**Glycogenic Control and Associated Factors among Diabetic Patients Visiting Adama Specialized Hospital, Oromiya, Ethiopia: A Facility Based Cross Sectional Study**

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**SUMMARY**

**Introduction: Although glycaemic control is essential in diabetes management, evidences are lacking in resource limited settings. Therefore, this study was intended to assess the level of glycaemic control and associated factors among diabetic patients.**

**Methods: The data were collected from 332 diabetic patients in Adama Specialized Hospital, Ethiopia from February to March 2012. A patient was included in the study if he/she was 15 years and above. The data were collected using structured questionnaires; a medical card review and anthropometric measurement was done by trained nurses. SPSS version 16.0 was used to analyze the data.**

**Results: The study revealed that 180 (55.9%) of the respondents were adequately controlled their glycaemic level. The remaining were poorly controlled their glycaemic level. Poor glycaemic control was found among rural residents, type I diabetic patients, older age groups (>46 years), those who consumed alcohol and less restricted simple sugar intake, don't adhere to their meal time and had been prescribed oral hypoglycaemic drug alone ($p<0.05$). On the other hand, being physically active, obtaining advice from health workers and self monitoring blood glucose level significantly helped patients to control their gylcaemic level ($p<0.05$).**

**Conclusions: Significant proportions of diabetic patients were not able to control their glycaemic level and poor diabetic control was mainly found in patients with poor self care practices. Thus, health care providers should deliver individualized patient education and support those with elevated glycaemic level to help them better controls their conditions.**

**Keywords**: Diabetic, Glycaemic control, Ethiopia

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## Background

Diabetes Mellitus (DM) is a metabolic disorder characterized by chronic hyperglycemia with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action, or both [1- 2]. DM is increasingly prevalent and one of the top public health concerns all over the world. The International Diabetes Federation (IDF) estimates that 23 million years of life are lost due to disability and reduced quality of life as a result of complications associated with diabetes. Evidence has shown that $232 billion U.S. dollars were spent worldwide in 2007 to treat and prevent diabetes. This figure is expected to climb to a minimum of over $300 billion in 2025 [3]. The Diabetic Prevention Programs (DPP) found conclusively that with moderate exercise and change in diet people can reduce their risk of developing type 2 diabetes by 58%. Sub-Saharan Africa, like the rest of the world, is experiencing an increasing prevalence of diabetes alongside other non-communicable diseases [2].

DM and its complication are becoming more prevalent in Ethiopia. Although no population-based prevalence study exists, facility based studies have shown that there is an increase of hospital admissions due to DM, its complication and cost of its management in Ethiopia [4]. WHO estimated that the number of diabetic patient is expected to increase to 1.8 million by 2030 in Ethiopia [4]. The cost of inpatient diabetes management is significantly higher than the cost of other inpatient managements [5]. Thus, glycaemic control is fundamental to the management of DM, reduce mortality and morbidity and its complication [6,7].

Glycosylated Hemoglobin (HbA1C) is the primary indicator of glycaemic control. In this regard, smaller values of HbA1C indicate better glycaemic control [8]. HbA1c is a gold standard in analysis of patients' status, and is essential to ensure the optimal care of diabetic patients. HbA1C is the index that indicates the average blood glucose during the past 3 months. In one percent reduction in the value of HbA1C, the risk of micro vascular complications is reduced by 40 percent. Despite evidences that strict glycaemic control could reduce micro vascular and macro vascular complications, a high proportion of patients remain poorly control their blood glucose level. Achieving optimal glycaemic control in clinical practice is difficult and the reasons for its poor controls are complex. A variety of factors influence glycaemic control including demographic factors, personal behaviors and lifestyle, self care practices [9]. Evidences are very limited, particularly in resource limited settings, to help practitioners and decision makers for evidence based diabetic management. Therefore, this study was aimed to measure the level of glycaemic control and its associated factors among diabetic patients attending Adama Specialist hospital.

## Methods and Materials

**Study setting**: Cross sectional study was conducted among Diabetic follow up clinic in Adama Specialized Hospital, Adama, Ethiopia. During the study period, there were 1698 diabetic patients registered for follow-

up care and on average 162 patients were receiving follow-up service weekly. The data were collected over a period of 30 days (February 1, 2012- March1, 2012)

**Population**: A patient was included in the study if he/she was 15 years and older and must have been on follow up for at least one year at diabetic follow up clinic. Patients with mental problem, hearing impartment or any other serious health problem and were unable to provide appropriate information were excluded.

