Prevalence and correlates of dyslipidemia, awareness, and management among adults in Bangladesh in 2018

Karl Peltzer[1,2]

AFFILIATION
1 Department of Psychology, University of the Free State, Bloemfontein, South Africa
2 Department of Psychology, College of Medical and Health Science, Asia University, Taichung, Taiwan

CORRESPONDENCE TO
Karl Peltzer, Department of Psychology, College of Medical and Health Science, Lioufeng Rd., Wufeng, Taichung 41354, Taiwan.

Email: kfpeltzer@gmail.com
ORCID ID: https://orcid.org/0000-0002-5980-0876

ABSTRACT

INTRODUCTION The aim of the study was to evaluate the prevalence and correlates of dyslipidemia among people (aged 18–69 years) in Bangladesh.
METHODS National data were analyzed from 7027 individuals aged 18–69 years, with mean age of 39.5 years, that took part in the Bangladesh cross-sectional STEPS survey in 2018, and had complete lipid measurements. Dyslipidemia was defined using the guidelines of the Adult Treatment Panel III. Multivariable analysis was conducted using Poisson regression to assess the extent of association between variables.
RESULTS The prevalence of dyslipidemia was 80.4%, 21.7% high total cholesterol (TC), 35.5% high triglycerides (TG), 20.2% high low-density lipoprotein cholesterol (LDL-C) and 68.9% low high-density lipoprotein cholesterol (HDL-C).

Among those with dyslipidemia, 2.6% were aware. Among those who knew, the proportion of lipid-lowering drug treatment was 36.7%, and among those taking lipid-lowering drugs in the past 2 weeks, 79 (100%) had their dyslipidemia controlled. In multivariable analysis, male sex (adjusted prevalence ratio, APR=1.46; 95% CI: 141–1.52), obesity (APR=1.17; 95% CI: 1.12–1.22), hypertension (APR=1.04; 95% CI: 1.01–1.08), diabetes (APR=1.09; 95% CI: 1.05–1.13), physical inactivity (APR=1.08; 95% CI: 1.04–1.13), and current tobacco use (APR=1.10; 95% CI: 1.06–1.14), were positively associated with dyslipidemia prevalence.
CONCLUSIONS Four in five adults in Bangladesh had dyslipidemia. Several factors associated with dyslipidemia that can be used to target public health interventions are identified.

INTRODUCTION

Dyslipidemia constitutes one or a combination of low high-density lipoprotein cholesterol (HDL-C), elevated triglycerides (TG), elevated total cholesterol (TC), and high low-density lipoprotein cholesterol (LDL-C)[1]. Dyslipidemia can cause major clinical conditions including cardiovascular diseases (CVD). Single plasma lipids and lipoprotein are associated with dyslipidemia and cardiovascular risk, and in the past 30 years the prevalence of dyslipidemia has increased significantly worldwide[1]. CVDs contribute to 30% of mortality in 2018 in Bangladesh[2]. The population-based prevalence of CVDs in Bangladesh was 5.0%, with 1% stroke and 21% heart disease[3]. In South Asia, the prevalence of dyslipidemia was 76.4% in India (Chennai and Delhi) and Pakistan (Karachi) (≥20 years)[4] and 96% in another study in Pakistan (≥20 years)[5]. In the 2006 STEPwise approach to

NCD risk factor surveillance (STEPS) survey in Bangladesh, the prevalence of high TC (≥200 mg/dL) was 5.8%[6], and in a community survey in Dhaka (shantytown) (18–64 years), the prevalence of high TC (≥190 mg/dL) was 34.0% in women and 25.7% in men[7]. In a small community study among general adults (318 males and 87 females) in the Sylhet region, Bangladesh, the prevalence of elevated TC (≥240 mg/dL) was 23.7%[8]. The prevalence, awareness, treatment, and control of dyslipidemia in China (>18 years) was 34.0%, 31.0%, 19.5% and 8.9%, respectively[9].

Limited data are available regarding the prevalence, awareness, treatment, and control of dyslipidemia in South Asia, including Bangladesh, where the pattern and management may be different to other regions or countries of the world[4]. Considering rapid socioeconomic, demographic and health risk behavior changes in the region, the

prevalence of dyslipidemia is probably going to increase and with it, CVD morbidity and mortality[4]. Moreover, there is a great need to classify the major types of dyslipidemia as well as its awareness, treatment and control to improve successful treatments that can lower CVD events and mortality in Bangladesh. Consequently, we analyzed a nationally representative population-based survey to determine the frequency and pattern of dyslipidemia, awareness, treatment, and control in Bangladesh.

