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# ASSESSMENT OF NEXT TEN YEARS' RISK OF CORONARY HEART DISEASE IN TYPE2 DIABETES MELLITUS IN SUDANESE PATIENTS

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## ABSTRACT

The Risk of Coronary Heart Disease (CHD) based on the Framingham Heart criteria, was used to estimate the risk of CHD in Sudanese patients with type 2 diabetes mellitus (T2DM) over the next ten years. Systolic and diastolic blood pressure, high-density lipoprotein cholesterol (HDL-C), total cholesterol (TC), and total cholesterol (TC), diabetes mellitus, smoking, demographic data were used to divide patients and control subjects into three classes. The first group which at low risk of developing CHD, represented by 7.7% of patients and 31.7% of control subjects, while the second group which at moderate risk of developing CHD, represented by 27.9% of patients and 61.6% of control subjects, the last group which at high risk of developing CHD, represented by 64.4% of patients and 6.7% of control subjects. The study also showed a significant increase in CHD risk in female patients (91.7% at high risk), when compared with males at high risk of developing CHD (41.1%) with (P-value 0.000). In comparison to the control group, there was a dramatic increase in HbA1c, TC, non-HDL-C, TGs, and LDL-C in patients (P-value 0.000). In the patients' group, systolic blood pressure and diastolic blood pressure were significantly high when compared to normal control (P-values 0.016 and 0.004, respectively). Female patients had substantially higher TC, non-HDL, TGs, and LDL-C levels than male patients (P-values 0.003, 0.026, 0.046, and 0.014). Other parameters such as SBP, DBP, and HbA1c, on the other hand, showed no substantial differences (P-values of 0.818, 0.995, and 0.122, respectively). We concluded that T2DM could increase the risk factors affecting CHD in the next decade.

**Keywords:** Coronary Heart Disease, Type 2 Diabetes Mellitus, Lipid Profile, HbA1c

## INTRODUCTION

Over the past decades, coronary heart disease (CHD), also known as ischemic heart disease (IHD) or atherosclerotic heart disease, it becomes top of the causes of death all over the world, with an ever-increasing incidence (Erhardt, 2009). According to the most recent World Health Organization (WHO) results, CHD deaths in Sudan reached 9491 in May 2014, accounting for 3.64 percent of all deaths. Sudan is ranked 146 in the world, with a death rate of 56.31 per 100,000 people adjusted for age. Although CHD was once thought to be rare in Africa, it is now the eighth leading death in both men and women (Steyn et al.,2005). For people aged 60 and up in the African region, CHD is now the leading cause of death in males and the second leading cause of death in females (Dean et al., 2006). CHD killed approximately 361,000 people in Africa in 2005, based on the WHO, and current projections suggest that figure will nearly be duplicated by the end of this decade. According to more recent mortality and disease burden projections, cardiovascular disease (CVD) will overtake HIV/AIDS as the leading cause of death in the 3rd world by 2030, accounting for 13.4% of total deaths versus 13.3% for HIV/AIDS. CHD will also be the fifth leading cause of hand caped and adjusted life years (DALYs) in poor countries by 2030 (WHO, 2006).

Many risk factors for CHD are mainly based on people's diet style. Obesity, high hypertension, and DM are all examples of these disorders, as are high blood total TC, reduction of low-density lipoprotein cholesterol (LDL-C), raised triglycerides with low high-density lipoprotein cholesterol (HDL-C), and obesity. Elevated LDL-C levels (130 mg/dl), low HDL-C levels ( 40 mg/dl ), current smoking, blood pressure 140/90 mmHg, and genetic history of premature CHD are all are high risks, according to (NCEP, 2001). CHD risk equivalents (e.g. diabetes mellitus, obesity, menopause, stress, etc.), gender CHD is more common in male than in females before menopause), and finally age (men 45 years than female above 55 years of age) are all variables that affect a human risk for developing CHD and facilitate the progression of atherosclerosis. High serum triglycerides, according to recent research (Miller et al. 2002), are a separate risk factor for CHD, especially in people with low HDL cholesterol (HDL-C). This study aimed to evaluate the risk of Sudanese diseased patients with T2DM toward developing CHD over the next ten years based on the international criteria.

