ADDIS ABABA UNIVERSITY

COLLEGE OF HEALTH SCIENCES

SCHOOL OF PUBLIC HEALTH

ASSOCIATION BETWEEN MULTI-MORBIDITY AND BLOOD GLUCOSE CONTROL AMONG ADULT PATIENTS WITH TYPE 2 DIABETES MELLITUS AT SELECTED HEALTH CENTERS IN ADDIS ABABA, ETHIOPIA, 2024

By: EPHRATA TEGEN(BSc)

THESIS SUBMITTED TO THE GRADUATE PROGRAM OF THE ADDIS ABABA UNIVERSITY, COLLEGE OF HEALTH SCIENCES, SCHOOL OF PUBLIC HEALTH IN PARTIAL FULFILLMENT FOR THE DEGREE OF MASTER OF PUBLIC HEALTH IN EPIDEMIOLOGY AND BIOSTATISTICS SPECIALITY.

Date: JUNE, 2024

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APPROVAL SHEET

ADDIS ABABA UNIVERSITY SCHOOL OF GRADUATE STUDIES

As thesis research advisor, I hereby certify that I read and evaluated this thesis prepared under my guidance by Ephrata Tegen, entitled: "Association between multimorbidity and blood glucose control among patients with type 2 diabetes mellitus at selected Health Centers, Addis Ababa, Ethiopia, 2024: Unmatched case-control study, in partial fulfillment of the requirements for the Degree of Master of Public Health speciality in Epidemiology and Biostatistics is recommended to be submitted as fulfilling the thesis requirements and regulations of the University and meets the accepted standards to originality and quality.

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Abstract

Background- Uncontrolled blood glucose level is an important public health concern due to the development of diabetic-related complications and death. Multi-morbidity is considerably more common in type 2 diabetes patients, and it can have a substantial effect on blood glucose control. However, despite a high prevalence of multimorbidity reported in Addis Ababa, its association with blood glucose control was not well studied in this study area.

Objective- To assess the association between multi-morbidity and blood glucose control among adult type 2 diabetes patients at selected health centers, Addis Ababa, Ethiopia, 2024.

Methods- A facility-based unmatched case-control study was carried out from February 12 to March 31, 2024, using interviewer-administered structured questionnaires and medical records. A multi-stage sampling method was employed in the selection of study participants. Data were collected using KoboToolbox and exported to the Statistical Package for Social Science version 26.0 for analysis. Bivariable and Multi-variable logistic regressions were utilized to determine the association between multi-morbidity and blood glucose control and other determinant factors associated with uncontrolled blood glucose.

Results- The response rate of the study participants was 98%. From the participants, 148(43.3%) had multi-morbidity, of which 92 (80.7%) had uncontrolled blood glucose control. The presence of multi-morbidity (AOR: 6.52, CI: 2.92-14.54) was significantly associated with uncontrolled blood glucose levels. Moreover, medication non-adherence (AOR: 2.42, CI: 1.03-5.71), using oral hypoglycemic agent alone (AOR: 0.11, CI: 0.01-0.82), having polypharmacy (AOR: 0.03, CI: 0.01-0.16), dietary non-compliance (AOR: 4.44, CI: 1.8-10.94) and alcohol consumption (AOR: 3.63, CI: 1.36-9.69) were determinants of uncontrolled blood glucose level.

Conclusion: This study showed that significant number of patients with type 2 diabetes mellitus failed to control their blood glucose levels due to additional non-communicable chronic diseases they had. Therefore, need to consider comprehensive patient-centered approaches that take into account the complex care needs of those patients living with multi-morbidity.

Keywords: Multi-morbidity, Diabetes Mellitus, blood glucose control, Addis Ababa.

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Abbreviation and acronyms

AAU	Addis Ababa University
ADA	American Diabetic Association
AOR	Adjusted odd ratio
BMI	Body mass index
CI	Confidence interval
CKD	Chronic kidney disease
CVD	Cardiovascular disease
DHL	Diabetic Health Literacy
DM	Diabetes mellitus
ED	Emergency Department
ETB	Ethiopian Birr
FBS	Fasting blood sugar
HbA1C	Glycated Hemoglobin A1C
HC	Health Center
HTN	Hypertension
IRB	Institutional Review Board
LDL	Low Density Lipoprotein
NCDs	Non Communicable Diseases
NGO	Non Governmental Organization
OHA	Oral Hypoglycemic Agent
PAD	Peripheral Arterial Disease
SC	Sub-City

SDSCA	Summary of Diabetes Self- Care Activities
SMBG	Self-Monitoring Blood Glucose
SPSS	Statistical package for the social sciences
TASH	Tikur Anbessa Specialized Hospital
USD	United States Dollar
VIF	Variance Inflation Factor
WHO	World health organization

1. Introduction

1.1 Background

Diabetes mellitus is a chronic metabolic disease that occurs when the blood glucose level is raised. There are four general classifications of diabetes mellitus, based on the American Diabetic Association; Type 1, Type 2, specific diabetes due to other causes (for example monogenic diabetes, syndrome, disease of the exocrine pancreas, and drug or chemical-induced diabetes), and gestational diabetes mellitus (1). Type 2 diabetes mellitus, is the most common type which is usually caused by the body's resistance to insulin (2).

Diabetes was estimated to affect 536.6 million people in 2021; by 2030 that number is expected to increase to 643 million, and by 2045 it will have reached 783.2 million, and an estimated 6.7 million persons aged 20-70 are believed to have died in 2021 from diabetes or its complications, as well as the global health cost related to diabetes were predicted to be 966 billion USD in 2021, and are projected to increase to 1,054 billion USD by 2045 (3).

Blood glucose control is the optimal blood glucose level in diabetes patients, and there are three different indicators of blood glucose control: fasting blood sugar, postprandial glucose, and glycosylated hemoglobin (2).

Achieving optimal blood glucose control in diabetes patients has been described to avoid long-term complications (4). More intensive blood glucose control was observed to reduce the relative risk for kidney and eye diseases, by 20% and 30% respectively (5), and type 2 diabetes patients who had intensive blood glucose control showed a risk reduction of 8.6 major cardiovascular diseases per 1000 person-year (6).

NCDs have become an issue for developing countries and have also constituted a major cause of adult deaths in Addis Ababa (7). Multi-morbidity is the co-existence of two or more chronic conditions in the same individual, and it is highly prevalent in this region (8).

Diabetes patients are more likely to have multi-morbidity, a report from Nepal revealed it has been found that 70.1 % of diabetic patients develop multi-morbidity (9), particularly those suffering from type 2 diabetes (10–12).

Based on the study carried out in Ethiopia in 2021, the overall prevalence of at least one or more chronic diseases was 55.8% among diabetic patients (95% CI: 50.3-61.3), with hypertension being the most common, and of those diabetic patients with comorbidity, 76.4% had poor blood glucose control (13).

1.2 Statement of the problem

Type 2 diabetes patients who have uncontrolled blood glucose levels are a serious public health concern and pose a serious risk associated with the emergence of diabetic complications (14). Even though glycemic control improved in high-income countries, it is still a concern in low and middle-income countries, like in Africa (15).

Uncontrolled blood glucose level was reported in three of every four patients with type 2 diabetes in two sub-Saharan African countries, Guinea and Cameroon (16). In Addis Ababa, research carried out among type 2 diabetes patients at TASH over various periods reported that uncontrolled blood glucose was high 80% and 73.4% (7,17).

Managing and regulating blood glucose levels; can help to prevent the long-term microvascular and macrovascular complications of diabetes mellitus (4,6). To improve the quality of life for diabetes patients maintaining proper control of blood glucose is crucial, but uncontrolled blood glucose level was highly prevalent in Ethiopia, particularly the highest proportion (65.57%) reported in Addis Ababa (18).

In those people with diabetes, multi-morbidity can have a substantial effect on glycemic control, particularly among type 2 diabetes patients who often have and develop co-occurring conditions (11). Increasing multi-morbidity in type 2 diabetes is related to higher mortality and hypoglycemia (19), and due to this hypoglycemia, there is a higher rate of hospitalization and emergency room visits in adult diabetes patients (20). When compared to individuals with one chronic disease or no co-existing illness, people with multiple chronic illnesses are more likely to have glycemic control issues. Studies demonstrated that people with multi-morbidity have difficulty of achieving LDL and glycemic goals (21). The standard of living of diabetes patients is affected when they have other additional chronic diseases (22).

The most common multi-morbidity clusters associated with diabetes are as follows: obesity, hypertension, and dyslipidemia in cardio-metabolic diseases are first on the list, vascular conditions, such as atrial fibrillation, micro- and macro-vascular diseases, and chronic kidney diseases are second; and third are mental health issues, such as substance abuse, depression, and anxiety (11). A large retrospective study found that type 2 diabetes patients with co-morbidities are more likely to have CVD-related events and death (23).

Patients with diabetes who also have other chronic conditions are more likely to take multiple medications daily (19). This polypharmacy can have negative effects on diabetic patients, such as poor blood glucose control and an increased risk of hypoglycemia, due to interactions between anti-diabetic medications and other medications that may alter the anti-diabetic medications effect (24).

In different regions of Ethiopia, the impact of having additional chronic conditions on blood glucose control among type 2 diabetes mellitus patients was reported (25–27), but in Addis Ababa even though the magnitude of comorbidities in patients with type 2 diabetes patients has been studied (17), the association between multiple chronic conditions and glucose levels control among adult type 2 diabetes patients was not well investigated.

Since Addis Ababa has the highest (63.2%) reported prevalence of NCDs (28), studying the effect of multi-morbidity on blood glucose control is important to have updated evidence and to develop different strategies that are used for better management of diabetes, therefore this study aimed to determine the association between multi-morbidity and blood glucose control among patients with type 2 diabetes mellitus at selected health centers in Addis Ababa.

1.3 Significance of the study

The findings of this study could be used to understand the effect of multi-morbidity on blood glucose control among adult type 2 diabetic patients in the study setting. In addition, the data from this study may help in the development of management strategies, treatment options, and evidence-based guidelines particularly for individuals with multimorbidity which could enhance the overall state of health. Furthermore, the findings will give insight to the healthcare providers to enhance their understanding and improve their ability to manage the complexities faced by

type 2 diabetes patients with additional chronic diseases. Information from this study may help enrich the literature available on the issue and may help in directing future studies.

2. Literature review

2.1 Prevalence of Multi-morbidity

Multi-morbidity is defined as the co-occurrence of at least two chronic diseases in the same individual, and this definition is accepted and commonly used by WHO (29).

Multi-morbidity has increased in various population groups. The pooled prevalence of multi-morbidity was found to be 42.4% in high-income countries (4), 43% in Latin America and the Caribbean (30), and 36.4% in low and middle-income countries (31). A study has shown a high prevalence of multi-morbidity in Africa. A systematic review of studies on the prevalence of multimorbidity in South Africa indicated that it is commonly found in the country, particularly among older adult patients (32). Multi-morbidity is a major concern in Ethiopia due to several factors, such as epidemiological shifts marked by a rise in chronic non-communicable diseases and the persistence of infectious diseases (33).

A multi-centered facility-based study conducted in Bahirdar revealed the high magnitude of multi-morbidity in chronic outpatient care with a high prevalence of hypertension, followed by diabetes and heart diseases (34). Comparable facility-based longitudinal research in the same study area reported that the level of multi-morbidity has increased from 54.8% at baseline to 56.8% after a year, and the reason was individuals with single morbidity are likely to acquire multi-morbidity if it is not appropriately managed (35).

2.2 Multi-morbidity and Blood glucose control

A descriptive cross-sectional study revealed that 70.1% of diabetic patients admitted to a tertiary care center had multiple medical conditions, indicating a high occurrence of multi-morbidity (8). According to nationwide research conducted by Fu significant proportion of Chinese diabetes patients (65.2%) had multiple medical conditions (36). In the same way, research by Teljur on a

group of patients with type 2 diabetes in Ireland, found that 90% of patients had at least one additional chronic condition, while a quarter of them had four or more chronic diseases (37).

The study found that those with type 2 diabetes who also had multiple medical conditions had a higher frequency of visits to their general practitioners, and were prescribed more drugs, indicating a higher treatment burden (37). A study done on type 2 diabetic patients at TASH revealed that; 40% of patients had co-morbidities, with hypertension being the most common (17).

According to Heikkalas's study from 2021, multi-morbidity which includes risks and musculoskeletal diseases is significantly more common in those with type 2 diabetes and can affect their ability to achieve treatment goals for HbA1c (21). Furthermore, a 2013 study by Teljeur revealed a prevalence of multi-morbidity among patients with type 2 diabetes, suggesting a potential connection, between glycemic control and patients' awareness of their chronic condition (37). A cohort study in the United States revealed, the presence of multiple comorbidities among patients with type 2 diabetes mellitus associated with hypoglycemia-related ED visits and hospitalizations (20).

Common comorbidities in patients with type 2 diabetes mellitus are hypertension, lipid disorders, cardio-vascular related conditions, micro-vascular related conditions, and depression (12). A systematic literature review found that hypertension rates were high in all regions of the world, with most studies reporting rates above 50% (38).

A study conducted at Hiwot Fana Specialized Hospital in Harar reported a higher prevalence of concordant comorbidity among people with diabetes, and the most common comorbidity was hypertension, followed by obesity, CVD, dyslipidemia, and CKD (13).

2.3 Factors associated with blood glucose control and multimorbidity

2.3.1 Socio-demographic factors

According to community-based cross-sectional research in China and India, elderly patients with diabetes frequently experience multimorbidity (39,40). Another research shows that multi-morbidity is common in older adults with diabetes, and they have been associated with a variety

of unfavorable outcomes, such as disability and death (41). Even though; multi-morbidity is widespread in older adults, the proportion of patients who had controlled blood glucose levels was highest in older, multi-morbid individuals (42,43). Similarly, A cross-sectional study conducted at Ayder Referral Hospital in Mekelle found that being younger than 60 years was substantially related to a greater chance of having uncontrolled blood glucose level (44).

