PREVALENCE OF CONCORDANT DIABETES COMORBIDITIES AND ASSOCIATED FACTORS AMONG ADULT DIABETIC OUT-PATIENTS AT HIWOT FANA SPECIALIZED UNIVERSITY HOSPITAL, HARAR, EASTERN ETHIOPIA

SPECIALTY CERTIFICATE THESIS

ABDISA EJETA

November, 2020

Haramaya University, Harar, Ethiopia

Prevalence of Concordant Diabetes Comorbidities and Associated Factors among adult Diabetic Out-patients at Hiwot Fana Specialized University Hospital, Harar, Eastern Ethiopia

A Thesis submitted to School of Medicine,
School of Graduate Studies
HARAMAYA UNIVERSITY

In Partial Fulfillment of the Requirement for the degree of,
SPECIALTY CERTIFICATE OF INTERNAL MEDICINE

Abdisa Ejeta (MD)

Major Advisor: Dr. Tekabe Abdosh (MD, Associate professor of Internal Medicine)
Co-Advisor: Mr. Behailu Hawulte (MPH, Assistant Professor)

November, 2020

Haramaya University, Harar, Ethiopia

APPROVAL SHEET

HARAMAYA UNIVERSITY

SCHOOL OF GRADUATE STUDY

I hereby certify that I have read and evaluated thesis entitled with Prevalence of Concordant Diabetes Comorbidities and Associated Factors among adult Diabetic Out-patients at Hiwot Fana Specialized University Hospital, Harar, Eastern Ethiopia under my guidance by Abdisa Ejeta. I recommend that it be submitted as fulfilling the Thesis requirement.

_____	_____	_____
Major Advisor	Signature	Date
_____	_____	_____
Co-Advisor	Signature	Date

As a member of the board of examiners of the Specialty Certificate Thesis Open Defense Examination, I certify that I have read and evaluated the Thesis prepared by Abdisa Ejeta and examined the candidate. I recommend that the Thesis be accepted as fulfilling the Thesis requirements for the Specialty Certificate in Internal Medicine.

_____	_____	_____
Chair Person	Signature	Date
_____	_____	_____
Internal Examiner	Signature	Date
_____	_____	_____
External Examiner	Signature	Date

Final approval and acceptance of the Thesis is contingent upon the submission of its final copy to the Council of Graduate Studies (CGS) through the Candidate's Department or School Graduate Committee (DGC OR SGC)

STATEMENT OF THE AUTHOR

By my signature below, I declare and affirm that this Thesis is my own work. I have followed all ethical and technical principle of scholarship in the preparation, data collection, data analysis, and compilation of this Thesis. Any scholarly matter that is included in the Thesis has been given recognition through citation.

This Thesis is submitted in partial fulfillment of the requirements for Specialty Certificate in Internal Medicine at the Haramaya University. The Thesis is deposited in the Haramaya University Library and made available to borrowers under the rule of the Library. I solemnly declare that this Thesis has not been submitted to any other institution anywhere for the award of academic degree, diploma or certificate.

Brief quotations from this may be made without special permission provided that accurate and complete acknowledgement of the source is made. Request for permission for extended quotations from or reproduction of this Thesis in whole or in part may be granted by the Head of the School when in his or her judgements the proposed use of the material is in the interest of scholarship. In all other instance, however, permission must be obtained from the author of the Thesis.

Name: _____ Signature_____

Date: _____

School/Department: _____

BIOGRAPHICAL SKETCH

The author was born in 1981 in Wollaga, Oromia Regional State, Ethiopia. I completed my primary school in Kombolcha Elementary school. I attended my secondary and preparatory school in Ficha secondary and Shambu preparatory school. After completion of preparatory school, I joined University of Hawassa in 2006. At University of Gondor I studied Medicine and got my degree in Medical Doctor in 2012. After graduation I was employed in Metu Karl Referral Hospital and served until I left for my graduate study.

In January 2018, I joined Hramaya University Post Graduate Program Directorate as sponsored by Oromia Regional State to study in Internal Medicine Specialty.

ACKNOWLEDGMENT

First and foremost, I would like to thank Haramaya University College of Health and Medical science, Department of Internal Medicine for giving this opportunity to conduct this educational research as it is a great experience for me. Next, I would like to express my deepest gratitude and appreciation to my advisors Dr. Tekabe Abdosh and Mr. Behailu Hawulte for their valuable comments, scientific suggestion and continuous guidance and support in various aspects. In addition, I would like to extend my grateful thanks and appreciation to all staffs of Haramaya University College of Health and Medical science, School of Medicine and Hiwot Fana Specialized University Hospital for their co-operation during searching of some of the literature, documents and books I used as a guide and all staffs that supported during data collections. I would also like to thank all the writers and researchers whose work has shed some light and understanding on this particular topic**.**

TABLE OF CONTENTS

List of tables and figure

ACRONYMS AND ABBREVIATIONS

ADA	American Diabetes Association
AOR	Adjusted Odds Ratio
BP	Blood Pressure
BMI	Body Mass Index
CAD	Coronary Artery Disease
CI	Confidence Interval
CSA	Central Statistics Agency
COR	Crude Odds Ratio
CVD	Cardiovascular disease
CKD	Chronic Kidney Disease
CLD	Chronic Liver Disease
DM	Diabetes Mellitus
DKA	Diabetic Ketoacidosis
EDA	Ethiopian Diabetes Association
ETB	Ethiopian Birr
FBS	Fasting blood sugar
HbA1c	Hemoglobin A1c
HNRS	Harari National Regional State
HFSUH	Hiwot Fana Specialized University Hospital
HDL	High Density Lipoprotein
HHS	Hyperosmolar Hyperglycemic State

HTN	Hypertension
IHD	Ischemic heart disease
IDF	International Diabetes Federation
LDL	Low Density Lipoprotein
NCEP	National Cholesterol Education Program
NQF	National Quality Forum
PAD	Peripheral Artery Disease
RBS	Random blood sugar
RRT	Renal Replacement Therapy
T1DM	Type 1 Diabetes Mellitus
T2DM	Type 2 Diabetes Mellitus
SPSS	Statistical Package Forth Social Science
WHO	World Health Organization

ABSTRACT

Background. Comorbidities among diabetes mellitus (DM) constitute a major public health problem that significantly increases the morbidity, mortality, and complications of DM. Additionally, comorbidity among DM patients reduces productivity and contribute to the economic burden. Identifying the magnitude of DM comorbidities can help to develop interventions that reduce risks of diabetic related complications and death. Despite increments in the prevalence of diabetes and its complications, there are limited studies on the prevalence and their associated factors of concordant comorbidities among diabetic patient in Ethiopia including the current study area, although some of the comorbidities are studied separately.

Objective: This study was conducted to determine the prevalence of concordant DM comorbidities and associated factors among diabetic out- patients at Hiwot Fana Specialized University Hospital, Eastern Ethiopia, from September 30,2019 to September 30,2020

Methodology: A hospital-based cross-sectional study was conducted by reviewing medical record charts of diabetic outpatients, who has been on follow up at HFSUH. The data was cleaned and entered in to Epi data version 3.1 and exported to STATA version 16.0 for analysis. Descriptive analysis was employed to describe the independent and outcome variables. Binary logistic regression was carried out to identify factors associated with DM comorbidities. Adjusted Odds Ratio with 95% CI was used to measure strength of association and variables with $p \leq 0.05$ was considered as statistically being significant.

Result: A total of 319 adult diabetic patents were reviewed with response rate of 86.7%. The overall prevalence of concordant comorbidity among adult diabetic out-patients was 55.8% at 95% CI (50.3-61.3). Mean age of respondents was about 45 years. A larger proportion of patients 232 (72.73%) were diagnosed for type II DM. Hypertension (42.32%), CVD (8.15%), Overweight/Obesity (21.63%), dyslipidemia (4.08%) and CKD (10.66%) were reported comorbidity among DM patients. The odds of having concordant comorbidity among adult diabetic out-patients who were 55 or more years old was 7.52 times greater than those in the age group of 18-24 years old. In general, most of the cases of comorbidities were observed amongst elder people {AOR: 7.52, 95% CI (1.24, 45.75)}. Adult diabetic out-patients of type II DM diagnosis were 9.01 times more likely develop concordant comorbidity as compared to those of Type I DM {AOR: 9.01, 95% CI (1.50, 54.04) . Respondents who had 2-5years duration of DM

treatments were 77% less likely develop comorbidities as compared to those more than10 years {AOR: 0.23, 95 CI (.078, .691)}. Likewise, an odd of having concordant comorbidity among adult diabetic out-patients of poor glycemic control was 4.41 times greater than those of good glycemic control {AOR: 4.4 1, 95% CI (2.34, 8.32). Age, Types of DM, duration of treatment of DM and glycemic control were acknowledged as independent predictors significantly associated with experience of comorbidity.

Conclusion: Consistent with previous studies, the current findings show that patients with diabetes have a high prevalence of comorbidity, therefore multiple demands on the health care providers. Age, types of DM, glycemic control and duration of treatment of DM were acknowledged as independent predictors of experiences of comorbidity. Further studies are required in to search and produce extra suggestion.