**Sample size**: The sample size was calculated assuming 0.5 % of proportion (p) of diabetic patients having good glycaemic control, 5% marginal error (d) and confidence interval of 95%. Based this assumption, the sample size was calculated by single population proportion formula ($n=(Z_{1-\alpha/2})^2 p (1-p)/ d^2$). This yields a sample size of 384. Since the source population was less than 10,000 the sample size was adjusted with correction formula and considering 10% non-response rate, the final sample size was 332 diabetic patients.

**Sampling methods**: Systematic sampling technique was used to select patients. The diabetic clinic provides service only two days per week (Wednesday and Thursday) and on average the clinic provides services for 162 patients per week and 648 patients per month. The data were collected over a period of one month and the sampling interval was determined by dividing the expected number of diabetic patients per month to the sample size (332) which gives a sampling interval of two. Thus, every other patients coming to the clinic for follow up service was interviewed until the total sample size was reached.

**Measurements**

Data collection instruments were adapted from similar study [10]. Patients were interviewed using structured questionnaires which was prepared in English and translated into Amharic and Afan Oromo (local languages) back translated to check its consistency. The Amharic and Afan Oromo version was used for data collection after pretesting on 5% of the actual sample size and necessary revision has made.

**Outcome variable**: Glycaemic control is an outcome variable. Glycaemic status was categorized as good if HbA1c < 7% and poor if HbA1c ≥7%[11]. To identify the patterns of glycaemic control, patients' chart was reviewed retrospectively for the last three consecutive Fasting Blood Sugar (FBS) measure and an average of the three measures were taken to label glycaemic control level.

**Explanatory variables**

**Body Mass Index (BMI)**: Anthropometric measurements were used to assess the BMI of the patients as weight of the subject in Kg divided by height of the subject in meters squared [BMI = weight (kg)/ height in (meters)$^2$]. The measurement was made by trained nurses. Then, BMI was classified as underweight (<19 kg/m$^2$), normal (19-25 kg/m$^2$), overweight (26- 30 kg/m$^2$), obese (31-40 kg/m$^2$) and very obese (>40 kg/m$^2$) [12].

**Physical activities**: Patients were considered physically active if they engaged in physical activities (physical exercise and walking) for at least 30 min for three days or more in the previous 7 days [13]. Otherwise, a respondent was considered as physically

inactive. Respondents' dietary practice was measured on 4-point Likert scale ranging from 'strongly agree (3) to strongly disagree (4). And self monitoring blood glucose was defined if patients performed home glucose monitoring for 5 days or more in the previous 7 days using glucometers [13].

**Medication adherence:** Patients were classified as highly adherent if he/she never missed his/her medications in the previous 7 days and not adherent if he/she missed his/her medications once or more in the previous 7 days [13].

**Smoking:** A respondent was considered as smoker if they report that they smoked at least 100 cigarettes in their lifetime and now report smoking cigarettes everyday or some days.

**Alcohol consumption:** A standard measure was used to define binge drinking as the consumption of 5 or more drinks in a row for men (4 or more drinks for women) on at least one occasion during the past 2 weeks.

**Data collection procedure:** The interview was conducted by trained data collectors who were diploma holders in clinical nursing. They were approached respondents after they get the required services and interviewed them about their physical activities, dietary practices, self monitoring blood glucose, medication adherence, alcohol consumptions, smoking and other demographic variables. Weight and height was measured with light clothes and taking the shoes off. Weight was taken to the nearest 0.5 kilogram and height was taken to the nearest centimeter. In addition, respondent's chart was reviewed by data collectors.

**Statistical analysis:** The data were analyzed by SPSS version 16.0. Descriptive statistics was used to summarize socio-demographic data and other study variables. Chi-square test was employed to examine the presence of association between outcome variable (glycaemic control) and explanatory variables. Finally, variables which showed significant association on bivariate analyses were fitted into multivariable logistic regression model. All statistical tests were two sided and statistical significance was set at P-value<0.05 and 95%. Odds ratio was used to show the strength of the associations.

