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Impact of Gender on Heart Diseases among Patients with Type 2 Diabetes: Prevalence and Associated Factors in Sana'a city, Yemen

Research Submitted in Partial Fulfillment of the Requirements for Bachelor's Degree in Medicine , Faculty of Medicine and Health Sciences, Emirates International University

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Dedication

Frist of all, we dedicate this study to our almighty **Allah**, who gives us strength, knowledge and skills to move forward.

To our dear proud beloved **parents** who support us unconditionally- whatever we thought of quitting, providing us all over spiritual, moral and financial requirements. Moreover, it's to our **brothers, sisters, friends and colleagues** who shared their piece of advice and encouragement to successfully finish this study.

Acknowledgement

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Abstract

Introduction: The prevalence of heart diseases among individuals with type 2 diabetes mellitus (T2DM) is notably high due to diabetes affecting the cardiovascular system through various mechanisms, including gender variations, resulting in management challenges. While men have a higher prevalence of diabetes, women carry a higher risk of cardiovascular events. Recent guidelines on cardiovascular prevention have acknowledged sex-related differences, necessitating specific health considerations. This study aimed to assess and compare the prevalence of heart disease between men and women within the T2DM population.

Study objective: This study aimed to evaluate and compare the prevalence of heart disease among men and women in the group of patients with type 2 diabetes.

Methodology: This analytical cross-sectional study was conducted in government and private hospitals and diabetic clinics from October 15, 2024, to October 30, 2024. Face-to-face interviews were used to administer the questionnaire. Sociodemographic, clinical, lifestyle, and psychosocial factors were evaluated. Chi-square and Mann-Whitney tests were used to compare the prevalence of heart disease between men and women.

Results: out of 334 patients with T2DM were included in this study, heart disease was present in 31.4% of participants, with coronary artery disease (CAD) documented in 35.2%, followed by heart failure (26.7%). The prevalence of heart disease was higher in men (33%) than in women (28.8%), although this difference was not statistically significant ($P = 0.442$). The odds ratio indicated that men had a 1.22 times higher risk of heart disease compared to women. Men exhibited significantly higher rates of smoking, chewing Qat, consuming fast food, higher stress levels, and less sleep duration than women ($p < 0.05$), which were significantly associated with heart disease ($p < 0.05$). Conversely, women had higher rates of high body mass index (BMI), single or divorced status, non-formal education level, unemployed status, and a greater likelihood of having support to help manage DM or heart disease ($p < 0.05$). No significant gender differences were observed in other variables included in the questionnaire ($p > 0.05$).

Conclusion: The study highlights gender-specific risk factors for heart disease among the T2DM population, emphasizing the need for tailored prevention strategies. Addressing

lifestyle factors such as smoking and stress, particularly in men, could improve cardiovascular outcomes.

Keyword's: Heart diseases, diabetes patient, Prevalence, Associated factors, Yemen.

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Abbreviations

BMI	**Body Mass Index**
CVDs	**Cardiovascular diseases**
CHD	**Coronary heart disease**
DKD	**Diabetic kidney disease**
GDM	**Gestational diabetes mellitus**
GLP1-RAs	**Glucagon-like peptide-1 receptor agonist**
HbA1c	**Glycated Hemoglobin**
IFG	**Impaired fasting glucose**
IGT	**Impaired glucose tolerance**
NAFLD	**Non-alcoholic fatty liver disease**
MS	**Metabolic Syndrome**
PAD	**Peripheral arterial disease**
SGLT-2Is	**Sodium–glucose transport protein 2 inhibitor**
SPSS	**Statistical package for social science**
T2DM	**Type 2 diabetes mellitus**
BP	**Blood pressure**
LDL	**Low-density lipoprotein**
HDL	**high-density lipoprotein**
AHA	**American heart association**
RR	**Respiratory rate**
SPECT	**Single-photon emission computed tomography**
MACEs	**Major adverse cardiac events**
CR	**Coronary revascularization**
CD	**Cardiac death**
HR	**Hazard ratio**
IQR	**Interquartile range**

FH	**Family history**
FBG	**Fasting blood glucose**
SBP	**Systolic blood pressure**
DBP	**Diastolic blood pressure**
TC	**Total cholesterol**
MC	**Multiple sclerosis**

Chapter 1: introduction

Chapter 1: Introduction

1.1 Background

Cardiovascular diseases (CVDs) are a leading cause of morbidity and mortality in patients with diabetes (1). Comprehensive assessment and treatment of CVD risk factors, such as diabetes, obesity/overweight, hypertension, dyslipidemia, and smoking, are recommended for prevention (1). According to the International Diabetes Federation, the global prevalence of diabetes in 20- to 79-year-olds was 10.5% or 536.6 million people in 2021, costing healthcare systems 966 billion USD for control (2).

In the domain of endocrinology and metabolism, the greatest body of evidence for important clinical implications of sexual dimorphisms comes from studies in the field of type 2 diabetes mellitus (T2DM). Genetic background, lifestyle, and environment contribute to the pandemic increase of T2DM and its associated complications, presenting a challenge for healthcare systems (3). It is widely known that complications of T2D tend to appear over time and menace health and quality of life, especially when diabetes is unmanaged. The most prevalent complications include cardiovascular disease (CVD), retinopathy, neuropathy and diabetic kidney disease (DKD) (4).

Recent growing evidence has suggested that diabetes is a stronger risk factor for CVDs, such as coronary heart disease (5), stroke (6), and heart failure (7), in women than in men. In addition, these estimates may also be influenced by the fact that women in many parts of the world often suffer from inequality in access to primary and secondary screening controls and more generally in access to health care. In women, diabetes mellitus appears to be less controlled considering each metabolic parameter, especially given the fact that they tend to have lower insulin sensitivity than their male counterparts,

resulting in greater use of insulin units to maintain optimal glycemic values and compliant with therapeutic goals (8).

1.2 Problem statement

Despite men having a higher prevalence of diabetes, women with diabetes have a higher risk of cardiovascular events (9). The mechanisms responsible for the greater diabetes - related consequences in women compared with men are uncertain. Sex disparities in diabetes control may be involved (6,7,10), as well as sex differences in the control of other cardiovascular risk factors (5–7), suggesting the importance of sex-specific management of diabetes and cardiovascular risk factors (11).

1.3 Justification of the study

Nowadays, the gaps in evidence were reached within the recently published European guidelines for the management of cardiovascular diseases in patients with diabetes (12), where new recommendations for a systematic survey of cardiovascular symptoms have been summarized.

Differences in health care systems, as well as cultural and sociological backgrounds, across countries, highlight the need to clarify sex differences in the management of cardiovascular risk factors.

Despite the available evidences that, to some extent, tried to explain the sex differences in these factors, they remain unclear and, in some researches, there are discrepancies in results indicating the clear gap knowledge that need to be addressed. the available evidence on this topic is limited in Asia, especially in Middle East (including Yemen) (1).

The epidemiology of DM in Yemen remains unclear (13). To the best of our knowledge, no studies have been conducted in Yemen investigating sex differences in the association of heart diseases and type 2 diabetes patients.

1.4 Research Questions

1. What is the proportion of male and female diabetic patients diagnosed with various heart conditions in Sana'a city, Yemen?

2. How do socio-demographic characteristics (such as age, education, and income) and modifiable risk factors (such as smoking status, physical activity levels, body mass index, blood pressure, and blood glucose control) differ between male and female diabetic patients with heart disease?

1.5 Hypothesis

H1: There are significant gender differences in the prevalence and types of heart diseases among patients with type 2 diabetes in Sana'a city, Yemen.

H2: Socio-demographic characteristics such as age, education, and income significantly influence the prevalence of heart diseases among male and female diabetic patients in Sana'a city, Yemen.

H3: There are significant gender differences in modifiable risk factors for heart disease, such as smoking status, physical activity levels, body mass index, blood pressure, and blood glucose control, among patients with type 2 diabetes.

1.6 Objectives of the study

1.6.1 General objective

To study the impact of gender on the prevalence of heart diseases and identify associated risk factors among patients with type 2 diabetes in Sana'a city, Yemen.

1.6.2 Specific objectives

1) To determine the proportion of male and female diabetic patients who have been diagnosed with a heart condition.

2) To compare the presence of comorbidities between patients with and without heart disease.

3) To evaluate the association of socio-demographic characteristics like age, education, income with prevalence of co-morbid heart conditions among male and female respondents.

4) To assess the gender differences in modifiable risk factors for heart disease such as smoking status, physical activity levels, body mass index, blood pressure and blood glucose control.

5) To explore self-reported healthcare access and medication adherence between male and female diabetes patients with or without heart disease.

Chapter 2: Literature Review

Chapter 2: Literature review

2.1 Overview

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by hyperglycemia due to defects in insulin secretion, insulin action, or both. It is classified mainly into Type 1 DM, Type 2 DM, gestational diabetes, and other specific types. Type 2 DM, the most common form, results from a combination of resistance to insulin action and inadequate insulin secretion. The prevalence of diabetes is increasing globally, driven by aging populations, urbanization, and lifestyle changes. Incidence rates vary by region, with higher rates observed in developed countries. Globally, diabetes affects approximately 10% of adults, with Type 2 DM accounting for about 90% of cases (14).

Type 2 diabetes is influenced by genetic and environmental factors. Major risk factors include obesity, physical inactivity, family history, and age. Obesity, particularly central adiposity, plays a significant role by inducing insulin resistance. Pathophysiologically, Type 2 DM involves impaired insulin secretion and increased glucose production by the liver. Chronic hyperglycemia leads to complications such as retinopathy, nephropathy, neuropathy, and increased risk of infections. Long-term consequences also include macrovascular complications like cardiovascular diseases and stroke, significantly impacting morbidity and mortality (14).

Type 2 DM is closely linked to cardiovascular disease (CVD), the leading cause of morbidity and mortality in diabetic patients. Hyperglycemia, insulin resistance, and associated metabolic abnormalities contribute to atherogenesis. Diabetic individuals often present with dyslipidemia, hypertension, and pro-inflammatory states, accelerating cardiovascular risk. The presence of diabetes doubles the risk of coronary artery disease, heart failure, and stroke. Effective management of glucose levels, blood pressure, and

lipid profiles is crucial in reducing cardiovascular complications in patients with Type 2 DM (14).

The prevalence of diabetes has reached alarming levels globally. According to the 9th edition of the International Diabetes Federation, in 2019, approximately 463 million adults (or 9% of the global adult population) were living with diabetes. The rising prevalence of diabetes has been attributed principally to the ageing of populations. However, decreasing mortality among those with diabetes due to improving medical care as well as increases in diabetes incidence in some countries resulting from increasing prevalence of diabetes risk factors, especially obesity, are also important drivers of higher prevalence (15,16).

