ORIGINAL RESEARCH

Determinants of Type 2 Diabetes Mellitus Among Adults in Dill-Chora Referral Hospital, Dire Dawa, East Ethiopia

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Introduction: Ethiopia has been exhibiting trends that are shifting the populace's way of life toward urbanization. As a result, the country's primary focus is on treating infectious diseases, whereas chronic noncommunicable diseases receive less attention. Type 2 diabetes has emerged as a major noncommunicable disease that is endangering African nations' economic, social, and cultural underpinnings. There has been research mostly on prevalence, factors associated, and glycemic control of diabetes but not adequate on the causes of T2DM in Ethiopia, particularly in the study region.

Objective: To identify the determinants of type 2 diabetes mellitus among adults at Dill-Chora hospital, from August 30 to October 30, 2021.

Methods: An unmatched case-control study was carried out at Dill-Chora referral hospital using face-to-face interviews. The data was collected, cleaned, coded, and entered to epi data version 3.1 before being exported to SPSS version 23 for analysis. The analyses used were descriptive and logistic regression.

Results: The study included 331 individuals, 113 cases and 218 controls. Cigarette smoking (AOR: 3.15, 95% CI: 1.24–7.96), extra salt consumption (AOR: 5.52, 95% CI: 2.33–13.05), low fruit consumption (AOR: 5.28, 95% CI: 2.12–13.16), infrequent physical activity (AOR: 3.72, 95% CI: 1.65–8.39), waist to hip ratio (AOR: 18.88, 95% CI: 7.35–48.42), and triglyceride level (AOR: 2.93, 95% CI: 1.34–6.32) were strongly linked to the onset of type 2 diabetes mellitus.

Conclusion and Recommendation: This study discovered a variety of risk factors for type 2 diabetes, including triglyceride levels, fruit consumption, smoking, increased salt consumption, irregular exercise, and waist to hip ratio. By focusing preventative efforts on these risk factors, the occurrence of type 2 diabetes may be reduced. Furthermore, diabetes mellitus screening is crucial, particularly in those with a high waist-to-hip ratio, a smoking history, and high triglyceride levels.

Keywords: diabetes mellitus, cases, controls, determinants, Dire Dawa

Introduction

Diabetes mellitus is a collection of metabolic disorders defined by hyperglycemia caused by deficiencies in insulin production, action, or both. The great majority of diabetes patients fit into one of two basic etiopathogenetic groups.[1] Type 1 diabetes is caused by a total lack of insulin secretion.[1] Individuals at high risk of developing this kind of diabetes are frequently recognized by serological evidence of an autoimmune pathologic process happening in the pancreatic islets, as well as genetic markers. Type 2 diabetes mellitus (T2DM) is caused by a combination of insulin resistance and an insufficient compensatory insulin secretory response.[1,2] A degree of hyperglycemia sufficient to produce pathologic and functional alterations in numerous target tissues but without clinical symptoms may be established for a long time before diabetes is discovered in the latter group.[3]

Diabetes is one of the most serious worldwide health problems of the twenty-first century. According to the World Health Organization (WHO), 422 million persons over the age of 18 had diabetes in 2014.[4] T2DM accounts for about 90% of all diabetes cases.[5] According to Wild et al, the global prevalence of diabetes has more than quadrupled from 171 million in 2000 to 366 million in 2030.[6] To date, the International Diabetes Federation (IDF) estimates that 451 million individuals worldwide have diabetes, with a predicted increase to 693 million by 2045 if effective prevention techniques are not implemented.[7] Much of this rise is expected to be caused by population growth, ageing, growing living standards, consistent urban migration, and lifestyle changes such as bad diets, obesity, and sedentary habits in emerging nations.[8]