As previously reviewed[10], risk factors for dyslipidemia prevalence include sociodemographic factors (male sex, urban residence, and ethnicity), chronic conditions (obesity, CVD, hypertension, and diabetes), and health behavior risk factors (smoking, and physical inactivity. Factors associated with awareness of dyslipidemia diagnosis include sociodemographic factors (older age, urban residence, higher education), chronic conditions (higher BMI, CVD, hypertension, and diabetes)[10]. Factors associated with the treatment of dyslipidemia include female sex, and chronic conditions (CVD, diabetes, and hypertension), and factors positively associated with control of dyslipidemia include female sex, urban residence, chronic conditions (CVD, diabetes, underweight and overweight/obesity), and physical activity[10]. The aim of the study was to assess the prevalence, distribution, and correlates of dyslipidemia among people aged 18–69 years in Bangladesh. As part of the national non-communicable diseases (NCD) prevention and control plan in Bangladesh, it is vital to equip primary healthcare with basic medicines and technology for NCD services[11].

METHODS
Participants and procedures
Secondary data analyses were applied to the cross-sectional national data with complete lipid measurements from the 2018 Bangladesh STEPS survey; the overall study response rate was 84.6%[11]. The survey used a multistage probability-based sampling procedure to randomly select one household member aged 18–69 years[11]. Inclusion criteria were: have stayed in the household the night before the survey regardless of citizenship, and aged 18–69 years. Exclusion criteria were: those staying in institutions, those mentally unfit, those with any physical disability or were severely ill, and those unable or unwilling to give informed consent[11].

Data collection included in step 1 administration of a structured questionnaire on social and health information, in step 2 blood pressure and anthropometric measurements, and in step 3 biochemical tests (blood glucose and blood lipids)[11]. Anthropometry used the Somatometre-Stanley 04-116 device and the GIMA electronic scales[11]. Blood pressure was measured with an automatic OMRON Model M5 blood pressure monitor, and the last two of the three readings were averaged[11]. Biochemical assessments were performed the next day (instructed to fast overnight for 12 hours) for blood glucose and total cholesterol, measured in venous blood samples. Concentrations of glucose, total cholesterol and

HDL cholesterol were measured in plasma samples[11]. Venous blood (5 mL) was collected with a disposable syringe, 2 mL of this blood was used for serum glucose testing and 3 mL of the blood for plasma separation (for lipid profile)[11]. The sample for blood glucose was left in upright position in vacutainer rack and then centrifuged and separated serum was kept in the cold box (2–8°C) surrounded by ice packs and sent to the NIPSOM Lab within 24 hours[11]. Lab analyses included blood glucose, lipid profile with biochemistry auto analyzer (Selectrao Pro M) for blood glucose, Human®, Germany; for HDL with control, Elitech®; TG, Elitech®; with control, Humatrol/serodos®; cholesterol, Elitech® with control Humatrol®, Germany[11].

Ethics approval was provided by the Bangladesh Medical Research Council (BMRC) and written or finger impressions informed consent was obtained from all participants.

Measures
Construct validity and associative validity for the STEPS key survey measures, have been established for providing aggregate data for valid inter-country comparisons[12].

Dyslipidemia was classified[13] as being on antilipidemic medication or having one or more of the following: elevated total cholesterol (TC) ≥5.17 mmol/L (200 mg/dL); high triglycerides (TG) ≥1.70 mmol/L (150 mg/dL); low HDL-C female ≤1.29 mmol/L (50 mg/dL), male ≤1.03 mmol/L (40 mg/dL); and high LDL-C: ≥3.36 mmol/L (130 mg/dL).

The awareness rate of dyslipidemia was defined as: 'Having been diagnosed by a healthcare provider as having high cholesterol among those with dyslipidemia. The rate of dyslipidemia treatment was defined as the self-reported use of lipid lowering drugs in the past 2 weeks among participants who were aware of dyslipidemia. The control rate for dyslipidemia was classified as the proportion among those treated for dyslipidemia who reach the lipid standard (TG <1.70 mmol/L, TC <5.18 mmol/L, HDL-C ≥1.04 mmol/L and LDL-C <3.37 mmol/L)'[13].