2.1.1 Prevalence by Gender

The global prevalence of diabetes in men is 10.8%, which is 0.6% more than in women (2). All-cause mortality rates decreased from 42.6 to 24.4 annual deaths per 1000 persons in men with diabetes between 1971 and 2000 in the US population (17). However, these rates in the same period increased from 18.4 to 25.9 annual deaths per 1000 persons in women with diabetes, which indicates better progress in mortality reduction rates in men than in women (17). Previous research has shown discrepancies between genders in the risk of experiencing micro- and macrovascular diabetes complications. Several studies reported a higher risk of CVD, non-alcoholic fatty liver disease (NAFLD), retinopathy, neuropathy and diabetic nephropathy in men with diabetes (18). On the contrary, other studies showed that the risk of kidney disease, cancer, coronary heart disease (CHD) and retinopathy are higher among women with diabetes (19)

2.2 Sex differences in DM

2.2.1 Risk factors

(A) Insulin resistance

Studies show premenopausal women have higher insulin sensitivity and secretion than men, resulting in lower fasting glucose and HbA1c (23,24). However, at menopause increases in body fat, BP, LDL-cholesterol and HbA1c occur alongside impaired glucose tolerance (23). Older women display higher glucagon-like peptide-1 responses than similar-aged men, though this benefit lessens with impaired glycemia (25). In overt type 2 diabetes, young women show comparable mortality risks to men (23,26). Importantly, women experience greater increases in BMI, BP and lipids before diabetes onset (27,28).

(B) Obesity and body fat distribution

Men develop type 2 diabetes at younger ages and lower BMIs than women (23,29). At diagnosis, women show higher burdens like BP and excess weight gain, particularly for white and younger women (11,23). Waist circumference indicates visceral fat better in women, and represents a stronger cardiometabolic predictor than BMI (24,30). Both waist and BMI relate to mortality in those with type 2 diabetes, with significantly increased risk at higher BMIs only for women (31,32).

(c) Prediabetes

Impaired glucose tolerance (IGT) is more common in women while Impaired fasting glucose (IFG) is diagnosed more in men. Higher 2h glucose levels in women may relate to prolonged gut glucose absorption. Both IFG and IGT risk mortality differently between sexes (33).

(D) Endocrine factors

Sex steroid hormones contribute to sex differences in diabetes risk. Estrogen protects premenopausal women while testosterone deficiency increases risk in men. Testosterone therapy may prevent diabetes in obese older men. Polycystic ovary

syndrome increases women's risk via testosterone excess. Screening for hypogonadism should be considered in obese men with diabetes (33).

(E) Pregnancy

Pregnancy may uncover metabolic disturbances, leading to 5-16% of women developing Gestational diabetes mellitus (GDM), which is heterogeneous and affects insulin resistant obese women and lean women with low beta cell capacity (23,34). GDM diagnosis varies by age, ethnicity and screening procedures (Yuen, Wong, and Simmons 2018). GDM strongly predicts future type 2 diabetes progression in women, with relative risk of 8.3 that rises by 12% per year and 18% per BMI unit after pregnancy(36,37).

2.2.2 Macrovascular complications

In men and women, CVD is the leading cause of death, with type 2 diabetes contributing to premature mortality (23,34). While absolute CVD mortality risk is higher in men, relative risk (RR) is significantly greater in women with type 2 diabetes (34,38–41). A recent analysis showed effects of type 2 diabetes on CHD risk without sex differences (41). Higher RRs were found in younger individuals, especially 35–59-year-old women (39). In young women, type 2 diabetes associates with greater weight gain leading to worse cardiometabolic risk (34). Even with mild deglycation, women show earlier subclinical inflammation and coagulopathy (34). This could explain highest RR for CVD in younger women(39). For women, higher RR of cardiovascular death associates with newly diagnosed type 2 diabetes in smokers, those with hypertension or hypercholesterolemia, or overweight individuals (42). Hyperglycemia may have stronger synergistic effects on these risks in women than men, requiring more aggressive intervention (42). CVD risks like obesity, hypertension worsen with menopause, aggravating insulin resistance, inflammation and dyslipidemia in women with type 2 diabetes(40,43).

A) Coronary heart disease

In the non-diabetic population, CHD risk is 3-5-fold greater in men versus premenopausal women. In diabetes, the female protective factor disappears and risk of CHD death is greater in women. Studies show T2DM increases CHD risk 2-5-fold in women and 1-3-fold in men, placing women at double risk. This may relate to adverse risk factor patterns in women with diabetes. However, men with T2DM receive more comprehensive treatment. A meta-analysis found no sex difference after adjusting for risk factors, but later studies reported a stronger effect of T2DM on CHD risk in women even after adjustments. In T1DM, limited data suggests higher standardized mortality ratios for CHD in women versus men at all ages (44).

B) Peripheral arterial disease

In T2DM, limited data shows PAD risk is greater in women versus men. The Framingham Heart Study reported risk of CHD, stroke and heart failure is 3-4 times higher in women with PAD and diabetes versus either alone. In men, PAD doubles stroke risk and increases heart failure risk 3 times. Studies show sex differences in PAD risk factors in T2DM, indicating preventative strategies need be sex-specific (44).

C) Stroke

While diabetes raises stroke risk for both sexes, studies show conflicting results on sex differences in risk. Reasons for variation may relate to population, diabetes type, and study design differences. The analysis method is important due to non-diabetic sex stroke risk differences. Recent reports from a large meta-analysis and AHA guidelines indicate T2D confers greater relative stroke risk in women versus men, with RRs of 2.28 in women and 1.83 in men. Data also shows worse long-term stroke outcome in women with diabetes versus men. The Nurses' Health Study reported a 4-6-fold higher stroke risk

in women with T1DM/T2DM versus non-diabetic women. A meta-analysis suggests worse stroke outcomes in women with T1DM as well (44).

2.2.3 Sex differences in pharmacological therapy and management

Sex differences exist in lifestyle and pharmacological management of type 2 diabetes. Men exhibit greater weight loss and diabetes remission from interventions than women. Metformin is less well adhered to and tolerated by women despite comparable effects. Sodium–glucose transport protein 2 inhibitor (SGLT-2Is) and Glucagon-like peptide-1 receptor agonist GLP1-RAs are prescribed less often to women despite cardiovascular benefits (33).

2.3 Previous studies

Study 1

In Iran (2024), a cross-sectional study was conducted by Kiavash Mokhtapour et al, aimed to compare the prevalence of DM complications between men and women, on 1867 T2DM patients reported that 62.1% of the studied population had at least one complication, and complications were 33.5% for diabetic kidney disease, 29.6% for CAD, 22.9% for neuropathy and 19.1% for retinopathy. The prevalence of CAD and neuropathy was higher in men. However, diabetic kidney disease and retinopathy were more prevalent among women. Odds ratio of experiencing any complication, CAD, and retinopathy in men compared to women were 1.57 (95% CI: 1.27 -2.03), 2.27 (95% CI: 1.72-2.99) and 0.72 (95% CI: 0.52-0.98), respectively, after adjusting for demographic factors, anthropometric measures, metabolic parameters and the consumption of dyslipidemia drugs and antihyperglycemic agents. The previous study concluded that the prevalence of diabetes complications was significantly higher in men with diabetes, highlighting the need for better treatment adherence. CAD was associated with the male gender, whereas retinopathy was associated with the female gender. Men and women

with diabetes should be monitored closely for CAD and retinopathy, respectively, regardless of their age, diabetes duration, anthropometric measures, laboratory findings and medications (45).

Study 2

In Japan (2023), by Toshiaki Ohkuma et al, A total of 4923 Japanese patients with type 2 diabetes were included in this cross-sectional study titled "Sex differences in cardiovascular risk, lifestyle, and psychological factors in patients with type 2 diabetes: the Fukuoka Diabetes Registry". This study showed that Women were less likely than men to achieve recommended ranges for glycated hemoglobin, low-density lipoprotein cholesterol, non-high-density lipoprotein cholesterol, and obesity-related anthropometric indices such as body mass index and waist circumference, but were more likely than men to be on target for high-density lipoprotein cholesterol and triglycerides. Women were also more likely than men to have an unhealthy lifestyle and psychological factors, including less dietary fiber intake, less leisure-time physical activity, shorter sleep duration, more constipation, and more depressive symptoms. Similar findings were observed when the participants were sub grouped by age and past history of cardiovascular disease. The authors of this study concluded that they observed significant sex differences for a range of cardiovascular risk factors, as well as lifestyle and psychological factors, suggesting the importance of adopting a sex-specific approach for the daily clinical management of diabetes (46).

Study 3

A multinational study in 2022, conducted by Guillermo Romero-Farina et al, showed that A cohort of 1327 consecutive diabetic patients (age 66.5 ± 9 years) underwent gated SPECT (single-photon emission computed tomography). During a mean

follow-up of 4.7 ± 2.2 years post gated SPECT, major adverse cardiac events (MACEs) (non-fatal MI, cardiac death (CD), and late coronary revascularization (CR)) were evaluated according to gender stratified by CAD. Among diabetic patients without known CAD (N = 731), men had more MACEs (hazard ratio (HR) 1.9;95%CI 1.2-3.2) than women. Among diabetic patients with known CAD (N = 596), there was no difference in MACEs in diabetic men and women (sHR 1.15;95%CI 0.73-1.8). Diabetic women with known CAD (n = 143) were the group with the highest risk (sHR 1.7; P = .041) for MACEs (4.5% MACEs/year, [95%CI 3.1%- 6.4%]), compared to the remaining diabetic patients (N = 1184) (3% MACEs/year, [95%CI 2.6%-3.5%]). This study concluded that the prognosis of diabetic patients for MACEs is different in men and women stratified by CAD. The worst prognosis for MACEs occurs in women with known CAD (47).

Study 4

In USA, a study (published on 2017) used the 2012 National Health Interview Survey which was done by Lixin Li et al, on 2335 T2DM patients aimed to assess The associations of moderate alcohol consumption, sleep duration, and tobacco smoking with coronary heart disease (CHD) among patients with type 2 diabetes mellitus (T2D). this study reported that the CHD prevalence among patients with T2D was 14.2% (18.1% and 10.4% for males and females, respectively), which increased with age (10.3% and 19.6% for age groups 18-64 and 65+, respectively). After adjusting for other factors, weighted logistic regression analyses showed that CHD among patients with T2D was significantly associated with being male, older age, past smoking, long sleep duration, hypertension, and high cholesterol level. Furthermore, the significant association of older age, past smoking, hypertension and high cholesterol level were observed particularly in males, while the association of long sleep duration with CHD was only observed in females. Hypertension was associated with CHD for both genders. The study concluded that

gender, age, past smoking, long sleep duration, hypertension and high cholesterol level were significantly associated with CHD among T2D patients; however, such associations differed by gender. Such gender disparities should be considered in the prevention and treatment of T2D (48).