According to a secondary data analysis of a large, nationally representative data set in Scotland, females are more likely to develop multi-morbidity in every age group (45). The main cause of this was a higher prevalence of combined physical and mental multi-morbidity, which began at a younger age than in men, and due to low socio-economic and poor educational status of women (46). However, compared to males, females suffering from diabetes and multiple chronic diseases are more likely to achieve the target HbA1c (43). A study conducted in Malaysia found that males were more likely to develop poor glycemic control than females (47). On the other hand, an observational study in South India revealed that being female had an impact on achieving optimal glycemic control (48).

A cross-sectional population-based study conducted on elders in Brazil discovered that lower socioeconomic level is positively related to the prevalence of multi-morbidity (49). Similarly, a population-based cohort study conducted in ten regions of China found that multi-morbidity is high in those who belong to a lower Socioeconomic stratum (39), and participants in high Socioeconomic status groups had significantly better glycemic control than those in low Socioeconomic status group (50,51).

A study in the Heidelberg, cohort of European Prospective Investigation into Cancer and Nutrition (EPIC) revealed that low educational attainment was significantly linked with a higher prevalence of multi-morbidity compared to a higher level of education (52), similarly, A study among type 2 patients in China found that patients with a low level of education had the more morbid event and poor blood glucose control (53). In accordance with a cross-sectional study among diabetes patients in Jimma Medical Center, patients without formal education had a higher risk of having poor glycemic control than those having a high level of education (54).

2.3.2 Diabetic self-care and behavioral activities

Diabetic self-care practices include self-blood glucose monitoring, physical activity, diabetic foot care, dietary compliance and not smoking, and these self-care activities were related to optimum glycemic control (55).

A study carried out in Northwest Ethiopia also showed that most patients had low levels of adherence, and this had an impact on blood glucose control which means those who had good medication adherence were more unlikely to have uncontrolled blood glucose level compared to those who had inadequate medication adherence (56). Similarly, a cross-sectional study conducted in Jimma concluded that individuals who failed to adhere to their medications were 3.36 times more likely to have uncontrolled blood glucose level than those who did (54).

Cluster analysis of the general health status of elderly patients with diabetes indicated that diabetes patients with multiple morbidities smoke more than those with diabetes alone (57), A study in Ethiopia also reported that smoking was a factor that affected blood glucose control, and the risk of having uncontrolled blood glucose level was two times higher in smokers compared to non-smokers (18).

The study reported that patients with diabetes alone exercise more frequently than patients with multi-morbidities (57). An unmatched case-control study among diabetic patients indicated that physical inactivity or a sedentary lifestyle may be a factor that contributes to uncontrolled blood glucose (58). A cross-sectional carried out in the West Shewa Zone found that alcohol consumption increased the risk of having poor glycemic control by 1.88 times (59). A quasi-experimental study conducted in Saudi Arabia revealed that diabetes patients with uncontrolled HgbA1c levels had a history of diabetic foot complications due to poor diabetic foot care (60).

An observational cross-sectional study in Turkey also found a significant association between dietary compliance and glycemic control (61). Similarly, a case-control study in Southern Ethiopia among type 2 diabetic patients revealed that; patients who follow dietary recommendations had a 69% lower chance of experiencing uncontrolled blood glucose compared to those who do not adhere to dietary recommendations (25).

A study in Jimma among type 2 diabetes patients reported that; participants who failed to self-monitor their blood glucose level were 3.44 times more inclined to develop uncontrolled blood glucose levels (27). A study in Gamo Gofa reported, that compared to type 2 DM with good social support, individuals with poor social support had 3.05 times higher odds of having uncontrolled blood glucose level (25).

2.3.3 Clinical and diabetes-related factors

Research in Japan on diabetic patients revealed that patients had a high rate of multi-morbidity and poly-pharmacy, indicating that they had a high pill burden (43). According to a case-control study in Gamo Gofa, the odds of having poor glycemic control were 2.35 times higher in patients with type 2 diabetes with comorbidity, and 2.83 times higher in type 2 DM individuals with polypharmacy in comparison to those without (25).

A study reported that patients with diabetes for more than ten years showed a higher prevalence of concurrent medical conditions related to the diseases (58). According to a study conducted in TASH, patients with diabetes who had the disease for a longer duration (5-10 years) were more likely to have uncontrolled blood glucose level than patients who had the disease relatively for a short time (<5 years), as well as patients who were use insulin had a higher risk of having poorly controlled FBS than those using oral hypoglycemic agent alone (17). In contrast, a cross-sectional survey conducted in type 2 diabetes patients reported that those who were taking both oral and insulin medication had a risk of developing uncontrolled blood glucose (62). The study among diabetes patients revealed that participants had a 2.9 times increased risk of having uncontrolled blood glucose level if they had a family history of DM (59).

A study conducted in Gondar stated, there is a significant association between adequate diabetic health literacy and good blood glucose control. According to the study, diabetic patients with high diabetic literacy had a 1.85-fold higher chance of having their blood sugar under control compared to those with low diabetic health literacy (26).

2.3.4 Anthropometric factors

A multi-centered facility-based study conducted in Bahirdar reported that multi-morbidity was higher in obese or overweight individuals than in normal-weight individuals (34). A cross-

sectional study conducted in referral hospitals of the Amhara Region found that an increase in patients' BMI is a predictor of uncontrolled blood glucose level (63).

In summary, several studies have shown that patients with diabetes, particularly those with type 2 diabetes had a high prevalence of one or more chronic conditions. However, there is contradicting evidence regarding the association between multi-morbidity and glycemic control in diabetes. A recent comprehensive review demonstrated that four out of the fourteen studies reported that elevated HbA1c was associated with a higher level of multi-morbidity, whereas the other ten studies found no significant association between multi-morbidity and HbA1c (19).

3.Conceptual framework

The conceptual framework has shown the interrelation between Socio-demographics (such as the relation between age and blood glucose control(42–44), sex with blood glucose control (43,47,48), Socioeconomic status or income and blood glucose control(50,51), educational level with blood glucose control (53,54), clinical or diabetic factors (having pill burden and blood glucose control (25,56)), duration of diabetes and type of medication association with blood glucose control(7), lifestyle and behavioral activities with blood glucose control (58), and Anthropometric factor and blood glucose control (63), as well as the effect of multi-morbidity on blood glucose control is depicted on the figure below.

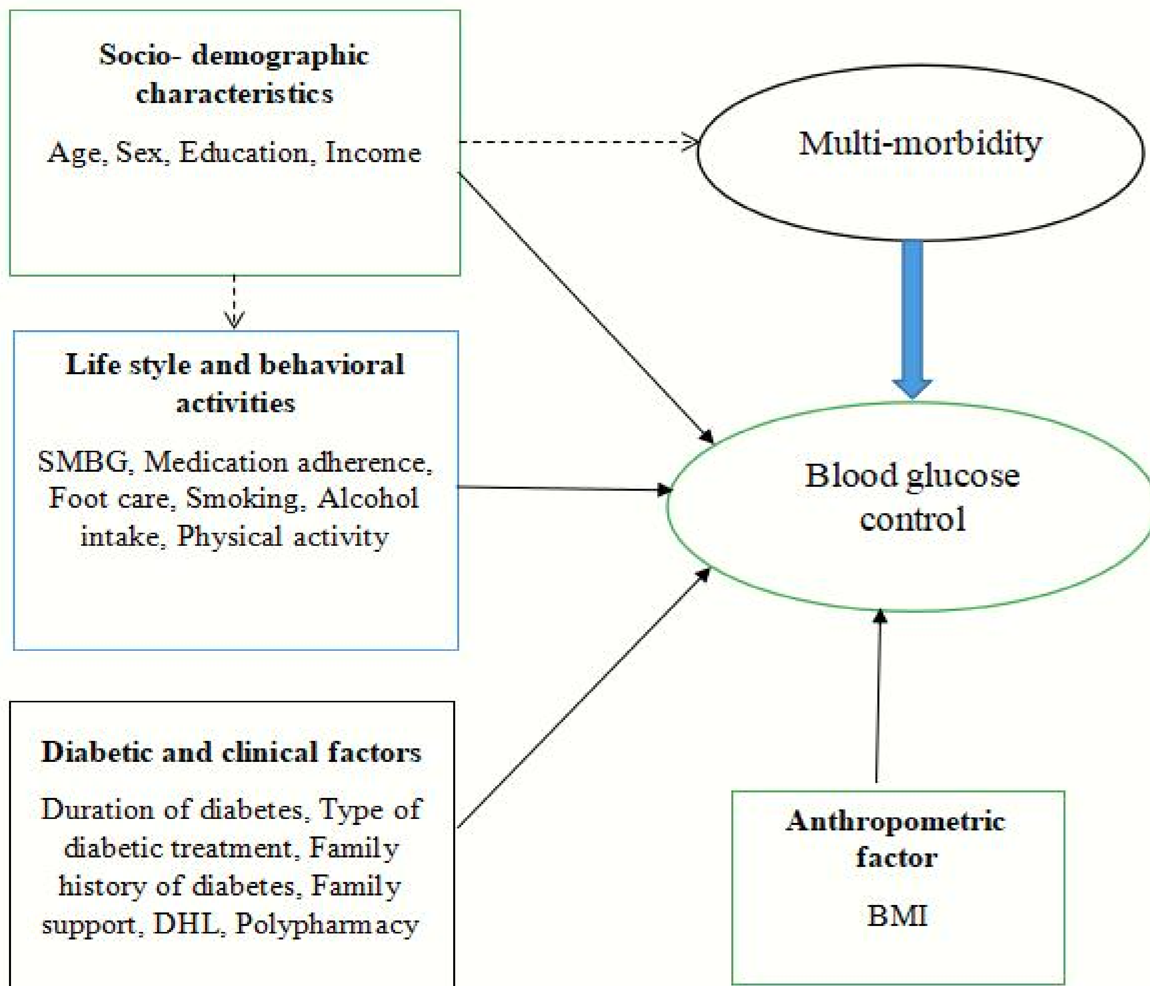

Figure 1 Conceptual framework of blood glucose control and associated factors adopted from various literatures, 2024.

4 Objective

4.1 Hypothesis

Null hypothesis- There is no association between multi-morbidity and blood glucose control among adult patients with type 2 diabetes mellitus.

Alternative hypothesis- There is significant association between multi-morbidity and blood glucose control among adult patients with type 2 diabetes mellitus.

4.2 Objectives

4.2.1 General objective

- ✓ To determine the association between multi-morbidity and blood glucose control among adult patients with type 2 diabetes mellitus at selected health centers in Addis Ababa, Ethiopia, 2024.

4.2.2 Specific objectives

- ✓ To identify the proportions of multimorbidity and other factors among cases and controls among adult patients with type 2 diabetes mellitus at selected health centers in Addis Ababa, Ethiopia, 2024.
- ✓ To determine the effect of multi-morbidity on blood glucose control among adult patients with type 2 diabetes mellitus at selected health centers in Addis Ababa, Ethiopia, 2024.

5. Methods and materials

5.1 Study setting

This study was conducted in health centers in Addis Ababa, the capital and largest city of Ethiopia. Addis Ababa lies at an elevation of 2,355m or 7726ft above sea level, with a sub-tropical highland climate with a moderate temperature of approximately 23°C average high and 11°C low throughout the year. There are 11 sub-cities and 99 woredas. The population was estimated at 5,460,591 in 2023. There are currently 54 hospitals in Addis Ababa: 14 state-run hospitals (including 3 comprehensive, 6 general hospitals, and 5 referral hospitals), 40 private hospitals, and there are a total of 98 health centers. All health centers providing care for chronic non-communicable diseases.

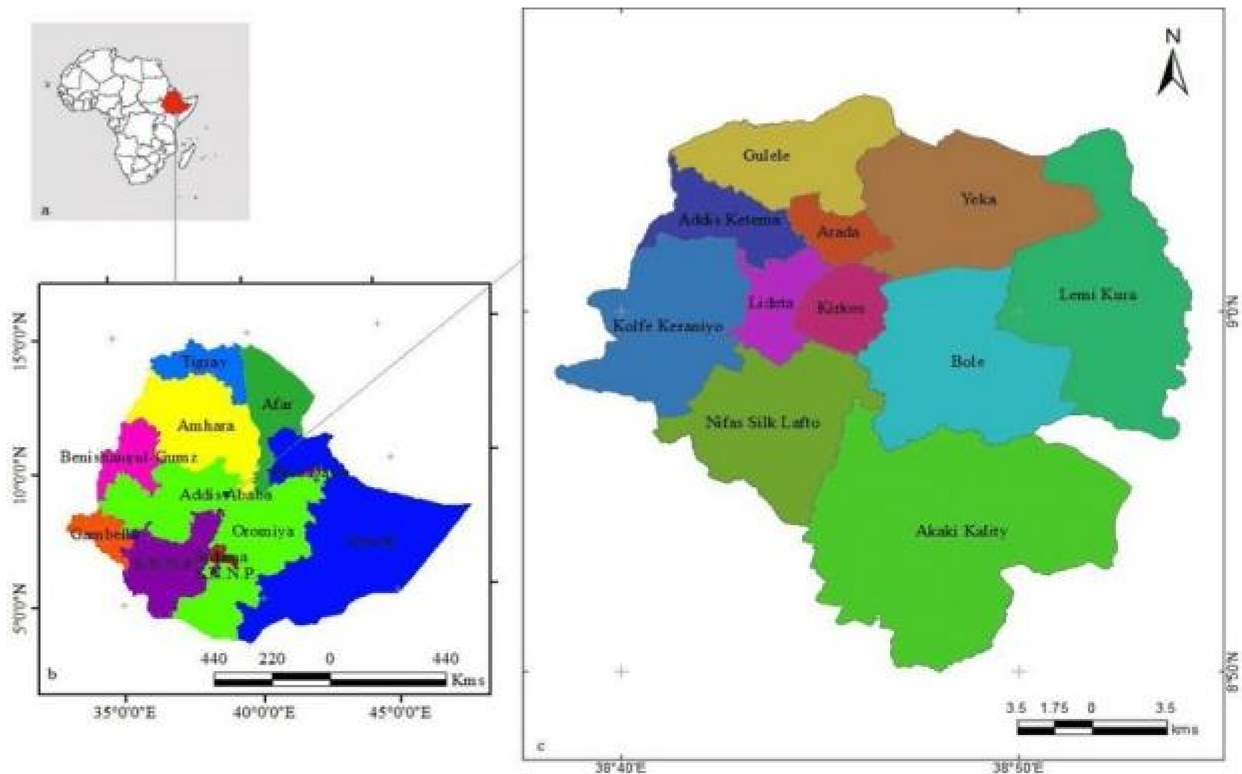

Figure 2 Map of Addis Ababa, 2024

5.2 Study design

Facility-based unmatched case-control study design was undertaken.

