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Prevalence of Dyslipidemia and The Associated Factors Among Type 2 Diabetes Patients in Turbo Sub- County, Kenya

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Abstract

Background: A large number of deaths worldwide are attributed to non-communicable diseases (NCDs). Diabetes, an important NCD, contributes to this large mortality mainly through cardiovascular complications. Cardiovascular disease in diabetes is caused by multiple co-morbid conditions; key of which is dyslipidemia.

Objectives: This study aimed to determine prevalence of dyslipidemia and its associated factors among patients with type 2 diabetes mellitus attending Chronic Disease Management clinics (CDM) in Turbo sub-county, Kenya.

Methodology: This was a cross sectional study conducted between 2015 and 2016 at Huruma County hospital and Turbo health centre CDM clinics. Data was collected from 208 randomly selected fasting participants using: structured questionnaires; laboratory investigations (lipid profile and fasting blood sugar); and health records. Data was analyzed using SAS 9.2. All variables at $p \leq 0.2$ level of significance in the univariate analysis were included in the multivariate model. Using backward elimination criteria, variables that had a p value of <0.05 were retained.

Results: A total of 179 out of 208 (86.1%) patients had dyslipidemia. Employment status [OR 3.1; (95% CI 1.3-7.5); p=0.01], BMI [OR 2.7; (95% CI 1.3-5.9); p=0.0007], FBS [OR 3.4; (95% CI 1.6-7.1); p=0.001] and physical activity [OR 4.8; (95% CI 1.1-21.2); p=0.04] were significantly associated with dyslipidemia. Surprisingly, age and being hypertensive were not associated with occurrence of dyslipidemia although the condition was more prevalent in elderly patients and those with elevated blood pressure.

Conclusion: There is a high prevalence of dyslipidemia amongst patients with T2DM in the two CDM clinics studied. Employment status, BMI, FBS and physical activity are important factors associated with dyslipidemia in these patients.There is need to prioritize research driven control and management of dyslipidemia, diabetes and related CVD risk factors plus more vigorous patient education on importance of physical activity. This should be done at both the national level and county level with government and society playing the role.Given the failure to show any association of dyslipidemia with historical CVD risk factors such as age and blood pressure, it is imperative that screening for lipids be done in all diabetes patients routinely.

Keywords: Dyslipidemia ; Type 2 Diabetes;

Abbreviations: AMPATH: Academic Model Providing Access To Healthcare; BMI: Body mass index; BP: Blood pressure; CDM: Chronic diseases management; CVDs: Cardiovascular diseases; HbA1c: Glycated hemoglobin; HDL-C: High density lipoprotein cholesterol; JKUAT: Jomo Kenyatta University of Agriculture and Technology; LDL-C: Low density lipoprotein cholesterol; MET: Metabolic equivalent; MI: Myocardial infarction; MOH-K: Ministry of Health-Kenya; MTRH: Moi Teaching and Referral Hospital; NCDs: Non-Communicable Diseases; T2DM: Type 2 diabetes mellitus; TC: Total cholesterol; TG: Triglycerides; WHO: World Health Organization

Introduction

A large number of deaths worldwide are attributed to non-communicable diseases (NCDs) [1]. Diabetes, an important NCD, contributes to this large mortality mainly through cardiovascular complications [2, 3]. Type 2 diabetes mellitus (T2DM) is the most common form of diabetes and makes up about 90% of global diabetes cases, with the other 10% due primarily to type 1 diabetes mellitus and gestational diabetes. The burden of diabetes in the world is estimated to be 9% among adults aged 18 years and above [4]. A healthy diet, regular physical activity, maintaining normal body weight and avoiding tobacco use can prevent or delay the onset of type 2 diabetes [5]. Cardiovascular disease in Diabetes is caused by multiple co-morbid conditions; key of which is Dyslipidemia. Other cardiovascular diseases that include coronary heart diseases, stroke, and peripheral vascular diseases account for the majority of deaths in diabetic patients [6]. It is noted that most people with diabetes do not die of causes uniquely related to diabetes, but to cardiovascular complications that are caused by risk factors including Dyslipidemia. Dyslipidemia

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is defined as an abnormal lipid profile characterized by high total cholesterol (TC), high low-density lipoprotein cholesterol (LDL-C), low high-density lipoprotein cholesterol (HDL-C) and high triglycerides (TG). For diabetic patients the targets are: LDL <100mg/dl (2.6mmol/l), HDL > 40mg/dl (1.02mmol/l) and TG <150mg/dl (1.7mmol/l) [7].