Diabetes is one of the leading global causes of mortality; together with cardiovascular disease, cancer, and respiratory illness, these disorders account for more than 80% of all premature noncommunicable disease (NCD) fatalities.[9] It has been linked to a 2–3 fold increase in all-cause mortality[10] as well as an increase in infection, cardiovascular disease, stroke, chronic kidney disease, chronic liver disease, and cancer mortality.[11,12] Diabetes' long-term hyperglycemia affects not only the prognosis and speed of recovery from other chronic diseases, such as tuberculosis, cancer, and heart conditions, but also the long-term damage, dysfunction, and failure of many organs, particularly the eyes, kidneys, nerves, heart, and blood vessels.[13–15] Furthermore, spite of the growing in public health promotion and life expectancy, diabetes has the second-largest severe net influence on global health-adjusted life expectancy.[16]

T2DM prevalence in SSA has grown dramatically over the last 50 years, going from 1% in certain nations in the 1960s to 4.3% in 2012. Its incidence in African populations varies widely, with some countries, such as Reunion, showing an estimate of 16% and some others, such as Uganda, recording 1% in rural areas and Ethiopia, 1.9% in a study conducted in Bona district, Sidama.[17] The greatest rise in incidence has been observed among city dwellers.[17] Though the cause of the rapid growth in T2DM incidence is unknown, a variety of dietary behaviors, including a dietary consumption of saturated fats, a lack of dietary fiber, and active smoking, are linked to the disease's risk.[18–21] It has a number of etiological variables, including genetics, ethnicity, poor diet, sedentary behavior, obesity, and dyslipidemia.[22]

Ethiopia, a developing nation, has seen developments in recent decades that have shifted the population's way of life toward urbanization. This fast transition has resulted in the growth of CNCDs such as T2DM. Furthermore, because of a lack of funding and expertise, the nation places a greater emphasis on controlling infectious illnesses and pays less attention to CNCDs like T2DM. Despite various researches on glycemic control, adults with diabetes, and related risk factors, there is no adequate investigation on the determinants of T2DM in Ethiopia, particularly in the study region.

It is crucial that scientists do more studies using robust designs to examine those crucial components related with type 2 diabetes independently. Additionally, it is crucial for healthcare professionals to effectively intervene and realistically prevent the disease at all levels of the healthcare system organizations. The at-risk population must also be aware of the factors that contribute to T2DM in order to implement those preventive measures.

Methods and Materials
Study Setting
This research was carried out at Dill-Chora referral hospital in Dire Dawa, Ethiopia, in the country's east, close to the regional states of Oromia and Somalia. It is 515 kilometers from Addis Ababa, Ethiopia's capital city. There are 38 rural kebeles and 9 urban kebeles. The city was founded by the Ethio-Djibouti Railway in 1902 E.C. to serve as the mid-railway station. The entire population of Dire Dawa was 426,000. Four private hospitals and three government-run (public) hospitals offer diabetes diagnosis, care, and treatment. There were 850 type 2 diabetic patients following at dill Chora referral hospital outpatient clinic during the study period.

Research Design, Study Time Line and Sample Size
From August 30 to October 30, 2021, an unmatched case control study was undertaken at hospital. Clients aged 18 and above who sought clinical care at DCRH outpatient departments during the research period comprised the source population. Patients with T2DM who are at least 18 years and older were taken as cases, and control subjects in the same age group were identified in the same hospital where cases were selected after confirmation of the absence of either

type of diabetes. Epi-info version 7.2.2 software was used to calculate the sample size.[23] The sample size was calculated using an 80% power assumption, a 95% confidence level, and a case-to-control ratio of 1:2. As a result, a 10% non-response rate was applied to the initial sample size of 309, yielding a total sample size of 340.

Sampling Technique and Procedures

Data was gathered at the Dill-Chora referral hospital in Dire Dawa, Ethiopia. Following informed permission, cases were chosen from diabetes chronic care, which comprised patients 18 years of age and older who had recently (in six months) been diagnosed with type 2 diabetes mellitus and whose diabetic status had been established using WHO diagnostic criteria for diabetes from 2006.[24] Controls had been selected after their diabetes status was recognized. Applying exclusion criteria, their fasting or random blood sugar levels were measured, and individuals with a fasting blood sugar level of less than 126 mg/dl and a random blood sugar level of less than 200 mg/dl had been selected as controls. Then, for the selection of study units, a systematic sampling technique was used.

