

Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

Diabetes & Metabolic Syndrome: Clinical Research & Reviews

journal homepage: www.elsevier.com/locate/dsx

Original Article

Prevalence of dyslipidemia among the diabetic patients in southern Bangladesh: A cross-sectional study



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ARTICLE INFO

Article history:

Received 6 August 2018

Accepted 7 September 2018

Keywords:

Bangladesh

Cardiovascular diseases

Dyslipidemia

Type 2 diabetes

Prevalence

ABSTRACT

Aim: Diabetic dyslipidemia is one of the major risk factors for cardiovascular disease which has a vast mortality rate throughout the world. Early detection and treatment of dyslipidemia can avoid risk for cardiovascular disorder in diabetic patients. This study was conducted to determine the prevalence of and pattern of dyslipidemia in diabetic patients.

Materials and methods: This cross sectional study was performed in several specialized diabetic hospital of Noakhali, a southern district of Bangladesh. All known cases of diabetes mellitus were evaluated for their lipid profile. A total number of 1008 patients were included in the study having 683 (67.8%) female and 325 (32.2%) male subjects.

Results: The prevalence of dyslipidemia among the male subjects was 73% while among female subjects 71%. Among diabetic males the percentage of high serum Cholesterol, high serum TG (Triglyceride), low HDL (High density cholesterol) and high LDL (Low density cholesterol) was 35.69%, 44.31%, 50.15% and 72.92% respectively, whereas the female had the percentage at 35.29%, 40.85%, 49.49% and 70.57% respectively.

Conclusion: Majority portion of the study subjects were dyslipidemic. The most prevalent pattern among both male and female was high level of LDL and low level of HDL. The prevalence of dyslipidemia in Bangladesh is significantly high, which indicates the urgency of lifestyle intervention strategies to prevent and manage this important health problem and risk factor.

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1. Introduction

Gradually increasing rapid socioeconomic development and related lifestyle changes has been causing an increase in the prevalence of dyslipidemia dramatically over the past decade in Bangladesh and other South Asian countries [1–12]. Studies from India and Bangladesh showed an increasing trend in the prevalence of dyslipidemia [11].

Dyslipidemia has been clearly determined as a major risk factor for cardiovascular diseases that are the first cause of death in the developed and developing countries [13]. It has become one of the leading cause of death in most developed countries as well as in

developing countries, including Bangladesh [14,15]. The World Health Organization recently reported that dyslipidemia is significantly associated with more than half of global cases of ischemic heart disease [16].

Dyslipidemia in the diabetic patients is a common phenomenon, because insulin resistance or deficiency affects key enzymes and pathways in lipid metabolism and thus causing lipid abnormalities which are more prevalent in diabetes mellitus [17]. Particularly, the following processes are affected: apoprotein production, regulation of lipoprotein lipase, action of cholesteryl ester, transfer proteins and hepatic and peripheral actions of insulin [18,19]. The presence of dyslipidemia (DLP) significantly increases cardiovascular risk among patient with diabetes [20]. Again, studies show that about 70–80% of diabetic patients will die of cardiovascular disease [21,22].

Though identifying and screening dyslipidemia in every nation to prevent occurrence and progression of cardiovascular diseases is very important, there are no proper and correct statistics on the status of dyslipidemia and its determinants in majority of nations

Abbreviations: BMI, Body Mass Index; TC, Total cholesterol; TG, Triglyceride; HDL, High Density Lipoprotein; LDL, Low Density Lipoprotein; CVD, Cardiovascular Disease.

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<https://doi.org/10.1016/j.dsx.2018.09.006>

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[23,24]. Available data on the prevalence, types, and associated factors of dyslipidemia in the general population of our country is relatively insufficient. The lack of enough knowledge to the status of dyslipidemia will lead to inappropriate programming and treatment approaches. This will lead to difficulties in scheduling suitable national managerial approaches for lipid lowering [25]. The estimation of the prevalence of dyslipidemia will ensure proper planning of health care resources for both primary and secondary prevention of CVDs.

Therefore, the objective of this study was to gather current data on dyslipidemia and to find out the relation between serum lipid profile and blood sugar depending on the hypothesis that early detection and treatment of lipid abnormalities can minimize the risk for atherogenic cardiovascular disorder and cerebrovascular accident in diabetic patients.

