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*Research Article*

# Incidence and Cardiovascular Risk Factors Profile in Obese and Non-obese Type 2 Diabetes Mellitus subjects aged between 30 and 80 years in the polyclinic, in an Omani Population: ICD OMAN a Decade-Long Bawshar Study

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## ABSTRACT

**Background:** Coronary heart disease (CHD) and stroke are the major cardiovascular diseases (CVD) among populations with Type 2 diabetes mellitus (T2DM), leading to significant morbidity and mortality.

**Objective:** To identify the incidence and cardiovascular risk factor profiles of obese and non-obese Omani T2DM patients aged between 30 and 80 years followed since ten years in the polyclinic.

**Design:** An observational longitudinal retrospective cohort design was used.

**Setting:** A secondary care polyclinic in Bawshar, Muscat, Oman, was utilized where DM patients were seen three days a week.

**Sample Size:** A Convenient sample of 130 patients with T2DM between 1st November 2019 to 31st January 2020, who were free of CVD at baseline (January 2010) were involved in the study.

**Materials and Methods:** Socio-demographic data and CVD risk factor assessments at the baseline were retrieved from patient's records. The first CVD outcomes were traced from the date of diagnosis of T2DM to January 31st 2020. The study compared the CVD risk factors among obese and non-obese T2DM patients at baseline. Data were analyzed using Statistical Package for social sciences (SPSS)Statistics Inc., Chicago, US version 25.0. Incidence was expressed in percentage with 95% confidence intervals (CI). p-value< 0.05 was considered Statistically significant.

**Results:** The overall cumulative incidence of CVD was 16.15% over 10 years period. Middle aged (46 to 65years) individuals developed CVD with p value of 0.0028, p< 0.05. Out of 23 middle aged obese women 8 developed CVD compared to non-obese middle aged women with p value of 0.0375, p <0.05. Obese patients had uncontrolled Glycosylated hemoglobin (HbA1c) more than 8 mmol/l with calculated p value of 0.0018, p<0.05.

**Conclusion:** The study revealed higher cumulative incidence of CVD, 16.15% with incidence density of 16 per 1000 persons per year with no gender difference and higher prevalence of CVD risk factors among Omani T2DM patients. Middle aged patients with no gender difference and obese women compared to non-obese women had higher incidence of CVD. Obese patients had uncontrolled HbA1c with no gender difference.

**Limitations:** The study was retrospective in nature, and the sample recruited was a convenient sample which could cause selection bias.

**Recommendations:** The outcomes of the study recommend the Ministry of Health, Oman, to provide GLP-1 agonists for middle-aged obese women to reduce the incidence of CVD by weight reduction and better glycemic control which is currently unavailable in the institution.

## KEYWORDS

Incidence, Cardiovascular Disease, Coronary Heart Disease, Obesity, Stroke, Type 2 Diabetes, Oman.

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## Introduction

Cardiovascular morbidity and mortality have been shown to have increased in persons with T2DM compared to persons without T2DM. Individuals with T2DM have two to four- fold increase in coronary heart disease and stroke. The risk of CVD follows a gradient and it depends on both traditional (gender, age, dyslipidemia, obesity, smoking, alcohol, hypertension) and non-traditional risk factors (hypoglycemia, hyper homocysteinaemia, albuminuria) [1]. A literature search was done using internet data base (Google Scholar, Pub Med, Science Direct) from 2010 onwards using the following search terms: Type 2 diabetes mellitus, incidence, prevalence, cardiovascular disease, diabetes cardiovascular risk factors, mortality. In Oman, CVD and DM-related death accounts for 36% and 8% of total deaths, respectively [2]. According to National Communicable Disease (NCD) survey carried out in Oman in 2017, the prevalence of DM was found to be 14.5% and incidence of diabetes is 4 %. The prevalence of hypertension is 32 %, hyperlipidemia 37 %and obesity 35% respectively [3].

The studies from Italy, Scotland and China showed lower CVD incidence rates of 7.6%, 5.3 % and 4.9% in the T2DM population within median follow up period of 4, 4.1 and 5.4 years respectively. Studies from UAE, USA, England and Finland showed higher CVD incidence rates of 12.7%, 17.1%, 17.9% and 20% in T2DM population within median follow up period of 5.5,10,7 and 9 years respectively [1,4-6]. There were differences in CVD incidence in T2DM patients gender , obesity, Body Mass Index (BMI) and waist circumferences which were associated with major cardio metabolic factors like hypertension, and high LDL from systematic reviews [7]. The available literature focused mainly on identifying predictors of CVD in the general population. However, CVD risk factors specifically for those with T2DM may be different given the magnitude and type of diabetes mellitus [8]. Many systematic reviews and meta- analysis revealed different results of CVD incidence In T2DM patients with gender differences, some with increased incidence of CVD in men and other in women [9].