Coronary artery disease, especially myocardial infarction (MI) is also among the leading causes of morbidity and mortality worldwide [8]. The World Health Organization estimated that Dyslipidemia is associated with more than half of the global cases of ischaemic heart disease and more than 4 million deaths annually [9]. Dyslipidemia has emerged as an important cardiovascular risk factor in sub-Saharan Africa. Research shows that high cholesterol level (≥3.8 mmol/l) accounted for 59% of ischemic heart disease and 29% of ischemic stroke burden in adults age 30 and over. Dyslipidemia, especially elevated cholesterol has been shown to vary across regions in sub-Saharan Africa [10]. According to Kenya STEPWise Survey for NCDs Risk Factors 2015 report [11], mortality attributed to CVD in Kenya is reported to be 6.1% to 8%. The latest Kenya STEPWise Survey for NCDs Risk Factors (2015) report, estimated the prevalence of elevated TC to be 1.5% of Kenya's population while low HDL levels were 50% and 60% for males and females respectively. Despite this, Dyslipidemia levels among T2DM patients attending primary care centers in Kenya are still unclear. A previous hospital based study found a 70% prevalence of elevated levels of TC and TG requiring therapeutic intervention amongst T2DM patients with no obvious chronic complications [12]. A recently concluded study in Tanzania indicates a prevalence of 83% amongst T2DM patients with BMI reported to be an important predictor [13]. To date diabetes management in primary setting has focused on glycemic control at the detriment of holistic management of all CVD risk factors in these patients. Additionally, there is a gap in data on prevalence of Dyslipidemia among T2DM patients in primary care settings in the country. Identification of predictors of Dyslipidemia in T2DM would be an important first step in designing a locally appropriate way to address the CVD risk factor.

We set out to determine the prevalence of Dyslipidemia and describe the associated factors among type 2 diabetes patients attending Chronic Disease Management clinics in Turbo sub-county, Kenya.

Methods

Study design and setting

This was a cross sectional study conducted at Turbo health center and Huruma county hospital CDM clinics in Turbo sub-county which is one of the six sub-counties in Uasin Gishu County. Turbo health center is located 34 km north-west of Eldoret town along the Eldoret-Webuye road and serves the rural population of Turbo sub-county. It currently serves diabetes patients in its Comprehensive Care Center (CCC). Huruma County hospital is 6.5km north-north-west of Eldoret town along Eldoret-Kitale road and serves the urban population. These are public facilities managed by Ministry of Health with same AMPATH support for its CCC; to offer both HIV and diabetes care. They are among the earliest in the country to be supported by AMPATH on MOH partnership organization for HIV care and later diabetes and hypertension care in level 3.

Recruitment of participants

The study population was adult diabetes patients attending the CDM clinics. Inclusion criteria were adults over 35 years of age who had confirmed diabetes. Exclusion criterion was all patients diagnosed with diabetes mellitus before the age of 35. Patients attending the two CDM clinics and met inclusion criteria were approached for recruitment.

Data collection

Data was collected from September 2015 to December 2015 at the two CDM clinics.

Data collected from all participants who met the inclusion criteria included socio-demographic; age, sex, level of education, occupation/employment status, monthly income and residence. Clinical data collected include blood pressure (BP), fasting blood sugar (FBS) weight and height which were measured using Omron M2 intelligence automatic blood pressure monitor, accu-chekperfoma, seca weighing scale and height stature meter 2M respectively.

Other clinical data recorded were duration since DM diagnosis, personal and family history of cardiac disease. Behavioral/practice data included physical activity levels, sedentary behavior; determined using GPAQ self-administered questionnaire level i.e. Metabolic Equivalent Minutes per week (METmis/week). Clinic attendance, alcohol consumption, cigarette smoking, adherence to medication and dietary advice were also collected.

