ASSESSMENT OF CLINICAL CHARACTERISTICS, COMPLICATIONS AND GAPS ENCOUTERED IN MANAGEMENT OF DIABETIC PATIENTS ON FOLLOW UP AT OUTPATIENT DIABETIC CLINIC OF JUMC, SOUTHWEST ETHIOPIA

BY DR. ADDISALEM FEKADU (MD)

THESIS SUBMITTED TO JIMMA UNIVERSITY, INSTITUTE OF HEALTH, MEDICAL FACULTY, DEPARTMENT OF INTERNAL MEDICINE; IN THE PARTIAL FULFILMENT OF THE REQUIREMENTS OF SPECIALITY CERTIFICATE IN INTERNAL MEDICINE

JANUARY, 2021

JIMMA, ETHIOPIA

JIMMA UNIVERSITY
INSTUTITE OF HEALTH
MEDICAL FACULITY

ASSESSMENT OF CLINICAL CHARACTERISTICS, COMPLICATIONS AND GAPS ENCOUTERED IN MANAGEMENT OF DIABETIC PATIENTS ON FOLLOW UP AT OUTPATIENT DIABETIC CLINIC OF JUMC, SOUTHWEST ETHIOPIA

BY
ADDISALEM FEKADU, MD
Cell phone: +251954867056
E-MAIL: afekadu06@gmail.com

ADVISORS: -
DR. TADESSE DUKESSA (M.D, INTERNIST, CARDIOLOGIST)
DR. HIWOT AMARE (M.D, INTERNIST)
Mr. TADESSE G/MEDHIN (BSc, MPHE)

JANUARY, 2021
JIMMA, ETHIOPIA

ABSTRACT

***BACKGROUND**- Diabetes is increasing at alarming rate in low-and middle-income countries due partly to rapid urbanization, lifestyle changes, and limited resources and diabetes care in such resource limited countries is far below standards. The management gaps of diabetic patients in JUMC are not well known.*

***OBJECTIVES**- The aim of this study was to assess the clinical characteristics, complications and gaps encountered in management among diabetic patients on follow up at outpatient diabetic clinic of Jimma University Medical Center, South-West Ethiopia.*

***METHODS**-Hospital-based cross-sectional study was conducted on patients consecutively selected from those who were attending the diabetic clinic at Jimma University Medical Center from September 1 to November 30, 2020. Patients age of 18 years and above were included. Socio-demographic characteristics and diabetic related information was collected from 272 selected patients consecutively by using structured questionnaires. Chart of the patients was reviewed for type of diabetes, diabetic complications, diabetic medication and laboratory results. Data were entered into Epidata software 3.1 version and exported to SPSS version 25.0 software for analysis.*

***RESULTS**-The mean +/-SD of the study participants were 50+/-15 years with female to male ratio of 1:1.5. Type 2 diabetes found in 220 (80.9%) of patients and 200(73.5%) of the patients had fasting blood sugar of above 130mg/dl (poor glycemic control). The common symptoms at time of disease onset were polyuria and polydipsia 216(79.4%). Hypertension was the most common comorbid disease 128 (47%) and 121(94.5%) of them were type 2 diabetes. One hundred seventy-five (64.3%) of the patients had at least one diabetic complication and 114 (72.6%) were type 2 diabetes. One hundred fifteen (65.7%) patients had diabetes for more than five years. Diabetes ketoacidosis was the most common acute complication 54 (19.9%) of which 41(76%) of the patients were type 1 diabetes. Peripheral neuropathy 71(26.1%), retinopathy 32 (11.7%), nephropathy 23 (8.4%) and coronary heart disease/stroke 19 (7%) were the common chronic microvascular and macrovascular complication. Only 65 (23.9%) were doing vigorous/moderate physical exercise and 108 (39.7%) of the patients were obese/overweight. Thirty-nine (14.3%) and 82 (30.1%) had HbA1C and lipid profile results respectively. Regarding diabetic education 213 (78.3%), 209 (76.8%) and 109 (40.1%) of patients had no explanation about diabetic treatment during illness, home blood glucose measurement and on blood glucose measurement techniques respectively and most of the managing physician were junior residents and General Practitioner at diabetic clinic.*

***CONCLUSION**- The overall diabetes care at the hospital was far below recommended guidelines. To prevent or delay diabetes related complication, managing patients based on standard diabetes guideline at least with the resource what we have is crucial.*

***KEYWORDS**: Clinical characteristics, complications, diabetes, Ethiopia, management gaps,*

ACKNOWLEDGEMENT

Table of content

LIST OF FIGURES

LIST OF TABLES

ACCRONNOMY AND ABBREVATION

ACEI-Angiotensin converting enzyme inhibitor

ADA- American Diabetic Association

BMI- Body Mass Index

CHD - Coronary Heart Disease

DFU- Diabetic Foot Ulcer

DKA- Diabetic Ketoacidosis

DM- Diabetes Mellitus

eGFR- Estimated Glomerular Filtration Rate

FBS- Fasting Blood Sugar

Hb1C-Hemoglobin A1C

HDL-C- High density lipoprotein cholesterol

HHS- Hyperosmolar Hyperglycemia State

HIV- Human Immunodeficiency Various

HCV-Hepatitis C Virus

IDF-International Diabetes Federation

JUMC- Jimma University Medical Center

LDL-C- Low density lipoprotein cholesterol

PAD- Peripheral Arterial Disease

RBS- Random Blood Sugar

TG- Triglyceride

WC- Waist circumference

WHO- World Health Organization

CHAPTER ONE

1.1 INTRODUCTION

Diabetes is one of the common non-communicable disease increasing at alarming rate globally causing significant mortality and morbidity through its cardiovascular complication (1,2) Although type 2 diabetes is accounting for 90% of global diabetes cases, both type 2 diabetes and type 1 diabetes causes serious microvascular and macrovascular complications such as cardiovascular disease, neuropathy, nephropathy and retinopathy (3). The burden of diabetes is particularly higher in low and middle-income countries because of late diagnosis, poor diabetic care and increased risk of infectious disease like Human Immunodeficiency virus infection, tuberculosis and pneumonia (4). Delay in screening and management of diabetic complication in resource limited setting is another factors leading to significant mortality and morbidity particularly among productive age group (5). Moreover, diabetes is the leading causes of lower extremity amputation, end-stage renal disease and adult blindness in United states (6).

In addition to chronic complication, patients with diabetes are at risk for acute complication such as diabetic ketoacidosis, hyperosmolar hyperglycemic state and hypoglycemia (7) which are life-threatening unless managed earlier (2). In Ethiopia diabetes prevalence ranges from 2% to 6.5% and retinopathy, neuropathy, kidney disease and hypertension are frequent complication identified (8). Like in other part of the world type 1 diabetes is less predominate than type two diabetes in Ethiopia too and most of patients presented with typical symptoms (9).

Mortality and morbidity related to diabetes can be reduced by timely consistent surveillance including detection, prevention and management of DM related complication. Good glycemic control, detection and management of diabetic related complication and risk factors modifications are the mainstay of diabetes management to delay or control diabetic related complications (10). Increasing physical activity, low carbohydrate diet, smoking cessation, weight reduction among obese/overweight individuals, treating lipid abnormality and quitting alcohol consumption are the integral part of diabetic care (11) .

1.2 STATEMENT OF THE PROBLEM

Nowadays, non-communicable diseases have become the common causes of mortality and morbidity globally (12). It is also increasing in alarming rate in developing countries because of economic growth along with aging population, obesity, unhealthy diet and physical inactivity (13). Diabetes mellitus is one of the important non-communicable disease and impose serious health, social and economic burden worldwide (1). With epidemics rising of metabolic syndrome, diabetes mellitus will be the likely leading cause of mortality and morbidity in the future (12).

The global burden of diabetes is increasing and in 2011 there were 366 million people with diabetes which is expected to increase to 552 million by 2030 (14). In 2017, 425 million of people had diabetes which is the latest estimated prevalence of diabetes and is expected to rises to 629 million by 2045(15). In 2013, World Health Organization projected (WHO) the number of diabetics in Ethiopia to be about 800,000 cases by the year 2000, and the number is expected to increase to 1.8 million by 2030 (16).

Diabetes mellitus is associated with significant macrovascular and microvascular complication globally:-nephropathy (29-61%), retinopathy (34%), neuropathy (31-73%), coronary heart disease (14-21%)' heart failure (19-26%), stroke (8-12%) and peripheral arterial disease (16-29%) are the frequent diabetic complication worldwide (1). In high income countries, the macrovascular complications are common whereas microvascular complications are prevalent in in low-and middle-income countries (4). The frequent diabetic complication identified among Iranian diabetic patients were retinopathy (6%), neuropathy (52%), nephropathy (10%), hypertension (58.5%) and hyperlipidemia (73.5%) (17).

In Ethiopia diabetes and diabetes related complication are major causes of mortality and morbidity and the frequent complication identified are retinopathy (2.7%–25%), neuropathy (4.8%–35.0%), depression (13.0%–61.0%), kidney diseases (18.2%–23.8%), hypertension (23.0%–54.82%), anemia (19.0%) (8). The self-care practice among diabetes patients particularly in rural dwellers is poor in Ethiopia (18).

The clinical characteristics of diabetes depends on types of diabetes, income of the countries and place where the patients live (4). Type 1 diabetes patients are younger, have lower BMI, less family history and have osmotic symptoms than type 2 diabetes patients(7). Most patients with diabetic ketoacidosis are type 1 diabetic patients presenting with polyuria and polydipsia and were newly diagnosed patients (19). Among individuals from high income countries, the most frequent type of complication is macrovascular complication whereas in those from low-and middle-income countries microvascular complication are predominant (4). Diabetic patients may have different comorbidities, education level and place of residency and harmful habits (20).