2. Materials and methods

2.1. Study location and sample size

This was a multicenter, non-interventional, cross-sectional observational study. Patients with diabetes mellitus who visited the two specialized Diabetic hospitals approved by Bangladesh Diabetic Association, namely-i) M.A. Hashem Diabetic Hospital, Chowmuhani, Noakhali and ii) Alhaz Sirajul Hoque Diabetic Hospital, Majidee, Noakhali, were included in the trial. Data from patients, who had agreed to informed consent to provide information, were collected during their interaction with the doctor and subsequent testing of lipid profile. For this study, data were collected from 1008 diabetic patient attending the hospital randomly.

2.2. Data collection

For data collection from respondents a questionnaire was prepared in accordance with the objective set for the study. Before preparing the questionnaire, a draft questionnaire was developed and then pre-tested in the study area. The questionnaire was then modified and rearranged according to experience gathered in the pre-testing. The final questionnaire then developed in logical sequence so that the respondents could answer chronologically. Question related to age, gender, religion, area, diagnosis included in the questionnaire. After preparing questionnaire, the primary data collected from target sites during January 29, 2018 to April 17, 2018.

2.3. Data processing and analysis

After collection of data, these were edited. All the collected data were summarized and scrutinized carefully and then recorded. Finally, relevant tables were prepared in accordance with the objectives of the study. Data presented mostly in the tabular form because it is simple in calculation, widely used and easy to understand. Microsoft excel program and IBM-SPSS Statistics program (Version 25, IBM Corp.) were used for data analysis and for chart, group and diagram preparation.

3. Results

In this retrospective study 1008 diabetic patients were included, where female and male were 683 and 325 respectively. The age range and mean age of female subjects was 21–99 years and 49.77 ± 13.36 , while the age range and mean age for male subjects was 18–96 years and 52.74 ± 12.86 years, respectively (Table 1).

Total 1008 subjects were classified into 5 different age groups as following: below 41 years, 41–50 years, 51–60 years, 61–70 years and above 70 years. Table 2 shows a comparative view of different

Table 1

Gender distribution and age of selected diabetic patients.

Gender	No. of Patients	Age ^a
Female	683	49.77 ± 13.36
Male	325	52.74 ± 12.81
Total	1008	50.73 ± 13.37

^a Units expressed as years (mean ± SD).

general characteristics of the subjects according to age and gender including: age, weight, height, BMI (Body Mass Index), region, systolic and diastolic blood pressure, total cholesterol (TC), TG (Triglyceride), HDL (High density Lipoprotein), LDL (Low density Lipoprotein) and plasma glucose. According to the findings, the percentage of underweight, normal weight, overweight and obese subjects were 8.2%, 41.7%, 31.2% and 18.9%, respectively. The percentage of rural and urban subjects were 82.04% and 17.96%, respectively. Table 2 also shows the serum lipid profile of the subjects according to different age group, whereas Fig. 1 shows individual lipid profile for males and females. In male, total cholesterol, TG, HDL and LDL were 203.44 ± 55.3 mg/dl, 208.96 ± 129.63 mg/dl, 36.99 ± 10.06 mg/dl and 121.59 ± 48.83 mg/dl, respectively, while those were in female 207.72 ± 90.46 mg/dl, 209.04 ± 140.83 mg/dl, 37.18 ± 9.37 mg/dl and 132.75 ± 75.11 mg/dl, respectively.

Specific prevalence association of dyslipidemia in our study subjects depending on age groups are presented in Table 4. In male, abnormal cholesterol level was 35.69%, age group of 41–50 years had the highest prevalence of disturbance cholesterol (42.85%). 44.31% had greater than 150 mg/dl abnormal triglyceride level. The low HDL level was identified 50.15%, while 72.92% was high level of LDL. The prevalence of both low HDL and high LDL level were the highest in male subjects. In female, percentage of patients with disturbed cholesterol level were 35.69%, percentage was highest most in the subjects above the age of 70 years. In high level of triglyceride out of 40.85%, 45.45% were >70 years and 44.79% were 51–60 years group. With low level of HDL was found 49.49% and 70.57% were identified as high level of LDL in female. Overall, the highest prevalence of low HDL level and increased LDL level were calculated 49.70% (n = 501) and 71.33% (n = 719) (Table 3). Alternatively, the abnormal cholesterol level was found in highest percentage in the underweight population (46.3%) and high LDL level was found in overweight population (74.8%). But the prevalence of both high TG and low HDL were highest in the obese population 44.5% and 52.5% respectively (Fig. 2).

