ADDIS ABABA UNIVERSITY COLLEGE OF HEALTH SCIENCE SCHOOL OF PUBLIC HEALTH

ASSESSMENT OF THE MAGNITUDE OF GLYCEMIC CONTROL AND ITS ASSOCIATED FACTORS AMONG PATIENTS WITH TYPE 2 DIABETES AT TIKUR ANBESSA SPECIALIZED HOSPITAL, ADDIS ABABA, ETHIOPIA, 2015.

BY

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A THESIS SUBMITTED TO ADDIS ABABA UNIVERSUTY COLLEGE OF HEALTH SCIENCE SCHOOL OF PUBLIC HEALTH IN PARTIAL FULFILLMENT OF THE REQUIREMENT OF MASTER OF PUBLIC HEALTH DEGREE.

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List of abbreviations and Acronyms

ADA	American diabetes association
CI	confidence interval
DCCT	Diabetes control and complication trials
DDS	Diabetic distress scale
DM	Diabetes mellitus
FBG	Fasting blood glucose
HbA1c	Glycosylated hemoglobin
IDF	International diabetes federation
IQR	Inter quartile range
OR	Odds ratio
SDSCA	Summary of diabetic self care activities
SMBG	Self monitoring of Blood Glucose
T2DM	Type 2 diabetes mellitus
TASH	Tikur Anbessa Specialized hospital
UKPDS	United Kingdom prospective diabetes studies
WHO	World health organization

Table of Contents

List of tables

Page

List of figures

Pages

Abstract

Back ground: Diabetes is increasing at an alarming rate throughout the world and about 80% of diabetics‟ lives in low and middle income countries. Glycemic control is the most important predictor of diabetes related complications and death. Identifying factors associated with glycemic control will help health care providers to design programs which improve quality of services provided to diabetic patients.

Objectives: The aim of this study was to assess the magnitude and factors associated with glycemic control among type 2 diabetic patients at Tikur Anbessa Specialized hospital, Addis Ababa, Ethiopia. From march to April, 2015.

Methods: Facility based cross sectional study was conducted on a sample of 412 type 2 diabetic patients attending diabetic clinic of Tikur Anbessa Specialized Hospital. The study subjects were selected using systematic random sampling technique from March to April, 2015. Quantitative data were collected on demographic, fasting blood sugar, self reported adherence to diabetes self care and diabetic distress scales using structured questionnaires. The data was entered and analyzed on SPSS V20. Descriptive statistics were used to determine magnitude of glycemic control among type 2 diabetes patients. Logistic regression was used to identify factors associated with outcome variables.

Result: A total of 412 type 2 diabetic patients were interviewed. Median age of participants was 52 years (IQR= 40-60 years). 51.7% of the respondents were females. Median duration of diabetes is 10 years (IQR: 5-16 years). About 80% had uncontrolled fasting glycemic level. The factors which are significantly associated with poor glycemic control were longer duration of diabetes (AOR: 2.72 95%CI [1.16, 6.32]) and being on insulin therapy (AOR= 3.01 95% CI: 1.5-5.9).

Conclusion: proportion of patients with poor glycemic control is high. Longer duration of the disease and being on drug regimen insulin is was associated with poor glycemic control. Appropriate attention should be given to patient with longer duration of disease and those on insulin therapy.

1. Introduction

1.1. Background

Diabetes (DM) is defined as a metabolic disorder of multiple etiologies characterized by chronic hyperglycemia with disturbance in carbohydrate, protein and fat metabolism resulting from defect in insulin secretion, insulin action or both [1-4]

Diabetes is one of the commonest non communicable diseases throughout the world and 80% of diabetic patients live in low and middle income countries[1, 5]

Globally there are about 382 million people living with diabetes in 2013, with global prevalence of 8.3%. If this trend continuous, about 592 million peoples are expected to have diabetes by 2035. Worldwide 5.1 million diabetes related deaths occurred among adults aged between 20-79 years in 2013, which accounts for 8.4% of global all cause mortality in this age group[1].

In Africa, International Diabetes Federation (IDF) estimated about 19.8 million adults were estimated to have diabetes and regional prevalence of DM is 4.9%. Out of this more than 50% lives in four highly populated countries namely: Nigeria, South Africa, Ethiopia and Tanzania[1].

In Ethiopia, IDF reported about 1.9 million adults aged 20-79 years were estimated to have diabetes in 2013 and another 2.9 million people living with impaired glucose tolerance who are at higher risk of developing diabetes. With national diabetes prevalence of 4.36% and there was about 34,262 estimated diabetes related deaths occurred in same year[1].

Type 2 diabetes accounts for 85% -95% of all diabetes. People with DM are at increased risk of a number of disabling and life threatening health problems. Persistent higher blood glucose level can result in serious health condition affecting heart, blood vessel, kidney and nerves [1-5]

Maintenance of blood glucose at levels that prevent the diabetes related complication requires an appropriate balance between dietary intake, physical activity and drug therapy. Achieving this balance requires active and effective participation of people with diabetes, as well as of their healthcare providers and adjustments of medication and other treatment components according to daily blood glucose profiles [6].

1.2. Statement of the problem

Hyperglycemia and diabetes are important causes of mortality and morbidity worldwide, through both direct clinical consequences and increased mortality from cardiovascular and kidney diseases. Control of hyperglycemia is a major therapeutic objective for all diabetes patients to prevent complications arising from diabetes[7]. Several large prospective studies and clinical trials established the benefits of intensive diabetes management in reducing micro vascular complications of diabetes[8].

Despite the established facts that diabetes patients benefited from control of hyperglycemia [8-12], majority of the patients fail to achieve adequate level of glycemic control[13-16] and reasons for poor glycemic control is complex and multi factorial[17].

According to study conducted by Feleke and Enqousellassie In Addis Ababa, Ethiopia,2003, only 5% of diabetes patients had access to self monitoring of blood glucose at home and none of them had glycated hemoglobin (HbA1c) determination and 51% of the patients did not have urine analysis, BUN, creatinine and lipid profiles in previous 1-2 years and 75% of the patients requires admission directly or indirectly due to uncontrolled diabetes[18].

Hospital based study conducted in Tikur Anbessa Specialized hospital, Addis Ababa, Ethiopia, 2012 by Yonas and his colleagues among type 2 diabetes patients found that more than 70% of patients poorly controlled their diabetes(HbA1c >8%), but the study did not looked at risk factors associated with poor glycemic control[14]

The present study determines the magnitude of glycemic control and factors associated with poor glycemic control among type 2 diabetic patients.

1.3. Rational of the study

In recent years non communicable diseases are becoming problems of developing country and contributing significant number of adult deaths in this region. Diabetes is one commonest non communicable disease with high prevalence and higher risk of lifelong chronic complication. Ethiopia is one of low income country experiencing increased prevalence diabetes and other non communicable diseases.

Despite that prevention of non communicable disease is an effective intervention for resource limited countries, significant number of population is living with diabetes. This number is expected to double in the coming twenty years. So it is important to reduce deaths and complication related with disease among those living with the problem. Glycemic control is the most predictor of diabetes related death and complication[8-10].

This study is conducted among type 2 diabetic patients at largest diabetes center in Ethiopia to identify factors related to poor glycemic control. Most of previous studies are either on both types 1 and 2 or type 1 diabetes patients. Also previous studies used only hyperglycemia as poor glycemic control but this study used both hyperglycemia and hypoglycemia as poor glycemic control. Since both are out of the target of the diabetes treatment.

The present study conducted among type 2 diabetic patients only. This will help homogeneity among study subjects to identify factors among type 2 diabetics; since different types of diabetes have different disease process and require different treatment modalities. Knowing those factors will contribute to reduction of premature deaths from type 2 diabetes, improvement of diabetes management and indicate areas of intervention to health care providers and patients.

2. Literature review

2.1. Magnitude of the problem

There were 382 million people living with diabetes throughout the world in 2013. A further 316 million with impaired glucose tolerance are at high risk of developing the disease. If this trend continues there will be 592 million diabetics by 2035. Because of this diabetes become a global public health challenge[1].

Diabetes is on the rise all over the world with 8.3% global prevalence of DM, almost all regions of the world experiencing the increased prevalence. 4.8% prevalence in Africa, 6.8% in Europe, 10.9% in middle east and north Africa, 9.6% in north America and Caribbean, 8.2% in south and central America, 8.7% in south east Asia, 8.1% in western pacific[1].

In Africa IDF estimated 19.8 million people living with diabetes and if this trend continues it will be 41.5 million at the end of 2035. The number of people living with impaired glucose tolerance is 29.7 million and projected to 66 million at 2035[1].

In Ethiopia IDF estimated the national prevalence of DM 4.36%, but community based survey in Ethiopia suggested even greater prevalence of diabetes. Community based cross sectional study conducted among adults 35 years and above in Gondar, Ethiopia, 2012, found prevalence of diabetes 5.1% in urban and 2.1% in rural[19]. Another study conducted among commercial bank of Ethiopia employees Addis Ababa, Ethiopia, 2012, found 6.35% prevalence of diabetes[20].

Diabetes mellitus is a growing cause of morbidity and mortality through macro vascular complications (stroke, myocardial infarction, and coronary artery disease) and micro vascular diseases (retinopathy, nephropathy and neuropathy) [21]. Prevalence reports from studies worldwide on micro vascular and macro vascular complications of Type 2 diabetes show varying rates. The prevalence of cardiovascular complications is varying between 10% to 22.5%[22, 23]. The rate of recurrence of cataracts is 26% to 62%.[24], nephropathy 17% to 28%[25] and neuropathy 19% to 42%[26, 27].

2.2. Glycemic control in type 2 diabetes

The main goal of diabetes management is to eradicate symptoms of hyperglycemia, to reach optimum control of blood glucose, and to reduce or eliminate micro and macro vascular complications of diabetes[28, 29].

Most national bodies have recommended glycemic control with fasting blood glucose level from 70 to 130 mg/dl[30], however majority of the patient fail to achieve this level and reasons for this failure is complex and multi factorial[17].

Evidences shows that most predictor of diabetes related complication and death is level of glycemic control achieved[4, 7, 31]. Poor glycemic control associated with high prevalence of diabetic complications like retinopathy, nephropathy, and ischemic heart diseases[8, 9, 12].