In general, the management of diabetes mellitus is suboptimal particularly in low-and middle-income countries. The reasons identified were lack of access to HbA1c monitoring, inequitable access to diabetes medication, delay, and fear to initiate and optimize insulin therapy among health care workers, low levels of patient education, and, generally, knowledge gaps in diabetes management among the health care workers and resistance of the patients to start insulin injection therapy (4,20,21). Poor guideline adherence is another important factor that result in suboptimal diabetic care (3). Lack of compliance by the patients to lifestyle recommendation, ineffective diabetic medications and types of diabetic medication used are also result in poor glycemic control (22,23) .

CHAPTER TWO

2.1 LITRATURE REVIEW

With rising epidemics of metabolic syndrome, diabetes mellitus will be a likely leading cause of morbidity and mortality in the future (12). Good glycemic control, diabetic education, lifestyle modification, good adherence, cessation of harmful habits, identifying and treating comorbidity, screening for diabetes and its complication are the main goals to prevent or control long-term complication of diabetes (10,18).

A cross-sectional study conducted in Uganda at three outpatient diabetic clinics of Mulago National Referral and Teaching Hospital, a public Mengo Hospital and Our Lady of Consolata Hospital Kisubi from September 2014 to July 2015. A total of 424 diabetic patients age ≥ 18 years were included. The mean age of study participants was 52.2+/- 14.4 and females were predominated. Most of the study participants were educated to the level of primary or lower level and urban dwellers. Hypertension was common comorbidity and family history of diabetes was common. Type 2 diabetes is the most common type in this study population and majority of the patients are on combination oral hypoglycemic agents. Majority of the patients are non-smoker and the duration of diabetes is short with median age of 4.5 years. Majority of the patients had suboptimal glycemic control as defined as HbA1C ≥7%. The identified reasons for suboptimal glycemic control were lack of access to HbA1c monitoring, inequitable access to diabetes medication, delay, and fear to initiate and optimize, insulin therapy among health care workers, low levels of patient education, and, generally, knowledge gaps in diabetes management among the health care workers and resistance of the patients to start insulin injection therapy (20).

An observational study conducted in post Graduate Department of Medicine, S.C.B Medical College, Cuttack between January 2017 and June 2018. A total of 80 diabetic patients were included. Male patients were account for 66.2% and type 1 diabetes is the most common type of diabetes. Mean age at diagnosis for type one was 19.75 +/- 4 years and for type 2 diabetes 21.37+/- 3 years. Type 1 diabetes osmotic symptoms (73.5%), weight loss (58.49%) and ketosis (5.6%) were more common. Family history of diabetes and higher BMI is more common with type 2 diabetes. There were no difference in terms of microvascular or macrovascular complications (7) .

A nationwide cross-sectional survey conducted in Venezuela from January to June 2007. A total of 4075 type 1 and type 2 diabetes were included. Type 2 diabetes were account for 91.4% and majority of the patients were 40 years and older whereas about half of type 1diabetic patients were less than 40 years of age. Most of the study population were female, their education level was primary or less, about 46% and 16% of type 1 diabetes have normal BMI and obese respectively and 35% of type 2 diabetes were obese. Approximately 87% of type 1 diabetes and 75% of type 2 diabetes had poor glycemic control. Patients with diabetic duration more than five years and those who were on insulin therapy either type 1 or type 2 diabetes had poor glycemic control than those on oral medication (22).

A cross sectional study conducted at Institute of Endocrinology and Metabolism in Iran University of Medical Sciences (IUMS) from October to March 2006. A total of 200 newly diagnosed diabetes patients were included and screened for diabetes complication. The frequent complications identified were hyperlipidemia (73.5%), hypertension (58.5), neuropathy (52%), nephropathy (10%) and retinopathy (6%) (17).

A cross sectional study conducted at Benishangul Gumuz public hospitals (Assosa and Pawi Hospitals) from March 15-April 15/2018 G.C. Western Ethiopia. a total of 383 diabetic patients ≥18 years were included. About 54.6% of the participants were male and type 2 diabetes is the most common type of diabetes. Mean age of participants were 44.5 years and their mean diabetic duration were 4.55 years. About 80% of the participants had no self-glucometer, more than half had family history, approximately 83% had no chronic comorbidities and seventeen percent never had diabetic education. The education level for majority of the participant were primary level and lower level and about two third of population were urban dwellers. About 46% of participant had poor diabetic self-care practice (24).

A cross sectional institution-based study conducted at Ayder referral hospital, Mekelle Ethiopia from December 2013-January 2014. A total of 228 participants were included. Male participants were account for 62%, about 70% of participants were older than 40 years, 32% were at higher educational level, hypertension and renal disease were common comorbidities identified, type 2 diabetes was most common type of diabetes, more than half of the patients have poor glycemic

control, about 80% were urban dweller and prevalence of smoker and alcoholic patients were low. About 12% of the patients had diabetic foot ulcer (25).

A cross-sectional institution-based study conducted at Debre Markos Referral Hospital, Debre Markos, Northwest Ethiopia from April 1-30/ 2019. A total of 302 diabetic patients were included. The mean age of respondents was 42.2 years and 75% of them are urban dwellers. About 37.4% of the participants had family history, 35% governmental or non-governmental employers and more than 45% had higher education level. The prevalence of cigarette smoker was 0.3% and alcohol consumption is 17.1%. approximately 26% of patients are overweight or obese and about half of participants had good glycemic control by fasting blood sugar. Type 2 diabetes the most common type of diabetes, about 61% of participants visit hospital every one month and 37% of them had diabetic duration more than ten years (26).

A systematic review of 39 studies published from 1984-2017 in Ethiopia. Most of the participants were type 2 diabetes. Only 21% of patients had regular blood sugar monitoring and more than half of patients didn't have urine analysis, blood urea nitrogen, creatinine, and lipid profiles, and none received hemoglobin A1c test in 1–2 years of follow-up. About three-fourth of patients admitted at least for poor glycemic control and only quarter of the patients had diabetic education. Only 5% of the patients had self-monitoring blood glucose at home and about 90% of patients had regular follow up at respective hospital or health center. The most frequently reported diabetes-associated complication identified were retinopathy (2.7%–25%), neuropathy (4.8%–35.0%), depression (13.0%–61.0%), kidney diseases (18.2%–23.8%), hypertension (23.0%–54.82%), anemia (19.0%)(8) .

A cross-sectional study conducted at Dessie Referral hospital, northeast Ethiopia from April to May 31 2013. A total of 216 diabetic patients were included. The most common type of diabetes was type 2 diabetes and male predominate. The median age of diagnosis was 45 years and mean duration of diabetes was 5 years. Approximately 60% of patients had diabetic complication and more prevalent among type two diabetes. The most frequent complication were hypertension, visual disturbance, neuropathy, foot ulceration, nephropathy and impotence in decreasing order (27).

A retrospective study conducted at Yekatit 12 Hospital from February, 2013 to July,2013, Addis Ababa Ethiopia. A total of 588 diabetic patients age 18 years and above were included. Female patients were account for 60% of study participant and type 2 diabetes is the most common type of diabetes. Of total participant 413 patients had diagnosed hypertension and 167 patients had dyslipidemia. About 99% of patients were on anti-diabetic medication. Approximately 99% of diabetic patients had no documentation of HbA1C and none of them had a documentation that the test was recommended. Only 167 of patients were at a goal of FBS (70-130mg/dl). For the documented lipid profile, 53% and 54.0% were at a goal for triglycerides (<150 mg/dl) and total cholesterol (<200 mg/dl), respectively. Among patients with diagnosed hypertension only half of the patients were on medication and less than five percent of them achieve their blood pressure goal (28).

A prospective hospital based observational study conducted at Mettu Karl Referral Hospital, Southwest Ethiopia, from 15 April to 09 August 2019. A total of 330 patients age 18 years and above were included. About 96% of participants were never smoked cigarette, about 8% were alcoholic, and 82% of participant were not chewing khat. Approximately 40% of the patients follow sufficiently healthy diet instruction and 40.3% of the participants performed at least 30 minutes physical activity during the seven days immediately before study period. About 60% of patients were not adherent to their medication, 54% had good diabetic knowledge and 22% monitored their blood glucose at home. Family history of diabetes present in 29% of patients and the duration of diabetes was more than ten years in 31% of participant. DKA present in 30% of patients and 43% of participants had additional chronic disease of which hypertension was the most common. The eGFR > 90ml/min/1.73m2 in 60% of participants. Statin and aspirin were initiated for 12% and 10% of participants respectively. About 71% of participant had poor glycemic control. Retinopathy, neuropathy and nephropathy were the frequent chronic diabetic complication identified (29).

The aim of diabetes management is to achieve near-normal glycemic control, prevention, detection and treatment of diabetic complication and identifying and treating comorbidities and risk factors which involves integrate team approach (10). Prevention of diabetes complication requires integrated managements of cardiometabolic risk factors in addition to blood glucose management. Most diabetic patients had at least one diabetic complication (microvascular and

macrovascular) which is more prevalent in resource limited setting because of the patients are not receiving recommended diabetic care, lack of education, poor screening practice for diabetic complications, lack resource, underutilization of drugs and poor adherence to medications (5,20). In general, appropriate guideline based diabetic care is the main stay of treatment to prevent or delay diabetic related complication (30,31).

