

FACTORS ASSOCIATED WITH GLYCAEMIC CONTROL AMONG TYPE 2 DIABETES MELLITUS PATIENTS

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ABSTRACT

Background: Type 2 diabetes mellitus has become one of the most serious global health problems recently. The Malaysian National Diabetes Registry has reported that 76.2% of the population have poor glycaemic control (HbA1c \geq 6.5%). Thus, the objective of this study is to determine the association between sociodemographic and medical profiles with glycaemic control among type 2 diabetes mellitus patients in five health clinics in the Tampin district.

Materials and Methods: A cross sectional study was conducted in five health clinics in the Tampin district, Negeri Sembilan, Malaysia. Three hundred and twenty four type 2 diabetes mellitus patients participated in this study. A face-to face interview was conducted with each respondent using validated questionnaire. Descriptive analyses, such as the chi square test, were performed using the Statistical Packages for Social Sciences version 22 software.

Results: The response rate was 90%. The percentage of poor glycaemic control was 66.4%. They were associated with age ($\chi^2=10.405$, p 0.006), marital status ($\chi^2=5.718$, p 0.017), and education status ($\chi^2=7.312$, p 0.026). In addition, types of medication intake ($\chi^2=18.058$, $p<0.001$), family history ($\chi^2=7.234$, p 0.007), and co-morbidities ($\chi^2=5.718$, p 0.017) are also associated with the percentage.

Conclusion: The majority of the respondents of this study had poor glycaemic control. The factors that contribute to the poor glycaemic control are among respondents who are: of older age (\geq 65 years); single/widowed/separated/divorced; of non-formal education; on insulin alone / combination of oral agent and insulin; no family history; and do not experience co-morbidities. For the future wellbeing of all type 2 diabetes mellitus patients, a good glycaemic control is important. Therefore, plans with appropriate significance on early preventive measures to diabetic treatment need to be strengthened in order to boost quality of life among type 2 diabetes mellitus patients.

Key Keywords: Glycaemic control, Type 2 Diabetes Mellitus, Health Clinics, Tampin District, Malaysia

1.0 Introduction

By 2035, it is predicted that about 592 million individuals will suffer from diabetes (International Diabetes Federation, 2011). In 2013, 382 million people were diagnosed with diabetes and this had caused 5.1 million deaths. 80% of them also lived in low and middle income countries. Furthermore, an estimate of 175 million people with diabetes are undiagnosed (International Diabetes Federation [IDF], 2013). These non-communicable diseases are “silent killers” and rated as the leading cause of deaths in recent years. The prevalence of type 2 diabetes mellitus among Malaysians has increased by 31.0% in 5 years, from 11.6% in 2006 to 15.2% in 2011 (National Health Morbidity Survey IV [NHMS IV], 2011). Currently, approximately 2.6 million adults aged 18 years and above live with type 2 diabetes mellitus (National Diabetes Registry [NDR], 2009-2012). Furthermore, studies from Malaysia show the predominance of type 2 diabetes mellitus in Malaysia that has expanded radically throughout the most recent two years; from 11.6% in 2006 to the present general prevalence of 22.9%, with 12.1% of the citizens recently diagnosed (Wan Nazaimoon et al., 2013).

Improving glycaemic control is a high priority in decreasing the burden of type 2 diabetes mellitus and delaying its complications (Nichols G et al., 2000). For instance, glycaemic control can be indicated by glycosylated haemoglobin (HbA1c). Furthermore, the desirable value of good glycaemic control was defined as having a level of HbA1c <6.5%, whereas poor control of glycosylated haemoglobin was $\geq 6.5\%$ as recommended by the Clinical Practices Guidelines (CPG) for type 2 diabetes mellitus (CPG, Ministry of Health Malaysia 4th Edition). Besides that, glycosylated haemoglobin (HbA1c) is essential in ensuring the optimal care of diabetic patients (Roszyk et al., 2007). Major public health problems and risk factors for the development of type 2 diabetes mellitus complications are usually related to poor and inadequate glycaemic control among patients with type 2 diabetes mellitus (Koro et al., 2004). The significant factors that are associated with glycaemic control are patients aged >60 years, taking one oral hypoglycaemic agent, an ulcerated foot, a high self-efficacy level, overall self-care behaviour, self-care of diet, and self-care for physical exercise (Sandi et al., 2010).