Study 5

In China, a case control study conducted by Danli Kong et al, which included 3,824 participants, including 1,175 controls, 1,163 T2DM cases, 982 CAD cases, and 504 comorbidity cases., reported that Bayesian network model unveiled factors directly and indirectly impacting T2DM, such as age, region, education level, and family history (FH). Variables like exercise, LDL-C, TC, fruit, and sweet food intake exhibited direct effects, while smoking, alcohol consumption, occupation, heart rate, HDL-C, meat, and staple food intake had indirect effects. Similarly, for CAD, factors with direct and indirect effects included age, smoking, SBP, exercise, meat, and fruit intake, while sleeping time and heart rate showed direct effects. Regarding T2DM and CAD comorbidities, age, FBG, SBP, fruit, and sweet intake demonstrated both direct and indirect effects, whereas exercise and HDL-C exhibited direct effects, and region, education level, DBP, and TC showed indirect effects (49).

Study 6

In China (2016), a retrospective study done by Mei-Fang Yao et al, on 1514 patients reported that women had lower CHD risk (15.3% versus 26.3%), fatal CHD risk (11.8% versus 19.0%), stroke risk (8.4% versus 10.3%), and fatal stroke risk (1.4% versus 1.6%) compared with men with T2DM ($p < 0.05$-0.001). The CHD risk (28.4% versus 22.6%, $p < 0.001$) was significantly higher in men with MS than in those without MS. The CHD (16.2% versus 11.0%, $p < 0.001$) and stroke risks (8.9% versus 5.8%, $p <$

0.001) were higher in women with metabolic syndrome (MS) than in those without MS. In conclusion, the findings indicated that Chinese women with T2DM are less susceptible to CHD and stroke than men. Further, MS increases the risk of both these events, highlighting the need for comprehensive metabolic control in T2DM (50).

Study 7

In Nigeria (2015), a cross-sectional study done by O Stephen et al, on 124 patients showed that Fifteen subjects were identified as having an increased 10-year risk for stroke and ten as having an increased risk for a coronary event. The odds of a T2DM subject with MS having an increased risk for stroke compared with a T2DM subject without MS was 0.9579≈1 while the odds of a T2DM subject with MS developing an increased risk for a coronary event compared with a T2DM subject without MS was =3.451≈3. this study concluded that MS was more common in subjects with T2DM compared with controls (irrespective of the diagnostic criteria used) and MS appears to increase the risk of a coronary event in subjects with T2DM by threefold. Also from this study, MS did not appear to cause an additional increase in the risk of stroke in subjects with T2DM (51).

Chapter 3: Methodology

Chapter 3: Methodology

3.1 Study design

This study was analytical cross-sectional study.

3.2 Study settings

Our study was conducted at:

Two government hospitals:

- Al Thawrah hospital
- Al Gumhori Teaching hospital

Private hospitals:

- Modern German hospital

Four private clinics:

- Dr Zayed Atef clinic
- Dr Buthainah AL-Sharaphy clinic
- Dr Adel AL-Hadramy clinic
- Dr Ahlam AL-Mortada clinic

3.3 Study period

The study period started from 15 October 2024 to 30 October 2024.

3.4 Study population

The study population was all patients with T2DM aged 20-80 years who have attended the specified locations in Sana'a city, over the study period.

3.5 Sample size calculation

Sample size was calculated using OpenEpi online calculation (52).

To determine an appropriate sample size for calculating the prevalence, we used a 95% confidence level and 80% power based on previous study (45) showing a 29.6% prevalence of heart diseases (figure 1).

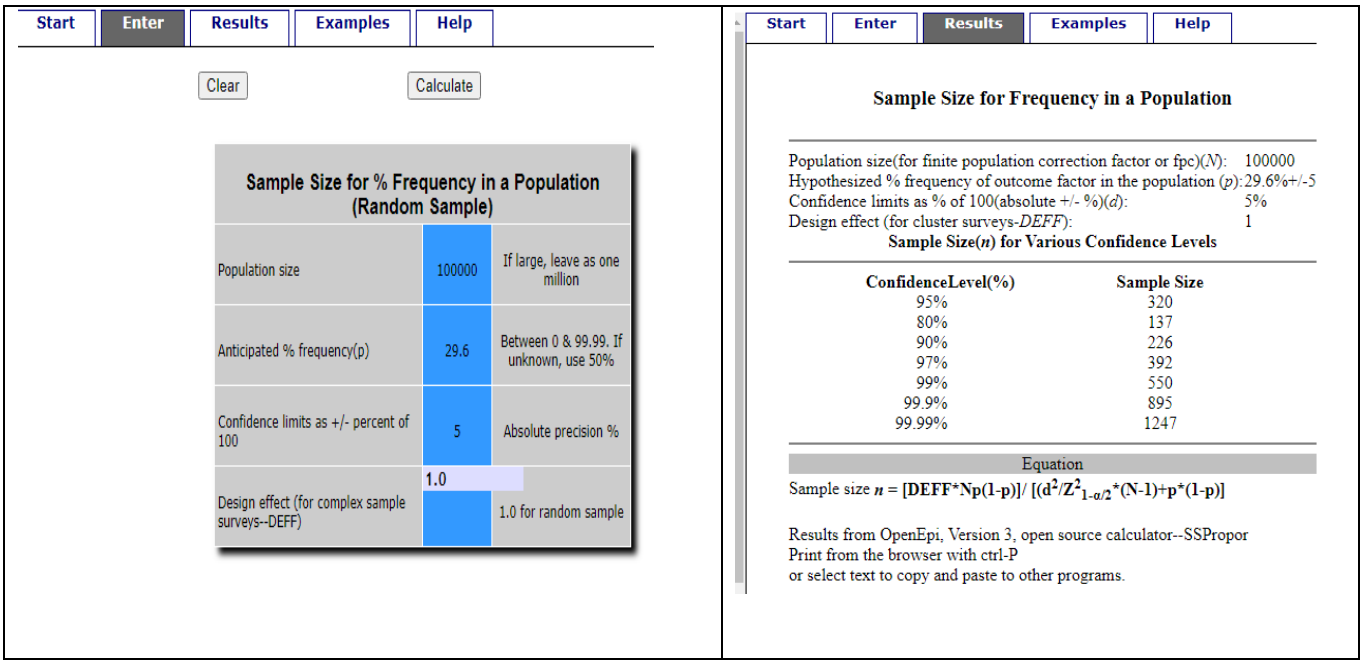

Figure 1: Calculating the required sample size in this study.

Based on figure, the minimum sample size required to measure the prevalence of heart diseases among T2DM patients were at least 320 participants.

3.6 Sampling technique

Convenience non random sampling technique was used to collect the data.

3.7 Inclusion and Exclusion Criteria

Inclusion criteria: Patients aged 20-80 years (53,54) with a diagnosis of type 2 diabetes were included.

Exclusion criteria: Patients with history of heart disease before having type 2 diabetes, those using drug-induced diabetes or those with serious diseases other than diabetes, such as advanced malignancies or decompensated liver cirrhosis were excluded. Furthermore, participants who refused to complete the participation were excluded.

3.8 Study collection tool and outcome measurements

By face-to-face interview, we used a questionnaire which was adopted from many previous researches and modified according to the local situation in Yemen. The questionnaire contain questions covering the following: (1) socio demographic feature: Age, sex, marital status, level of education, level of income and occupation; (2) medical history: Year of diabetes diagnosis, family history of diabetes, medication for diabetes, history of heart disease, type of heart disease, duration of heart disease diagnosis medication for heart disease and history of other comorbidities; (3) lifestyle factors: smoking status, chewing Qat, physical activity, dietary habits (how often consuming fruits, vegetables, and fast foods); (4) psychosocial factors: sleep duration, stress level, support system, knowledge about diabetes management, and adherence to medications, healthcare access; (5) clinical measurements: BMI, glycated hemoglobin (HbA1c level), and lipid profile.

3.9 Definitions of variables

The main **independent variable** in this study is the gender of the participants, as it is the attribute being investigated for its influence on the dependent variable. The main **dependent variable** is the occurrence of heart diseases, as it is the outcome that is being measured and analyzed in relation to the independent variable of gender. The questionnaire aims to gather information on the demographic characteristics, medical history, lifestyle factors and clinical measurements of the participants, which would act as confounding variables that can affect the relationship between gender and the occurrence of heart diseases among type 2 diabetes patients. Key aspects like the duration of diabetes, family history, medications, comorbidities, physical activity, diet, stress level, knowledge and adherence would provide important context to understand their role along with gender in the development of heart conditions in this population.

Heart disease was determined based on the presence of past history of heart disease documented in medical records.

Body mass index was calculated from measurements of height and weight. obesity defined as BMI ≥23 kg/m2 (55). Using the WHO Asian BMI risk cut points, the 3 categories are 18.5–22.9 kg/m^2 (normal weight), 23–27.5 kg/m^2 (overweight) and ≥27.5 kg/m^2 (obese). Based on these shortcomings of the BMI measure in Asian populations, a WHO Expert Consultation panel, using all available data from Asian countries, in 2002 proposed lowering BMI cut points to trigger public health action for Asians (55).

The other variables were designed as closed questions, either as "Yes or No', ordinal or nominal choices, which will be clarified in the results section.

3.10 Data Management and Analysis Plan

Firstly, we did several checks for completeness of data then data were entered into Excell software and analyzed by using SPSS version 26. Categorical variables were summarized using frequencies and percentages. Chi square test was used to compare differences in prevalence of heart disease between male and female groups. After checking the normality distribution of continuous variables by using Shapiro Wilk test, parametric and or non-parametric tests was used. Figures and tables were used to present the data.

Median and IQR were used instead of mean and SD for all continuous variables in this study because these variables were abnormally distributed. Moreover, Man-Whittney test was used instead of student t test because of the abnormally distributed data.

3.11 Ethical Considerations

After gaining the ethical approval from the ethical committee of our university, consents from the selected health facilities were taken. The patient agreed to have information taken from him. All participants were informed that they are free to participate or not. Participants' identities were kept anonymous.

Chapter 4: Results

Chapter 4: Results

4.1 Patients' Sociodemographic and Clinical Characteristics

Among the 334 patients, the majority of the patients were male (209 patients) accounted to be 62.6% of the total sample size (figure 2).

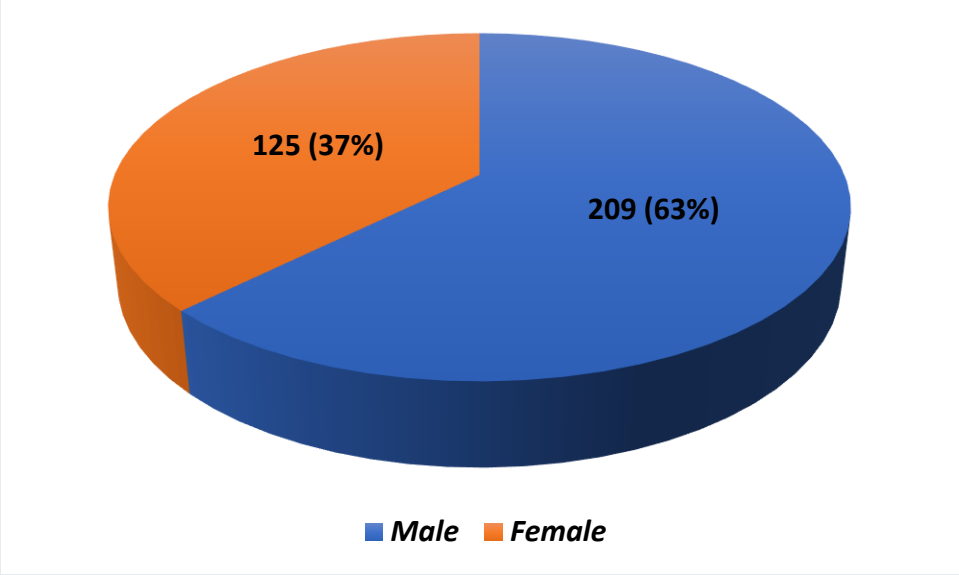

Figure 2:Gender distribution among type 2 diabetes mellitus.

