



Original article

Prevalence and control of cardiovascular risk factors among type 2 diabetes mellitus patients in southern region of Saudi Arabia

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ABSTRACT

Background/Aim: Dyslipidemia is a significant predictor of cardiovascular events and mortality in diabetes patients. The aim of this study is to estimate the prevalence rates, characteristics of dyslipidemia and their control in outpatient population in a Diabetic Centre.

Methods: A cross sectional prospective study design was used to collect data from 255 patients which included patient characteristics, past medical history of CVD, medications and parameters related to DM and cardiovascular risk factor control. Blood pressure and laboratory measurements for glycosylated hemoglobin and lipoprotein panel were recorded.

Results: Body mass index (BMI) of the dyslipidemic diabetic patients was significantly higher for females. In terms of age, duration of diabetes, family history, diabetes treatment offered did not differ significantly among genders. Clinical characteristics of HDL values were significantly higher for female in comparison to men ($P = 0.02$) whereas glycosylated hemoglobin and blood pressure appeared not to differ significantly. Among the three factors studied BMI, duration of diabetes mellitus and drug therapy on lipoprotein levels of diabetes patients, except for the influence of drug therapy which influenced significantly the total cholesterol level ($P = 0.02$). Number of females with normolipid were more than males ($P = 0.009$) and number of males with abnormal cholesterol and triglyceride patients were significantly more than females (0.0002).

Conclusion: Dyslipidemia among males were higher than females which could be a significant risk factor for causing low glycemic control culminating in cardiovascular events. Control of hyperglycaemia and other CVD risk factor appears to be suboptimal in Saudi Arabia. Addressing health system components such as providing medical staff training, incentive to health professionals and better patient education may improve quality of DM care.

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1. Introduction

Cardiovascular disease (CVD) is a serious but preventable complication of type 2 diabetes mellitus (T2DM) that results in substantial disease burden, increased health services use, and higher risk of premature mortality.¹

In Saudi Arabia prevalence of diabetes mellitus (DM) is 23.7% with more prevalence among Saudis living in urban areas as compared to rural areas.²

Mortality from cardiovascular disease (CVD) in diabetes is associated with dyslipidaemia, which is characterized by raised

triglycerides, low high density lipoprotein and high small dense low density lipoprotein particles. Abnormal serum lipids are likely to contribute to the risk of coronary artery disease in diabetic patients.³

Increasing evidence prove that hyperglycemia and dyslipidemia are associated with an excessive cardiovascular risk.⁴

According to the International Diabetes Federation four Arab states, namely United Arab Emirates, Saudi Arabia, Bahrain, Kuwait and Oman are among the top 10 countries with the highest prevalence of DM in the world. This projected trend is to continue until 2030.⁵

Hence, the present work was carried out to outline the characteristics and prevalence of dyslipidemia and their control in patients with T2DM and discuss strategies that may reduce the risk of CVD in this population at Asir Diabetic Center, Saudi Arabia.

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Table 1
Comparison of demographics among male and female diabetic patients.

| Characteristics | All, n (%) | Male, n (%) | Female, n (%) | p-value |
|---|--------------|---------------|---------------|----------|
| Age, Mean ± SD, years | 53.9 ± 10.02 | 54.06(±10.58) | 53.65(±9.07) | 0.7 |
| Age group | | | | |
| 30–39 | 17(6.67) | 13(8.18) | 4(4.17) | |
| 40–49 | 69(27.05) | 41(25.79) | 28(29.17) | |
| 50–59 | 92(36.07) | 56(35.22) | 36(37.5) | |
| 60+ | 77(30.19) | 49(30.82) | 28(29.17) | |
| Duration of diabetes | 9.82 ± 6.34 | 9.76(±6.65) | 9.94(±5.81) | 0.8 |
| Family history | | | | 0.7 |
| First degree | 61(23.92) | 39(24.53) | 22(22.92) | |
| Second degree | 9(3.52) | 5(3.14) | 4(4.17) | |
| BMI, Mean ± SD, (kg/m²) | 30.87 ± 5.73 | 29.47(±4.72) | 33.2(±6.49) | <0.0001* |
| Obese ≥ 30 | 134(52.54) | 66(41.51) | 68(70.83) | |
| Overweight 25–29.9 | 87(34.11) | 68(42.77) | 19(19.79) | |
| Normal < 25 | 34(13.33) | 25(15.72) | 9(9.38) | |
| Current tobacco use | 32(12.54) | 32(20.13) | 0(0) | 0.3 |
| Current diabetes treatment | | | | |
| OHA/OHA combinations | 96(37.65) | 64(40.25) | 32(33.33) | |
| Insulin alone | 32(12.55) | 22(13.83) | 10(10.42) | |
| Insulin and oral medications | 127(49.8) | 74(46.54) | 53(55.21) | |

