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Prevalence, patterns and management of diabetic dyslipidemia among black South African patients with type 2 diabetes at a South African semi-urban tertiary Hospital

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Abstract

Background: Despite widespread availability and use of statin lipid lowering drugs in the management of diabetic dyslipidaemia (DD), many patients with Type-2 diabetes mellitus (T2DM) do not reach the lipid targets recommended by most diabetic management guidelines. This study, highlights the prevalence and patterns of DD among black South African patients with T2DM, and assesses the management of DD at Dr George Mukhari Academic Hospital (DGMAH).

Methods: Two hundred and three medical records of black South African patients with T2DM were reviewed retrospectively. The last three lipid profile results were recorded and analysed for

the presence of DD as well as for the patterns of DD. In addition, information regarding how physicians at DGMAH manage DD was recorded and analysed.

Results: The study subjects were predominantly males (58.5%) and the prevalence of DD among the subjects was 56.3%. The patterns of dyslipidaemia observed in the study were mixed dyslipidaemia (7.1%), combined dyslipidaemia (25.7) and single isolated dyslipidaemia (23.5%). The most common types of combined dyslipidaemia were elevated total cholesterol (TC) + elevated low density lipoprotein (LDL) (10.9%) and reduced high density lipoprotein (HDL) + elevated triglycerides (TG) (9.8%) whereas the most common single dyslipidaemia was reduced HDL (15.3%). With regards to the management of DD at DGMAH, the study revealed that physicians at this hospital do not manage DD in accordance with recommendations of most DD treatment guidelines.

Conclusion: The prevalence of DD at DGMAH is lower than those previously reported in the literature. The most common patterns of DD at this hospital are the combined (↓[HDL], & ↑[TG] and single isolated reduced HDL. Also, the management of DD at this hospital is not in line with recommendations by treatment guidelines.

Keywords: Diabetic dyslipidaemia, prevalence, patterns, management, South Africans.

Introduction

Type 2 diabetes mellitus (T2DM) is an established risk factor for the development of cardiovascular diseases (CVD)[1,2]. Patients with T2DM develop cardiovascular diseases as a result of the combined effects of hyperglycaemia-induced advanced glycation end products, high blood pressure and a type of dyslipidaemia known as diabetic dyslipidaemia (DD)[2.3,4]. Thus, any treatment strategy for the prevention of CVD in T2DM patients must include, in addition to the optimization of glycaemic control and control of blood pressure, the detection and effective management of DD. In order to effectively manage DD, physicians involved in the management of DD need to be aware of both the prevalence and common patterns of DD in their patient populations[,5,6]. Very few studies, have however, investigated both the prevalence and patterns of DD among predominantly rural or semi-rural black South African populations. In one of these

few studies, Vezi and Naidoo[7] investigated and reported a DD prevalence of 91.3% and a pattern of elevated low density lipoprotein cholesterol (LDL-C), elevated triglyceride (TG) and reduced high density lipoprotein cholesterol (HDL-C) among rural black South African patients with T2DM in the KwaZulu Natal province of South Africa. In another more recent South African study, Daya et al[8] investigated and reported a prevalence of and a pattern of DD among T2DM patients at a teriary Johannesburg hospital. The population and sample in the latter study was however, multi-racial.

Since the study by Vezi and Naidoo[7], many more South African blacks have undergone lifestyle changes associated with urbanization, physical inactivity and consumption of unhealthy diets[9]. In light of the fact that the latter factors are known to be associated with the development of dyslipidaemia, there is a need to investigate and report on the current status of both the prevalence and pattern of DD among black South African patients with T2DM. Also, an evaluation of the DD management strategy at a public health institution such as DGMAH which caters mostly for black South African patients will go a long way towards the prevention of cardiovascular complications in black South African T2DM patients.

Methods

A retrospective, hospital based descriptive research design was adopted for the current study. In brief, 203 medical records of black South African T2DM patients attending the diabetic outpatient clinic at DGMAH were randomly selected and reviewed. Specifically, information regarding the last three lipid profile results was collected, averaged and analyzed. Also, information regarding the physician's management of DD from the time it was diagnosed was collected and analyzed.

