self-report and thus subjected to recall bias.

### Conclusion

Significant factors related to poor glycemic control in patients with type 2 DM were longer duration of diabetes, medication type consisting of insulin and elevated systolic blood pressure. It is recommended that health care providers should pay special attention to type 2 diabetes patients with longer duration, elevated systolic blood pressure and those on insulin treatment.

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