5.3 Source and study population

5.3.1 Source population

All adult patients with type 2 diabetes, who had follow-ups at health centers were the source population for this study.

5.3.2 Study population

All adult patients with type 2 diabetes, who visited selected health centers during the data collection period, and selected to participate in the study were the study population.

Cases- type 2 diabetic patients who had uncontrolled blood glucose.

Controls- type 2 diabetic patients who had controlled blood glucose were engaged as controls.

5.4 Eligibility criteria

5.4.1 Inclusion criteria

Adult type 2 diabetes patients who had follow-ups in the selected health centers were included.

5.4.2 Exclusion criteria

Adult type 2 diabetes patients who were unable to communicate due to serious illness, pregnant women, and those who had incomplete data records in the last three months were excluded from the study.

5.5 Study variables

5.5.1 Dependent variable

- ✓ Blood glucose control level (controlled or uncontrolled)

5.5.2 Independent variables

- **Socio-demographic**: Age, Sex, educational status, income.
- **Self-care and behavioral factors**- Smoking, alcohol intake, dietary compliance, self-blood glucose monitoring, medication adherence, physical exercise, foot care.
- **Clinical factors**- multi-morbidity, duration of diabetes, type of medication, family support, family history of DM, polypharmacy, and diabetes health literacy were included.
- **Anthropometric factor**- BMI.

5.6 Sample size determination

- ✓ Expected proportions were taken from a previous case-control study conducted in Gamo Gofa Zone, southern Ethiopia (25).

$$n = \frac{(r+1)(p^*)(1-p^*)(Z_{\alpha/2} + Z_{\beta})^2}{r(p_1-p_2)^2}$$

Where r= ratio of controls to cases 2:1

p*= Average proportion exposed= (proportion of exposure among cases + proportion of exposure among controls)/2

P1= Proportion of multi-morbidity among patients with uncontrolled blood glucose= 0.5 (25)

P2= Proportion of multi-morbidity among patients with controlled blood glucose= 0.3 (25)

$Z_{\alpha/2}$= the value from standard normal distribution (for 95% CI= 1.96)

Z_{β}= standard normal variate for power (for 80% CI = 0.84)

p1-p2= difference in proportion expected

$$= \frac{(2+1)(0.4)(1-0.4)(1.96+0.84)^2}{2(0.5-0.3)^2} = \frac{5.64}{0.08} = 70.5$$

sample size **211.5**, cases= **70.5** and controls = 70.5*2=141

Design effect 211.5*1.5= 317, after adding 10% non-response rate= 348 **(116 cases, and 232 controls)**

5.7 sampling technique

Addis Ababa has eleven sub-cities; comprising Addis Ketema, Akaky Kaliti, Arada, Bole, Gullele, Kirkos, Kolfe-Keranio, Lideta, Nifas-silk Lafto, Yeka, and Lemi kura. Within the sub-cities, there are 98 health centers. Multistage sampling method was used to select the study participants, first simple random sampling was employed to select one health center from each sub-city. The selected health centers from each sub-city were: Ginbot 20 Health Center (Addis Ketema sub-city), Gelan Health Center (Akaki Kality sub-city), Janmeda Health Center (Arada sub-city), Dilfre Health Center (Bole sub-city), Adisu Gebeya Health Center (Gulele sub-city), Meshualekiya Health Center (Kirkos sub-city), Woreda 01 Health Center (Kolfe sub-city), Goro Health Center (Lemikura sub-city), Lideta Health Center (Lideta sub-city), Woreda 10 Health Center (Nifas silk sub-city), and Yeka Health Center (Yeka sub-city).

The sample size for both cases and controls was proportionally allocated to each health center based on the number of type 2 diabetes patients in follow-up who enrolled in the cohort registration book and based on their blood glucose control status. The total number of diabetes patients with uncontrolled blood glucose was used for allocating the sample size of cases, and the number of diabetes patients with controlled blood glucose was used to allocate the sample size of controls to each health center.

Controls were selected, using systematic random sampling at every four patients interval (after calculating the sampling interval (k), by dividing the total number of type 2 diabetes patients with controlled blood glucose who enrolled to cohort registration book (N) by the proportionally

allocated sample size of controls or the desired sample size (n)), for example for the first health center, N=105, and n=29, then k=105/29= 3.62≈4. The first participant was randomly selected from numbers 1 to 4, and number 1 was randomly picked, then every fourth participant was selected in the study till the allocated sample size for each health center was reached. Cases were selected until the amount of sample needed was reached by consecutive methods of sampling, and the data were collected from February 12 -March 31, 2024 (See Figure 3).

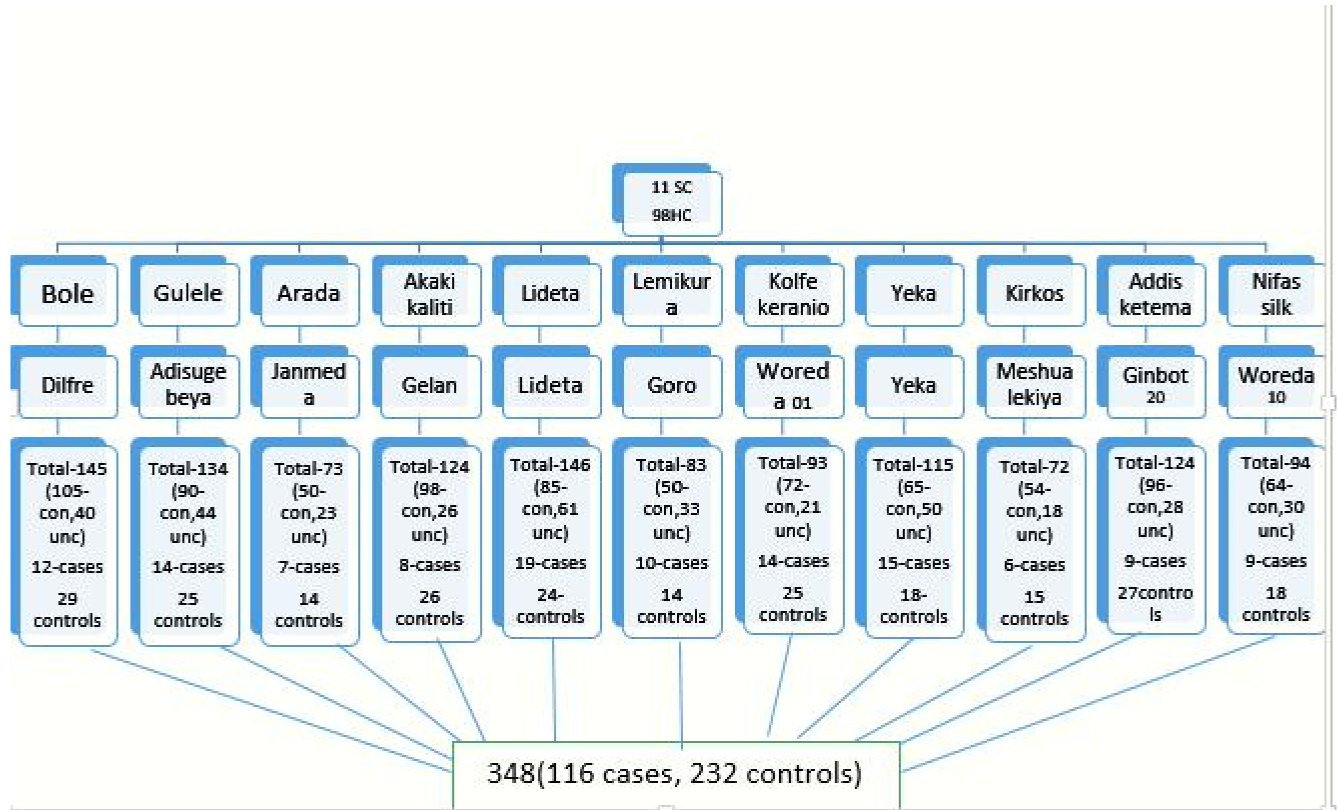

Figure 3 Schematic presentation of the sampling procedure for the study of association between multi-morbidity and blood glucose control among type 2 diabetes patients

5.8 Data collection procedures

Interviewer-administered structured questionnaires were used to collect primary data from type 2 diabetes patients using KoboToolbox. Blood glucose levels and some clinical characteristics were collected from medical records. The questionnaire was developed after consulting various literature. The tool had multiple sections, including an assessment of socio-demographic,

lifestyle and behavioral activities (diabetes self-care), diabetic and clinical factors. Medical records of the last three months FBS values were recorded, and self-care practices were measured using the Summary of Diabetes Self-care Activities (SDSCA), developed by Toobert and Glasgow.

SDSCA: Questions about diet, exercise, self-monitoring of blood glucose, medication adherence, foot care, and smoking cigarettes were included in the questionnaire. Each question used a scale from 0 to 7 to indicate the level of self-care the patient practiced for the last seven days, in case the participant experienced illness in the previous seven days, they were requested to reflect on the last seven days when they were well. The SDSCA is a multi-dimensional measure of diabetes self-management with, for the most part, adequate internal and test-retest reliability, and evidence of validity and sensitivity to change (55). In the previous psychometric property study of the questionnaire, SDSCA had a content validity index of 0.83 and a Cronbach's alpha reliability of 0.69 (64). Alcohol use was checked by the WHO STEPwise approach to Surveillance (STEPS) (65). Diabetic health literacy was assessed by 14 Likert scale questionnaires that contain five scales, answering five for each question was considered 100%, so the final average percent of all questions was taken to identify the diabetic health literacy status, In the previous study, the tool had high internal consistency (Cronbach's α=0.93) (66).

Anthropometric factors were measured using standardized techniques and well-calibrated equipment. The participants' weight were recorded to the nearest 0.1 kilogram and participants were measured with their bare feet and light clothing. A standing weight scale was used to measure the participant's height to the nearest 0.1 centimeter. Then, the BMI of participants was determined using the formula weight in kilogram divided by height in meters squared.

5.9 Data Analysis Procedures

The collected data were checked for completeness, coded, cleaned, and entered into a Microsoft Excel sheet, and exported to SPSS version 26 for analysis. For categorical data, descriptive statistical analysis like, frequency and percentage were computed and presented using tables, graph, and pie chart. Continuous variables were summarized using means, medians, and standard

deviation, after checking for the distribution. Bivariate and multivariable logistic regressions were conducted.

In the bivariate logistic regression, variables having a P-value of <0.25 with 95% CI were entered into multivariable logistic regression. The overall goodness of fit of the binary logistic regression model was checked by Hosmer and Lemeshow test (p-value was ≈ 0.94). Assumptions of binary logistic regression, such as multicollinearity and outliers were checked for the model, and no multicollinearity (VIF and tolerance test) and no concern with outliers. AOR with 95% confidence intervals was estimated to assess the strength of the association, and a p-value of$<$ 0.05 was used to declare statistically significant factors.

5.10 Data Quality Assurance

The structured questionnaire was prepared in English first and translated into Amharic Language and back to English for consistency and better understanding with the respondents. Four data collectors with bachelor's degrees in public health and one supervisor with MPH were employed. Three days of training were given for data collectors on the questionnaire, data collection techniques, and how to communicate with respondents. Before conducting the main study, pretesting on 5% of the sample size was done at two non-selected health centers. The data collectors were closely supervised, and daily checks were made to ensure the completeness of the collected data.

5.11 Operational definitions

- **Chronic diseases**- Disease that lasts for more than three months or a disease that comes with time (67).
- **Multimorbidity**- In this study, multimorbidity was defined by the presence of one or more of the listed disease conditions such as Hypertension, Dyslipidemia, Asthma, or Arthritis in addition to diabetes mellitus in an individual.
- **Fasting blood sugar**- Blood glucose level obtained from venous blood after fasting for at least eight hours (7).