In correlation studies, FBS showed significant positive correlation with total cholesterol ($P < 0.01$), TG ($P < 0.01$) and HDL ($P < 0.001$) (Table 4). TC also showed significant positive correlation with TG, HDL and LDL ($P < 0.001$). TG showed a significant positive correlation with HDL ($P < 0.01$) and a significant negative correlation with LDL ($P < 0.001$). However, there is also a significant positive correlation between HDL and LDL ($P < 0.001$).

4. Discussion

Rapidly growing prevalence of dyslipidemia has become a public health problem throughout the world. This prevalence varies widely according to the socioeconomic, cultural and ethnic characteristics. This study was the first time to analyze the prevalence of dyslipidemia among the population of southern Bangladesh. The results revealed that the age-standardized prevalence among the population of southern Bangladesh was considerably higher than another study for prevalence of dyslipidemia in Bangladesh [11]. Different genetic predisposition, socioeconomic stratum and lifestyles of the studied subjects, as well as diagnostic criteria used can

Table 2
General characteristics of type 2 diabetic patients according to age and gender.

Variables	Total Subjects	Age groups									
		≤40		41–50		51–60		61–70		>70	
		Female	Male								
Frequency (%)	1008	197 (19.5%)	58 (5.8%)	188 (18.7%)	91 (9%)	163 (16.2%)	98 (9.7%)	102 (10.1%)	59 (5.9%)	33 (3.3%)	19 (1.9%)
Age ¹	50.73 ± 13.4	34.10 ± 5.29	34.79 ± 4.97	46.58 ± 2.78	46.02 ± 2.97	56.20 ± 3.05	56.55 ± 2.75	65.83 ± 2.82	65.02 ± 2.60	80.12 ± 6.71	81.84 ± 7.99
Weight ²	60.33 ± 10.85	59.18 ± 9.98	61.57 ± 11.04	56.28 ± 9.93	63.76 ± 10.92	60.65 ± 11.19	64.26 ± 11.19	58.99 ± 10.71	64.38 ± 11.14	57.08 ± 10.21	53.6 ± 10.8
Height ³	1.547 ± 0.0843	1.556 ± 0.08	1.515 ± 0.081	1.544 ± 0.082	1.543 ± 0.0807	1.558 ± 0.0821	1.549 ± 0.0995	1.539 ± 0.0839	1.542 ± 0.078	1.533 ± 0.090	1.572 ± 0.08
BMI	25.40 ± 5.25	24.62 ± 4.75	27.15 ± 6.21	24.24 ± 4.93	25.91 ± 4.99	25.16 ± 5.21	26.74 ± 5.52	25.09 ± 5.08	27.39 ± 5.66	24.65 ± 5.89	21.6 ± 3.24
Under weight	82 (8.2%)	18	6	22	1	14	4	8	4	3	1
Normal	421 (41.7%)	98	15	87	32	71	36	43	17	10	7
Overweight	314 (31.2%)	51	17	58	37	54	33	29	17	5	2
Obese	191 (18.9%)	28	20	21	20	24	25	22	21	6	0
Region	827 (82.04%)	164	50	157	72	132	82	84	45	19	8
Rural											
Urban	181 (17.96%)	33	18	31	19	31	16	18	14	5	2
Systolic BP	122.04 ± 16.99	117.93 ± 17.47	115.13 ± 13.66	121.40 ± 17.79	123.29 ± 15.11	124.77 ± 16.66	125.77 ± 17.53	124.38 ± 16.05	124.57 ± 14.77	118.13 ± 17.97	120.63 ± 23.97
Diastolic BP	79.17 ± 10.11	79.48 ± 9.78	78.5 ± 11.61	79.38 ± 10.27	78.00 ± 9.72	79.92 ± 10.47	80.32 ± 9.34	78.95 ± 9.38	78.83 ± 9.96	76.25 ± 12.71	76.25 ± 14.82
Total Cholesterol	206.33 ± 80.69	203.39 ± 47.85	205.67 ± 52.71	201.68 ± 49.37	208.74 ± 47.14	208.60 ± 55.43	195.55 ± 45.05	225.37 ± 204.2	208.69 ± 81.51	216.78 ± 71.08	187.88 ± 32.99
TG	209.02 ± 137.19	200.05 ± 117.8	221.49 ± 155.6	194.74 ± 116.4	194.28 ± 86.00	219.82 ± 148.7	208.83 ± 105.6	211.70 ± 103.8	206.23 ± 133.4	326.09 ± 398.2	174.00 ± 79.99
HDL	37.12 ± 9.59	36.98 ± 8.7	37.39 ± 9.58	36.67 ± 8.98	37.95 ± 8.57	37.93 ± 10.08	35.56 ± 8.19	36.87 ± 9.56	37.94 ± 14.82	39.41 ± 12.92	34.16 ± 5.99
LDL	131.75 ± 67.67	129.79 ± 44.43	124.25 ± 44.88	130.21 ± 44.28	138.13 ± 39.74	132.29 ± 45.22	123.48 ± 43.48	147.27 ± 167.4	135.18 ± 69.00	122.88 ± 46.66	127.62 ± 33.36
Plasma Glucose	10.53 ± 4.90	9.60 ± 4.24	10.83 ± 5.50	10.47 ± 4.62	10.82 ± 4.55	10.55 ± 4.82	10.03 ± 3.85	11.00 ± 6.59	12.41 ± 4.95	12.00 ± 4.86	8.62 ± 4.37