Multiple studies have established that poor glycemic control as measured by hemoglobin A1C (HbA1c) level is associated with increased mortality in persons with type 2 diabetes[23, 31-38]. Norfolk, United Kingdom, component of the European Prospective Investigation into Cancer and Nutrition (EPIC-Norfolk), demonstrated that HbA1c was continuously related to subsequent all-cause, cardiovascular, and ischemic heart disease mortality through the whole population distribution, with the lowest rates being seen among persons with HbA1c concentrations below 5%. In the EPIC-Norfolk study, an HbA1c level of 5% was used as the reference category, and there was a significant linear relation between HbA1c and risk of death, such that there was an almost 3-fold increased risk of death in men with HbA1c concentrations greater than or equal to 7% [23].

Several large clinical trials have demonstrated that tight control of blood glucose correlates with a reduction in the micro vascular complications of diabetes [8, 9, 11-13, 17]. United Kingdom prospective studies of Diabetes (UKPDS) are one of the largest studies conducted among 4585 type 2 diabetes patients to determine the relationship between exposure to glycemia over a period of time and risk of development of macro and micro vascular complications of diabetes. The study found that risk of development of diabetic complications is strongly associated with glycemic control. Each one percent reduction in HbA1c value was associated with reduction in risk of 21% for any end points related to diabetes (95% CI, 17% -24%, $p<0.0001$), 21% for death

related to diabetes (95% CI, 15%-27%, p<0.0001), 14% for myocardial infarction (95% CI, 8%-21%, p<0.0001), and 37% for micro vascular complications (95% CI, 33%-41%, p<0.001) [8].

A longitudinal cohort conducted in USA, comprised of 8,812 veterans with type 2 diabetes who are followed for 9 years found that 1% increase in HbA1C value is associated with two fold increase in mortality risk (hazard ratio=2.1; 95CI: 1.3,3.6) [39].

Study conducted by Yonas and his colleagues at Tikur Anbessa specialized hospital, Ethiopia,2012, found that more than 70% of the patients have poor glycemic control at the level of HbA1c >8%.[14]

2.3. Factors associated with glycemic control

Glycemic control is significantly associated with age, race/ethnicity, and duration of diabetes, type and number of medications taken, obesity, psychological variables, and family support.[40-49] Several observational studies revealed initiation of self monitoring of blood glucose among poorly controlled diabetes patient has positive impact on improvement of HbA1C values and patient life style[13].

Longitudinal study from 2000 to 2002 in San Diego found that patients who were uninsured, had diabetes for a longer period of time, used insulin or multiple oral agents, or had high cholesterol had higher A1C values over time indicating poorer glycemic control. The younger subjects also had poorer control[49]

Study in Jordan found 65.1% of the patients have poor glycemic control (HbA1c <7%) and In the multivariate analysis, increased duration of diabetes (>7 years vs. ≤7years) (OR=1.99, P≤.0005), not following eating plan as recommended by dietitians (OR=2.98,P≤.0005), negative attitude towards diabetes, and increased barriers to adherence scale scores were significantly associated with increased odds of poor glycemic control[50].

Another cross sectional study among Type 2 DM patients in Amman Jordan, 2006, found being shorter duration of disease, lower BMI <25kg/m^2 is associated with improved glycemic control[51].

Hospital based cross sectional study conducted among type 2 DM patients in north Jordan,2008, found that about 48.4% of the patients had poor glycemic control and those with longer duration of disease more than 10 years had higher odds of poor glycemic control (OR=1.53; 95% CI: 1.09- 2.17) compared to those with duration of 10 years or less[52].

Across sectional study conducted in south India, 2012 found that 51% of the patients had good glycemic control (HbA1C<7%) and patients in age group < 55years (p=0.03) are more likely to have good glycemic control as compared to those who are >55 years. Longer duration of disease (>6years) is also associated with poor glycemic control (p=0.0006) as compared to those with shorter duration of disease (<6 years). Poor glycemic control is also found to be common among those who are non adherent to medication, diet and exercise (p=0.0001), and also this study investigated association of glycemic control and diabetic distress and found that patients with clinically diabetic distress had poor glycemic control (65.8%; p=0.0001)[53].

A study conducted in Najran armed force hospital, Saudi Arabia, 2014 found that 22% of the patients have poor glycemic control (HbA1C <7%) and factors such as being in age group <65years (OR=3.71; 95CI: 1.26, 10.87) and having total cholesterol value above 200mg/dl (OR=6.08; 95CI: 1.26, 29.47) are associated with poor glycemic control[54].

Another study conducted in Tehran, Iran, 2009, among 103 female type 2 diabetes patients aged 15 to 75 years found that 43.7% of the patients had good glycemic control (HbA1C<7%) and waist circumference is associated increased level of HbA1C value (OR=1.04;95CI: 1-1.08, p=0.04)[55].

Cross sectional study conducted in Jimma university specialized hospital, Ethiopia,2012, among insulin treated diabetic patients showed proportion of patients with good glycemic control (FBS <126mg/dl) is 18% and non adherence to dietary management (AOR=0.35;p=0.005), body weight greater than 70 KG (AOR=0.21; P<0.001), knowledge deficit about sign and symptoms of hyperglycemia (AOR=3.6, p=0.004) is independently associated with poor glycemic control[15].

Another study conducted among diabetic patients in Jimma university specialized hospital, Ethiopia,2010, found that only 18.1% of patients achieved adequate level of glycemic control (FBS<126mg/dl) and being educated (AOR=3; 95% CI, 1.14-6.97, P<0.05), walking by foot for

30 minute (AOR=2.21; 95% CI, 1.25-4.21, p<0.05), taking single dose of oral hypoglycemic agents (3.5;95CI, 1.27-7.6, p<0.05) were independently associated with glycemic control[16].

The most recent cross sectional study among type 2 diabetes patients at Ambo hospital, Ethiopia, 2014, found that 50% of the patients achieved glycemic control at level below FBS<126mg/dl and those in age range of 51-60years (p=0.0388) and 61-70(p=0.017) were poorly managed their blood glucose[56].

Another cross sectional study conducted in Jimma University specialized hospital in 2011 found that the mean fasting blood glucose of the whole respondents was 171.7±63.6 mg/dl. Majority 73.1% of the patients had FBS>130 mg/dl. Only 5% of the patients had access to diabetic education. Patients taking oral hypoglycemic agents only were found to have better glycemic control than those taking insulin or combination of insulin and oral hypoglycemic agents[57].

Study conducted in different public health sectors of Addis Ababa, Ethiopia in 2005 to asses health care system for diabetic patients found that only 5% of the patients had access to self monitoring blood glucose at home, none of the patients had HbA1c determination, about 75% of the patients never attended diabetic education, majority 67.2% of the patients had no adequate knowledge target blood glucose for the diabetes management and nearly 75% of the patients required admission directly or indirectly related to their diabetes[18].

A hospital-based cross-sectional study conducted at the University of Gondar Referral Hospital, Ethiopia in 2013 found that 64.7% of diabetic patients poorly controlled their glycemic level (HbA1c >7%) and Being on insulin treatment (AOR =2.51; 95% CI =1.25, 5.04) and reporting poor medication adherence (AOR =3.19; 95% CI =1.76, 5.80) were found to be associated with poor glycemic control among Type 2 DM patients[58].

2.4. Conceptual frame work

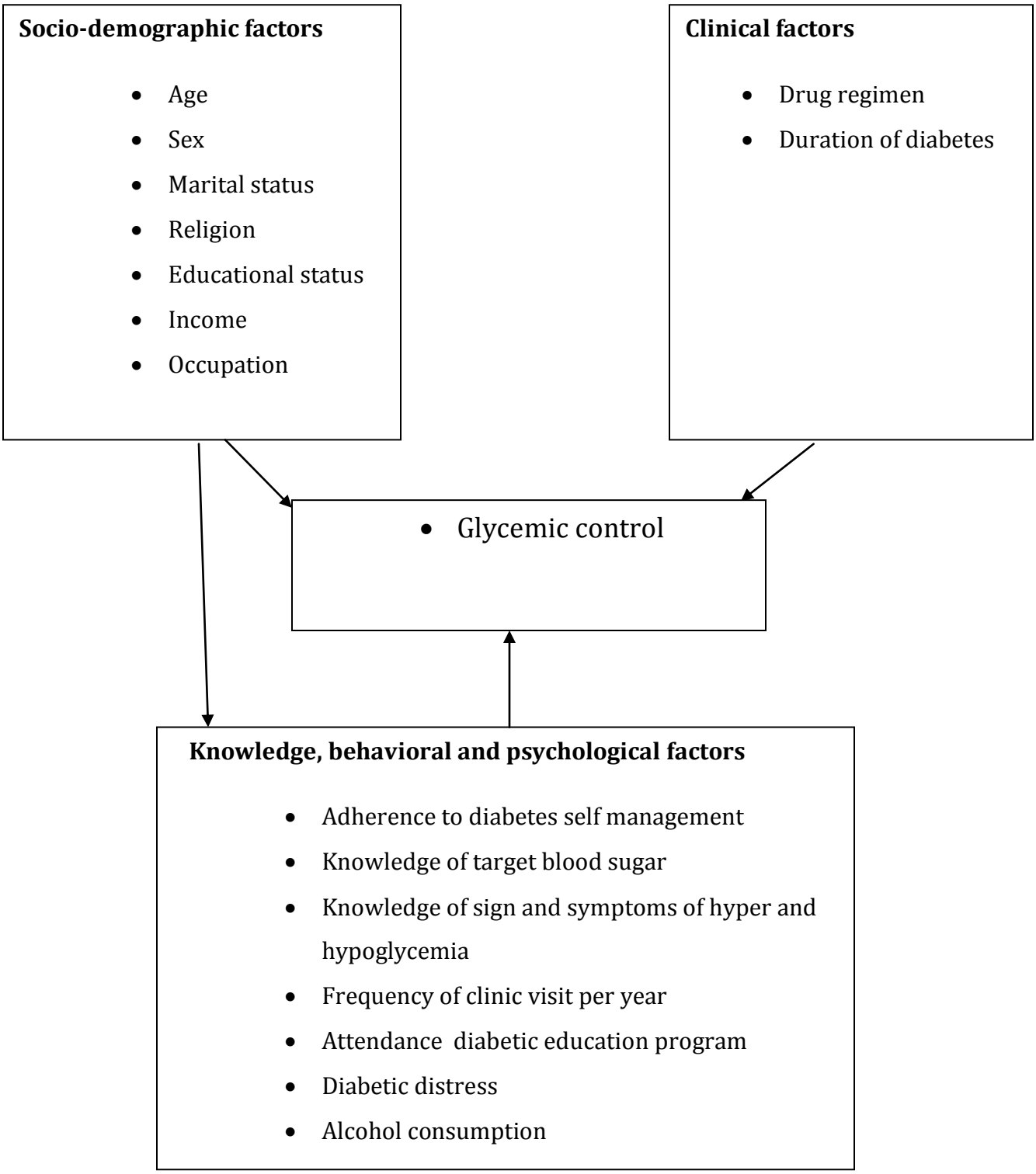

Fig 1: schematic representation of conceptual frame work

3. OBJECTIVES

3.1. General objectives

- To asses magnitude of glycemic control and its associated factors among type 2 diabetes patients at Tikur Anbessa Specialized hospital, Addis Ababa, Ethiopia; From March to April, 2015.