Other biological measures included measured body mass index (BMI, kg/m^2), defined as: normal 18.5–22.9, underweight <18.5, overweight 23.0–24.9, obesity class I 25.0–29.9, and obesity class II ≥30.0[14]. Hypertension/raised blood pressure (BP) defined as: systolic BP ≥140 mm Hg and/or diastolic BP ≥90 mm Hg, or where the participant is currently on antihypertensive medication[15]. Diabetes was defined as having: fasting plasma glucose levels ≥7.0 mmol/L (≥126 mg/dL) or using insulin or oral hypoglycemic drugs[16].

Behavioral measures included current tobacco use, meals per week outside home, times of eating snacks per day, and physical inactivity (low physical activity) according to the Global Physical Activity Questionnaire[17]. Sociodemographic information included region, residence status, sex, education level, and age[11].

History of CVDs included self-reported response to: 'Have you ever had a heart attack or chest pain from heart disease (angina) or a stroke (cerebrovascular accident or incident)?' (yes/no)[11].

Statistical analysis

All statistical analyses were conducted with STATA software version 14.0 (Stata Corporation, College Station, TX, USA). Descriptive statistics were used to describe lipid profiles. Univariable and multivariable analyses were conducted using Poisson regression, with simple robust variance, and estimative prevalence ratios (PRs) with 95% confidence intervals (CIs) to assess the extent of association between variables. Svy commands in STATA were applied to adjust for sampling design, sampling weights, and stratification, and the calculation of standard errors. Taylor linearization methods were used for variance estimation in which linear approximates (i.e. the estimated variance) of a nonlinear function (i.e. the true variance) are derived by taking the first-order Taylor series of the approximation. Co-variates were selected and included based on a previous literature review[10], region was excluded due to collinearity. Variables significant in univariable analyses were subsequently included in multivariable analyses. A p<0.05 was considered significant, and missing values were discarded. The variance inflation factor (VIF) was calculated to check for multicollinearity, and none was found between the study variables.

RESULTS

Sample characteristics

The sample with complete lipid measurements included 7027 people (aged 18–69 years), with a mean age of 39.5 years (SD=12.2 years), in 2018. The prevalence of dyslipidemia was 80.4%, 21.7% high TC, 35.5% high TG, 20.2% high LDL-C, and 68.9% low HDL-C. Among the nine regions of Bangladesh, the highest proportion of dyslipidemia was found in Sylhet (85.7%) and the lowest in the Rangpur region (74.4%). The average values (median; interquartile range) for the dyslipidemia subcategories were for TC (168.0; 144.0–195.0), TG (123.0; 85.0–180.0), LDL-C (100.8; 80.8–122.8) and HDL-C (37.0; 32.0–43.0). Further sample characteristics are described in Table 1.

Table 1. Sample description and prevalence of dyslipidemia and its subtypes, cross-sectional population survey, Bangladesh 2018 (N=7027)

Characteristics	Total	High TC	High TG	Low HDL-C	High LDL-C	Dyslipidemia
	n (%)[a]	%[b]	%[b]	%[b]	%[b]	%[b]
Total	7027 (100)	21.7	35.5	68.9	20.2	80.4
Age (years)						
18–29	1546 (22.0)	15.7	26.6	64.0	15.0	74.5
30–44	3058 (43.5)	20.0	37.2	69.2	17.7	79.6
45–59	1904 (27.1)	28.2	41.6	71.3	26.8	85.2
60–69	519 (7.4)	31.0	39.5	77.5	30.2	89.9
Sex						
Female	3792 (54.0)	23.0	30.1	47.7	21.5	67.1
Male	3235 46.0	20.2	42.0	94.5	18.6	96.6
Education level						
No schooling	2200 (31.4)	20.6	32.1	67.6	20.3	79.9
<Primary	1063 (15.2)	19.0	31.0	71.9	16.9	81.9
Primary	2192 (31.3)	21.9	36.0	66.5	20.4	78.2
≥Secondary	1553 (22.2)	25.3	43.6	72.5	22.3	83.5
Residence						
Rural	3730 (53.1)	20.9	33.8	68.1	19.8	79.5
Urban	3297 (46.9)	25.1	42.1	72.0	21.8	84.1
Region						
Barisal	841 (12.0)	28.6	35.3	68.9	28.4	80.7
Chittagong	847 (12.1)	24.5	38.7	71.8	24.9	83.9
Dhaka Rural	760 (10.8)	22.6	37.8	69.0	20.1	79.2
Khulna	945 (13.4)	25.4	34.3	60.5	22.2	77.9
Mymensingh	910 (13.0)	15.9	32.6	75.8	14.4	84.6