Keywords: Prevalence, discordant comorbidities, Diabetic Mellitus, Hiwot Fana, Hospital, Eastern Ethiopia

1. INTRODUCTION

1.1. Background

Diabetes is a heterogeneous chronic metabolic disorder, which have common characteristics of persistent hyperglycemia with disturbance of carbohydrate, protein and fat metabolism occurred due to a deficiency in insulin secretion and, or insulin action(World Health Organization, 2006). It is caused by a complex interaction of genetics and environmental factors which includes, family history of DM, race, overweight, inactivity, older age, high blood pressure, gestational diabetes, polycystic ovary syndrome and abnormal cholesterol and triglyceride level(International Diabetes Federation, 2017)

DM can be classified to various forms based on the basis of the pathogenic process, but the major forms are Type1 diabetes mellitus (T1DM) and Type2 diabetes mellitus (T2DM)(ADA, 2018). Type 1 diabetes (T1DM) results from absolute deficiency of insulin as a result of autoimmune destruction of pancreatic β-cells(ADA, 2018). It usually affects children or young adults and diagnosed before chronic complications. Type 2 DM (T2DM) which accounts 90% of all diabetes results from insulin resistance and/or relatively insufficient insulin secretion. T2DM happens most of the time in adults and elders, but currently the prevalence is increasing in children and adolescents. T2DM may remain undiagnosed until chronic complications become evident because of its long asymptomatic period and the gradual development of chronic complications(ADA, 2018). Although T1DM and T2DM are common forms, there is also increasing recognition of other forms of diabetes in which the molecular pathogenesis is better understood and may be associated with a single gene defect and may share features of type 1 and/or type 2 DM(ADA, 2019).

DM comorbidity is defined as the occurrence of one or more chronic disease in diabetic patient (ADA, 2019). It can be classified as concordant and discordant comorbidities. Concordant comorbidities are two or more diseases which share similar components of pathophysiology and are more likely to be the focus of the same disease. The managements of concordant comorbidities targeted on pathophysiology of the disease. Dyslipidemia, Hypertension, Obesity, CVD, and CKD are concordant comorbidities of DM because they share similar pathophysiology. Discordant comorbidities are two or more diseases which are not directly interrelated in terms of pathogenesis

or managements. For example, depression and DM are discordant comorbidities because they have totally different pathophysiology. Comorbidities are common in diabetic patients. According to different medical survey(Du, Heidemann, Gößwald, Schmich, & Scheidt-Nave, 2013) most of DM patients have at least one comorbidity disease and 40% of them have three or more comorbidities. Although the prevalence of comorbidities among diabetes are different from region to region(Yimama, Jarso, & Desse, 2018) most studies have been shown that hypertension, cardiovascular disease, obesity, chronic kidney disease and dyslipidemia are the most common identified worldwide(Erasmus et al., 2012).

Diabetic patients with comorbidities likely face difficulties in choosing appropriate managements for their primary disease state and they are poorly adherent to their medications. Both diabetes related and non-diabetes related comorbidities increase the demand for health care and increase cost of the hospitalizations, medication, laboratory, and increase the frequency of medical follow up(J. Piette & E. Kerr, 2006)

The impact of comorbidities on diabetic patient is high throughout the countries(American Assosiation of Clinical Endocrinologists, 2015). Obesity causes challenges on DM managements because it increases insulin resistant, increases the risk of cardiovascular comorbidities, changes the metabolism and may limit patient's physical activities.

Prevention of comorbidities are the core principles of DM managements(American Assosiation of Clinical Endocrinologists, 2015) For example, each 10mmHg decreases in systolic blood pressure is associated with, a 12% reduction in myocardial infarction, 17% reduction in rates of diabetic related mortality and a 13% reduction in microvascular endpoints (American Assosiation of Clinical Endocrinologists, 2015) Therapeutic lifestyle changes are central to controlling lipids, but pharmacologic therapies should be used to achieve the target(American Assosiation of Clinical Endocrinologists, 2015). CKD is one of the chronic complications of DM, but it is also frequently a comorbidity that can present before the onset of diabetes. CKD doubles the risk of CVD(American Assosiation of Clinical Endocrinologists, 2015). Cardiovascular disease is the primary cause of death in DM patents, so controlling the CVD and CVD risks are the other parts of management in diabetic patients. CVD encompasses: coronary artery disease, cerebrovascular disease and coronary heart disease (American Assosiation of Clinical Endocrinologists, 2015).

1.2. Statement of the problem

Diabetes mellitus with comorbid complications constitute a major public health problem worldwide. Most adults with diabetes have at least one comorbid chronic disease and as many as 40% have at least three. Similar to the global report, the comorbid disease in diabetic patient are highly increasing in sub Saharan area which have implications for prognosis, overall disease burden and treatment options(Ekoru et al., 2019).

DM comorbidities significantly increase the burden of diabetes mellitus worldwide. It has been shown to increase chronic complications, mortality, morbidity and increase medical costs of diabetic patients. It can cause complications and death directly or they can worsen the complications of diabetes and attribute the mortality indirectly. Diabetes related healthcare outcomes, options of treatments, care needs and associated costs are complicated by the presence of comorbidities (J. Piette & E. Kerr, 2006). Identifying comorbidities and their associated factors among diabetic patients is the key, to diabetes care and management in order to delay the onset or decrease the incidence of complications and in the prevention of diabetes related disability. Ignoring comorbid disease management, however, can lead to ineffective control of diabetic related complications and may miss opportunities to improve patients' functioning, quality of life, and mortality risk(Norlund, Apelqvist, Bitzeân, P.Nyberg, & Schersteân, 2001). So generally it is difficult to achieve the goals of diabetic management without identifying and managing comorbidity and their associated factors (J. Piette & E. Kerr, 2006).

A better understanding of diabetic related comorbidities and their associated factors can enhance the type and capacity of medical health care utilization as well as it enables to gain vision into future health care burdens of patients with DM. The integrated Diabetes care guidelines also focus not only on medical management, but also identification and early managements of comorbidities. Prevention of comorbidities among diabetic patients, screening and early identification and managements are components of comprehensive diabetes care. When diabetic patients have multiple chronic comorbidities, screening, counseling, and treatment needs can far exceed the time available for patient-provider visits. Life style modification is the other strategy to prevent comorbidities among diabetic patients.

The major comorbidities, their clinical manifestations, their impact on diabetic patients, their managements and their associated factors in diabetic patients are well studied and documented in western populations, but there are limited studies in developing countries including Ethiopia. Even though, identifying comorbidities has been shown to prevent the development and progression of diabetic complications, as well as to increase the life expectancy and quality of life of patients, there is no enough studies in Ethiopia which are clearly indicating the exact figure of comorbidities and their associated factors among diabetic patients. Early identification and managements of comorbidities among diabetic patients also help to decrease the health costs associated with complication.

1.3. Significance of the study

The study has substantial input to the health care system to decrease complications, morbidity and mortality by identifying the major diabetic related comorbidities and their associated factors. The study benefits the region and the hospital to focus on the comorbidities among DM and their associate factor other than focusing only on DM to decrease mortality and complications.

The study also benefits the hospital as well in planning and allocating both human and financial resources because comorbidity has been shown to intensify health care utilization and to increase medical care costs for patients with diabetes, as findings help to formulate strategies to improve the quality of diabetes care and delay or decrease diabetes related complications.

The study also benefits diabetic patients to focus on comorbidities to decrease morbidity and mortality associated with diabetes mellitus. Diabetic patients can also change their life style, can get regular education, can be early screened to prevent comorbidities to improve quality of life. The study has also inputs for the providers to improve the diabetic care as findings showed high prevalence of concordant comorbidities.

Lastly, the finding will benefit researchers those interested in the field by providing information regarding the prevalence of concordant diabetes comorbidities and associated factors.

1.4. Objective of the study

1.4.1. General objective

To assess the prevalence of concordant DM comorbidities and their associated factors among adult diabetic out-patients at HFSUH, Eastern Ethiopia, from September 30,2019 to September 30,2020.

1.4.2. Specific objectives

- ✓ To determine the prevalence of concordant comorbidities among adult diabetic out-patients at HFSUH, from September 30,2019 to September 30,2020
- ✓ To assess factors associated with concordant comorbidities among adult diabetic out-patients at HFSUH, from September 30,2019 to September 30,2020.

2. LITERATURE REVIEW

Study done World wide

Chronic diseases are the main challenges facing health-care systems in all countries, but health systems are largely focused for individual diseases rather than comorbidities. The most common chronic disease experienced by adults is comorbidities, the coexistence of multiple diseases together. The result from a cross-sectional study done in Scotland on Epidemiology of multimorbidity and implications for health care, research, and medical education showed 42·2% (95% CI 42·1–42·3) of all patients had one or more morbidities, and 23·2% (23·08–23·21) were multimorbid. The prevalence of multimorbidity increased substantially with age and was present in most people aged 65 years and older(Mary, Tinetti, Terri R. Fried, & Cynthia M. Boyd, 2012). More than 75% of individuals age 65 years and above have multiple chronic conditions, but less frequent for young age groups(Barnett et al., 2012). The National Quality Forum (NQF) currently focused on the development of the treatment strategy of multiple chronic conditions than single disease.