Seventy-five percent of the patients (n = 249) were in the age group 35 – 69 years old, while only 8% (n = 26) were in the age group <35 years old. More than 88% of the patients (n = 295) were married and only 4% were single (figure 3).

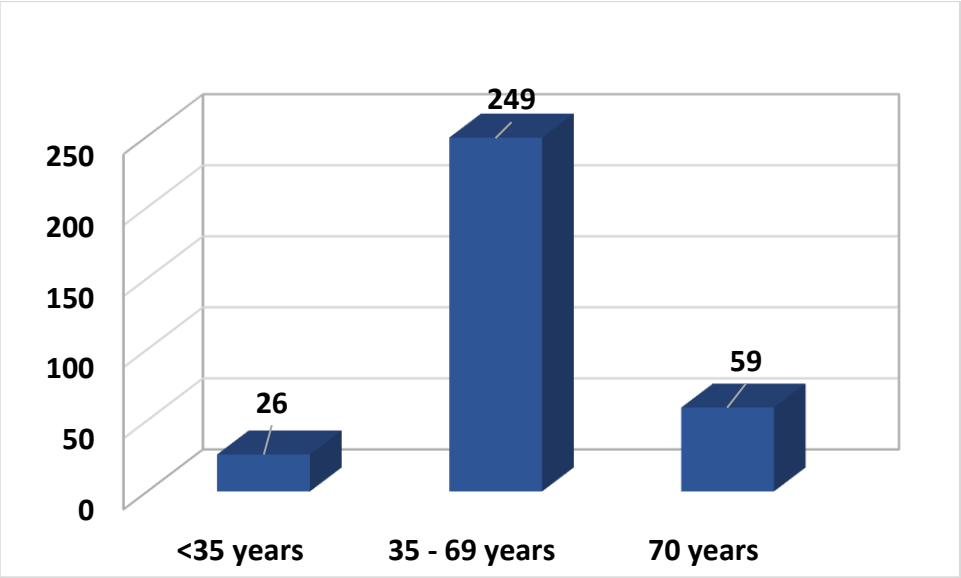

Figure 3: Classification of study participants based on age groups.

The median age was 53.5 years old [IQR 23 (42 – 65)] (table 1).

For the educational level, a considerable proportion of the patients [139 (41.6%)] had no formal education, while only 18.6% of the patients (n = 62) had reached to higher education level. Furthermore, also a considerable number of the patients [136 (40.7%)] were unemployed (table 1).

In term of Monthly family income, more than half of the participants [184 (55.1%)] had low level of income (< 100 thousand Yemeni Rials), while only 10% of the participants had high level of income (> 200 thousand Yemeni Rials) (table 1).

Table 1: Sociodemographic characteristics of type 2 diabetes patients (n = 334).

Sociodemographic variables	**Frequency**	**Percentage (%) or**
Age (years) (median)	53.5	23 (42 – 65)
Marital status		
Single	13	4%
Married	295	88.3%
Divorced or widowed	26	7.7%
Educational level		
Non formal education	139	41.6%
Primary or secondary education	133	39.8%
Higher education	62	18.6%
Occupation		
Unemployed	136	40.7%
Employed	137	41%
Retired	61	18.3%
Monthly family income		
Low (< 100 thousand YER)	184	55%
Middle (100 – 200 thousand YER)	117	35%
High (>200 thousand YER)	33	10%

Regarding clinical characteristics of the overall study participants, most of the patients [184 (54,8%)] had a family history of DM (table 2). The median BMI was 24 kg/m^2 [IQR (21 – 26)]. The median HbA1c was 8.35% [IQR (7 – 10)]. Nearly all patients [304 (91%)] were recorded to have diabetic level of HbA1c (≥ 6.5%) in the last follow up (table 2).

The median duration of living with T2DM since diagnosis was 6 years [IQR 12.1 (2 – 14.1)] (table 2). about half of the patients [159 (47.6%)] had been living with T2DM for less than five years ago. Meanwhile, 19.8% of patients (n = 66) have been living with T2DM for five to ten years. The remaining patients (32.6%) have lived with T2DM for more than ten years (table 2).

97% of the patients (n = 425) were taking oral hypoglycemic drugs in which 73% of them (n = 227) were taking oral hypoglycemic drugs without insulin and the remaining were taking the drugs with insulin (table 2).

The median duration of living with heart disease since diagnosis was 3.6 years [IQR (1 – 6.7)]. Table 2 shows that most of the T2DM patients [48 (45.7%)] had been living with heart disease for less than three years ago. Meanwhile, 25.7% of patients (n = 27) have been living with heart disease for three to six years. The remaining patients (26.6%) have lived with heart disease for more than six years.

Table 2: Clinical characteristics of T2DM patients.

Clinical variables (categories)	**Frequency**	**Percentage (%)**
Family history		
Yes	183	54.8%
No	151	45.2%
HbA1c		
Normal (<5.7%)	3	1%
Prediabetes (5.7% – 6.4%)	27	8%
Diabetes (≥ 6.5%)	304	91%
Duration of T2DM (years)		
<5 years	159	47.6%
5 – 10 years	66	19.8%
>10 years	109	32.6%
Types of DM medications		
Oral hypoglycemic	244	73%
Insulin	9	3%
Both	81	24%
Duration of heart disease (years) (n = 105)		
<3 years	48	45.7%
3 – 6 years	27	25.7%
>6 years	30	26.6%
Clinical variables (numerical)	**Median**	**IQR**
BMI	24	21 – 26
HbA1c	8.35	7 – 10
Duration of T2DM (years)	6	2 – 14.1
Duration of heart disease (years) (n = 105)	3.6	1 – 6.7

Notably, the majority of the patients were overweight or obese (BMI ≥ 23.0) which accounted to be 208 (62.3%) patients, while 22 (6.6%) patients recorded to be underweight (BMI<18.5) (figure 4).

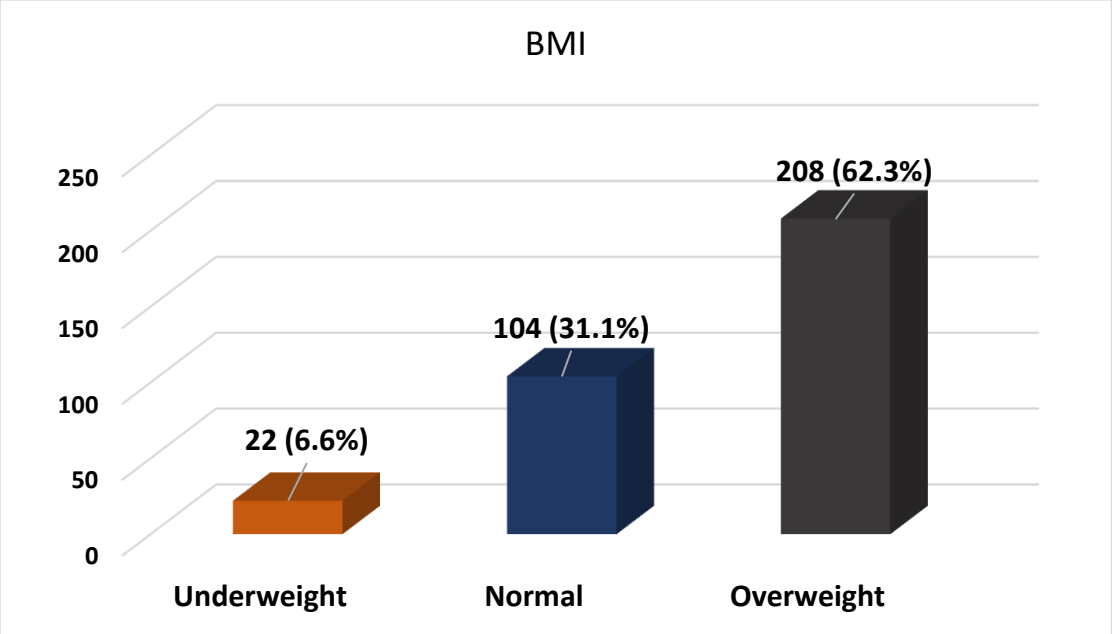

Figure 4: Number of type 2 diabetes patients in BMI categories.

4.2 The Prevalence of Heart Disease Among T2DM

A total of 31.4% of the study participants (n = 105) were found to have clinically significant heart disease. Among the various heart diseases, CAD was documented in 35.2% of participants (n = 37), followed by heart failure which was documented in 26.7% of the participants (n = 28) (figure 6).

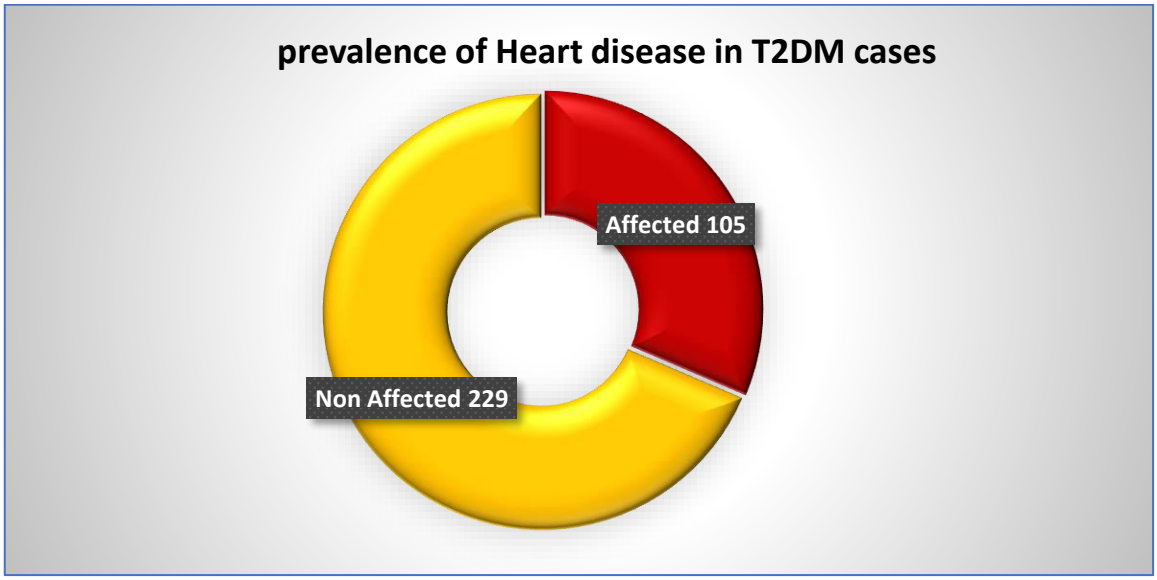

Figure 5: The Number of heart disease cases among T2DM cases.