Continued

Table 1. Continued

Characteristics	Total	High TC	High TG	Low HDL-C	High LDL-C	Dyslipidemia
	n (%)[a]	%[b]	%[b]	%[b]	%[b]	%[b]
Rajshahi	981 (14.0)	18.7	34.1	65.7	16.1	78.9
Rangpur	902 (12.8)	15.2	28.3	66.7	14.3	74.4
Sylhet	841 (12.0)	23.9	39.7	76.6	23.4	85.7
BMI						
Normal	2782 (40.3)	16.4	28.0	71.2	17.2	79.6
Underweight	930 (13.5)	8.2	14.6	64.9	9.8	69.8
Overweight	1159 (16.8)	26.7	43.1	70.0	22.3	82.3
Obesity	2395 (30.0)	32.0	52.0	69.4	28.0	86.0
Health status						
Hypertension	1846 (26.3)	35.2	50.4	68.3	31.2	84.7
Diabetes	669 (9.5)	42.5	65.2	77.1	32.9	94.2
Cardiovascular disease	764 (10.9)	26.4	38.0	66.9	27.0	82.0
Physical inactivity	1038 (14.9)	30.4	45.3	70.3	26.0	85.3
Consumption						
Meals outside home	2059 (29.3)	20.2	41.2	85.5	18.1	91.2
Snacks	3044 (44.5)	20.5	36.8	73.3	18.4	83.0
Current tobacco use	3895 (47.6)	21.9	38.1	79.1	20.3	88.2

a Unweighted. **b** Weighted. BMI: body mass index. TC: total cholesterol. TG: triglycerides. HDL-C: high-density lipoprotein cholesterol. LDL-C: low-density lipoprotein cholesterol.

Distribution of awareness, treatment, and control of dyslipidemia

Among those with dyslipidemia, 2.6% were aware. Among those who knew, the proportion of lipid-lowering drug treatment was 36.7%, and among those taking lipid-lowering drugs in the past 2 weeks, 79 (100%) had their dyslipidemia controlled. In terms of different regions in Bangladesh, the prevalence of dyslipidemia was highest in Sylhet (85.7%) and Mymensingh 84.6%, and lowest in Rangpur (74.4%), while the prevalence of awareness was highest in Barisal (5.0%) and Dhaka Rural (4.9%), and lowest in Rangpur (1.0%) and Mymensingh (1.1%) (Table 2).

Risk factors for the prevalence of dyslipidemia

In multivariable analysis, male sex (adjusted prevalence ratio, APR=1.46; 95% CI: 1.41–1.52), obesity (APR=1.17; 95% CI: 1.12–1.22), hypertension (APR=1.04; 95% CI: 1.01–1.08), diabetes (APR=1.09; 95% CI: 1.05–1.13), physical inactivity (APR=1.08; 95% CI: 1.04–1.13), and current tobacco use (APR=1.10; 95% CI: 1.06–1.14) were positively associated with dyslipidemia prevalence, and being underweight (APR=0.88; 95% CI: 0.83–0.93) was negatively associated with dyslipidemia prevalence (Table 3).

Associations with dyslipidemia awareness and treatment

In multivariable analysis, higher education (APR=3.11; 95%

Table 2. Dyslipidemia awareness, treatment, and control, cross-sectional population survey, Bangladesh 2018 (N=7027)

Variable	Dyslipidemia [Control: N=79 (100%)]	
	Awareness (N=571)	Treatment (N=200)
	%	%
Total	2.6	36.7
Age (years)		
18–29	0.6	22.2
30–44	2.5	24.8
45–59	4.0	43.0
60–69	4.5	53.8
Sex		
Female	2.6	30.0
Male	2.6	42.3
Education level		
No schooling	1.4	31.9
<Primary	0.8	16.4
Primary	3.3	41.5

Table 2. Continued

Variable	Dyslipidemia [Control: N=79 (100%)]	
	Awareness (N=571)	Treatment (N=200)
	%	%
≥Secondary	4.8	37.1
Residence		
Rural	1.9	31.5
Urban	5.1	43.9
Region		
Barisal	5.0	40.3
Chittagong	2.0	40.4
Dhaka Rural	4.9	37.8
Khulna	2.5	57.1
Mymensingh	1.1	12.8
Rajshahi	1.3	9.5
Rangpur	1.0	38.5
Sylhet	2.6	23.6