2.2 SIGNIFICANCE OF STUDY

To combat the burden of non-communicable disease and related complication it is important to implement prevention strategies in high-risk individuals. Early diagnosis and initiation of treatment is important to prevent or control long-term complications. Health education including adherence counselling to create awareness toward diabetes and its medication is mandatory. Lifestyle modification like increasing physical activity, weight loss, smoking cessation and healthy diets are helpful in reducing avoidable mortality and morbidity related to diabetes and its complications. Early screening for diabetic complication and strict glycemic control is helpful in preventing diabetic complications. It is also important to identify and treat comorbid conditions like hypertension, dyslipidemia and metabolic syndrome among diabetes patients. Diabetic care is more complex and there is multiple intervention beyond blood glucose control which improve clinical outcome.

Integrated interventional management on diabetes will increase health and wellbeing of the patients. Knowing the patient's clinical characteristics and management gaps helps to improve the health care providers management practice and improve patient's outcome. This study also will help as integral in evidence-based policy formulation and implementation in national and institutional diabetes management programs. In general, to improve diabetes care this study will provides important information for various shareholders including hospitals, health professionals, health programmers and different non-governmental organization to give emphasis on improving diabetic knowledge through diabetes education and supporting individuals with diabetes in all aspect.

CHAPTER THREE
OBJECTIVES

3.1.1 General objectives:

To assess clinical characteristics, complication and gaps encountered in management among diabetic patients on follow up at outpatient diabetic clinic of Jimma University medical center (JUMC) from September 1 to 30, 2020 G.C.

3.1.2 Specific objectives:

- To assess clinical characteristics of diabetic patients on follow up at outpatient diabetic clinic of JUMC
- To assess diabetic complication among diabetic patients on follow up at outpatient diabetic clinic of JUMC
- To assess gaps encountered in management among diabetic patients on follow at outpatient diabetic clinic of JUMC

CHAPTER FOUR
METHOD AND MATERIALS

4.1. Study Period and Area

The study was conducted at diabetic referral clinic of JUMC, Jimma University, Jimma from September 1- November 30/2020 G.C. Jimma zone comprises Jimma town and its nearby woredas. It is located in South West of Ethiopia, Oromia regional state. Based on 2007 census this zone has a total population 2,495,795(32) . The town is located 346 KM from the capital, Addis Ababa. About 1500 diabetic patients had follow up at diabetic clinic of Jimma University medical center and on average 200 to 250 diabetic patients come for follow up each month.

Jimma University medical center is one of teaching and referral hospital for southwest population in the country. The hospital gives health service at inpatient and outpatient level as a referral Hospital for 20 million populations in the South West of the country.

4.2. Study Design

Facility based descriptive cross-sectional study design was conducted to assess clinical characteristics, complication and gaps encountered in management among diabetic patients on follow up at outpatient diabetic clinic of JUMC

4.3. Source and Study Population

4.3.1. Source Population
All diabetic patients on follow up at outpatient diabetic clinic of Jimma University medical center

4.3.2. Study Population
All consecutively selected diabetic patients on follow up at diabetic clinic of JUMC during study period and fulfill inclusion criteria

4.4. Inclusion and Exclusion Criteria

Inclusion criteria

All diabetic patients with age ≥ 18 years old were included.

Exclusion criteria

Diabetic patients who included in the study and come more than once during study period

Diabetic patients who are unwilling to give consent and critically ill subjects

All diabetic patients age <18 years

4.5. Sample Size Determination

Sample size was calculated using single population formula

$n=(z\alpha/2)^2 P(1-P)/d^2$

Where n = sample size

$z\alpha/2$= Z-score at 95% confidence interval = 1.96

P= is 6.5% highest hospital based prevalence of diabetes in Ethiopia , Addis Ababa Black Lion Hospital(8).

d= marginalized error which is 0.05

$n= (1.96)2*0.065*0.935/ (0.05)^2$

n=93 -adding 5% non-response rate our minimum sample size was 98 patients. since the prevalence was low and sample size was small, we adjusted marginal error to 0.03 to get adequate sample size. So, our sample size was:

$$n=(z)2 *p(1-p)/d^2$$

n= ((1.96) *1.96*0.065*0.935)/0.03*0.03

n=259- adding non response rate final sample size was **272** patients

4.6. Sampling Technique

Consecutive sampling technique was used from patients who visited diabetic clinic from September 1 to November 30 2020 G.C.

4.7. Study Variables

1**. Sociodemographic status** (age, sex, marital status, residency, income, occupation, education).

2. **Behavioral factors** (smoking cigarette, alcohol consumption, herbicide or pesticide exposure, physical activity, khat chewing, dietary condition).

3. **Clinical factors** (family history of diabetes, duration of diabetes, medications, symptoms at disease onset, adherence, physical examination findings, gestational diabetes, glucometer, follow up interval)

4. **Diabetic complication and comorbidities** (retinopathy, nephropathy, neuropathy, diabetic foot ulcer (DFU), stroke, coronary heart disease (CHD), peripheral artery disease, obesity HIV, tuberculosis)

5. **Laboratory indices** (lipid profile, FBS, HbA1C, creatinine, urine analysis, eGFR).

6. **Anthropometry** (BMI, waist circumference, height, weight)

4.8. Data Collection Process

Data collection was carried out using structured questionnaires prepared for this study. The Questionnaire includes the question that assess the sociodemographic characteristics, diabetes and its related complication, clinical factors, behavioral factors, dietary condition, comorbidities, anthropometry, physical and laboratory findings which was developed following review of relevant literatures (28,29,33,34). The participants were interviewed for their sociodemographic features, behavioral factors, symptoms of disease at onset and diabetes related characters. The patients' chart was reviewed for types of diabetes, types of treatment for diabetes, laboratory data, diabetic complication, ophthalmologic eye evaluation and for comorbidities. The questionnaire was prepared in English language and translated to local language for participants. Anthropometric measurements were taken using standardized techniques and calibrated equipment. Patients were weighed to the nearest 0.1 kg in light indoor clothing and bare feet or with stockings. Height was measured using a stadiometer; waist circumference was measured by placing a plastic tape to the nearest 0.5 cm horizontally, midway between the 12th rib and the iliac crest on the midaxillary line.

Two trained personnel one medical intern and one General Practitioner who were working at JUMC was involved in data collection using structured questionnaires. One day training was given for data collectors and data collectors were supervised by principal investigator Data was checked daily for completeness and consistency throughout the data collection period. The data collectors were applied hand sanitizer, surgical glove and face masks and the study subjects were used face masks. Social distance was kept as much as possible.

4.9. Data Processing and Analysis Plan

The collected data was edited, coded and entered into a computer using Epidata 3.1 and analyzed using Statistical Package for Social Science (SPSS) version 25.0. The data was summarized using tables, graph and also narrated. Descriptive statistics was used to put results of the study in the form of findings and percentages.

4.10. Definition of the Terms and Operational Definitions

Body mass index (BMI)- is defined as the ratio between body weight and height in meter square and the patients classified based on their BMI as follows;

Underweight-BMI<18.5kg/m^2

Normal -BMI 18.5-24.9kg/m^2

Overweight -BMI 25-30kg/m^2

Obese-BMI $>=30$kg/m^2

Substances- In this study were alcohol like 'areke', 'tej', beer and cigarette/tobacco. Current substance user, a person who consume at least one of substances regularly with a frequency of at least twice per week in the last 3 months of data collection period (35).

Vegetables -A part of plants that consumed by human and other animal including: cabbage, carrot, tomatoes, garlic, potatoes, onion, root beets etc.

Fruits -Are part of plants that consumed by human and other animals as food including (grapes, banana, orange, lemon, apples, watermelon, strawberry, mangoes, avocadoes, etc.) and are important healthy diet.

Cereals -Are seeds/grains serves as food including maize, rice, wheat, barley, teff and sorghum

Legumes- Are seed plants that include peas, bean, chickpea and lentils

Dietary diversity- It is referring to as having food from different source (i.e. cereals, legumes, fruits, vegetables, milk and dairy products, meat, oils/fat, fish, etc.) and individual dietary diversity assessed by giving a score of "1" to a food group if the participant had eaten at least one food in that group, or a "0" if they did not eat any food in that group and classified as follow;(36)

    Low dietary diversity- score of 0-3

    Moderate dietary diversity-score of 4-6

    High dietary diversity-score of 7 and more

Physical activity: For substantial healthy benefit adults should do vigorous physical activities at least 75 minutes per week or moderate physical activities at least 150minutes per week over 3-4 days in week with no more than 2 days without exercise(10,37)

    Inactive- is not performing any moderate or vigorous intensity physical activity beyond basic movement from daily life activities.

    Active is doing the equivalent of 150 minutes to 300 minutes of moderate-intensity physical activity a week or 75 minutes to 150 minutes of vigorous physical activity a week.

    Patients who participated in at least 30 min of physical activity daily or participated in a specific exercise session were considered to have adequate physical activity; otherwise, the patient was classified as having inadequate physical activity (10,29) .

Good glycemic control: FBS 70-130mg/dl for three and more months or HbA1C <7% and poor glycemic control is when FBS≥130mg/dl of HbA1C≥7% (10,38).

Waist circumference- is measured by placing non-stretchable tape meter between lowest ribs and upper crest of hip bone, the patient stands up-right position. It is used to assess the central/ visceral obesity and the patient is classified as high risk if the measurement is ≥102cm for men and ≥88cm for women.(39)

Diabetic retinopathy-estimate Retinopathy is defined by documented diagnosis or a past procedure for the treatment of retinopathy(40).