*P values ≤ 0.05, BMI Body Mass Index, OHA Oral Hypoglycemic Agent.

2. Patients and methods

A cross sectional prospective study design was used to estimate the prevalence rates among T2DM outpatient population receiving health care at Asir Diabetic Center, Abha, K.S.A, during the period of January to June, 2013. The center receives patients from the southern part of the country who are referred either from the area of PHCC (Primary Health Care Center) or from Asir Central Hospital.

Sample size was calculated to be 255 which was estimated using following equation after making provision for 12% missing and finite population correction⁶:

$$n = (Z/e)^2(\pi)(1 - \pi)$$

where, Z = standard normal deviation at significant level 0.05, e = precision of estimate = 0.05, π = a proportion of samples = 6%.

T2DM patients of age group above 18 years of either gender were included in the study. Gestational diabetes mellitus, type-1 diabetes mellitus and patients less than 18 years were excluded from the study. The sources of data used in this study were medical

records, from which data were entered in a structured data collection form.

The patients registered at the center were subjected to routine battery of tests. Data collection included patient characteristics, past medical history of CVD, history of selected DM complications, medications and parameters related to DM and CVD risk factor control. Systolic and diastolic BP (blood pressure) and laboratory measurements for glycosylated haemoglobin (HbA1c), total cholesterol, triglycerides, LDL-C and HDL-C were recorded.

The national guidelines for diabetes published by the Saudi Commission for Health Specialties (NDG)⁷ and the American Diabetes Association (ADA)⁸ standards of medical care for patients with DM were used to define desirable levels of HbA1c, BP and serum lipids such that: good glycemic control was defined as HbA1c <7%, hypertension as systolic and/or diastolic BP < 130/80 mmHg. Body mass index (BMI; kg/m²) was categorized as per the World Health Organization guidelines; normal weight (BMI <25 kg/m²), overweight (BMI ≥25 and ≤29.9 kg/m²) and obesity (BMI ≥30 kg/m²). Current tobacco use was defined as using tobacco at the time of the survey.⁹ Criteria of adult treatment panel III of American Medical Association was used to assess the percentage of patients falling into desirable, borderline and high risk categories based on lipoprotein levels.¹⁰

Continuous and categorical variables were summarized using the Chi-square test and Students *t* test respectively. One way ANOVA was used to evaluate the influence of factors on lipoprotein levels. A *p* value ≤0.05 was considered to be statistically significant.

3. Results

The study sample consisted of 255 patients (62.4% male) with previously diagnosed T2DM. Demographic characteristics are presented in Table 1.

The overall mean ± SD ages of the patients were 53.9 ± 10.02 years. There was no significant difference (*p* = 0.7) among the genders in duration of diabetes and family history.

Females were more obese (70.8 vs 41.5%) than male patients. The mean ± SD BMI was significantly higher for females than male patients (*p* < 0.0001). Regarding the treatment for diabetes, nearly half of the patients were on combination of insulin and oral hypoglycemic agents (49.8%, *n* = 127) and both male and female patients were receiving more or less the same type of drug therapy.

The clinical characteristics and the lipid profile of the diabetics are given in Table 2. The mean ± SD HbA1c value was 8.34 ± 1.56%.