Inclusion criteria: Medical records of all black South Africans diagnosed and treated for T2DM at DGMAH were included in the study.

Exclusion criteria: Medical records of patients satisfying the above-mentioned inclusion criteria, but with missing information relating to one or more key variables of the study.

A sample size of 138 medical records of patients was included in this study. The sample size was statistically derived by the formula outlined in the report by Daniel [10], with a 95% confidence and

the expected prevalence of diabetic dyslipidaemia among T2DM patients being 97%, according to a report by the Centre for Disease Control [11].

Demographic data (race, age and gender) and anthropometric data (weight and height) were collected from the medical records. Body mass index (BMI) was calculated as weight in kg divided by height in meters squared. Glycated hemoglobin (HbA1c) and lipid profile data (last three measurement results) were also obtained from the medical records. Study subjects with at least one non-fasting lipid/lipoprotein abnormality according the criteria described by Yoshida[12] for non-fasting dyslipidemia were classified into the mixed DD, combined DD category (any two lipid/lipoprotein abnormality) and isolated single parameter lipid/lipoprotein abnormality category[5.6.7]. The number of patients in each category divided by the total number of the study subjects multiplied by hundred was regarded as a percentage prevalence of DD in that category.

Information about the management of DD at DGMAH was collected from medical records using a questionnaire designed specifically for the purpose of the study. The questionnaire consisted among others, the following questions

- Did the physician managing the patient score the patient with regard to the overall cardiovascular risk before treating the patients? If yes, what scoring method did he or she use?
- Did the physician exclude other known secondary causes of dyslipidemia before embarking on the treatment of DD?
- Was the glycemic control optimized before prescription of the lipid lowering drug?
- Did the physician recommend a lifestyle treatment modality or refer the patient to a dietician before prescribing a lipid lowering drug to patients with either low HDL-C or high TG levels?
- What is the most common lipid lowering treatment regimen prescribed to patients with DD at DGMAH?
- How often do the physicians at DGMAH change either the dose or type of the lipid lowering drug at DGMAH?

Data analysis

Categorical variables were expressed as percentages; continuous variables were expressed as mean ± standard deviation in tables. For categorical variables, differences among groups were

analyzed using the Chi square test. For continuous variables differences among groups were analyzed using either the student's t-test or one-way analysis of variance (ANOVA). P-value ≤ 0.05 was considered to be statistically significant. The associations between the age of the study subjects, BMI and prevalence of DD were determined through the calculation of the Pearson's correlation coefficient.

Results

The demographics and selected clinical characteristics of the study subjects stratified by gender are presented in Table 1. Significant difference between male and female study subjects was observed only for the variable BMI ($p < 0.05$). Otherwise there was no significant differences between male and female study subjects regarding the variables of age, glycaemic control and duration of diabetes mellitus.

Table 1 Demographic and selected clinical characteristics of the study subjects

	Females	**Males**	
Variable	**N =117 (57.9%)**	**N = 86 (42.1%)**	**P value**
Age: mean ± SD (yrs.)	59.9 ± 1.08	60.7 ± 1.78	0.663
BMI: mean ± SD ((kg/m^2)	32.5 ± 0.67	28.8 ± 0.67	0.0002
HbA1c: mean ± SD (mmol/L)	10.1 ± 0.21	10.2 ± 0.31	0.991
Glycaemic controlled (%)	7.6	7.7	0.995
DOD: mean ± SD (yrs.)	14.8 ± 0.75	15.0 ± 1.01	0.889
TC: mean ± SD (mmol/L)	4.43 ± 0.13	4.26 ± 0.12	0.386
LDL: mean ± SD (mmol/L)	2.41 ± 1.73	2.9 ± 0.8	0.338
HDL: mean ± SD (mmol/L)	1.17 ± 0.413	1.15 ± 0.49	0.862
TG: mean ± SD (mmol/L)	1.92 ±1.02	2.08 ± 0.414	0.384