- **Controlled blood glucose** -average of three consecutive months of fasting blood glucose 80-130mg/dl (1).
- **Uncontrolled blood glucose** - average of three consecutive months of fasting blood glucose >130mg/dl or <80mg/dl (1).
- **Hypoglycemia-** for diabetic patients when the blood glucose level is <70 mg/dl (1).
- **Adherence**- The extent to which a person's behavior toward executing lifestyle changes, corresponds with agreed recommendations from a health provider (68).
- **Healthy dietary practice**- If the participant followed a healthy eating plan for an average of three or more days over the last seven days were classified as having adequate adherence, while those who followed the plan for less than three days were classified as having inadequate adherence (7).
- **Level of physical activity**- participants who had engaged in moderate to vigorous intensity exercise for a minimum of 30 minutes, for three or more days during the last week were classified as having adequate adherence to exercise, otherwise it was deemed to have inadequate adherence (7).
- **Medication adherence**- patients who took all his/her anti-diabetic medications as per the prescribed frequency and dose in the last seven days were categorized as adherent to medication (7).
- **Self-monitoring of blood glucose**- patients who did their blood glucose check at least three days in the last seven days were considered as adequate toward SMBG, otherwise considered as inadequate SMBG (7).
- **Foot care**- diabetic patients who reported an average of three or more days to foot care questions were classified as having adequate foot care, while those for less than days were categorized as having inadequate foot care (68).
- **Alcohol consumer**- If the study participant reported consumption of alcohol twelve months before the study (59).
- **Polypharmacy** - taking a combination of ≥5 medications per day (25).

- **High diabetic health literacy**- if diabetic health literacy assessment score is 75% and above (66).
- **Moderate diabetic health literacy**- if diabetic health literacy assessment score is between 60-74% (66).
- **Low diabetic health literacy**- if diabetic health literacy assessment score is less than 59% (66).
- **Body mass index-** is a measurement of a person's weight concerning his or her height based on the WHO body mass index score (69) is classified as underweight (<18.5 kg/m^2), normal (18.5- 24.9 kg/m^2), overweight (25-29.9 kg/m^2), obese (30 kg/m^2 or above).

5.12 Ethical consideration

Ethical clearance was obtained from the Institutional Review Board (IRB) of AAU, College of Health Science, School of Public Health. A written official letter from Addis Ababa University Public Health and Emergency Department Directorate was given to selected health centers. Permission to conduct the study was obtained from the health center's administrative offices. Informed written consent was obtained from each participant after clearly explaining the purpose, procedure, potential risks, and benefits of the study. Participation was voluntary, and the right to refuse or withdraw from the study at any stage was respected. Furthermore, data were collected after assuring confidentiality by excluding the names of the respondents from any questionnaire. The information was not shared with anybody else except the authorized personnel. The study design had no harm to the study participants. The data were stored securely, and regular backups were implemented to prevent data loss.

5.13 Dissemination of findings

The results of the study will be submitted to the School of Public Health at Addis Ababa University. To disseminate the result final thesis defense will be used. The study findings will be shared with the Addis Ababa City Health Bureau. Moreover, an effort will be made to publish in a peer-reviewed reputable journal, and the findings will be presented at seminars and conferences.

6. Results

6.1 Socio-demographic and socio-economic factors

A total of 342 patients with type 2 diabetes mellitus (114 cases and 228 controls) participated in the study with a 98% response rate. More than half, 189 (55.3%) of the participants were females; of whom 123 (53.9%) were controls and 66 (57.9%) were cases. The mean (±SD) age of the study participants was 60.64 (±9.97) from those, cases constituted 64.98(±10.31), and controls constituted 58.47 (±9.07) with ages ranging from 36 to 86 years, and more than half of cases were in the age group of ≥65 years. The majority (75.7%) of the participants were Orthodox followed by Muslim (15.2%). Of the participants, 78.1% (178) of controls and 64.0% (73) of cases were married. Regarding the educational status of the participants, 71 (20.8%) had college and above educational level; of whom 17 (14.9%) and 54 (23.7%) were cases and controls respectively. More than one-third, 139 (40.6%) of the study participants were employees, and 71 (62.3%) of cases and 184 (80.7%) of controls had income ≥3500 ETB. (See Table 1).

Table 1 Socio-demographic and socio-economic characteristics of patients with type 2 diabetes mellitus at selected health centers in Addis Ababa, 2024.

Variables	Category	Total (%)	Frequency (%)	
			Cases	Controls
Sex	Male	153(44.7%)	48(42.1%)	105(46.1%)
	Female	189(55.3%)	66(57.9%)	123(53.9%)
Age	18-44	17(5.0%)	3(2.6%)	14(6.1%)
	45-54	78(14.0%)	16(14.0%)	62(27.2%)
	55-64	110(32.2%)	23(20.2%)	87(38.2%)
	≥65	137(40.0%)	72(63.2%)	65(28.5%)
Religion	Orthodox	259(75.7%)	96(84.2%)	163(71.5%)
	Muslim	52(15.2%)	16(14.0%)	36(15.8%)
	Protestant	31(9.1%)	2(1.8%)	29(12.7%)
Marital status	Single	3(0.9%)	2(1.8%)	1(0.4%)
	Married	251(73.4%)	73(64.0%)	178(78.1%)
	Widowed	61(17.8%)	33(28.9%)	28(12.3%)
	Divorced	27(7.9%)	6(5.3%)	21(9.2%)
Education	Unable to read and write	19(5.6%)	7(6.1%)	12(5.3%)
	Primary school	142(41.5%)	62(54.4%)	80(35.1%)
	Secondary school	110(32.1%)	28(24.6%)	82(36.0%)
	College and above	71(20.8%)	17(14.9%)	54(23.7%)
Occupation	Government/private	139(40.6%)	29(25.0%)	110(48.3%)

	employee			
	Self-employed	54(15.8%)	14(12.3%)	40(17.5%)
	Housewife	99(28.9%)	44(38.6%)	55(24.1%)
	Retired	50(14.6%)	27(23.7%)	23(10.1%)
Income	<3500	87(25.4%)	43(37.7%)	44(19.3%)
	≥3500	255(74.6%)	71(62.3%)	184(80.7%)

6.2 Lifestyle and Behavioral Activities

Most, 219 (64.0%) of the participants had engaged in at least 30 minutes of physical activity for more than three days a week, of which 88 (77.2%) were cases, and 131 (57.5%) were controls. Eighty-three percent (94) of cases and sixty-nine percent (158) of controls had inadequate self-blood glucose control behavior. The majority of the participants, 282 (82.5%) adhered to their prescribed anti-diabetic medication during the previous week before the study, of whom 87 (76.3%) were cases and 195 (85.5%) were controls. Fifty percent (172) of the participants had adequate foot care practice, from these the cases constituted 46 (40.4%), and the controls constituted 126 (55.3%). More than half, 193 (56.4%) of the participants had not followed the recommended eating plan adequately, of which the cases were 85 (74.6%), and controls were 111 (48.7%). Ninety-eight percent of the participants were non-smokers, and 36 (10.5%) of the participants had consumed alcohol, of which the cases constituted 14 (6.1%), and the controls constituted 22 (19.3%). (See Table 2).

Table 2 Lifestyle and behavioral factors of patients with type 2 diabetes mellitus at selected health centers in Addis Ababa, 2024.

Variables	Category	Total (%)	Frequency (%)	
			Cases	Controls
Physical Exercise	Adequate	123(36.0%)	26(22.8%)	97(42.5%)
	Inadequate	219(64.0%)	88(77.2%)	131(57.5)
SMBG	Adequate	90(26.3%)	20(17.5%)	70(30.7%)
	Inadequate	252(73.7%)	94(82.5%)	158(69.3%)
Medication adherence	Adherent	282(82.5%)	87(76.3%)	195(85.5%)
	Non-adherent	60(17.5%)	27(23.7%)	33(14.5%)
Foot care	Adequate	172(50.3%)	46(40.4%)	126(55.3%)
	Inadequate	170(49.7%)	68(59.6%)	102(44.7%)
Dietary compliance	Adequate	146(42.7%)	29(25.4%)	117(51.3%)
	Inadequate	196(57.3%)	85(74.6%)	111(48.7%)
Smoking	Yes	6(1.8%)	1(0.9%)	5(2.2%)
	No	336(98.2%)	113(99.1%)	223(97.8%)
Alcohol consumptio n	Yes	36(10.5%)	22(19.3%)	14(6.1%)
	No	306(89.5%)	92(80.7%)	214(93.9%)
SMBG- Self Monitoring Blood Glucose				

6.3 Diabetic and Clinical Factors

More than half (53.2%) of the study participants had a family history of diabetes mellitus, of which 45.6% were cases and 57.0% were controls. From the participants, 101 (44.3%) of controls, and 25 (21.9%) of cases had diabetes for less than 5 years. The majority, 324 (94.7%) of the participants took oral anti-diabetic drugs alone, of which 213 (93.4%) were controls, and 111 (97.4%) were cases. Of the participants, 184 (80.7%) of controls and 90 (78.9%) of cases had family support. More than half, 182 (53.2%) of the participants had high diabetic health literacy, of which 139 (61.0%) were controls and 43 (37.7%) were cases. Of the participants, 3 (1.3%) of controls and 38 (33.3%) of cases had polypharmacy. (See Table 3)

Table 3 Diabetic and clinical factors of patients with type 2 diabetes mellitus at selected health centers in Addis Ababa, 2024.

Variables	Category	Total (%)	Frequency (%)	
			Cases	Controls
Family history of DM	Yes	182(53.2%)	52(45.6%)	130(57.0%)
	No	160(46.8%)	62(54.4%)	98(43.0%)
Duration of DM	<5 years	126(36.8%)	25(21.9%)	101(44.3%)
	5-10 years	104(30.4%)	26(22.8%)	78(34.2%)
	>10 years	112(32.8%)	63(55.3%)	49(21.5%)
Type of treatment	Oral	324(94.7%)	111(97.4%)	213(93.4%)
	Combined (Insulin+oral)	18(5.3%)	3(2.6%)	15(6.6%)
Family support	Yes	274(80.1%)	90(78.9%)	184(80.7%)
	No	68(19.9%)	24(21.1%)	44(19.3%)
Diabetic health literacy	High	182(53.2%)	43(37.7%)	139(61.0%)
	Moderate	49(14.3%)	20(17.5%)	29(12.7%)
	Low	111(32.5%)	51(44.7%)	60(26.3%)
Polypharmacy	No (<5 drugs/day)	301(88.0%)	76(66.7%)	225(98.7%)
	Yes (≥5drugs/day)	41(12.0%)	38(33.3%)	3(1.3%)

6.4 Anthropometric factors

Regarding anthropometric factors among the study participants, 51 (14.9%) were underweight, of which the cases constituted around 18 (15.8%), and the controls constituted 33 (14.5%), more than half (56.1%) of the participants were in normal weight category, of them cases constituted 49 (43.0%), and controls constituted 143 (62.7%), as well as around sixteen percent of the participants, were in the overweight category, of which fourteen percent were cases and around seventeen of the participants were controls. In addition out of the study participants, 45 (13.2%) were obese, with approximately twenty-seven percent representing cases and six percent representing controls. (See Figure 4).

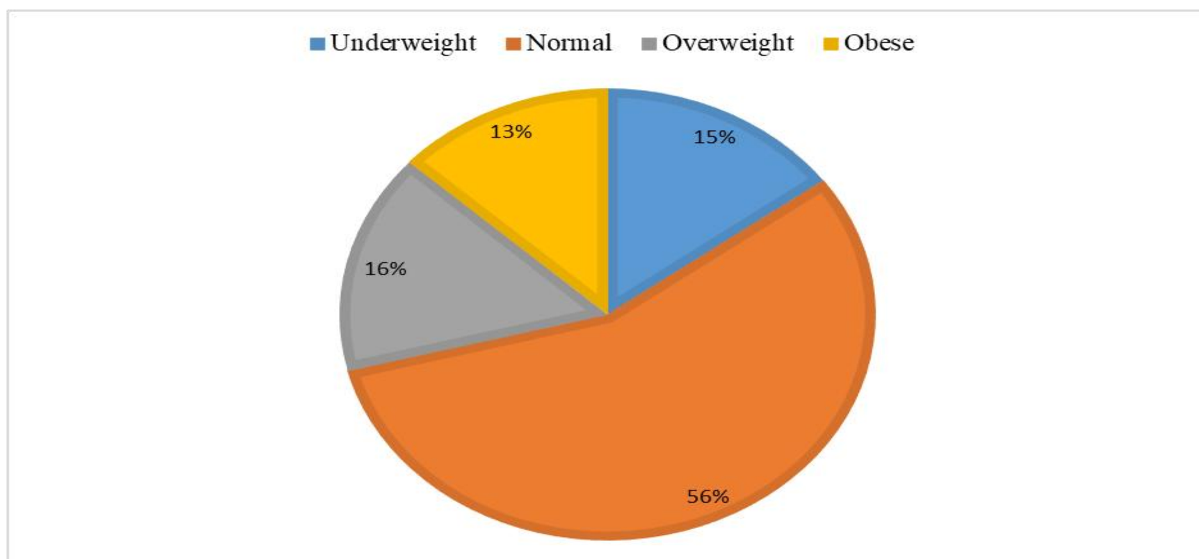

Figure 4 Anthropometric factor among patients with type 2 diabetes mellitus at selected health centers in Addis Ababa, 2024.

6.5 Multi-morbidity and blood glucose control

The average of three months' FBS of participants were 128.6±23.5. Of the total participants, 148 (43.3%) of them had additional non-communicable chronic diseases other than diabetes mellitus, of which 92 (80.7%) of them had uncontrolled blood glucose levels, and 56 (24.6%) of them had controlled blood glucose levels. On the other hand, 194 (56.7%) of the participants had only diabetes, and from those, only 19.3% had poorly controlled glucose levels. (See Figure 5).