So, in summary there are knowledge gaps in the incidence and risk factors of CVD in T2DM population especially diabetes along with obesity and gender differences in CVD incidence in the T2DM population. Very limited population-based causative studies of CVD in a T2DM specific – group were found in Oman along with lack of studies with long duration of follow up. Identifying CVD incidence and risk factors in patients with T2DM is critical for better health care and health policy planning.

The literature review revealed that CVD incidence was 9.4%. Over 5.6 years with an incidence density of 17.6 per 1000 person-years in a study conducted in primary care settings of Oman [1].

This is the first study conducted in Oman with a long duration in the polyclinic setting in the region. A longer duration of 10 years gives a better idea of CVD incidence in the region. There are no previous studies done in Oman providing results in gender and obese T2DM patients developing CVD. Hence, the aim of the study was to explore a 10-year incidence rate of CVD among obese and non-obese T2DM Omani patients aged between 30 and 80 and to compare other CVD risk parameters between the two groups.

### Research Question and Hypothesis of the study Population

It was hypothesized that
(1) There may be differences in the CVD risk factor profiles between obese and non- obese Omani individuals with T2DM given obesity is more prevalent in middle east. (2) There may be higher incidence rates of CVD in Omani obese individuals with T2DM than non-obese individuals with T2DM as a consequences of obesity. (3) There may be gender differences in the CVD incidence rate in Omani patients given that gender differences in different part of the world which was not addressed before.
H0 There are no differences in CVD risk factor profiles, incidence of CVD among obese and non-obese Omani patients and there is no gender difference in the incidence of CVD.
H1There is a difference in CVD risk factor profiles, incidence of CVD among obese and non-obese Omani patients and there is gender difference in the incidence of CVD.

## Methods

An observational longitudinal retrospective cohort design was used to follow-up a retrospective cohort with a convenience sample size within three months.

## Study Population

The target population was the Omani population diagnosed with T2DM between 30 and 80 years of age who were followed up in a secondary care polyclinic, a specialized DM clinic in Bawshar located in Muscat, the capital of Oman. The accessible study population included all the target population who fulfilled the inclusion and exclusion criteria.

## Sample Size

Patients followed up in the DM clinic from November 1, 2019, to January 31, 2020 were selected. Inclusion criteria were Omani citizens aged between 30-80 years diagnosed as T2DM by a treating physician either clinically or by measuring C -peptides and antibodies to rule out type-1 diabetes (T1DM), diagnosed on or before 2010 and free of cardiovascular disease on or before 2010. Exclusion criteria included Omani patients aged below 30 years