Table 2
Comparison of male and female diabetic patients on the basis of clinical characteristics.

| Characteristics | All | Male | Female | P value |
|--|----------------|----------------|----------------|---------|
| HbA1c, (Mean ± SD), % | 8.34 ± 1.56 | 8.21(±1.6) | 8.54(±1.46) | 0.09 |
| <7% | 51(20) | 35(22.01) | 16(16.67) | |
| 7–8% | 71(27.84) | 47(29.56) | 24(25) | |
| >8% | 133(52.16) | 77(48.43) | 56(58.33) | |
| Systolic blood pressure, Mean ± SD, mmHg | 122.67 ± 13.41 | 122.16(±12.67) | 123.5(±14.66) | 0.46 |
| At goal (<130 mmHg) | 211(82.75) | 135(84.91) | 76(79.17) | |
| Above goal (>130 mmHg) | 44(17.25) | 24(15.09) | 20(20.83) | |
| Diastolic blood pressure, Mean ± SD, mmHg | 75.96 ± 9.32 | 76.43(±9.21) | 75.19(±9.5) | 0.31 |
| At goal (<80 mmHg) | 208(81.57) | 127(79.87) | 81(84.38) | |
| Above goal (>80 mmHg) | 47(18.43) | 32(20.13) | 15(15.62) | |
| Hypertension | | | | 0.3 |
| At goal (<130/80 mmHg) | 192(75.29) | 123(77.36) | 69(71.88) | |
| Above goal (>130/80 mmHg) | 63(24.71) | 36(22.64) | 27(28.12) | |
| Lipoproteins (mg/dl) | | | | |
| Total cholesterol | 168.39 ± 38.05 | 169.39(±37.34) | 166.73(±39.35) | 0.59 |
| Triglyceride | 154.62 ± 80.26 | 161.35(±87.96) | 143.48(±64.4) | 0.06 |
| LDL | 101.6 ± 31.32 | 102.91(±31.63) | 99.43(±30.85) | 0.39 |
| HDL | 40.61 ± 11.92 | 39.16(±10.7) | 43(±13.42) | 0.02* |

*P values ≤ 0.05, LDL Low Density Lipid, HDL High Density Lipid.

Table 3
Percentage distribution of desirable, moderate risk and high risk levels of lipoproteins in DM patients.

| Lipid types | Desirable | | | Moderate risk | | | High risk | | |
|-------------------|-----------|-----------|----------|---------------|----------|----------|-----------|-----------|----------|
| | All | Male | Female | All | Male | Female | All | Male | Female |
| Total Cholesterol | 202(79.2) | 122(76.7) | 80(83.3) | 43(16.9) | 31(19.5) | 12(12.5) | 10(3.9) | 6(3.8) | 4(4.2) |
| Triglyceride | 150(58.8) | 88(55.3) | 62(64.6) | 48(18.8) | 30(18.9) | 18(18.8) | 57(22.4) | 41(25.8) | 16(16.7) |
| LDL cholesterol | 126(49.4) | 74(46.5) | 52(54.2) | 84(32.9) | 54(34) | 30(31.3) | 45(17.6) | 31(19.5) | 14(14.6) |
| HDL cholesterol | 29(11.4) | 22(13.8) | 7(7.3) | 58(22.7) | 37(23.3) | 21(21.9) | 168(65.9) | 100(62.9) | 68(70.8) |

The mean \pm SD HbA1c values ($8.54 \pm 1.46\%$ vs $8.21 \pm 1.6\%$) for female and male patients were comparable. Overall, 20% of patients had HbA1c at the NDG/ADA goal ($<7.0\%$), and the male achieved this goal more often than the female (22% vs 16.7%).

In this study, the serum level of HDL was found to be low in 46.27% of the study population.

Though the mean levels of lipoprotein for male were higher than female with the exception of HDL, except HDL which differed significantly ($p = 0.02$).

The total cholesterol, triglyceride, LDL, HDL levels were not significantly different in groups having HbA1c value below and above 7% (data not shown).

More male patients were at goal for BP, based on NDG/ADA (systolic and diastolic $<130/80$ mmHg) than female (77.4% vs 71.9%).

The percentage distribution of desirable, moderate and high risk levels of lipoproteins in the study population are tabulated in Table 3. Dyslipidemia was observed in 83.9% of the patients. Among the dyslipidemic patients, combined hyperlipidemia, hypercholesterolemia and hypertriglyceridemia were found in 90 (61.1%), 15 (51.2%) and 67 (11.5%) patients respectively.

Fig. 1 shows the dyslipidemia pattern among male and female diabetic patients. Total number of dyslipidemic ($p = 0.009$), and combined hyperlipidemic patients were significantly more than normolipid patients ($p = 0.0002$). Male patients were having dyslipidemia compared with female patients.