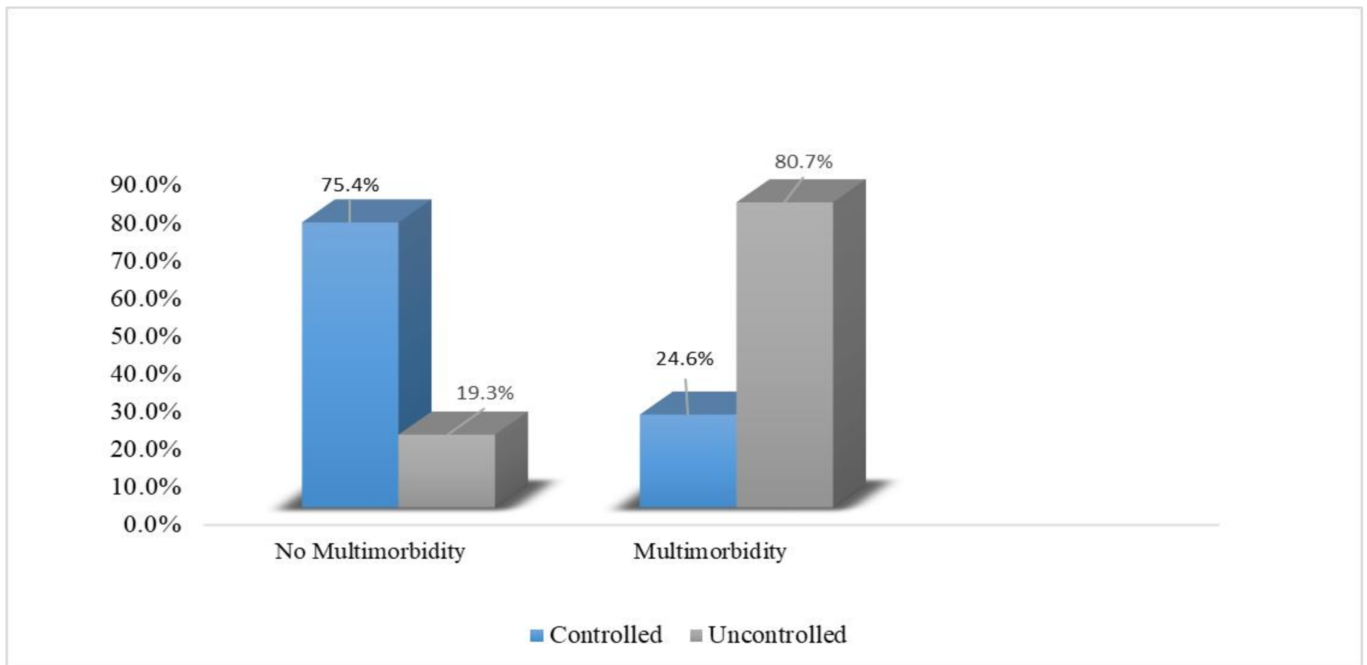

Figure 5 Proportion of multi-morbidity among patients with type 2 diabetes mellitus at selected health centers in Addis Ababa, 2024.

Hypertension, dyslipidemia, asthma, and arthritis were additional non-communicable chronic diseases that were found in type 2 diabetes patients in selected health centers. The concordant or diseases that are related to diabetes pathophysiologically (hypertension and dyslipidemia) were found in 80% of cases, and 48% of controls. Discordant or diabetic-unrelated diseases (asthma and arthritis) were found in 8% of cases and 8% of controls, and both concordant and discordant conditions (HTN+Asthma and HTN+Dyslipidemia+Asthma) were found in roughly 3% of cases.

The most common non-communicable chronic condition among type 2 diabetes patients was hypertension such as 78 (52.7%), cases constitute 41 (35.9%), and controls constituted 37 (16.2%), followed by hypertension+dyslipidemia which was 42 (28.4%), from those cases constitute 35 (30.7%), and controls constituted 7 (3.1%). Asthma cases were found in 3.1% of diabetes patients with controlled blood glucose and 2.6% with uncontrolled, Dyslipidemia was found in 1.8% of controls and 3.5% of cases, arthritis was found in 0.4% of controls, and 4.4% of cases, but the chronic conditions Hypertension+Asthma and Hypertension+Dyslipidemia+ Asthma were found only in diabetes patients with uncontrolled blood glucose level, at 2.6% and 0.9% respectively. (See Figure 6).

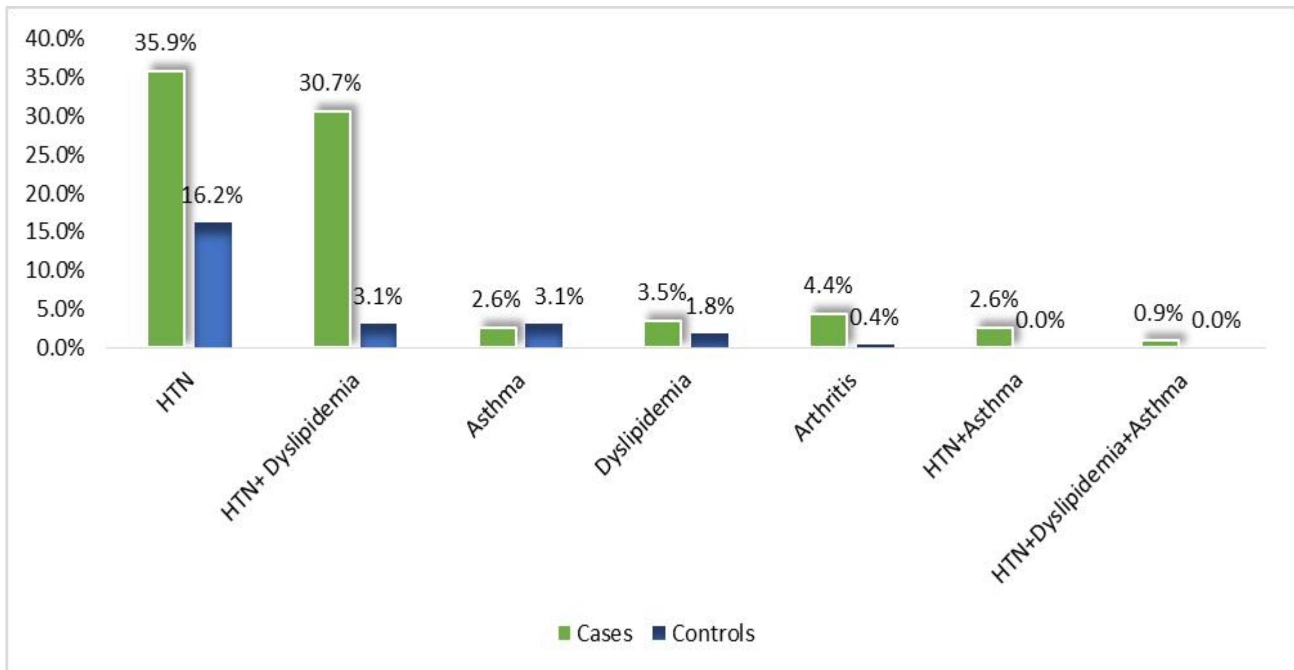

Figure 6 Frequency of chronic non-communicable diseases in patients with diabetes mellitus among cases and controls at selected health centers in Addis Ababa, 2024.

6.6 Factors associated with uncontrolled blood glucose

Based on bi-variable logistic regression, around 19 variables were candidates ($p<0.25$) for multivariable logistic regression including age of the participant, religion, education level, marital status, occupation, monthly income, duration of diabetes, family history of diabetes, type of diabetes treatment, presence of multi-morbidity, polypharmacy, diabetes health literacy,

physical activity of the patient, self-monitoring of blood glucose, medication adherence, foot care, diet, alcohol consumption, and BMI.

Finally, from the multi-variable logistic regression type of treatment of diabetes, the presence of chronic diseases, polypharmacy, medication adherence, dietary compliance, and alcohol consumption were found to be statistically significant(at $p<0.05$) factors of uncontrolled blood glucose.

The odds of uncontrolled blood glucose control levels among patients taking both insulin and oral-antidiabetic medication were 89% less likely compared to those taking only hypoglycemic agents (AOR =0.11, 95% CI =0.01-0.82). Moreover, the odds of uncontrolled blood glucose levels among patients with multi-morbidity were 6.52 times more likely compared to those without multi-morbidity (AOR =6.52, 95% CI= 2.92-14.54). Furthermore, the odds of uncontrolled blood glucose control levels among patients who took less than 5 drugs per day were 97% less likely compared to those who had polypharmacy (AOR =0.03, 95% CI =0.01-0.16).

Additionally, patients who were not adherent to their anti-diabetic medications were 2.42 times more likely to experience uncontrolled blood glucose levels compared to those who adhered to anti-diabetic medications (AOR =2.42, 95% CI =1.03-5.71). Likewise, the odds of uncontrolled blood glucose levels among patients who fail to comply with their diet were 4.44 times more likely compared to those who comply with their diet (AOR =4.44, 95% CI =1.80-10.94).

Patients who consumed alcohol were 3.63 more likely to have uncontrolled blood glucose compared to those who did not consume alcohol (AOR =3.63, 95% CI =1.36-9.69).(See Table 4).

Table 4 Multi-variable logistic regression for the study of uncontrolled blood glucose level and associated factors among patients with type 2 diabetes mellitus in Addis Ababa, 2024.

Variables	Category	Blood glucose control		COR(95%CI)	AOR(95%CI)	P-value
		Controlled	Uncontrolled			
Age	≤64 years	163	42	1	1	
	≥65 years	65	72	4.30(2.67-6.95)	1.15(0.48-2.75)	0.758
Religion	Orthodox	163	96	1	1	
	Muslim	36	16	0.76(0.39-1.43)	0.83(0.29-2.32)	0.716
	Protestant	29	2	0.12(0.27-0.50)	0.56(0.02-1.35)	0.091
Education level	Unable to read and write	12	7	1.85(0.63-5.45)	0.26(0.04-1.84)	0.175
	Primary school(1-8)	80	6	2.46(1.30-4.66)	0.79(0.21-3.04)	0.737
	Secondary school(9-12)	82	28	1.09(0.54-2.17)	0.69(0.23-2.01)	0.493
	College and above	54	17	1	1	
Marital status	Married	178	73	1	1	
	Unmarried	50	41	1.99(1.22-3.28)	0.87(0.36-2.15)	0.771

Occupation	Currently employed	150	43	1	1	
	Unemployed	78	71	3.17(1.99-5.06)	1.59(0.64-3.95)	0.321
Monthly income	<3500	44	43	2.53(1.53-4.18)	0.86(0.31-2.44)	0.785
	≥3500	184	71	1	1	
Duration of DM	<5	101	25	1	1	
	5-10	78	26	1.35(0.72-2.51)	0.78(0.33-1.82)	0.564
	>10	49	63	5.19(2.92-9.23)	2.11(0.76-5.86)	0.153
Treatment of DM	Oral-antidiabetic	213	111	1	1	
	Combined (oral+insulin)	15	3	0.38(0.11-1.35)	0.11(0.01-0.82)	**0.031***
Family history of DM	No	98	62	1	1	
	Yes	130	52	0.63(0.40-0.99)	1.29(0.66-2.56)	0.450
Diabetic health literacy	High	139	43	1	1	
	Medium	29	20	2.23(1.15-4.33)	0.51(0.17-1.57)	0.095
	Low	60	51	2.75(1.65-4.56)	0.31(0.08-1.23)	0.244
Multi-morbidity	No	172	22	1	1	
	Yes	56	92	12.84(7.38-22.36)	6.52(2.92-14.54)	**<0.001***
Poly-	No (<5 drugs)	225	76	0.03(0.01-0.09)	0.03(0.01-0.16)	**<0.001***

pharmacy	Yes (≤ drugs)	3	38	1	1	
Physical activity	Adequate	97	26	1	1	
	Inadequate	131	88	2.51(1.51-4.17)	0.73(0.31-1.73)	0.478
SMBG	Adequate	70	20	1	1	
	Inadequate	158	94	2.08(1.19-3.64)	1.37(0.51-3.69)	0.537
Medication adherence	Adherent	195	87	1	1	
	Non-adherent	33	27	1.83(1.04-3.24)	2.42(1.03-5.71)	**0.043***
Foot care	Adequate	126	46	1	1	
	Inadequate	102	68	1.82(1.16-2.88)	1.20(0.54-2.66)	0.646
Dietary compliance	Adequate	117	29	1	1	
	Inadequate	111	85	3.09(1.88-5.07)	4.44(1.8-10.94)	**0.001***
Alcohol consumption	No	214	92	1	1	
	Yes	14	22	3.65(1.79-7.46)	3.63(1.36-9.69)	**0.010***
BMI	Underweight	33	18	1	1	
	Normal	143	49	0.63(0.32-1.21)	1.18(0.49-2.89)	0.710
	Overweight	38	16	0.77(0.34-1.75)	0.98(0.31-3.19)	0.983
	Obese	14	31	4.06(1.73-9.53)	1.19(0.29-5.00)	0.803

*** statistically significant**

BMI- Body Mass Index COR-Crude Odds Ratio AOR- Adjusted Odds Ratio CI- Confidence Interval

7. Discussion

This study reports the association between multimorbidity and blood glucose control and assessed other determinant factors among adult patients with type 2 diabetes mellitus at health centers of Addis Ababa. Accordingly, the identified factors significantly associated with uncontrolled blood glucose level were multi-morbidity, type of diabetes treatment, polypharmacy, medication adherence, dietary compliance, and alcohol consumption.

The finding from this study showed that the proportion of patients with type 2 diabetes mellitus having multi-morbidity in our study is 43.3%, this is relatively low compared to the study in Nepal and Japan (9,43), this discrepancy might be due to socio-demographic, economic, and lifestyle differences between those two countries, as well as the possibility that fewer diabetes patients in our study area are examined and screened for other chronic diseases. Thus, it is important to improve the availability of healthcare services, obtain the diagnosis, and encourage health-seeking behavior, as well as promote effective patient-provider communication (29). This implies healthcare policies should enhance the training of healthcare providers on managing diabetes patients with co-existing conditions.