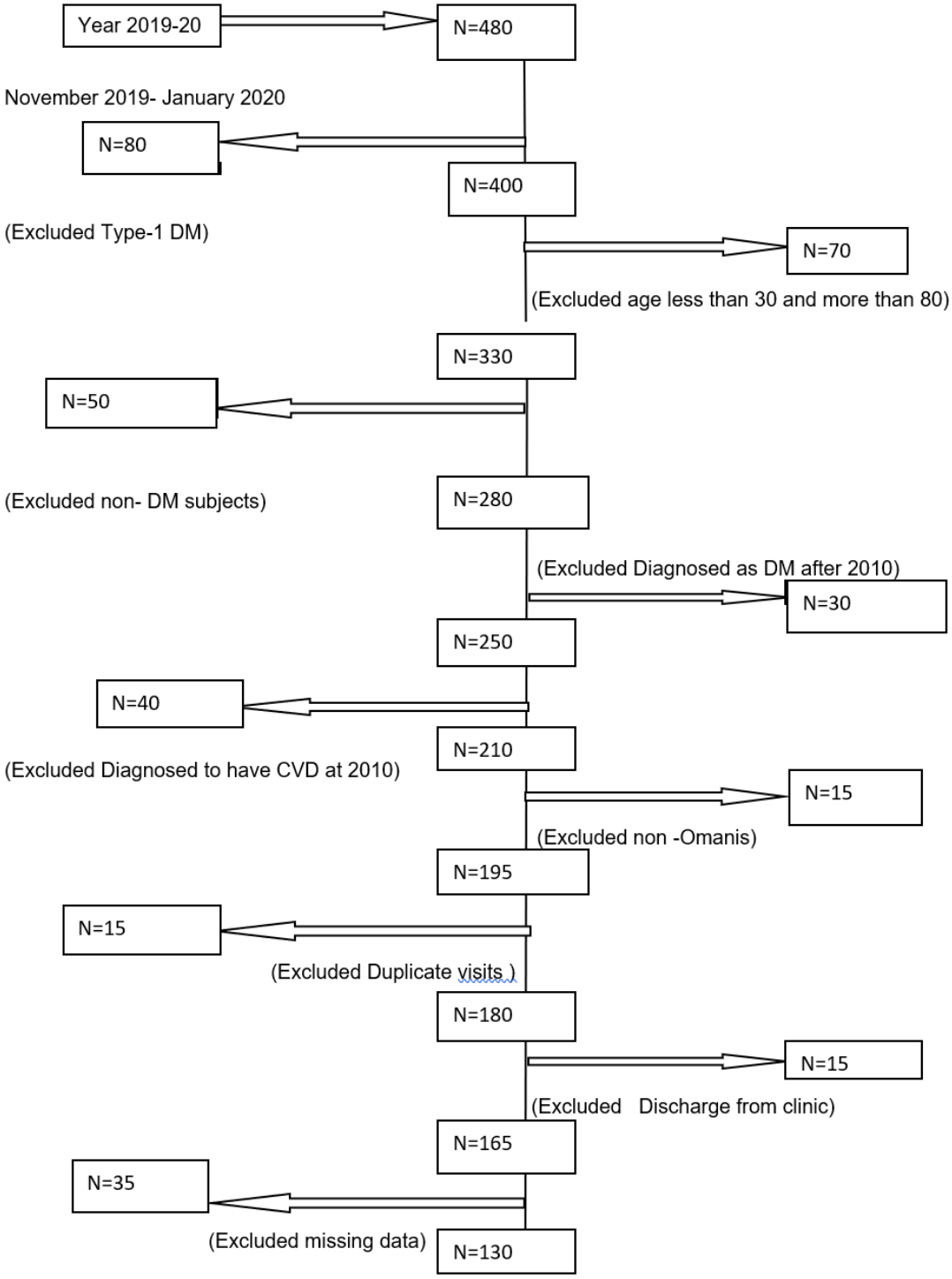



**Figure 1:** Selection of study subjects and sample size.

and above 80 years diagnosed with T2DM, patients with T1DM, those who had CVD on or before 2010, pregnant women, those who diagnosed as T2DM after 2010 and non-Omani residents. The sample size was confirmed with a 95% confidence interval, and 5% margin of error and population proportion of DM is 14.5[9] with a prevalence of DM in Omani men and Omani women at 13.8% and 15.8%, respectively. A non-probability convenience sample of 480 patients were seen in these three months was obtained.

Out of 480 patients those with T1DM and patients aged below 30 years and above 80 years resulted in sample size of 330. Out of the 330 patients, 50 were non-DM patients. Out of the remaining 280 patients, those who were diagnosed as T2DM after 2010, those who had cardiovascular disease at entry point year 2010, those who were non-Omani residents, as well duplicate visits, missing data and those discharged from clinic were excluded as per exclusion criteria, which resulted in a final sample size of 130 (Figure 1).

## Materials and Procedure

Patients' data were accessed through electronic patient records from the outpatient clinic. Demographic data like age, gender, height, and weight were used to calculate BMI reported as kg/m$^2$ were measured. The CVD risk factor variables included Blood Pressure (BP), Low Density Lipoprotein (LDL), HbA1c, albuminuria and duration of diabetes. From these patients, the CVD risk parameters between the study group (obese DM) and control cohort (non-obese DM) were compared along with gender differences. The definitions of CVD risk factors and CVD outcome measures are illustrated in detail (Table 2).

The recent three months data was collected to best assess patients' current control of metabolic profiles, namely target HbA1c, BP, and LDL. All these parameters are measured at the baseline year of 2010 of those who were free of CVD. The electronic patient records were retrieved to identify those who developed CVD outcomes from the baseline year 2010 and, until the year 2020, the cumulative incidence of CVD. All the data was collected by trained physicians and diabetes nurses and recorded in a well-designed data collection excel sheet. The CVD outcomes were traced from baseline January 2010 to January 2020 using 'Al-Shifa' health information management system.

### Data Analysis

Data entered was analysed using SPSS Statistics (SPSS Statistics Inc., Chicago, US) version 25.0. The relationship of CVD risk factors between obese and non-obese T2DM patients, gender differences and the relationship of these factors to develop CVD was assessed by Chi-square test with a 95% confidence interval (CI).