Laboratory investigations were done at Moi Teaching and Referral Hospital (MTRH) to determine fasting lipid profile using COBAS Integra 400plus. All participants were given a unique code number alongside their questionnaire for easy identification and tracking on the clinical and laboratory results. Data was entered into a Microsoft Excel database. Data cleaning was done at the end of data collection analysis.

Statistical analyses

• ***Dependent variable:*** was Dyslipidemia which was defined as; Total cholesterol >5.2mmol/dl (200mg/dl), and or increased LDL cholesterol >2.6mmol/L (130mg/dl), and or decreased HDL cholesterol <0.9 mmol/l (35mg/dl) and or triglycerides >1.7mmol/l (150mg/dl) [6].

• ***Independent variables:*** were age, sex, level of education, employment status, monthly income, marital status, residence, BP, FBS, BMI, physical activity (METmins/week), sedentary behavior, clinic attendance, alcohol consumption, cigarette smoking, family and personal cardiac history.

Analyses were done using SAS 9.2. Descriptive statistics were done to describe distribution of Dyslipidemia against all variables. Univariate analysis was done to assess for association with Dyslipidemia, and factors found to be associated by the way of $p \leq 0.2$ were subjected to multivariate analysis. Using backward

elimination criteria, those variables that attained p<0.05 on the multivariate logistic regression were considered statistically significant.

Comparisons of occurrence of Dyslipidemia were done between males and females.

Results

Participants' characteristics

Socio-demographic and economic characteristics:

The mean age of the participants was 58.4years (sd =11.4) The majority (64%) were female, had attained primary level education or below (62%) , were of low social-economic status as 66% earned a monthly income of Kshs <15,000 (66%) and lived in rural areas (71%) (Table 1).

Table 1: Socio-demographic and economic characteristics of T2DM patients in Turbo Sub-County

Participant Characteristics	Unit (s)	No. (%) N=208
Age group	35-49	40 (19)
	50-64	106 (51)
	65+	62 (30)
Gender	Male	75 (36)
	Female	133 (64)
Level of Education	Non e	34 (16)
	Primary	95 (46)
	Secondary	62 (30)
	College & University	17 (8)
Occupation	Unemployed	37 (18)
	Business person	56 (27)
	Farmer	79 (38)
	Employed	23 (11)
	Retired	13 (6)
Monthly Income (Kshs)	≤15,000	138 (66)
	>15,001	70 (34)
Marital status	Single	17 (8)
	Married	157 (75)
	Previously married	34 (17)
Residence	Urban	60 (29)
	Rural	148 (71)

Clinical characteristics:

Prevalence of Dyslipidemia and other CVD risk factors: Among all participants, majority (86%) had Dyslipidemia, (61%) had been diagnosed with diabetes mellitus within the past 5 years, had hypertension (67%). Overweight and obesity was noted in 65%; while fasting blood sugar was suboptimal (FBS above the recommended 7.0mmol/L) in 75% of them. Despite the significant history of cardiac disease in 51% of the participants, and high rates of multiple CVD risk factors in the study, 63% reported only fair or poor medications' adherence (Table 2a).

Behaviour and practices: Majority (99%) of the participants reported having received dietary advice on the management of their illness. However, 38% did not always adhere to the dietary advice they had received. Fortunately, only a minority consumed alcohol (10%) or smoked tobacco (9%). Additionally, 77% achieved physical activity levels (≥600 Met mins/week) albeit, over half of the participants also spent more than 3 hours on sedentary behavior. Almost half (46%) had an adherence index of 5, which implies that patients only reported one or more but not all of the following: always strictly takes medication, takes the right amount of medicine, takes medication as prescribed by the doctor, visits his doctor as scheduled and follows his doctor's or nurse's advice (Table 2b).

Univariate analyses of factors associated with Dyslipidemia :

On univariate analysis, sex, employment status, marital status, level of education, BMI, BP, FBS, physical activity and adherence to medication were significantly associated with Dyslipidemia (attained a p ≤ 0.2) (Table 3).