Exclusion Criteria

Subjects who had taken any medicine with a potential influence on glucose homeostasis in the preceding three months other than anti-diabetic drugs during the data collection period were excluded to reduce false positives for diabetes mellitus. Pregnant women were not allowed to take part in the research because of the potential influence of pregnancy on physicochemical and biochemical data.

Operational Definitions

Type 2 diabetes: If a physician puts it as a main diagnosis or as additional diagnosis with prescription of at least one anti-diabetic medicine in a particular year, we consider it as type 2 diabetes.[25]

Gestational diabetes history: any history of impaired glucose tolerance or elevated blood sugar levels that began or were first recognized during pregnancy.

If a person has central obesity, they have a waist-to-hip ratio (WHR) of 0.90 for males and 0.85 for women, meaning they have proportionately more body fat in their belly or trunk than their hips and lower limbs.[27,28]

Frequency of physical exercise: An individual's deliberate workout conducted fewer than three days per week and three or more days per week was deemed less frequent and regular or frequent physical activity, respectively, in this study.[26]

In this study, alcohol intake was defined as when a person consumes at least one standard alcohol unit per week using local customary measurements.

Smoking cigarettes: Participants were categorized as smokers if they had been doing so for more than six months and smoked at least one stick a day.

Hypertension is described as having a systolic blood pressure of 140 mmHg or higher, or a diastolic blood pressure of 90 mmHg or higher.[26]

Family history of diabetes: a reported diabetes history among the respondent's blood relatives, specifically his mother, father, full brother or sister, grandmother, and grandfather.[29]

Additional salt use: it is taken into account if the research participant adds more salt to a ready-to-eat meal.[30]

Collection and Measurement of Data

A systematic, pretested questionnaire based on existing literature was used. To guarantee uniformity, the questionnaire was written in English, translated into the local language, and then translated back into English by language specialists. All anthropometric measures, such as height, weight, and waist circumference, were taken in accordance with standards.[31]

Demographic and Behavioral Characteristics

To gather demographic and behavioral risk indicators, face-to-face interviews with an interviewer-administered questionnaire were used. Demographics, gender, education level, marital status, occupation, physical exercise, experience

with hypertension and diabetes, dietary habits, particularly fruit and vegetable intake, alcohol intake, and lifestyle variables were all inquired of each participant.

Physical Measurements

During this phase, physical measurements of height and weight were taken in order to calculate body mass index (BMI). Blood pressure (BP) was measured in a sitting position using a digital sphygmomanometer. The mean of two measures taken 5 minutes apart was chosen as the final BP result. To measure the subject's weight and height while wearing light clothing and standing erect on a level surface, a mobile weighing and height scale was used. The BMI was calculated by dividing the weight in kilograms by the height in meters squared. A soft measuring tape was used to measure the waist circumference (WC) midway in between inferior portion of the last noticeable rib and the apex of the iliac crest. Hip circumference was measured across the widest part of the hip using a soft tape measure after removing outer garments and putting the feet together. After that, the WC was divided by the hip circumference to determine the waist to hip ratio.

Biochemical Analysis

Total cholesterol, triglyceride (TG), high-density lipoprotein (HDL), and low-density lipoprotein (LDL) were all tested. Three milliliters (mL) of fasting venous blood were taken from each participant using Serum Separator Tube (SST) tubes/ gold-topped tubes for biochemical testing and evaluated after 30 minutes for TG, LDL, HDL, and total cholesterol levels using the Cobas C 311 chemistry analyzer.

Quality Assurance

Pre-testing of the data collection tools was done with 5% of the sample population. We conducted a pretest before to the research period, and we revised the questionnaire based on the results to guarantee clarity, sequence, and language. The survey team and supervisor received two days of training. Each day, the supervisor monitored the data collection process, and the researchers examined for completeness of information on a daily basis and any gaps discovered were promptly notified to the supervisor and data collectors.