In contrast to the study done in Australia, in this study concordant conditions (diabetic-related) were more common than diabetic-unrelated or discordant conditions (10), and the common morbidity among type 2 diabetes patients was hypertension. This finding is consistent with studies done in Harar, Addis Ababa, Ireland, and Mekelle (14,17,37,44).

The presence of multi-morbidity or additional non-communicable chronic diseases other than DM was significantly associated with uncontrolled or poorly controlled blood glucose levels (p-value<0.001). Diabetes patients who had multi-morbidity were 6.52 times more likely to have uncontrolled blood glucose, the finding is consistent with studies done in Jimma, and Mekelle (27,44). This might be due to the presence of multi-morbidity among type 2 diabetes patients which leads to an increased pill burden from taking multiple medications per day due to this reason patients may discontinue or fail to remember to take the anti-diabetic medication as prescribed. So, the presence of muti-morbidity among diabetes patients might contribute to the aggravation of the disease process and decrease quality of life (23), and the presence of multimorbidity in those patients may reduce the ability to make lifestyle changes that challenge

and overwhelm individuals and lead to poor outcomes (19). However, this finding is in contrast to the study done in Australia (10), the possible reason for this difference might be due to the limited access to adequate health services in our country and the difference in clinical characteristics of the patients to help with glucose management in diabetes patients with multimorbidity.

Poor medication adherence was significantly associated with poor blood glucose control, those who did not adhere to their medication were 2.42 times more likely to have uncontrolled blood glucose levels. Findings from other studies support this finding (62,63). The possible explanation for this is medication non-adherence can disrupt the delicate balance needed to manage diabetes effectively which might reduce medication effectiveness, leading to poor blood glucose control and increased risk of complications, with a significant problem for the healthcare system (56). Patients who do not take their anti-diabetic medication as prescribed may raise blood glucose levels, due to increased hepatic glucose synthesis, decreased beta cell insulin secretion, or decreased skeletal muscle glucose uptake (58).

This study revealed that polypharmacy was significantly associated with uncontrolled blood glucose levels. Those type 2 diabetic patients who took less than 5 drugs per day were 97% less likely to have poor blood glucose control than those with polypharmacy. This finding is in line with studies done in Gamo Gofa and Romania (25,70), the possible explanation for this could be if there are multiple medications to take, the complex nature of the medication regimen can have an impact on their medication adherence to anti-diabetic drugs, which leads to inadequate glycemic control and increases the risk of diabetic complications (56). Patients with type 2 DM who had pill burden were prone to experience drug-drug and food-drug interactions (25). Polypharmacy may have an impact on the management and course of diabetes by increasing the risk of poor glycemic control and hypoglycemia due to the interaction between anti-diabetic drugs and other medications which may affect the pharmacokinetics of the anti-diabetic drugs and possible adverse drug reactions (24), and this can harm patients' quality of life (43).

In this study, the type of diabetic treatment was significantly associated with poor blood glucose, those who take both insulin and oral anti-diabetic medication were 89% less likely to have uncontrolled blood glucose levels, this finding contrasts with studies done in various regions of

Ethiopia (17,62,68). A possible explanation could be that the number of patients in this study who were using both insulin and oral hypoglycemic agents was quite small. However, the finding is in line with a study done in America, which indicated that for patients with type 2 diabetes mellitus who take oral hypoglycemic agents only, the prompt addition of insulin to oral anti-diabetic therapy will lead to better outcomes in their glycemic control without encouraging weight gain or severe hypoglycemia (71).

In this study, dietary compliance was significantly associated with poor blood glucose control, those who did not follow their dietary advice were 4.44 times more likely to have uncontrolled blood glucose levels, this finding is consistent with different studies conducted in Gamo Gofa, and Turkey (25,61). The reason might be due to high carbohydrates affect body mass index, abdominal circumference, blood pressure, triglyceride, and fasting blood glucose. Therefore, a low carbohydrate diet in patients with type 2 diabetes mellitus results in the improvement of glycemic control (72). Maintaining optimal blood glucose requires an integrated approach that includes dietary adherence in addition to anti-diabetic medication adherence (73).

Our finding showed that alcohol consumption was significantly associated with poor blood glucose control, with those who consume alcohol 3.63 times more likely to have uncontrolled blood glucose levels. This result is consistent with the study conducted among diabetes patients in Oromia Region of Ethiopia (59). This might be because alcoholic drinks such as beer and sweetened mixed drinks are high in carbohydrates, and this carbohydrate content of beverages is not well known by consumers, due to this reason the consumption of too much of it might have an impact on their blood glucose control. Furthermore, alcohol has a lot of calories, which can cause weight gain and make diabetes management more difficult. Additionally, alcohol calories are stored in the liver as fat, which over time can raise blood glucose levels by increasing insulin resistance in the liver, and study conducted in Mizan Tepi indicated that anyone with diabetes should use extra caution while consuming alcohol because of its impact on effectiveness on anti-diabetic medications (73).

7.1 Strengths and limitations of the study

This study has its strengths and limitations using an appropriate study design to determine the effect of multi-morbidity and other determinant factors associated with blood glucose control.

Despite the above strength, the use of FBS instead of HgbA1c is one limitation, since FBS can fluctuate throughout the day based on various factors which may lead to an underestimation of the overall glycemic control, but to overcome this problem we used the three-month average of fasting blood glucose level. Information on determinant factors of blood glucose control was obtained from self-reports of diabetes patients, which could result in recall bias.

8. Conclusion

This study provides an investigation of the association between multimorbidity and blood glucose control as well as other determinant factors that were associated with uncontrolled blood glucose level at selected health centers in Addis Ababa. About forty-three percent of patients with type 2 diabetes mellitus had additional chronic non-communicable diseases, and from those around eighty-one percent of patients with multimorbidity had uncontrolled blood glucose level. Further findings revealed that not adhering to anti-diabetic medication, type of treatment for diabetes, polypharmacy, failure to comply with dietary advice, and alcohol consumption were positively associated factors with uncontrolled blood glucose levels. Generally, a significant number of patients failed to control their blood glucose levels due to additional non-communicable chronic diseases they had.

9. Recommendations

Based on the findings from the current study the following recommendations are forwarded:

Policymakers should develop policies that assist in improving access to healthcare services and resources for type 2 diabetes patients living with multi-morbidity.

Health centers need to develop a comprehensive or multi-integrated patient-centered approach, that takes into account the complex care needs of those patients living with multi-morbidity and should emphasize early screening and treatment of diabetic patients for other chronic diseases.

Healthcare providers should weigh the potential risks and benefits of prescribed drugs to minimize drug interactions and should refrain from prescribing unnecessary medications to reduce the high pill burden. Encouraging patients' adherence to their anti-diabetic medications, and they should provide counseling on a healthy diet, and cessation of excessive use of alcohol.

For researchers, further prospective studies are needed to identify which specific diseases have a greater impact on blood glucose for individuals with type 2 diabetes and multi-morbidity.

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Annexes

Annex I: Information sheet and Consent form

ADDIS ABABA UNIVERSITY

SCHOOL OF PUBLIC HEALTH

DEPARTMENT OF EPIDEMIOLOGY AND BIOSTATISTICS

Part I – Participant's Information Sheet

My name is ______________________ and I am working on behalf of research conducted by Ephrata Tegen, Addis Ababa University postgraduate student. You are selected to be a participant in this study if you give me consent after you have understood the following information:

Project title- Association between Multi-morbidity and blood glucose control among adult type 2 diabetic patients at selected health centers in Addis Ababa, Ethiopia.

Purpose of the study- The purpose of this study is to determine the effect of multi-morbidity on blood glucose control among adult Type 2 diabetic patients attending selected health centers in Addis Ababa. The findings of this study will provide important information on conditions related to multi-morbidity and blood glucose control among adult diabetic patients as well as it will help in providing information on strategies and programs that will facilitate better management, control, and implementation of set guidelines for patients with diabetes, particularly those who have multi-morbidities.

Study procedures- I invite you to help me with the study by taking part in this survey as the information you provide us will contribute a lot in preventing multi-morbidity and poor blood glucose control as well as premature death due to their complications. If you are willing to participate in the study, I will proceed with the interview and administer questions that help to answer the study questions. If you do not wish to answer any of the questions included in the study, you may skip them and move to the next question.

Risks, stress, or discomfort- There might be slight discomfort in sharing some personal information. However, I do not want this to happen and you may refuse to answer any of the questions if you feel uncomfortable.

Benefits- Your participation will help us to find out more about multi-morbidity and glycemic control among adult Type 2 diabetes patients. Our study may help diabetes patients, health professionals, and health facilities for better improvement of diabetes care.

Incentives- you will not receive payment for participating in this study, but I appreciate your participation.

Right to refuse or withdraw -Your participation is voluntary. You may withdraw from this study at any time.

Confidentiality - The information that we collect in this study will be kept confidential and will not be given to anyone.

Voluntary nature of the study- Participation in this study is voluntary. If anything is not clear or if you need further information, I shall provide it to you. Your decision whether or not to participate in this study will not affect your current or future relations with this facility or other institutions.

Contacts and Questions - The researcher conducting this study is Ephrata Tegen. You may ask any questions you have now, or if you have questions later, kindly you can contact through this number: 0930670600 e-mail eph2706@gmail.com.

Part II: Informed Consent form

I have read this form or it has been read to me in the language I understand and I have realized all conditions stated above. Are you willing to participate in this study?

1. No (Say Thank you) . 2. Yes ☐ (continue the interview)

I certify that the nature and purpose, potential benefits, and possible risks associated with

participating in this study have been explained to the volunteer.

Signature of interviewer ____________________________ Date ________________

Annex II: English Version Questionnaire

ADDIS ABABA UNIVERSITY

SCHOOL OF PUBLIC HEALTH

DEPARTMENT OF EPIDEMIOLOGY AND BIOSTATISTICS

This questionnaire was used to collect data for patients with type 2 diabetes at the study area. The information from the respondent was handled confidently without discrimination of any participants.

Participant Code______________/2024

Venue: ________________

Part I: Socio-demographic characteristics			
S. No.	Questions	Response	skip
101	Age in years	_____________ Years	
102	sex	1. Male 2. Female	
103	What is your marital status?	1. Single 2. Married 3. Divorced 4. Widowed	
104	What is your religion?	1. Orthodox 3. Protestant 2. Muslim 4. Catholic 5. Others	
105	What is the highest education level you have attained?	1. Unable to read and write 2. elementary school 3. secondary school	

		4. college and above	
106	What is your occupation?	1. employee (government/NGO) 2. Merchant/self-employee 3. Housewife 4. daily worker 5. Other (specify)___________	
107	Income per month (ETB)	_____________Birr	
Part II: Clinical or diabetes-related factors			
S.No.	Question	Response	Skip
201	Does anyone else in your family (Mother, Father and siblings) have diabetes?	1. Yes 2. No	
202	Duration since the disease diagnoses (in years) (observe the record)	_______________year/s	
203	Do you have family support related to your disease?	1. Yes 2. No	If No skip to Q205
204	If yes, to Q203 what type of support? (more than one answer is possible)	1. Remembering to take medication 2. Financial support 3. Physical support 4. Psycho-social support	

		5. Others(specify)_______________	
205	Do you have a glucometer to measure your blood glucose at home?	1. Yes 2. No	
206	Specify the type of anti-diabetic medication regimen the participant taking currently	1. Insulin Only 2. Oral Anti Diabetic/s 3. Combined (Insulin +Oral)	
207	Does the participant have any chronic diseases other than DM?	1. Yes 2. No	If No, skip to Q 212
208	If yes, for Q207 which additional chronic diseases do you have?	1. Hypertension 2. Dyslipidemia 3. Asthma 4. Others(specify)_______________	
209	If yes, for Q207 does s/he take medication for this disease?	1. Yes 2. No	
210	If yes, for Q209 how many medications does the participant take per day	___________________________	
211	List of FBS of the last three consecutive months	FBS 1. _________________mg/dl 2._________________ mg/dl	

		3.________________mg/dl	
212	Weight and height	1.weight____________kg 2.height____________cm 3. BMI………………kg/m^2	
Part III **Diabetic Self-care practice questions** The questions below ask you about your diabetes self-care activities during the past seven days. If you were sick during the past seven days, please think back to the past seven days that you were not sick.			
3.1 Diet			
301	How many of the last SEVEN DAYS have you followed a healthful eating plan?	0 1 2 3 4 5 6 7	
302	On average, over the past month, how many days per week have you followed your eating plan?	0 1 2 3 4 5 6 7	
303	How many of the last SEVEN DAYS did you eat five or more servings of fruits and vegetables?	0 1 2 3 4 5 6 7	
304	How many of the last SEVEN DAYS did you eat high fat foods such as red meat or full fat dairy	0 1 2 3 4 5 6 7	

	products?		
3.2 Exercise			
305	On how many of the last seven days did you participate in at least 30 minutes of physical activity?	0 1 2 3 4 5 6 7	
306	On how many of last seven days did you participate in a specific exercise session (such as swimming, walking, and biking) other than what you do around the house or as part of your work?	0 1 2 3 4 5 6 7	
3.3 Blood sugar testing			
307	On how many of the last SEVEN DAYS did you test your blood sugar?	0 1 2 3 4 5 6 7	
308	On how many of the last SEVEN DAYS did you test your blood sugar based on the number of times recommended by your health care provider?	0 1 2 3 4 5 6 7	
3.4 Foot care			
309	On how many of the last SEVEN DAYS did you inspect the inside of your	0 1 2 3 4 5 6 7	

	shoes?		
310	On how many of the last SEVEN DAYS did you wash your feet?	0 1 2 3 4 5 6 7	
311	On how many of the last SEVEN DAYS did you soak your feet?	0 1 2 3 4 5 6 7	
312	On how many of the last SEVEN DAYS did you dry between your toes after washing?	0 1 2 3 4 5 6 7	
3.5 Medication			
313	What type of diabetes medication do you take?	1. Insulin injection 2. Diabetic pills	
314	If the answer is insulin injection for Q312, on how many of the last SEVEN DAYS, did you take your recommended insulin injection?	0 1 2 3 4 5 6 7	
315	If the answer is diabetic pills for Q312, how many of the last SEVEN DAYS, did you take your recommended diabetic pills?	0 1 2 3 4 5 6 7	
3.6 Smoking			

