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Original Article

Diet Pattern and Dyslipidemia among Type II Diabetes Mellitus Patients Diagnosed More Than One Year Visiting Tribhuvan University Teaching Hospital

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ABSTRACT

Introduction: Dyslipidemia is a risk factor for coronary artery disease, a leading cause of mortality in patients with type 2 diabetes mellitus. This study aims to study the dietary pattern and dyslipidemia of type 2 diabetes mellitus patients visiting Tribhuvan University Teaching Hospital.

Materials and Methods: Quantitative study was done to find out the dietary pattern and dyslipidemia of type 2 diabetes mellitus patients visiting Tribhuvan University Teaching Hospital. Patients with type 2 diabetes mellitus diagnosed for more than one year were included in the study.

Results: The percentage of dyslipidemia in type 2 diabetes mellitus was found to be 88.5%. Dyslipidemia was found to be significantly associated ($p<0.05$) with alcohol consumption, regular dietary management, sedentary behavior, waist-hip ratio, body mass index, glycated hemoglobin, and hypertension. Dyslipidemia was also found to be significantly associated ($p<0.05$) with the dietary habit (vegetarian and non-vegetarian), consumption of cereals and its product, consumption of fruits, consumption of fast foods and street foods, consumption of red meat, and consumption of oilseeds.

Conclusions: This study indicates the importance of dietary awareness and lifestyle modification for the management of dyslipidemia among type 2 diabetes mellitus.

Keywords: Dietary pattern; Dyslipidemia; HbA1; Type 2 diabetes mellitus

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INTRODUCTION

Type 2 diabetes mellitus (T2DM) patients have a greater likelihood of having dyslipidemia, hypertension, and obesity. Because early detection and prompt treatment may reduce the burden of diabetes and its complications, screening for diabetes may be appropriate under certain circumstances.[1] Dyslipidemia is a risk factor for coronary artery disease, a leading cause of mortality in T2DM. Dyslipidemia remains largely undiagnosed and untreated in high-risk populations, such as in T2DM.[2]

Well-known risk factors for cardiovascular disease include age, gender, hypertension (HTN), and T2DM. Other lifestyle behaviors such as tobacco, smoking, excessive alcohol consumption, sedentary lifestyle, and poor diet with resultant obesity further contribute to elevating one's Coronary vascular disease (CVD) risk. T2DM patients often suffer from HTN and also have abnormal lipoprotein metabolism.[3] Dyslipidemia is one of the major risk factors for CVD in T2DM. The most common pattern of dyslipidemia is hypertriglyceridemia and reduced high-density lipoprotein (HDL) cholesterol and an increased concentration of small dense low-density lipoprotein (LDL) particles. The precise pathogenesis of diabetic dyslipidemia is not known; however, a large body of evidence suggests that insulin resistance has a central role in the development of this condition.[4] The percentage of dyslipidemia is found to be very high in T2DM.[5-8] This study aimed to study the dietary pattern and dyslipidemia of T2DM patients visiting Tribhuvan University Teaching Hospital.

MATERIALS AND METHODS

A quantitative study was done to find out the dietary pattern and dyslipidemia in T2DM using a descriptive cross-sectional. The study was conducted from August 2020 to February 2021 at the outpatient department (OPD) of Tribhuvan University Teaching Hospital (TUTH). Patients with T2DM diagnosed for more than one year were included in the study. Patients who refused to respond, who were disabled (cannot speak or unconscious), and who were not taking food due to the illness during hospital visits were excluded from the study.

The sample size was determined by using single proportion formula.

$n = z^2pq/e^2$ Where,

n is the desired sample size;

Z is the standard normal deviate at 95% confidence level (1.96); p is the prevalence, q is 1-p

e is an allowable error (0.05).

After adjusting the allowable error 0.05 and 0.1 non-response rate, the sample size was 130.