Zeinab et al. (2010) concluded that it is very difficult to achieve optimal glycaemic control in clinical practices as there are complex reasons for poor glycaemic control. However, Gilmer et al. (2005) reported that better glycaemic control among patients with type 2 diabetes mellitus may be associated with lower health care resources in view of its use and cost. Moreover, despite significant advances in diagnosis and management of type 2 diabetes mellitus in recent years, constancy of deficient metabolic control still remains and numerous patients still have not achieved the best glycaemic control. This also means that patients encounter less complications as well as their quality of life. In addition, poor glycaemic control may be caused by the failure of type 2 diabetes mellitus self-management by patients as well as the lack of intervention strategies by doctors. Although the importance of glycaemic control is well established, it is often not achieved. Based on previous literatures, various factors are associated with glycaemic control. For instance, poor glycaemic control is due to the paucity of information available to patients on the importance of compliance to glycaemic control and adherence to self-care behaviours; as well as to healthcare providers on the patient's barrier to compliance to glycaemic control; and practicing diabetes self-care behaviours. The objective of this study is to access the factor associated with glycaemic

control among type 2 diabetes mellitus patients in five health clinics in the Tampin district, Malaysia.

2.0 Materials and Methods

2.1 Study Design and Sample Size

A cross-sectional study was conducted among five health clinics in the Tampin district, Negeri Sembilan, Malaysia. Five health clinics in the district were included into the study and a total of 360 adults with type 2 diabetes mellitus were recruited into the study. The respondents were selected using stratified random sampling, and the appointment register of type 2 diabetes mellitus patients in the clinics were used as the sampling frame of this study. The respondents included in this study had criteria such as: type 2 diabetes mellitus patients that must receive diabetic treatment for one year or more; and Malaysian citizens and patients having diabetic records available at each five health clinics in the Tampin district for one year or more.

2.2 Study Instruments

Pre-tested questionnaire were used in the study. Patients were interviewed face-to-face by trained interviewers where each of the respondent used a reliable questionnaire. The sections involved in the questionnaire were socio-demographic factors (gender, age, race, marital status, education background, occupation, and income status); and medical profiles (type of medication, duration since type 2 diabetes mellitus diagnosis, family history, and comorbidities).

2.3 Data analysis

Analysis of data was done using the statistical computer software, "Statistical Package for Social Science (SPSS)" version 22. Univariate, bivariate, and multivariate analysis were used to process the data. Chi-square test was the bivariate analysis conducted to access statistical significance for differences of categorical variables; with $p < 0.05$ considered as statistically significant. The chi-square test was also used to determine the relationship between variables such as sociodemographic, socioeconomics, and medical profiles of the respondents.

3.0 Result

3.1 Distribution of respondents based on socio-demographic and socioeconomics characteristics and glycaemic control

324 or 90% of eligible respondents participated in this study. It was found that 109 (33.6%) respondents practiced good glycaemic control with HbA1c reading $< 6.5\%$. The confidence interval (95%) to the ratio of good glycaemic control in the population was between 28.7% and 38.6%. Meanwhile, 215 (66.4%) respondents had poor glycaemic control with HbA1c reading $\geq 6.5\%$. The confidence interval (95%) to the ratio of poor glycaemic control in the population was between 61.4% and 71.3%. The distribution of respondents according to

socio-demographics and socioeconomics characteristics were 113 male (34.9%) and 211 female (65.1%) respondents. The mean age was 58.23 ± 8.681 years old and ranged between 30 – 88 years old. The majority of the respondents were 50 – 64 years of age (66.4%). The respondents consisted of Malays (60.8%), Indians (23.5%) and Chinese (15.7%). Majority of the respondents are married (81.8%); where more than half of the respondents attended at least primary school (56.8%); with a monthly household income of less or equal to RM1000 (47.8%) or unemployed (65.8%).