Diabetic nephropathy- defined as GFR <60ml/min/1.73m^2 calculated from creatinine using the CKD-EPI creatinine equation and documented diagnosis (40).

Diabetic neuropathy- defined as tingling, burning, coldness or numbness in the feet and reduced or absent vibration test with tuning fork 128Hz (41).

Peripheral arterial disease- intermittent claudication or discomfort in the leg with exercise or at rest and absence of pulse in the peripheral arteries like femoral, tibial, posterior tibialis or dorsalis pedis artery. Based of Fontaine classification (42) there are four stages

Diabetes related heart disease: CHD and cardiomyopathy

Good adherence- if missed less than 20% of the doses of diabetic medication last month (43) .

Poor adherence -If missed 20% and above of the doses of diabetic medication last month

Type 1 diabetes- Age at onset of diabetes below 30 years or insulin treatment from diagnosis

Type 2 diabetes-Age at onset of diabetes ≥ 30 years and initial treatment with oral agents.

Diabetic foot ulcer -is nontraumatic lesion of the skin (partial or full thickness) on the foot of a person who has diabetes mellitus.

Good oral hygiene-Pink gum, clean teeth without debris and no bad odor

Poor oral hygiene -Bleeding gum, change in texture of tongue with bad odor

4.11.   Ethical Consideration

The ethical clearance was secured from the institutional review board of Jimma University Institute of Health. Then officials at and responsible bodies in JUMC were communicating through letter for permission to collect data.

4.12. Dissemination of the Results

Study result will be communicated to relevant bodies (i.e., Jimma University, Jimma zone health bureau, Oromia regional health bureau and Federal ministry of health) and will be published.

CHAPTER FIVE
RESULTS

5.1. Baseline Characteristics of the Patients

This study was conducted on 272 diabetic patients who came to follow-up referral diabetic clinic of JUMC for the period of 2 months data collection with response rate of 100%. Among study participants 162 (59.6%) were males and 221 (81.3%) were married. Regarding the occupation of the patients 71 (26.1%), 65 (23.9%) and 64 (23.5%) were farmers, governmental/non-governmental employee and housewife 64 (23.5%) respectively. Hundred forty-seven (54%) were living in urban area and 116 (42.6%) of the study participants had 5-7 individuals in their family who were living together. The mean ± SD of the patients was 50 ± 15 years. Seventy-two percent of the patients participated in this study had at least the primary level of education and 46 (16.9%) achieved college and above.

Table 1 Baseline Characteristics of diabetic patients on follow up at JUMC, 2020

Variables	Frequency n (%)
Age*	50 ± 15
Sex	
Male	162 (59.6)
Female	110 (40.4)
Residence	
Urban	147 (54.0)
Rural	125 (46.0)
Family Size	
1-4	95 (34.9)
5-7	116 (42.6)
8-10	48 (17.63)
>10	13 (4.8)

*Data is mean and standard deviation.

5.2. Life Style Characteristics of the Patients

Table 2 showed that, about 269 (98.9%) of the Diabetic patients participated in this study had responded that they took fruit and vegetable at once per day with 212 (78.8%) of them had consumed fruit and/or vegetable two and more days in typical week. Two hundred twenty-four (82.4%) of the patients consumed moderately diverse diet each week. The experience of using pesticides among study participants were 268 (98.5%) and 194 (71%) of the study participants used sunflower oil for their consumption. Regarding Khat chewing behavior 85 (31.2%) of the study participants consumed Khat at specific day of the week and twenty-three (8.5%) used substance within last three months.

Table 2 Life style Characteristics of diabetic patients on follow up at JUMC, 2020

Variables	Frequency n (%)
Current substance use within last 3 months	
Yes	23 (8.5)
No	249 (91.5)
Khat Consumption at specific day of the week	
Yes	85 (31.2)
No	187 (68.8)
Physical Activity	
Moderate and/or Vigorous	65 (23.9)
Neither moderate nor vigorous	207 (76.1)
Fruit and Vegetable intake	
Yes	269 (98.9)
No	3 (1.1)
Frequency of Fruit and Vegetable intake per day	
Once	57 (21.2)
Twice and more	212 (78.8)
Dietary diversity in typical week	
Low	40(14.7)
Moderate	224(82.4)
High	8(2.9)
Pesticide exposure	
Yes	268 (98.5)
No	4 (1.5)
Types of oil used	
Olive Oil	12 (4.4)
Sunflower Oil	194 (71.3)
Others	66 (24.3)

5.3.Clinical Characteristics of the Patients

Among study participants 164 (60.3%) of the patients had diabetes for more than five years. In this study 220 (80.9%) of the diabetic patients had type 2 diabetes mellitus and 74 (27.2%) had family history of diabetes mellitus. Seventy (25.7%) of the diabetic patients participated in this study had received metformin with glibenclimide, 74 (27.2%) received Insulin and similarly 74 (27.2%) had received Insulin with metformin. Fifty (18.4%) and 43 (15.8%) of the patients were on lipid-lowering agents and Aspirin respectively. One hundred twenty-eight (47.2%) of the patients had hypertension as comorbid disease. Regarding symptoms at time of disease onset 219

(79.4%) of the study participants presented with excessive thirsty, frequent and large amount of urine and the remaining 17 (6.3%) had no symptoms, 13 (3.7%) increased body weight and 10 (3.7%) had blurring of vision. In this study 267 (98.2%) of the patients had good adherence to their medication. Hundred thirty-seven (50.4%) of the patients visited the clinic every two months and 122 (44.9%) visited clinic monthly. Among study participants 108 (39.7%) of the patients were obese/overweight and 64 (58.2%) of females had waist circumference (WC) ≥88cm.

Table 3 Clinical characteristics of diabetic patients on follow up at JUMC, 2020

Variables	Frequency n (%)
Body mass index, kg/m^2	
Underweight	17 (6.3)
Normal	147 (54)
Overweight	85 (31.3)
Obese	23 (8.5)
Waist circumference, cm	
Females	
Waist circumference ≥88	64 (58.2)
Waist circumference <88	46 (41.8)
Males	
Waist circumference ≥102	20 (12.3)
Waist circumference <102	142 (87.7)
Comorbidities	
Hypertension	128 (47.2)
Tuberculosis	22 (8.1)
HIV	10 (3.7)
Coronary heart disease /stroke	19 (7.0)
Medications	
Insulin	74 (27.2)
Metformin	53 (19.5)
Insulin and Glibenclamide	1 (0.4)
Insulin and metformin	74 (27.2)
Metformin and Glibenclamide	70 (25.7)
Statin	50(18.4)
Aspirin	43(15.8)

When we see the duration of time period for diabetic mellitus since diagnosed, 164 (60.3%) had diabetes for more than five years and only 15 (5.5%) of the diabetic patients were less than one (Figure 1).
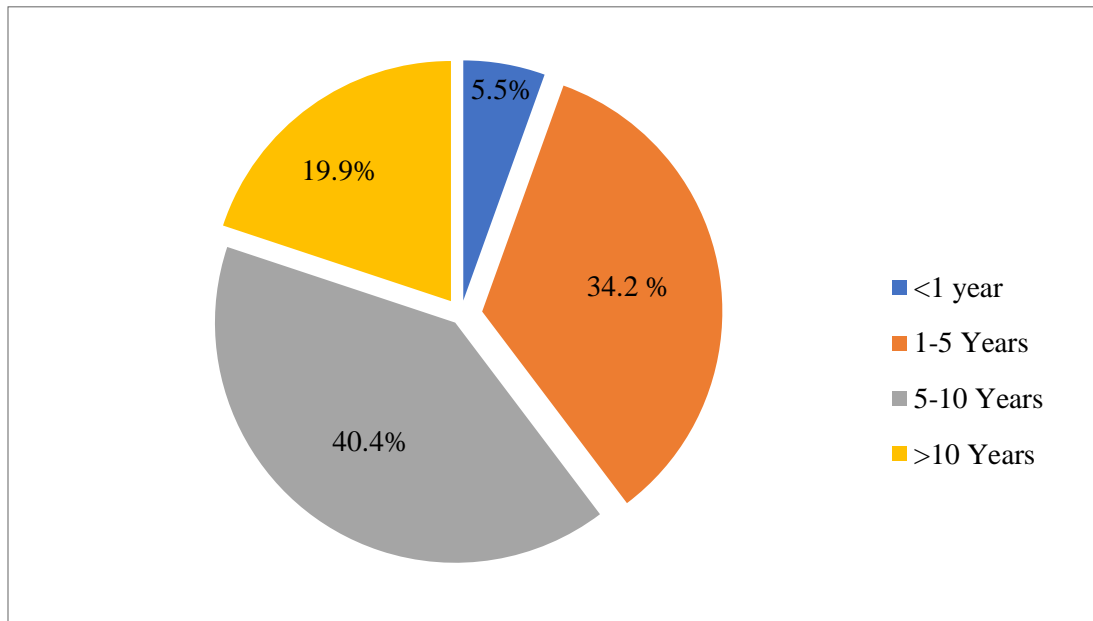
Figure 1 Durations of Diabetes Mellitus since diagnosis among of diabetics on follow up at JUMC, Jimma, Ethiopia, 2020

5.4. Distribution Oral Hygiene Problem and Biochemical Parameter of the Patients

All study participants had fasting blood glucose (FBS) level during the study period and with mean of 174 mg/dl and SD of ± 59 and about 200 (73.5%) had FBS ≥130mg/dl. Eighty-two (30.1%) of patients had at least one result values for lipid profile and 231 (84.9%) of the study participants had serum creatinine result with mean +/- SD of 0.88 +/-0.3. Thirty-nine (14.3%) had HbA1C results. In this study 262 (96.3%) patients had urine analysis and 124 (47.3%) of them had positive urine protein. Only 97 (35.7%) had good oral hygiene.