4.3 Gender difference in the prevalence of heart disease among T2DM

Among 334 T2DM patients, there were 69 men, out of 209 men, recorded to have heart disease making the prevalence rate of heart disease up to 33% among male T2DM patients which is higher prevalence when compared to women group in which there were 36 women, out of 125 women, recorded to have heart disease making the prevalence rate up to 28.8% among female T2DM patients. Table 3 shows that the probability of having heart disease in men (33%) is higher than women (28.8%). Therefore, among T2MD population, men had 1.22 times higher odds ratio than women of having heart disease. However, chi-square test revealed that was not statistically significant (p value = 0.442).

Table 3: Association between gender and the presence of heart disease among T2DM patients.

Variables		**Men (n = 209)**	**Women (n = 125)**	**Odds ratio (CI*)**	**P value**
History of heart disease	Affected	69 (33%)	36 (28.8%)	1.22 (0.75 – 1.97)	0.442
	Non-Affected	140 (67%)	89 (71.2%)		
***(CI): Confidence Interval**					

4.4 Factors Associated with Gender Difference in the Prevalence of Heart Disease Among T2DM Patients

4.4.1 Sociodemographic factors

Table 4: Sociodemographic factors associated with gender and the presence of heart disease among T2DM patients.

Variables	**Men (n=209)**	**Women (n= 125)**	**P value**	**History of heart disease**		**P value**
				Yes (n=109)	No (n=229)	
Age (years)	54 (23)	52 (18)	0.225	61 (18)	50 (21)	**0.001**
<35	15 (7%)	11 (9%)	0.448	1 (1%)	25 (11%)	**0.001**
35 – 69	153 (73%)	96 (77%)		73 (70%)	176 (77%)	
≥70	41 (20%)	18 (14%)		31 (29%)	28 (12%)	
Marital status						
Single	5 (2%)	8 (7%)	**0.001**	1 (1%)	12 (5%)	**0.022**
Married	197 (94%)	98 (78%)		91 (87%)	204 (89%)	
Divorced or widowed	7 (3%)	19 (15%)		13 (12%)	13 (6%)	
Educational level						
Non formal	69 (34%)	70 (56%)	**0.001**	46 (44%)	93 (41%)	0.790
Primary or secondary	91 (44%)	42 (34%)		39 (37%)	94 (41%)	
Higher education	49 (23%)	13 (10%)		20 (19%)	42 (18%)	
Occupation						
Unemployed	44 (21%)	92 (74%)	**0.001**	41 (39%)	95 (41%)	**0.021**
Employed	118 (56%)	19 (15%)		36 (34%)	101 (44%)	
Retired	47 (22%)	14 (11%)		28 (27%)	33 (14%)	
Monthly family income (in Yemeni Rials)						
Low (< 100 thousand)	116 (56%)	68 (54%)	**0.806**	58 (55%)	126 (55%)	0.989
Middle (100-200 thousand)	71 (34%)	46 (37%)		37 (35%)	80 (35%)	
High (> 200 thousand)	22 (11%)	11 (9%)		10 (10%)	23 (10%)	

The study examined the association between sociodemographic factors and gender differences in the prevalence of heart disease among patients with type 2 diabetes mellitus (T2DM). The analysis included 209 men and 125 women, and the results showed no significant difference in the mean age between men and women (54 years for men, 52 years for women; P = 0.225). However, when considering the presence of heart disease, patients with a history of heart disease were significantly older (61 years) compared to those without heart disease (50 years) (P < 0.001). Age distribution further revealed that a larger proportion of patients with heart disease were over 70 years old (29%) compared to those without heart disease (12%), while individuals under 35 were less likely to have heart disease (1% vs. 11%, P < 0.001) (table 4).

Marital status showed a significant gender difference, with a higher percentage of women being single (7%) or divorced/widowed (15%) compared to men (2% and 3%, respectively; P < 0.001). Regarding the relationship between marital status and heart disease, there was a significant association, as divorced or widowed individuals had a higher prevalence of heart disease (12%) compared to those without heart disease (6%) (P = 0.022) (table 4).

Educational level also varied significantly by gender. Women were more likely to have no formal education (56%) compared to men (34%), while men were more likely to have completed higher education (23% vs. 10%; P < 0.001). However, no significant association was found between education level and heart disease prevalence (P = 0.790), with similar proportions of patients across educational levels in both the heart disease and non-heart disease groups (table 4).

Employment status exhibited a stark gender disparity, with 74% of women being unemployed compared to only 21% of men (P < 0.001). There was also a significant

association between employment status and heart disease (P = 0.021), as a larger proportion of heart disease patients were unemployed (39%) compared to those without heart disease (41%). Conversely, a higher percentage of those without heart disease were employed (44%) compared to those with heart disease (34%) (table 4).

Regarding income, no significant gender differences were observed, with 56% of men and 54% of women falling into the low-income category (P = 0.806). Similarly, no significant relationship was found between income level and the presence of heart disease (P = 0.989), as the distribution of low, middle, and high-income individuals was nearly identical in both the heart disease and non-heart disease groups (table 4).

4.4.2 Clinical Factors

Table 5: Clinical factors associated with gender and the presence of heart disease among T2DM patients.

Variables	**Men (n=209)**	**Women (n= 125)**	**P value**	**History of heart disease**		**P value**
				Yes (n=109)	No (n=229)	
BMI	24 (5)	24.2 (5)	**0.033**	25 (5)	23.2 (4.4)	**0.003**
HbA1c	8.4 (3)	8.3 (2.7)	0.673	9 (2.4)	7.9 (2.4)	**0.001**
Duration of DM (years)	6	7	0.993	132	60	**0.001**
Duration of HD (years)	4	2	0.132			
Comorbidities						
Yes	114 (55%)	71 (57%)	0.688	88 (84%)	97 (42%)	**0.001**
No	95 (45%)	54 (43%)		21 (16%)	132 (58%)	
Positive family history of DM	113 (54%)	70 (56%)	0.731	64 (61%)	119 (52%)	0.125
Type of HD						
CAD	27 (13%)	10 (8%)	0.609			
Heart failure	19 (9%)	9 (7%)				
Arrythmia	3 (1%)	2 (2%)				
Other	20 (10%)	15 (12%)				
Medications for DM						
Oral hypoglycemic	151 (72%)	93 (74%)	0.624	54 (51%)	190 (83%)	**0.001**
Insulin	7 (35)	2 (2%)		7 (7%)	2 (1%)	
Both	51 (24%)	30 (24%)		44 (42%)	37 (16%)	

Table 5 presents clinical factors associated with gender differences in the prevalence of heart disease among patients with type 2 diabetes mellitus (T2DM). The

data show a statistically significant difference in body mass index (BMI) between men and women, with men having a slightly lower BMI (median 24.0) compared to women (median 24.2, P = 0.033). Additionally, BMI was significantly higher in patients with a history of heart disease (mean 25.0) compared to those without heart disease (median 23.2, P = 0.003), suggesting a possible association between higher BMI and heart disease prevalence.

The mean HbA1c levels did not differ significantly between men and women (8.4% in men vs. 8.3% in women, P = 0.673), but patients with heart disease had significantly higher HbA1c levels (median 9.0%) compared to those without heart disease (median 7.9%, P < 0.001), indicating poorer glycemic control in patients with heart disease (table 5).

Duration of diabetes showed no significant difference between men and women (6 years for men vs. 7 years for women, P = 0.993). However, patients with heart disease had diabetes for a significantly longer duration (mean 132 years vs. 60 years, P < 0.001), reinforcing the association between longer diabetes duration and heart disease. The duration of heart disease did not differ significantly between men and women (4 years in men vs. 2 years in women, P = 0.132) (table 5).

Comorbidities were common among both genders, with no significant difference between men (55%) and women (57%, P = 0.688). However, there was a strong association between the presence of comorbidities and heart disease, with 84% of patients with heart disease having comorbidities compared to 42% of those without heart disease (P < 0.001) (table 5).

Family history of diabetes was similar between men (54%) and women (56%, P = 0.731), and no significant association was found between family history of diabetes and heart disease (P = 0.125).

In terms of heart disease type, there were no significant gender differences in the prevalence of coronary artery disease (CAD), heart failure, arrhythmias, or other heart conditions.

Regarding diabetes medications, the majority of patients used oral hypoglycemics, with no significant difference between men (72%) and women (74%, P = 0.624). However, patients with heart disease were less likely to be treated solely with oral hypoglycemic agents (51%) compared to those without heart disease (83%, P < 0.001). The use of both insulin and oral hypoglycemics was more common in patients with heart disease (42%) than in those without (16%, P < 0.001), suggesting a more intensive treatment regimen for those with heart disease (table 5).

4.4.3 Lifestyle Factors

Table 6: Lifestyle factors associated with gender and the presence of heart disease among T2DM patients

variables	Men (n=209)	Women (n= 125)	P value	History of heart disease		P value
				Yes (n=109)	No (n=229)	
Smoking						
Yes	107 (51%)	23 (18%)	**0.001**	50 (48%)	80 (35%)	**0.027**
No	102 (49%)	102 (82%)		55 (52%)	149 (65%)	
Chewing Qat						
Yes	170 (81%)	69 (55%)	**0.001**	85 (81%)	151 (66%)	**0.005**
No	39 (19%)	56 (45%)		20 (19%)	78 (34%)	
Physical activity						
Sedentary	37 (18%)	35 (28%)	0.136	34 (32%)	38 (17%)	**0.005**
Light activity	60 (29%)	36 (29%)		27 (26%)	69 (30%)	
Moderate activity	110 (53%)	53 (42%)		42 (40%)	121 (52.5%)	
Vigorous activity	2 (1%)	1 (1%)		2 (2%)	1 (0.5%)	
Consuming fruits and vegetables						
Daily	45 (22%)	31 (25%)	0.273	21 (20%)	55 (24%)	**0.013**
Several times a week	104 (50%)	68 (54%)		46 (44%)	126 (55%)	
Occasionally	60 (28%)	26 (21%)		38 (35%)	48 (21%)	
Consuming fast food						
Daily	42 (21%)	8 (6%)	**0.002**	23 (22%)	27 (12%)	**0.020**
Several times a week	49 (23%)	42 (34%)		21 (20%)	70 (31%)	
Occasionally	118 (56%)	75 (60%)		61 (58%)	132 (57%)	

Table 6 presents lifestyle factors associated with gender differences in the prevalence of heart disease among patients with type 2 diabetes mellitus (T2DM).