From retrospective study(Iglay, Hannachi, Howie, Jinfei Xu, & Engel, 2016) done using the quintiles record database, on prevalence and co-prevalence of comorbidities among T2DM patients from July 2014 to June 2015, the main results were; most of them had (97.5%) one or more morbidity in addition to diabetes and 88.5% had two or more multimorbidities. The burden increases with age and common in males than females. The common comorbidities identified in T2DM were in decreasing order hypertension, overweight/obesity, hyperlipidemia, CKD and CVD (82.1%,78.2%,77.2%,24.1% and 21.6%) respectively. Co-prevalence was high in the study, the combination of hypertension and hyperlipidemia were the most common (67.5%), followed by hypertension and overweigh or obesity together (66.0%). The other combinations demonstrated were hyperlipidemia and overweigh or obesity (62.5%), HTN and CKD (22.4%), hyperlipidemia and CKD which accounted 21.1%, HTN and CVD (20.2%), CVD and hyperlipidemia (20.1%), overweigh/obesity and CKD (19.1%) and overweigh/obesity and CVD (17.0%).

A retrospective cohort and case control study done on Prevalence, incidence and concomitant co-morbidities of type 2 diabetes mellitus in South Western Germany has been shown that the prevalence of adiposity, hypertension, coronary heart disease, stroke, renal insufficiency and

retinopathy were high in DM patents than non-diabetic patients. The results were prevalence rate of 31.13 vs 8.08, 77.01 vs 19.37, 22.99 vs3.32, 4.15 vs 0.64, 7.57 vs 1.23, 24.83 vs 3.24 respectively. The study had been also shown that the prevalence of hypertension, coronary heart disease, stroke, renal insufficiency and retinopathy were increasing with age, but the prevalence of adiposity increase with age, peak between 44-55 years then started to decrease(Boehme et al., 2015).

From a large English primary care cohort studies, more people living in the most deprived areas had ≥1 comorbidities present at the time of diagnosis (64% of males ;72% of females) when compared to the most developed areas (59% of males;67% of females). The study had been shown that hypertension is the most common comorbidity among T2DM patients with high prevalence in females than males (45.8% [45%; 46.4%] vs 42.8% [42.3–43.3%]). In females' depression was being the second most prevalent comorbid, and high in the most deprived areas (20.2% [19.3%; 21.1%]) than from most affluent areas (15.6% [14.7%; 16.5%]). In males CVD was the second common comorbidity next to the hypertension. It was being more prevalent in deprived areas (13.6% [12.9%; 14.3%]), than from the most affluent areas (10.8% [10.3%; 11.3%]). The study had been also shown that the hypertension and CKD had the highest age-standardized co prevalence rate among all patients and the prevalence increased with age and duration of DM(Nowakowska et al., 2019).

From the study done in northeastern Italy on prevalence and comorbidities of unknown diabetes, frequent isolated comorbidities were identified. Hypertension, cardiac dysrhythmias, other chronic forms of ischemic heart disease, heart failure, hypertensive heart disease were the most frequent comorbidities, accounting 39.5%, 22%,21.7%, 19.8% and 16.4% respectively. CKD (13.6%), chronic bronchitis (11.6%), disorders of lipid metabolism (10.2%), other disease of lung (9.2%), overweight and obesity (7.8%), atherosclerosis (7.6%), CLD and cirrhosis (6.3) were the other comorbidities identified(Valent, Tillati, & Zanier, 2013).

In another study done on large population of the Greece the prevalence of CV comorbidities was high in diabetes compared with non-diabetic patient (24.0% vs. 8.9%), although the study did not include the other causes of CV disease. The same study has been shown that the prevalence of lung diseases, kidney diseases, liver diseases, benign blood diseases, and solid organ and/or blood malignancies were higher in DM patient than non-diabetic populations(Tentolouris et al., 2018).

The other cross-sectional study done in patients with type 2 diabetes in a Mediterranean region(Mata-Cases, Franch-Nadal, Real, Cedenilla, & Mauricio, 2019) and a total of 373 185 patients were analyzed. The main results of the study were: 82% of patients exhibited ≥2 comorbidities and 31% of patients had at least 4 comorbidities. The most frequent comorbidities were hypertension (72%), hyperlipidemia (60%), obesity (45%), CKD (33%), chronic renal failure (CRF), (28%) and cardiovascular disease (23%). The most frequently co prevalent pairs of chronic conditions were the combination of hypertension with hyperlipidemia (45%), obesity (35%), CKD (28%), CRF (25%) or cardiovascular disease (19%), as well as the combination of hyperlipidemia with obesity (28%), CKD (21%), CRF (18%) or cardiovascular disease (15%). The combinations of obesity/CKD, obesity/CRF, hypertension/retinopathy, hypertension/albuminuria, hypertension/urinary tract infection, CVD/CRF and CVD/CKD were also not uncommon, present in more than 10% of patients.

A cross sectional survey done in India has been shown that overall 84% of T2DM patients have one or more comorbidity. Similar results to the most study, hypertension is the leading comorbidities in T2DM patients (62%), followed by acid peptic disease (28%), chronic back pain (22%) and osteoarthritis (21%). The average numbers of comorbidities in T2DM patient was two. 16% of T2DM patient had no comorbidities, 29% had one comorbidities, quarter of them had two comorbidities and 30% of them have three or more comorbidities. The study has also been shown that the number of comorbidities increase with age and most of them found at the age of 6o years and above for both males and females. The study showed that comorbidities in diabetes patients were highly related to the age. There was no significant difference regarding the sex, but the range of the number of comorbidities were wider in males than females (0-14 vs 0-6)(Pati & F.G.Schellevis, 2017).

The retrospective study carried out in Diabetic Unit at King Khalid Hospital, Hail, Kingdom of Saudi Arabia (KSA), from records of 50 diabetic patients, the comorbidities were found as follows: HTN (56%), thyroid disease (24%), Dyslipidemia (36%), Asthma (16%), Myocardial infarction (12%), Stroke (4%), Retinopathy (38%), Loss of vision (14%), Kidney complications (16%), Peripheral neuropathy (40%) of patients. Diabetic septic foot was also identified in 14% and amputation was done for 2 patients. In this study most of the comorbidities were found at the age of 45 years and above(Alshaya et al., 2017).

The other study was done on comorbidities and their associated factors among diabetic patients. Secondary data were studied from the data, Malaysian National Diabetic Registry, from all diabetics who had been received the treatment. 567,442 diabetic patients included for analysis. The mean age were 56.59 years. The common comorbidities identified in these study were, hypertension 65% (365,765), 55% (312,260) with dyslipidemia, 4% ischemic heart disease and 1% cerebrovascular disease. The study has been shown that as the number of comorbidities increase, the complications of diabetes increases with the highest hazard ratio risk: 1 comorbid (aHR: 2.47, 95% CI: 2.39, 2.55), 2 comorbidities (aHR: 4.34, 95% CI: 4.22, 4.47), 3 comorbidities (aHR: 6.56, 95% CI: 6.31, 6.81) and 4 comorbidities (aHR: 9.13, 95% CI:8.20,10.17). The same study had been shown that old age and smoking were contributing to the complications of diabetes mellitus(Asiah et al., 2018).

Study done in Africa

There is limitation of data on burden of chronic illness in Africa including east Africa, but regarding the results similar to the worldwide study. The study that has been done in different countries of Africa showed that hypertension was the leading comorbidities. From literature review that was conducted in East Africa the comorbidity of hypertension and diabetes mellitus is rising. The study done in Kenya has been also shown that the prevalence of hypertension among diabetes was higher among urban population than the rural areas. Life style, obesity and smoking were highly related to the comorbidities. It was found that among chronic complications like CKD, 90% were hypertensive, 16% were diabetic, 11.5% being smokers and 71.9% had HbA1c<11g/dl. In Tanzania hypertension was the leading comorbidities in diabetes patients (54.5%). 81.7% of them were on treatment, but in only 34%, the target level of control was achieved(Marwa, Immaculate, Gladness, Mtshali, & Gloria, 2017).

In the study that was done in south Africa colored population, the prevalence of metabolic syndrome was higher with the JIS definition (62.0%) than the IDF (60.6%), and the National Cholesterol Education Program (NCEP) ATP III (55.4%) (T. Erasmus et al., 2012). The other data from South African National Health and Nutrition Examination Survey has been shown that old age, physical inactivity and smoking were associated with cardiovascular comorbidities among diabetic patients(Mutyambizi et al., 2017).

Overweight and obesity, are risk for the development of DM and CVD. The highly increased prevalence of DM in Africa is highly linked to the obesity. In cohort study that was done among people aged >65 years in Nigeria, urban residence and high socioeconomic status were found to be the main risk factors for the development of DM(Kengne, Echouffo-Tcheugui, Sobngwi, & Mbanya, 2013).

A descriptive cross-sectional study was done in Kenya at rural and semi urban five hospitals. Out of 1548 case included for the study 59% were females with mean age of 58 ± 13.5 years. T2DM comprised 94-98 at different hospitals. Hypertension was the top comorbidities identified, but the prevalence was varied across the countries. The correlation between age, gender, and presence of a co- morbidity and diabetes different in the region(Githinji et al., 2019).

Study done in Ethiopia

There are few data available in Ethiopia. One of the cross-sectional study was conducted between December 2015 and April 2016, in Northern part of Ethiopia, on outpatient diabetes patients. 188 type 2 diabetic patients attending Ayder Referral Hospital were included for the study. In only 8.5% of diabetes patients, the combined targets of BP control, lipid control and plasma sugar control were achieved. 58.5% of diabetes mellitus have poor lipid control and more than half have high blood pressure. The study also showed that most of the patients (68.1%) had at least one comorbidity. Female sex had more dyslipidemia than males(Belay et al., 2017).