Continued

Table 2. Continued

Variable	Dyslipidemia [Control: N=79 (100%)]	
	Awareness (N=571)	Treatment (N=200)
	%	%
BMI		
Normal	1.1	44.2
Underweight	0.1	64.4
Overweight	1.4	24.1
Obesity	6.5	35.5
Health status		
Hypertension	6.4	45.8
Diabetes	11.9	50.8
Cardiovascular disease	7.6	48.3
Physical inactivity	3.4	45.8
Consumption		
Meals outside home	2.4	22.1
Snacks	2.2	45.4
Current tobacco use	2.1	38.6

Table 3. Risk factors for dyslipidemia prevalence, cross-sectional population survey, Bangladesh 2018 (N=7027)

Variable	PR (95% CI)	p	APR (95% CI)	p
Age (years)				
18–39 (Ref.)	1		1	
40–69	1.11 (1.07–1.14)	<0.001	1.03 (1.00–1.06)	0.069
Sex				
Female (Ref.)	1		1	
Male	1.44 (1.39–1.49)	<0.001	1.46 (1.41–1.52)	<0.001
Education level				
No schooling (Ref.)	1		1	
<Primary	1.03 (0.98–1.08)	0.295	1.04 (1.00–1.08)	0.064
Primary	0.98 (0.94–1.02)	0.345	1.00 (0.96–1.05)	0.846
≥Secondary	1.05 (1.00–1.09)	0.046	1.00 (0.95–1.04)	0.906
Residence				
Rural (Ref.)	1		1	
Urban	1.06 (1.03–1.09)	<0.001	1.02 (0.98–1.05)	0.333
BMI				
Normal (Ref.)	1		1	
Underweight	0.88 (0.82–0.94)	<0.001	0.88 (0.83–0.93)	<0.001
Overweight	1.03 (0.99–1.09)	0.167	1.07 (1.02–1.12)	0.003
Obesity	1.08 (1.04–1.12)	<0.001	1.17 (1.12–1.22)	<0.001

Continued

Table 3. Continued

Variable	PR (95% CI)	p	APR (95% CI)	p
Health status				
Hypertension	1.07 (1.04–1.11)	<0.001	1.04 (1.01–1.08)	0.018
Diabetes	1.19 (1.15–1.23)	<0.001	1.09 (1.05–1.13)	<0.001
Cardiovascular disease	1.02 (0.96–1.08)	0.462	-	
Physical inactivity	1.07 (1.03–1.11)	<0.001	1.08 (1.04–1.13)	<0.001
Consumption				
Meals outside home	1.19 (1.15–1.23)	<0.001	1.01 (0.98–1.04)	0.539
Snack intake	1.06 (1.02–1.10)	0.002	0.99 (0.96–1.02)	0.551
Current tobacco use	1.19 (1.16–1.23)	<0.001	1.10 (1.06–1.14)	<0.001

APR: adjusted prevalence ratio; adjusted for age group, sex, education level, residence status, body mass index, hypertension, diabetes, cardiovascular disease, physical inactivity, meals outside home, snack intake, and current tobacco use.

CI: 1.58–6.11), obesity (APR=3.27; 95% CI: 1.75–6.13), hypertension (APR=1.66; 95% CI: 1.05–2.61), diabetes (APR=2.87; 95% CI: 1.77–4.66), and CVD (APR=3.04; 95% CI: 2.13–4.35) were positively associated with awareness of dyslipidemia, and being underweight (APR=0.14; 95% CI: 0.03–0.61) was negatively associated with dyslipidemia awareness. Among those who were aware of their state of dyslipidemia, diabetes (APR=1.73; 95% CI: 1.10–2.70) was positively associated with the treatment of dyslipidemia (Table 4).