Table 1.1: Distribution of respondents based on socio-demographic and socioeconomics characteristics and glycaemic control (N=324).

Characteristics	Frequency	Percentage	Mean \pm SD	95% CI
Gender				
Male	113	34.9		
Female	211	65.1		
Age (Years)			58.23 ± 8.681	57.30 , 59.21
30-49	36	11.1		
50-64	215	66.4		
≥ 65	73	22.5		
Ethnic				
Malay	197	60.8		
Chinese	51	15.7		
Indian	76	23.5		
Marital Status				
Single / Widowed / Separated / Divorced	59	18.2		
Married	265	81.8		
Education Status				
Non-formal	73	22.5		
Primary	184	56.8		
Secondary/University/ College	67	20.7		
Income Status			1376.95 ± 1546.502	1000, 1200
\leq RM 1000	155	47.8		
RM 1001 – RM 1300	90	27.8		
\geq RM 1300	79	24.4		
Occupation				
Working	98	30.2		
Not Working	184	56.8		
Retired	42	13.0		
Glycaemic Control Status				
HbA1c $< 6.5\%$	109	33.6		28.7 , 38.6
HbA1c $\geq 6.5\%$	215	66.4		61.4 , 71.3

3.2 Distribution of respondents based on their medical profile

Table 1.2 represents the distribution of respondents according to their medical profile. 217 respondents were on oral anti-diabetic agent therapy and 107 respondents took insulin alone or a combination of oral agent and insulin. The mean duration of having type 2 diabetes mellitus was 7.63 ± 5.298 (95% CI 7.06 – 8.23) years. Majority (39.8%) of the respondents had suffered type 2 diabetes mellitus for 1 to 5 years. Moreover, majority (36.7%) of the respondents had family history of type 2 diabetes mellitus. Other than that, majority of the respondents had certain chronic diseases (81.8%) and only 59 respondents had diabetes alone without other co-morbidities.

Table 1.2: Distribution of respondents based on their medical profile (N=324).

Medical Profile	Frequency	Percentage	Mean \pm SD	95% CI
Types of medication				
Oral anti-diabetic agent	217	67.0		
Insulin alone / combination of oral agent and insulin	107	33.0		
Duration of having Type 2 Diabetes Mellitus (years)				
1 – 5	129	39.8	7.63 ± 5.298	7.06 , 8.23
6 – 9	88	27.2		
≥ 10	107	33.0		
Family history of having Type 2 Diabetes Mellitus				
Yes	205	36.7		
No	119	63.3		
Co-morbidities				
Yes	265	81.8		
No	59	18.2		

3.3 Association between sociodemographic and socioeconomics characteristics with glycaemic control

Table 1.3 presents the association between sociodemographic characteristics and socioeconomics with glycaemic control. About 66.4% of both male and female respondents had poor glycaemic control, which was also found among 72.6% in the older age group (≥ 65 years). According to ethnic groups, 68.5% Malays, 65.8% Indians, and 58.5% Chinese had poor glycaemic control. Among those who were single/widowed/separated/divorced, 79.7% had poor glycaemic control. For respondents who had non-formal education, 79.5% had poor glycaemic control. Among respondents who earned an income of less or equal to RM1000, 72.9% had poor glycaemic control while among the employed respondents, 69.4% were found to have poor glycaemic control. There is a significant association between age ($\chi^2=10.40$, p 0.006), marital status ($\chi^2=5.718$, p 0.017), and education status ($\chi^2=7.312$, p

0.026) with glycaemic control. However, there was no significant association between gender, ethnic, income status, and occupation status with glycaemic control.