3.2. Specific objectives

1. To determine the magnitude of glycemic control among type 2 diabetes patients at Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia, from March to April, 2015.
2. To asses factors associated with glycemic control among type 2 diabetes patients at Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia, from March to April, 2015.

4. METHODS

4.1. Study area and period

The study was conducted in Tikur Anbessa specialized hospital (TASH), Ethiopia. TASH is found in Lideta Sub City, Addis Ababa, Ethiopia. The hospital has been inaugurated under its former name "Prince Mokonnen Memorial Hospital" on 3/11/1973. Tikur Anbessa, the largest referral hospital in the country, with 700 beds and is the main teaching hospital for both clinical and preclinical training of most disciplines. Patients are referred to this hospital from other health institution across the country. It is also an institution where specialized clinical services that are not available in other public or private institutions are rendered to the whole nation. TASH has 200 doctors, 379 nurses and 115 other health professionals dedicated to providing health care services. The various departments, faculties and residents under specialty training in the School of Medicine provide patient care in the hospital. The hospital also has 950 permanent and contract administrative staff to support the hospital activities. The hospital has separate endocrinology center which provide specialized service for patients with different endocrinological problem. Every year about 10,000 clinic visits of the patients with type 2 diabetes provided service at this centre. This study was conducted from August, 2014 to April, 2015 at Endocrinology unit of the hospital.

4.2. Study design

The study used facility based cross sectional analytic study design.

4.3. Source population

All type 2 diabetes patients who have follow up at diabetic clinic of TASH.

4.4. Study subjects

Study population was randomly selected Type 2 diabetes patients attending diabetic clinic of TASH during data collection period.

4.5. Inclusion criteria

- Patients who were diagnosed to have type 2 diabetes.
- Having at least one year follow up at the clinic.
- Willingness to participate in the study

4.6. Sample size determination

The required sample size for the first objective i.e. magnitude of glycemic control is estimated using the proportion of diabetics with poor glycemic control 50% which was reported from study conducted in Ambo hospital among type 2 diabetic patients [56]. The level of significance (α) equals to 0.05 and marginal error of 5%.

$$n = \frac{(z_{\alpha/2})^2 \times pq}{d^2}$$

Where

n= the desirable sample size

Z (α/2) =the critical value at 95% level of significance (1.96)

p=proportion of patients with good glycemic control

d=precision of measurement (acceptable marginal error)

p=0.5

d=0.05

$n = \frac{(1.96)^2 \times (0.5) \times (0.5)}{(0.05)^2} = 384$

After adding 10% non response rate the final sample size was **422.**

For the second objective i.e. factors associated with glycemic control the following assumption is taken: proportion of patients with good glycemic control among those with body weight <70kg being 55.8%; good glycemic control among those body weight ≥70kg being 44.2%[15]. A type I error of 5%, power to detect the assumed difference 80% and a 10% non response rate, the sample size required for the study was 161 in each group, a total of 323.

$$n_1 = \frac{[Z\alpha_{/2}\sqrt{2pq} + Z_{1-\beta}\sqrt{p_1q_1+p_2q_2}]^2}{(P_1-p_2)^2}$$

$n_2 = n_1$, $n = n_1 + n_2$

Where n_1=number of patients with body weight ≥70kg.

n_2 =number of patients with body weight <70kg.

p_1= proportion of glycemic control among patients with body weight ≥70kg.

p_2=proportion of glycemic control among patients with body weight <70kg.

$p = \frac{p_1 + p_2}{2} = 0.5$, q=1-p =0.5

$\frac{z\ \alpha}{2}$ =critical value at 95% level of significance

α is type I error with a value of 5%

$z1 - \beta$ = standard normal distribution value corresponding to 80% power to detect the assumed difference =0.84

$$n_1 = \frac{\left[1.96\sqrt{2x0.5x0.5} + 0.84\sqrt{0.442x0.558 + 0.558x0.442}\right]2}{(0.442\text{-}0.558)^2}$$

n_1=147 (patients with body weight <70kgn)

$n_2 = n_1$

n_2 =147 (patients with body weight ≥70kg).Therefore the total sample size (n) =**323** with 10% non-response rate.

Since the sample size for the first objective is the maximum, **422** was taken as a final sample size for this study.

4.7. Sampling procedures

Systematic random sampling technique was used to select the study subjects. While the study hospital was selected using purposive sampling method. Tikur Anbessa specialized hospital (TASH) is the only largest tertiary hospital with specialized service for diabetic patient. The

endocrinology unit has two clinics visit every week for patients with type 2 diabetes and average number of patients attending the clinic in one month was estimated to be 526. Using this estimated number sampling fraction was determined (K=2). The first eligible study subject was selected randomly. Then every other eligible patient visiting the clinic during the data collection period was interviewed using structured data collection questionnaire until desired sample size is achieved.

4.8. Data collection procedures

Data was collected through face to face interview and chart review using structured questionnaire which was adapted from different similar studies. The tools contains information about socio demographic characteristics of the patient, self care activities, clinical, behavioral, psychological characteristics and tools to review patients medical record. The data collection tools were first prepared in English and translated to Amharic, finally back translated to English by different person to ensure validity of translation.

Data collection tool sections are listed below:

Part 1: questionnaires on socio demographic variables was prepared, patients were interviewed face to face.

Part 2: tools to asses self care activities of the patients: summary of diabetes self care activities (**SDSCA**) scale is used this scale was developed by Toobert and Glasgow; it has acceptable reliability and validity. It contains 12 questions about the diet, exercises, blood sugar test, foot care and medication. Patients were interviewed face to face for each question[59]

Part 3: Tools to assess diabetic distress level of the patients and the diabetic distress score (DDS) was used. This scale is developed by Fisher and his colleague[60]. Diabetic distress scale (**DDS17**) which is composed of 17 questions used to explore contents of diabetic distress among patients.

Part 4: Tools to review patient‟s medical record**.** After patients completed the interview finally their respective medical record was reviewed using a check list to obtain their last three fasting blood glucose and current drug regimen.

4.9. Operational definition

Glycemic control: for purpose of this study we categorized patients based on American Diabetic Association (ADA) recommendation in to two groups:

- Good glycemic control: fasting blood glucose of 70-130 mg/dl [30].
- Poor glycemic control: fasting blood glucose of <70mg/dl and >130mg/dl.

Fasting blood sugar: blood glucose measured from venous blood after at least 8 hours of overnight fasting.

Moderate diabetic distress: If the patient mean item score for "DDS17" is ≥3 is considered as a level of distress worthy of clinical attention.

Adherence to medication: if the patients took all his/her anti diabetic medication in last seven days.

Adherence to blood glucose testing: if the patient measured his blood glucose for more than 3 days in last seven days.

Adherence to diet: If the patient follow recommended diet for more than 3 days in last seven days.

Adherence to exercise: If the patient follow recommended level of exercise for more than 3 days in last seven days.

Alcohol consumption- if reported consumption of alcohol twelve month prior to the survey.

Knowledge of target blood glucose for diabetic management was assessed by use of „yes/no" questions. Mentioning correct answer was coded as „1" and failure to mention as „0"; the score was converted to percentage score. The mean score is used to classify patients in to adequate and inadequate knowledge level.

Knowledge of sign and symptoms of hyperglycemia: it is composed of 17 questions and mentioning correct answers are coded as „1" and failure to mention as „0". Then percentage score is computed. Adequate level of knowledge if individual"s percentage score is above mean percentage score.

4.10. Study variables

The dependent (main outcome variable) in this study is “glycemic control”.

Independent variables are socio-demographic variable, knowledge, behavioral, psychological factors and clinical factors. These include:

Socio demographic variables:

- Age
- Sex
- Educational status
- Income

Behavioral, psychological and clinical characteristics

- Adherence to diabetic self management
- Knowledge of blood glucose target
- Knowledge of sign and symptoms of hyper and hypoglycemia.
- Diabetes education attended
- Diabetic distress
- drug regimen
- Alcohol consumption
- Smoking

4.11. Data management and quality assurance

To ensure the quality of data, training was given for data collectors on the objective of the study, contents of the questionnaires and how to maintain confidentiality and privacy of the study subjects. In order to check the functionality of data extraction forms, a pre-test was carried out on 5% of the sample at zewditu memorial hospital. The collected data was checked for completeness and accuracy and corrected on daily basis before leaving the facilities. Prior to data entry data was coded and edited properly by the principal investigator (PI) and then entered into statistical computer package using SPSS version 20 by PI. The study participants were

dichotomized based on their fasting blood glucose (FBG) in to controlled glycaemia (FBG 70-130mg/dl) and uncontrolled glycaemia (FBG <70 mg/dl and >130 mg/dl). Adherence to diabetes self management was categorized into two categories (adherent and non-adherent) based on their average score, diabetes distress into (moderate distress and no distress) categories based on average scores. After categorization completed each variables were checked for missed values and normality test is performed.

4.12. Data analysis procedures

Data entry and analysis was carried out using Statistical package for social science version 20. Descriptive statistics like frequency, proportion, mean, median and standard deviation was employed to describe socio demographic, clinical and behavioral characteristics of patients. Chi-square test was be used to assess association of the difference in the percentages of good and poor glycemic control according to independent categorical variables. Variables found significant at p-value <0.05 in bivariate analysis was included in to multivariate logistic regression analysis. Multivariate logistic regression analysis was conducted to identify factors associated with glycemic control. Statistical significance was declared at $p< 0.05$.