### Ethical considerations

The study was approved by the Research and Ethical Review and Approval Committee of the Ministry of Health, Oman approval no. MOH/CSR/20/23365.

## Results

### Baseline of the study population

Out of 130 patients, 62 (48%) were men, of which 29 (47%) patients were obese, while 68 (52%) patients were women, of which 43 (63%) were obese (BMI ≥ 30) (Table 1). The calculated p -value between gender and obesity in our study population was 0.059 which was statistically not significant at the p <0.05. Total obese patients were 72 (55%). The mean BMI was 31.0 (5.3) kg/m$^2$. The median duration of diabetes was two years, ranging from 0 to 19 years. The mean age was 48.0 (9.3) years. 90 (69%) patients had uncontrolled HbA1c more than 8mmo/l, of which 55 (61%) patients were obese with calculated p value of 0.0018 which was statistically significant at p<0.05 suggesting obese patients had more uncontrolled HbA1c than non-obese patients. Among younger age group (less than 45

| Characteristics at Baseline 2010 | Developed CVD | Not Developed CVD | p-value | Significant at P<0.05 |
|---|---|---|---|---|
| Male | 10 | 52 | 0.994 | No |
| Female | 11 | 57 | 0.994 | No |
| Obese | 10 | 62 | 0.434 | No |
| Non-Obese | 11 | 47 | 0.434 | No |
| LDL less than, 1.8mmo/l | 2 | 6 | 0.482 | No |
| LDL more than 1.8mmo/l | 19 | 103 | 0.482 | No |
| HbA1c less than 8mmo/l | 7 | 33 | 0.780 | No |
| HbA1cmore than 8mmo/l | 14 | 76 | 0.780 | No |
| ACR present | 3 | 39 | 0.0537 | No |
| ACR absent | 18 | 70 | 0.0537 | No |
| Normal BP | 10 | 75 | 0.061 | No |
| Abnormal BP | 11 | 34 | 0.061 | No |
| Duration of Diabetes Mellitus (DM) less than 20 years | 18 | 96 | 0.763 | No |
| Duration of Diabetes 20 years and above | 3 | 13 | 0.763 | No |
| Age group between 46 to 65 years | 18 | 55 | 0.0028* | Yes |
| Age group below 46 and above 65 years | 3 | 54 | 0.0028* | Yes |
| Middle aged obese female between 46 to 65 years | 8 | 15 | 0.0375* | Yes |
| Middle aged non obese female between 46 to 65 years | 1 | 15 | 0.0375* | Yes |

**Table 1:** Baseline characteristics and comparison of CVD parameters of DM patients.

| Definition and cut-off points | Variables |
|---|---|
| Time to the first fatal or non-fatal CVD recorded events from the following list: Confirmed physician diagnosis of CHD in the form of stable angina, unstable angina, or acute myocardial infarction.<br>Confirmed physician diagnosis of ischemic or hemorrhagic stroke. | CVD outcome |
| Physician diagnosis of HTN<br>(SBP ≥ 140 mmHg or DBP ≥ 90 mmHg confirmed in BP chart readings after excluding other causes) | HTN |
| SPB ≥ 140 mmHg or DBP ≥ 90 mmHg | Uncontrolled BP |
| LDL≥ 1.8 mmol/L | High risk LDL |
| Persistent albumin/creatinine ratio of ≥ 2.5 in males and ≥ 3.5 in females, confirmed at least twice within three months or more after excluding other possible causes. | Albuminuria (micro or macro) |
| Glycemic control is considered borderline control if HbA1c less than 8% and poor control if > 8% | Glycemic control |
| BMI = body weight / square of height in meters. obese as BMI ≥ 30, non -obese BMI 30 or less | Obese as BMI ≥ 30 |

Note: CVD - Cardiovascular Disease, CHD - coronary Heart Disease LDL - Low Density Lipoprotein, HTN- Hypertension, BMI -Body Mass Index, HbA1c-Glycosylated Hemoglobin, SBP- Systolic Blood Pressure, DBP- Diastolic Blood Pressure.
The variables are defined as per American Diabetes Association ADA/AACE American Association of Clinical Endocrinologist treatment targets guidelines 2020.
"Modified and adopted from source: Oman medical journal, 32(2), 106. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5397087/ "