Units expressed as ¹years(mean ± SD), ²Kg(mean ± SD), ³Meter(mean ± SD). [Abbreviations: BMI-Body Mass Index; BP-Blood Pressure; TG-Triglyceride; HDL-High Density Lipoprotein; LDL-Low Density Lipoprotein].

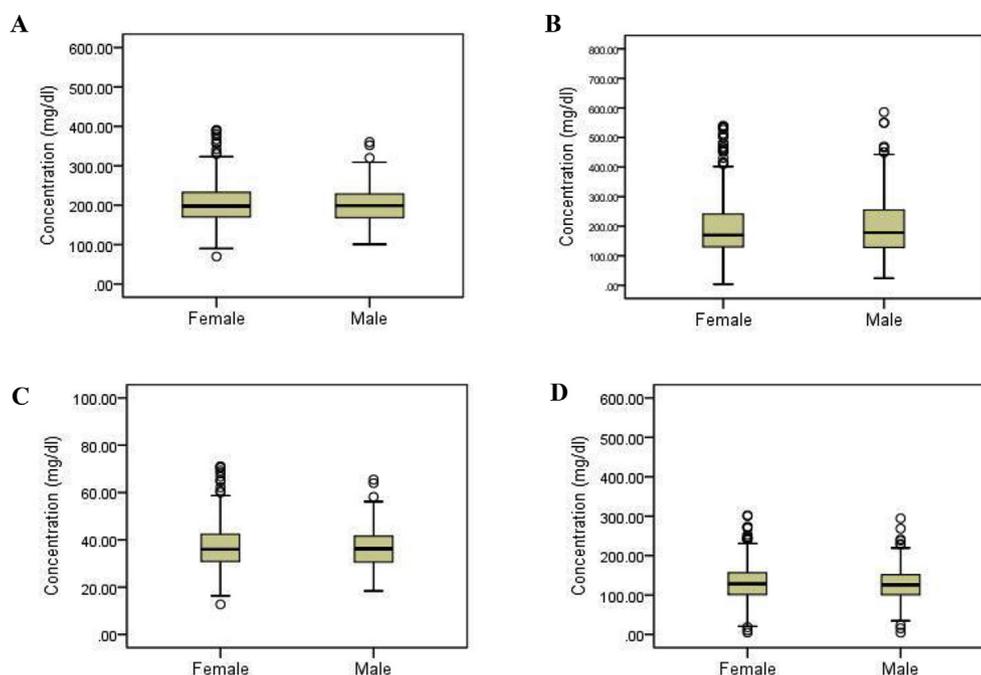


Fig. 1. Serum lipid profile in male and female. A total of 1008 study subjects were evaluated for the prevalence of dyslipidemia in type 2 diabetic patients in Bangladesh. Boxplot showing the median, maximum and minimum value range. **A** Total Cholesterol, **B** Triglyceride, **C** HDL, **D** LDL.

Table 3
Specific prevalence association of dyslipidemia according to age groups.