4.13. Ethical consideration

Ethical clearance was obtained from institutional review board (IRB) of Addis Ababa University, college of health science, school of public health. After ethical clearance received, permission to conduct the research was obtained from department of internal medicine of Addis Ababa University. Information sheet was prepared and read to all eligible participants of the study. All participants were informed the purpose of the study and their participation was on voluntary basis. Verbal informed consent was received from all participants. Name of the participant was omitted from the questionnaire; instead we used medical record number to ensure confidentiality.

4.14. Dissemination of the result

The result of this study was presented to Addis Ababa University College of health science, school of public health as partial fulfillment of the requirement of master degree in public health. Further more the result will be shared with endocrinology unit of TASH and also the manuscript of the research will be prepared and submitted to appropriate journals for possible publication.

5. Study results

5.1. Socio-demographic characteristics

A total of 412 respondents with response rate of 97.6% were participated in the study. Out 412 respondents, 213(51.7%) and 189(49.3%) were females and males respectively. The median age of respondents is 52 years (IQR 40-60 years). Out of total, 281(68.2%) respondents were married. Majority 325(78.9%) of the respondents were Orthodox Christian by religion. Seventy seven (18.7%) are illiterate and 125(30.3%) were completed grade 12^{th} and above. One hundred twenty (29.1%) were un- employed, 120(29.1%) were government or private employee, 121(29.4%) self employed and 50(12.1%) were retired. Table 1 below describes socio demographic characteristics of the respondents.

Table 1: **socio demographic characteristics of study participants (type 2 diabetes patients, n=412); at Tikur Anbessa specialized hospital (TASH), Addis Ababa, Ethiopia, 2015.**

Characteristics / variables	Frequency	Percentage
Sex		
Male	199	48.3
Female	213	51.7
Age		
<40	96	23.3
40-49	73	17.7
50-59	123	29.9
≥60	120	29.1
Educational status		
Illiterate	77	18.7
1-6	114	27.7
7-12	96	23.3
>12	125	30.3
Marital status		
Single	74	18
Married	281	68.2
widowed	37	9
Divorced/separated	20	4.8
Religion		
Orthodox	325	78.9
Muslim	35	8.5
Protestant	42	10.2
Others	10	2.4
Ethnicity		
Amhara	229	55.6
Oromo	37	9.1
Gurage	89	22
Tigre	25	6.2
Others	25	6.2
Occupation		
Unemployed	121	29.4
Government or private employee	120	29.1
Self employed	121	29.4
Retired	50	12.1
Income		
≤1000 birr	123	52.1
>1000 birr	112	47.9

5.2. Self-care behaviors of the study participants

Two hundred fifty seven (57.5%) of the respondents found not following their general dietary program correctly. 224(54.4%) were taking adequate physical exercise. 350(85%) of respondents were not testing their blood glucose level adequately. Three hundred fifty seven (86.7%) respondents were taking their medication as recommended by their doctor. (Table 2 below describes the self care practices of the respondents).

Table 2: **Summary of diabetic self care activities (SDSCA) of the study participants, TASH, Addis Ababa, Ethiopia, 2015**

Variables	**number**	**percent**
Compliance to general diet program in last seven days		
>3 days (adequate)	175	42.5
0-3 days (in adequate)	237	57.5
Compliance to specific diet program in last seven days		
>3 days (adequate)	312	75.7
0-3 days (in adequate)	100	24.3
Physical exercise in last seven days		
>3 days (adequate)	224	54.4
0-3 days (in adequate)	118	45.6
Compliance to blood sugar testing in last seven days		
>3 (adequate)	62	15
0-3 (in adequate)	350	85
Compliance medication in last seven days		
7 days (adequate)	357	86.7
< 7 days in adequate	55	13.3

5.3. Diabetic distress

Mean item score for diabetic distress scale is 2.68±1.09 SD. Of total 412 interviewed patients, one hundred sixty (38.8%) had moderate diabetic distress worthy of clinical attention. Two hundred twenty three (54.1%) had moderate emotional distress; Each sub scale of diabetic distress is described in the table below. The items „‟DDS17‟‟ attached in annexes.

Table 3: **Diabetic distress and its subscale among type 2 diabetes patients at TASH, Addis Ababa, Ethiopia, 2015**

Variables	number	Percent
Diabetic distress		
Low	252	61.2
moderate	160	38.8
Emotional distress		
Low	189	45.9
Moderate	223	54.1
Physician related distress		
Low	284	68.9
Moderate	128	31.1
Regimen related distress		
Low	242	58.7
Moderate	170	43.3
Interpersonal distress		
Low	275	66.7
Moderate	137	33.3

5.4. Knowledge, behavioral and clinical characteristics of the respondents

Three hundred seven (74.5%) of the respondents do not know target blood glucose level for diabetes management. 196(47.6%) respondents never attended diabetic education. 298(72.3%) of respondents had less than three times follow up to the clinic per year. majority 335(81.3%) of respondents had no adequate knowledge of sign and symptoms of hyper and hypoglycemia. 90(20.2%) reported history alcohol consumption 12 months prior to the survey. Median duration of diabetes is 10 (IQR 5-16) years. A total of 303(97.8%) respondents were on pharmacological therapy for diabetes. Out of those who were on medication for diabetes, 237(57.5%) respondents were taking insulin alone, 128(31.1%) were taking oral hypoglycemic agent and the rest were 38(9.2%) on both insulin and oral hypoglycemic agents.

(Table: 4) below describes behavioral, clinical and knowledge characteristics of the respondents.

Table 4: **knowledge, Behavioral and clinical characteristics of the respondents at TASH, Addis Ababa, Ethiopia, 2015**

Variables	**frequency**	**Percentage**
Ever attended diabetic education		
Yes	216	52.4
No	196	47.6
Number of follow up to diabetic clinic per year		
≤3	298	72.3
>3	114	27.7
Number diabetic education Sessions ever attended =215		
1-2 times	124	57.6
≥3 times	91	42.4
Knowledge of target blood glucose level		
yes	105	25.5
no	307	74.5
Knowledge of sign and symptoms of hyper and hypoglycaemia		
Yes	77	18.7
No	335	81.3
Alcohol consumption		
Yes	90	21.8
No	322	78.2
Smoking		
yes	8	2
Yes	404	98
Duration of diabetes		
<5	91	22.1
5-10	121	29.4
>10 years	200	48.5
Drug regimen		
Oral hypoglycaemic agent(OHA)	128	31.1
Insulin	237	57.5
Insulin and oral hypoglycaemic agents	38	9.2

5.5. Magnitude of Glycemic control among the respondents.

Glycosylated hemoglobin (HbA1c) test is the gold standard to determine the glycemic control of the patient; HbA1c was done for none of the patients. Instead fasting blood glucose was used as proxy indicator of glycemic control.

Fasting blood glucose result of last three clinic visit was obtained from patient‟s medical record to determine glycemic level of the patients. The average the last three fasting blood glucose measurements were used to determine patient‟s glycemic control status.

Mean fasting blood glucose (FBS) of the whole respondents was 165.63 mg/dl ±51.82 mg/dl. Proportion of patients with good glycemic control at level of FBS 70-130 mg/dl was 83(20.1%) [95% CI: 16.5%-24%], most 324(78.6%) had FBS >130 mg/dl, and only five (1.2%) had FBS<70 mg/ dl.

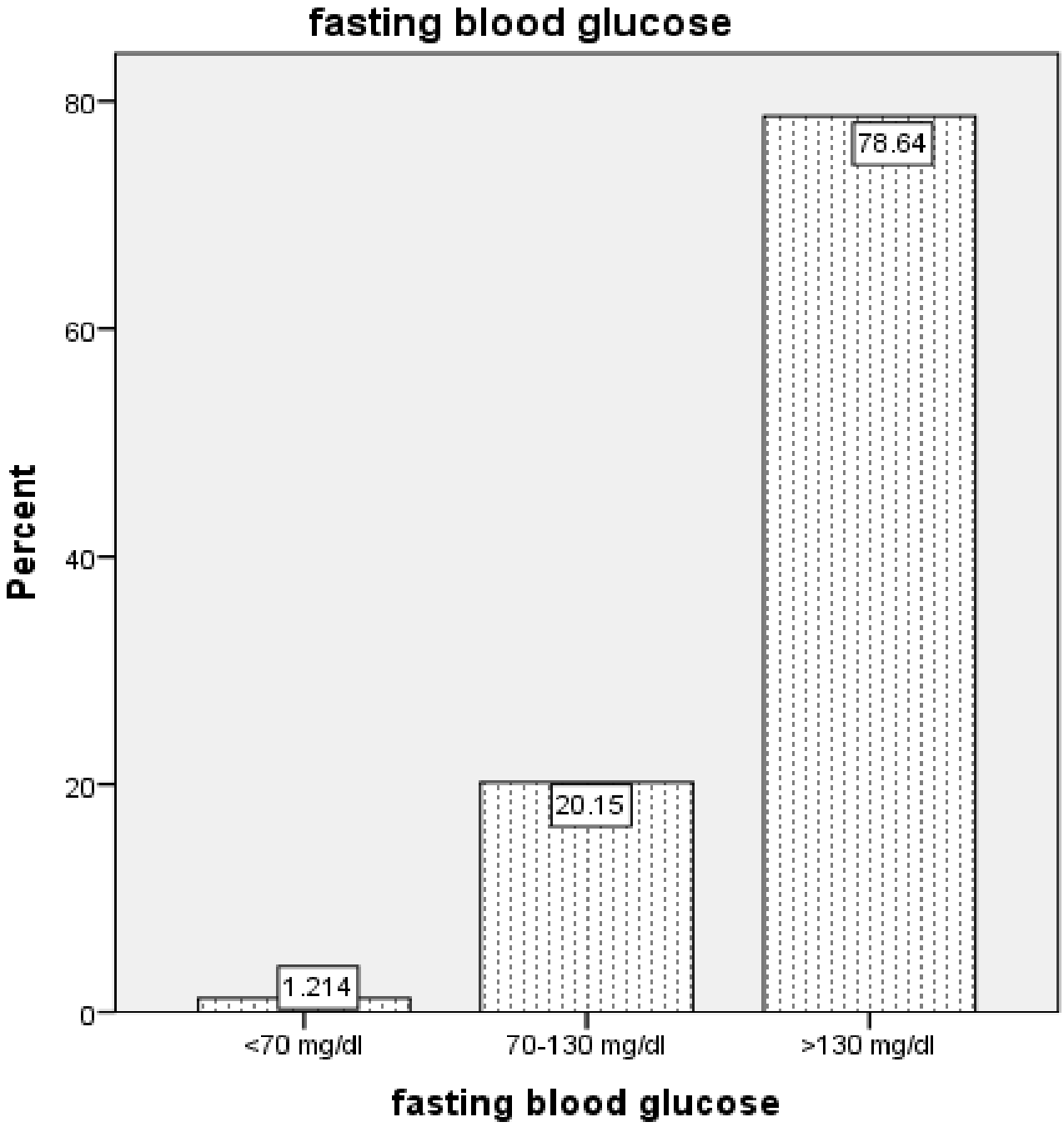

Fig 2: magnitude of glycemic control among type 2 diabetes patients at TASH, Addis Ababa, Ethiopia, 2015.