Data Processing and Analysis

The collected data was coded, cleaned, and entered to Epi-Data version 3.1 and exported to SPSS version 23 is used for social science analysis. Descriptive statistics were used. Bivariable and multivariable binary logistic regression analysis was performed to see the association between the outcome and independent variables.

Variables with a p-value of 0.25 or below in Bivariable logistic regression were considered for multivariable logistic regression, and variables with a p-value of 0.05 were considered statistically significant, and the odds ratios linked with these prospective variables were provided as a measure of strength, along with the relevant 95% confidence intervals. Hosmer and Leimshow were used to assess the model's fitness.

Ethical Approval and Consent to Participate

Ethical approval confirmation was obtained from Dire Dawa University research ethics review committee on 16 September 2021 with reference number DDU-ERC-2021-026. A support letter was taken from Dill-Chora referral hospital CEO, and the study participant had been informed about the purpose of the study, the importance of their participation in the study, and written informed consent had been obtained.

The study subjects were informed that any information they provided us would be kept confidential and we would not leave out personal information for others to see. We do not take their names, and aggregate information was used. Their privacy on delivering the data was also protected by facilitating a private interview site and they were informed they could decline any questions that they did not want to answer. Informed permission from participants covered the publishing of their anonymous replies and the fact that the study was carried out in line with the Declaration of Helsinki.

Result

Respondent Sociodemographic Characteristics

In this study, a total of 113 cases with type 2 diabetes and 218 controls that were diabetes-free participated, with a response rate of 97.4%. Cases had a mean (±SD) age of 57.4 (±9.4) years and controls had a mean (±SD) age of 45 (±11.9) years. Among the participants, more than half of the cases and controls (54.4%) were females, and the majority of the respondents (74%) were urban residents. The majority of study participants (41.7%) had completed secondary school, while nearly 26.9% had a college diploma or higher. Around 30.8% and 26% of the participants were employed (either government or non-government) and merchants, respectively, and nearly 62% of participants were married (Table 1).

Table 1 Socio Demographic Characteristics of Cases and Controls (N=331)

Variables		Cases(n1=113)	Controls(n2=218)	Total (N=331)
		No. (%)	No. (%)	No. (%)
Sex	Male	53(46.9)	98(44.9)	151(45.6)
	Female	60(53.1)	120(55.1)	180(54.4)
Age	18–24	0(0)	11(5)	11(5)
	25–34	0(0)	29(13.3)	29(13)
	35–44	8(7)	63(28.9)	71(21.5)
	45–54	42(37.2)	80(36.7)	122(36.9)
	≥55	63(55.8)	35(16.1)	98(29.6)
Education	No formal education	19(16.8)	3(1.4)	22(6.6)
	Primary education	29(25.6)	53(24.3)	82(24.8)
	Secondary education	38(33.7)	100(45.8)	138(41.7)
	College/University	27(23.9)	62(28.5)	89(26.9)
Residence	Urban	90(79.6)	155(71.1)	245(74)
	Rural	23(20.4)	63(28.9)	86(26)
Occupation	Farmer	19(16.8)	32(14.6)	51(15.4)
	Employed	39(34.6)	63(28.9)	102(30.8)
	Daily laborer	10(8.8)	41(18.8)	51(15.4)
	Merchant	28(24.8)	58(26.7)	86(26)
	House wife	17(15)	24(11)	41(12.4)
Marital status	Single	16(14.2)	27(12.3)	43(13)
	Married	69(61.1)	137(62.8)	206(62.2)
	Divorced	21(18.6)	36(16.5)	57(17.2)
	Widowed	7(6.1)	18(8.4)	25(7.6)
Family size	1–3	28(24.8)	59(27.1)	87(26.3)
	4–5	61(54)	131(60.1)	192(58)
	>5	24(21.2)	28(12.8)	52(15.7)