**Ethical consideration:** The ethical issues of this study was reviewed and approved by the Ethical Committee of Jimma University. Verbal informed consent was sought from each respondent before the start of each interview.

## Results

### Socio-demographic characteristics of respondents

Three hundred twenty two respondents were participated in the study producing response rate of 97.0%. Table 1 contains socio-demographic characteristics of the respondents. The mean age of respondents was 47 years (range: 16-81 years). More than half of the respondents, 179 (55.6%), were males. Majority of the respondents, 207 (64.3%), were orthodox in religion and in terms of ethnic groups, Oromo accounts more than half (52.5%).

**Table 1**: Socio-demographic Characteristics of the participants, Adama Specialized Hospital, Ethiopia, February, 2012

| Variables | Categories | Frequency (n=322) | Percent |
|---|---|---|---|
| Residence | Urban | 167 | 51.9 |
| | Rural | 155 | 48.1 |
| Age | 15-25 | 56 | 17.4 |
| | 26-35 | 69 | 21.4 |
| | 36-45 | 67 | 20.8 |
| | ≥46 | 130 | 40.4 |
| Gender | Male | 179 | 55.6 |
| | Female | 143 | 44.4 |
| Ethnicity | Oromo | 169 | 52.5 |
| | Amara | 95 | 29.5 |
| | Gurage | 24 | 7.5 |
| | Tigre | 14 | 4.3 |
| | Others** | 20 | 6.2 |
| Marital status | Single | 50 | 15.5 |
| | Married | 225 | 69.9 |
| | Divorced | 25 | 7.8 |
| | Widowed | 22 | 6.8 |
| Religion | Orthodox | 207 | 64.3 |
| | Muslim | 43 | 13.4 |
| | Protestant | 51 | 15.8 |
| | Catholic | 18 | 5.6 |
| | Others * | 3 | 0.9 |

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**Respondents' diabetic related knowledge**

The study revealed that 312(96.9%) and 303 (94.1%) of the respondents knew that DM is a chronic disease and not curable disease respectively. Similarly, the majority of the respondents correctly responded to some specific knowledge items: DM is controllable (96.6%); complication of DM (88.5%); sign and symptom of hypoglycemia (93.5%) and prevention of hypoglycemia (92.9%). In addition, respondents believed that stress (81.1%) and infection (18.6%) would worsen DM.

**Respondents' dietary practice**

Table 2 presents the dietary practice of the respondents. Accordingly, 222 (68.9%) of the

respondents kept their meal time correctly. However, the percentage of respondents who restricted simple sugar intake was very low, 122 (37.9%). The practice of having fiber diet was tending to higher, 289 (89.8%) among the respondents (table 2).

**Table 2**: Dietary practice of respondents, Adama Specialized Hospital Adama, February, 2012

| Variables | Response categories | Frequency | Percent |
|---|---|---|---|
| Keeping meal time | Yes | 222 | 68.9 |
| | No | 100 | 31.1 |
| Controlling food intake while eating out | Yes | 197 | 61.2 |
| | No | 125 | 38.8 |
| Control on snacks | Yes | 267 | 82.9 |
| | No | 55 | 17.1 |
| Control food intake by exercise | Yes | 99 | 30.7 |
| | No | 223 | 69.3 |
| Restriction on fat and cholesterol | Yes | 270 | 83.9 |
| | No | 52 | 16.1 |
| Restriction on sodium intake | Yes | 122 | 37.9 |
| | No | 200 | 62.1 |
| Restriction on simple sugar intake | Yes | 122 | 37.9 |
| | No | 200 | 62.1 |
| Eat dietary fibers | Yes | 289 | 89.8 |
| | No | 33 | 10.2 |
| Eating a variety of food | Yes | 291 | 90.4 |
| | No | 31 | 9.6 |

**BMI, Self care practice and medication adherence**

In this study, for about two third (67.1%) of the respondents, BMI index was normal (19–25kg/$m^2$) and only 8(2.5%) of the respondents were underweight. For 98 (30.4%) of the respondents, BMI was above normal range (>25kg/$m^2$). Regarding substance use, the study revealed that cigarette and alcohol consumption was uncommon among the study participants. Only, 28 (8.7%) and 47 (14.6%) of the respondents were smoker and consumed alcohol respectively. The study also showed that more than half, 176 (54.7%), of the respondents were physically inactive. With regard to adherence to medication, nearly three fourth, 233 (72.4%) of the respondents were highly adhere to their treatment regimen. However, only 9.6% of the

respondents were reported that they were monitoring their blood glucose level at their home.