Table 4 Biochemical parameter of diabetic patients on follow up at JMUC, 2020

Biochemical Parameter	Available results of test, n (%)	Mean ± SD

FPG, mg/dl	272 (100)	174 ± 59
Glycaemic Control Status (FBG)	272 (100)	174.6 ± 59.3
<70 mg/dl		2(0.7)*
70-130 mg/dl		70(25.7)*
>130 mg/dl		200 (73.5)
Glycated haemoglobin, %	39(14.3)	8.6 ± 2.1
HDL, mg/dl	82 (30.1)	40 ± 12
LDL, mg/dl	71 (26.1)	103 ± 43
Renal function test		
Creatinine, mg/dl	231 (84.9)	0.88 ± 0.3
eGFR, md/dl	231 (84.9)	106 ± 25

*Data are frequency and percentages.

Abbreviations: eGFR estimated glomerular filtration rate, FPG Fasting plasma glucose, HbA1c Glycated haemoglobin, HDL high density lipoprotein, LDL low density lipoprotein,

5.5. Management Gaps Encountered among Diabetic Patients on Follow Up At JUMC, 2020

Two hundred (73.5%) of patients had fasting blood glucose >130mg/dl (poorly controlled). Among study participants only 82 (30.1%) and 39 (14.3%) had lipid profile and HbA1c results respectively. Two hundred seven patients doing neither moderate/vigorous physical exercise as recommended by ADA. Regarding diabetic education 213 (78.3%), 209 (76.8%), 109 (40.1%) and 56 (20.6%) of the study participants had no explanation on diabetic treatment during illness, home blood glucose monitoring, blood glucose measurement technique and diabetic complications respectively. Only eighty-two (30.1%) of patients had home glucometer.

As presented in figure 2 the overall 157 (57.7%) of the patients had at least one complication and about 71(26.1%), 54 (19.9%), 32 (11.7%), 23 (8.4%) and about 19 (7%) had neuropathy, diabetic ketoacidosis, retinopathy, nephropathy and IHD/stroke respectively.
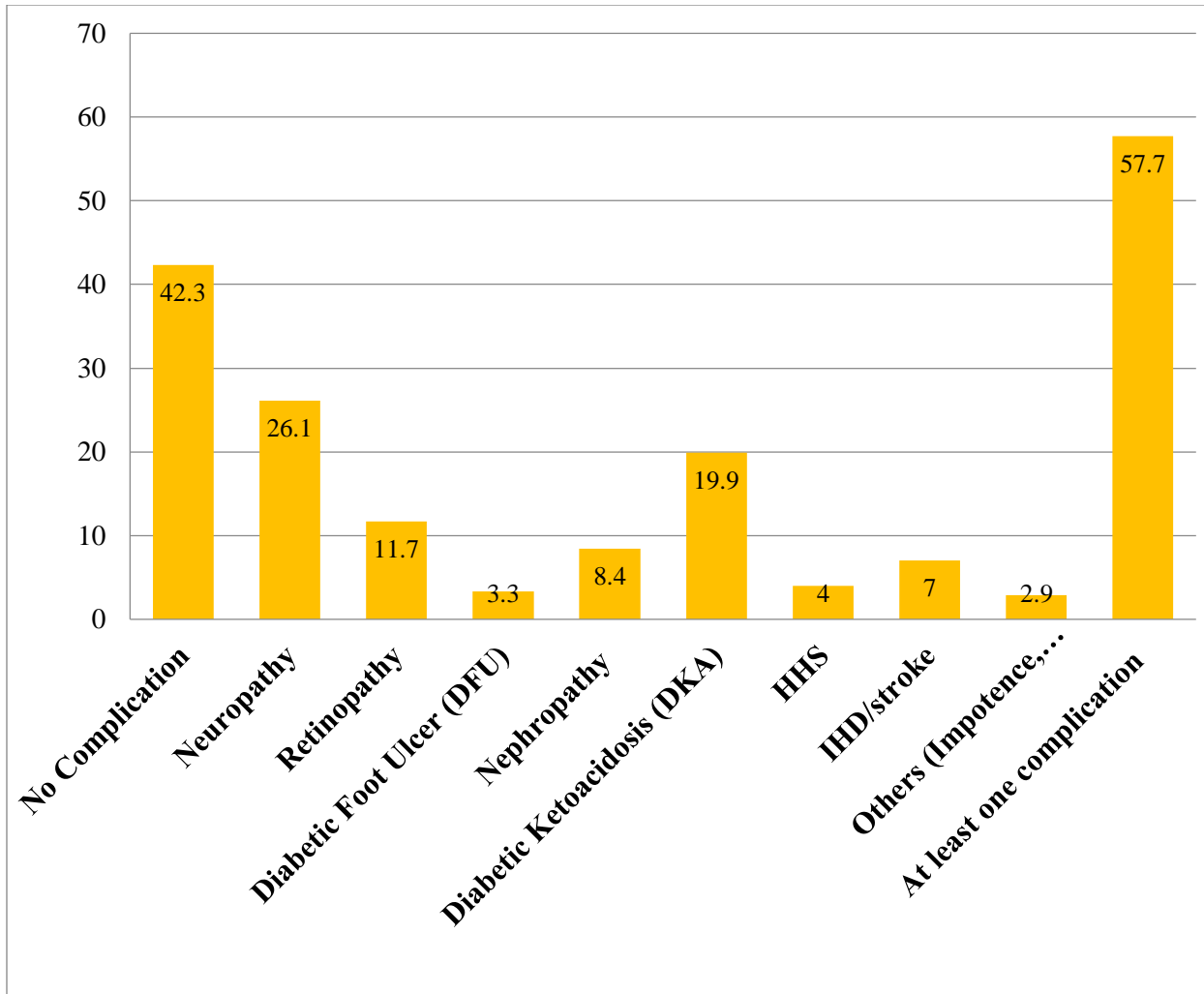
Abbreviations: HHS: - Hyperosmolar Hyperglycemic State, IHD: - Ischemic Heart Disease, Others are impotence, hypoglycemia, skin lesion)

Figure 2 Distribution Diabetic complications of diabetic patients on follow up at outpatient diabetic clinic of JMUC, Jimma, Ethiopia, 2020

Table 5 Diabetes education status of diabetic patients on follow up at JUMC, 2020

Variables	Frequency (%)
Explanation on hypoglycemia and its treatment	
Yes	250 (91.9)
No	22 (9.1)
Explanation on diet	
Yes	261 (95.9)
No	11 (4.1)
Explanation on diabetic complication	
Yes	216 (79.4)
No	56 (20.6)
Explanation on foot and skin care	
Yes	251 (92.3)
No	21 (7.7)
Explanation on smoking cessation	
Yes	228 (83.8)
No	44 (16.2)
Explanation on diabetic treatment during illness	
Yes	59 (21.7)
No	213 (78.3)
Explanation on glucose measurement technique	
Yes	163 (59.9)
No	109 (40.1%)
Explanation on home blood glucose monitoring	
Yes	63 (30.1)
No	209 (76.8)
Explanation on exercise	
Yes	249 (91.5)
No	23 (8.5)
Explanation on weight reduction	
Yes	215 (79)
No	57 (21)

CHAPTER SIX
DISCUSSION

6.1. Baseline Characteristics of Patients

This aim of this study was to asses clinical characteristics, complications and gaps encountering in management among diabetes who had follow up at JUMC. Among 272 study participants more than half were males 162 (59.6%) which was comparable with study conducted in Benishangul-Gumuz (54.6%) (24) and Bong District, Sidama Zone (56.9%) (44). About 177 (65%) of the patients had more than five individuals in their family which was comparable with study conducted in Bonga District, Sidama Zone(63.6%)(44). Among study participants 147 (54%) were urban dweller and seventy two percent of the patients participated in this study had at least the primary level of education which was lower than study conducted at Ayder Referral Hospital Mekelle in which (80%) were urban dweller and (77.6%) achieved at least primary level education (25). The mean ± SD of the patients was 50 ± 15 years and about 221 (81.3%) were married. Majority of the participant were farmer 71 (26.1%), governmental/non-governmental employee 65 (23.9) and housewife 64 (23.5%) in their occupation which was differ from study conducted at Ayder Referral Hospital farmer (8%), governmental/non-governmental employee (57.9%) (25) which might be explained by level of education and place of residency.

6.2. Clinical Characteristics of the Patients

This study has revealed that more than three-quarter 220 (80.9%) were type 2diabetes which was higher than the study done in the same hospital previously(64.4%) (45). The results at Ayder Referral Hospital (75%) (25) and at Yekatit 12 hospital (77.3%) (28) were comparable with this result. About 74 (27.2%) had family history of diabetes and 60 (81.1%) were type 2 diabetes which was higher when compared with the previous study in the same hospital (20.4%) and at Felege Hiwot Hospital (10.7%) (45,46) The possible explanation is most of study participants in our study were type II diabetes and older. At the time of study more than quarter of participants 75 (27.6%), about 74 (27.2%), seventy (25.7%) and about 53 (19.5%) were taking combination of insulin and oral glycemic agents, insulin alone, combination of oral glycemic agents and single oral glycemic agents respectively. When compared to previous study conducted in the same hospital insulin monotherapy (51.7%) was lower in our study and other regimens were

comparable(45) and insulin monotherapy (62.5%) and oral glycemic agents (33.4%) (28) were commonly used at Yekatit 12 Hospital. The possible explanation was most of the patients in our study were type 2 diabetes.