Ethical approval was taken from the research committee of the College of Applied Food and Dairy Technology (CAFODAT) College, Nepal Health and Research Council (NHRC), and the administration of TUTH to collect data from T2DM patients visiting the hospital as well as written consent was taken from the respondents.

Weight was measured using a portable weighing scale, height was measured using a portable stadiometer, waist and hip circumference were measured using a non-stretchable measurement tape and the dietary pattern was determined using a food frequency questionnaire and 24-hour dietary recall method.

Serum total cholesterol (TC) and triglyceride (TG) were measured by the enzymatic method. HDL was measured by precipitation followed by enzymatic methods. LDL was calculated by Fridewald's formula. Fasting blood glucose (FBG) and postprandial blood glucose (PPBG) were measured by glucose oxidase method, as described by Trinder, using commercial kit Biolabo Reagents, France. HbA1c was measured by Hb-Vario Analyzer which uses pressure cation-exchange high-performance liquid chromatography (HPLC) in conjunction with gradient elution to separate human hemoglobin subtypes and variants from hemolyzed whole blood.

Descriptive statistics (mean, mode, and standard deviation, etc.) were used to organize and analyze the data whereas binary logistic regression analysis was used to calculate odds ratio (OR) and analyze the association between dependent and independent variables. Data analysis was done using SPSS version 20 software. All probability values less than 0.05 ($p<0.05$) were considered statistically significant.

RESULTS

Data from 130 T2DM patients visiting Endocrinology OPD of TUTH, were collected to assess dietary patterns and percentage of dyslipidemia. Percentage of T2DM with FBG ≥ 126 mg/dl was 68.5%, PPBG ≥ 200 mg/dl was 63.8%, and HbA1c ≥ 6.5% was 70.8%.

While analyzing the 24 hours dietary recall of respondents, mean energy consumption was 1535.2 kcal, mean carbohydrate consumption was 228.1g, mean protein consumption was 50g, and mean fat consumption was 46.7g. While analyzing the macronutrient consumption of respondents, 60.7% respondents had a distribution of macronutrients as per the National Institute of Nutrition (NIN) recommendation for a balanced diet (45-65% kcal from CHO, 5-15% kcal from protein, and 15-35% kcal from fat).

The percentage of dyslipidemia in diabetic patients was found to be 88.5%. The prevalence of dyslipidemia in males was 87.7% and in females 89.9%. The most common form of dyslipidemia was hypertriglyceridemia. Regarding the pattern of dyslipidemia, 57.7% had low HDL, 75.4% had high LDL, 63.8% had high total cholesterol, and 77.7% had high triglyceride. (Table 1)

Table 1: Percentage of dyslipidemia in type 2 diabetes Mellitus patients (n=130)

Characteristics		Participants	Percentage (%)
Dyslipidemia	Yes	115	88.5
	No	15	11.5
Dyslipidemia in male (n=81)	Yes	71	87.7
	No	10	12.3
Dyslipidemia in female (n=49)	Yes	44	89.8
	No	5	10.2

A significant association was seen between dyslipidemia and alcohol consumption (P=0.02). Dyslipidemia was found to be higher in those who consumed alcohol than those who did not (OR=3.6). Similarly, a significant association was found between dyslipidemia and regular dietary management (P=0.02). Dyslipidemia was higher in those who did not manage their diet regularly than those who managed their diet regularly (OR= 4.12). Sedentary behavior was also found to be significantly associated with dyslipidemia (P=0.04). Dyslipidemia was found to be higher in those with a sedentary lifestyle (physically inactive for more

than 6 hours a day) than those with an active lifestyle (OR= 3.9). Dyslipidemia was also found to be significantly associated with waist-hip ratio (WHR) (P =0.01) and BMI (P =0.02). Dyslipidemia was higher in those with WHR of an at-risk category than those with WHR of normal value (OR= 4.44). Similarly, dyslipidemia was also higher in those with BMI ≥23 than those with BMI <23 (OR=3.57). A significant association was seen between dyslipidemia and HbA1c(P=0.02). Dyslipidemia was found to be higher in those having higher HbA1c (OR=6.2). Dyslipidemia was also found to be significantly associated with hypertension (P=0.04). In comparison to those who did not have hypertension, dyslipidemia was higher in those who had hypertension (OR= 4.8). (Table 2 and 3)