5.6. Factors associated with glycemic control

Bivariate logistic regression revealed that age, duration of disease and drug regimens were associated with glycemic control.

After controlling of potential confounding factors on multivariate logistic regression we found that the drug regimen and duration of disease independently associated with glycemic control.

Odds of poor glycemic control of diabetic patients who were on insulin therapy were three times higher (AOR=3.0, 95% CI: 1.5, 5.9) when compared to patients who were using drug regimen oral hypoglycemic agents only.

Odds of poor glycemic control is 2.72 times higher (AOR=2.72, 95% CI: 1.16, 6.32) for patients with 5-10 years duration of diabetes when compared to patients whose duration of diabetes is <5 years.

Table 5: **Bivariate logistic regression of factor associated with glycemic control among type 2 diabetes patients at TASH, Addis Ababa, Ethiopia, 2015.**

Variables	**No (%)**	**COR(95%CI)**	**P-value**
Age			
<40	96(23.3)	1	reference
40-49	73(17.7)	0.824(0.36,1.88)	0.648
50-59	123(29.9)	0.797(0.38,1.64)	0.53
≥60	120(29.1)	0.48(0.25,0.92)	0.028*
Duration of diabetes			
<5 years	91(22.1)	1	reference
5-10	121(29.4)	2.98(1.42,6.02)	0.002*
>10	200(48.5)	1.63(0.92,2.88)	0.08
Type of medication			
Oral hypoglycaemic agents (OHA)	128(31.1)	1	reference
Insulin	237(57.5)	2.35(1.4,3.96)	0.001*
Insulin and OHA	38(9.2)	0.44(0.17,1.14)	0.094
None	9(2.2)	1.18(0.28,4.98)	0.818

*Significant at $p< 0.05$

COR: crude odds ratio

Table 6: **Multivariate logistic regression of factors associated with glycemic control among type 2 DM patients at TASH, Addis Ababa, Ethiopia, 2015**

Variables	Number (%)	COR(95%CI)	AOR (95% CI)
Age			
<40	96(23.3)	1	1
40-49	73(17.7)	0.824(0.36,1.88)	2.14(0.74,6.2)
50-59	123(29.9)	0.797(0.38,1.64)	2.46(0.91,6.63)
≥60	120(29.1)	0.48(0.25,0.92)	1.02(0.37,2.78)
Duration of diabetes			
<5 years	91(22.1)	1	1
5-10	121(29.4)	2.98(1.42,6.02)	**2.72(1.16,6.32)** *
>10	200(48.5)	1.63(0.92,2.88)	1.7(0.8,3.7)
Drug regimen			
Oral hypoglycaemic agents (OHA)	128(31.1)	1	1
Insulin	237(57.5)	2.35(1.4,3.96)	**3.01(1.5,5.99)***
Insulin and OHA	38(9.2)	0.44(0.17,1.14)	1.2(0.24,6.27)
Diet only	9(2.2)	1.18(0.28,4.98)	2.9(0.86,9.9)

* Significant at $p<0.05$

COR: crude odds ratio

AOR: adjusted odds ratio

6. Discussion

This study assessed magnitude of glycemic control and its associated factors among type 2 diabetic patients at TASH, Addis Ababa, Ethiopia. The study found that over all glycemic control among the study subjects was far below the recommended standards. The mean fasting blood glucose of the overall study subjects were 165.63±51.82 mg/dl. This finding is comparable with study in Jimma, Ethiopia where mean fasting blood glucose was 171±63 mg/dl [57]. And also in line with study in Addis Ababa where mean fasting blood glucose was 190±89.6 mg/dl[18]. But our finding is much higher than the American Diabetic Association recommendation[30].

None of the patients had HbA1c determination; which is similar with previous studies in Jimma, Ethiopia [16, 57] and Addis Ababa, Ethiopia.[18]. This is due to unavailability of the laboratory service for the HbA1c determination in the public health institutions of Ethiopia.

This study found that proportion of patients with poor glycemic control is very high 80%. This finding is similar with study conducted at Jimma, Ethiopia where proportion of patients with poor glycemic control is 82%, 81.7% [15, 55, 57]. The study conducted in Ambo came up with proportion of poor glycemic control is 50% which is lower than our finding[56]. Proportion of poor glycemic control is much higher than the study conducted in Amman Jordan where poor glycemic control is 65.1% and 64.7% in Gondar[50, 58]. The possible explanation for difference could be patients seeking advanced management are referred to this hospital, since Tikur Anbessa specialized hospital is the only hospital in the country where patients are referred to this hospital from the whole regions of the country.

This study found that only 19.7% of the patients had adequate knowledge of sign and symptoms of hyper and hypoglycemia. This finding is lower than study conducted in Jimma, Ethiopia where about 70% of the patients had satisfactory knowledge of sign and symptoms of hyperglycemia[15]. This variation could be related to difference in scoring and categorization of knowledge question items; where this study used mean score of knowledge item questions to categorize respondents in to adequate and inadequate knowledge level whereas the former study used 60% score and above as satisfactory knowledge level.

Practice self monitoring of blood glucose at home is low in the present study. This finding is similar with previous studies 5.5% in Addis Ababa and 5% in Jimma[18, 57]. This could be related with financial capacity of the patients to buy glucometer and its strips.

Majority of the participants does not have adequate knowledge of target blood glucose level for diabetes management. This finding is similar with study in jimma[16]. This indicates that patients solely depend on their health care provider"s assistance to control their diabetes. It is difficult for patients to take appropriate measures without knowing target of the treatment. Unless patients understand the chronic nature of the disease and actively involved in their treatment process it would be difficult to attain adequate level of glycemic.

We found no statistical association between diabetic distress scales and glycemic control. This is inconsistent with others previous study finding where diabetic distress is associated with poor glycemic control[53]. This could be related with limitation in the diabetic distress scale which may vary in different population with different socio demographic status.

This study found no statistically significant association between diabetic self care activities and glycemic control. This finding is inconsistent with previous studies[15, 16, 61]. This could be explained by self care activities merely does not improve glycemic control unless patients understand rationales behind each self-care activities. Another possible explanation is inadequate knowledge of relationship between each self-care activity. Self-care activities were also assessed seven days prior to survey this may not represent actual self care behavior of the respondents.

This study found that patients who were on insulin were more likely to poorly control their fasting blood glucose level (AOR=3.01 95% CI: 1.5- 5.99) when compared to patients taking oral hypoglycemic agents only. This finding is consistent with other similar studies [16, 49]. The possible explanation for this could be that type 2 DM patients with good glycemic control stay on the oral hypoglycemic agents and those with poor glycemic control most likely transferred to insulin therapy so that number of patients with poor glycemic control was higher among insulin using patients. Also this study did not assessed duration on insulin therapy so that the shorter duration on insulin therapy might be also possible reason for poor glycemic control among insulin using patients. The storage condition of insulin may also possible factor of poor glycemic control among insulin using patients.

This study found that patients with longer duration (5-10 years) of diabetes were more likely (AOR=2.72 95% CI: 1.16-6.32**)** to have poor glycemic control when compared with patients with relatively shorter (< 5 years) duration of diabetes. This could be explained by progressive nature of the disease. May also be explained as duration increases and patients with shorter duration of disease may be relatively adherent to medication and fruit and vegetable eating. This finding is consistent with several previous studies [53, 62].

Duration of diabetes >10 years did not significantly associated with poor glycemic control. It may be explained by patients with duration of 10 years and above may suffer from one or more diabetic related complications and might become stricter to manage their diabetes to prevent further complications.

7. Strength of the study

- This study is conducted among type 2 diabetic patients as the disease is increasing in developing world and getting more attention nowadays.
- The study may be used as baseline information for other researchers.
- The study subjects were selected randomly

8. Limitation of the study

- This study is cross sectional, where causal relationship between the independent and dependent variables cannot be established.
- Medication adherences, dietary intake, blood glucose testing and physical activities were obtained by self-report and may be limited by recall and social desirability bias.

9. Conclusion

This study revealed that 80% of patients poorly controlled their diabetes. None of the patients had HbA1c determination; which is gold standard to determine patients‟ glycemic level. Absence of HbA1c determination directly compromise quality service provided to the patients; since FBS reflect the glycemic status of the one spot.

Knowledge of sign and symptom of hyper and hypoglycemia and knowledge of target blood glucose is meager. On other hand this affects patients‟ active involvement in appropriate diabetes self-care. This study also found that health educations provided to the patient were low both in terms of coverage and contents of the topics provided.

Percentage of patients practicing self monitoring of blood glucose was very low, this could lead to delay in taking appropriate measurement at home and during their routine daily activities before going place where health service is rendered.

The finding obtained from multivariate logistic regression suggested that longer duration of disease and being on insulin therapy associated with poor glycemic control. Special attention should be given for patient with longer duration of disease and those on insulin.

10. Recommendations

To health facility

- Health facilities should be aware of that majority of patients do not achieve adequate level of glycemic control and take appropriate action.
- Health facilities should provide patients with adequate health education.
- Special attention should be given to patients with longer duration of disease and those who are on insulin.

To patients

- Patients should know rationales of self care activities and take appropriate action accordingly.
- Patients should be warned of consequences of persistent hyperglycemia.

To researchers

- Further researches should be conducted using HbA1c.
- Longitudinal studies also encouraged to asses determinants over period of time.
- Barriers of glycemic control should also be explored since this study does not look at barriers.
- The reason for poor glycemic control in insulin using patients better if explored.