A significant difference in smoking habits was observed between men and women, with 51% of men reporting smoking compared to only 18% of women ($P < 0.001$). Additionally, smoking was significantly associated with heart disease, as 48% of patients with heart disease were smokers compared to 35% of those without heart disease ($P = 0.027$). The odds of being a smoker are approximately 4.65 times higher in men compared to women ($P < 0.001$). The odds of having heart disease are 1.69 times higher in smokers compared to non-smokers ($P = 0.027$). This indicates that smoking is a significant risk factor for heart disease among T2DM patients.

Chewing qat was also more prevalent among men, with 81% of men engaging in this behavior compared to 55% of women ($P < 0.001$). Similarly, a significant association was found between qat chewing and heart disease, with 81% of patients with heart disease reporting this habit compared to 66% of those without heart disease ($P = 0.005$). The odds of chewing qat are approximately 3.54 times higher in men compared to women ($P < 0.001$). The odds of chewing qat are 1.20 times higher in patients with heart disease compared to those without heart disease ($P = 0.005$). This suggests that qat chewing is significantly associated with an increased risk of heart disease among T2DM patients.

Physical activity levels did not show a significant difference between men and women ($P = 0.136$). However, sedentary behavior was more common among patients with heart disease (32%) compared to those without (17%, $P = 0.005$), suggesting that a lack of physical activity may be associated with the development of heart disease. Moderate activity was more likely in patients without heart disease (52.5%) compared to

those with heart disease (40%), further highlighting the potential protective effects of physical activity.

Dietary habits, specifically the consumption of fruits and vegetables, did not vary significantly between men and women (P = 0.273). However, there was a significant association between fruit and vegetable consumption and heart disease prevalence. Patients with heart disease were less likely to consume fruits and vegetables daily (20%) compared to those without heart disease (24%), and more likely to consume them only occasionally (35% vs. 21%, P = 0.013), indicating that a lower intake of fruits and vegetables may be linked to heart disease.

Fast food consumption showed a distinct gender difference, with 21% of men consuming fast food daily compared to only 6% of women (P = 0.002). Daily fast-food consumption was also significantly more common among patients with heart disease (22%) compared to those without heart disease (12%, P = 0.020), suggesting that frequent fast-food intake may be a risk factor for heart disease in this population. However, occasional consumption of fast food did not significantly differ between the heart disease and non-heart disease groups.

Overall, the results suggest that lifestyle factors such as smoking, qat chewing, physical inactivity, low fruit and vegetable intake, and frequent fast-food consumption are significantly associated with the prevalence of heart disease among T2DM patients, with notable gender differences in smoking, qat chewing, and fast-food consumption.

4.4.4 Psychosocial Factors

Table 7: Psychosocial factors associated with gender and the presence of heart disease among T2DM patients.

Variables	**Men (n=209)**	**Women (n= 125)**	**P value**	**History of heart disease**		**P value**
				Yes (n=109)	No (n=229)	
Sleep duration (hours)	6 (2)	7 (2)	**0.041**	6 (3)	7 (2)	**0.005**
Stress level						
Low	33 (16%)	29 (23%	**0.019**	10 (9%)	52 (32%)	**0.001**
Moderate	100 (48%)	69 (55%)		47 (45%)	121 (53%)	
High	76 (36%)	28 (22%)		48 (46%)	56 (24%)	
Supporter to help managing DM or HD						
Yes	107 (51%)	78 (62%)	**0.046**	54 (51)	131 (57%)	0.324
No	102 (49%)	47 (38%)		51 (49%)	98 (43%)	
Knowledge about DM						
Poor	63 (30%)	32 (26%)	0.326	38 (36%)	57 (255)	0.170
Fair	67 (32%)	48 (38%)		32 (31%)	83 (36%)	
Good	69 (33%)	35 (28%)		28 (27%)	76 (33%)	
Excellent	10 (5%)	10 (8%)		7 (6%)	13 (6%)	
Healthcare access						
Easy	60 (29%)	35 (28%)	0.609	25 (23%)	70 (30%)	0.245
Moderate	102 (49%)	67 (54%)		53 (51%)	116 (51%)	
Hard	47 (22%)	23 (18%)		27 (26%)	43 (19%)	
Adherence to medications						
Always	108 (52%)	53 (42%)	0.217	48 (46%)	113 (49%)	0.404
Often	85 (28%)	46 (37%)		30 (29%)	74 (32%)	
Sometimes	32 (15%)	22 (18%)		20 (19%)	34 (16%)	
Rarely	11 (5%)	4 (3%)		7 (6%)	8 (3%)	

Table 7 provides an overview of psychosocial factors associated with gender differences in the prevalence of heart disease among patients with type 2 diabetes mellitus (T2DM). One notable finding is that men reported a shorter median sleep duration (6 hours) compared to women (7 hours, P = 0.041). Additionally, sleep duration was significantly associated with heart disease, as patients with heart disease reported fewer hours of sleep (6 hours) compared to those without heart disease (7 hours, P = 0.005). These results suggest that insufficient sleep may contribute to the development of heart disease in T2DM patients.

Stress levels also differed significantly by gender. A higher proportion of men reported high stress levels (36%) compared to women (22%, P = 0.019), while women were more likely to report low stress levels (23%) compared to men (16%). Furthermore, stress was strongly associated with heart disease, with 46% of heart disease patients reporting high stress levels compared to 24% of those without heart disease (P < 0.001). Conversely, low stress levels were more common among patients without heart disease (32%) compared to those with heart disease (9%). This suggests that high stress levels may be a significant risk factor for heart disease in this population.

The presence of a supporter to help manage diabetes or heart disease was more common among women (62%) than men (51%, P = 0.046). However, the presence of a supporter did not show a significant association with heart disease status, with a similar proportion of patients with (51%) and without heart disease (57%, P = 0.324) reporting having a supporter.

Knowledge about diabetes did not differ significantly between men and women, with similar proportions reporting poor, fair, good, or excellent knowledge (P = 0.326).

Likewise, no significant association was observed between diabetes knowledge and heart disease status (P = 0.170), suggesting that knowledge levels alone may not be a decisive factor in the development of heart disease among T2DM patients.

Healthcare access was reported as easy by 29% of men and 28% of women, with no significant gender differences (P = 0.609). Similarly, healthcare access did not significantly differ by heart disease status (P = 0.245), with both groups reporting similar access levels—23% of heart disease patients and 30% of non-heart disease patients reported easy access to healthcare.

Adherence to medications was also examined, but there were no significant differences between men and women in terms of how often they adhered to their medication regimens (P = 0.217). Additionally, medication adherence did not show a significant relationship with heart disease status (P = 0.404), with similar proportions of patients in both groups reporting that they "always" adhered to their prescribed medications (46% in heart disease patients vs. 49% in non-heart disease patients).

In summary, the results suggest that psychosocial factors such as sleep duration and stress levels are significantly associated with both gender and heart disease status. Men tended to have shorter sleep duration and higher stress levels, which were also more prevalent in patients with heart disease. However, factors such as the presence of a supporter, diabetes knowledge, healthcare access, and medication adherence did not show significant associations with either gender or heart disease status. This highlights the importance of addressing stress management and sleep quality in efforts to reduce the burden of heart disease among T2DM patients.

Chapter 5: Discussion

Chapter 5: Discussion

The prevalence of heart disease among the study participants was notably high. This may be due to that Yemeni patient are poor, therefore they cannot afford for the appropriate medical care services such as regular follow up, frequent investigation. This finding is consistent with other studies (44, 45) which also reported a heightened risk of cardiovascular disease among individuals with T2DM.

Among the T2DM population, men had a higher prevalence of heart disease than women, although this difference was not statistically significant. This result may be because Yemeni men people are more consumer of smoking and Qat which effect the CVS. Moreover, Men are responsible for family needs resulting in more stress life on men and less sleep due to that. This finding agrees with study conducted in Iran and contrasts with findings from the Chinese study (45), which suggested that women with T2DM might have a higher relative risk of developing cardiovascular diseases compared to men, despite having a lower overall prevalence. The lack of a statistically significant difference in heart disease prevalence between genders in the current study may be due to sample size limitations or population-specific factors. Nonetheless, the odds ratio of men having heart disease was 1.22 times higher than that of women, suggesting that male gender may still be a risk factor for heart disease in this cohort.

Sociodemographic factors were also explored as potential contributors to gender differences in heart disease prevalence. The study found no significant difference in mean age between men and women, but patients with heart disease were significantly older ($P < 0.001$), a finding that supports previous studies (22, 20), which have consistently shown that advanced age is a major risk factor for cardiovascular disease in diabetic populations.

Our study shows a higher prevalence of heart disease among certain groups, a finding supported by previous research highlighting the impact of social and emotional stressors on heart disease risk (54). The relationship between marital status and cardiovascular health has been noted to influence stress levels, which can exacerbate heart disease.

Education level demonstrated significant gender differences, with women less likely to have formal education. However, this variable was not significantly associated with heart disease prevalence ($P = 0.790$), consistent with Saydah et al.'s findings that education is not a strong independent predictor of cardiovascular outcomes in T2DM patients (56). Employment status, on the other hand, was significantly associated with heart disease ($P = 0.021$), aligning with Kivimäki et al.'s work linking unemployment with increased cardiovascular risk due to stress and reduced access to health-promoting resources (57).

Clinically, a higher body mass index (BMI) was observed in patients with heart disease ($P = 0.003$), corroborating extensive evidence linking obesity with cardiovascular diseases in diabetic patients (31). Additionally, while HbA1c levels did not differ significantly between genders, patients with heart disease had significantly higher HbA1c levels ($P < 0.001$), consistent with the advance trial's findings on poor glycemic control as a predictor of cardiovascular events in T2DM patients (11). Longer diabetes duration also showed a strong association with heart disease ($P < 0.001$), as supported by the Diabetes Control and Complications Trial (DCCT), which highlighted the cumulative effect of diabetes duration on cardiovascular complications.

Comorbidities were prevalent, with 84% of heart disease patients having at least one comorbidity ($P < 0.001$), aligning with Gu et al.'s findings that comorbid conditions

like hypertension and dyslipidemia increase cardiovascular disease risk in diabetics. Interestingly, family history of diabetes was not significantly associated with heart disease (P = 0.125), contrasting with Karter et al., who suggested varying influences of family history on cardiovascular risk across populations (18).

Lifestyle factors significantly contributed to gender differences observed. Smoking was more common among men (P < 0.001) and was significantly associated with heart disease (P = 0.027), supporting Pan et al.'s findings (48). Chewing qat, more prevalent in men (P < 0.001), was significantly associated with heart disease (P = 0.005), with its stimulant properties linked to adverse cardiovascular outcomes .

Physical inactivity was more common among heart disease patients (P = 0.005), consistent with findings from the Nurses' Health Study indicating that physical inactivity is a significant predictor of cardiovascular disease in diabetic individuals (48). Additionally, a lack of regular fruit and vegetable consumption was associated with increased cardiovascular risk (P = 0.013) (55).

Psychosocial factors were significant contributors to heart disease risk. Men reported shorter sleep durations (P = 0.041), with sleep duration significantly associated with heart disease (P = 0.005), aligning with other (47). Higher stress levels in men, strongly associated with heart disease (P < 0.001), reflect identification of stress as a major heart disease risk factor (48).