## MATERIALS AND METHODS

**Study population:**

A total of 104 diseased patients with type 2DM, (56 men and 48 women, ages 40 to 70) were chosen at random. There is no history of CHD, liver disease, renal impairment lesion, cardiac valvular disease, heart failure, tumors, or immune disorders in the patients.

To represent the control group, a total of 104 healthy individuals (56 men, 48 women, 40 to 70 years old) were recruited, all of whom had no history of coronary heart disease, diabetes, or other diseases

**Study design:**

This study is an analytical case-control hospital-based study.

**Ethical consideration:**

Permission to carry out this research was obtained from health authorities, and blood sample collection was carried out under the full supervision of medical doctors. All subjects included in this study were fully informed and signed consent.

**Reagents and devices:**

Total CL kits, HDLP-C kits, LDLP-C kits, triglycerides kits, and other reagents and instruments were used in this analysis. COBAS INTEGRA: Cat. No. 20753521 322; Hemoglobin A1c: System-ID 07 5352; COBAS INTEGRA: Cat. No. 20753521 322; COBAS INTEGRA: Cat. No. 20753521 322; COBAS INTEGRA: 1. A COBAS INTEGRA 700

**Biochemical measurements:**

Biochemical analyses were carried out using standard methods following the manufacturer's recommendations.HbA1c was determined using turbidimetry. Spectrophotometry was used to assess serum total cholesterol, HDL-C, LDL-C, and triglycerides using normal enzymatic methods. Non-HDL-C (non-HDL-C) is calculated by subtracting HDL-C from total cholesterol.

**Measurement of blood pressure:**

The sum of multiple blood pressure measurements was used to calculate blood pressure (systolic pressure/diastolic pressure) by trained medicinal practitioners. A questionnaire was used to collect information on age, gender, and cigarette smoking.

**Estimating risk of CHD in the next ten years:**

In this research, the risk of CHD for the next ten years was calculated using the Global Risk of CHD, based on the Framingham Heart Study (Anthony and Stacey, 2010). The complete distress of a CHD-related occurrence in a fixed time, normally one decade, is known as global CHD risk. A "hard" event (e.g., myocardial infarction, sudden cardiac death) or a "soft" event (e.g., chest pain) may occur. The risk estimate is determined using an empirical equation and is based on major risk factors.

**Statistical Methods:**

For data processing, the SPSS software was conducted. The information was presented in the form of means and standard deviations. Both parameters for the patient and control groups had compared using one-way analytical variances (ANOVA), and multiple comparisons were used to determine significance between the two groups.

## RESULTS

Table 1 demonstrate the next 10 years' risk of CHD among patients and controls. In which the patients and controls were classified according to the next 10 years' risk of CHD status into low risk 7.7% and 31.7%, moderate risk 27.9% and 61.5%, and high risk 64.4% and 6.7% respectively. It can be seen that a fast increase in the next ten years' risk of CHD in patients than controls (P-value 0.000).

Table 2 and Figure (1: a and 1: b): demonstrate the next ten years' risk of CHD among male and female patients. In which the male patients and female patients were classified according to the next year's risk of CHD status into low risk 12.5% and 2.1%, moderate risk 46.4% and 6.3%, and high risk 41.1% and 91.7% respectively. It can be seen that a significant increase in the next ten years' risk of CHD in female patients compared with male patients (P-

value 0.000). The mean value of study variables in patients with low CHD risk, moderate CHD risk, and high CHD risk are shown in Table (3). There were no substantial differences in the mean values of HbA1c, SBP, DBP, and HDL-C between patients with low CHD risk, moderate CHD risk, and high CHD risk (P-value > 0.05), but there were significant differences in the mean concentrations of TC, non-HDL-C, TGs, and LDL-C between patients with low CHD risk, moderate CHD risk, and high CHD risk (P-value > 0.05), however, there are substantial variations in the mean concentrations of TC, non-HDL-C, TGs, and LDL-C between patients with low CHD risk, moderate CHD risk, and high CHD risk (P-value 0.05).