Modifiable Risk Factors

Nearly 12.4% of the research participants were now smoking, and around 79.5% had smoked cigarettes in the past. In the survey, 38.2% of individuals now drank alcohol, and about 41.4% had previously consumed alcohol. Around 36.5% of research participants consumed less fruit each week, while 64.6% of individuals reported eating veggies 1–2 days each week. The majority (64.7%) consumed fatty meals, and 32.6% used more salt than usual. The majority of research participants (80.7%) engaged in regular physical activity, and 44.6% did so more frequently each week. The majority (63.1%) had a normal BMI, but roughly 60.2% and 44.1% had big waist circumferences and large waist to hip ratios, respectively (Table 2).

Metabolic and Biochemical Risk Factors

Of the study's participants, about 20.5% had a history of hypertension, and 18.5% had high blood pressure. 50.4% of study subjects had a history of diabetes mellitus in their families, and 6% of the female participants had had gestational diabetes in the past. A total cholesterol level of more than 200 mg/dl was found in nearly 60.1% of

Table 2 Modifiable Risk Factors (N=331)

Variables		Cases (n1=113)	Controls (n2=218)	Total (N=331)
		No. (%)	No. (%)	No. (%)
Ever smoking status	Yes	99(87.6)	164(75.2)	263(79.5)
	No	14(12.4)	54(24.7)	68(20.5)
Current smoking status	Yes	4(3.5)	37(16.9)	41(12.4)
	No	109(96.5)	181(83.1)	290(87.6)
Alcohol drinking status ever	Yes	55(48.7)	82(37.6)	137(41.4)
	No	58(51.3)	136(62.4)	194(58.6)
Current alcohol drinking status	Yes	53(46.9)	80(36.7)	127(38.2)
	No	60(53.1)	138(63.2)	198(59.8)
Fruit consumption	<2 days/week	18(15.9)	103(47.2)	121(36.5)
	≥2 days/week	95(83.1)	115(52.8)	210(63.5)
Vegetable consumption	1–2 days/week	75(66.4)	139(63.8)	214(64.6)
	≥3 days /week	38(33.6)	79(36.2)	117(35.4)
Fatty food consumption	Yes	79(66.9)	135(61.9)	214(64.6)
	No	34(33.1)	83(38.1)	117(35.4)
Additional salt use	Yes	59(52.2)	49(22.5)	108(32.6)
	No	54(47.8)	169(77.5)	223(67.4)
Regular physical exercise	Yes	90(79.6)	177(81.2)	267(80.7)
	No	23(20.4)	41(19.8)	64(19.3)
Frequency of PE	<3 days/week	66(73.3)	82(56.3)	148(55.4)
	≥3 days/week	24(26.7)	95(43.7)	119(44.6)
Way of transport	Foot	91(80.5)	177(81.2)	268(81)
	Vehicle	22(19.5)	41(19.8)	63(19)

study subjects, and a triglyceride level of more than 150 mg/dl was found in 54.1%. The majority of subjects (68.9%) had high density lipoprotein levels over 40 mg/dl and about 82.2% had serum low density lipoprotein levels below 100 mg/dl (Table 3).

Determinants of Type 2 Diabetes Mellitus

Ever smoking, drinking, fruit intake, regular physical activity, frequency of physical activity, increased salt usage, family history, waist to hip ratio, blood pressure, total cholesterol, and triglyceride level all revealed a significant linkage with type 2 diabetes with a p value of 0.25. While the impacts of chosen factors were controlled for, cigarette smoking, frequency of physical activity, salt usage, waist to hip ratio, fruit intake, and triglyceride level were shown to have statistically significant associations with type 2 diabetes mellitus at p 0.05.

The odds of developing type 2 diabetes mellitus among cigarette smokers are 3.15 times as high as those who do not smoke ever (AOR: 3.15, 95% CI: 1.24–7.96, p-0.015).