BMI: Body mass index; HbA1c: glycated haemoglobin. DOD: Duration of diabetes; TC: Total cholesterol;

LDL: Low Density Lipoprotein; HDL: High Density Lipoprotein; TG: Triglycerides

Gender prevalence of DD

The gender prevalence and patterns of diabetic dyslipidaemia observed in the study are presented in Figure 1. The overall prevalence of diabetic dyslipidaemia was 58.5%, 55.5% and 56.3% respectively for males, females and all study subjects (Figure 1).

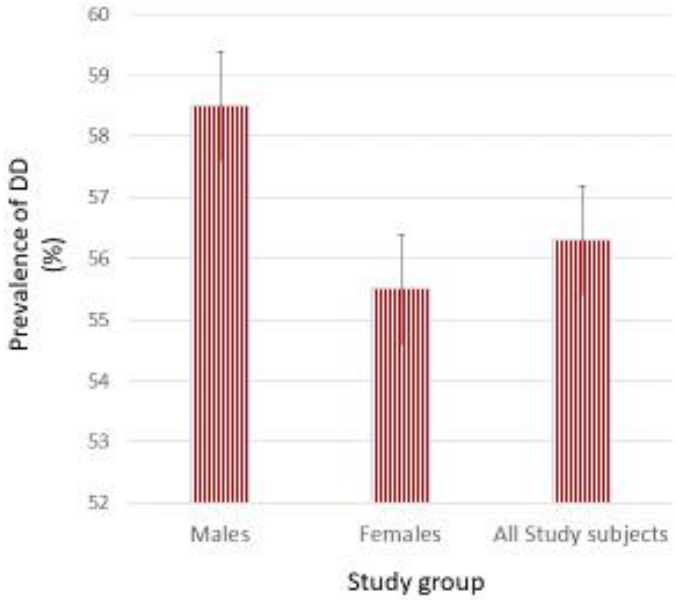

Figure 1: Gender prevalence of diabetic dyslipidaemia

Age prevalence of DD

The age-prevalence of diabetic dyslipidaemia are presented in Figure 2. In this case the overall prevalence of dyslipidaemia was highest among the 61-70 age group (66.1%) followed by that of the >70-year age group (62.1) and lowest among the < 40-year age group (28.5%) (Figure 2).