About 128 (47.2%) of the study participants had confirmed hypertension of which 121 (94.5%) were type 2 diabetes and all of them were taking antihypertensive medication and the most common antihypertensive medication was ACEI 87 (32%) followed by combination of calcium channel blockers and ACEI 18 (6.6%). This result was lower than that of Yekatit 12 Hospital (71.1%) (28) and higher than the previous result in the same hospital (44.4%) (45) and it was similar to the result from systematic review in Ethiopia (23-54.8%) (8). This study has revealed that only 49 (38.3%) of hypertensive patients had blood pressure of ≤130/80mmHg which might be explained by non-compliance to lifestyle modification. About 108 (39.7%) of the patients were obese/overweight and 101 (93.5%) of them were type 2 diabetes and when compared to previous result at the same hospital (29%) the result was higher which may be explained by small sample size in previous study(47) and when compared to result at Dessie Referral Hospital (16.4%) it was also higher which is explained by most patients in this study were type 2 diabetes(5) and Uganda (15.5%) of patients had BMI above 25kg/m^2 (20). The study conducted at Debre Markos Referral hospital has revealed that about (25.8%) of study participants were obese/overweight which was lower than in our study which might be explained by older patients in our study (26). More than half of females 64 (58.2%) had WC ≥88cm and only 20 (12.3%) of males had WC ≥102cm which showed abdominal obesity is more common in females.

The most common presenting symptom were excessive thirsty, frequent and large amount of urine and unexplained weight loss 219 (79.4%) and about 164 (60.3%) of participants had diabetes for more than five years which was higher than previous result from similar hospital (52.3%) (45).

Only 82 (30.1%) of patients had home glucometer which was improving from previous result at similar hospital (5.5) (45) and other study in Ethiopia showed only (20.1%) of patients had home glucometer (24). Majority of the patients 137 (50.4%) visited the clinic every two months which was higher when compared to study conducted at Debre Markos Referral Hospital which might be explained by lower urban dweller in our study (26). About 267 (98.2%) were adherent to their medication which was higher than study conducted at Mettu Karl Referral Hospital (50%)(29).

Majority of study participants 262 (96.3%) had at least one urine analysis and about 124 (47.3%) were positive for protein, about 231 (84.9%) serum creatinine with mean +-/ SD 0.88+/-0.3 and eighty-two (30.1%) of patients had at least one documented values for lipid profile which is higher when compared with previous study at same hospital in which urine analysis (65.6%), renal function test (29.5%) and lipid profile test (4.9%) (45). Other study conducted in Ethiopia showed that about 44.1% of the patients had at least one documented values lipid profile which is higher than our study result (28).

Regarding the dietary condition of the patients this study has revealed that majority of the study participants 269 (98.9%) consumed either vegetables/fruits in typical week and 212(78.8%) of them consumed two and more days per week. About 23 (8.5%) of the patients were either current smoker/drink alcohol and eighty-five (31.1%) chewing khat. A study conducted at Mettu Karl Referral Hospital showed that (8.2%) either smoker/drink alcohol which was similar to this study result, but khat chewing was lower (7.6%) (29).

6.3. Distribution of Diabetic Complication of the Patients

Patients with diabetes are suffering both from chronic and acute complication in which chronic microvascular was common in low-and middle-income countries where as chronic macrovascular was common in high-income countries (4). This study has revealed that about 175 (64.3%) of the patients had at least one complication which was higher when compared to study conducted in the same hospital which might be explained by longer duration of diabetes in our study (45) and the result was comparable with study conducted at Dessie Referral Hospital (59.7%) (27).In our study the most common complications were neuropathy 71 (26.1%), DKA 54 (19.9), retinopathy 32 (11.7%), nephropathy 23 (8.4%), coronary heart disease/stroke 19 (7%) and DFU 9 (3.3%) which was comparable with systematic review conducted in Ethiopia (8) and previous study conducted at the same hospital (45).

6.4. Management Gaps Encountering among the Patients

The main component of diabetes management are complete medical evaluation, dietary management, lifestyle modification and pharmacological therapy (10). The mean +/- SD FBS was 174+/-59 which was similar to previous study at similar hospital (171+/-63.6) (45) and Gondar hospital (174.25+/-57.14) (33). In majority of the patients' glycemic control was

assessed by FBS and most of the patients were not at FBS goal. Only 70 (25.7%) of the patients have achieved their FBS goal 70-130mg/dl. About 200 (73.5%) of the patients had FBS above 130mg/dl in this study which is comparable with the previous result in the same hospital (73.1)(45), Mettu Karl Referral Hospital (72.7%) (29), Yekatit 12 Hospital (69.4%) (28), Dessie Referral Hospital (70.8%)(5), Venezuela (76%) (22) and higher when compared with result at Gondar Hospital (60.5%)(33).   Only 82 (30.1%) of the patients had lipid profile test and home glucometer. Among study participants only 39 (14.3%) of the patients had documented result of HbA1C with mean +/- SD 8.5 +/-2.1 Previous study at the same hospital has revealed none of the patients had no HbA1C (45) and other study conducted in Ethiopia showed only 1.2% of patients had HbA1C(28). Together, these studies showed that diabetic patients are not tested for HbA1c as per the ADA recommendation for their glycemic control. This study has revealed that majority of the patients had poor oral care 175 (64.3%) which might be overlooked in previous studies and inadequate patient evaluation at clinic and most of the treating physician at the clinic were general practitioner. Although most of study participants were doing physical exercise for their daily activity, only 65 (23.9%) of the patients were doing vigorous/moderate physical activity according to ADA recommendation (10) . Regarding diabetic education, 213 (78.3%), 209 (76.8%), 109 (40.1%) and 56 (20.6%) of the study participants had no explanation on diabetic treatment during illness, home blood glucose monitoring, blood glucose measurement technique and diabetic complications respectively. This study also revealed that despite poor glycemic control there was no management modification.

6.5. Limitation of the Study

Consecutive sampling technique is poor in generalizing the result and due to poor recording system of the patient's information there might be underestimation the results. Single laboratory measurement of the study participants was reviewed from their chart which might be leading to overestimation/underestimation of the result. The subjective nature of self-reported response for some items might be affected by recall bias.

CHAPTER SEVEN
CONCLUSIONS AND RECOMMENDATIONS

7.1. Conclusions

This study has revealed that most patients were type 2 diabetes, hypertensive, duration of diabetes for more than five years, poor glycemic control and higher prevalence of overweight/obese. Most of the patients had at least one diabetic complication. The diabetes care was far below recommended standard guideline and inadequate knowledge, inappropriate patient evaluation, inadequate diabetic education, inadequate patient evaluation, patients' non-compliance to lifestyle modification, poor standard guideline-based practice and trends of poor documentation at the clinic were major constraints identified affecting over all care of diabetes patients.

7.2. Recommendations

The health professionals have to manage the patients based on guideline recommendation as much as possible with resource what we have, timely optimize medication, screen timely for chronic complication and comorbidities with available cost-effective means like thorough physical examination particularly (oral or dental, neurological, skin/foot), echocardiography/electrocardiograms, ophthalmologic evaluation and urine analysis. The emphasis also has to be given for adequate diabetic education, particularly lifestyle modifications which is cost-effective and applicable in resource limited countries like in our settings. The patients have to be compliant to their management especially life style modification.

The hospital and health care system in general have to improve access to HbA1C, diabetic medication, recording system and assign treating physician who had better knowledge on diabetic management. They also have to prepare diabetes follow up chart for each patient at follow up clinic. The diabetes management guidelines we used are high-income countries based which is difficult to apply in resource limited countries and it is better if we have guidelines that is applicable in our setting. Most of the study participants in this study had poor glycemic control and in the future study have to be conducted to search for associated factors that leads to poor glycemic control.