Table 1.3: Association between sociodemographic and socioeconomic characteristics with glycaemic control (N=324)

Sociodemographic and socioeconomic characteristics	Glycaemic control		Total	χ^2	p-value
	Good HbA _{1c} < 6.5% n (%) (N=109)	Poor HbA _{1c} ≥ 6.5% n (%) (N=215)			
Gender				<0.001	0.997
Male	38 (33.6)	75 (66.4)	113		
Female	71 (33.6)	140 (66.4)	211		
Age (Years)				10.40	0.006*
30-49	5 (13.9)	31 (68.5)	36		
50-64	84 (39.1)	31 (60.9)	215		
≥65	20 (27.4)	53 (72.6)	73		
Ethnic				1.723	0.422
Malay	62 (31.5)	135 (68.5)	197		
Chinese	21 (41.2)	30 (58.5)	51		
Indian	26 (34.2)	50 (65.8)	76		
Marital Status				5.718	0.017*
Single/Widowed/Separated/Divorced	12 (20.3)	47 (79.7)	59		
Married	97 (36.6)	168 (63.4)	265		
Education Status				7.312	0.026*
Non-formal	15 (20.5)	58 (79.5)	73		
Primary	68 (37.0)	116 (54.0)	184		
Secondary/University/College	26 (38.8)	41 (61.2)	67		
Income Status				5.752	0.056
≤ RM 1000	42 (27.1)	113 (72.9)	155		
RM 1001 – RM 1300	35 (38.9)	55 (61.1)	90		
≥ RM 1300	32 (40.5)	47 (59.5)	79		
Occupation				0.948	0.622
Working	30 (30.6)	68 (69.4)	98		
Not Working	66 (35.9)	118 (64.1)	184		
Retired	13 (31.0)	29 (69.0)	42		

Note: (*) Significant of $p < 0.05$

3.4 Association between respondents based on their medical profile with glycaemic control

The association between respondents based on their medical profiles with glycaemic control is presented in Table 1.4. Among those on insulin alone or taking a combination of oral agent and insulin, 82.2% had poor glycaemic control compared to those taking oral anti-diabetic agent only. Moreover, 69.8% of those suffering from type 2 diabetes mellitus between 1 to 5 years had poor glycaemic control. 75% of respondents who did not have any family history of type 2 diabetes mellitus had poor glycaemic control. According to co-morbidities, 79.7% of respondents who did not have any co-morbidities experienced poor glycaemic control. Thus, we found that there is a significant association between types of medication ($\chi^2=18.058$, $p<0.001$), family history ($\chi^2=7.243$, $p=0.007$), and co-morbidities ($\chi^2=5.718$, $p=0.017$) with glycaemic control. However, the duration of having type 2 diabetes mellitus did not have a significant association with glycaemic control.

Table 1.4: Association between respondents based on their medical profile with glycaemic control (N=324)

Medical Profile	Glycaemic control		Total	χ^2	p- value
	Good HbA _{1c} <6.5% n (%) (N=109)	Poor HbA _{1c} ≥6.5% n (%) (N=215)			
Types of medication				18.058	<0.001*
Oral anti-diabetic agent	90 (41.5)	127 (58.5)	217		
Insulin alone / combination of oral agent and insulin	19 (17.8)	88 (82.2)	107		
Duration of having Type 2 Diabetes Mellitus (Years)				2.195	0.334
1 – 5	39 (30.2)	90 (69.8)	129		
6 – 9	35 (39.8)	53 (60.2)	88		
≥ 10	35 (32.7)	72 (67.3)	107		
Family history of Type 2 Diabetes Mellitus				7.243	0.007*
Yes	80 (39.0)	125 (61.0)	205		
No	29 (24.4)	90 (75.0)	119		
Co-morbidity				5.718	0.017*
Yes	97 (36.6)	168 (63.4)	265		
No	12 (20.3)	47 (79.7)	59		