**Table 2:** Defnitions of CVD risk factors and CVD outcome mesures.

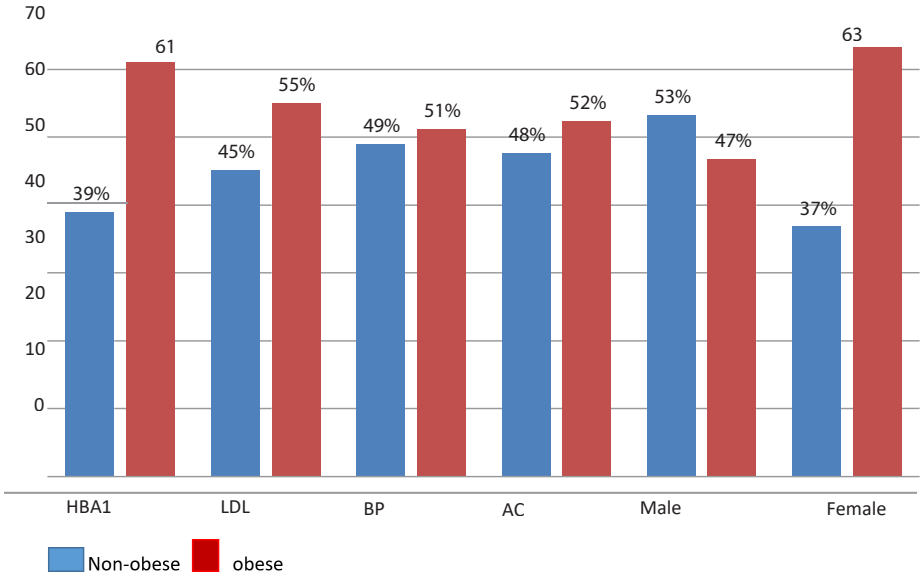



**Figure 2:** Baseline (2010) CVD characteristics, Percentage of (uncontrolled targets) for Obese and Non-Obese.

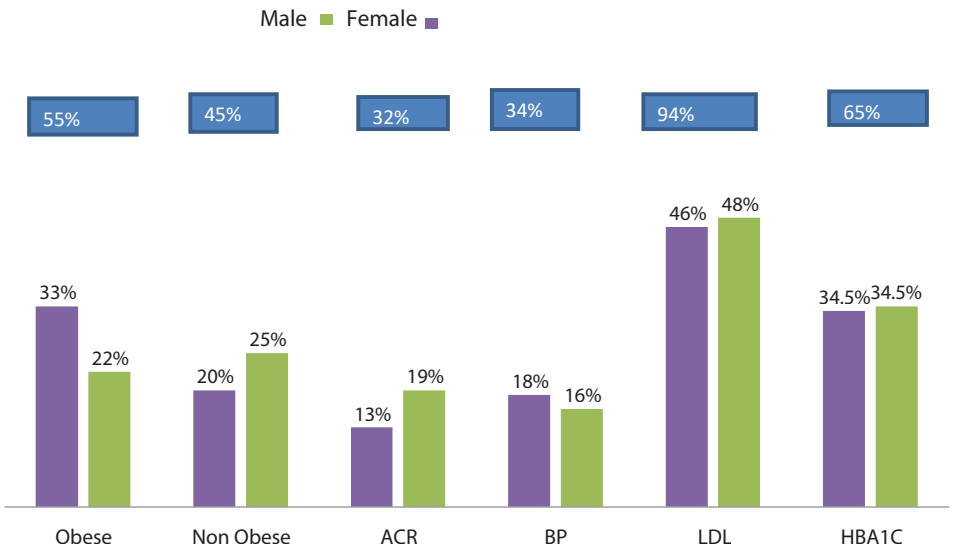
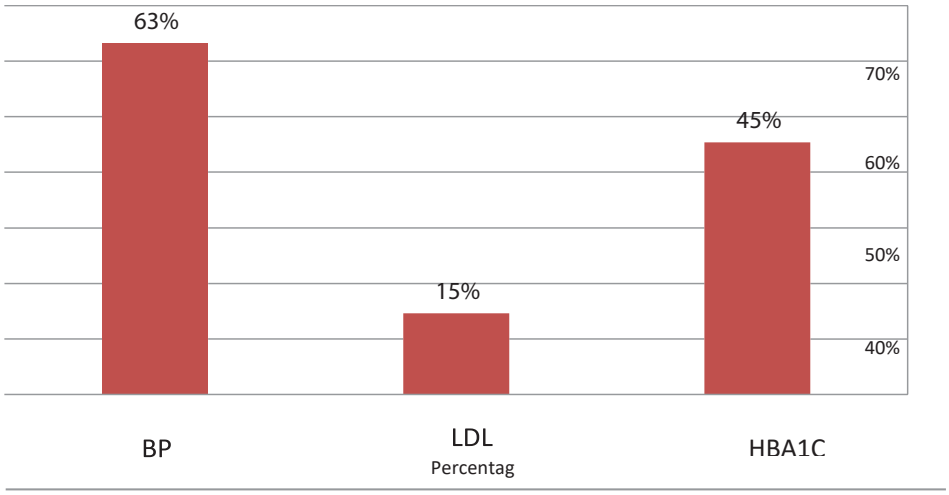



**Figure 3:** Gender wise distribution of uncontrolled target levels of CVD parameters at baseline 2010.




Normal target values LDL less than 1.8mmo/l, BP less than 140/90mmhg,

HbA1c less than 8mmo/l a ccording to current ADA targets 2020 .