REFERENCES

1.   Dal Canto E, Ceriello A, Rydén L, Ferrini M, Hansen TB, Schnell O, et al. Diabetes as a cardiovascular risk factor: An overview of global trends of macro and micro vascular complications. Eur J Prev Cardiol. 2019;26(2_suppl):25–32.
2.   Ali MK, Weber MB, Narayan KMV. The Global Burden of Diabetes. Textb Diabetes Fourth Ed. 2010;69–84.
3.   Satman I, Imamoglu S, Yilmaz C. A patient-based study on the adherence of physicians to guidelines for the management of type 2 diabetes in Turkey. Diabetes Res Clin Pract [Internet]. 2012;98(1):75–82. Available from: http://dx.doi.org/10.1016/j.diabres.2012.05.003
4.   Pastakia SD, Pekny CR, Manyara SM, Fischer L. Diabetes in sub-Saharan Africa - from policy to practice to progress: Targeting the existing gaps for future care for diabetes. Diabetes, Metab Syndr Obes Targets Ther. 2017;10:247–63.
5.   Fiseha T, Alemayehu E, Kassahun W, Adamu A, Gebreweld A. Factors associated with glycemic control among diabetic adult out-patients in Northeast Ethiopia. BMC Res Notes [Internet]. 2018;11(1):4–9. Available from: https://doi.org/10.1186/s13104-018-3423-5
6.   Harris MI. Diabetes in America: Epidemiology and scope of the problem. Diabetes Care. 1998;21(12 SUPPL.).
7.   Sahu P, Das S. Clinical characteristics, types and complications of diabetics with young age at the onset (14–25 years). Diabetes Metab Syndr Clin Res Rev [Internet]. 2019;13(3):2122–5. Available from: https://doi.org/10.1016/j.dsx.2019.04.012
8.   Bishu KG, Jenkins C, Yebyo HG, Atsbha M, Wubayehu T. in Ethiopia : A systematic review of prevalence , risk factors , complicatioDiabetesns , and cost. Obes Med [Internet]. 2019;15(August):100132. Available from: https://doi.org/10.1016/j.obmed.2019.100132
9.   Lester FT. The Clinical Pattern of Diabetes Mellitus. 1984;7(1).
10.   Of S, Carediabetes M. ADA 2018 standard diabetic medical care. 2018;41(January).
11.   Lambrinou E, Hansen TB, Beulens JWJ. Lifestyle factors , self-management and patient empowerment in diabetes care. 2019;
12.   Solomon S. Disease burden and associated risk factors for metabolic syndrome among adults in Ethiopia. 2019;5:1–8.
13.   Nigatu T. Epidemiology, complications and management of diabetes in Ethiopia: A systematic review. J Diabetes. 2012;4(2):174–80.
14.   Whiting DR, Guariguata L, Weil C, Shaw J. IDF Diabetes Atlas : Global estimates of the prevalence of diabetes for 2011 and 2030. Diabetes Res Clin Pract [Internet]. 2011;94(3):311–21. Available from: http://dx.doi.org/10.1016/j.diabres.2011.10.029
15.   Forouhi NG, Wareham NJ. Epidemiology of diabetes. Med (United Kingdom) [Internet]. 2019;47(1):22–7. Available from: https://doi.org/10.1016/j.mpmed.2018.10.004
16.   Feleke Y, Enquselassie F. An assessment of the health care system for diabetes in Addis Ababa, Ethiopia. Ethiop J Heal Dev. 2006;19(3).
17.   Heydari I, Radi V, Razmjou S, Amiri A. Chronic complications of diabetes mellitus in newly diagnosed patients. Int J Diabetes Mellit [Internet]. 2010;2(1):61–3. Available from: http://dx.doi.org/10.1016/j.ijdm.2009.08.001
18.   Ayele K, Tesfa B, Abebe L, Tilahun T, Girma E. Self Care Behavior among Patients with Diabetes in Harari , Eastern Ethiopia : The Health Belief Model Perspective. 2012;7(4).

19. Alemnew GM, Abegaz TM. Clinical characterstics, precipitating factors and glycemic control among diabetic ketoacidosis patients admitted to university hopsital in Northwest Ethiopia: A hospital based observational study. 2019;1–19.

20. Kibirige D, Akabwai GP, Kampiire L, Kiggundu DS, Lumu W. Frequency and predictors of suboptimal glycemic control in an african diabetic population. Int J Gen Med. 2017;10:33–8.

21. Sobngwi E, Ndour-Mbaye M, Boateng KA, Ramaiya KL, Njenga EW, Diop SN, et al. Type 2 diabetes control and complications in specialised diabetes care centres of six sub-Saharan African countries: The Diabcare Africa study. Diabetes Res Clin Pract [Internet]. 2012;95(1):30–6. Available from: http://dx.doi.org/10.1016/j.diabres.2011.10.018

22. Duarte E, Jr M, Celestino R, Neves S, Conceic M, Almeida C De, et al. Glycemic control and its correlates in patients with diabetes. 2010;87:407–14.

23. Amod A, Riback W, Schoeman HS. Diabetes guidelines and clinical practice: Is there a gap? The South African cohort of the International Diabetes Management Practices Study. J Endocrinol Metab Diabetes South Africa. 2012;17(2):85–90.

24. Chali SW, Salih MH, Abate AT. Self - care practice and associated factors among Diabetes Mellitus patients on follow up in Benishangul Gumuz Regional State Public Hospitals , Western Ethiopia : a cross - sectional study. BMC Res Notes [Internet]. 2018;1–8. Available from: https://doi.org/10.1186/s13104-018-3939-8

25. Referral A, Diabetic H, Mekelle C. Prevalence and Factors Associated With Diabetic Foot Ulcer among Adult Diabetes & Metabolism Prevalence and Factors Associated With Diabetic Foot Ulcer among Adult Patients in Ayder Referral Hospital Diabetic Clinic Mekelle , North. 2016;(August).

26. Tilahun M, Gobena T, Dereje D, Welde M, Yideg G. Prevalence of diabetic retinopathy and its associated factors among diabetic patients at debre markos referral hospital, Northwest Ethiopia, 2019: Hospital-based cross-sectional study. Diabetes, Metab Syndr Obes Targets Ther. 2020;13:2179–87.

27. Abejew AA, Belay AZ, Kerie MW. Diabetic Complications among Adult Diabetic Patients of a Tertiary Hospital in Northeast Ethiopia. 2015;2015.

28. Melaku S, Enquselassie F, Shibeshi W. Assessment of glycaemic, lipid and blood pressure control among diabetic patients in Yekatit 12 Hospital, Addis Ababa, Ethiopia. Ethiop Pharm J. 2016;31(2):131.

29. Sheleme T, Mamo G, Melaku T, Sahilu T. Glycemic Control and its Predictors among Adult Diabetic Patients attending Mettu Karl Referral Hospital, Southwest Ethiopia: A Prospective Observational Study. Diabetes Ther [Internet]. 2020;11(8):1775–94. Available from: https://doi.org/10.1007/s13300-020-00861-7

30. Evaluation of a Diabetes Management System Based on Practice Guidelines , Integrated Care , and Continuous Quality. Sci Technol. 2008;31(5).

31. Benjamin, E.; Schneider, M.; Hinchey K. Implementing Practice Guidelines for Diabetes Care Using Pro b l e m - B a s e d. Diabetes Care. 1999;22(10):1672–8.

32. Agency cent. stat. central Statistical Agency ofEthiopia population and housing census 2007 report. Cent Stat Agency,Addis Ababa. Popul census Comm. 2007;

33. Syndrome M. Glycemic control and diabetes complications among diabetes mellitus patients attending at University of Gondar Hospital , Northwest Ethiopia. :75–83.

34. Mariam TG, Alemayehu A, Tesfaye E, Mequannt W, Temesgen K, Yetwale F, et al. Prevalence of Diabetic Foot Ulcer and Associated Factors among Adult Diabetic Patients

Who Attend the Diabetic Follow-Up Clinic at the University of Gondar Referral Hospital , North West Ethiopia , 2016 : Institutional-Based Cross-Sectional Study. 2017;2017.

35. Gebremedhin T, Workicho A, Angaw DA. Health-related quality of life and its associated factors among adult patients with type II diabetes attending Mizan Tepi University Teaching Hospital, Southwest Ethiopia. BMJ Open Diabetes Res Care. 2019;7(1):1–8.

36. Mayega RW, Guwatudde D, Makumbi F, Nakwagala FN, Tomson G, Ostenson C. Diabetes and Pre-Diabetes among Persons Aged 35 to 60 Years in Eastern Uganda : Prevalence and Associated Factors. 2013;8(8):1–11.

37. Physical activity guidelines for Americans. Okla Nurse. 2008;53(4):25.

38. Fekadu G, Bula K, Bayisa G, Turi E, Tolossa T, Kasaye HK. Challenges and factors associated with poor glycemic control among type 2 diabetes mellitus patients at nekemte referral hospital, Western Ethiopia. J Multidiscip Healthc. 2019;12:963–74.

39. Patry-Parisien J, Shields M, Bryan S. Comparison of waist circumference using the world health organization and national institutes of health protocols. Heal Reports. 2012;23(3):3–10.

40. Afroz A, Zhang W, Wei Loh AJ, Jie Lee DX, Billah B. Macro- and micro-vascular complications and their determinants among people with type 2 diabetes in Bangladesh. Diabetes Metab Syndr Clin Res Rev [Internet]. 2019;13(5):2939–46. Available from: https://doi.org/10.1016/j.dsx.2019.07.046

41. Moghtaderi A, Bakhshipour A, Rashidi H. Validation of Michigan neuropathy screening instrument for diabetic peripheral neuropathy. 2006;108:477–81.

42. Dua A, Lee CJ. Epidemiology of Peripheral Arterial Disease and Critical Limb Ischemia. Tech Vasc Interv Radiol [Internet]. 19(2):91–5. Available from: http://dx.doi.org/10.1053/j.tvir.2016.04.001

43. Tewabe T, Kindie S. Level of insulin adherence among diabetes mellitus patients in Felege Hiwot Referral Hospital, Bahir Dar, Northwest Ethiopia, 2017: A cross-sectional study. BMC Res Notes [Internet]. 2018;11(1):1–6. Available from: https://doi.org/10.1186/s13104-018-3398-2

44. Alemayehu Z, Zekewos A, Loha E, Egeno T, Wubshet K, Merga Z. Prevalence of Diabetes Mellitus and Associated Factors in Southern Ethiopia : A Community Based Study.

45. Gudina EK, Amade ST, Tesfamichael FA, Ram R. Assessment of quality of care given to diabetic patients at Jimma University Specialized Hospital diabetes follow-up clinic, Jimma, Ethiopia. BMC Endocr Disord. 2011;11.

46. Feleke SA, Alemayehu CM, Adane HT. Assessment of the level and associated factors with knowledge and practice of Diabetes Mellitus among Diabetic Patients attending at FelegeHiwot Hospital , Northwest Ethiopia. 2013;2(6):110–20.

47. Cheneke W, Suleman S, Yemane T, Abebe G. Assessment of glycemic control using glycated hemoglobin among diabetic patients in Jimma University specialized hospital ,. BMC Res Notes. 2016;1–10.