A cross-sectional community survey has been done in southern Ethiopia, on diabetes and risk factors. The identified associated factors were old age, high waist circumference, systolic HTN and postsecondary education(Zekewos, Loha, Egeno, Wubshet, & Merga, 2018).

From retrospective descriptive study using patient chart, who were admitted to black lion hospital, 418 medical records retrieved. Most of the patient included had T2DM (72%) and 28% of them had T1DM. 62% Of them were male and most of the patients were old age with median 60 years. The study showed 39% had diabetic foot ulcers and 21% have cardiovascular disease. 756 complications were identified. Neuropathy, Hypertension, nephropathy, diabetic foot ulcer and retinopathy constitutes for 85% of the complications. Diabetic foot ulcer/gangrene and cardiovascular disease were the main reason of admissions(Gizaw et al., 2015).

From systemic review, Hypertension, obesity and chronic kidney disease were the most frequent concordant conditions with heart failure being the least frequently measured. Among discordant comorbidity, depression was the most identified morbidity. The same systemic review also showed that most of the T2DM patents with comorbidities have poor adherent to their medication regimen than without comorbidities(Aga, Dunbar, Kebede, & Gary, 2019).

According to the survey conducted in Ethiopia on the screening of metabolic syndrome, the prevalence of raised blood pressure was 15.8%. The prevalence of diabetes mellitus including those on medication was 3.2%. 9.1% had impaired fasting glucose according to the ADA diagnostic criteria, but only 3.8% with WHO diagnostic criteria. 5.2%, had Hypercholesterolemia while 21.0% had hypertriglyceridemia. 14.1% had high LDL cholesterol and low HDL cholesterol was found in 68.7%. The study has been shown that, the prevalence of metabolic syndrome according to IDF definition was 4.8%. Obesity, raised waist circumference, old age, urban residence, lack of physical exercise, total blood cholesterol and raised waist hip ratio were significantly associated with raised blood pressure and diabetes mellitus(Gebreyes et al., 2018).

The other cross-sectional study was conducted at Jimma University Specialized Hospital(S. Tamiru & F. Alemseged, 2010) on associated factors of cardiovascular comorbidities among diabetic patients. The results were: hypertension was the most prevalent identified (46.5%), followed by obesity (23.4%) in diabetic patients. The other comorbidities identified were dyslipidemia and physical inactivity which account 63.5%, and 55.1% respectively. Type 2 diabetes, obesity and age more than 45 were risk factors for hypertension. The same study has been also shown that poor glycemic control (FBS ≥180mg/dl), female sex and hypertension were associated to dyslipidemia.

Even though adequate studies were not conducted in Ethiopia, few studies have been shown that, hypertension is the most common comorbidity identified in type 2 diabetes patients. Prospective cross sectional study was done in southwest Ethiopia on 300 T2DM patients with the hypertension comorbidity(Yimama et al., 2018). The identified results were: 64.7% were males and the mean age of the participants was 54.44 ± 11.68 years. Aspirin was prescribed to 182 (60.7%) participants. Statins were ordered to one-third (65.67%) of the patients.

3. METHODS AND MATERIALS

3.1. Study area and study period

The study was conducted at HFSUH, which is found in Harari, the capital city of Harari regional state located 526 KM from Addis Ababa, the capital of Ethiopia. Harar is surrounded by the State of Oromia. There are nine woredas and 19 kebeles in Harari region. The State's size is estimated at 340 km2.The Harari National Regional State (HNRS) is populated by 183,344 people with 1:1 male to female ratio CSA 2007).

According to the current regional health bureau report, there are 2 publics, 2 private, 1 police, 1 non-government (Fistula) hospitals in Harari region. Additionally, there are eight Health Centers, twenty-nine private clinics, twenty-six health posts and one regional laboratory were serving the community currently in the region.

Hiwot Fana Hospital is one of the two public Hospitals in the region. Its administration by Haramaya University and serves as the Referral Hospital of the Harari regional State and East Hararge Zone of Oromia. It is expected to serve about 5.2 million catchments. Diabetes patients have regular follow up at chronic medical follow up OPD. Diabetic clinic serves diabetic patients five times a week. Currently there are 382 diabetic patients who has been on follow up at chronic medical follow up OPD.

The study was conducted from October 1,2020 to October 30,2020

3.2. Study design

A Hospital - based cross- sectional study design was used.

3.3. Source population

All adult DM patients attending outpatient DM follow up clinic at Hiwot Fana Specialized University Hospital was the source of population

3.4. Study population

Randomly selected adult DM patient’s file, who has been on follow up at chronic follow up OPD, HFSUH from September 30,2019 to September 30, 2020.

3.5. Inclusion and Exclusion criteria

3.5.1. Inclusion criteria

- All adult diabetic patients who has been on follow from September 30,2019 to September 30, 2020 and having follow-up at least for 06 months at HFSUH.

3.5.2 Exclusion criteria

Patients whose medical record was lost or incomplete for independent variables.

Pregnant woman

3.6 Sample size determination

For the first objective: sample size was calculated by using single population proportion considering the following assumption: 95% CI, 5% margin of error and prevalence (68.1%) of the patients who had comorbidities (E. Belay et al., 2017). Accordingly, the sample size for the first objective was as depicted in the table 1.

For second objective: Double population proportion formulae was considered to address the second specific objective by considering formula,

$$n = \frac{(\mathrm{Z}\alpha/2 + \mathrm{Z}\beta)2 \ * \ (\mathrm{p1}(1-\mathrm{p1}) + \mathrm{p2}(1-\mathrm{p2}))}{(\mathrm{p1}-\mathrm{p2})2}$$

where Zα/2 is the critical value of the Normal distribution at α/2 (e.g. for a confidence level of 95%, α is 0.05 and the critical value is 1.96), Zβ is the critical value of the Normal distribution at β (e.g. for a power of 80%, β is 0.2 and the critical value is 0.84) and p1 and p2 are the expected sample proportions of the two groups(patients with at least one comorbidities and the vice versa).

Table 1. Sample size determination

Sample size determination by using Single population proportion formula for patients having at least one comorbidity		
Dependent variables	**Assumptions**	$n = \frac{\mathrm{Za}/2^2 * p * (1-p)}{\mathrm{d}^2}$
Prevalence of the patients who had comorbidities	P= 68.1%, d=0.05, CI=95%	$n = \frac{1.96^2 * 0.681 * 0.319}{0.05^2} = \mathbf{334}$
Sample size determination considering factors using double population proportion formula		

Factors associated (Independent variables)	$n = \frac{(\mathrm{Z}\alpha/2 + \mathrm{Z}\beta)2 \ * \ (\mathrm{p}1(1-\mathrm{p}1) + \mathrm{p}2(1-\mathrm{p}2))}{(\mathrm{p}1 - \mathrm{p}2)2}$	n
Sex against HTN P1=HTN among male= 57.7% P2=HTN among female= 45.2%	$\frac{(1.96 + 0.84)2 \ * \ (0.452(1-0.452) + 0.577(1-0{,}57}{(0.577 - 0.452)2}$	**247**
Sex Against dyslipidemia	$\frac{(1.96 + 0.84)2 \ * \ (0.679(1-0.679) + 0.51(1-0.49)}{(0.679 - 0.49)2}$	**129**

From the calculated sample size for the first and second objective, the adequate sample size which can address both objectives was 334. Considering 10% non- response rate the final sample size will be

334+334*10=368

3.7 Sampling procedure

Systematic random sampling method was used to select medical record charts. All lists of Medical Record Numbers of diabetic patients from adult outpatient diabetic clinic, HFSUH, who has been on follow up from September 30,2019 to September 30,2020, was taken from the Log book. Then the medical record numbers were listed. After this it was selected by Systematic random sampling method.

3.8 Data extraction tools and methods

The medical record chart of diabetic patients, who has been included in sample size was collected from the hospital card room and was used by data collection team to fill it. Secondary data from medical record chart of each patient was used.

Structured checklist prepared by Principal investigator, by reviewing literature was used to obtain important demographic data and registered comorbidities and their associated factors among adult diabetic patients by data collection team. The data collection team comprised of 10 medical interns and principal investigator. The principal investigator act as supervisor to coordinate data collecting process.

3.9 Variables

3.9.1 Dependent variable

Concordant DM comorbidities

3.9.2 Independent variables

Age, sex, type of diabetes, Payment modality, Initiation of primary prophylaxis, duration of diabetes, Treatment regimen, Residence, glycemic control

3.10 Operational definition

Concordant comorbidity: The presence or absence of at least one or more chronic conditions (hypertension, obesity, dyslipidemia, cardiovascular disease, and/or CKD), in diabetic patients(ADA, 2019).

Hypertension – Documented systolic blood pressure (SBP) ≥140mmHg or diastolic blood pressure ≥90 mmHg (at least two records in different days or four hours apart in a single day) or being on treatment for a physician diagnosed hypertension(European Society of Hypertension, 2018).

Dyslipidemia: the presence of at least one of the following: high plasma total cholesterol (>200mg/dl), high LDL-C (>130mg/dl), low HDL-C (<40mg/dl in men or < 50mg/dl in women), high triglyceride level (>150mg/dl) or being on treatment for a physician diagnosed dyslipidemia(American College of Cardiology, 2018).