There were only three patients who achieved all the recommended goals for all risk factors (HbA1c $<7\%$, BP $<130/80$ mmHg, total serum cholesterol <200 mg/dl, LDL-C <100 mg/dl, HDL-C >45 mg/dl, triglycerides <150 mg/dl, BMI <25 kg/m², and non-smoker) using NDG.

Factors like BMI, duration of DM does not appear to influence the lipoprotein characteristics, as in Table 4, while drug therapy does affect the total cholesterol ($p = 0.02$) and LDL-C ($p = 0.02$) values significantly.

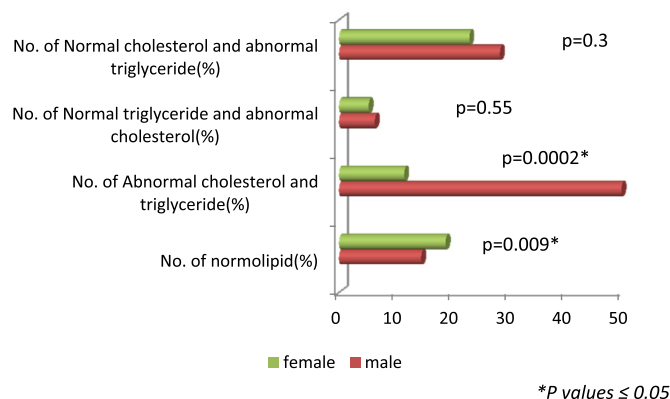


Fig. 1. Genderwise comparison of normolipidemia and dyslipidemia among diabetic patients.

4. Discussion

The most common cause of death in diabetes is cardiovascular disease (CAD). Several studies have demonstrated that diabetes patients have a risk that is two to three times higher than that among patients without diabetes.¹¹ Multiple risk factors are associated with cardiovascular disease in subjects with diabetes, including hypertension, hyperlipidemia and obesity.¹²

The present study, for the first time, reports the level of control of CVD risk factors in patients of T2DM with regard to gender in the southern region of Saudi Arabia. It reveals that hyperglycaemia, hypertension, and dyslipidaemia have been poorly controlled in such patients, despite widespread coverage of medical care.

In the present study, most of the explored CVD risk factors appeared to condense among the female when compared with the male patients. In consistent with the earlier study conducted in Iraq,¹³ the female diabetic subjects in general, shared a significantly longer duration of diabetes, obesity, higher systolic BP, higher mean HbA1c%, hypertension and larger number of unfavorable HDL-C than the male diabetic group. All these trends have adverse impact on the outcome of diabetes among the female diabetic group. The male diabetics, on the other hand, have higher record of family history of diabetes, overweight, higher proportion of tobacco use, higher diastolic BP and unfavorable total cholesterol, triglycerides and LDL-C.

The most likely factor that makes the female diabetic population to have higher rate of cardiovascular risk factors in comparison with the male diabetics could be higher prevalence of obesity among the females (BMI: 33.2 ± 6.49 vs 29.47 ± 4.72 kg/m²), which is in agreement with a study conducted in Saudi patients.¹³ The diabetic females were distinguished by having a higher BMI, more hypertensives, higher systolic BP, and higher numbers with low HDL-C than the diabetic males.

It was alarming to note that 70.83% of the female diabetics were found to be obese compared to 41.51% of the males (i.e., BMI ≥ 30 kg/m²). Mean \pm SD female BMI (kg/m²) of $33.2(\pm 6.49)$ in our study against 28.5 ± 5.6 was higher in a similar studies.^{14,15} This may be partially explained by the fact that most females in Saudi Arabia lead a sedentary lifestyle indoors with little exercise.

Moderate and high risk of total cholesterol was found in 29.04% of patients, whereas 14% of diabetics were reported to have hypercholesterolemia according to Al-Nuaim.¹⁶ This figure appears to be increasing with time requiring serious intervention in the form of health education, dietary instructions, and lifestyle modifications.