The odds of developing type 2 diabetes mellitus among participants who eat fruit less than 2 days per week were 5.28 times as high as those who eat fruit more than 2 days per week (AOR: 5.28, 95% CI: 2.12–13.16, p-0.0001). The odds of

Table 3 Metabolic and Biochemical Risk Factors (n=131)

Variables		Cases (n1=113)	Controls (n2 =218)	Total (N=331)
		No. (%)	No. (%)	No. (%)
Family history of DM	Yes	51(45.1)	116(53.2)	167(50.4)
	No	62(54.9)	102(46.8)	164(49.6)
History of hypertension	Yes	34(30)	34(15.6)	68(20.5)
	No	79(70)	184(84.4)	263(79.5)
Blood pressure	Normal	76(67.3)	194(89)	270(81.5)
	High	37(32.7)	24(11)	61(18.5)
BMI[a]	Normal	42(37.2)	167(76.6)	209(63.1)
	Overweight/obese	71(62.8)	48(23.4)	119(35.9)
Waist circumference	Normal	99(87.6)	33(15.1)	132(39.8)
	High	14(12.4)	185(84.9)	199(60.2)
Waist to hip ratio	Normal	99(87.6)	86(39.4)	185(55.9)
	High	14(12.4)	132(61.6)	146(44.1)
Total cholesterol	<200 mg/dl	65(57.5)	67(30.7)	132(39.9)
	>200 mg/dl	48(42.5)	151(69.3)	199(60.1)
Triglycerides	<150 mg/dl	76(67.3)	76(34.8)	152(45.9)
	>150 mg/dl	37(32.7)	142(65.2)	179(54.1)
HDL[b]	>40 mg/dl	61(54)	167(76.6)	228(68.8)
	<40 mg/dl	52(46)	51(23.4)	103(31.2)
LDL[c]	<100 mg/dl	60(53.2)	212(97.3)	272(82.2)
	100–129 mg/dl	50(44.2)	6(2.7)	56(16.9)
	≥130 mg/dl	3(2.6)	0(0)	3(0.9)

Notes: "a" Body mass index, "b" High density lipoprotein, "c" low density lipoprotein, "n1"number of cases, "n2" number of controls, "N" total study participants.

Table 4 Determinants of T2DM at Dill-Chora Referral Hospital Dire Dawa, Ethiopia (n=331)

Variables		Diabetes (Type 2)		COR(95% CI)	p- value	AOR(95% CI)	P-value
		Cases (n1=113)	Control (n2=218)				
		No. (%)	No. (%)				
Ever smoking	Yes	99(87.6)	164(75.2)	2.328(1.23–4.409)	0.009	3.15 (1.24–7.96)	0.015
	No	14(12.4)	54(24.7)	1		1	
Ever drinking	Yes	55(48.7)	82(37.6)	0.636(0.402–1.007)	0.053		
	No	58(51.3)	136(62.4)	1			
Fruit consumption	<2days/wk.	18(15.9)	103(47.2)	0.21(0.120–0.370)	<0.0001	5.28(2.12–13.16)	<0.001
	≥2 days/wk.	95(83.1)	115(52.8)	1		1	
Additional salt use	Yes	59(52.2)	49(22.5)	3.76 (2.315–6.134)	<0.0001	5.52(2.33–13.05)	<0.001
	No	54(47.8)	169(77.5)	1		1	
Regular exercise	Yes	90(79.6)	177(81.2)	0.58(0.340–0.990)	0.049		
	No	23(20.4)	41(19.8)	1			
Frequency of physical ex.	<3 days/wk.	66(73.3)	82(56.3)	3.18(1.830–5.530)	<0.0001	3.72(1.65–8.39)	0.002
	≥3 days/wk.	24(26.7)	95(43.7)	1		1	
Family history	Yes	51(45.1)	116(53.2)	1.38(0.87–2.18)	0.164		
	No	62(54.9)	102(46.8)	1			
W/H ratio	Normal	99(87.6)	86(39.4)	1		1	
	High	14(12.4)	132(61.6)	10.85(5.8–20.2)	<0.0001	18.88(7.35–48.4)	<0.001
BP	Yes	76(67.3)	194(89)	3.93(2.20–7.00)	<0.0001		
	No	37(32.2)	24(11)	1			
Cholesterol	<200 mg/dl	65(57.5)	67(30.7)	1			
	≥200 mg/dl	48(42.5)	151(69.3)	3.052(1.90–4.80)	<0.0001		
Triglycerides	<150 mg/dl	76(67.3)	76(34.8)	1		1	
	≥150 mg/dl	37(32.7)	142(65.2)	3.83(2.37–6.21)	<0.0001	2.93(1.34–6.32)	0.007