**Figure 4:** Percentage of controlled target values of CVD risk factors year 2020.

years old), 14 (45%) were obese men and 17 (55%) were obese women. Among the age group of 46 to 65 years (middle age group), 13 (36%) were obese men and 23 (64%) were obese women. In age group more than 65 years (older age group), 2 (40%) were obese men and 3 (60%) were obese women at baseline. The calculated p-value for gender differences between the 3 age groups were 0.750 which was statistically not significant at $p<0.05$. The calculated p-value for obese and non -obese patients between the 3 age groups is 0.0157which was statistically significant at $p<0.05$. suggesting obese patients in all age groups with no gender difference.

Out of 130 patients 122 (94%) patients LDL levels were more than 1.8mmol/l, above target levels. The mean LDL is 3±1 mmol/l. Out of 122 subjects with high LDL, 67 (55%) patients were obese with calculated p- value 0.157, which was statistically not significant at the p-<0.05. Out of 42 patients with albuminuria 25 were men and 17 were women with a calculated p- value of 0.062 which was statistically not significant at the $p<0.05$. Out of 45 patients with uncontrolled BP 23 patients were obese. The calculated p-value was 0.457 which was statistically not significant at the $p<0.05$ between obese and non-obese uncontrolled BP patients.16% men and 18% women had uncontrolled BP compared to 84% men and 82% women with controlled BP respectively. The calculated p-value is 0.706 which was statistically not significant at the $p <0.05$. The mean systolic BP was 136 ± 16.8 mmHg and mean diastolic BP were 77 ± 9.5 mmHg. The baseline CVD characteristics at baseline year 2010 between obese and non- obese patients with gender differences is summarized in Figure 2 and 3 bar graphs.

Out of 130 patients 19 had one CVD risk factors , 28 patients had two CVD risk factors, 48 patients had three CVD risk factors ,30 patients had four CVD risk factors and 5 patients had five CVD risk factors respectively .Out of 130 patients, 21 patients developed CVD ,of which 4 (19%) patients developed stroke and 16 (76%) patients developed CHD and 1 (5%) patient developed both CHD and stroke. The total cumulative incidence of those who developed CVD in this study is 16.15% with men at 17.19% and women at 15.15% . The p -value is 0.994 which was not statistically significant at $p<0.05$.

## Results of participants who developed CVD

10 men and 11 women developed CVD, 10 obese and 11 non-obese patients developed CVD. Only 19 patients with high LDL more than 1.8mmol/l developed CVD and 14 patients with HbA1c and more than 8 mmol/l above target range developed CVD. 3 patients with albuminuria developed CVD and 11 patients with high BP more than 140/90mmhg developed CVD. On the other hand, 3 patients with duration of diabetes more than 20 years developed CVD. In summary all the above seven parameters gender, high LDL, obesity, high BP, albuminuria, high HbA1c and duration of diabetes as cause for CVD in T2DM patients in our study group were not statistically significant at p-<0.05.18 middle aged patients between 46 to 65 years old developed CVD but only 3 patients in the younger age group less than 46 years and older age group above 65 years developed CVD with p value is 0.0028 which was statistically significant at (p-<0.05.) suggesting middle aged patients had higher incidence of CVD. Out of 18 middle- aged patients who developed CVD 9 were men and 9 were women respectively. Out of these 2 were obese men and 8 were obese women. The calculated p value is 0.951 which was statistically not significant at the $p<0.05$. Suggesting no gender differences in CVD between obese middle-aged men and women respectively. Out of 23 middle aged obese women 8 developed CVD and out of 16 non- obese middle -aged women only 1 middle-aged women developed CVD. The calculated p value is 0.0375 which was statistically significant at the $p<0.05$. This result suggests that obese middle- aged women had more CVD events than non- obese middle -aged women. All the baseline characteristics of CVD parameters at baseline year 2010 with p- values is summarized (Table 1).