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Annex I: Information sheet

Hello. My name is _____ and I am data collector of the study conducted by Yohannes Tekalegn, master's student at Addis Ababa university school of public health, conducting this research for partial fulfillment of master's degree in public health. We would very much appreciate your participation in this survey. The information you provide will help us to contribute to improvement of quality health service for diabetes patients. The interview takes between 30-45 minutes to complete. As part of the study we would first like to ask you socio demographic and self care behaviors and we would like to access your medical record to abstract your fasting blood sugar. Whatever information you provide will be kept strictly confidential, and will not be shared with anyone other than members of our research team. Participation in this survey is voluntary, and if we should come to any question you don't want to answer, just let me know and I will go on to the next question; or you can stop the interview at any time. However, we hope you will participate in the survey since your views are important.

At this time, do you want to ask me anything about the survey?

May I begin the interview now?

Signature of interviewer: ---------- Date: ----------/--------/--------

1. RESPONDENT AGREES TO BE INTERVIEWED→ interview
2. RESPONDENT DOES NOT AGREE TO BE INTERVIEWED→ end

For more information and questions here is the contact address of investigator.

Yohannes Tekalegn
Tel: +251913578901
E-mail: mailto:yohannesefa@gmail.com

Annex II: Consent form

I_____ am informed on study to be conducted by Masters Student in AAU, college of health sciences school of public health on magnitude of glycemic control and its associated factors among type 2 diabetes patients at Tikur Anbessa specializes hospital. My participation in this study is voluntary, no obligation to answer any questioner. There is no harm by not answering the questions and no special benefit by answering the question and also the interview will take 30- 45 minutes .I heard all the information mentioned above and willing to participate in the interview.

1. Name of interviewer_____ Signature_____ date_____/_____/____

(Signature of interviewer certifying that respondent has given informed consent verbally)

Annex III: English version of questionnaire

Part I: socio demographic questions

s.no	Questions	Alternatives/choices of response	Skip
101	How old are you?	age in completed years_____	
102	Have you ever attended formal school?	1. Yes 2. no →	**104**
103	If yes for question number 102, What is the highest level of school you attended in completed years?	1. 1-6 2. 7-12 3. >12 4.	
104	What is your religion?	1. ORTHODOX 2. CATHOLIC 3. PROTESTANT 4. MOSLEM 5. TRADITIONAL 6. OTHER (SPECIFY)……	
105	What is your ethnicity?	1. Amhara 2. Gurage 3. Oromo 4. Tigre 5. Others (specify)……	
106	What is your marital status now?	1. Never married 2. Married 3. Widowed 4. Divorced 5. Separated 6. Other……	
107	What is your occupation	1. Unemployed 2. Government/private employee 3. Self employed 4. Other……	
108	How much money do you earn in monthly basis?	----------Ethiopian birr	

109	How many years back were you diagnosed by health professional to have diabetes?	----------years.	
110	How many times do you visit diabetic follow up clinic per year?	----------times/year.	
111	Have you ever attended diabetes education provided at this hospital?	1. Yes 2. No	
112	How many times in last year have you attended the diabetes education?	1. One time 2. Two time 3. Three time and above	
113	What is optimum blood sugar level you should achieve to prevent diabetes related complication?	1. ……mg/dl 2. I don't know	
114	Which drug regimen you are following currently for your diabetes?	1. Oral anti diabetic medications only 2. Insulin only 3. Insulin and oral anti diabetic medications 4. Only following dietary plan as recommended	

Part II: Tools to assess levels of diabetes self care activities using summary of diabetes self care activities (SDSCA)

Instruction: The questions below ask you about your diabetes self-care activities during the past 7 days. If you were sick during the past 7 days, please think back to the last 7 days that you were not sick.

Diet		**Number of days**							
201	How many of the last SEVEN DAYS have you followed a healthful eating plan? Fruit and vegetables, high fibre diet, low unsaturated fat, etc…	0	1	2	3	4	5	6	7
202	On average, over the past month, how many DAYS PER WEEK have you followed your eating plan?	0	1	2	3	4	5	6	7
203	On how many of the last SEVEN DAYS did you eat five or more servings of fruits and vegetables?	0	1	2	3	4	5	6	7
204	On how many of the last SEVEN DAYS did you eat high fat foods such as red meat or full-fat dairy products?	0	1	2	3	4	5	6	7
Exercise		**Number of days**							
205	On how many of the last SEVEN DAYS did you participate in at least 30 minutes of physical activity? (Total minutes of continuous activity, including walking).	0	1	2	3	4	5	6	7
206	On how many of the last SEVEN DAYS did you participate in a specific exercise session (such as swimming, walking, biking) other than what you do around the house or as part of your work?	0	1	2	3	4	5	6	7
Blood sugar testing		**Number of days**							
207	On how many of the last SEVEN DAYS did you test your blood sugar?								
208	On how many of the last SEVEN DAYS did you test your blood sugar the number of times recommended by your health care provider?								
Smoking									
209	Have you smoked a cigarette—even one puff—during the past SEVEN DAYS?	1. Yes 2. No							
210	*If yes*, how many cigarettes did you smoke on an average day?	..... Number of cigarettes.							
Medications		**number of days**							
211	On how many of the last SEVEN DAYS, did you take your recommended diabetes medication?	0	1	2	3	4	5	6	7

212	On how many of the last SEVEN DAYS did you take your recommended insulin injections?	0	1	2	3	4	5	6	7
213	On how many of the last SEVEN DAYS did you take your recommended number of diabetes pills?	0	1	2	3	4	5	6	7

Part III Questions regarding signs and symptoms of hypo and hyperglycemia

Which of the following sign of hyperglycemia do you know? Please circle the answers; more than one answer is possible.

1. Dry mouth
2. Frequent urination
3. Drowsiness
4. Extreme thirst
5. Hunger
6. Frequent urge to urinate
7. Extreme tiredness and paleness
8. Blurred vision
9. Dry skin

Which of the following sign of hypoglycemia do you know? Please circle the answers; more than one answer is possible.

1. Fast heart beat
2. Sweating
3. Shaking
4. Dizziness
5. Anxious
6. Weakness or fatigue
7. Headache
8. Irritable
9. Hunger

Part IV: tools to assess the diabetic distress level among diabetes patients (DDS2)

Directions: Living with diabetes can sometimes be tough. There may be many problems and hassles concerning diabetes and they can vary greatly in severity. Problems may range from minor hassles to major life difficulties. Listed below are 2 potential problem areas that people with diabetes may experience. Consider the degree to which each of the 2 items may have distressed or bothered you DURING THE PAST MONTH and circle the appropriate number. Please note that we are asking you to indicate the degree to which each item may be bothering you in your life, NOT whether the item is merely true for you. If you feel that a particular item is not bother or a problem for you, you would circle "1." If it is very bothersome to you, you might circle "6."

Part A: DDS2 questions

Feeling		**Not a problem**		**Moderate problem**		**Serious problem**	
301	Feeling overwhelmed by the demands of living with diabetes.	1	2	3	4	5	6
302	Feeling that I am often failing with my diabetes regimen.	1	2	3	4	5	6

Notes:

- If mean score of **DDS2** is ≥3 go to next page and interview the patient for "**DDS17"**
- If mean score of DDS2 <3, say thanks and finish the questions here.

Part B: DDS 17 questions

Feeling	**Not a problem**		**Moderate problem**		**Serious problem**		**Office use only**
1. Feeling that diabetes is taking up too much of my mental and physical energy every day.	1	2	3	4	5	6	A
2. Feeling that my doctor doesn't know enough about diabetes and diabetes care.	1	2	3	4	5	6	B
3. Feeling angry, scared and/or depressed	1	2	3	4	5	6	A

when I think about living with diabetes.							
4. Feeling that my doctor doesn't give me clear enough directions on how to manage my diabetes.	1	2	3	4	5	6	B
5. Feeling that I am not testing my blood sugars frequently enough.	1	2	3	4	5	6	C
6. Feeling that I am often failing with my diabetes regimen.	1	2	3	4	5	6	C
7. Feeling that friends or family are not supportive enough of my self-care efforts (e.g. planning activities that conflict with my schedule, encouraging me to eat the "wrong" foods).	1	2	3	4	5	6	D
8. Feeling that diabetes controls my life.	1	2	3	4	5	6	A
9. Feeling that my doctor doesn't take my concerns seriously enough.	1	2	3	4	5	6	B
10. Not feeling confident in my day-to-day ability to manage diabetes.	1	2	3	4	5	6	C
11. Feeling that I will end up with serious long-term complications, no matter what I do.	1	2	3	4	5	6	A
12. Feeling that I am not sticking closely enough to a good meal plan.	1	2	3	4	5	6	C
13. Feeling that friends or family doesn't appreciate how difficult living with diabetes can be.	1	2	3	4	5	6	D
14. Feeling overwhelmed by the demands of living with diabetes.	1	2	3	4	5	6	A
15. Feeling that I don't have doctor who I can see regularly about my diabetes.	1	2	3	4	5	6	B
16. Not feeling motivated to keep up my diabetes self-management.	1	2	3	4	5	6	C
17. Feeling that friends or family don't give me the emotional support that I would like.	1	2	3	4	5	6	D

Part v: Tools to assess alcohol use behavior

401	Have you consumed alcohol (such as beer,wine, Katikala, Tej, arake) in your life time?	1. Yes 2. No	If no skip to
402	Have you consumed alcohol (within the **last 12 months**?	1. Yes 2. No	
403	In the **past 12 months,** how frequently have you had at least one drink?	1. Daily 2. 5-6 days per week 3. 1-4 days per week 4. 1-3 days per month 5. Less than once a month	
404	When you drink alcohol, on average, how many drinks do you have during one day?	Number ___ ___ Don't know 88	
405	Have you consumed alcohol within the **last 30 days**?	1. Yes 2. No	
406	During each of the **past 7 days**, how many standard drinks of any alcoholic drink did you have each day?	Monday _____ Tuesday _____ Wednesday _____ Thursday _____ Friday _____ Saturday _____ Sunday _____	

Part VI: checklist to review patient's medical record

401	**Last three fasting blood sugar**	**Values**
	1	……..mg/dl
	2	……..mg/dl
	3	……..mg/dl
402	**Latest Lipid profiles**	**Values**
	HDL	……..mg/dl
	LDL	……..mg/dl
	Cholesterol	……..mg/dl
	Triglycerides	……..mg/dl
403	**Had HbA1c value in last four months?**	1. Yes 2. No
404	**Weight**	……KG
405	**height**	……meters
406	**Body mass index**	……kg/m^2
407	**Which drug regimen patient following is following currently?**	1. Oral anti diabetic agents alone 2. Insulin alone 3. Both Insulin and oral anti diabetic agents 4. Following dietary plan as recommended