316	Have you smoked a cigarette—even one puff—during the past SEVEN DAYS?	1. Yes 2. No	
317	If yes to Q316, how many cigarettes did you smoke on an average day?	_______________ cigarettes	
3.7 Alcohol intake			
318	Have you ever consumed any alcohol such as beer, wine, tela, or arekie?	1. Yes 2. No	
319	If yes, Have you consumed any alcohol within the past 12 months?	1. Yes 2. No	If No, skip to Q321
320	If yes, During the past 12 months, how frequently have you had at least one standard alcoholic drink?	1. Daily 2. 5-6 days per week 3. 3-4 days per week 4. 1-2 days per week 5. 1-3 days per month 6. Less than once a month 7. Never	
321	Have you consumed any alcohol within the past 30 days?	1. Yes 2. No	If No, skip to Q324
322	If yes, During the past 30	1. Number ----------------	

	days, on how many occasions did you have at least one standard alcoholic drink?	2. Do not know/remember	
323	During the past 30 days, when you drank alcohol, how many standard drinks on average did you have during one drinking occasion?	1. Number_____________ 2. Do not know/remember	
324	During each of the past 7 days, how many standard drinks did you have each day?	1. Monday _________________ 2. Tuesday_________________ 3. Wednesday_________________ 4. Thursday_________________ 5. Friday_________________ 6. Saturday________________ 7. Sunday_________________	

Part IV: The questions below ask you about diabetic health literacy Instruction- these are questions concerning the diabetic health literacy of patients		
S.No.	Questions	Response
1. When reading instructions or leaflets from health facilities or pharmacies, how do you agree or disagree about the following? (1. Strongly agree, 2. Agree, 3. Not sure, 4. Disagree, 5.		

Strongly disagree)						
401	You find characters that you cannot read	5	4	3	2	1
402	You find that the print was too small to read (even if you wear glass)	5	4	3	2	1
403	You feel the content was too difficult for you to understand	5	4	3	2	1
404	It takes you a long time to read them	5	4	3	2	1
405	you need someone to help you to read them	5	4	3	2	1
2. Since you are diagnosed as having diabetes Mellitus, have you had the following experiences in seeking information related to diabetes (e.g., diagnosis, treatment, self-care issues, alternative therapy, etc.)? (1. strongly disagree, 2. disagree, 3. Not sure, 4. Agree, 5. Strongly agree)						
406	You collect information from various sources	1	2	3	4	5
407	You extract the information you wanted	1	2	3	4	5
408	You understand the information that you obtained	1	2	3	4	5
409	You tell your opinion about your illness to your doctors, families or friends	1	2	3	4	5
410	You apply the obtained information to your daily life	1	2	3	4	5
3. Since you are diagnosed as having Diabetes Mellitus, you can obtain information about diabetes and its treatment, how do you agree or disagree about the following? (1.Strongly						

disagree, 2. disagree, 3. Not sure, 4.Agree, 5. Strongly agree)						
411	You consider whether the information applies to you or not	1	2	3	4	5
412	You consider whether the information is credible	1	2	3	4	5
413	You checked whether the information is valid and reliable	1	2	3	4	5
414	You collect information to make your health care decisions	1	2	3	4	5

THANK YOU

Annex III: Amharic version Information sheet and consent form

በአዲስ አበባ ዩኒቨርሲቲ

የህብረተሰብ ጤና ትምህርት ቤት

የኤፒዲሚዮሎጂ እና ባዮስታትስቲክስ ትምህርት ክፍል

የጥናቱ ማብራሪያ የፍቃደኝነት መጠየቂያ እና መተማመኛ ቅጽ

ክፍል 1 - የጥናቱ ማብራሪያ እና የፍቃደኝነት ቅጽ

ሰላምታ: ደህና አደሩ

ስሜ........................እባላለሁ፡፡ አሁን እየሰራሁ ያለሁት በአዲስ አበባ ዩኒቨርስቲ ተማሪ የሆነችው አፍራታ ተገን በምትሰራው ጥናታዊ ምርምርን በመወከል መረጃ ሰብሳቢ ሆኜ ነው። የሚከተሉትን መረጃዎች ካስተዋሉኝ በኋላ በዚህ ጥናት ውስጥ ተሳታፊ እንዲሆኑ ተመርጠዋል።

የፕሮጀክቱ ርዕሰ- በስር የሰደዱ በሽታዎች እና በደም የስኳር መጠን ቁጥጥር መካከል ያለውን ግንኙነት ዓይነት ሁለት ስኳር ባላቸው አዋቂዎች በአዲስ አበባ ውስጥ ባሉ ጤና ጣቢያዎች ለማጥናት

የጥናቱ ዓላማ - የዚህ ጥናት ዓላማ ስር የሰደዱ በሽታዎች በአይነት ሁለት የስኳር ህመምተኞች ላይ ያላቸውን መጠን እና በስኳር ቁጥጥር ላይ ያላቸውን ተፅዕኖ ለማጥናት ነው። ጥናቱ በስር የሰደዱ በሽታዎች እና በስኳር መጠን ቁጥጥር ዙሪያ ስላለው ሁኔታ ጠቃሚ መረጃ ይሰጣል፡፡ የጥናቱ ግኝቶች ለስኳር ህመምተኛ በተለይም ስር ሰደድ በሽታዎች ላሉባቸው የተሻሉ መመሪያዎችን, ቁጥጥር እና አፈፃፀምን ለማመቻቸት ስልቶችን እና ፕሮግራሞችን ለማስታወቅ ወይም ለማቀድ ይረዳሉ፡፡

የማጥኛ ደንቦች- እርስዎ የሚሰጡን መረጃ ስር የሰደዱ በሽታዎች እና ያልተቆጣጠሩት የስኳር መጠንን ለመከላከል እንዲሁም የስኳር ህመምተኞች ጋር ተያይዞ ሊመጡ የሚችሉ ችግሮችን እንድሁም በህመምተኞችን የሚደርሰዉን ሞት ለመከላከል አስተዋፅኦ ስለሚያደርግ በዚህ ጥናት ውስጥ በመሳተፍ ጥናቱን እንዲያግዙን እንጋብዝዎታለን። በጥናቱ ለመሳተፍ ፈቃደኛ ከሆኑ በቃለ-መጠይቁ ሂደት እቀጥላለሁ እናም ለጥናት ጥያቄዎች መልስ ለመስጠት የሚረዱ ጥያቄዎችን እጠይቃለሁ፡፡ በጥናቱ ውስጥ ከተካተቱት ጥያቄዎች ውስጥ አንዳቸውንም ለመመለስ የማይፈልጉ ከሆነ ይዘላሉ እና ወደሚቀጥለው ጥያቄ ይለፉ።

ስጋት፤ውጥረት ወይም አለመረጋጋት - አንዳንድ የግል መረጃዎችን ለማጋራት ትንሽ ሊያስቸግር ይችላል፤ ይሁን እንጂ ይህ እንዲከሰት አንፈልግም እና የማይስማሙ ከሆኑ መልስዎን አለመስጠት ይችላሉ፡፡

የጥናቱ ጥቅሞች - ተሳትፎዎ በስር የሰደዱ በሽታዎች እና በደም የስኳር መጠን ቁጥጥር መካከል ያለውን ግንኙነት የበለጠ ለማወቅ ይረዳናል፡፡ ጥናታችን የስኳር ህመምተኞችን የጤና ባለሙያዎችን እና የጤና ተቋማትን የስኳር ህክምና አገልግሎት ለማሻሻል ሊያደርግ ይችላል፡፡

ማትጊያዎች - በዚህ ጥናት ተሳታፊ ስለሆኑ ክፍያ አይከፈልም፤ሆኖም ስለተሳትፎዎን እናመሰግናለን።

የመተው ወይም የማቋረጥ መብት -ተሳትፎዎ በፈቃደኝነት ነው፡፡በማንኛውም ጊዜ ያለምንም ቅጣት ከዚህ ጥናት ሊቋረጡ ይችላሉ፡፡

ሚስጢራዊነት -በዚህ ጥናት ውስጥ የምንሰበስበው መረጃ በሚስጢር ይጠበቃል እና ጥናቱን ከሚሰራ ሰዉ በስተቀር ለማንም አይሰጥም.

የጥናቱ ፈቃደኝነት ተፈጥሮ -በዚህ ጥናት መሳተፍ በፈቃደኝነት ነው። ግልጽ ካልሆነ ወይም ተጨማሪ መረጃ ከፈለጉ እኛ እንሰጥዎታለን። በዚህ ጥናት ውስጥ መሳተፍ ወይም ያለመሳተፍ ውሳኔዎ ከዚህ ጤና ጣቢያ ወይም ከሌሎች የጤና ተቋማት ጋር አሁን ወይም የወደፊት ግንኙነትዎን አይጎዳም።

እውቂያዎች እና ጥያቄዎች

ይህን ጥናት የምትመራው አፍራታ ተገን ናት ።አሁን ያለዎትን ጥያቄ ሊጠይቁ ይችላሉ፤ወይም ጥያቄ ካሎት

በዚህ ቁጥር: 0930670600, ኢሜል eph2706@gmail.com በደግነት ሊያነጋግሯት ይችላሉ፡፡

ክፍል ሁለት፡- የመረጃ ፍቃድ ቅጽ

ይህን ቅጽ አንብቤዋለሁ ወይም እኔ ልረዳዉ በምችለው ቋንቋ ተነቦልኛል እና ከላይ የተዘረዘሩትን ሁሉንም ሁኔታዎች በሚገባ አውቀዋለሁ።

በዚህ ጥናት ለመሳተፍ ፈቃደኛ ነዎት?

1. አይ አመሰግናለሁ

2. አዎ ☐ ቃለ መጠይቅዎን ይቀጥሉ

በዚህ ጥናት ውስጥ ከመሳተፍ ጋር የተያያዘው ተፈጥሮና ዓላማ, ጥቅሞች እና ሊያስከትሉ የሚችሉ አደጋዎች ለተሳታፊዉ

ገልጬአለሁ፡፡ የመረጃ ሰብሳቢ ፊርማ ________________ ቀን __________

Annex IV: Amharic Version Questionnaire

በአዲስ አበባ ዩኒቨርሲቲ

የህብረተሰብ ጤና ትምህርት ቤት

የኤፒዲሚዮሎጂ እና ባዮስታትስቲክስ ትምህርት ክፍል

ጥያቄዎች

ይህ ጥያቄ ዓይነት ሁለት የስኳር በሽታ ካለባቸዉ ታማሚዎች መረጃ ለማሰባሰብ የሚዉል ነዉ፡፡ ከተጠያቅዎቹ የሚሰበሰበዉ መረጃ የሁሉን ሳይለይ ምስጥራዊ በሆነ መልኩ ይይዛል፡፡

የተጠያቂዉ መለያ ቁጥር __________/2024

ቦታ: ---

ክፍል አንድ: የተሳታፊ የማህበራዊ እና ኢኮኖሚያዊ ሁኔታ			
ተ. ቁ	**ጥያቄ**	**መልስ**	**ዝለል**
101	ዕድሜ በሙሉ ዓመት	____________ዓመት	
102	ጾታ	1. ወንድ 2. ሴት	
103	የትዳር ሁኔታ	1. ያላገባ/ች 2. ያገባ /ች 3.ፍቺ የፈጸመ/ች 4. ሚስቱ የሞተችበት ወይም ባሏ የሞተባት	
104	ሐይማኖትዎ ምንድን ነው?	1. ኦርቶዶክስ 2. ሙስሊም 3. ፕሮቴስታንት 4. ካቶሊክ 5. ሌሎች ________	
105	የተጠያቂዉ/ዋ ትምህርት	1.ማንበብ እና መጻፍ የማይችል/የማትችል	

	ደረጃ	2.የመጀመሪያ ደረጃ 3. የሁለተኛ ደረጃ 4. ኮሌጅ እና ከዚያ በላይ	
106	ዋና ስራዎ ምንድን ነው?	1. የመንግስት ወይም የግል ድርጅት ተቀጣሪ 2. ነጋዴ 3. የቤት እመቤት 4. የቀን ሰራተኛ 5. ሌሎች ________	
107	በአማካይ የወር ገቢዎ ስንት የኢትዮጵያ ብር ነዉ ?	____________ ብር	
ክፍል ሁለት፡ ከሊንካል ወይም ከስኳር ህመም ጋር የተያያዙ ጥያቄዎች			
ተ. ቁ	**ጥያቄ**	**መልስ**	**ዝለል**
201	ከቤተሰብዎ (አባት ወይም እናት ወይም ወንድም/እህት) ዉስጥ የስኳር በሽታ የነበረበት ሰዉ አለ?	1. አዎ 2. አይደለም	
202	የስኳር በሽታ ከተገኘብዎት ወዲህ ስንት ዓመት ነዉ? (መዝገቡን ተመልከት/ች)	___________ዓመት	
203	ህመሙን በተመለከተ ከቤተሰብዎ ድጋፍ አለ ወይም ይደረጋል?	1. አዎ 2. አይደለም	መልሱ "አይደለም" ከሆነ ወደ 205ኛ ጥያቄ ዝለል
204	ለ203ኛ ጥያቄ መልሱ አዎ ከሆነ ምን ዓይነት ድጋፍ	1. መድኃኒት እንድወስድ ማስታወስ 2. የገንዘብ ድጋፍ	