Chronic kidney disease: Patients being on treatment for a physician diagnosed CKD, or urine dipstick protein ≥+1 at least two times in the last 03 months or serum creatinine level ≥1.2mg/dl in males and ≥ 1.0mg/dl in females at least two times in the last 03 months(American Family Physician, 2017).

CVD: Presence of at least one of the following: patients being on treatment for a physician diagnosed stroke or patients being on treatment for a physician diagnosed ischemic heart disease, ECG finding of ischemic heart disease (ST elevation or pathological Q waves) or echocardiography finding of ischemic heart disease (wall motion abnormality or akinesia or hypokinesia or dyskinesia)(American College of Cardiology, 2018).

Good Glycemic control: The recent (determined in less than 3 months) HgA1C less than 7%, or the last FBS ≤ 130mg/dl in the absence of document HgA1C. HgA1C >7% and/or FBS >130 mg/dl is bad glycemic control(ADA, 2019).

Body Mass Index (BMI): Calculated as: weight in kg/ (Height in meters)^2

<18 under weight

18-24.9 -Normal

25-29.9 -overweight

30-34.9 – Class 1 Obesity

35-39.9- Class 2 Obesity

≥40- Class 3 Obesity(Purnell, 2018).

3.11. Data quality control

The overall activity was controlled by the investigators of the study. The data collection team was trained on data collection process for 02 days. Data quality was controlled by designing the proper data collection materials and through continuous supervision. The medical chart number of the patient was checked whether clinically matched (diabetic patient) or not. Completeness, accuracy and consistency of data collection was checked on each day of the data collection period, before using the filled questionnaires. Data was cleaned and filled to Epi data version 3.1 by the principal investigator. All completed data collection form was examined for completeness and consistency during data storage and analysis.

3.12. Methods of data analysis

After data collection was complete, the data was edited and coded and entered in to Epi data version 3.1. then the data was exported to STATA version 16.0 for cleaning and analysis. Descriptive analysis like frequency, percent, mean, table, and graph were used to describe and present the data. Binary logistic regression was carried out to identify factors associated with DM comorbidities. Adjusted Odds Ratio with 95% CI was used to measure strength of association and

variables with $p \leq 0.05$ was considered as statistically being significant. Multicollinearity test was checked using VIF and good of the test was also checked.

3.13. Ethical consideration

Ethical clearance was secured from the Haramaya University, College of Health and Medical Sciences Institutional Health Research Ethics Review Committee (IHRERC) prior to data collection. An official letter was sent to Hiwot Fana Specialized University Hospital and informed voluntary consent form was taken from the head of the HFSUH prior to data collection. Purpose, procedure, duration, possible risks and benefits of the study was explained to the HFSUH administrator before consent. Cooperation letter was written to OPD and HFSUH Card room where medical record charts of diabetic patients was collected. Information gained from medical record charts was held anonymous and confidential. No names or personal identifiers was used on data collection forms. The findings were discussed with the HFSHU administrator and submitted to internal medicine department.

3.14. Dissemination plan

The finding of the study will be submitted to the department of Internal Medicine, School of Medicine and College of Health and Medical Sciences Haramaya University in partial fulfillment of the requirements for Internal medicine specialty. The copy of the research will be given to the hospital as well. The finding will also be presented for different work-shops and seminars and will be published in a peer reviewed journal.

4. RESULTS

Socio- demographic characteristics

A total of 319 adult diabetic patents' medical charts were reviewed yielding a response rate of 86.7%. Around 53.29% of the respondents were male gender and 58.4% were urban residents. The mean (± SD) age of the respondents was 44.94 (±17.27) years and around one-third were within the age group of 35-54 years of age. Regarding the schemes of payments for treatments for diabetic care, more than half, 53.29% of the adult diabetic out-patients were seeking diabetic care out-of-pocket (see table 2 for detail).

Table 2 . Socio-demographic characteristics of adult diabetic out-patients at HFSUH, October, 2020

Variables	Frequency (percentage)
Mean age of the respondents	44.94(SD ± 17.27)
Age (Years)	
18-24 years	49 (15.36)
25-34 years	41(12.85)
35-54 years	126 (39.50)
>=55 years	103 (32.29)
Sex	
Male	170 (53.29)
Female	149 (46.71)
Residence	
Urban	173(54.23)
Rural	146 (45.77)
Types of payment	
Fee waivers	149 (46.71)
Out of pocket	170(53.29)

Clinical characteristics

In the current study, the mean (±SD) duration of DM was 7.76 (SD± 6.42). The majority, 72.73% of the DM patients was diagnosed for Type -II DM and 40.44% were currently using Oral hypoglycemic agents for the treatment of DM. Based on clinical record review the mean fast blood sugar (FBS) of the respondents was 156.20 mg/dl. Glycemic control was calculated the average of the last three records of fasting blood sugar values. Overall, 57.37% of the patients showed poor glycemic control.

Table 3. Clinical characteristics of adult diabetic out-patients at HFSUH, October, 2020

Variables	Frequency (number/percentage)
BMI	
Overweight/obese	69 (21.63)
Underweight/ Normal	250 (78.37)
Glycemic control	
Controlled	136 (42.63)
Uncontrolled	183(57.37)
Types of DM	
Type I DM	87(27.27)
Type II DM	232 (72.73)
Duration of treatment in a year	
Less than or equal 1 year	33 (10.34)
2- 5 years	109 (34.17)
6-10 years	108 (33.86)
more than10 years	69(21.63)
Treatment for DM	
Insulin	120 (37.62)
Oral hypoglycemic agents	129 (40.44)
Both	70(21.94)
Oral hypoglycemic agents	
Metformin	103 (51.76)
Glibenclimide	6 (3.02)
Both	90(45.23)
Treatment of hypertension	
Yes	112 (35.11)
No	308 (96.55)
Ant hypertensive Drugs	
ACEI	44 (39.29)
ARB	2(1.79)
BB	1(0.89)
Diuretics	12 (10.71)
CCB	10 (8.93)
more than one medications	43(38.39)
Primary prophylaxis for CVD	
Yes	81(25.39)
No	238(74.61)
Urine dipstick protein	
Negative	264(82.76)
+1	35 (10.97)

+2	15 (4.70)
+3	5 (1.57)
Treatment of IHD	
Yes	22(6.90)
No	297(93.10)
Treatment of Stroke	
Yes	11 (3.45)
No	172(80.4)
Persistent Urine dipstick protein >+1	
Yes	29(9.09)
No	290 (90.91)
Persistent high creatinine level	
Yes	15 (4.70)
No	304 (95.30
On RRT or referred to nephrologist	
Yes	2 (0.63)
No	317 (99.37)
ECG features of ischemia	
Yes	18 (5.64)
No	301(94.36)
Echocardiography feature of ischemia	
Yes	19(5.96)
No	300 (94.04)

Prevalence of concordant comorbidity

The overall prevalence of concordant comorbidity among adult diabetic out-patients was 55.8% at 95% CI (50.3-61.3). Grounded on clinical record review, comorbidity Hypertension (42.32%), over weight/obesity (21.63%) CVD (8.15%), dyslipidemia (4.08%) and CKD (10.66%) were reported comorbidities among adult diabetic out-patients on follow up for treatment of DM. Hypertension was documented as major comorbid diseases reported(Figure1).

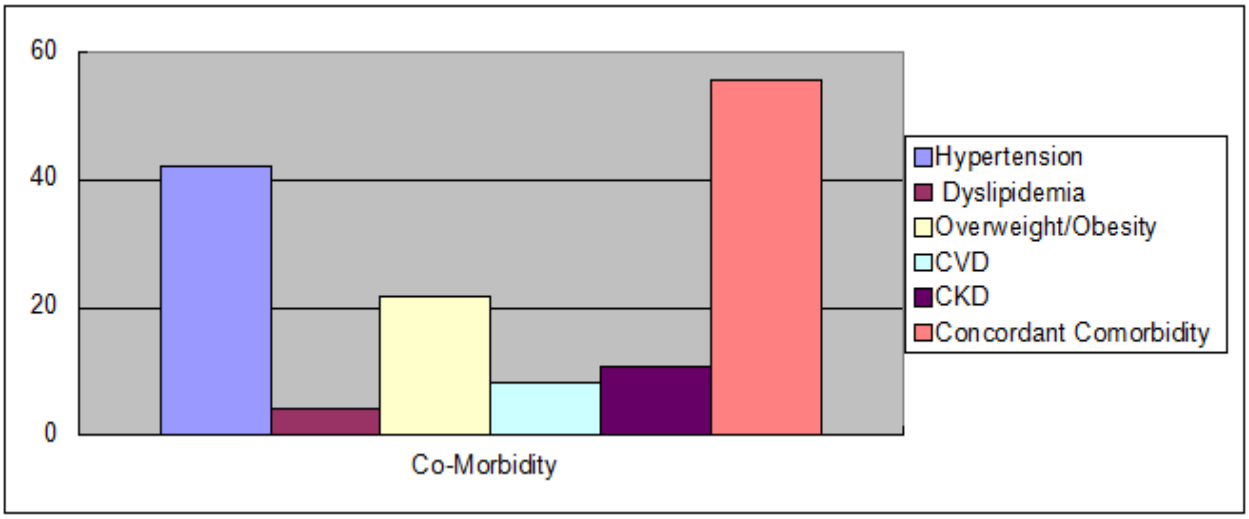

Figure 1 Distribution of spectrum of comorbid diseases among adult diabetic out-patients at HFSUH, October, 2020.