Table 4. Associations with prevalence of dyslipidemia awareness and treatment, cross-sectional population survey, Bangladesh 2018 (N=7027)

Variable	Awareness (N=5714)				Treatment (N=200)			
	PR (95% CI)	p	APR (95% CI)[a]	p	PR (95% CI)	p	APR (95% CI)[b]	p
Age (years)								
18–39 (Ref.)	1		1		1		1	
40–69	3.45 (2.09–5.69)	<0.001	2.62 (1.46–4.69)	<0.001	2.50 (1.16–5.40)	0.020	2.10 (0.97–4.53)	0.058
Sex								
Female (Ref.)	1		-		1		-	
Male	1.03 (0.69–1.52)	0.897			1.41 (0.83–2.39)	0.203		
Education level								
No schooling (Ref.)	1		1		1		-	
<Primary	0.59 (0.26–1.34)	0.207	0.82 (0.33–2.07)		0.52 (0.12–2.29)	0.383		
Primary	2.41 (1.34–4.34)	0.004	2.46 (1.38–4.38)		1.23 (0.59–2.56)	0.586		
≥Secondary	3.44 (1.84–6.43)	<0.001	3.11 (1.58–6.11)		1.15 (0.54–2.42)	0.715		
Residence								
Rural (Ref.)	1		1		1		-	
Urban	2.68 (1.76–4.09)	<0.001	1.49 (0.97–2.30)		1.34 (0.84–2.15)	0.216		
BMI								
Normal (Ref.)	1		1		1		-	
Underweight	0.11 (0.02–0.49)	0.004	0.14 (0.03–0.61)		1.54 (0.50–4.78)	0.451		
Overweight	1.26 (0.62–2.56)	0.527	0.79 (0.39–1.61)		0.47 (0.17–1.30)	0.145		
Obesity	5.92 (3.51–10.00)	<0.001	3.27 (1.75–6.13)		0.85 (0.46–1.59)	0.610		

Table 4. Continued

Variable	Awareness (N=5714)				Treatment (N=200)			
	PR (95% CI)	p	APR (95% CI)[a]	p	PR (95% CI)	p	APR (95% CI)[b]	p
Health status								
Hypertension	4.83 (3.20–7.30)	<0.001	1.66 (1.05–2.61)		2.08 (1.14–3.81)	0.018	1.52 (0.88–2.64)	0.135
Diabetes	7.40 (4.95–11.08)	<0.001	2.87 (1.77–4.66)		1.90 (1.16–3.11)	0.011	1.73 (1.10–2.70)	0.017
Cardiovascular disease	3.88 (2.60–5.79)	<0.001	3.04 (2.13–4.35)		1.62 (0.97–2.72)	0.066	-	
Physical inactivity	1.39 (0.88–2.19)	0.161	-		1.38 (0.85–2.26)	0.191	-	
Consumption								
Meals outside home	0.92 (0.59–1.44)	0.707	-		0.53 (0.28–1.01)	0.054	-	
Snack intake	0.76 (0.51–1.14)	0.182	-		1.32 (0.79–2.22)	0.287	-	
Current tobacco use	0.65 (0.45–0.96)	0.028	0.94 (0.60–1.48)		1.15 (0.69–1.90)	0.589	-	

APR: adjusted prevalence ratio. **a** Adjusted for age group, education level, residence status, body mass index, hypertension, diabetes, cardiovascular disease, and current tobacco use. **b** Adjusted for age group, hypertension, and diabetes.

DISCUSSION

The study presents for the first time national data on the prevalence and distribution of dyslipidemia in people aged 18–69 years in Bangladesh in 2018. The proportion of dyslipidemia in Bangladesh (80.4%) was higher than in India (Chennai and Delhi) and Pakistan (Karachi) (≥20 years) (76.4%)[4] and lower than in Pakistan (≥20 years, 96%)[5]. The most prevalent component of dyslipidemia component was low HDL-C (68.9%), followed by high TG (35.5%), high TC (21.7%), and high LDL-C (20.2%). A similar order of prevalence of components of dyslipidemia was found in Dhaka (Shantytown)[7], in the Sylhet region, Bangladesh[8], in Pakistan[5], and China[9], with a low HDL-C having the highest prevalence. Low HDL-C levels are a risk factor for coronary heart disease[13].

The prevalence of high TC (≥200 mg/dL or on medication, 21.7%) in this study was higher than in the 2006 STEPS survey in Bangladesh (5.8%)[6], lower than in Dhaka (shantytown) (TC ≥190 mg/dL or on medication, 25.7% in men and 34.0% in women)[7], and Pakistan (≥20 years, 39.3%)[5]. The prevalence of high TG (35.5%) in this study was higher than in Dhaka (shantytown) (32.2% in men and 22.4% in women)[7], and lower than in Pakistan (48.9%)[5]. The prevalence of high LDL-C (20.2%) in this study was higher than in a shantytown in the city of Dhaka shantytown (11.7% in men and 12.6% in women)[7], and in Pakistan (39.7%)[5]. The prevalence of low HDL-C (68.9%) in this survey was lower than in the Sylhet region, Bangladesh (78.8%)[8], similar to that in the city of Dhaka (shantytown) (73.2% in men and 55.7% in women),[7] but lower than in Pakistan (87.4%)[5].