	ነዉ?	3. አካላዊ ድጋፍ (ለምሳሌ ሲታመሙ ደግፎ ለህክምና መዉሰድ) 4. የስነ-ልቦና ድጋፍ 5.ሌሎች ካሉ ይጠቀስ___________________	
205	በግል የደም ስኳር መጠን መለኪያ መሣሪያ(ግሉኮሜትር) አለዎት?	1. አዎ 2. አይደለም	
206	ተሳታፊዉ/ዋ አሁን እየወሰደ/ች ያለዉን የስኳር መድኃኒት ዓይነት ምንድነዉ?	1 ኢንሱሊን ብቻ 2. በአፍ የሚወሰድ መድኃኒት 3. ሁለቱንም (ኢንሱሊን እና በአፍ የሚወሰድ)	
207	ከስኳር በሽታ ዉጭ ሌላ ተላላፊ ያልሆነ ወይም ስር የሰደደ በሽታዎች አብዎት?	1. አዎ 2. አይደለም	መልሱ አይደለም ከሆነ ወደ 212ኛ ጥያቄ ዝለል
208	ለ207ኛ ጥያቄ መልሱ አዎ ከሆነ የበሽታዉን ዓይነት ምንድነዉ?	1. የደም ግፊት መጨመር 2. የሠውነት ቅባት መጠን መጨመር 3. አስም 4. 5.ሌሎች ካሉ ይጠቀስ___________________	
209	ለ207ኛ ጥያቄ መልሱ አዎ ከሆነ ለህመሙ መድኃኒት ይወስዳል/ትወስዳለች?	1. አዎ 2. አይደለም	
210	ለ209ኛ ጥያቄ መልሱ አዎ ከሆነ በቀን ስንት መድሃኒት	________________________	

	ይወስዳሉ?		
211	የተሳታፊዉን/ዋን የሦስት ተከታታይ ወራት ስኳር (FBS) መጠን	FBS 1. ____________ሚግ/ዴሊ 2.____________ ሚግ/ዴሊ 3.____________ ሚግ/ዴሊ	
212	የተሳታፊዉ/ዋ ክብደት እና ቁመት	1. ክብደት __________ኪ.ግ 2. ቁመት__________ሴ.ሜ ክብደት/ቁመት^2 ------------------	
ክፍል ሶስት- የስኳር ህሙማን ለራሳቸው የሚያደርጉት እንክብካቤ ከዚህ በታች ያሉት ጥያቄዎች ባለፉት ሰባት ቀናት ውስጥ ስላደረጉት የስኳር ህመም ራስን የመንከባከብ እንቅስቃሴዎች ይጠይቁዎታል።ባለፉት ሰባት ቀናት ውስጥ ታመው ከነበሩ እባክዎ ከዛ በፊት የነበሩትን ሰባት ቀናት መለስ ብለው ያስቡ			
3.1 **አመጋገብ**			
301	ባለፉት ሰባት ቀናት ዉስጥ ለምን ያህል ቀን የአመጋገብ እቅድዎን ተገበሩት?	0 1 2 3 4 5 6 7	
302	በአማካይ ባለፈው ወር ውስጥ በሳምንት ለስንት ቀናት የአመጋገብ ዕቅድዎን ተከትለዋል?	0 1 2 3 4 5 6 7	
303	ባለፉት ሰባት ቀናት ዉስጥ ለምን ያህል ቀን አምስትና ከዚያ በላይ ፍራፍሬና አትክልቶችን ተመግበዋል?	0 1 2 3 4 5 6 7	
304	ባለፉት ሰባት ቀናት ዉስጥ ለምን ያህል ቀን ቀይ ስጋ	0 1 2 3 4 5 6 7	

	ወይም የወተት ተዋፅዖዎችን ተመገቡ?									
3.2 **የአካል ብቃት እንቅስቃሴ**										
305	ባለፉት ሰባት ቀናት ዉስጥ ለምን ያህል ቀን አካላዊ አንቅስቃሴ አድርገዋል (የእግር ጉዞን ጨምሮ)	0	1	2	3	4	5	6	7	
306	ከመደበኛ ስራዎ ውጪ ባለፉት ሰባት ቀናት ዉስጥ ለምን ያህል ቀን (ለምሳሌ ውሃ ዋና ወይም ብስክሌት መንዳት) እንቅስቃሴ አደረጉ?	0	1	2	3	4	5	6	7	
3.3 የራስን የደም የስኳር መጠን መለካት										
307	ባለፉት ሰባት ቀናት ዉስጥ ለምን ያህል ቀን የደምዎን ስኳር መጠን ለክተዋል?	0	1	2	3	4	5	6	7	
308	ባለፉት ሰባት ቀናት ዉስጥ ለምን ያህል ቀናት የጤና ባለሙያ ባዘዘልዎት መሰረት የደምዎን የስኳር መጠን ለክተዋል?	0	1	2	3	4	5	6	7	
3.4 **የእግር እንክብካቤ**										
309	ባለፉት **ሰባት ቀናት** ዉስጥ ለምን ያህል ቀናት የውስጠኛውን የጫማዎን ክፍል ተመልክተዋል?	0	1	2	3	4	5	6	7	
310	ባለፉት **ሰባት ቀናት** ዉስጥ ለምን ያህል ቀናት እግርዎን ታጠቡ?	0	1	2	3	4	5	6	7	

311	ባለፉት **ሰባት ቀናት** ዉስጥ ለምን ያህል ቀናት እግርዎን ውሃ ውስጥ ዘፈዘፉ?	0 1 2 3 4 5 6 7	
312	ባለፉት **ሰባት ቀናት** ዉስጥ ለምን ያህል ቀናት እግርዎን ከታጠቡ በኋላ ጣቶችዎን አድርቀዋል?	0 1 2 3 4 5 6 7	
3.5 የስኳር መድሃኒት አወሳሰድ			
313	ምን አይነት የስኳር መድሃኒት ይወስዳሉ?	1. ኢንሱሊን 2. እንክብል	
314	ለጥያቄ ቁጥር 313 መልሱ ኢንሊሉን ከሆነ ባለፉት ሰባት ቀናት ዉስጥ ለምን ያህል ቀናት የታዘዘልዎትን ኢንሱሊን መርፌ ተወግተዋል?	0 1 2 3 4 5 6 7	
315	ለጥያቄ ቁጥር 313 መልሱ እንክብል ከሆነ ባለፉት ሰባት ቀናት ዉስጥ ለምን ያህል ቀናት የታዘዘልዎትን የስኳር መድሃኒት እንክብል ወስደዋል?	0 1 2 3 4 5 6 7	
3.6 ሲጋራ ማጨስ			
316	ባለፉት ሰባት ቀናት ዉስጥ ሲጋራ አጭሰው ያውቃሉ?	1.አዎ 2. አጭሼ አላውቅም	
317	ለጥያቄ ቁጥር 316 መልሱ አዎ ከሆነ ባለፉት ሰባት ቀናት ውስጥ በአማካይ በቀን ምን ያህል ሲጋራ አጭሰዋል ?	__________ ሲጋራ	

3.7 አልኮል መጠጣት			
318	አልኮል /ቢራ፤ ወይን፤ጠላ፤ አረቂ/ ጠጥተው ያውቃሉ?	1. አዎ 2. አይደለም	መልሱ "አይደለም" ከሆነ ወደ 401ኛ ጥያቄ ዝለል
319	ለ318ኛ ጥያቄ መልሱ አዎ ከሆነ ባለፉት 12 ወራት አልኮል ጠጥተዋል?	1. አዎ 2. አይደለም	መልሱ "አይደለም" ከሆነ ወደ 321ኛ ጥያቄ ዝለል
320	ለ319ኛ ጥያቄ መልሱ አዎ ከሆነ ባለፉት 12 ወራት አንድ (ለጠላ ብርጭቆ፤ለአረቂ መለኪያ፤ለቢራ ጠርሙስ ይጠይቁ) እና ከዚያ በላይ አልኮል ምን ያክል ጊዜ ጠጥተዋል?	1. በየቀኑ 2. ከ5-6 ቀናት በሳምንት 3. 3-4 ቀናት በሳምንት 4. ከ1-2 ቀናት በሳምንት 5. ከ1-3 ቀናት በ ወር 6. በወር ከ1 ቀን ያነሰ	
321	ባለፈው አንድ ወር አልኮል ጠጥተዋል?	1. አዎ 2. አይደለም	መልሱ "አይደለም" ከሆነ ወደ 324ኛ ጥያቄ ዝለል
322	ለ320ኛ ጥያቄ መልሱ አዎ ከሆነ ባለፈው አንድ ወር አንድ ብርጭቆና ከዚያ በላይ አልኮል ለምን ያክል ጊዜ ጠጥተዋል?	1.________ጊዜ 2. አላስታውስም	
323	ባለፈው ወር አልኮል ሲጠጡ በአንድ ጊዜ የመጠጥ አጋጣሚ ስንት ብርጭቆ ጠላ / መለኪያ አረቂ /ጠርሙስ ቢራ ጠጡ?	1. ቁጥር------------- 2. አላስታውስም	
324	ባለፈው ሳምንት በእያንዳንዱ ቀናት ስንት ብርጭቆ ጠላ /	1. ሰኞ __________	

	መለኪያ አረቂ /ጠርሙስ ቢራ ጠጥተዋል?	2. ማክሰኞ ______ 3. ረቡዕ ________ 4. ሐሙስ _______ 5. ዓርብ ________ 6. ቅዳሜ _______ 7. እሁድ ________	

ክፍል አራት- ከዚህ በታች ያሉ ጥያቄዎች ስለ ስኳር ህመም የጤና እውቀት ይጠይቁዎታል

መመሪያ- እነዚህ የታካሚዎችን የስኳር በሽታ ጤና እውቀትን የሚመለከቱ ጥያቄዎች ናቸው

ተ. ቁ	ጥያቄ	መልስ				
1. ከጤና ተቋማት ወይም ከፋርማሲዎች መመሪያዎችን ወይም በራሪ ፅሁፎችን በሚያነቡበት ጊዜ በሚከተሉት ላይ እንዴት ይስማማሉ ወይም አይስማሙም(1. በፅኑ እስማማለሁ, 2. እስማማለሁ, 3. እርግጠኛ አይደለሁም, 4. አልስማማም, 5. በፅኑ አልስማማም)						
401	ማንበብ የማይችሏቸውን ፅሁፎች ያገኛሉ?	5	4	3	2	1
402	ህትመቱን ለማንበብ በጣም ትንሽ ሆኖ አግኝተውታል (መነፅር አድርገውም እንኳን)	5	4	3	2	1
403	ይዘቱን ለመረዳት ለእርስዎ በጣም ከባድ እንደሆነ ይሰማዎታል	5	4	3	2	1
404	እነሱን ለማንበብ ረጅም ጊዜ ይወስድብዎታል	5	4	3	2	1
405	እነሱን ለማንበብ የሚረዳዎት ሰው ያስፈልግዎታል	5	4	3	2	1
2. የስኳር በሽታ እንዳለብዎ ስለሚታወቅ ከስኳር በሽታ ጋር የተያያዙ መረጃዎችን(ለምሳሌ ምርመራ፣ሕክምና፣ራስን መንከባከብ፣አማራጭ ህክምና ወዘተ በመፈለግ ረገድ የሚከተሉት ተሞክሮዎች ኢጋጥምዎታል(1. በፅኑ አልስማማም, 2. አልስማማም, 3. እርግጠኛ አይደለሁም, 4. እስማማለሁ, 5. በፅኑ እስማማለሁ)						

406	ከተለያዩ ምንጮች መረጃዎችን ይሰበስባሉ?	1	2	3	4	5
407	የሚፈልጉትን መረጃ በሚገባ ይመርጣሉ?	1	2	3	4	5
408	ያገኙትን መረጃ ተረድተዋል?	1	2	3	4	5
409	ስለህመምዎ ያለዎትን አስተያየት ለሀኪምዎ፣ቤተሰብዎ ወይም ጓደኛዎ ይናገራሉ?	1	2	3	4	5
410	ያገኙትን መረጃ ለዕለት ተዕለት ሕይወትዎ ተግባራዊ ያደርጋሉ?	1	2	3	4	5
3. የስኳር በሽታ እንዳለብዎ ስለሚታወቅ ስለ ስኳር በሽታ እና ስለ ህክምናው መረጃ ማግኘት ይችላሉ? በሚከተሉት ላይ እንዴት ይስማማሉ ወይም አይስማሙም(1. በፅኑ አልስማማም, 2. አልስማማም, 3. እርግጠኛ አይደለሁም, 4. እስማማለሁ,5.በፅኑ እስማማለሁ)						
411	መረጃው ለእርስዎ ተፈፃሚ መሆኑን ያስባሉ?	1	2	3	4	5
412	መረጃው ታማኝ እንደሆነ ግምት ውስጥ ያስገባሉ?	1	2	3	4	5
413	መረጃው ትክክለኛ እና አስተማማኝ ነው የሚለውን አረጋግጠዋል?	1	2	3	4	5
414	የጤና እንክብካቤ ውሳኔዎች ለማድረግ መረጃ ይሰበስባሉ?	1	2	3	4	5

ስለ ትብብርዎ እናመሠግናለን