Annex IV: Amharic version of questionnaire

<u>ለጥናቱ ተሳታፊዎች የሚሰጥ መረጃ</u>

ጤና ይስጥልኝ ፤ ስሜ _____ ይባላል፡፡

ከፍተኛ የሆነ የስኳር መጠን መቆጣጠር እና ተጓዳኝ የሆኑ ችግሮችን ለመዳሰስ የሚደረገው ጥናት እንዲሳተፉ እንጠይቃለን፡፡ይህ ጥናት የሚካሀደዉ በዋነኝነት በ አዲስ አበባ ዩኒቨርሲቲ የህብረተሰብ ጤና ፤ የድህረ ምረቃ ተማሪ በሆኑት አቶ ዩሀንስ ተካልኝ በሚሰራ ሲሆን በዚሁ ዩኒቨርሲቲ አባል የሆኑት ዶ/ር አዳሙ አዲሴ እና ዶ/ር ተድላ ከበደ እንዲሁም አቶ ወንድሙ አየሌ ይሳተፉበታል፡፡

የእርሶን ተሳትፎ በጣም እናበረታታለን፡፡እርሶ የሚሰጡን መረጃ ለስኳር ህሙማን የሚሰጠውን ህክምና ጥራት ለማሻሻል ለሚደረገው ዕቅድ ለማሳካት እጅጉን አስፈላጊ ነው፡፡ ቃለ መጠይቁ ከ30-45 ደቂቃ ሊፈጅ ይችላል፡፡እንደ ጥናቱ አካል የእርሶ ማህበራዊ እና ኢኮኖሚያዊ መረጃ እንዲሁም የስኳር ህመም ለማስታመም ተግባቸዎት ዉስጥ ለራስዎ የሚያደርጉትን እንክብካቤ በተመለከተ አንድ አንድ ጥያቄዎችን እጠይቅዎታለሁ እንዲሁም የህክምና መዝገብዎት ላይ ያሉትን መረጃ ለጥናቱ መጠቀም እንፈልጋለን፡፡ ማንኛውም የሚሰጡን መረጃ በሚስጥር የምያዝ ይሆናል፡፡በጥናቱ ላይ መሳተፍ ባልዎት ሙሉ ፍቃደኝነት ላይ የተመሰረተ ይሆናል፡፡ በቃለ መጠይቁ መካከል እርሶ መመለስ የማይፈልጉትን ጥያቄ ካለ ወይም በመሀል መቋረጥ ቢፈልጉ ያሳውቁኝ፡፡በጥናቱ ላይ በፍቃደኝነት እንደሚሳተፉ አንጠራጠርም፡፡ እርስዎ የሚሰጡን መረጃ እጅጉን አስፈላጊ ስለሆነ፡፡

አሁን ቃለ መጠይቁን መጀመር እችላለሁ? አዎ ☐ አይደለም ☐

የቃለ መጠይቁ ጠያቂ ስም _____ **ፊርማ**_____ **ቀን** __ /__/__

1. **ተሳታፊው ጥናቱ ላይ ለመሳተፍ ፍቃደኛ ከሆኔ ወደ ቃለመጠይቁ ይህዱ፡፡**
2. **ተሳታፊው ጥናቱ ላይ ለመሳተፍ ፍቃደኛ ካልሆኔ ቃለመጠይቁን ያቀርጡ፡፡**

ለበለጠ መረጃ የዋናው ተማራማሪ አድራሻ ከፈለጉ

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ኢሜል :yohannesefa@gmail.com

2.የተሳትፎ ስምምነት መግለጫ ቅፅ

እኔ _____ ከፍተኛ የሆነ የስኳር መጠን መቆጣጠር እና ተጓዳኝ የሆኑ ችግሮችን ለመዳሰስ የሚደረገው ጥናት በተመለከተ ገርርዝር መረጃ ተሰጥቶኛል፡ ጥናቱ ላይ ለመሳተፍም ሙሉ በሙሉ ፍቃደኛ መሆኔን እገልፃለሁ፡፡

የጠያቂው ስም _____ ፊርማ _____ ቀን ___/___/____

(የቃለመጠይቁ ጠያቂ ፊርማ፤ተሳተፊዉ፤ሙሉ በሙሉ፤ፍቃደኛ፤መሆኑን፤ያረጋግጣል)

ክፍል 1፡ ማህበረሰባዊ እና ግላዊ ጥያቄዎች

ተ/ቁ	ጥያቄዎች	ምርጫዎች	እለፍ
101	እድሜህ/ሽ/ዎት ስንት ነው?	_____ ዓመት	
102	መደበኛ ትምህርት ተከታትለዉ ያዉቃሉ?	1.አዎ 2 አይደለም	
103.	ለጥያቄ ቁ፡102 መልዎ አዎ ከሆነ መደበኛ ት/ት የተከታተሉት ለስንት ዓመት ነው?	1 1-6 2. 7-12 3. >12 4.	
104.	የትኛውን ሀይማኖት ተከታይ ኖት?	1. ኦርቶዶክስ 2. ካቶሊክ 3. ፕሮቴስታንት 4. ሙስሊም 5. ዋቀፌታ 6. ሌላ ካለ ይግለፁ--------	
105.	የየትኛው ብሄረሰብ አባል ኖት?	1. አማራ 2. ጉራጌ 3. ኦሮሞ 4. ትግሬ 5. ሌላ ይግለፅ---------	
106.	የጋብቻ ሁኔታዎ ይግለፁልኝ	1. ያላገባ 2. ያገባ 3. የሞተበት/ባት 4. የተፋቱ /የተለያዩ 5. ሌላ.....	
107.	የመተዳደሪያ ስራዎት ምንድነው?	1. ስራ አጥ / በቤተሰብ ጥገኛ 2. የመንግስት/የግል ድርጅት ሰራተኛ 3. የግል ስራ	

		4. ሌላ ካለ ይገለፅ----------	
108.	ባጠቃለይ ምን ያህል ወርሀዊ ገቢ ያገኛሉ?	_____ብር	
109.	የስኳር ህመም እንዳለብዎት በጤና ባለሙያ ከተነገርዎት ስንት ዓመት ሆነ ?	_____ዓመት	
110.	በዓመት ስንት ግዜ የስኳር ህሙማን ክትትል ወደ ሚደረገው ጤና ተቋም ይሄዳሉ ወይም በዓመት ስንት ግዜ ወደዚህ ክልኒክ ክትትል ያደርጋሉ?	_____ጊዜ	
111.	ለስኳር ህሙማን የሚሰጠውን የጤና ትምህርት ተከታትሎ ያውቃሉ?	1.አዎ 2. አይደለም	
112.	ለጥያቄ ቁጥር 111 መልስዎ አዎ ከሆነ ባለፈው ዓመት ስንት ጊዜ ት/ቱን ተከታተሉ?	1.አንድ ጊዜ 2.ሁለት ጊዜ 3. ሶስት ጊዜና ከዛም በላይ	
113.	ከፍተኛ በሆኔ የደም ዉስጥ የስኳር መጠን የሚመጡ የጤና ችግሮች ለመከላከል በአማካይ የደም ውስጥ የስኳር መጠንዎ ስንት መሆን አለበት?	1. ----------mg/dl 2. አላውቅም	
114.	የስኳር መጠንዎን ለመቆጣጠር ምን ዓይነት የመድሀኒት ውህደት እየተጠቀሙ ነው?	1.የሚዋጥ የስኳር መቀነሻ ክኒን/እንክብል 2. ኢንሱሊን 3. ኢንሱሊን እና የሚዋጥ የስኳር ክኒን/እንክብል 4.ምግብን በማስተካከል እየተከታተሉኩ ነው	

<u>ክፍል ሁለት</u>፡ የስኳር ህመሙን ራሳቸውን ለመንከባከብ የሚያደርጉትን ድርጊቶች ለመዳሰስ የተዘጋጀ ቅፅ፡፡

<u>መሣሰብያ</u>፡- የሚከተሉትን ጥያቄዎች ባለፉት ሰባት ቀናት ውስጥ ስለ ስኳር ህመምዎ ያደረጉትን ድርጊቶች በተመለከቱ ናቸው፡፡ባለፉት ሰባት ቀናት በጠና ታምመው ከነበሩ ከዚያም በፊት በነበረው ሰባት ቀናት ውስጥ የነበረውን ሁኔታ ይንገሩን፡፡

ተ.ቁ	አመጋገብን የተመለከቱ ጥያቄዎች	ቀናት							
301	ባለፉት 7 ቀናት ውስጥ ለስንት ቀናት ጤናማ የሆነ የአመጋገብ ስርዓት የተከተሉ;አትክልት እና ፍራፍሬ፤ፋይበር ይዘት ያለዉ ምግብ፤	0	1	2	3	4	5	6	7
302	ባለፈው ወር ዉስጥ በአማካኝ በሳምንት ለስንት ቀን የምግብ ፕሮግራምዎን በትክክል ተከታተሉ?	0	1	2	3	4	5	6	7
303	ባለፉት 7 ቀናት ውስጥ ለስንት ቀናት 5 ጊዜ ወይም ከዛ በላይ የአትክልት እና ፍራፍሬ ተመገቡ?	0	1	2	3	4	5	6	7
304	በላፉት 7 ቀናት ውስጥ ለስንት ቀናት ከፍተኛ የፋት ይዘት ያላቸውን ምግብ ተመገቡ ለምሳሌ ፡-ቀይ ስጋ፣ወተትና ፡ቅቤ ፡ወዘተ...	0	1	2	3	4	5	6	7

1. <u>የአካላዊ እንቅስቃሴ</u>

305	ባለፉ 7 ቀናት ውስጥ ለስንት ቀናት በትንሹ ለ30 ደቂቃ የሚሆን የአካል ብቃት እንቅስቃሴ አደረጉ (የእግር ጉዞ ወይም የጉልበት ስራ ይምረጡ)	0	1	2	3	4	5	6	7