Table 2:Factors associated with dyslipidemia in T2DM

Variables		Yes	No	Odds ratio (OR)	p-value
Gender	Male	71 (61.7%)	10 (66.7%)	1	
	Female	44 (38.3%)	5 (33.3%)	1.239 (0.39to 3.86)	0.71
Age	31-45	21 (18.3%)	4 (26.7%)	1	
	45-60	60 (52.2%)	6 (40%)	1.9 (0.49 to 7.4)	0.35
	>60	34 (29.6%)	5 (33.3%)	1.2 (0.31 to 5.3)	0.7
Alcohol	Yes	74 (64.3%)	5 (33.3%)	3.6 (1.15 to 11.27)	0.02*
	No	41 (35.7%)	10 (66.7%)	1	
Sedentary behavior	Sitting >6 hr/day	57 (49.6%)	3 (20%)	3.9 (1.05 to 14.6)	0.04*
	Sitting ≤6 hr/day	58 (50.4%)	12 (80%)	1	
WHR	Normal	15 (13%)	6(40%)	1	
	At risk	100(87%)	9(60%)	4.44 (1.3 to 14.27)	0.01*
Body mass index	BMI <23	34(29.6%)	9 (60.0%)	1	
	BMI ≥23	81(70.4%)	6 (40%)	3.57 (1.2 to 10.8)	0.02*
Glycated haemoglobin	HbA1c <6.5	28 (24.3%)	10 (66.7%)	1	
	HbA1c ≥6.5	87 (75.7%)	5 (33.3%)	6.2(1.9 to 19.7)	0.02*
Hypertension	Yes	49 (42.6%)	2 (13.3%)	4.8 (1.04 to 22.3)	0.04*
	No	66 (57.4%)	13 (86.7%)	1	

**p<0.05, statistically significant*

Table 3A: Eating behavior and its association with dyslipidemia in T2DM

Variables		Yes	No	Odds ratio (OR)	P-value
Alcohol	Yes	74 (64.3%)	5 (33.3%)	3.6 (1.15 to 11.27)	0.02*
	No	41 (35.7%)	10 (66.7%)	1	
Regular dietary management	Yes	46(40%)	11 (73.3%)	1	
	No	69 (60%)	4 (26.7%)	4.12 (1.2 to 13.74)	0.02*
Dietary habit	Vegetarian	34 (29.6%)	11 (73.3%)	1	
	Non vegetarian	81 (70.4%)	4 (26.7%)	6.5 (1.9 to 22)	0.002*
Cereals and its products	1 to 2 times a day	36 (31.3%)	10 (66.7%)	1	
	≥ 3 times a day	79 (68.7%)	5 (33.3%)	4.3 (1.3 to 13.7)	0.01*
Pulses and legumes	1 to 2 times a day	73 (63.5%)	6 (40%)	2.6 (0.8 to 7.8)	0.08
	≥3 times a day	42 (36.5%)	9 (60%)	1	
Green leafy vegetable	Daily	48 (41.7%)	9 (60%)	1	
	Once a week	28 (24.3%)	2 (13.3%)	2.6 (0.5 to 13)	0.2
	2 - 3/week	39 (33.9%)	4 (26.7%)	1.8 (0.5 to 6.3)	0.3
Fruits	Daily	26 (22.6%)	11 (73.3%)	1	
	Once a week	69 (60%)	3 (20%)	9.7 (2.5 to 37)	0.00*
	2 - 3/week	20 (17.4%)	1 (6.7%)	8.4 (1 to 71)	0.04