Table 1. Risk of CHD among patients and control.

| CHD GARDE | Grouping | | Total |
|---|---|---|---|
| | Patients | Control | |
| Low | 8 (7.7%) | 33 (31.7%) | 41 (19.7%) |
| Moderate | 29 (27.9%) | 64 (61.5%) | 93 (44.7%) |
| High | 67 (64.4%) | 7 (6.7%) | 74 (35.6%) |
| Total | 104 | 104 | 208 |
| P-value | 0 | - | - |

Table 2. Risk of CHD among male and female patients.

| | Group | | |
|---|---|---|---|
| CHD GARDE | Patients Male | Patients Female | Total |
| Low | 7 (12.5%) | 1 (2.1%) | 8 (7.7%) |
| Moderate | 26 (46.4%) | 3 (6.3%) | 29 (27.9%) |
| High | 23 (41.1%) | 44 (91.7%) | 67 (64.4%) |
| Total | 56 | 48 | 104 |
| P-value | 0 | | |

Table 3. Mean concentration of study parameters comparison across CHD grade among patients.

| **Parameters** | **Low Mean ±SD** | **Moderate Mean±SD** | **High Mean ±SD** | ***P-value*** |
|---|---|---|---|---|
| HbA1c (%) | 8.57±2.11 | 8.88±1.70$^{Ns}$ | 9.06±1.96$^{Ns}$ | 0.779 |
| SBP | 118.75±3.53 | 121.72±5.39$^{Ns}$ | 124.62±11.45$^{Ns}$ | 0.159 |
| DBP | 80.00±0.00 | 80.00±0.00$^{Ns}$ | 80.00±0.00$^{Ns}$ | 0.678 |
| T.CHOL(mg/dl) | 150.37±33.30 | 192.86±30.86$^{**}$ | 224.26±42.0$^{**}$ | 0.000 |
| HDL (mg/dl) | 37.12±15.85 | 42.37±9.59$^{Ns}$ | 38.85±9.11$^{Ns}$ | 0.209 |
| NON-HDL (mg/dl) | 113.25±25.52 | 150.48±27.87$^{**}$ | 185.41±39.06$^{**}$ | 0.000 |
| TG ( mg/dl) | 114.87±70.18 | 132.93±48.49$^{**}$ | 180.26±51.08$^{**}$ | 0.000 |
| LDL (mg/dl) | 90.62±29.45 | 123.89±27.12$^{**}$ | 149.31±34.81$^{**}$ | 0.000 |

Ns: not significant; $^{**}$Highly significant

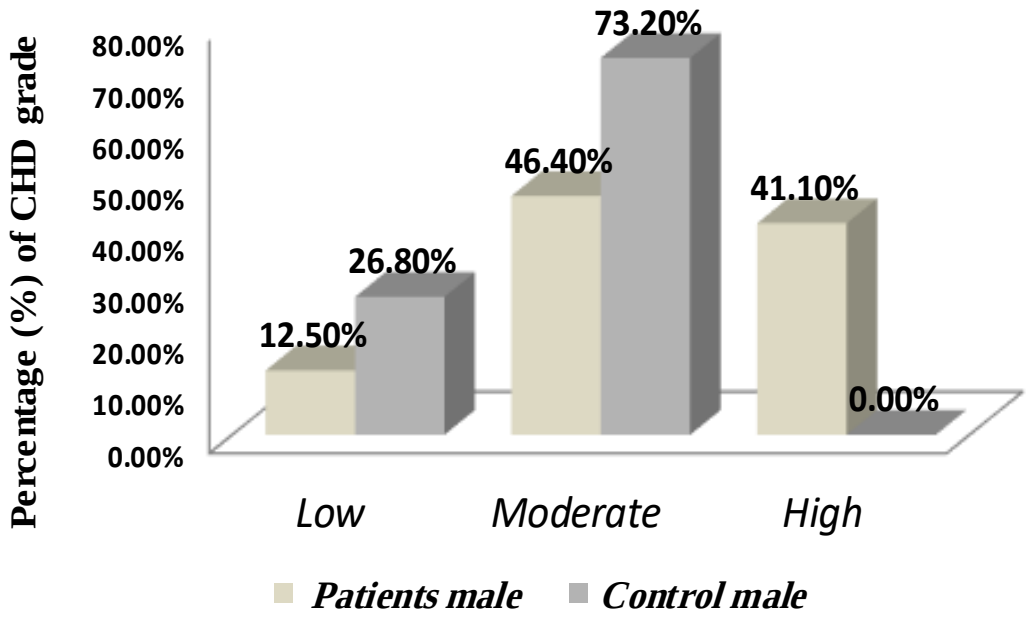


Fig. (1:a). Percentage of CHD risk among male patients and control group.