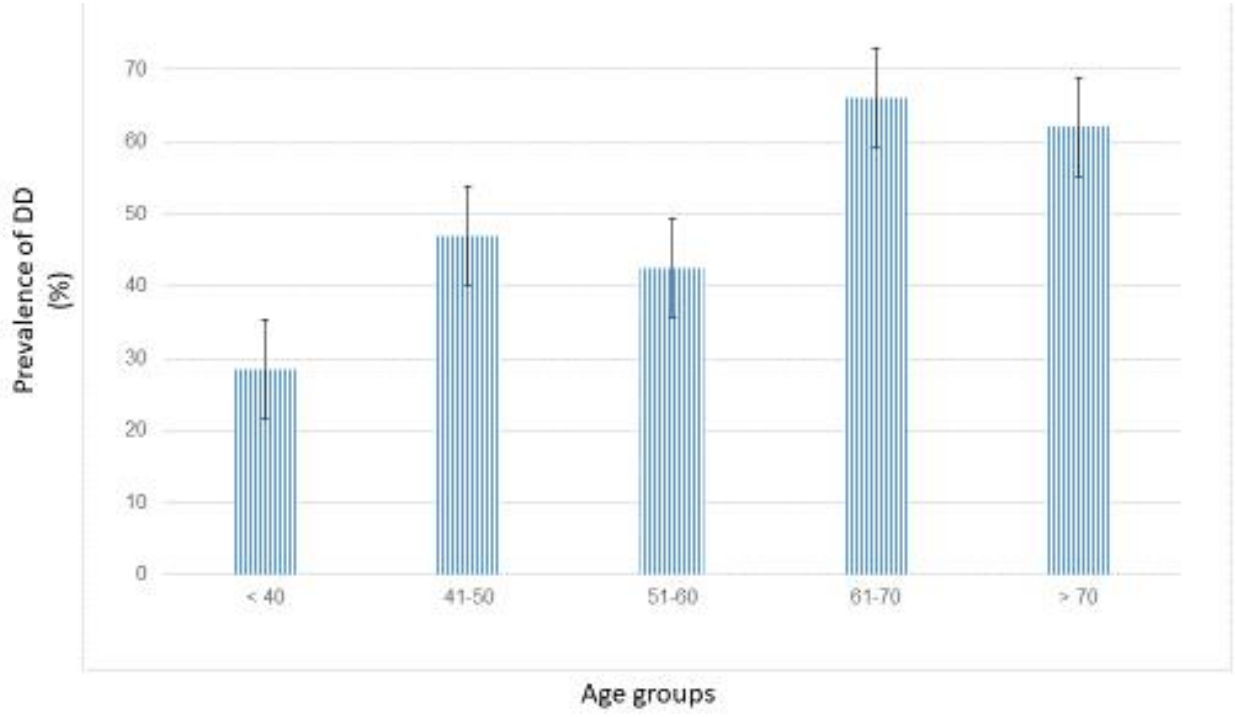

Figure 4.2: Age prevalence of diabetic dyslipidaemia

Patterns of diabetic dyslipidaemia among males, females and all study subjects

The patterns of diabetic dyslipidaemia observed among the study subjects are summarized in Figures 3 (A-C) In females, the most prevalent pattern of DD was combined DD (27.4%) whereas in males the most prevalent pattern was the single isolated DD (Figure 3A). The most common combined type of DD observed among male study subjects were elevated TC & elevated LDL-C as well as reduced HDL & elevated TG (Figure 3B) while the most common combined type of DD observed among female study subjects commonly was elevated TC & elevated LDL-C (Figure 3B). The most commonly observed single isolated type of DD amongst both male and females was reduced HDL (Figure 3C).