developing type 2 diabetes mellitus among those who do physical exercise less than 3 days/week was 3.72 times as high as those who do physical exercise more than 3 days/week (AOR: 3.72, 95% CI: 1.65–8.39, p-0.002). Those who use additional salt were 5.52 times at a higher risk of developing type 2 diabetes mellitus than those who do not use it (AOR: 5.52, 95% CI: 2.33–13.05, p 0.0001). The odds of developing type 2 diabetes mellitus were 18.88 times higher in those with a high waist to hip ratio than in those with a normal waist to hip ratio (AOR: 18.88, 95% CI: 7.35–48.42, p 0.0001), and the odds of developing type 2 diabetes were 2.93 times higher in those with plasma triglyceride levels of 150 mg/dl or higher (AOR: 2.93, 95% CI: 1.34–6.32, p 0.007) (Table 4).

Discussion

The purpose of this study was to find risk variables for T2DM in patients at DCRH. Cigarette smoking, less fruits consumed, higher salt consumption, frequency of physical activity, waist to hip ratio, and serum triglyceride level were all significantly related with the occurrence of T2DM in this study.

This study revealed cigarette smoking an independent determinant of T2DM. When compared to those who do not smoke, those who smoke cigarettes were 3.15 times at higher risk of developing T2DM. This outcome is similar to findings from China and Japan.[32,33] Smoking is a major risk factor for cardiovascular disease and the biggest cause of preventable death globally.[32] Despite the fact that most studies have been done in Western countries, epidemiological data has solidly connected cigarette smoking with T2DM risk[34] after decades of research. The precise mechanism through which smoking increases the risk of diabetes and impairs glucose metabolism is uncertain, but existing research indicates that the habit promotes insulin resistance and has also related to an amplified risk of chronic pancreatitis and pancreatic cancer.[35]

T2DM was more likely to develop in people who consumed less fruit. Individuals who ate fruit less than twice a week were 5.28 times at higher risk of acquiring type 2 diabetes mellitus when compared to those who ate fruit twice a week or more. This conclusion is consistent with prior research on the association of fruit consumption and the risk of acquiring T2DM.[36–38] The molecular processes behind fruits' positive effects on glucose control and type 2 diabetes risks are likely complex. Aside from their low calorie contribution, often fruits have a low glycemic index and are abundant in fiber, minerals, vitamins, and phytochemicals, those could be helpful.

Another determining factor substantially related with T2DM was increased salt consumption. Individuals who added salt to their prepared meals were 5.52 times more risk to acquire T2DM. This conclusion is similar with other observational studies that show that consuming more salt raises the risk of T2DM, while the exact explanation is unknown.[30,38] The Lithuanian study found that adding salt to prepared meals when there is not enough, or practically every time without tasting, has a nearly two-fold increased risk of acquiring type 2 diabetes mellitus compared to participants who never add salt to prepared meals[39] This might be because higher salt consumption is linked to increased carbohydrate consumption.[40]

Individuals who engage in little or no regular physical activity were 3.72 times more likely to acquire T2DM than those who engage in regular physical activity at least three times per week. This outcome is consistent with research undertaken in Japan and China.[32,41] It might be because weight reduction from healthy diet and increased physical exercise allows muscle cells to utilize insulin and glucose more efficiently, decreasing the risk of diabetes. On the contrary, a lack of activity might cause muscle cells to lose their sensitivity to insulin, which controls blood glucose levels.