Lipid profile n (%)	Age groups					Total n (%)
	≤40	41–50	51–60	61–70	>70	
Total cholesterol > 200 mg/dl						
Male	20 (34.48%)	39 (42.85%)	26 (26.53%)	23 (38.98%)	8 (42.11%)	357 (35.42%)
Female	62 (31.47%)	64 (34.04%)	66 (40.49%)	35 (34.31%)	14 (42.42%)	
TG > 150 mg/dl						
Male	28 (48.28%)	37 (40.56%)	45 (45.92%)	27 (45.76%)	7 (36.84%)	423 (41.96%)
Female	71 (36.04%)	76 (40.43%)	73 (44.79%)	44 (43.13%)	15 (45.45%)	
HDL < 40/50 mg/dl						
Male	26 (44.82%)	40 (43.95%)	55 (56.12%)	31 (52.54%)	11 (57.89%)	501 (49.70%)
Female	149 (75.6%)	173 (92.02%)	133 (81.6%)	78 (76.47%)	23 (69.7%)	
LDL > 100 mg/dl						
Male	39 (67.24%)	69 (75.82%)	71 (72.45%)	45 (76.27%)	13 (68.42%)	719 (71.33%)
Female	82 (41.62%)	77 (40.96%)	62 (38.04%)	31 (30.39%)	12 (36.36%)	

TG: triglyceride, LDL: Low Density Lipoprotein, HDL: High Density Lipoprotein.

be the reason behind the difference between this study and others. The prevalence of dyslipidemia in our study was higher than that in Sri Lanka [26], India [2,27], Bangladesh [11] and Saudi Arabia [28], but lower than that in India [10]. In our study, the most prevalent type of dyslipidemia among the subjects is high LDL, a finding that agree with those from other studies in Asian countries [2,10,26,29]. This phenomenon probably indicates the increased intake of high simple carbohydrates and high-fat diets in recent decades. But the interventions for low HDL-C are not readily available for now. Therefore, further research into effective intervention measures is needed.

The present study reports one of the largest population-based lipid studies ever conducted in Bangladesh, in which current epidemiological characteristics of dyslipidemia in Noakhali district were analyzed. The study includes a large proportion of both male and female subjects from both rural and urban region who were randomly selected, so the study provides a very representative data applicable to the study population. Our study revealed an

alarmingly high prevalence of dyslipidemia in Bangladesh. Lipid abnormalities may be the result of unbalanced metabolic state of diabetes and improved control of hyperglycemia does moderate diabetes-associated dyslipidemia [30]. One thousand and eight subjects were recruited for this study and there was a significant difference between the number of male (325) and female (683) subjects. Majority (74.7%) of the diabetic patients were aged above 40 years. The age of diabetic patients was observed to be above 40 years confirmed by earlier workers, their studies reported that age plays a major role in the risk of developing type 2 diabetes especially after 40 years [31,32]. In our study prevalence of dyslipidemia was 71% in diabetic patients. Two different studies conducted in India showed the prevalence of dyslipidemia in diabetic patients was 89% and 92.4% [12,33]. Prevalence of dyslipidemia in diabetic patients was 72.9% in males and 70.6% in females, where as in the study of Jayarama it was 95.40% and 86.75% for male and female, respectively [12].

In this study high prevalence of dyslipidemia could be credited

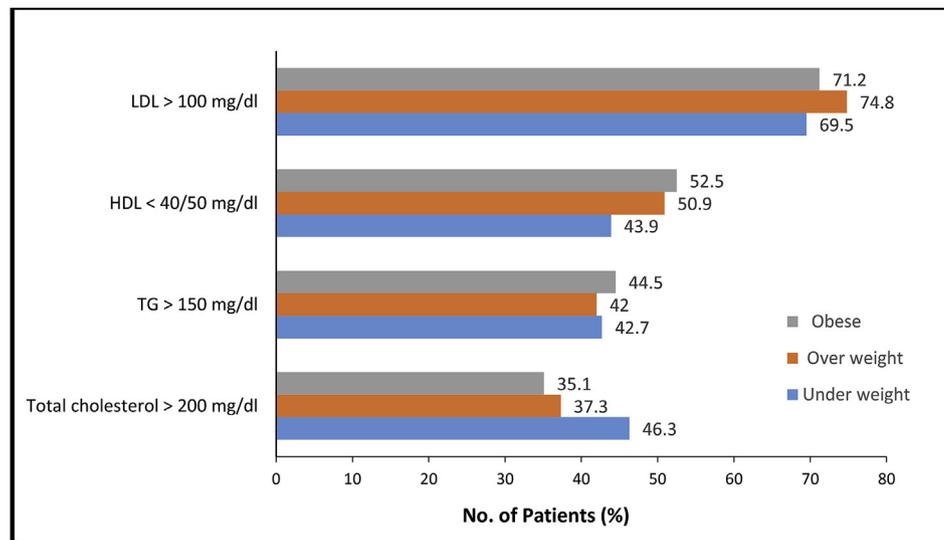


Fig. 2. Graphical presentation of association of dyslipidemia with body mass index.