ANNEX I CONSENT FORM

Individual consent form

Jimma University medical center-Department of Internal Medicine individual consent form for the study on assessment of clinical characteristics, complications and gaps encountered in management of diabetic patients at JUMC, Jimma, Ethiopia

My name is --------------------I am working with research team of JUMC. We would like to assure that your name will not be mentioned in the questionnaire and the information that you will be give us will be kept confidential and only used for research purpose. You have the full right to refuse to take part or interrupt the interview at any time. But the information you will give us is quite useful to achieve the objective of the study.

Are you willing to participate in the study?   A.YES   B. NO

If the answer is "YES" thank you. Conduct the interview. If the answer is "NO" thank you.

Don't force or reinforce an individual to participate in the study

Name of participant --------------------------------signature-----------

Date of interview----------date-------month/2020 G.C

Checked on-----------date-----------month/2020 G.C

Complete-------incomplete---------other(specify)

I would also like to inform you that this study will be approved by Department of Internal Medicine. If you have any questions about the study, the name and contact of the principal investigator is given below.

Name of principal investigator: Dr. Addisalem Fekadu

Tel: +251954867056   E-mail address: afekadu06@gmail.com

ANNEX-II QUESTIONNIARIES

Part I Sociodemographic status of the participant's(Q1-8)

S.NO	Questions	Response
1	Age	/---------/years
2	Sex	/------/male, /------/female
3	Place of residency	/------/urban, /-------/rural
4	Occupation	/-----/daily worker, /----/farmer/----/house wife/-----/merchant/----/retired/---/governmental employee/----/student/----/-------/other specify---
5	Marital status	/----/married/------/single/------/divorced/-----/widowed
6	What is your estimated amount of tax you payed per year?	/-------/
7	What is maximum education level you achieved?	/-----/unable to read and write/----/can read and write/-----/grade 1-8/----/grade 9-12/-----/above
8	Number of family member	/------/

Part II checklist for behavioral factors(Q9-14)

S.NO	Questions	Response
9	Have you consumed at least one of substances [(Alcohol (tej, beer, areke, wine), cigarette/tobacco)] in the last 3 months?	/-----/ YES, /------/ NO
10	By what frequency you take them per week?	/-----/ once, / two and more
11	Do you use pesticide at home for pest control?	/-------/ YES, /-------/NO
12	Do you use pesticide or herbicide on your own farm? (if farmer only)	/--------/ YES, /-------/ NO
13	Have you ever chewing khat in a typical week?	/-------/ YES, /-------/NO
14	How frequent?	/------/occasionally / ----/daily

Part III checklist for dietary condition (15-23)

S.NO	Questions	Responses
15	What is your frequent diet you used made of? (more than one answer is possible	1. Cereals II. Legumes III. Dairy products 2. Meat /-------YES/----NO 3. Fish /---------YES, /-----NO 4. Chicken /-----YES, /-----NO 5. Egg /-------YES, /-----/------NO 6. Enset /----YES, /--------NO 7. Nuts /------YES, /-------NO
16	How you ever consumed fruits/vegetables in typical week?	/------------/YES/----------/NO
17	How frequent?	/---------/once/--------/twice and more/-----/never consumed
18	How many times do you have meal each day?	/----/once/----/twice/----three times/----/four and more times
19	What amount of salt have you used per day	/---/less than one teaspoon/---/one teaspoon/---two teaspoon/---/three and more teaspoons /---------/ I don't know
20	What amount of simple sugar have you used per day	/----/less than 6 teaspoons/----/six teaspoons/----more than six teaspoons/-----/never used/---------/ I don't know
21	What type of oil are you used frequently	/---/sunflower/---olive/----/fish/----/other specify
22	How many liters of oil do you consume each month?	/-----/one/---two/----/three/---/four and more/---------/I don't know
23	What amount of butter do you consume each month?	/----/250grams/----500grams/----/one kilogram/----two kilograms/---/three kilograms/----more than three kilograms/----/ never used/------------/I don't know

Part IV checklist for physical activity(Q24-31)

S.NO	Questions	Response
24	Did you do vigorous physical activity?	/------/YES, /--------/NO
25	How many days do you do vigorous physical activities like heavy lifting, digging or fast bicycling per week?	/------/days
26	How much times do you usually spend doing vigorous physical activities on one of those days?	/-------/ hours /-------/minutes/----/I don't know/not sure
27	How many days do you do moderate physical activities like carrying light load, or bicycling at regular pace per week?	/------/ days
28	How much times do you usually spend doing moderate physical activities on one of those days?	/-------/hours, /-------/minutes/----/I don't know/not sure
29	How many days do you walk for at least 10 minutes at a time per week?	/-------/days
30	How much times do you usually spend walking on one of those days?	/-----/hours/----/minutes/------/I don't know/not sure
31	How much time do you spend sitting per week?	/------/hours/--------/minutes/----/I don't know/not sure

Part V checklist for diabetes related questions and comorbidities (32-50)

S. NO	Questions	Response
32	Duration of diabetes	/------/years
33	Types of diabetes	/-------/type 1DM/-----/type 2DM/----/other specify
34	Family history of diabetes	--------------/YES/---------NO
35	Body weight at time of onset	/-------/kilograms
36	Symptoms at time of disease onset (more than one answer is possible)	/----/excessive thirsty/-----/frequent and large amount of urine/----/weight loss/----/increased body weight/----/blurring of vision/---/other specify
37	Home glucometer	/----------/YES/-----------/NO
38	Doses of diabetic medication missed during last month	/-----/one/----/two/----/three/---/four/----/five----/six and more/-------------/-not missed
39	Follow up interval	/-----/monthly/------/every two months/---/every three months/----/every six month/----/annually/----/other specify
40	Do you feel numbness or tingling in your feet?	/-------/YES/--------/NO
41	Do you experience discomfort in your leg while walking or at rest?	/---------/YES/----------/NO
42	Have you ever had diabetes mellitus during pregnancy? (for female respondent only	/--------/YES/---------/NO
43	Diabetic medication used (chart review)- more than one answer possible	/-----/metformin/-----/insulin/----/ Glibenclamide /-----/other specify
44	Medications other than diabetic medication (more than one answer is possible)-chart review	/-----/aspirin/-----/----atorvastatin/-----/simvastatin/-----/lovastatin/-----/I don't know its name/---/other specify
45	Diabetic complication -chart review	/----/DKA/----HHS/----/PAD/-----/stroke/-----/CHD/----/cardiomyopathy/------retinopathy/------/neuropathy/-----/nephropathy/------/DFU/---/other specify

46	HIV infection	/------/positive/------negative/-----/ not screened
47	HCV	/------/positive/-----/negative/----/not screened
48	Have you ever treated for tuberculosis infection?	/--------/YES/-------/NO
49	Confirmed hypertension	/------/YES/-------/NO
50	Antihypertension medications	/------/Enalapril/------/Hydrochlorothiazide /-----/ Amlodipine/---- / Losartan/-----/Other specify /-----/Not taking medication

Part VI checklist for anthropometry and laboratory findings (51-61)

S.NO	Questions	Response
51	Blood pressure	/---------/mmHg
52	Height	/--------/centimeters
53	Body weight	/---------/kilogram
54	BMI	/---------/kg/m^2
55	WC	/---------/centimeters
56	FBS/RBS	/--------/--------/mg/dl
57	HbA1C	/--------/%
58	Serum creatinine	/--------/mg/dl
59	eGFR	/---------------/ml/min/$1.73m^2$
60	Urine analysis	/--------/protein positive/-----/protein negative/------ketone positive/----/ketone negative/----/normal finding/-----/other specify
61	Lipid profile panel	Total cholesterol/------/mg/dl
		HDL-C/-----------/mg/dl
		LDL-C/---------/mg/dl
		TG/----------/mg/dl

Part VII checklist for physical examination (q62-65)

S.NO	Questions	Response
62	Oral/dental examination finding	/----/clean teeth without debris, pink gum without bad odor/----/swollen or bleeding gum, exposed root of the teeth, change in texture of tongue and bad odor/----/gingivitis/----/dental caries/---/dental loss
63	Cardiovascular examination findings	/-----/normal findings/----/neck vein engorged or raised JVP/----/ S3/S4 gallop/----/murmurs
64	Musculoskeletal and skin examination findings	/-----/normal findings /-----/callus or deformity/-----/ulcer----- /diabetic dermopathy/-----/absent or asymmetric pulses/-------/Atrophic injection site/-----/ Hypertrophic injection site/----/Amputation
65	Neurologic examination findings	/-----/paresis/------/Absent or reduced vibration over medial malleoli/-----/normal findings

Part VIII check list for diabetic education (Q66-77)

S.NO	Questions	Response
66	Did your doctor explains about diabetes	/--------/YES, /--------/NO
67	Did your doctor explain diabetic medication storage, technique and equipment?	/--------/YES, /-------/NO
68	Did your doctor explain hypoglycemia and its treatment?	/-------/YES, /-------NO
69	Did your doctor explain diet?	/-------/YES, /-------/NO
70	Did your doctor explain diabetic complication?	/---------/YES, /-------/NO
71	Did your doctor explain foot and skin care?	/-------/YES, /-------/NO
72	Did your doctor explain smoking cessation?	/-------/YES, /-------/NO

73	Did your doctor explain diabetic treatment during illness?	/------/YES, /------/NO
74	Did your doctor explain blood glucose measurement technique?	/------/YES, /------/NO
75	Did your doctor explain home blood glucose monitoring?	
76	Did your doctor explain exercise?	/--------/YES, /-------/NO
77	Did your doctor explain weight reduction?	/--------/YES, /---------/NO

Thank You for Your Cooperation!