Multivariate analyses of factors associated with Dyslipidemia:

Multivariate logistic regression was performed for variables that attained p≤0.2 on univariate section. Employment status [OR 3.1; (95% CI 1.3-7.5); p=0.01], BMI [OR 2.7; (95% CI 1.3-5.9); p=0.0007], FBS [OR 3.4; (95% CI 1.6-7.1); p=0.001] and physical activity [OR 4.8; (95% CI 1.1-21.2); p=0.04] remained significantly associated with Dyslipidemia (Table 4).

Discussions

This study found out 86% of the patients with diabetes in the primary care setting had dyslipidemia. This was similar to findings in India where 86% and 89% dyslipidemia prevalence were reported [14, 15]. The current study prevalence was lower than findings in Tanzania 95% [16] and Pakistan 94% [17] but higher compared to those done in Nigeria 74% [18]. This difference may be due to the variation in cut-offs for dyslipidemia in these different studies. And difference in stage of urbanization in the various settings. [19]. A third of participants had insufficient amount of physical activity which is similar to previous findings [20]. Dyslipidemia was more prevalent in females than in males which is consistent with a study in the Middle East that found females to be more dyslipidemic [21]. Despite short period since diagnosis of diabetes, majority had dyslipidemia and multiple CVD risk. This finding was similar to previous study that found that T2DM patients compared with non-diabetic people have increased cardiovascular risk [22]. Part of this is associated with a higher prevalence of other cardiovascular risk factors like obesity and hypertension [23].

Employment status, BMI, fasting, FBS and insufficient physical activity (MET mins/week<600) were important factors associated with occurrence of dyslipidemia. Working was found to be significantly associated with dyslipidemia. This is in concordance with a previous study that found dyslipidemia to be associated with occupation [24] which may have been from lack

Table 2a: Clinical characteristics: Prevalence of dyslipidemia and other CVD risk factors among T2DM patients in Turbo Sub-County

Participant Characteristics	Unit (s)	No. (%) N=208	Male N=75 (36%)	Female N=133 (64%)	P value
Dyslipidemia	Present	179 (86)	60 (33)	119 (67)	**0.05***
	Absent	29 (14)	15 (52)	34 (48)	
Blood pressure‖	Normal	68 (33)	23 (34)	45 (66)	0.64
	Elevated	140 (67)	52 (37)	88 (63)	
BMI category	Underweight	3 (1)	1 (33)	2 (67)	0.39
	Normal weight	70 (34)	30 (43)	40 (57)	
	Overweight	81 (39)	29 (36)	52 (64)	
	Obese	54 (26)	15 (28)	39 (72)	
Fasting Blood Sugar	<7mmol/L	51 (25)	22 (43)	29 (57)	0.22
	≥7mmo/L	157 (75)	53 (34)	104 (66)	
Family history of cardiac disease	Present	81 (39)	35 (43)	46 (57)	0.09
	Absent	127 (61)	40 (32)	87 (68)	
Personal history of cardiac disease	Present	106 (51)	37 (35)	69 (65)	
	Absent	102 (49)	38 (37)	64 (63)	
Duration since DM diagnosis	1-4 years	127 (61)	47 (37)	80 (63)	0.92
	5-9 years	42 (20)	15 (36)	27 (64)	
	10+ years	39 (19)	13 (33)	26 (67)	

‖Normal refers to "systolic <140mmHG & Diastolic <90 mmHg) &not on anti-hypertensive medication" while Elevated refers to Systolic ≥140mmHG or Diastolic ≥90mmHg or on anti-hypertensive's

*significance as p<0.05

Table 2b: Behavior and practices of T2DM patients in Turbo Sub-County

Participant Characteristics	Unit (s)	No. (%) N=208
Received dietary management advice	Yes	207 (99)
	No	1 (1)
Adhere to dietary advice	Always	130 (62)
	Not always	78 (38)
Alcohol consumption	No	188 (90)
	Did but stopped	17 (8)
	Yes	3 (2)
Smoke(d) tobacco	No	190 (91)
	Did but stopped	14 (7)
	Yes	4 (2)
Received physical activity advice	Yes	208 (100)
Physical activity (MET mins/week)	≥ 600	160 (77)
	<600	48 (23)
Sedentary behaviour	≥3 hours/day sitting/reclining	112 (54)
	<3 hours/day sitting/reclining	96 (46)
Level of adherence to medication	Always	77 (37)
Adherence index‖	4.0-5.0	95 (46)
	1.0-3.0	113 (54)
Clinic Attendance	Always	146 (70)