In conclusion, this study highlights several factors contributing to the gender differences in heart disease prevalence among T2DM patients, including clinical, lifestyle, and psychosocial factors. While some findings, such as the association between higher BMI, poor glycemic control, and heart disease, are consistent with existing literature, other factors, such as qat chewing and stress, suggest the need for culturally

tailored interventions to address these unique risk factors. Future research should continue to explore these associations in larger, more diverse populations to better understand the complex interplay between gender, lifestyle, and heart disease in T2DM patients.

Chapter 6:

Conclusions,

Recommendations

& Limitations

Chapter 6: Conclusions, Recommendations & Limitations

6.1 Conclusions

This study aimed to assess and compare the prevalence of heart disease between men and women within the T2DM population. We concluded the following:

1) The prevalence of clinically significant heart disease among T2DM patients in this study was 31.4%, with coronary artery disease (CAD) being the most common form, followed by heart failure.
2) The prevalence of heart disease was higher in men (33%) than in women (28.8%), although this difference was not statistically significant ($P = 0.442$). The odds ratio indicated that men had a 1.22 times higher risk of heart disease compared to women.
3) Patients with heart disease were significantly older (mean age 61 years) compared to those without heart disease (mean age 50 years), suggesting that age is a major risk factor for heart disease in T2DM patients ($P < 0.001$).
4) High stress levels were significantly associated with heart disease, with 46% of heart disease patients reporting high stress compared to 24% of those without heart disease ($P < 0.001$).
5) Smoking was significantly associated with heart disease, with 48% of heart disease patients being smokers compared to 35% of those without heart disease ($P = 0.027$). Men were more likely to smoke than women ($P < 0.001$).
6) Qat Chewing and Heart Disease: Qat chewing was significantly associated with heart disease, with 81% of heart disease patients reporting this habit compared to 66% of those without heart disease ($P = 0.005$). Men were more likely to chew qat than women ($P < 0.001$).

7) Patients with heart disease had significantly higher HbA1c levels, indicating poorer glycemic control (median 9.0%) compared to those without heart disease (median 7.9%, $P < 0.001$).
8) Sedentary behavior was more common among heart disease patients (32%) compared to those without heart disease (17%, $P = 0.005$), suggesting that physical inactivity is a risk factor for heart disease in T2DM patients.
9) Patients with heart disease were less likely to consume fruits and vegetables regularly, with a significant association between low fruit and vegetable intake and heart disease prevalence ($P = 0.013$).

6.2. Recommendations

- ✓ Implement smoking cessation programs specifically targeting male T2DM patients, as smoking is a significant risk factor for heart disease.
- ✓ Health authorities should develop culturally sensitive interventions to reduce qat chewing, particularly among male T2DM patients, due to its strong association with heart disease.
- ✓ Introduce stress management programs for T2DM patients, with particular attention to those with high stress levels, as stress is significantly associated with heart disease.
- ✓ Encourage regular physical activity among T2DM patients, particularly those at higher risk of heart disease, to reduce sedentary behavior and improve cardiovascular outcomes.
- ✓ Emphasize the importance of tight glycemic control by providing education and support to T2DM patients, as higher HbA1c levels are associated with increased heart disease risk.
- ✓ Promote the consumption of fruits and vegetables, particularly among T2DM patients with heart disease, to improve dietary habits and potentially reduce heart disease risk.
- ✓ Implement routine cardiovascular screening for older T2DM patients and those with long durations of diabetes, as age and diabetes duration are significant risk

6.3. Limitation:

The study's limitations encompass several key areas. Firstly, its cross-sectional design hinders the establishment of causal relationships between risk factors and heart disease. Additionally, the relatively small sample size, especially among women, may restrict the generalizability of findings and contribute to the insignificance of certain comparisons. Relying on Face to face interview, where patients were confidential to some data because they were unassured about their disease duration and other personal reasons. Moreover, the absence of complete information regarding the lipid profile and the oversight of unmeasured confounders like lipid profiles, blood pressure, or healthcare access potentially affect the observed associations, emphasizing the need for cautious interpretation of the study's outcomes.

✓

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Appendix

Don’t forget to check for exclusion criteria

Questionnaire

Section 1: Demographic Information

1. Gender:

- Male - Female

2. Age: (_____)

3. Marital Status:

- Single - Married - Divorced or Widowed

4. Educational Level:

- No formal education - Primary or Secondary - Higher education

5. Occupation:

- Unemployed - Employed - Retired

6. Monthly family Level of income:

-Low (< 100 thousand RY) -Moderate (100-200 Th RY) -High (>200 thousand RY)

Section 2: Medical History

7. Duration of Type 2 Diabetes: (_____/month)

8. Family History of Diabetes: **9. History of Heart Disease:**

- Yes - No _Yes -No

9. Type of Heart Disease Diagnosed:

- Coronary Artery Disease - Heart Failure - Arrhythmia -Other

10. Duration of Heart Disease Diagnosis: (_____/month)

11. HbA1c Level (Glycated Hemoglobin (_____)

12. Body Mass Index (BMI): (_____) Weight / Hight (in meter)

13. Medications for Diabetes:

- Oral hypoglycemics - Insulin - Both

14. History of other comorbidities:

-Yes -No

Section 3: Lifestyle Factors

15. Smoking Status: **16. chewing Qat:**

- Yes - No - Yes - No

17. Physical Activity:

- Sedentary - Light activity (walking, gardening)

- Moderate activity (brisk walking, cycling) - Vigorous activity

18. How often do you consume fruits and vegetables?

- Daily - Several times a week - Occasionally (Rarely)

19. How often do you consume fast food or processed foods?

- Daily - Several times a week - Occasionally (Rarely)

Section 4: Psychosocial Factors

20. Sleep Duration: (_____/hour)

21. Stress Level:

- Low - Moderate - High

22. Do you have a support system (family, friends) to help manage your diabetes and heart disease?

- Yes - No

23. Knowledge about Diabetes Management:

- Poor - Fair - Good
- Excellent

24. Healthcare access:

-Easy -Moderate -Hard

Adherence to Medication:

25. How often do you take your diabetes and heart disease medications as prescribed?

- Always - Often - Sometimes - Rarely

Republic of Yemen

Emirates International University

Sana'a

الجمهورية اليمنية

الجامعة الإماراتية الدولية

صنعاء

22 /10/2024

المحترم

الأستاذ الدكتور/ همدان باجري- مدير هيئة مستشفى الثورة

تحية طيبة وبعد،،

الموضوع:-بحث تخرج طلاب الطب البشري الدفعه السادسة

تهديكم كلية الطب والعلوم الصحية – الجامعة الاماراتية اجمل التحايا .

بالاشارة الى الموضوع اعلاه نرجو تكرمكم بالموافقه والسماح لطلاب الطب البشري الدفعة السادسة باجراء استبيان يخدم بحث تخرجهم والذي سيحمل عنوان :-

The impact of gender on heart diseases among patientwith type 2 diabetes: prevalence and associated factors inSana'a city, Yemen

شاكرين تعاونكم سلفا .....

وتقبلوا خالص التحايا،،

عميد كلية الطب والعلوم الصحية

أ.د/ صالح الظاهري

مرفق لكم

- كشف باسماء الطلاب

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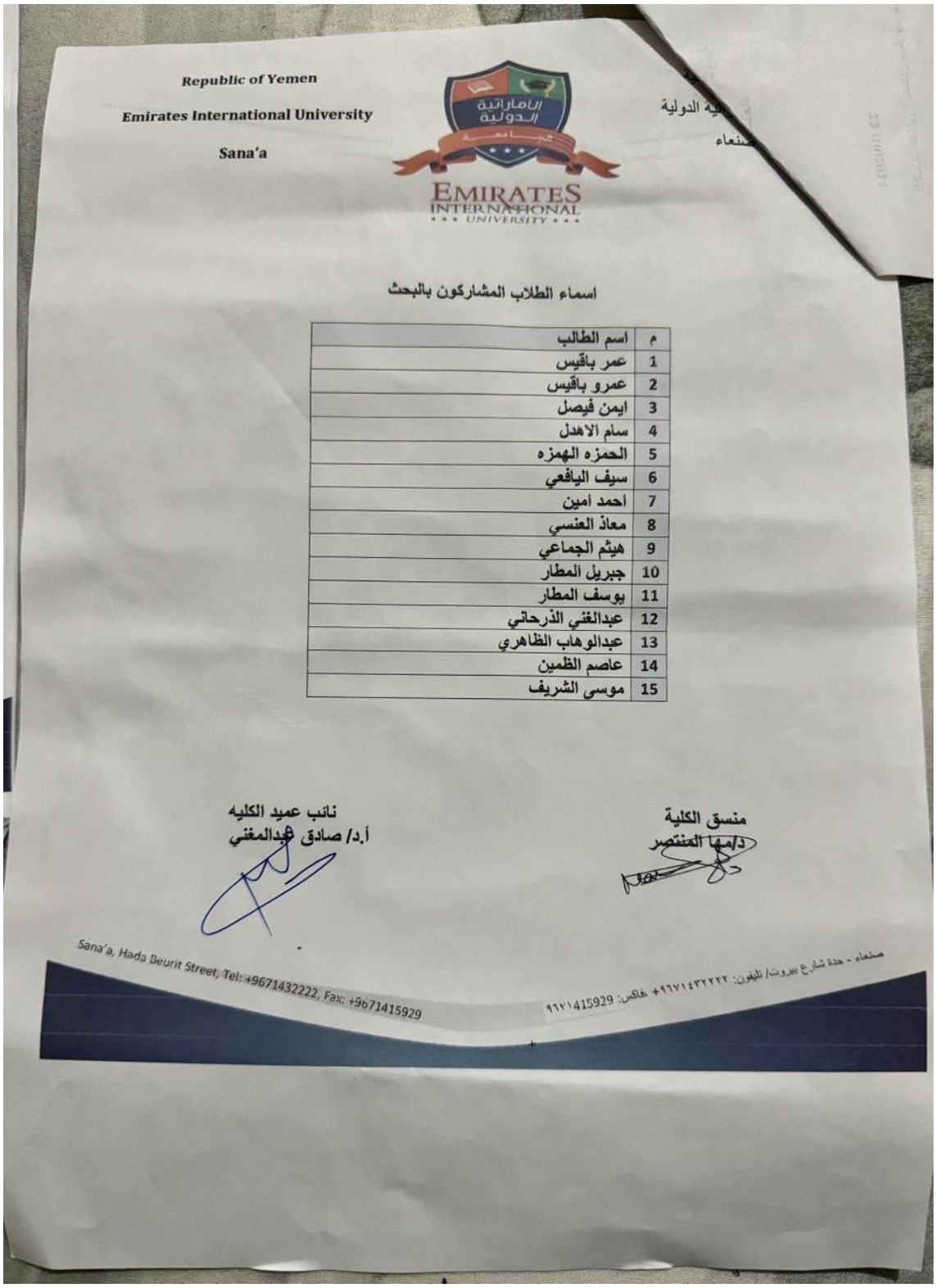

Republic of Yemen

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صنعاء

EMIRATES INTERNATIONAL UNIVERSITY

اسماء الطلاب المشاركون بالبحث

م	اسم الطالب
1	عمر باقيس
2	عمرو باقيس
3	ايمن فيصل
4	سام الاهدل
5	الحمزه الهمزه
6	سيف اليافعي
7	احمد امين
8	معاذ العنسي
9	هيثم الجماعي
10	جبريل المطار
11	يوسف المطار
12	عبدالغني الذرحاني
13	عبدالوهاب الظاهري
14	عاصم الظمين
15	موسى الشريف

نائب عميد الكليه

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Republic of Yemen

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الجمهورية اليمنية

الجامعة الإماراتية الدولية

صنعاء

22 /10/2024

الدكتور/ احلام المرتضى

المحترم

تحية طيبة وبعد،،

الموضوع:-بحث تخرج طلاب الطب البشري الدفعه السادسة

تهديكم كلية الطب والعلوم الصحية – الجامعة الاماراتية اجمل التحايا .