Note: (*) Significant of $p<0.05$

4.0 Discussion

The prevalence of the respondents found to have poor glycaemic control was 66.4%. This is similar to a study by Tan et al. (2011) on the Outpatient Dietetics Clinic, Universiti Sains Malaysia Hospital with 67.2% of proportion. This is also similar to the study by Darren et al. (2013), which indicated that 70.9% of the respondents had poor glycaemic control. In Hong Kong, Yue et al., (2011) found that 48.7% of the respondents had HbA1c $\geq 6.5\%$. Furthermore, a study by Sazlina (2010) carried out at an urban public primary clinic found that 84.4% of the population had poor glycaemic control. They attributed this finding to minimal compliance, insufficient education of patients in managing their illness, and lower-prescriptions of insulin therapy. For instance, good glycaemic control was only described in 33.6% of the study population. This finding was similar to other studies such as Rahmah et al. (2011). They investigated glycaemic control in Southern Malaysia and the finding was 25.5%. A study carried out in Hong Kong also showed a similar finding with 23.5% found to have good glycaemic control. In Indonesia, patients at a public health centre in the Bayoyali District had good glycaemic control (defined as HbA1c $< 6.5\%$), which was 21% of the patients (Aiditama, 2011). A study at the Cheras Health Clinic Malaysia recorded 27% with good glycaemic control (Hasimah et al., 2011). More females (65.1%) than males participated in this study. The high percentage of females in the study population is comparable to a previous study on glycaemic control in Turkey. It showed that the gender of patients attending an outpatient clinic for diabetes are predominantly females with 58.7% compared to males with 41.3% (Baltaci et al., 2012). This study found that type 2 diabetes mellitus female patients were less likely to have good glycaemic control compared to the male patients.

Similarly, a previous study in Kulim, Kedah, Malaysia found that 81.6% of female respondents have poor glycaemic control compared to male respondents (Rahmah et al., 2013). This study reported that 131 respondents were from the age range of 50 to 64 years old and experienced poor glycaemic control (HbA1c $\geq 6.5\%$). Only 31 respondents between the age of 30 to 49 years' experienced the poorest glycaemic control. A previous study on 340 patients showed similar findings with the age group ranging from 41 to 64 years old experiencing poor glycaemic control compared to those aged < 40 years who experienced poor glycaemic control with only 19 patients (Ahmad et al., 2013). For respondents aged ≥ 65 years old, 20 respondents maintained good glycaemic control while 53 respondents experienced poor glycaemic control. This might be because most of the older respondents had less appetite for eating and had been affected by type 2 diabetes mellitus for a long time; in which they are in a daily medication schedule as prescribed by a medical practitioner. Therefore, older respondents maintained good glycaemic control. These studies found that Malay respondents were least likely to have good glycaemic control when compared to Chinese and Indian respondents. The Malay ethnic was reported to have high percentage of poor glycaemic control, followed by Indians and Chinese. These findings are also similar to Ng et al. (2005) that found 38.5% of poor glycaemic came from Malay patients, followed by Indians (33.3%) and Chinese (27.5%). Moreover, the study conducted by Eid et al. (2003) also showed that poor glycaemic control observed in Malay patients as compared to non-Malay patients were 2.3% and 1.7%. In this study, there are significant associations between marital status and

glycaemic control with $p < 0.017$; which is similar to the study conducted by Quah et al. (2013) in Singapore. The study showed that married people tend to have poorer glycaemic control with 78.3% ($p < 0.01$).

From this study, it was found that 97 (36.6%) of married respondents maintained good glycaemic control while 12 (20.3%) of single/widowed/separated and divorced respondents maintained good glycaemic control. As a result, spouses contribute to a great component in diabetes management. According to King et al. (2007), male subjects described their wives as the supervisor in their lives. When providing healthcare information, family members usually take part in explaining what was told by the doctors or dietitians. This study revealed that 68 (37.0%) respondents from primary education background have good glycaemic control compared to respondents from secondary/university/college education background with 26 (38.8%) respondents and 15 (20.5%) respondents from non-formal education background. In regards to poor glycaemic control, this study found that 116 (63%) respondents are from primary education background, followed by 58 (79.5%) respondents from non-formal education background and 41 (61.2%) respondents from secondary/university/college background.