‖an adherence index of 5 refers to a patient who always strictly takes his medication, takes the right amount of medicine, takes medication as prescribed by the doctor, visits his doctor as scheduled and follows his doctor's or nurse's advice. A lower adherence index refers to one or more (but not all) of the above 5 combinations

Table 3: Univariate analyses of factors associated with dyslipidemia among T2DM patients in Turbo Sub-County

Variables	Participant Characteristics	No. (%) N=208	Dyslipidemia¥ N=179 (86) N(%)	COR (CI)	P values
Socio-demographic and economic					
Age group	35-49	40 (19)	33 (83)	Ref	0.8
	50-64	106 (51)	92 (86)	1.3 (0.5-3.7)	
	65+	62 (30)	54 (87)	1.4 (0.5-4.3)	
Gender	Male	75 (36)	60 (80)	Ref	**0.05**
	Female	133 (64)	119 (89)	2.1 (1.0-4.7)	
Level of Education	Primary and below	129 (62)	115 (89)	Ref	**0.2**
	Secondary and above	79 (3811)	64 (81)	0.5 (0.2-1.1)	
Employment status **	Working	159 (76)	140 (89)	2.2 (0.9-5.0)	0.06
	Not working	50 (24)	39 (78)	Ref	
Monthly Income in Kshs	≤15,000	138 (66)	118 (86)	0.8 (0.4-2.0)	0.7
	>15,001	70 (34)	61 (87)	Ref	
Marital status	Single	17 (8)	14 (82)	Ref	**0.1**
	Married	157 (75)	132 (84)	1.1 (0.3-4.2)	
	Previously married	34 (17)	33 (97)	7.1 (0.7-73.9)	
Residence	Urban	60 (29)	53 (88)	1.3 (0.5-3.3)	0.5
	Rural	148 (71)	126 (85)	Ref	
Clinical					
DM Duration	1-4 years	127 (61)	111 (87)	Ref	0.6
	5-9 years	42 (20)	34 (81)	0.6 (0.2-1.7)	
	10+ years	39 (19)	34 (87)	1.6 (0.5-5.3)	
Blood pressure	Normal BP	68 (33)	59 (86)	Ref	**0.06**
	Elevated BP	140 (67)	120 (86)	0.9 (0.4-2.0)	
BMI***	Underweight Normal	83 (38)	60 (82)	Ref	**0.003**
	Overweight & Obese	135 (65)	119 (88)	1.4 (2.5-5.0)	
Fasting blood sugar	<7 mmol/L	51 (25)	41 (80)	Ref	**0.2**
	≥7mmol/L	157 (75)	138 (88)	3.3 (0.7-10.0)	
Family history of cardiac disease	Present	81 (39)	71 (88)	1.2 (0.5-2.8)	0.6
	Absent	127 (61)	108 (85)	Ref	
Personal Cardiac history	Present	106 (51)	91 (86)	0.9 (0.4-2.1)	0.9
	Absent	102 (49)	88 (86)	Ref	
Behavior and practices					
Adhered to dietary advice	Not always	78 (38)	66 (85)	1.2 (0.5-2.7)	0.6
	Always	130 (62)	113 (87)	Ref	
Alcohol consumption	None	188 (90)	160 (85)	Ref	0.5
	Yes	3 (2)	3 (100)	-	
	Did but stopped	17 (8)	16 (94)	2.8 (0.4-21.9)	

Smoke tobacco	No	190 (91)	162 (85)	Ref	0.5
	Yes but stopped	14 (7)	13 (93)	2.2 (0.3-17.9)	
	Yes	4 (2)	4 (100)	-	
Sedentary behavior (sitting)	≥3 hours/day	112 (54)	101 (90)	2.1 (0.9-4.7)	**0.06**
	<3 hours/day	96 (46)	78 (81)	Ref	
Physical activity (met mins/week)	≥ 600	150 (77)	133 (83)	Ref	**0.03**
	<600	48 (23)	46 (96)	4.7 (1.1-20.4)	
Clinic Attendance	Not Always	62 (30)	56 (90)	1.7 (0.7-4.5)	0.21
	Always	146 (70)	123 (84)	Ref	
Medication adherence level	Not always	131 (63)	116 (88)	1.7 (0.8-3.8)	**0.2**
	Always	77 (37)	63 (82)	Ref	
Adherence index‖	4.0-5.0	95 (46)	80 (84)	Ref	0.5
	1.0-3.0	113 (54)	99 (88)	0.8 (0.3-1.7)	