Factors Associated with concordant comorbidities.

Binary logistic regression was run to identify factors associated with the outcome variable. Accordingly, age, Types of DM, duration of treatment of DM, and glycemic control were identified as independent predictors that significantly associated with DM comorbidity. The odds of having concordant comorbidity among adult diabetic out-patients who were 55 or more years old was 7.52 times greater than those in the age group of 18-24 years old. In general, most of the cases of comorbidities were observed amongst elder people {AOR: 7.52, 95% CI (1.24, 45.75)}

Moreover, being type II DM patient resulted in increased odds of having concordant comorbidity. Adult diabetic out-patients of type II DM diagnosis were 9.01 times more likely develop concordant comorbidity as compared to those Type I DM {AOR: 9.01, 95% CI (1.50, 54.04**).** The study found that duration of diabetes of more than 10 years was significantly risk for having concordant comorbidity. Respondents who had 2-5years duration of DM treatments were 77% less likely develop concordant comorbidities as compared to those more than10 years {AOR: 0.23,95% CI (.08, .69)}. Likewise, an odd of having concordant comorbidity among adult diabetic out-patients of poor glycemic control was 4.41 times greater than those of good glycemic control {AOR: 4.4 1, 95% CI (2.34, 8.32)} (Table 4).

Table 4. Multiple logistic regression analysis for demographic and clinical risk factor concordant comorbidities among adult diabetic out-patients at HFSUH, October, 2020

Expiatory variables	Concordant Comorbidity		COR(95% CI)	AOR(95%CI)	p-value
	No(n=141)	Yes(n=178)			
Age (Years)					
18-24 years	45 (31.91)	4(2.25)	1	1	
25-34 years	32 (22.70)	9(5.06)	3.16 (.89, 11.18)	1.63 (.39, 6.77)	0.498
35-54 years	50 (35.46)	76(42.70)	17.1(5. 78, 50.51)	3.40 (.67, 17.37)	0.141
>=55 years	14 (9.93)	89(50.00)	71.51 (22.25, 229.88)	7.52 (1.24, 45.75)	0.029
Residence					
Urban	68(48.23)	105(58.99)	1	1	
Rural	73 (51.77)	73(41.01)	1.54(.1.14, 2.10	.79(.43, 1.46)	0.451
Types of DM					
Type I DM	74 (52.48)	13(7.30)	1	1	
Type II DM	67(47.52)	165(92.70)	114.01 (.7.29, 26.97)	9.01 (1.50, 54.04)	0.016
Duration of treatment in a year					
Less than or equal 1year	18 (12.77)	15(8.43)	.125 (.05, .33)	.28 (.075, 1.08)	0.064
2- 5 years	75 (53.19)	34(19.10)	.068 (.03, .15)	.23 (.08, .69)	0.009
6-10 years	39 (27.66)	69(38.76)	.26 (.11 21. .59)	.61 (.22, 1.70)	0.344
More than10 years	9(6.38)	60(33.71)	1	1	
Treatment for DM					
Insulin	77 (54.61)	43(24.16)	1	1	
Oral hypoglycemic agents	47(33.33)	82(46.07)	3.12 (1.86, 5.24)	.63(.14, 2.77)	0.543
Both	17(12.06)	53(29.78)	5.58 (2.88, 10.82)	.36 (.08, 1.62)	0.185
Glycemic control					
Controlled	94(66.67)	42(23.60)	1	1	
Uncontrolled	47(33.33)	136(76.40)	6.48(3.96, 10.59)1	4.4 1(2.34, 8.32)	0.000

5.DISCUSSION

The present study assessed the prevalence of concordant DM comorbidities and its associated factors among adult diabetic out-patients at HFSUH, Eastern Ethiopia. Diabetes mellitus with comorbid complications constitute a major public health problem worldwide (Ekoru et al., 2019). Globally, DM comorbidities significantly increase the burden of diabetes mellitus (J. Piette & E. Kerr, 2006). In the present study, a high prevalence of concordant comorbidities among adult diabetic out-patients 55.8% at 95% CI (50.3-61.3) was documented in this study area. The current result of the prevalence of concordant comorbidities among diabetic patients is comparably lower than the findings of studies conducted in different parts of the world, Mediterranean region (82%), India (84%) and Ethiopia (68.1%) (Mata-Cases, Franch-Nadal, Real, Cedenilla, & Mauricio, 2019, Pati & F.G.Schellevis, 2017, Belay et al., 2017). In contrast, this study found a slightly higher prevalence as compared to the previous cross-sectional study done in Scotland, which found 42.2%(Mary, Tinetti, Terri R. Fried, & Cynthia M. Boyd, 2012. The reason for variation across studies might be due to the difference in the target population, most of the studies used patients with type 2 diabetes, which is different from this study that considered both types of DM. Further, the context of socio-demographic variations and methodologies used might explain the observed differences.

The finding of the current study also showed that patients with diabetes mellitus have a high prevalence of concordant comorbidities, particularly comorbidities related to diabetes, such as hypertension, cardiovascular disease, dyslipidemia, and chronic kidney disease. The most prevalent comorbidity was Hypertension (42.32%) and followed by Overweight/Obesity 21.63% and CKD (10. 66%). These comorbidities as well as display a high prevalence of comorbidities in these patients. This finding is in agreement with studies conducted, in the UK (Nowakowska et al., 2019), Jarman (Boehme et al., 2015), and Italy(Valent, Tillati, & Zanier, 2013) which had shown that hypertension is the most common comorbidity among DM patients. Thus, strong evidence demonstrated that hypertension, Obesity and CKD diseases were most common (Valent, Tillati, & Zanier, 2013, Mata-Cases, Franch-Nadal, Real, Cedenilla, & Mauricio, 2019, Pati & F.G.Schellevis, 2017, Marwa, Immaculate, Gladness, Mtshali, & Gloria, 2017))

Factors associated with the occurrence of comorbidities among adult DM patients who were on follow-up were as well assessed. Age was one of the identified risk factors associated with developing comorbidities among DM patients. The odds of having concordant comorbidity among

adult diabetic out-patients who were 55 or more years old was 7.52 times greater than those in the age group of 18-24 years old. In general, most of the cases of comorbidities were observed amongst elder people {AOR: **7.52, 95% CI (1.24, 45.75)}**. Accordingly, occurrences and burden of chronic comorbidities in patients with diabetes in the current study increase with age. Consistent results were reported by Mary et al, Tinetti, who found that occurrence of comorbidity increased substantially with age and was present in most people aged 65 years and older in a study using a similar design with a larger database (Mary, Tinetti, Terri R. Fried, & Cynthia M. Boyd, 2012). Another evidence generated by Barnett et al concluded that more than 75% of individuals age 65 years and above have multiple chronic conditions, but less frequent for young age groups(Barnett et al., 2012). Moreover, the retrospective study carried out in the Diabetic Unit at King Khalid Hospital, Hail, Kingdom of Saudi Arabia had shown that most of the comorbidities were found at the age of 45 years and above (Alshaya et al., 2017). This might be due to as age increase blood vessels become hard, losing their elasticity and become more stiffened. GFR is also decreases with age (Gates,2009).

This study noticed an association of types of diabetes mellitus with the occurrence of comorbidity among adult patients. Adult diabetic out-patients of type II DM diagnosis were 9.01 times more likely develop concordant comorbidity as compared to those who were diagnosed Type I DM {**AOR: 9.01, 95% CI (1.50, 54.04**). The current result is consistent with studies done in northeastern Italy and the Mediterranean region, which reported that having type 2 diabetes mellitus was a risk factor for the occurrence of comorbidity and; Patients with type 2 diabetes have a high frequency of co-prevalence of metabolic risk factors for comorbidity among DM patents (Valent, F., Tillati, S., & Zanier, L. (2013, Mata-Cases, M., Franch-Nadal, J., Real, J., Cedenilla, M., & Mauricio, D. (2019). Patients with type II DM are much more likely to experience more concordant comorbidity than those with Type I DM. This might be due to high atherogenesais in T2 DM. The duration and age might also affect. dyslipidemia, and insulin resistance will be more pronounced in T2DM. (Wolfsdorf Ji et al, 2018).

The finding of the present study documented that the duration of diabetes is a risk factor for diabetes mellitus comorbidity. The study found that the duration of diabetes of more than 10 years was significantly risked of having concordant comorbidity. Accordingly, respondents who had 2-5 years' duration of DM treatment were 77% {AOR: 0.23,95% CI (.08, .69)} less likely to develop

comorbidities as compared to those more than10 years. This result is in agreement with a study done in Malaysia and Debre Tabor General Hospital which noted that a longer duration of DM treatment contributes to increased risk for diabetes complications (Muhamad et al, 2018, Yonas Akalu 2019). This might be due to as duration increase the effect of hyperglycemia, dyslipidemia, and insulin resistance will be more pronounced. Moreover, changes caused by DM such as microvascular damage, sympathetic damage, an enhanced RAS, decreased insulin sensitivity will get worse (Patel,2016)

The current study identified that glycemic control is another dominant for the experience of comorbidities among DM patients. An odd of having concordant comorbidity among adult diabetic out-patients of poor glycemic control was 4.41 times greater than those of good glycemic control {AOR: 4.4 1, 95% CI (2.34, 8.32)}. A consistent finding was reported by a cross-sectional study conducted in Jimma University Specialized University Hospital, which has shown that poor glycemic control was significantly associated with risky of experiences of comorbidity among adult diabetic patients(S. Tamiru & F. Alemseged, 2010). This finding is also in agreement with the study that was conducted in Debre Tabor General Hospital (Yonas Akalu 2019). This might be due to excess glucose chemically attaches to free amino groups of proteins collagen and other long lived proteins in blood vessel walls, which, in turn may trap circulating LDL that promotes the deposition of cholesterol in the intima thus accelerates atherogenesis. Hyperglycemia also increases the osmolality of the extracellular fluid, triggering water to shifts from the intracellular to extracellular space and cause volume expansion and high BP. (Wolfsdorf Ji et al, 2018).