Consistent with previous research[5,9,18,19], obesity, hypertension, diabetes, physical inactivity and tobacco use increased risk, and underweight decreased risk of dyslipidemia. The tendency to have a higher prevalence of dyslipidemia with higher levels of BMI can be attributed to 'global metabolic effects of insulin resistance and an excess of visceral fat'[20]. Bangladesh is undergoing a nutritional transition[21], which may contribute to the found high prevalence of overweight or obesity (46.2%), increasing the risk of dyslipidemia. Tobacco use is a known risk factor that impairs insulin and may be implicated in insulin resistance[22,23]. Although the prevalence of dyslipidemia increased as expected with age, already 74.5% of young adults (aged 18–29 years) had dyslipidemia, emphasizing the importance of early screening, management, and health promotion[19].

In agreement with some studies in China[9,24], we found that being male was positively associated with dyslipidemia, mainly due to a higher high TG and a higher low HDL-C in men than in women. Although some research[9] showed a positive association between CVD and dyslipidemia, we did not find this association, but we found a positive association between CVD and awareness of dyslipidemia. It is possible that those with CVD have been more likely diagnosed, treated and controlled their dyslipidemia. Furthermore, we found regional differences in the prevalence and awareness of dyslipidemia, such that the prevalence of dyslipidemia was the highest in the regions of Sylhet (85.7%) and Mymensingh 84.6%, and the lowest in Rangpur (74.4%), while the prevalence of awareness was the highest in Barisal (5.0%) and Dhaka Rural (4.9%), and the lowest in Rangpur (1.0%) and Mymensingh (1.1%). The role of geographical or regional determinants of dyslipidemia and awareness is important in designing effective intervention strategies[25].

The prevalence of awareness of dyslipidemia (2.6%), treatment (36.7%), and control (100%) were in terms of awareness and treatment lower than in a 35-country study in low- and middle-income countries (31/36% and 29/33%, respectively) but higher in terms of control (7/19%)[26]. Awareness was also much lower than in China (31.0%) but treatment was higher than in China (19.5%) and control was higher than in China (8.9%)[9]. In particular, the low awareness of dyslipidemia emphasizes the need for opportunistic screening in Bangladesh. Consistent with previous results[18,25,26], older age, higher education level, obesity, hypertension, diabetes, and CVD were associated with increased awareness of dyslipidemia in this study. The association between higher education and higher awareness of dyslipidemia may be explained by higher health literacy and healthcare utilization in educated Bangladeshis[25]. The association between general obesity and awareness of dyslipidemia may be attributed to lipids being part of weight management.

Strengths and limitations

The strengths of the study include the national prevalence of dyslipidemia of a large sample and the use of standardized STEPS methods. Due to the cross-sectional design, we cannot draw causal conclusions. The Bangladesh STEPS survey 2018 did not include more details on dietary behavior and the family history of hyperlipidemia, which should be part of future studies. The behavioral variables evaluated were assessed by self-report, which may have led to biased responses.

Policy implications

The study has important policy implications for Bangladeshi policy makers in designing appropriate health programs to control dyslipidemia. The high prevalence of dyslipidemia with the associated risk factors seen in this study should provide good incentives for steps by health planners to control dyslipidemia. As a result of the very low awareness and treatment of dyslipidemia, the creation of community awareness programs and greater use of lipid-lowering drugs are indicated. Furthermore, since physical inactivity increased the risk of dyslipidemia, strategies to improve the adoption and adherence to exercise programs should be promoted and emphasized to improve health.

CONCLUSIONS

Four in five adults in Bangladesh had dyslipidemia. Several risk factors, including male sex, chronic conditions (hypertension and diabetes), physical inactivity, and current tobacco use were identified for dyslipidemia. The high prevalence and low awareness of dyslipidemia in Bangladesh warrants enhanced public health interventions, including the promotion of dyslipidemia screening using a multifaceted approach with special attention to controlling identified risk factors.

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