**P<0.05, statistically significant*

Table 3B: Eating behavior and its association with dyslipidemia in T2DM

Variables		Yes	No	Odds ratio (OR)	P-value
Fast foods and street foods	Never	28 (24.3%)	9 (60%)	1	
	Daily	37 (32.2%)	2 (13.3%)	5.9 (1.1 to 29.7)	0.03*
	Once a week	50 (43.5%)	4 (26.7%)	4 (1.1 to 14.2)	0.03
Red meat	Never	34 (29.6%)	11 (73.3%)	1	
	Daily	27 (23.5%)	1 (6.7%)	8.7 (1 to 71)	0.04*
	Once a week	33 (28.7%)	2 (13.3%)	5.3 (1 to 25.9)	0.03
	2 to 3 times a week	21 (18.3%)	1 (6.7%)	6.7 (0.8 to 56)	0.07
Fish	Never	59 (51.3%)	11 (73.3%)	1	
	Once a week	24 (20.9%)	3 (20%)	1.4 (0.3 to 5.8)	0.5
	Sometimes	32 (27.8%)	1 (6.7%)	5.9 (0.7 to 48.3)	0.09
Oilseeds	Never	46 (40%)	2 (13.3%)	1	
	Daily	8 (7%)	7 (46.7%)	0.05 (0.09 to 0.28)	0.001*
	2 to 3 times a week	23 (20%)	3 (20%)	0.33 (0.05 to 2.1)	0.24
	Once a week	18 (15.7%)	2 (13.3%)	0.39 (0.05 to 2.9)	0.36
	Sometimes	20 (17.4%)	1 (6.7%)	0.8 (0.07 to 10)	0.9

**P<0.05, statistically significant*

Dyslipidemia among T2DM was found to be associated with several dietary as well as other factors. In this study, most of the T2DM patients were found to be dyslipidemic (88.5%) and the most common form of dyslipidemia was hypertriglyceridemia. BMI, WHR, sedentary behavior, alcohol consumption, regular dietary management, HbA1c, and hypertension were the risk factors associated with dyslipidemia. A dietary pattern like consumption of cereals and their products, consumption of fruits, consumption of fast foods and street foods, consumption of red meat, dietary habit (vegetarian and non-vegetarian), and consumption of oilseeds were also found to be significantly associated with dyslipidemia. (Table 2)

DISCUSSION

The percentage of dyslipidemia among diabetic patients in our study was found to be very high i.e. 88.5%, which was similar to the study done in Mukalla city in Eastern Yemen by Al- Duais et *al.*, 2019, where the percentage of dyslipidemia was found to be 85%.[3] In a study done in Dhulikhel hospital by Shrestha *et al.*, 2017, dyslipidemia was found to be 85.33%.[7] The most common form of dyslipidemia was hypertriglyceridemia which was in accordance with the study done in T2DM of Bhubaneswar region, where the most common form of dyslipidemia was hypertriglyceridemia.[9]

In our study, dyslipidemia was found to be significantly associated with alcohol consumption (p =0.02, OR= 3.6). Dyslipidemia was found to be higher in those who consumed alcohol than those who did not. In a study done by Kwon *et al*., 2016, dyslipidemia was higher in those who consumed alcohol.[10] Also, dyslipidemia was found to be significantly associated with regular dietary management (p =0.02, OR= 4.12). Dyslipidemia was higher in those who did not manage their diet regularly than those who managed their diet regularly. This finding was similar to the finding of the study done by Rosa *et al*., 2015, which found that several pieces of scientific evidence are available on the beneficial effects of foods and their bioactive components in the regulation of the lipid profile, and thereby in the prevention and control of dyslipidemia.[11]