A better understanding of diabetic-related comorbidities and their associated factors can enhance the type and capacity of medical health care utilization as well as enables to gain vision into future health care burdens of patients with DM. Cross-sectional nature of the study makes some variables less explanatory and the cause-effect of relationships cannot be measured. This study only included certain comorbidities; therefore, this result only reflects a snapshot of diabetes-related comorbidities. Since most of the diagnoses were based on data recorded in the charts, a misclassification cannot be excluded.

6. CONCLUSION AND RECOMMENDATION

Consistent with previous studies, the current findings show that patients with diabetes have a high prevalence of concordant comorbidity, therefore multiple demands on the health care providers. Ages, types of DM, duration of treatment of DM and glycemic control were acknowledged as independent predictors of experiences of concordant comorbidity. Health care providers caring for DM patients should take co morbid conditions into account since co morbidity is the rule rather than the exception. The providers should focus on diabetic glycemic control and should give extra attention on diabetic patients who are at risk to develop comorbidities like older, T2DM and being on follow up for long period of time. This finding underline the importance for formulation of coordinated and comprehensive health care policies for clinical care of diabetics which includes not only diabetes care, but also care for the most common co morbid conditions. Prevention of comorbidities among diabetic patients needs screening and early identification and managements are components of comprehensive diabetes care. When diabetic patients have multiple chronic comorbidities, screening, counseling, and treatment needs can far exceed the time available for patient-provider visits. Life style modification is the other strategy to prevent comorbidities among diabetic patients. Finally, further studies are required in to search and produce extra suggestion.

7.REFERENCE

ADA, A. D. A. (2018). Standards of medical care in diabetes. THE JOURNAL OF CLINICAL AND APPLIED RESEARCH AND EDUCATION, 41, 150. doi:10.2337/dc18-SPPC01

ADA, A. D. A. (2019). Standards of Medical Care in Diabetes. THE JOURNAL OF CLINICAL AND APPLIED RESEARCH AND EDUCATION, 42, Supplement 1(care.diabetesjournals.org/content/42/Supplement_1.), S1-S193. doi:10.2337/dc19-SINT01

Aga, F., Dunbar, S. B., Kebede, T., & Gary, R. A. (2019). The role of concordant and discordant comorbidities on performance of self-care behaviors in adults with type 2 diabetes: a systematic review. Dovepress, 12, 333–356.

Alshaya, A. K., Alsayegh, A. K., Alshaya, H. K., Almutlaq, B. A., Alenazi, N. S. G., Rasheedi, H. M. A. A., . . . Ahmed, H. G. (2017). The Common Complications and Comorbidities among Saudi Diabetic Patients in Northern Saudi Arabia. Open Journal of Endocrine and Metabolic Diseases, 7, 151-161. doi:10.4236/ojemd.2017.77014

American Assosiation of Clinical Endocrinologists, A. (2015). Management of common comorbidities of Diabetes. AACE Diabetes Resource Center.

American College of Cardiology, A. (2018). Guideline on the Management of Blood Cholesterol. doi:10.1016/j.jacc.2018.11.003

American Family Physician, A. (2017). Chronic Kidney Disease: Detection and Evaluation. AFP Journal, 12, 776-783.

Asiah, N., Muhamad, Hatta, M., Mutalip, A., Mustapha, N., Dali, N. S. M., . . . Sulaiman, L. H. (2018). Association between Comorbidities and Selected Sociodemographic Factors with Complications of Diabetes: Results from the National Diabetic Registry Malaysia. Journal of Diabetes Mellitus, 8, 84-97. doi:10.4236/jdm.2018.83009

Barnett, K., Mercer, S. W., Norbury, M., Watt, G., Wyke, S., & Guthrie, B. (2012). Epidemiology of multimorbidity and implications for health care, research, and medical education: a cross-sectional study. 380, 37–43. doi:10.1016/S0140-6736(12)60240-2

Belay, E., Abera, A., Mehari, A., Gebremeskel, G., Endrias, A., & Endris, K. (2017). Achievements of Diabetes Goals and Their Determinants in Type 2 Diabetic Patients Attending Outpatient Diabetic Clinic in Northern Ethiopia. International Journal of Chronic Diseases, 1-8. doi:10.1155/2017/5713187

Boehme, M. W. J., Buechele, G., Frankenhauser-Mannuss, J., Jana Mueller, D. L., Boehm, B. O., & Rothenbache, D. (2015). Prevalence, incidence and concomitant co-morbidities of type 2 diabetes mellitus in South Western Germany - a retrospective cohort and case control study in claims data of a large statutory health insurance. BMC Public Health, 15:855, 1-18. doi:10.1186/s12889-015-2188-1

Du, Y., Heidemann, C., Gößwald, A., Schmich, P., & Scheidt-Nave, C. (2013). Prevalence and comorbidity of diabetes mellitus among non-institutionalized older adults in Germany - results of the national telephone health interview survey'German Health Update (GEDA)' 2009. BMC Public Health, 13:166, 1-13.

Ekoru, K., Doumatey, A., Bentley, A. R., Chen, G., Zhou, J., & Shriner, D. (2019). Type 2 diabetes complications and comorbidity in Sub-saharan Africans. EClinicalMedicine, 16, 30-41. doi:10.1016/j.eclinm.2019.09.001s

Erasmus, R. T., Soita, D. J., Hassan, M. S., Blanco-Blanco, E., Vergotine, Z., Kengne, A. P., & Matsha, T. E. (2012). High prevalence of diabetes mellitus and metabolic syndrome in a South African coloured population: Baseline data of a study in Bellville, Cape Town. SAMJ, Vol. 102, No. 11, 841-844. doi:10.7196/SAMJ.5670

European Society of Hypertension, E. (2018). Guidelines for the management of arterial hypertension. European Heart Journal, 00, 1-98.

Gebreyes, Y. F., Goshu, D. Y., Geletew, T. K., Argefa, T. G., Zemedu, T. G., Lemu, K. A., . . . Belayneh, A. B. (2018). Prevalence of high blood pressure, hyperglycemia,dyslipidemia,metabolic syndrome and their determinants in Ethiopia: Evidences from the National NCDs STEPS Survey,2015. PLOS ONE, 13(5):e0194819, 1-18. doi:10.1371/journal.pone.0194819

Githinji, G. G., Hussein, A. A., Kimani, T., Mutuku, B., Githuku, J., Gura, Z., . . . Ransom, J. (2019). Prevalence of diabetes and co-morbidities in five rural and semi-urban Kenyan counties, 2010–2015. ResearchGate, 1-13. doi: 10.1007/s13410-017-0566-1

Gizaw, M., Harries, A. D., Ade, S., Tayler-Smith, K., Ali, E., Firdu, N., & Yifter, H. (2015). Diabetes mellitus in Addis Ababa, Ethiopia: admissions, complications and outcomes in a large referral hospital. Public Health Action, 5 no 1, 74–78. doi:10.5588/pha.14.0107

Iglay, K., Hannachi, H., Howie, P. J., Jinfei Xu, X. L., & Engel, S. S. (2016). Prevalence and Co-prevalence of comorbidities among patients with type 2 diabetes mellitus. Current Medical Research and Opinion, 32(7), 1243-1252. doi:10.1185/03007995.2016.1168291

International Diabetes Federation, I. (2017). IDF Diabetes atlas Eighth edition. MERCK, 1-150.

J. Piette, P., & E. Kerr, M., MPH. (2006). The Impact of Comorbid Chronic Conditions on Diabetes Care. 29,number3, 725-731.