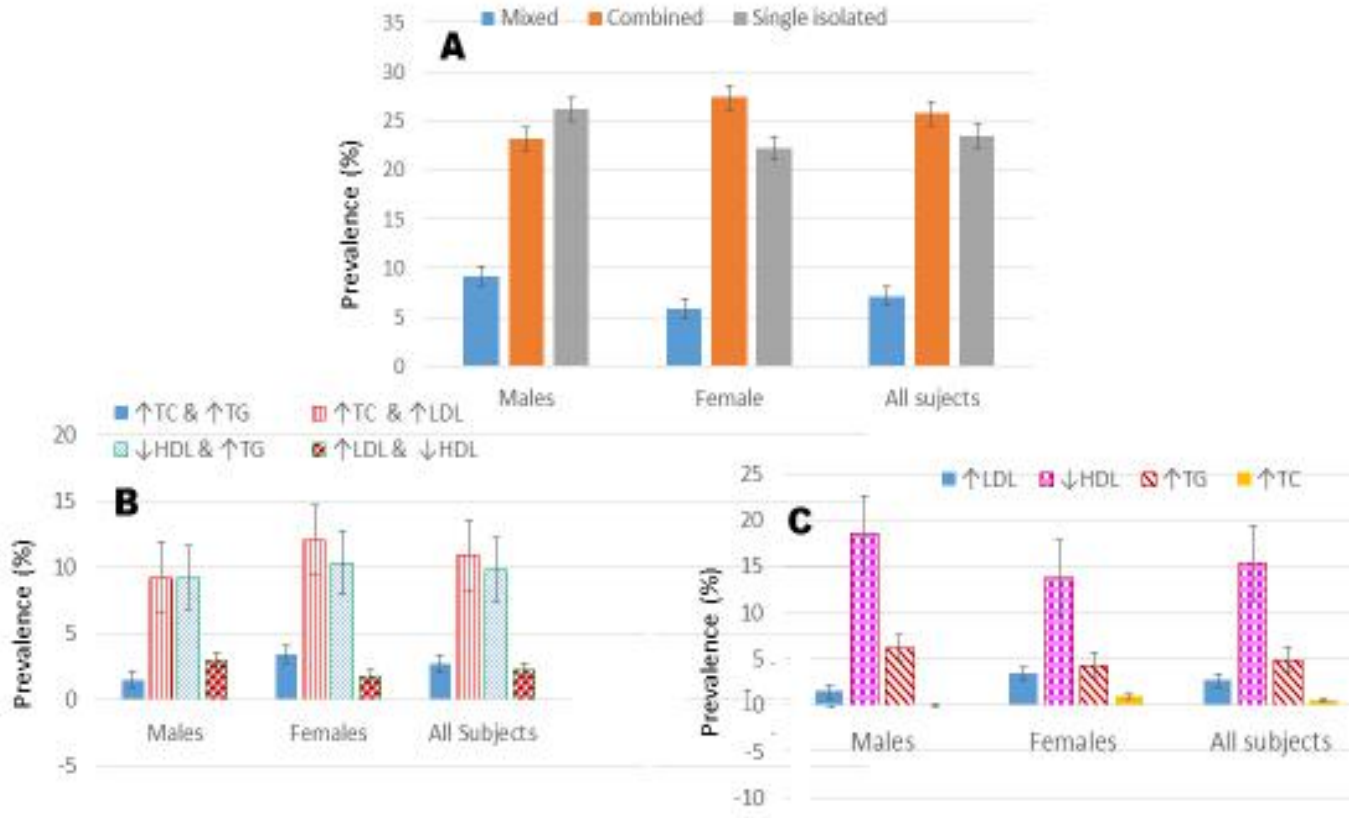

Figure 3: Patterns of diabetic dyslipidaemia. (A) Prevalence of mixed, combined and single isolated dyslipidaemia among the study subjects, (B) Patters of combined dyslipidaemia, (C) Patterns of single isolated dyslipidaemia

The most prevalent pattern of dyslipidaemia among males was single isolated diabetic dyslipidaemia whereas among females the most prevalent pattern of diabetic dyslipidaemia among females was combined dyslipidaemia (Figure 3A), whereas the most prevalent pattern of combined dyslipidemia and single isolated type of dyslipidaemia were ↑TC &↑LDL (10.9%) (Figure 3B) and ↓HDL (15.3%) (Figure 3C) respectively

Pattern of DD in the different age groups

The prevalence of mixed diabetic dyslipidaemia was highest among > 70 age year group (13%), lowest among the 51-60 age year group (5%) and 0% among the < 40 age year group. The prevalence of the combined diabetic dyslipidaemia was highest among the 51-60 age year group (34%) and lowest among the < 40 age year group (7%). On the other hand, the prevalence of single isolated