**Glycaemic control practice:** The study indicated that more than half of the respondents, 180 (55.9%), were adequately controlled their glycaemic level (HbA1c < 7%). The remaining percentage (44.1%) were poorly controlled their glycaemic level (HbA1c ≥7%).

**Factors independently predicted glycaemic control**

Table 3.1 and 3.2 contain the result of factors independently associated with glycaemic control level. Accordingly, rural respondents were less likely to achieve good glycaemic control compared to urban respondents (OR=0.17, 95%CI: 0.09- 0.31, p<0.01). Similarly, older respondents (age ≥46 years) were less likely to control their glycaemic level compared to younger respondents. As displayed in table 3, obtaining advice from health workers, being engaged in physical activity, self monitoring of blood glucose level, limiting simple sugar intake, and keeping meal time was associated with lower glycaemic level (p<0.05). However, alcohol consumption increased glycaemic level (p<0.05). With regard to types of DM, respondents having type 1 diabetes were less likely to control their blood glucose level than type 2 diabetes. The type of medication respondents were taking had also matters to achieve good glycaemic control: respondents who were using oral hypoglycaemic drug alone were less likely to control their blood glucose level.

**Table 3.1:** Factors independently predicted Glycaemic control among diabetic patients, March 1, 2012

| Variables | Response category | Glycaemic level | | AOR(95%CI) |
|---|---|---|---|---|
| | | Good (HbA1c ≤7 %) | Poor (HbA1c > 7%) | |
| Residence | Urban* | 131 | 36 | 1 |
| | Rural | 49 | 106 | 0.17 (0.09, 0.31)** |
| Age | ≥46* | 45 | 85 | 1 |
| | 26-35 | 49 | 20 | 9.13(3.68, 22.63) ** |
| | 36-45 | 40 | 27 | 3.43(1.59, 7.39) ** |
| | 15-25 | 46 | 10 | 2.98(1.37, 6.47) ** |
| Type of DM | Type 2* | 147 | 72 | 1 |
| | Type 1 | 33 | 70 | 0.31(0.16,0.57) *** |
| Alcohol consumption | No* | 163 | 112 | 1 |
| | Yes | 17 | 30 | 0.38(0.21, 0.74) *** |
| keeping meal time | Yes* | 144 | 78 | 1 |
| | No | 36 | 64 | 0.42(0.24,0.71) *** |
| Restriction on simple sugar intake | Yes* | 83 | 39 | 1 |
| | No | 97 | 103 | 2.56(4.27,1.53) ** |

**Table 3.2:** Factors independently predicted Glycaemic control among diabetic patients, March 1, 2012

| Variables | Response category | Glycaemic level | | AOR(95%CI) |
|---|---|---|---|---|
| | | Good (HbA1c ≤7 %) | Poor (HbA1c > 7%) | |
| Medication type | Insulin alone * | 83 | 72 | 1 |
| | Oral hypoglycaemic drug | 79 | 54 | 0.42(0.24,0.71) *** |
| | Insulin + oral hypoglycaemic drug | 18 | 16 | 0.97(0.46,2.05) |
| Self mentoring of blood glucose level | Yes | 29 | 2 | 11.93(2.56,55.46) ** |
| | No * | 151 | 140 | 1 |
| Physical activity | Yes | 108 | 38 | 4.05(2.36,6.95) |
| | No* | 72 | 104 | 1 |
| Advice from doctor or nurse | Yes* | 153 | 93 | 1 |
| | No | 27 | 49 | 0.22(0.42, .12) *** |

** reference category, ** statistically significant at p<0.01, *** statistically significant at p<0.05*

**Discussion**

This study has attempted to assess glycaemic control and factors associated with glycaemic control among diabetic patients in Adama specialized Hospital, Ethiopia. It is evident that Glycaemic control is essential in diabetes management and maintaining glycaemic control is a goal for all patients with diabetes [2]. In this study, more than half of the diabetic patients adequately controlled their blood glucose level (HbA1c ≥ 7%). Similar findings were also observed in some earlier studies in Ethiopia [14], Pakistan and Germany (15,16). However, the percentage of respondents who achieved good glycaemic control (HbA1c< 7%) is higher compared to some previous literatures from Denmark, Kuwait, and Saudi Arabia [17, 18]. This variation could be due to differences in the study population, contexts, and health education programs.