Kengne, A. P., Echouffo-Tcheugui, J.-B., Sobngwi, E., & Mbanya, J.-C. (2013). New insights on diabetes mellitus and obesity in Africa–Part 1: prevalence, pathogenesis and comorbidities. Global burden of cardiovascular disease, 99, 979–983. doi:10.1136/heartjnl-2012-303316

Marwa, Immaculate, Gladness, G., Mtshali, & Gloria. (2017). Comorbidity of Diabetes And Hypertension And Available Management Strategies In Eastern African Region. IOSR Journal of Nursing and Health Science, 6(6), 01-09. doi:10.9790/1959-0606070109

Mary, Tinetti, M., Terri R. Fried, M., & Cynthia M. Boyd, M., MPH. (2012). Designing Health Care for the Most Common Chronic Condition —Multimorbidity. JAMA, 307(23, 2493–2494. doi:10.1001/jama.2012.5265

Mata-Cases, M., Franch-Nadal, J., Real, J., Cedenilla, M., & Mauricio, D. (2019). Prevalence and coprevalence of chronic comorbid conditions in patients with type 2 diabetes in Catalonia: a population-based cross-sectional study. BMJ, 9:e031281, 1-9. doi:10.1136/bmjopen-2019-031281

Mutyambizi, C., Chola, L., Groot, W., Pavlova, M., Labadarios, D., & Hongoro, C. (2017). The extent and determinants of diabetes and cardiovascular disease comorbidity in South Africa–results from the South African National Health and Nutrition Examination Survey (SANHANES-1). BMC Public Health, 17:745 1-11. doi:10.1186/s12889-017-4792-8

Norlund, A., Apelqvist, J., Bitzeân, P.-O., P.Nyberg, & Schersteân, B. (2001). Cost of illness of adult diabetes mellitus underestimated if comorbidity is not considered. Journal of Internal Medicine 250, 57-65. doi:10.1046/j.1365-2796.2001.00852

Nowakowska, M., Zghebi, S. S., Ashcroft, D. M., Buchan, I., Chew-Graham, C., Holt, T., . . . Kontopantelis, E. (2019). The comorbidity burden of type 2 diabetes mellitus: patterns, clusters and predictions from a large English primary care cohort. BMC Medicin, 17:145, 1-10. doi:10.1186/s12916-019-1373-y

Pati, S., & F.G.Schellevis. (2017). Prevalence and pattern o fcomorbidity among type2 diabetics attending urban primary health care centers a t Bhubaneswar (India). PLOS ONE, 12(8), 1-12. doi:10.1371/journal.pone.0181661

Purnell, Q. (2018). Definitions, Classification, and Epidemiology of Obesity. 1.

S. Tamiru, M., & F. Alemseged, M., MPH. (2010). Risk factors for cardiovascular diseases among diabetic patients in southwest Ethiopia. Ethiop J Health Sci., 20, No. 2, 121-128.

Tentolouris, A., Eleftheriadou, I., Athanasakis, K., Kyriopoulos, J., Tsilimigras, D. I., Grigoropoulous, P., . . . Tentolouris, N. (2018). Prevalence of diabetes mellitus as well as cardiac and other main comorbidities in a representative sample of the adult Greek population in comparison with the general population. Hellenic Journal of Cardiology, 1-8. doi:10.1016/j.hjc.2018.04.008

Valent, F., Tillati, S., & Zanier, L. (2013). Prevalence and comorbidities of known diabetes in northeastern Italy. Journal of Diabetes Investigation, 4(4), 355-360. doi:10.1111/jdi.12043

World Health Organization, W. (2006). Definition and diagnosis of diabetes mellitus and intermediate hyperglycemia: report of a WHO/IDF consultation.

Yimama, Jarso, & Desse. (2018). Determinants of drug-related problems among ambulatory type 2 diabetes patients with hypertension comorbidity in Southwest Ethiopia: a prospective cross sectional study. BMC Research Notes, 11:679 (1-6), 1. doi:10.1186/s13104-018-3785-8

Zekewos, A., Loha, E., Egeno, T., Wubshet, K., & Merga, Z. (2018). Prevalence of Diabetes Mellitus and Associated Factors in Southern Ethiopia. Ethiop J Health Sci., 28, No. 4, 451-460. doi:10.4314/ejhs. v28i4.11

8. APPENDICES

7.1 INFORMATION SHEET AND INFORMED VOLUNTARY CONSENT FORM FOR HEAD OF HIWOT FANA SPECIALIZED UNIVERSITY HOSPITAL

My name is _____ I am working as a data collector for the study being conducted in this hospital by Dr. Abdisa Ejeta who is studying for his Internal Medicine Specialist at Haramaya University, the College of Health and Medical Sciences. I kindly request you to lend me your attention to explain you about the study and your institution being selected as the study setting.

1.The study/project title:

THE PREVALENCE OF CONCORDANT DIABETES COMORBIDITIES AND ASSOCIATED FACTORS AMONG ADULT DIABETIC OUT-PATIENTS AT HIWOT FANA SPECIALIZED UNIVERSITY HOSPITAL, HARAR, EASTERN ETHIOPIA.

2. Purpose/aim of the study:

The findings of this study can be of a paramount importance for the Hospital in planning and allocating both human and financial resources as comorbidity has been shown to intensify health care utilization and to increase medical care costs for patients with diabetes and also to formulate strategies to improve the quality of diabetes care and delay or decrease diabetes related complications Moreover, the aim of this study is to write a thesis as a partial requirement for the fulfillment of Internal medicine specialty.

3. Procedure and duration:

I will fill Secondary data from medical record chart of each patient for 25 minutes. The medical record chart will be collected from hospital card room with permission.

4. Risks and benefits:

The risk of taking secondary data from the patients file is very minimal, but the findings from this research may reveal important information for the hospital, providers and for the patients.

5. Confidentiality:

The information that we will be provided will be kept confidential. There will be no information that will identify the participants in particular. The findings of the study will be

general for the study community and will not reflect anything particular of individual persons. The questionnaire will be coded to exclude showing names.

6. Rights:

The hospital/card room has the right to get the medical chart of the patients at any time.

7. Contact address:

If there are any questions or enquires any time about the study or the procedures, please contact:

Dr. Abdisa Ejeta (principal investigator)

Phone numbers +251911756140_or +251909874141

email address- abdisaejeta@gmail.com

contact address of Institutional Health Research Ethics Review Committee (IHRERC)

office phone 0254662011

P.O.Box 235, Harar

8. Declaration of informed voluntary consent:

I have read the participant information sheet. I have clearly understood the purpose of the research, the procedures, the risks and benefits, issues of confidentiality, the rights to get the patients file at any time and the contact address for any queries. I have been given the opportunity to ask questions for things that may have been unclear. I am also informed that the Hospital has the right to stop this study from being conducted if any misdeeds and unethical procedures are observed during the data collection process in the Hospital's premises. Therefore, I declare my voluntary consent on behalf of HFSUH management to allow this study to be conducted in the Hospital with my initials (signature).

Name and Signature of Head of the Hospital: _____

Name and Signature of Data Collector: _____

7.2 Data collection check list

Instructions: write the required information or circle the number

NOTE: If the information is not available on the chart of the patient (either it is not recorded, or the investigation was not done/missed) leave the space provided empty or do not circle the No**.**

Date: _____/_____/_____ Code no: _____

I. Socio-demographic characteristics			
Code	**Variable**	**Response**	**Skip**
01	Age in years	_____years	
02	Sex	1. Male 2. Female	
03	Residence	1. Urban 2. Rural	
04	Payment modality for the treatment	1. Free 2. Out-of-pocket 3. Insurance	
Medical and clinical characteristics			
05	weight	_____Kg	
06	Height	_____m	
07	BMI	_____Kg/m2	
08	Types of DM	1. T1DM 2. T2DM 3. Other	
09	Duration of DM, after diagnosis	_____ years (fill "00" if less than one year)	
10	Treatment of DM?	1. Insulin 2. Oral hypoglycemic agents 3. Both	
11	If Oral hypoglycemic agents, please specify	1. Metformin 2. Glibenclimide 3. Others (specify)_____	

12	Recent three blood pressure measurements at least 04 hrs apart	_____ _____ _____ mm/hg	
13	Is the patient being on treatment for a physician diagnosed hypertension?	1. Yes 2. No	
14	If yes to code 13, specify the name/names of the drug/drugs	1. ACEI 2. ARB 3. Beta blockers 4. Diuretics 5. Calcium channel blockers	
15	Is the patient being on treatment for a physician diagnosed stroke?	1. Yes 2. No	
16	If yes to code 15, specify the name/names of the drug/drug	1. ASA 2. Statin 3. ACEI 4. Calcium channel blockers 5. Others (specify)_____	
17	Is the patient being on treatment for a physician diagnosed IHD?	1. Yes 2. No	
18	If yes to code 17, list, the name/names of drug/drugs	1. ACEI 2. ARB 3. Beta blockers 4. Aspirin 5. Calcium channel blockers 6. Statin 7. Others (specify)_____	
19	Is the patient being on treatment for a physician diagnosed CKD?	1. Yes 2. No	
20	If yes to code 19, list, the name/names of drug/drugs	1. ACEI 2. ARB 3. Beta blockers 4. Diuretics	

		5. Calcium channel blockers 6. Others (specify)_____	
21	Urine dipstick protein ≥ +1 at least two times in the last 03 months?	1. Yes 2. No	
22	Is there any Documented persistent high creatinine level (creatinine ≥1.2mg/dl for male and ≥1.0 for female) at least for 03 months?	1. Yes 2. No	
23	Is the patient being on RRT or referred to nephrologist?	1. Yes 2. No	
24	Is the patient being on treatment for a physician diagnosed dyslipidemia?	1. Yes 2. No	
25	Is the patient being on the primary prophylaxis for CVD?	1. Yes 2. No	
Laboratory results			
26	FBS the last record three records	_____ _____ _____ mg/dl	
27	HgA1c level (the recent)	_____%	
28	Urine dipstick protein (Recent)	1. +1 2. +2 3. +3 4. +4	
29	Serum Creatinine (recent)	_____mg/dl	
30	HDL	_____mg/dl	
31	LDL	_____mg/dl	
32	Triglyceride	_____mg/dl	
33	Total cholesterol	_____mg/dl	
34	ECG: is there features of ischemia (ST elevation or pathological Q wave)?	1.Yes 2. No	
35	Echocardiography: Is there features of ischemic heart disease wall motion abnormality or akinesia or hypokinesia or dyskinesia)?	1.Yes 2. No	