بالاشارة الى الموضوع اعلاه نرجو تكرمكم بالموافقه والسماح لطلاب الطب البشري الدفعة السادسة باجراء استبيان يخدم بحث تخرجهم والذي سيحمل عنوان :-

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أ.د/ صادق عبدالمغني

مرفق لكم

- كشف باسماء الطلاب

Sana'a, Hada Beurit Street, Tel: +9671432222, Fax: +9671415929

صنعاء - حدة شارع بيروت/ تليفون: ٩٦٧١٤٣٢٢٢٢+ ،فاكس: ٩٦٧١٤١٥٩٢٩

Republic of Yemen

Emirates International University

Sana'a

الجمهورية اليمنية

الجامعة الإماراتية الدولية

صنعاء

22 /10/2024

الدكتور/ زايد عاطف المحترم

تحية طيبة وبعد،،

الموضوع:-بحث تخرج طلاب الطب البشري الدفعه السادسة

تهديكم كلية الطب والعلوم الصحية – الجامعة الاماراتية اجمل التحايا .

بالاشارة الى الموضوع اعلاه نرجو تكرمكم بالموافقه والسماح لطلاب الطب البشري الدفعة السادسة باجراء استبيان يخدم بحث تخرجهم والذي سيحمل عنوان :-

The impact of gender on heart diseases among patientwith type 2 diabetes: prevalence and associated factors inSana'a city, Yemen

شاكرين تعاونكم سلفا .....

وتقبلوا خالص التحايا،،

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22 /10/2024

المحترم
الأستاذ الدكتور/ محمد جحاف - مدير هيئة مستشفى الجمهوري
تحية طيبة وبعد،،

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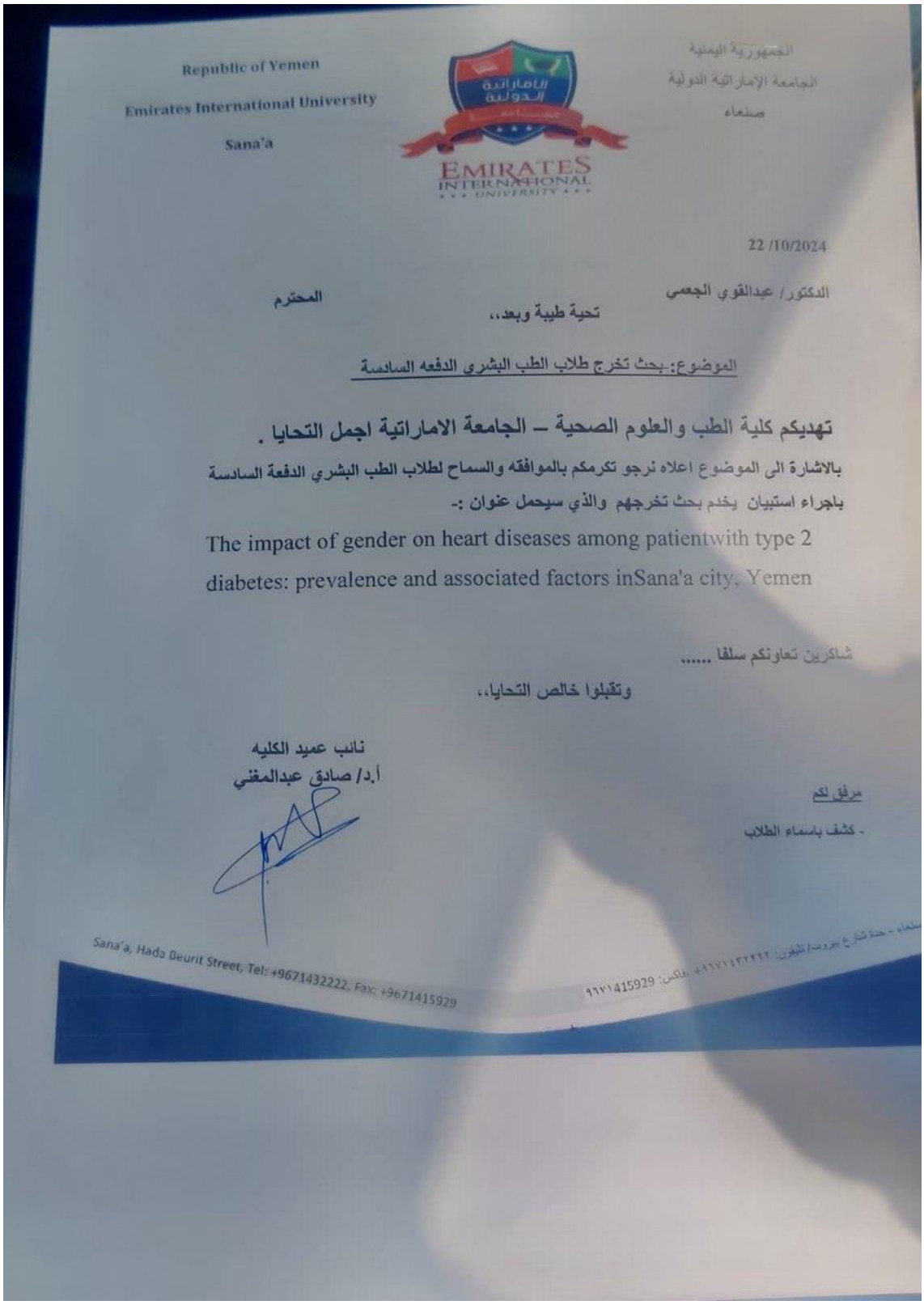

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الجمهورية اليمنية

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الملخص

ألمقدمة: إن انتشار أمراض القلب بين الأفراد المصابين بداء السكري من النوع الثاني (T2DM) مرتفع بشكل ملحوظ بسبب تأثير السكري على الجهاز القلبي الوعائي من خلال آليات مختلفة، بما في ذلك الفروق بين الجنسين، مما يؤدي إلى تحديات في علاج المرض. على الرغم من أن الرجال لديهم انتشار أعلى لمرض السكري، إلا أن النساء يحملن خطرًا أعلى للإصابة بالأحداث القلبية الوعائية. وقد اعترفت الإرشادات الحديثة بشأن الوقاية القلبية الوعائية بالفروق المرتبطة بنوع الجنس، مما يستلزم اعتبارات صحية خاصة. هدفت هذه الدراسة إلى تقييم ومقارنة انتشار أمراض القلب بين الرجال والنساء ضمن فئة المصابين بداء السكري من النوع الثاني.

هدف الدراسة: هدفت هذه الدراسة إلى تقييم ومقارنة انتشار أمراض القلب بين الرجال والنساء ضمن فئة المصابين بداء السكري من النوع الثاني.

المنهجية: أجريت هذه الدراسة التحليلية المقطعية في المستشفيات الحكومية والخاصة والعيادات المتخصصة في مرض السكري من 15 أكتوبر 2024 إلى 30 أكتوبر 2024. تم استخدام المقابلات المباشرة لتقديم الاستبيان. تم تقييم العوامل الديموغرافية والعوامل السريرية ونمط الحياة والعوامل النفسية والاجتماعية. استخدمت اختبارات مربع كاي و مان ويتني لمقارنة انتشار أمراض القلب بين الرجال والنساء.

النتائج: من بين 334 مريضًا مصابًا بداء السكري من النوع الثاني. وُجدت أمراض القلب في 31.4% من المشاركين، حيث تم توثيق مرض الشريان التاجي (CAD) في 35.2% منهم، يليه فشل القلب (26.7%). كان انتشار أمراض القلب أعلى لدى الرجال (33%) مقارنة بالنساء (28.8%)، رغم أن هذا الاختلاف لم يكن ذا دلالة إحصائية ($P = 0.442$). أشارت نسبة الأرجحية (Odds ratio) إلى أن الرجال كانوا معرضين لخطر الإصابة بأمراض القلب بمقدار 1.22 مرة مقارنة بالنساء. سجل الرجال معدلات أعلى بشكل ملحوظ في التدخين، ومضغ القات، واستهلاك الوجبات السريعة، وارتفاع مستويات التوتر، وقلة مدة النوم مقارنة بالنساء ($p < 0.05$)، حيث ارتبطت هذه العوامل بشكل كبير بحالات أمراض القلب ($p < 0.05$). من ناحية أخرى، كان لدى النساء معدلات أعلى من مؤشر كتلة الجسم (BMI) المرتفع، والحالة الاجتماعية العازبة أو المطلقة، ومستوى التعليم غير الرسمي، وحالة البطالة، ومعدل أعلى للحصول على مساعدة في إدارة مرض السكري أو أمراض القلب ($p < 0.05$). لم تلاحظ فروقات كبيرة بين الجنسين في المتغيرات الأخرى المدرجة في الاستبيان ($p > 0.05$).

الخلاصة: تسلط الدراسة الضوء على عوامل الخطر الخاصة بنوع الجنس لأمراض القلب بين فئة المصابين بداء السكري من النوع الثاني، مما يؤكد الحاجة إلى استراتيجيات وقائية مخصصة. يمكن أن يؤدي معالجة عوامل نمط الحياة مثل التدخين والتوتر، خاصة عند الرجال، ودعم النساء في إدارة السكري وأمراض القلب، إلى تحسين النتائج القلبية الوعائية.

الكلمات المفتاحية: أمراض القلب، مريض السكري، الانتشار، العوامل المرتبطة، اليمن.

الجمهورية اليمنية
وزارة التربية والتعليم والبحث العلمي
الجامعة الإماراتية الدولية
كلية الطب والعلوم الصحية
قسم طب المجتمع

تأثير نوع الجنس على أمراض القلب فيما بين مرضى السكري من النوع الثاني : معدل الإنتشار والعوامل المؤثرة في مدينة صنعاء, اليمن

بحث مقدم لكلية الطب والعلوم الصحية الجامعة الإمارتية الدولية لاستكمال متطلبات الحصول على درجة البكالوريوس في الطب العام والجراحة العامة

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