In this study, older age was associated with poor glycaemic control. This could be due to the fact the DM is more sever in older age people which make controlling of the situations more challenging. Some previous studies also documented similar findings in Ethiopia [14, 19] and other countries such as Jordan, Finland, India [20,21,22]. Longer duration of diabetes is known to be associated with poor control, possibly because of progressive impairment of insulin secretion with time because of Beta cell failure, which makes the response to diet alone or oral agents less likely [11].

However, the finding of the current study revealed that poor glycaemic control was found among type 1 diabetes compared to type 2 diabetes. Similarly, in the current study, poor glycaemic control was found among patients prescribed an oral anti diabetic agents. This could be attributed to the severity of the problem as combination therapy is prescribed for type 2 Diabetic patients' who had more progressive disease which required more aggressive treatment to provide glycaemic control. In those patients, achieving good glycaemic control is less possible.

In this finding distance from health care center is also associated with poor glycaemic control that is diabetic patients who were coming from rural areas were less likely to control their blood glucose. This finding is consistent with some earlier studies in Ethiopia [14,19]. Another important factor in glycaemic control is correctly following meal time. In this study, those respondents who did not follow their meal time were less likely to control their diabetic condition. Similarly, respondents who restricted simple sugar intake were more likely to control their blood glucose level than their counter parts.

Self monitoring of blood glucose levels needs to be taught and encouraged, as it is known to be associated with better glycaemic control regardless of diabetes type or therapy [23]. In this study diabetic patients who were practiced self mentoring of blood glucose were more likely controlled their blood glucose level than those who were not practiced self mentoring of blood glucose. This finding is inconsistent with a study conducted in other countries [23,24]. This inconsistence is probably due to difference in limited access to glucometers in Ethiopia. For instance a study done in 2005 indicated that access to blood glucose determination is poor and none had glycosylated hemoglobin (HbAlc) determination [4].

Diabetes self-management education is considered as the cornerstone of care for all persons with diabetes to achieve successful health related outcomes [25]. Empirical evidence supports actively involving people with diabetes in learning and exploring their feelings about having diabetes and health beliefs and personal understanding of diabetes and its treatment are considered to be the key factors influencing self-management, emotional well-being and glycaemic control [26]. In the current study, diabetic patients who received advice from health care providers were more likely control their blood glucose level than those who did not get advices implying that diabetic patient education really benefits patients to control their blood glucose level.

**Limitations of the study**

However, it must be noted that dietary assessment was based on self-reported dietary habits. We did not use diet diary method which is the most excellent tool to assess compliance with food intake for diabetic patients.

**Conclusion**

In conclusion, the current study revealed that more than half of the diabetic patients were able to adequately control their blood glucose level. However, still a significant proportions were not able to control their blood glucose to the desired level (HbA1c< 7%). Diabetic patients coming from rural areas; older age,

those who sick from type 1 diabetic were less likely control their glycaemic level. Similarly, taking alcohol, failure to keep meal time, using oral hypoglycemic drug alone, being less engaged in physical activities, and less restriction on simple sugar intake were significantly associated with elevated blood glucose. On the other hand, self mentoring of blood glucose at home and obtaining advice from health care providers helped patients to adequately control their blood glucose level. Hence, tailored educational program that emphasizes lifestyle modification with importance of physical activity, appropriate food items, keeping meal time and harmful habits such as alcohol consumptions would be of great benefit in glycaemic control. In addition, health care providers are required to encourage clients to monitor their blood glucose and provide individualized advice. On the other hand, patients who come from rural areas, older age, type I and those who prescribed oral hypoglycaemic drug alone needs special support and follow up to help them better control their blood glucose level. Further studies are required to investigate why patients taking oral hypoglycaemic drug alone were tending to less control their blood glucose level.

**Competing interests**

The authors declare that they have no competing interests.

**Authors' contributions**

TB, TB and EH conceived the study. TB, TB, EH and ZB were involved in the design, field work, data analysis and interpretation, report writing and manuscript preparation. In addition, ZB drafted the manuscript. All authors reviewed, read and approved the final version of the manuscript.

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