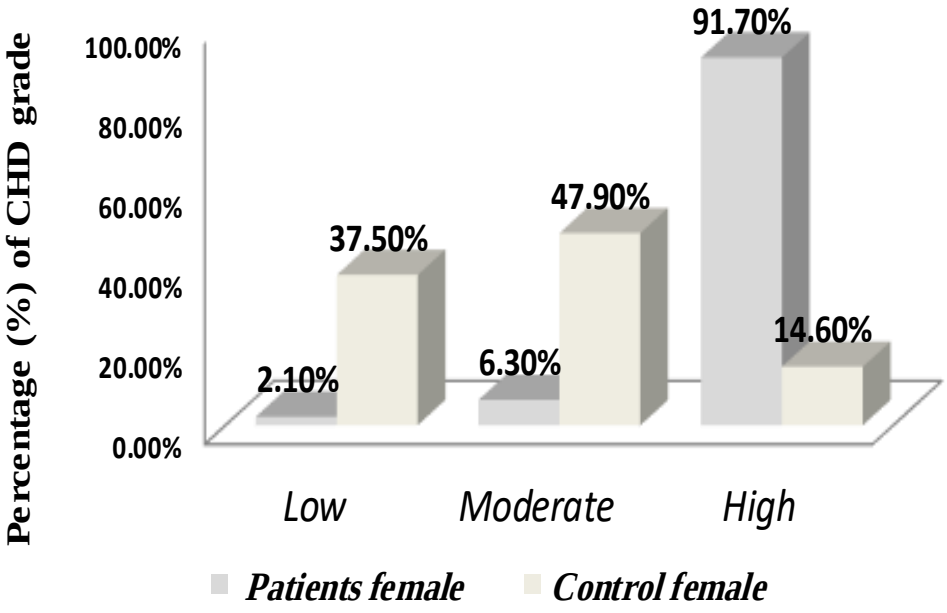


Fig. (1:b). Percentage of CHD risk among female patients and control group.

**DISCUSSION**

The Global Risk of CHD Assessment, which is focused on the Framingham Heart Study, was used to estimate and predict CHD in Sudanese type 2 diabetes patients (Anthony and Stacey, 2010). According to the results of this report, type 2 diabetes (64.4%) has a higher chance of CHD in the next 10 years than seemingly healthy controls

(6.7 percent). The results show a substantial increase in the mean of HbA1c, TC, non-HDL-C, SBP, and DBP in type 2DM patients when compared to controls (P-values 0.000, 0.000, 0.016, 0.004) and a significant decrease in HDL-C in patients when compared to controls (P-values 0.000, 0.000, 0.000, 0.016, 0.004) (P-value 0.000). In both diseased and normal subjects, higher HbA1c levels were related to an increased risk of heart deaths (Khaw et al., 2004). The current absolute factor indicates excess mortality across the entire population distribution, even at moderately elevated levels (Khaw et al.,2001). With just a 1% decrease in HbA1c, in the UK Prospective DM Study-35 (UKPDS-35) found a 21% reduction in the risk of DM-related deaths and a 14 percent reduction in the incidence of MI in type 2DM. Furthermore, the UKPDS 23 found that people with HbA1c >8% had a 150 percent higher risk of dying from heart disease. Type 2 diabetes, according to Laakso (2001), raises the risk of coronary heart disease (CHD) in diabetics by two to three times as compared to non-diabetic topics. Furthermore, (Auni et al., 2005) discovered that diabetes without prior MI and diabetes without prior MI both have a similar risk of CHD death in men and women, and diabetes without any prior evidence of CHD (MI, angina pectoris, or ischemic ECG changes) has a higher risk in non-diabetic subjects than prior evidence of CHD. Diabetics with hyperlipidemia should be treated as if they had previously suffered from coronary heart disease, according to the Adult Treatment Panel III (NCEP) (CHD). Diabetes is an independent risk factor for CVD in both men and women, according to a wide body of epidemiological and pathological evidence (Wilson et al., 1998). Furthermore, the American Heart Association's Scientific Advisory and Coordinating Committee have determined that diabetes mellitus is a significant risk factor for CVD, with type 1 and type 2 diabetes being separate risk factors for CHD (Wingard et al.,1993). While pro-atherogenic mechanisms linked to hyperglycemia may not be the sole cause of macrovascular complications, they may play a role. Increased glucose flux via the polyol pathway, increased glucose flux via the hexamine pathway, formation of advanced glycation end products (AGE), and activation of protein kinase C (PKC) are all pro-atherogenic pathways. The links between hyperglycemia and diabetes were recently summarized by scientists. In the long run, both of these processes result in an increase in superoxide production. Patients with cholesterol levels less than 150 mg/dl have the lowest incidence of CHD, according to the Framingham results. Just five subjects with cholesterol levels less than 150 mg/dl developed coronary heart disease in the first 50 years of the Framingham Heart Study. In a recent systematic review and meta-analysis, researchers discovered that high total cholesterol is a significant risk factor for CHD in both men and women (Peters et al., 2016). Furthermore, a series of studies conducted in the United States, Canada, and Europe found that reducing total cholesterol was responsible for 19% to 46% of the total decrease in coronary heart disease mortality between 1980 and 2010. The cause was a drop in total cholesterol levels as a consequence of behavioral changes and pharmacological care(Murray et al.,2008).