In this study, there was a significant association between sedentary behavior and dyslipidemia (p=0.04, OR= 3.9). Dyslipidemia was found to be higher in those with a sedentary lifestyle (physically inactive for more than 6 hours a day) than those with an active lifestyle. In the study done by Brungnara*et al*., 2016, a sedentary lifestyle was associated with dyslipidemia.[12] Dyslipidemia was also found to be significantly associated with WHR (p=0.01, OR=4.44) and BMI (P=0.02, OR=3.57). Dyslipidemia was higher in those with WHR of an at-risk category than those with WHR of normal. Similarly, dyslipidemia was also higher in those with BMI ≥23 than those with BMI <23. In a study done by Zheng *et al*., 2014, in China, it was found that dyslipidemia was statistically significant with WHR and it was seen that dyslipidemia was higher in those who had higher WHR than those who had lower WHR.[13] In the same way, overweight and obesity were independently associated with increased risks of hyperlipidemia (p<0.001) in a study done in China by Rao *et al*., 2016.[14]

A significant association was seen between dyslipidemia and HbA1c (P=0.02, OR=6.2). In a study done at Chitwan medical college by Sapkota*et al*., 2019, a significant association was seen between dyslipidemia and HbA1c.[6] In a study done in China by Zheng *et al*., 2014, dyslipidemia was found to be significantly associated with HbA1c.[13] Dyslipidemia was also found to be significantly associated with hypertension (P=0.04, OR=4.8). In comparison to those who did not have hypertension, dyslipidemia was higher in those who had hypertension. In a study done by Yu *et al*., 2015, dyslipidemia was higher in hypertensive patients.[15]

A significant association was found between dyslipidemia and consumption of cereals and their products. Dyslipidemia increased with the increased consumption of cereals and their products. In a study done in Korea by Na *et al*., 2019, it was seen

that an increase in the consumption of flour-based western food patterns was associated with an increased risk of dyslipidemia.[16] Significant association was also found between dietary habit and dyslipidemia (P=0.002, OR=6.5). Dyslipidemia was high in non-vegetarian respondents compared to vegetarian respondents. A study done by Yokoyama *et al*., 2017, found that consumption of vegetarian diets was associated with lower mean concentrations of total cholesterol, low-density lipoprotein cholesterol, and higher mean concentration of high-density lipoprotein cholesterol, compared with consumption of non-vegetarian diets.[17]Significant association was seen between dyslipidemia and consumption of fruits. An inverse relation was found between the consumption of fruits and dyslipidemia. Dyslipidemia decreased as the consumption of fruits increased. A review done in 2018 by Blekkenhorst, *et al*., 2018, found that most studies have demonstrated significant inverse associations between intakes of fruits and CVD outcomes.[18] Studies done by Djousse*et al*., 2004, found that consumption of fruits and vegetables was inversely related to LDL in men and women.[21] Similarly in a study done by Mellendick*et al*., 2018, it was found that diets rich in fruits and vegetables had cardioprotective effects.[19]

A significant association was also found between fast food/street food consumption and dyslipidemia. Dyslipidemia increased as the consumption of fast foods and street foods increased. In the study done by Na *et al*., 2019, the western staple pattern, which was rich in flour and processed foods, was independently associated with dyslipidemia in urban male residents of Korea.[16] Significant association was also seen between the consumption of red meat and dyslipidemia. It was found that as the consumption of red meat increased dyslipidemia also increased. In a study done by Diarz*et al*., 2020, meat consumption was positively associated with the high percentage of hyperlipidemia among the NCA Maasai.[20]

A significant association was found between the consumption of oilseeds and dyslipidemia. An inverse relation was found between the consumption of oilseeds and dyslipidemia, as the consumption increased, dyslipidemia decreased. In a study done by Rosa *et al*., 2015, it was found that PUFAs and MUFAs in appropriate proportions, soluble fiber (oats and psyllium, in particular), phytosterols, soy protein, oilseeds, and nuts had beneficial effects in the regulation of the lipid profile, and thereby in the prevention and control of dyslipidemia.[11]

CONCLUSIONS

This study shows that different dietary patterns and dietary habits are associated with dyslipidemia in T2DM. Hence managing these dietary factors can have a huge benefit in preventing and managing cardiovascular risk among T2DM which is one of the major causes of death in T2DM. This study can be used as a reference for further in-depth research in the future.

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