The study from Medina, shows that 87.5% of patients with non-formal education experienced poor glycaemic control, similar to this study (Al Mutari et al., 2013). The higher the education background of the patient, the more awareness and concern they have to adhere to medication in maintaining a good glycaemic control. These findings of education background have a significant association with glycaemic control with ($p < 0.026$). In terms of income status, those earning in a range from RM1000 and below tend to maintain good glycaemic control with 42 (27.1%) respondents; followed by \geq RM1300 with 32 (40.5%) and RM1001 – RM1300 with 35 (38.9%) respondents respectively. For this study, the respondents earning $<$ RM1000 tend to experience poor glycaemic control with 113 (72.9%) respondents followed by 55 (61.1%) respondents earning between RM1001 – RM1300. Only 47 (59.5%) respondents are earning \geq RM1300. Thus, the lower the income status, the higher the percentages of poor glycaemic control. This is because respondents earning a low income commonly have a low educational level, low knowledge, and less awareness on how to maintain a good glycaemic control. From this study, respondents who are unemployed also tend to experience poor glycaemic control with 118 respondents (64.1%) followed by 68 working respondents (69.4%) and 29 retired respondents (69%). These findings were similar to the study held in Medina. It showed that 77.9% of type 2 diabetes mellitus patients that have a poor glycaemic control are not working at all; and their sedentary lifestyle directly effects their glycaemic control.

The Chi-square test shows that there is a significant relationship between types of medication intake with glycaemic control ($p < 0.01$). The binary logistic regression shows that the respondents who are only on insulin or taking a combination of insulin and oral medication were 3.1 times greater in having poor glycaemic control (AOR 3.217; 95% CI 1.636-6.327). These results are also supported by Khattab et al. (2009), which found that respondents who have been taking a combination of insulin and oral medication had significantly poor glycaemic control than those who were on oral anti-diabetic agent. They also added that the delay in applying insulin on patients could be the possible cause. As reported by Adham et al. (2010), respondents under the combination of insulin and oral medication were found to have poorer glycaemic control because of their common experiences in more serious diseases. This leads to having a lack of more intrusive treatment to control their disease, while milder

diseases are more effortlessly controlled by diet or oral medications. From this study, the respondents who have been living with type 2 diabetes mellitus within 1 - 5 years duration found it harder to maintain a good glycaemic control. This is because the respondents do not know how to maintain their healthy lifestyle after being diagnosed with type 2 diabetes mellitus.

Furthermore, they are not well exposed on how to maintain a good glycaemic control by their healthcare provider. Besides that, these findings also found that respondents with 6 – 10 years of experience maintain a good glycaemic control by eating healthy foods, doing physical exercises regularly, and always doing blood glucose self-monitoring. However, the findings of this study are different from Khattab et al. (2009) and Xu et al. (2007). They found that subjects who have been living with type 2 diabetes mellitus for more than 7 years are more often associated with poor glycaemic control. In addition, this study found that positive family history of type 2 diabetes mellitus has the highest respondent proportion with poor glycaemic control. The majority of the respondents in this study have co-morbid disease with 81.8%.

5.0 Conclusion and recommendation

As a conclusion, most of the respondents in this study have poor glycaemic control; within the five health clinics in the Tampin district, Negeri Sembilan, Malaysia. Poor glycaemic control are prevalent among respondents with factors such as: aged $65 \geq$ years old; single/widowed/separated/divorced; from a non-formal education background; respondents who are on insulin alone or taking a combination of oral agent and insulin; respondents who do not have any family history of type 2 diabetes mellitus; and respondents who do not have any co-morbidity. Therefore, it is highly recommended for these patients to go for an education programme in order to create awareness on a healthier lifestyle, prevention, treatment, and glycaemic index control.

Ethical

The approval to conduct this study was obtained from the Universiti Putra Malaysia Ethics Committee for Research Involving Human Subjects (JKEUPM Reference Number: JKK_Feb(13)04). The suitable respondents were individually contacted and the information sheet regarding this study was provided. Respondents who gave a written consent were recruited for this study. Confidentiality was assured.

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Declaration

Author(s) declare that there is no conflict of interest regarding publication of this article.

Author's contribution

Author 1 (Wan Farzana Fasya W.H): Carried out the research, preparing the manuscripts, data collection, data analysis and drafting final manuscripts.

Author 2 (Muhamad Hanafiah Juni): Supervised during preparing manuscripts, advice on methodology, reviewed and edited final manuscripts.

Author 3 (Salmiah M.S): Supervised during preparing manuscripts, supervised during data analysis and reviewed final manuscripts.

Author 4 (Azuhairi A.A): Supervised during preparing manuscripts, advice on methodology and review final manuscripts.

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