### Percentage of control of treatment targets of CVD risk factors at baseline

In the year 2010, 111 (85%) patients had a higher than target LDL level of 1.8mmol/l, of which 51 (46%) were men, 60 (54%) women, and 64 (58%) were obese respectively. 71 (55 %) patients had uncontrolled HbA1c more than 8%, of which 42 (59%) patients were obese, 33 (46%) patients were men, and 38 (54%) patients were women, respectively. 48 (37%) patients had high systolic blood pressure, of which 22 (16%) were men, and 26 (20%) were women. 44 (34%) patients had albuminuria, of which 28 (63%) patients were obese, 24 (55%) patients were men, and 20 (45%) patients were women, respectively (Figure 2 and Figure 3).

### Percentage of current control of treatment targets of CVD risk factors

In the year 2020, 15% of patients' LDL in the target range of less than 1.8mmol/l, 68% were obese, and all were women. 45% of patients' HbA1c levels were less than 8% (which is in the target range), and 63% of patients' systolic BP was less than <140mmHg, of which 56% were obese. All patients' diastolic BP was well controlled (<90 mmHg) (Figure 4).

## Discussion

The study aimed to identify the incidence of CVD and prevalence of CVD risk factors in T2DM subjects aged between 30 and 80 years followed over 10 years. The study analyzed the difference in percentage of incidence and variations in prevalence of CVD risk factors in obese and non-obese T2DM subjects and between men and women T2DM subjects respectively. The study also estimated the current percentage of subjects in 2020 under treatment target goals especially in terms of glycemic control, lipid control and BP control according to American Diabetes Association (ADA) recommendations. The research questions and hypothesis were answered.

### Hypothesis 1: Obese T2DM patients had poor glycemic control which was statistically significant with no gender difference

At baseline year 2010, a significant majority of those who developed CVD were obese in all age groups (young, middle and old age) with a mean BMI of 31kg/m2. This is similar to the study conducted in USA involving 2, 48,567 T2 DM subjects where 63.4% were obese [10]. A study in Saudi Arabia of 748 subjects also showed a higher prevalence (64.3%) of obese patients in T2DM subjects. A study conducted in Oman found that 51% among T2DM subjects were obese [11]. However, the number of obese women was higher than that of obese men which was statistically not significant between gender and obesity. Most of the obese (BMI ≥30) patients were found to have poor glycemic control which was statistically significant with 80% power. This is due to multi factorial reasons like lack of job, lower literacy level, sedentary lifestyles, over eating, and having house maids for household work.

A study in the USA validated our findings showing that there is a positive and statistically significant association between suboptimal glycemic control and obesity [10]. Our study also found that obese women had a higher level of uncontrolled HbA1c which was statistically not significant. These results were similar to a nationwide cross-sectional study from Venezuela involving 9418 subjects in which 6214 women had worse glycemic control than men of which 35% of women were obese compared to 25% of obese men (46). The FDA approved drug Glucagon –like peptide (GLP-1) e.g. liraglutide for these obese subjects will facilitate both weight reduction and better glycemic control especially in women given our results showing obese subjects having uncontrolled HbA1c levels which is currently not available in our clinic. Possible reasons for higher prevalence of abnormal glycemic targets in females could be attributed to lack of estrogen in post-menopausal women, lack of adherence to prescribed medications, medication side effects, depression and anxiety.

Obese females had higher LDL targets than obese males which was statistically not significant. Similar results were also demonstrated in a cross- sectional study of 120 T2DM subjects in Yemen [12]. No significant difference by gender was found between obesity and raised BP, even though obese females had a higher BP than obese males. Over all albuminuria is more common in males than females but it is more likely in obese females compared to obese males which was found to be statistically not significant. In summary, baseline data (2010) among the study group showed higher prevalence of traditional risk factors for CVD such as obesity (55%), high LDL values (94%), high HbA1c (69%), albuminuria (32%), and uncontrolled BP (34%). A similar study in United Arab Emirates (UAE) found that out of 382 subjects with DM 59% had high HbA1c values, 53% had high BP readings and 28% had abnormal LDL values [13,14]. Regarding hypertension our study demonstrated that 56% had controlled BP values where as a study in neighboring country Saudi Arabia found only 39% of the subjects had BP control [15].

### Hypothesis 2&3: The incidence of CVD is more in middle aged subjects (46 to 65 years) and higher in obese females than non-obese females with no gender difference between men and women.

Age is the major non-modifiable risk factor. Middle aged individuals had higher incidence similar to Canadian study [17-19]. The total cumulative incidence of those who developed CVD in this study was 16.15% with women having slightly higher incidence than males though statistically not significant. In general, direct comparison of studies were not possible because the incidence rates of CVD in various longitudinal observational studies widely varied. Studies from Italy, Scotland and China showed lower CVD incidence rates of 7.6%, 5.3 % and 4.9% in the T2DM population within median follow up period of 4, 4.1 and 5.4 years respectively.