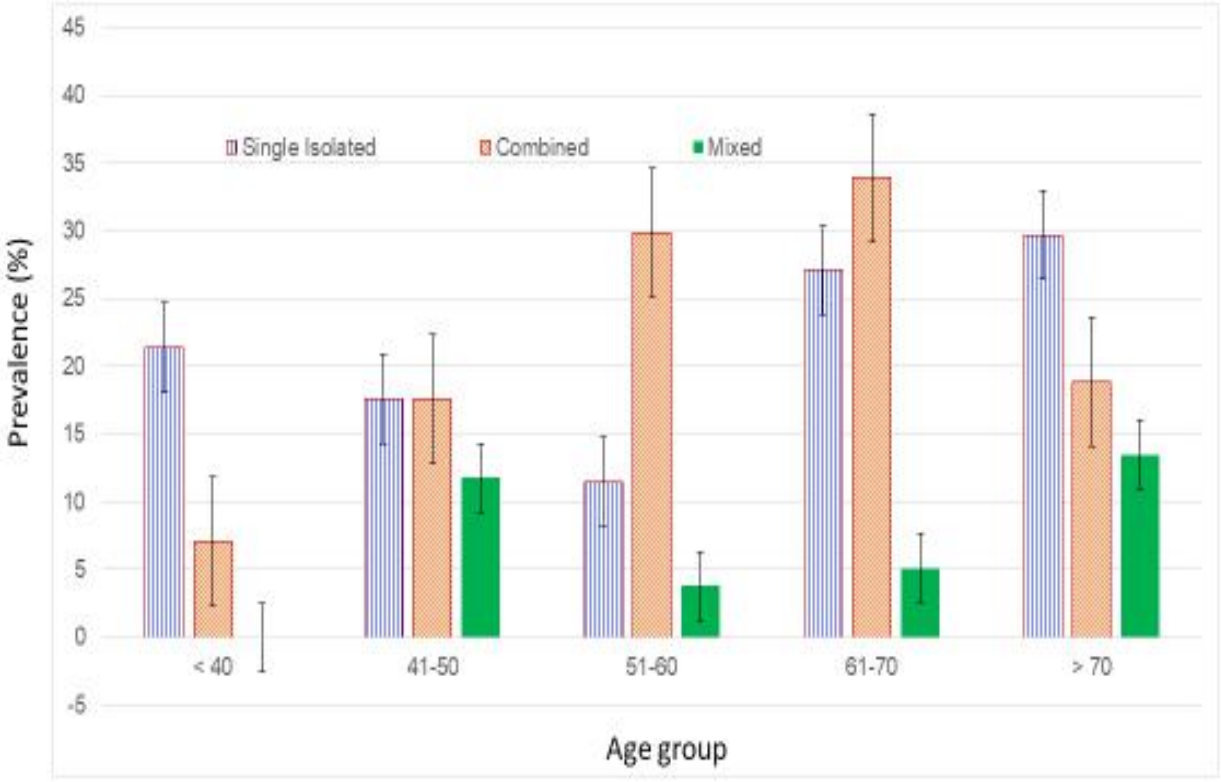

Figure 4: Pattern of diabetic dyslipidaemia among different age groups

Diabetic dyslipidaemia was highest among the > 70-year group (30%) and lowest among the 51 – 60-year group (12%)

Association between DD and both body mass index and age of study subjects

The most prevalent types of dyslipidaemia observed in the study, namely ↓[HDL], ↑[TG], ↑[TC] & ↑[LDL] and ↓[HDL] & ↑[TG] were correlated with both the body mass index and age of the study subjects using Spearman rank correlation coefficient (*R*). Results shown in Table 2 suggest only a moderate significant positive correlation ($p < 0.05$) between the increased concentration of triglycerides (↑[TG) and the age of the study subjects.

Table 2. Correlations between the BMI, age of the study subjects and the presence of the different types of dyslipidaemia observed in the study

Parameter	**↓[HDL]**	**↑[TG]**	**↑[TC] &↑[LDL]**	**↓[HDL]&↑[TG]**
R	-0.022	0.050	0.097	0.262

BMI	p-value	0.843	0.780	0.569	0.148
	N	84	33	37	32
	R	0.202	0.415*		
Age	p-value	0.066	0.016	0.046	0.295
	N	84	33	0.788	0.101
				37	32

R: Spearman rank correlation coefficient; **BMI**: Body mass index. **HDL**: High density lipoprotein. **TRG**: Triglycerides. **TC**: Total cholesterol. **LDL**: Low density lipoprotein. **HDL**: High density lipoprotein; *- Correlation is significant at $p < 0.05$ level.

Management of DD at DGMAH

Regarding the management of DD at DGMAH, results of the study also indicate that in just above half of cases investigated (52.7%), secondary dyslipidaemia, due to renal disease, was excluded before treatment of DD, whereas in 57.1% and 88.7% of cases investigated, secondary dyslipidaemia, due to liver disease and alcoholism respectively, was not excluded before treatment of DD.