** not working included retired and unemployed, working included Self employed includes Business persons and farmers

***Normal and underweight category includes 3 patients who were underweight and none of them had dyslipidemia

‖an adherence index of 5 refers to a patient who always strictly takes his medication, takes the right amount of medicine, takes medication as prescribed by the doctor, visits his doctor as scheduled and follows his doctor's or nurse's advice. A lower adherence index refers to one or more (but not all) of the above 5 combinations

Table 4: Multivariate analyses of factors associated with dyslipidemia among T2DM patients in Turbo Sub-County

	Participant Characteristics	**Dyslipidemia/Total 179/208 (86.1%) n/N (%)**	**COR (CI)**	**P value**	**AOR (95% CI)**	**P value**
Socio-demographic & economic						
Age group	35-49	33/40 (83)	Ref	0.8		
	50-64	92/106 (86)	1.3 (0.5-3.7)			
	65+	54/62 (13)	1.4 (0.5-4.3)			
Sex	Male	60/75 (80)	Ref	0.05*	Ref	0.11
	Female	119/133 (89)	2.1 (1.0-4.7)		1.9 (0.9-4.6)	
Level of Education	Primary and below	115/129 (89)	Ref	0.1		
	Secondary and above	64/79 (81)	0.5 (0.2-1.1)			
**Employment status ** **	Working	140/159 (89)	2.2 (0.9-5.0)	0.06	**3.1 (1.3-7.5)**	**0.01***
	Not working	39/50 (78)	Ref		**Ref**	
Monthly Income (Kshs)	≤15,000	118/138 (86)	0.8 (0.4-2.0)	0.7		
	>15,001	61/70(87)	Ref			
Marital status	Single	14/17 (82)	Ref	0.1*	Ref	0.2
	Married	132/157 (84)	1.1 (0.3-4.2)		1.4 (0.3-5.3)	
	Previously married	33/34 (97)	7.1 (0.7-73.9)		9.2 (0.8-102.0)	
Residence	Urban	53/60 (88)	1.3 (0.5-3.3)	0.5		
	Rural	126/148 (85)	Ref			
Clinical						
DM Duration	1-4 years	111/127 (87)	Ref	0.6		
	5-9 years	34/42 (81)	0.6 (0.2-1.7)			
	10+ years	34/39 (87)	1.6 (0.5-5.3)			

Blood pressure	Normotensive	59/68 (87)	ref	0.06		
	Hypertensive	120/140 (86)	0.9 (0.4-2.0)			
BMI* **	Normal &Underweight	60/83 (72)	Ref	0.003*	**Ref**	**0.0007***
	Overweight & Obese	119/135 (88)	1.4 (2.5-5.0)		**2.7 (1.3-5.9)**	
Fasting blood sugar	<7 mmol/L	41/61 (67)	Ref	0.0003*	**Ref**	**0.001***
	≥7mmol/L	138/157 (88)	3.3 (0.7-10.0)		**3.4 (1.6-7.1)**	
Family history of cardiac disease	Present	71/81 (88)	1.2 (0.5-2.8)	0.6		
	Absent	108/127 (85)	Ref			
Personal history of cardiac disease	Present	91/106 (86)	0.9 (0.4-2.1)	0.9		
	Absent	88/102 (86)	Ref			
Behavioral						
Physical activity(met mins/week**)**	≥ 600	133/160 (83)	Ref	0.03	**Ref**	**0.04***
	<600	46/48 (96)	4.7 (1.1-20.4)		**4.8 (1.1-21.2)**	
Clinic attendance	Not always	56/62 (90)	1.7 (0.7-4.5)	0.21		
	Always	123/146 (84)	Ref			
Adhere to dietary advice	Not always	66/78 (85)	1.2 (0.5-2.7)	0.6		
	Always	113/130 (87)	Ref			
Level of adherence to medication	Not always	116/131 (89)	1.7 (0.8-3.8)	0.2	1.8 (0.8-4.0	0.1
	Always	63/77 (82)	Ref		Ref	
Adherence index‖	4.0-5.0	80/95 (84)	Ref	0.5		
	1.0-3.0	99/113 (88)	0.8 (0.3-1.7)			