However the duration of these studies was short and only CHD was considered as CVD. Outcome risk factor. The cumulative incidence rate for Australia, china [16] and New Zealand were 14.9% and 17.9% for four and five years respectively in another study. Sudden death was included as a CVD outcome factor in the Australian study and whereas in the New Zealand study follow up period

was longer at eight years. Other studies from USA, England and Finland showed higher CVD incidence rates of 17.1%, 17.9% and 20% in T2DM follow up period of 5.5,10 and 7 years respectively. In the Finland and USA studies patients less than 45 years old were excluded from the study and the follow up period was long.The reason for the higher CVD incidence rate was that the study in England used additional CVD outcome factors like arrhythmias, heart failure along with Coronary heart disease (CHD), peripheral vascular disease (PAD) and stroke. Our study compared fatal CVD events like CHD and stroke only [1,4-6].

Our study also showed that the incidence of CVD was significantly more in middle aged obese women than non- obese women at ($p<0.05$). However no significant difference was found in incidence of CVD between obese and non-obese men and no direct gender difference between men and women were demonstrated. There was no gender difference in the rate of incidence of CVD and no difference between obese and non-obese subjects with respect to dyslipidemia. Similar results were also reported in Oman among 2039 subjects [1]. Our study results were consistent with The United Kingdom Prospective Diabetes Study (UKPDS) which found poor relation between duration of T2DM and CVD incidence.

### Percentage of current treatment targets for study participants year 2020

At the end of the follow -up period of our decade –long study we found that in 2020, 15% of the subjects had target LDL values of less than 1.8mmo/l compared to 6% in the year 2010 which was statistically significant. This showed our treatment of care is improving and this is consistent with current ADA Standards of Medical Care in DM 2020 position statement where 14% of subjects were in treatment targets worldwide. Similarly regarding HbA1c 45% had glycemic control in the target range compared to 30% in 2010 which was statistically significant and similar to ADA's position statement where they found globally 33% to 49% of DM subjects had uncontrolled HbA1c. Furthermore, 63% of our study subjects had controlled BP targets which is higher than the ADA 's report [20].

## Strengths and Limitations

The strengths of the study were it was the first long duration a decade - long follow up longitudinal study to find the incidence of CVD and prevalence of risk factors in T2DM Omani subjects with higher risk factors for CVD followed up in secondary health care settings in Oman. Furthermore, for more accurate determination of long-term CVD risk factors a long duration study is desirable. The limitations of the study were its retrospective nature and the sample was convenient sample rather than a random sample which will cause selection bias. Recall bias and missing data were the major constraints which was partially overcome by double checking of data by principal investigators. Whereas prospective data could have given better quality of data and less bias. Other common risk factors like smoking, waist circumference, family history, alcohol, diet, physical activity, family history and menopausal state were not included in our study due to the lack of documentation of these data which could have impacted study outcomes.

## Conclusion

The study revealed higher cumulative incidence of CVD (16%) over 10 years and high prevalence of risk factors among the Omani populations which is comparable to neighboring Arab countries. Middle age (46 to 65 years) and obese women when compared to non-obese women as CVD risk factors had statistically significant incidence of CVD. However, there were no gender differences between obese men and obese women. Furthermore, the current study did not show any statistically significant difference in relation to gender and difference between obese and non-obese subjects with high BP, high LDL, high HbA1c, duration of diabetes and albuminuria. Majority of the study subjects were obese and glycemic control was poor among obese subjects compared to non-obese subjects which was statistically significant with no difference in gender. When compared globally however there were important differences between CVD risk factors and association with CVD incidence which can be attributed to geographical, environmental, cultural, and social and life style factors with diabetes complications. The percentage of current treatment targets of glycemic control, LDL targets and BP controls were higher than that of current ADA Standards of Medical Care.

## Recommendations

Use of GLP-1 agonist's e.g.liraglutide, in obese middle- aged women especially given statistically significant CVD events in middle aged obese women compared to non-obese women with T2DM will reduce CVD events in obese middle aged women with reduction in their weight and better glycemic control. Currently GLP-1 agonists are not available in the institution where the study was conducted. This study would facilitate the concerned institution, Ministry of Health, Oman to provide GLP-1 agonists for the middle- aged obese women to reduce the incidence of CVD along with healthy life style, health education, increased physical activity, early recognition and management of complications of T2DM.

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