A one-milligram-per-dl rise in non-HDL-C increases the risk of death from cardiovascular disease by 5%, according to Liu et al., which appears to be a better predictor than conventional lipid risk factors. Patients with diabetes have significantly higher non-HDL-C levels and a 1.5 to 2.5 times higher relative risk of coronary complications than healthy people. The role of serum non-HDL-C in coronary artery calcification, which has been suggested as an early marker of subclinical atherosclerosis in some studies, is also being investigated. Raised non-HDL-C is the greatest risk indicator of all cholesterol measures, according to a new review of evidence from 68 studies, for both CHD injuries and strokes. (DiAngelantonio et al.,2009).

The development of CHD is aided by hypertension (HT). Because of its high prevalence and pathogenesis, HT is one of the most important risk factors for CHD (Collins and McMahon, 1994). Heart disease is caused by a variety of factors, including smoking, dyslipidemia, insulin resistance, diabetes, obesity, lack of physical activity, and certain genetic mutations. Furthermore, blood pressure, especially systolic blood pressure, is related to the prevalence of CHD. This has been shown in both clinical and ambulatory blood pressure measurement (ABPM) studies (Kannel, 1996). McMahon et al. (1990) discovered a linear, permanent, and independent relationship between blood pressure and coronary heart disease. Furthermore, Escobar (2002) asserted that hypertension and CHD share a common connection. This finding is consistent with Collins et al(1990) .'s findings, which showed that treating mild hypertension reduced morbidity and mortality by 14%. Similarly, a meta-analysis by (McMahon and Rodgers 1993) discovered that reducing blood pressure over 60 years decreased major coronary injuries by 19%.

According to a Chinese cross-sectional report published as part of the Prospective Urban Rural Epidemiology China review, hypertension was related to a two-fold increased risk of CHD and a three-fold increased risk of stroke.

**Conclusion**

According to the findings, Sudanese with type 2DM have a higher risk of CHD in the next decade than seemingly stable control subjects. Female patients have a higher risk of CHD in the decade than male patients, according to the present study. This study found a clear connection between HbA1c, TC, HDL-C, non-HDL-C, LDL-C, TGs, SBP, and DBP and the incidence of type 2DM, evaluating that it may be a beneficial marker for evaluation risk and management of both type2DM and CHD.

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**Conflict of interest:**

There are no conflicting interests declared by the authors.

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**Supplementary file**

**Questionnaire for assessment of next ten years risk of coronary heart disease(CHD) in Khartum state; among diabetes mellitus patients (Type2)**

UNIT : case / control Number……Tel……..
Age (years) ……...… Sex ……
Do you smoke cigarette : 1- Yes 2- No
If yes , how many cigarette / day .....
Blood sample number ……
Blood pressure……..…. Mm Hg; Total cholesterol (TC)…….. mg/dL
HDL-C …….. mg/dL; LDL-C …….. mg/dL
HbA1c ……..… mg/dL; C-reactive protein…….. mg/L
Weight …… Kg; Height ……..…. cm

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