Table 3. **Findings related to the management of diabetic dyslipidaemia at DGMAH**

Question asked	**Yes (%)**	**No (%)**
1) Did the physician use any cardiovascular score when managing dyslipidaemia?	0.0	100
2) Did the physician exclude other secondary forms of dyslipidaemia due to the following before commencement of treatment of DD?		
▪ Renal disease	52.7	47.3
▪ Liver disease	42.9	57.1
▪ Alcoholism		
3) Was the glycaemia controlled before commencement of treatment with a lipid lowering drug?		

	11.3	88.7
4) What type of a lipid lowering drug was used initially to treat DD? ▪ Simvastatin (Zocor) ▪ Atorvastatin (Lipitor) ▪ Other	21.7	78.3
5) Did the physician ever change the dosage of lipid lowering drug during the management of DD?	93.6	6.4
6) Did the physician recommend any life style intervention or referred the patient to a dietician for the management of DD	6.4	93.6
	0.0	0.0
	2	98
	40	60

In addition, the result of study indicates that Simvastatin (Zocor) is the most commonly used drug (93.6% of case) to initiate the treatment of DD at DGMAH. Furthermore, the result of the study indicated that in nearly all of the cases investigated (98%) physicians' at DGMAH did not change the dosage of the lipid lowering drug during the management of DD. Moreover, in most of the cases investigated (60%), physicians neither recommend any life-style intervention nor refer patients to a dietician for the management of DD.

Discussion

Diabetic dyslipidaemia is a well-recognized and modifiable risk factor for macrovascular cardiovascular diseases in patients with T2DM [2, 13]. However, despite the fact that many black South Africans have been undergoing lifestyle changes since 1994 there is no current information

regarding diabetic dyslipidaemia (DD) among black South African patient with type 2 diabetes mellitus (T2DM). In this study, we determined the prevalence, pattern and management of DD among black South African patients with T2DM at DGMAH, a tertiary hospital that caters for mostly semi-urban and rural black South Africans.

Despite the widespread availability and use of statin lipid lowering drugs in the management of DD, the prevalence of DD is reported to be high throughout the world. For example, it is reported to range between 48 and 89% in Nigeria[14,15,16] and between 32 and 83% in India[18,19, 17]. In South Africa, prevalence of 85.6% and 93.5% have been reported among multi-racial T2DM patients in a tertiary Johannesburg hospital[8, 18] and 90.3% and among rural black South African T2DM patients in KZN[7]. In the current study, the prevalence of DD was found to be 58.5%, 55.5% and 56.3% respectively for males, females and all study subjects with no significant difference between males and females study subjects. Thus, the findings of the current study are not in agreement with the result of the previous study conducted by Vezi and Naidoo[7]. Although it is not clear as to whether or not the study by Vezi and Naidoo[7] were not on any lipid lowering therapy, the discrepancy between the result of the current study and that of Vezi and Naidoo[7] could be the result of the treatment of study subjects in the current study with statins.

DD has been traditionally classified into patterns of mixed DD, combined DD and isolated single lipid/lipoprotein abnormality[6,14,19]. The most common combined patterns of DD are high LDL-C and reduced HDL-C and high TG and reduced HDL-C[4,6,14,15], whereas the most common type of isolated single type DD is high LDL-C, reduced HDL-C followed by elevated TG[6,14]. In agreement with the result of the study conducted by Okafor et al[14], Ogbera et al[15] and Pandya et al[6], the most prevalent combined pattern of DD observed in the current study was that of reduced HDL and increased TG. In contrast with the findings of Vezi and Naidoo[7] and Daya et al[8], the most common observed single isolated type of dyslipidemia was reduced HDL and not increased LDL as reported in these two previous studies. In general, with exception of the mixed pattern of DD, the age-prevalence of DD observed in the current study was higher in the 61-70-year group compared to the other age groups especially the younger age group (< 40 years). Although, the reasons for this observation is not immediately clear, this observation could possibly be attributed to poor adherence to treatment in the elderly. Unfortunately, there are no previous studies in the literature which have investigated and reported on the age-prevalence and pattern of DD among diabetic patients which can be compared with the current findings.