** not working included retired and unemployed, working included Self employed includes Business persons and farmers

***Normal and underweight category includes 3 patients who were underweight and none of them had dyslipidemia

‖an adherence index of 5 refers to a patient who always strictly takes his medication, takes the right amount of medicine, takes medication as prescribed by the doctor, visits his doctor as scheduled and follows his doctor's or nurse's advice. A lower adherence index refers to one or more (but not all) of the above 5 combinations

*significance as $p<0.05$

of physical activity. Previous studies reported that dyslipidemia occurrence is more prevalent in subjects whose occupation was management/administrative compared to those that doing physical/labour [25], although other studies found no significant association between occupation and dyslipidemia [26]. These differences may have been as a result of confounding factors.

Insufficient physical activity (MET mins/week < 600) was significantly associated with dyslipidemia. This concurs with previous findings that showed a strong dose-response association between exercise intensity and lipids [27]. Physical activity of >600METmins/week is associated with cardiovascular health benefits [28]. In a previous study, intense physical activity was found to be associated with improved lipids [29]. Also intervention study findings showed that increase in physical exercises has the same effect [30, 31]. Sedentary lifestyle has been found to be associated with most cardiovascular risk factors [32].

BMI was also significantly associated with dyslipidemia. This corroborated with previous study that showed excess weight to be associated with increased prevalence of dyslipidemia and metabolic syndrome [33, 34]. Obesity is also a well known determinant of dyslipidemia [35] suggesting that this could add to other existing forces responsible for rising burden of cardiovascular risk factors [36].

FBS was also found to be significantly associated with dyslipidemia. This was in agreement with previous studies in Kuwait [37] in India [38] and in China [39] which found the same association.

Surprisingly, sex, BP and age were not significantly associated with dyslipidemia. The association between sex and dyslipidemia showed no significance although females were more likely to have dyslipidemia compared to males. This was similar to findings in Pakistan [21] and Tanzania[16] that did not find any significant association. However, this contrasted an Ethiopian study [40] that

found a significant association. BP showed lack of significance with dyslipidemia but a higher proportion of dyslipidemic patients had elevated BP compared to non-dyslipidemic patients. This therefore joins other studies that try to explain probable existing link between hypertension and abnormal lipids [41, 42]. The study also found that there is unsatisfactory adherence to medication, and to diet despite dietary education but physical activity was generally good. Similar findings of poor diet adherence were reported in India [43] but this was lower compared to findings in US that found 52% followed a meal plan [44]. Regarding physical activity, more than half of T2DM patients were noted to attain required physical activity weekly [45].

Conclusions

The study found a high prevalence of dyslipidemia among T2DM patients attending CDM clinics in Turbo sub-county. This is high earlier on after diagnosis of DM despite good physical activity. Occupation, BMI, FBS and insufficient physical activity are important predictors of dyslipidemia. The alarming burden means that there is need for patient education and practice plan on importance of diet observation, clinical attendance, physical exercises and weight reduction especially to those in occupations that do not involve much physical activity (business persons). There is need to prioritize research driven control and management of dyslipidemia, diabetes and related CVD risk factors. This should be done at both national level and county level with government and society playing the role.

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Ethical considerations

Research proposal development was followed by ethical approval from Institutional Research and Ethics Committee/ Moi university bearing the reference number Ref: 0606. Prior to data collection, permission was sought from AMPATH. The PI was introduced to the facility in charge by the AMPATH program manager officially and to the clinics by the facility in charge. The subjects that met the inclusion criteria were given an information sheet and detailed consent form which they signed voluntarily with assistance from research assistants. The PI had coded the questionnaires to assure anonymity of the subjects hence keeping every detail confidential before the data were safely stored under lock and key. An excel database was created for data entry on a password secured computer.

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