Table 4
Correlation studies between the blood sugar and serum lipid profile.

Correlation Parameters	r	p
FBS and TC	0.098**	0.007
FBS and TG	0.125**	0.001
FBS and HDL	0.152***	0.000
FBS and LDL	0.066	0.067
TC and TG	0.206***	0.000
TC and HDL	0.671***	0.000
TC and LDL	0.906***	0.000
TG and HDL	0.324***	0.000
TG and LDL	-0.166***	0.000
HDL and LDL	0.549***	0.000

Abbreviations: r, correlation coefficient; P, significance; FBS, fasting blood sugar; TC, total cholesterol; TG, triglyceride; HDL, high density lipoprotein; LDL, low density lipoprotein.

The values expressed as Pearson correlation coefficients.

Correlation is significant at * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$ (two-tailed).

to urbanization in the population from villages. Modernized life style associated with increasing urbanization, characterized by no physical activity, change of diet plan causes obesity leads to development of diabetes type 2. The most prevalent lipid abnormality in our study was high LDL (71.33%) followed by low HDL (49.7%), whereas in another study conducted in Kuwait isolated dyslipidemia is the second most common pattern with increased LDL-cholesterol, observed in 21% of the patients [34]. Ramu Kandula et al. conducted a study in Hyderabad (India) showing that prevalence of dyslipidemia was 86%, while high total cholesterol was 41%, LDL was 64%, triglycerides was 47% and low HDL was 71% [35]. This prevalence of dyslipidemia was relevant to our study. From a study in Nishtar Hospital, Multan (Pakistan), it was found that 21% patients with diabetes had raised serum cholesterol and 34.2% had raised serum triglyceride level [30], while in another study from Pakistan (2011), 14% diabetic patients had raised cholesterol level while 31% patients had raised TG level [36].

In our study high cholesterol level was found in 35.42% patients and serum TG found in 41.97% diabetic patients. Different values of serum cholesterol may be due to different dietary habits of people in different cities of the country. In diabetic patients dyslipidemia was observed in the present study and there was a significant difference in the levels of HDL and LDL but when the mean \pm standard error of the variables were separated for male and female patients

then there was no significant difference found between them. The results showed no gender difference in the lipid metabolism of diabetic patients which was in agreement with the finding of Vinter-Repalust et al. (2007) [37]. However Gustafsson et al. reported a significant difference in the prevalence of diabetic patients between genders [38].

According to different survey reports diabetes mellitus has been one of the most prevailing diseases. Its complications may cause death directly and indirectly [39]. Coronary artery disease is the most common mortality in hyperglycemic patients and is associated with increased level of serum LDL. The risk of cardiovascular heart diseases in hyperglycemic patients is two to four times more as compare to normal. The complications can be reduced by management of diabetes. Further research would be done to determine the management of dyslipidemia and other complications. Adequate knowledge about the different factors controlling diabetes and its complications are important. Improper diet, treatment and life style may be the leading cause of dyslipidemia and other complications.

5. Conclusion

From this study we can come to the conclusion that dyslipidemia specially hypercholesterolemia, hypertriglyceridemia and elevated Low Density Lipoprotein cholesterol has become very common and threatening phenomenon in our country. There is a high prevalence of dyslipidemia found in this study and might be playing a major role in the development of cardiovascular diseases among diabetic patients here. These results remark the extensive need for routine screening programs for blood lipid levels and appropriate intervention programs targeting risk factor reduction. Routine monitoring of blood sugar and serum lipid profile should be included in the treatment of diabetic patients for optimum care. The optimum treatment with anti-diabetic drugs to obtain fair glycaemic control should go hand-in-hand with lipid-lowering drugs.

Author's contribution

HD and SB helped in the study design. HD and SB contributed in the data collection, data analysis and drafting of the manuscript. HD and SB helped in the data interpretation, editing, and reviewing the

manuscript. All authors read and approved the final manuscript. SB takes responsibility of the integrity of the work and is the guarantor.

Compliance with ethical standards

Funding

There was no funding for this study.

Declaration of conflicting interests

The authors declare that they have no competing interests.

Informed consent

Informed consent was obtained from all individual participants included in the study.

Acknowledgements

We are thankful to the authorities of M. A. Hashem Diabetic Hospital, Chowmuhani, Noakhali and Sirajul Haque Diabetic Hospital, Majidee, Noakhali for their heartfelt co-operation in performing this study.

Appendix A. Supplementary data

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.dsx.2018.09.006>.

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