A high level of HDL is considered a negative risk factor for CHD. Moderate and high risk hypertriglyceridemia were seen in 41.2% of the study population and this is higher than the figure 23% reported by Stern et al¹⁷ and nearly two and half times higher than Al-Nuaim (15%).¹⁶ More need to be done to improve this situation as it is reported that hypertriglyceridemia is associated with low HDL among diabetics.¹⁸

Numbers of dyslipidemic patients in our study were far higher than a similar study (83.9% vs 43%)¹⁶ with abnormal cholesterol and triglyceride level observed were almost same (Fig. 1), which is in

Table 4
Influence of BMI, duration of DM, drug therapy on lipid and lipoprotein levels.

| | Total cholesterol | | TGL | | LDL | | HDL | |
|------------------------------|-------------------|---------|--------------|---------|--------------|---------|-------------|---------|
| | Mean | p value | Mean | p value | Mean | p value | Mean | p value |
| BMI | | 0.41 | | 0.14 | | 0.13 | | 0.1 |
| <25 | 167.6 ± 4.6 | | 129.4 ± 68 | | 99.4 ± 42.1 | | 44.6 ± 13.1 | |
| 25–29.9 | 172.7 ± 37.1 | | 159.3 ± 65.4 | | 107.1 ± 29.4 | | 39.6 ± 11 | |
| ≥30 | 165.8 ± 37.1 | | 158 ± 90.6 | | 98.6 ± 29 | | 40.3 ± 12.1 | |
| Duration of DM | | 0.53 | | 0.5 | | 0.25 | | 0.93 |
| <5 years | 171.4 ± 39.8 | | 160.2 ± 73.5 | | 106.9 ± 34.7 | | 41.1 ± 13.8 | |
| 5–15 years | 168.8 ± 37.8 | | 156.3 ± 85.1 | | 99 ± 29.1 | | 40.5 ± 11.7 | |
| >15 years | 163.3 ± 36.8 | | 142.9 ± 73.3 | | 102.7 ± 33 | | 40.3 ± 10 | |
| Drug therapy | | 0.02* | | 0.08 | | 0.02* | | 0.8 |
| OHA/OHA combinations | 172.4 ± 41 | | 164.7 ± 75.8 | | 108.2 ± 31.6 | | 41.2 ± 13.9 | |
| Insulin alone | 150.7 ± 34.3 | | 128.8 ± 50.1 | | 91.8 ± 28.7 | | 40.2 ± 12.7 | |
| Insulin and oral medications | 169.8 ± 35.6 | | 153.6 ± 88.2 | | 99.1 ± 31 | | 40.3 ± 10.1 | |

*P values ≤ 0.05, TGL Triglyceride, LDL Low Density Lipid, HDL High Density Lipid, BMI Body Mass Index, DM Diabetes Mellitus, OHA Oral Hypoglycemic Agent.

agreement with the study of Al-Nuaim. Dyslipidemia among males were higher than females especially with combined hyperlipidemia, which is contrary to other such works.¹⁶

In our study, only a minute percentage (1.2%) of patients achieved the currently recommended levels of control for HbA1c, BP, and lipid profile (LDL, HDL, triglycerides, and total cholesterol). This percentage is very less on comparing with the same kind of study conducted at Fahad Medical City (KFMC) and Prince Salman Hospital (PSH), which reported this figure to be 3.57%.¹⁹ This illustrates the urgent need for more emphasis on patient education, in particular including DM health educators to PHC teams.

When our study is compared with a similar study, our study showed lower proportions of patients reaching recommended HbA1c and HDL-C goals (HbA1c 20% vs 24% and HDL-C 20.4% vs 41%) whereas higher total cholesterol and LDL-C levels (total cholesterol 79.22 vs 40%; LDL-C 49.4 vs 15%) were achieved.²⁰

Hypertension associated with DM, and may be related to underlying diabetic nephropathy or to coexisting essential hypertension.²¹ In our study the hypertension incidence was 24.7% compared with 17.2% reported by Salman et al.²² Control of hypertension remains a challenge in both developing and developed nations. This result showed the failure of T2DM patients in achieving the target levels of cardiovascular risk factors despite the wide availability of insulin and statins in all PHCC and the Diabetes Center.

5. Conclusion

Control of hyperglycaemia and other CVD risk factor appears to be suboptimal in Saudi Arabia. Dyslipidemia among males were higher than females which could be a significant risk factor for causing low glycemic control culminating in cardiovascular events. Addressing health system components such as providing medical staff training, incentive to health professionals and better patient education may improve quality of DM care.

Conflicts of interest

All authors have none to declare.

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