When compared to individuals with a normal waist to hip ratio, people with a high waist to hip ratio are 18.8 times more likely to acquire T2DM. It is consistent with research from Yaoundé, Cameroon[42] and Mizan Aman, south-west Ethiopia.[26] It is thought that increased belly fat deposits influence insulin action by releasing free fatty acids (FFA). Additionally, fat cells release signaling molecules including interleukin-6 (IL-6) and tumor necrosis factor- (TNF-), that both contribute to the development of insulin resistance.[43]

Those with a high serum triglyceride level (triglyceride level more or equal to 150 mg/dl) have a 2.93-fold increased risk of having T2DM as compared to those with a low serum triglyceride level (triglyceride level less than 150 mg/dl). This is consistent with the findings of a research done in south-west Ethiopia[26] where the prevalence of diabetes was greater among individuals with high triglyceride levels, as well as a study conducted among Chinese people in Shanghai where hypertriglyceridemia was shown to be strongly associated to T2DM.[44] This is consistent with the notion that those with a high lipid profile (high TG as well as high LDL and total cholesterol) are at a higher risk of diabetes and other cardiovascular problems.[45]

Conclusion and Recommendation

Cigarette smoking, frequency of physical activity, fruit consumption, additional salt use, waist to hip ratio, and serum triglyceride level were all significant predictors of type 2 diabetes mellitus. These risk factors are possibly controllable. As a result, focusing the preventative approach on lifestyle modifications may minimize the likelihood of developing T2DM.

Dill Chora referral hospital: It is better to include counseling and health education at each service point regarding lifestyle modification and early screening to know if there are any lipid profile derangements and to halt the progress of T2DM in its pre-diabetic stage.

Patients should adhere to a healthy lifestyle, ie, have regular physical exercise at least 3 days per week, practice a healthy diet focusing on adequate fruit consumption and avoid additional salt use in prepared meals. Moreover, it is better to develop the habit of having general screening tests in order to prevent chronic diseases like T2DM, to know their susceptibility, and to take measures before developing T2DM.

The Dire Dawa health office should mandate health institutions to incorporate NCCD-focused health education programs, such as T2DM, alongside clinical care, much as they do for infectious disease. Furthermore, it is preferable to create mass sports activities in order to further stimulate the community and promote it as a culture.

If possible, researchers should undertake an experimental investigation concentrating on these specific variables to confirm their true temporal connection with T2DM.

Abbreviations
AOR, adjusted odd ratio; BMI, body mass index; CI, confidence interval; CNCD, chronic non-communicable diseases; COR, crude odd ratio; DDU, Dire Dawa university; DM, diabetes mellitus; IU, International unit; ICD, International classification of diseases; HDL, High density lipoproteins; NCD, non-communicable diseases; OR, odds ratio; T2DM, Type 2 diabetes mellitus.

Data Sharing Statement
On request, the principal investigator will provide the data used to confirm the study's conclusions.

Ethics Approval and Consent to Participate
The ethical clearance was obtained from Dire Dawa University College of Medicine and Health Sciences research ethics review committee with reference number DDU-ERC-2021-026. Following the approval, an official letter of co-operation had been written to Dire Dawa health office, cordially written support letter to dill Chora referral hospital and Permission was obtained from the chief executive officer of the Hospital. Finally, informed consent was taken from each study participant to collect data keeping their privacy. The confidentiality of the patient was ensured by avoiding their identifiers from the data collection tool.

Consent for Publication
To proceed the research process and collect data, we got ethical clearance from Dire Dawa University research ethics review committee on 16 September 2021 with reference number DDU-ERC-2021-026. In addition, support letter from Dire Dawa health office, permission from Dill Chora referral hospital CEO and written informed consent was taken from each study participant. Along with the permission and written informed consent this study did not take a person's details such as name, images, or videos.

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Author Contributions
All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis, and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure
The authors report no conflicts of interest in this work.

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