Since the major aim of the treatment of DD is to avoid the development of cardiovascular in T2DM patients most T2DM and DD management and treatment guidelines recommend the initial scoring of patients with DD with respect to their cardiovascular risk[20,21,22]. Cardiovascular risk scoring is usually performed using either Framingham or ATPIII scoring systems and well documented cardiovascular risk factors such as hypertension and/or antihypertensive medication, cigarette smoking, BMI > 30 kg/m^2 and family history of cardiovascular disease[22,23]. The findings of the current study, however, suggest that physicians at DGMAH do not score their T2DM with respect to their cardiovascular risk before commencement of treatment of DD.

Most treatment guidelines also recommend the exclusion of secondary dyslipidemia due to renal disease, liver disease, alcoholism and hypothyroidism as well as normalization of glycemic control before commencement of the treatment of DD[20,21, 22]. Results of the current study indicate that secondary dyslipidemia due to renal disease was excluded in just above half of the cases investigated (52.7%), whereas in 57.1% and 88.7% of cases investigated secondary dyslipidemia due to liver disease and alcoholism respectively was not excluded before treatment of DD. Contradictory to recommendations by treatment guidelines glycemic control was normalized in only 11.3% of the study subjects before commencement of treatment of DD.

As suggested by Wu and Parhofer[4], there is a consensus among DD treatment guidelines that in those patients who are intolerant to statins, the first priority in the management of DD should be the lowering of LDL-C with HMG CoA inhibitors (statins) or cholesterol absorption inhibitors (e.g. ezetimbe)[4,20]. The second priority should be to raise the level of HDL-C in patients with predominantly reduced HDL-C levels coupled with life style/behavioral interventions such as weight loss, increased physical activity, and cessation of smoking[4,20]. In agreement with the notion that the first DD treatment priority should be the lowering of LDC-C with a statin, most physicians (96.3%) at DGMAH started their treatment of DD with Atorvastatin (Lipitor), a statin at a dose of 20 mg/day. However, these physicians appear to suffer from the so called “treatment inertia” (a mental condition in which health practitioners never changes or increases the dose of a treatment drug). Furthermore, physicians at DGMAH seem to be reluctant to advocate life-style intervention in order to raise HDL levels in their patients.

In addition to the lowering of LDL-C and raising HDL-C, the recommended third priority is to lower TG levels in patients with predominately elevated TG levels (> 5.65 mmol/L) by putting

patients on a low glycemic index carbohydrate diet followed by treatment with fibric acid derivatives (gemfirozil or fenofibrate) or high dose statins[4,20]. However, the findings of the current study indicate that physicians at DGMAH seldom refer their patients with elevated TG to a dietitian, instead they put them on fibrates before they could refer them to a dietician

Limitation of the study

The findings of the current study might have been influenced by several limitations. Firstly, the sample size was small, thereby making it difficult to generalize the findings. Secondly, the study was a cross-sectional study and therefore, cause and effect relationship could not be inferred from the study results. Thirdly, patients were recruited from a single institute rather than being a community-based sample, thus, the findings could not be generalized beyond this study sample. Fourthly, compliance to statin treatment was not accessed in the current study. However, despite these limitations, the current study offers insight into the prevalence, patterns and treatment of DD at DGMAH.

Conclusion

The prevalence of DD at DGMAH was found to be much lower than that previously reported by Vezi and Naidoo among multi-racial South African patients with T2DM and much lower than that reported among multi-racial T2DM South African patients in Johannesburg. The most common patterns of DD observed in the current were combined DD with reduced HDL and increased TG as well as the single isolated reduced HDL. In most cases that were investigated, the management of DD at DGMAH was found not to be in line with recommendations by most DD treatment and management guidelines.

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