306	ባለፉት 7 ቀናት ውስጥ ለስንት ቀናት የተለያዩ ስፖርታዊ እንቅስቃሴ ውስጥ ተሳትፉ (ለምሳሌ፡- ዋና ፣የእግር ጉዞ፣ ብስክሌት መንዳት ወይም ከመደበኛ ስራዎት ውጪ የሚያደርጉት እንሰቅስቃሴ	0	1	2	3	4	5	6	7
የስኳር መጠንዎን መለካት የተመለከቱ ጥያቄዎች									
307	ባለፉት 7 ቀናት ውስጥ ለስንት ቀን የስኳር መጠንዎን ለኩ	0	1	2	3	4	5	6	7
308	ባለፉት 7 ቀናት ውስጥ በሀኪሙ በታዘዘ መሰረት በህክምናዎት የስኳር መጠን ስንት ጊዜ እንዲለካ	0	1	2	3	4	5	6	7
ሲጋራ ማጨስን በተመለከተ									
309	ባለፉት 7 ቀናት ውስጥ ሲጋራ አጭሰዋል	1. አዎ 2. የለም							
310	መልሱ አዎ ከሆነ በአማካኝ በቀን ስንት ሲጋራ ያጨሳሉ	----------ሲጋራ							
የመድሀኒት አወሳሰድ በተመለከተ									
311	ባለፉት 7 ቀናት ስንት ቀናት በሀኪም የታዘዘሎትን መድሀኒት በትክክል ወስዱ	0	1	2	3	4	5	6	7
312	በለፉት 7 ቀናት ውስጥ ስንት ቀናት በትክክል ኢንሱሊንን ተወጉ	0	1	2	3	4	5	6	7
313	ባለፉት 7 ቀናት ውስጥ ለስንት ቀናት የስኳር ክኒንን በትክክል ወሰዱ	0	1	2	3	4	5	6	7

ክፍል ሶስት፡ የደም ዉስጥ የስኳር መጠን መጨመር እና መቀነስ የተመለከቱ ጥቄዎች፡፡

ከሚከተሉት ከተዘረዱት አማሮጮች ዉስጥ ከፍተኛ የሆኔ የደም ዉስጥ ጉሉኮስ መጠን ምልክቶች የሆኑት ንገረኝ/ሪኝ፡፡ ከአንድ መልስ በላ መመለስ ይቻላል፡፡

1. **የአፍ መድረቅ**
2. **ቶሎ ቶሎ ሽንት መሽናት**
3. **እንቅልፍ እንቅልፍ ማለት**
4. **ከፍተኛ የሆኔ የሆኔ የዉሃ ጥማት**
5. **ረሃብ**
6. **ከፍተኛ የሆኔ የድካም ስሜት**
7. **የአይን እይታ ብዥ ማለት**
8. **የሰዉነት ቆዳ መድረቅ**

ከሚከተሉት ከተዘረዱት አማሮጮች ዉስጥ የደም ዉስጥ ጉሉኮስ መጠን ሲቀንስ የሚታዩ ምልክቶች የሆኑትን ንገረኝ/ሪኝ፡፡ከአንድ መልስ በላ መመለስ ይቻላል፡፡

1. **የልብ ምት መጨመር**
2. **ላብ ላብ ማለት**
3. **መንቀጥቀጥ**
4. **ማዞር**
5. **የመረበሽ ስሜት**
6. **የድካም ስሜት**
7. **ራስ ምታት**
8. **ቁጣ ቁጣ የማለት ስሜት**
9. **የረሃብ ስሜት**

ክፍል_አራት፡ በስኳር ህመም ተያያዥ የጭንቀት መጠን መለኪያ ቅፅ

<u>መመሪያ፡-</u> **ከስኳር በሽታ ጋር መኖር አንድ አንድ ጊዜ ከባድ ነው።የተለያዩ ተጓዳኝ ችግሮች ሊያስከትል ይችላል።ችግሮቹ ትንሽ እስከ ትልቅ የሂወት መሰናክል ሊያደርሱ ይችላሉ።ከዚህ በታች 17 የተለያዩ ችግሮች ማለትም የስኳር ህመማንን ሊያጋጥሙ የሚችሉ ተዘርዝሯል።እርስዎ በለፉ ወራት ውስጥ የተዘረዘሩት ችግሮች ምን ያህል እንደረበሽዎት በደረጃ ያሰቀምጡት።**

ተ.ቁ	ስሜት	ችግሩ አላጋጠመኝም		በመጠኑ አጋጥሞኛል		በከፍተኛ ሁኔታ አጋጥሞኛል		ለቢሮ ብቻ
1.	የስኳር ህመምዬ አብዛኛው የአእምሮዬ እና የአካላዊ ጉልበቴን እየጨረሰብኝ እንደሆነ ይሰማኛል	1	2	3	4	5	6	A
2.	ሀኪሜ ስለ ስኳር ህመም እና ስለ ህክምናው በቂ የሆነ ዕውቀት እንደለለው ይሰማኛል	1	2	3	4	5	6	B
3.	ከስኳር በሽታ ጋር ስለመኖር ሳስብ፣በጣም እበሳጫለሁ ፣አዝናለሁ፣እፈራለሁ	1	2	3	4	5	6	A
4.	ሀኪሜ ስኳሬን ለማከም በቂ እና ግልፅ የሆነ ማብራሪያ እነደማይሰጠኝ ይሰማኛል።	1	2	3	4	5	6	B
5.	የደም ዉስጥ የስኳር መጠኔን በበቂ	1	2	3	4	5	6	C

	ሁኔታ እየለካሁ እንዳልሆኔ ይሰማኛል							
6.	የስኳር ህክምናዬን በትክክል እየተከታተልኩኝ እንዳልሆኔ ይሰማኛል	1	2	3	4	5	6	C
7.	ቤተሰቦቼ እና ጓደኞቼ ለስኳር ህክምናዬ ለማደርገው እንክብካቤ በቂ ድጋፍ አያደርጉልኝም ለምሳሌ ከፕሮግራሜ ውጪ የሆኔ ዕቅድ ያወጣሉ፣ትክክለኛ ያልሆኔ አመጋገብ እንዲመገብ ይገፋፉኛል።	1	2	3	4	5	6	D
8.	የስኳር ህመም ህይወቴን እንደተቆጣጠረ ይሰማኛል	1	2	3	4	5	6	A
9.	ሀኪሜ ችግሮቼን በጥሞና የሚከታተል መስሎ አይሰማኝም	1	2	3	4	5	6	B
10.	ቀን በቀን በማደረገው የስኳር ህመም ህክምናዬ የራስ መተማመን አይሰማኝም	1	2	3	4	5	6	C
11.	ምንም አይነት ህክምና ባደርግ በመጨረሻ በስኳር ህመም የሚመጡ የረዥም ጊዜ ችግሮች እንደሚደርስብኝ ይሰማኛል	1	2	3	4	5	6	A
12.	ትክክለኛ የሆነ የአመጋገብ ስርዓት እየተከተለኩኝ እንዳልሆነ ይሰማኛል	1	2	3	4	5	6	C
13.	በተሰቦቼ እና ጓዶኞቼ ከስኳር ህመም ጋር መኖር ምን ያህል ከባድ እንደሆነ	1	2	3	4	5	6	D

	እንደማይረዱኝ ይሰማኛል።							
14.	ከስካር በሽታ ጋር በመኖሬ የተጨናነቅኩኝ ሆኖ ይሰማኛል	1	2	3	4	5	6	A
15.	የስካር ህመምዬን በመደበኛ ሁኔታ የሚከታተለኝ ሀኪም እንደሌለኝ ይሰማኛል	1	2	3	4	5	6	B
16.	የስካር ህመምዬን ለማስታመም በማደርገው ሂደት ዉስጥ የተነቃቃው ሆኖ አይሰማኝም።	1	2	3	4	5	6	C
17.	ቤተሰቦቼ እና ጓደኞቼ የምፈልገውን የሞራልና የሀሳብድጋፍ እንደማ ያደርጉልኝ ይሰማኛል።	1	2	3	4	5	6	D

ክፍል አምስት፡ የአልኮል መጠጥ አጠቃቀምን የተመለከቱ ጥያቄዎች

	የ አልኮል አይነቶች እንደ (ጠጅ፡ ቢራ/ድራፍት፡	1. አዎ	መልሱ የለም ከሆነ ወደ ጥያቄ

	ወይን፡ አረቂ) የመሳሰሉትን በህይወት ዘመንህ/ሽ ጠጥተህ ታዉቃለህ/ሽ ?		ቁጥር ይለፉ
	ባለፉት 12 ወራት ዉስጥ የ አልኮል ጠጥተህ ታዉቃለህ/ሽ	1. አዎ 2. የለም	
	ባለፉት 12 ወራት ዉስጥ ምን ለምንያህል ጊዜ ብያንስ አንድ የ አልኮል መጠጥ ጠጣህ/ሽ	1. በየቀኑ 2.በሣምንት ከ 5-6 ጊዜ 3. .በሣምንት ከ 1-4 ጊዜ 4.በወር ከ 1-3 ጊዜ 5. .በወር ከ 1ጊዜ በታች	
	አልኮል በምትጠጣበት ጊዜ በ አማካኝ በቀን ምን ያህል አልኮል ትጠጣለህ/ሽ	ብዛት _____ አላዉቅም 88	
	ባለፉት 30 ቀናት ዉስጥ አልኮል ጠጥተህ ታዉቃለህ	1. አዎ 2. የለም	መልሱ የለም ከሆኔ ወደ ጥያቄ ቁጥር ይለፉ
	ባለፉት 7 ቀናት ዉስጥ ምን ያክል መደበኛ አልኮል መጠጫ ጠጣህ/ሽ	ሰኞ _____ ማክሰኖ _____ ረቡዕ _____ ሐሙስ _____ ዓርብ _____ ቅዳሜ _____ ዕሁድ_____	

<u>ክፍል ስድስት፡</u> **የታካሚዎችን የህክምና መዝገብ ለመዳሰስ የተዘጋጀ ቅፅ**

ተ.ቁ		
201	የመጨረሻ ሶስት ተከታታይ የደም የስኳር መጠን 1. 2. 3.	ውጤት _____mg/dl _____mg/dl _____mg/dl
202	የመጨረሻ የሊፒድ መጠን 1. ኤች.ዲ.ኤል 2. ኤል.ዲ.ኤል 3. ኮሊስትሮል 4. ትራይግላይ ስራይድ	 _____mg/dl _____mg/dl _____mg/dl _____mg/dl
203	የኤች.ቢ.ኤ.ሲ(HbA1c) ውጤት አለው	1. አዎ 2. አይደለም
204	ክብደት	_____ ኪ.ግ
205	ቁመት	_____ በሜትር
206	ቦዲማስ ኢንዴክስ	_____ ኪ..ግ/ሜ^2
207	በሽተኛው ምንዓይነት ህክምና ውህደት እየተከተለ ነው ?	1 ---------- 2. ---------- 3. ----------