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Factors associated with atherogenic dyslipidemia among hypertensive patients at southern Ethiopia

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Atherogenic dyslipidemia worsens cardiovascular functions and supporting data concerning dyslipidemia among hypertensive patients in Ethiopian situation is very limited. The objective of this study was to assess factors associated with atherogenic dyslipidemia among hypertensive patients at Southern Ethiopia. A cross-sectional study was conducted on 238 hypertensive participants at Hawassa University comprehensive specialized hospital from September 2015 to June 2016. Systematic random sampling technique was used and written informed consent was obtained from each participant. Socio-demographic and other relevant data were collected by pre-structured questionnaires. In addition overnight fasting blood sample was collected from each study subjects for serum biochemicals determination. About 90.8% of patients had least one dyslipidemia, with the most frequent being hypertriglyceridemia (62.2%) and low high-density lipoprotein cholesterol (HDL-c, 60.9%). Being a female was significantly associated with dyslipidemia. The adjusted odds ratio (95% CI) was 2.1 (1.2-3.9; P=0.01) for hypercholesterolemia (TC), 2.4 (1.1-4.9; P=0.02) for raised low-density cholesterol (LDL-c) and 2.9 (1.6-5.4; P<0.0001) for low HDL-c. In addition, patients with hyperuricemia were more likely to develop hypercholesterolemia, hypertriglyceridemia, low HDL-c and raised TC/HDL-c when compared to patients with normouricemia. The adjusted odds ratio (95% CI) was 1.8 (1.1-3.1; P=0.047), 2.6 (1.4-4.8; P= 0.001), 2.7 (1.5-4.8; P=0.001) and 3.1 (1.7-5.4, P<0.0001), respectively. The prevalence of raised TC, LDL-c, triglycerides and low HDL-c were higher in hypertensive patients and these are an established atherogenic lipid profiles. Therefore, lipid profiles should be performed at the baseline of hypertension diagnosis prior to starting any anti-hypertensive agents and then periodically through treatment follow-up to manage any increasing trends.

Key words: Atherogenic dyslipidemia, hypertension, cardiovascular risks, Southern-Ethiopia.

INTRODUCTION

Hypertension (HTN) is a disease that is characterized by raised blood pressure; and HTN is one of the main indicators of the cluster of clinical anomalies that characterize metabolic syndrome (MetS). About 30 to 40% of the hypertensive subjects develop MetS (Marchi-Alves et al., 2012). Dyslipidemia is the one, which causes atherosclerosis, and the atherosclerosis is linked with pathophysiologic as well as structural alteration in

arteries, and it contributes to the progress of arterial hypertension and other risks (Oparil et al., 2003). In addition, atherogenic dyslipidemia consists of raised blood triglycerides (TGs) and apolipoprotein B (apoB), raised level of small low-density lipoprotein cholesterol (LDL-c) particles, and a reduced level of high-density lipoprotein cholesterol (HDL-c) (NCEP III, 2002). Besides, it is well known that cardiovascular disease (CVD) is associated with HTN and altered level of blood lipids (increased levels of LDL-c, total cholesterol (TC), and TGs) and low level of HDL-c (NCEP III, 2002; Jacobson et al., 2014; Mora et al., 2013). The frequent bunching of hypertension with atherosclerotic dyslipidemia, and other metabolic derangements in patients has been obviously proven to be synergistic and accelerating the development of atherosclerosis and CVD related morbidity and mortality (NCEP III, 2002). Moreover, several studies suggested that serum LDL-c, TGs, TC, apolipoprotein-B levels, TG/HDL-c, were strongly associated with serum hyperuricemia, while the HDL-c level was significantly and inversely associated with hyperuricemia (Peng et al., 2015, Lu et al., 2012, and Conen et al., 2004). This signifies that serum uric acid is a strong risk factor of coronary heart diseases (CHD) (Choi and Ford, 2007). Besides, older age and female gender was also risk factors of dyslipidemia except for low HDL-c (Yu et al., 2015).

Furthermore, urbanization, increased life expectancy, the effect of non-healthy diet and individuals' lifestyle have a great impact on rising trend of CVD in developing as well as developed countries (Joshi et al., 2007). Nowadays, the increasing incidence of hypertension situation and atherogenic dyslipidemia in patients may worsen the health condition and predisposes to other non-communicable diseases. In addition, CVD related illnesses and diabetes are 21st century great temptations in most developing countries. However, data concerning dyslipidemia among hypertensive patients in Africa situation including Ethiopia is limited. Therefore, the present study aimed to assess factors associated with atherogenic dyslipidemia among hypertensive populations.

MATERIALS AND METHOD

Study setting and study population

This institution based cross sectional study was conducted at Hawassa University comprehensive specialized Hospital, Southern Nations Nationalities and Peoples Region (SNNPR) from September 2015 to June 2016. The Hospital was established in November 2006 and it provides teaching and health services for more than 15 million people of the south region and neighboring regions. Currently, the hospital has over 400 beds and gives different health services including students' practical training. All hypertensive subjects age greater than or equal to18 years old who had a regular follow-up were eligible in the study. However, patients using lipid-altering drugs, pregnant women, and patients with confirmed diabetes, cardiac and renal failure were excluded from the study.

Ethics approval and consent to participate

The study was approved by the Institutional Review Board of Hawassa University, College of Medicine and Health Sciences. All the study subjects were well informed about the procedures of the study, the involvement was voluntary and written informed consent was obtained from each study participant prior to data collection.

Sample size and technique

The sample size was calculated based on single population proportion formula and the prevalence of 17.8% of combined dyslipidemia in hypertensive patients (Akintunde et al., 2010).

Based on the above-mentioned, formula, including with 10% non-response rate, the final sample size was calculated to be 248. To select participants from the study population, direct patients flow was checked for one week in the chronic diseases clinic including with patients' logbook assessment. Thus, the trend showed that the average weekly hypertensive patients flow was about 80. Lastly, every fourth hypertensive patients were selected using systematic random sampling approach.

Data collection and measurements

Socio-demographic data and other important clinical information of the study participants were collected by trained nurses using pre-tested structured questionnaires. Hydrodynamic data (Systolic blood pressure and diastolic blood pressure) was measured from each subjects using automatic electronic sphygmomanometer (Omron). The accuracy of the measurment was sustained by measuring a minimum of two readings within 3-5 min differences after patients rested about 10-15 min in the clinic and finally the average blood pressure (BP) was taken and recorded Regarding anthropometric data, weight, height and waist circumference were measured based on WHO steps. By using weight and height, body mass index (BMI) was calculated for each individual as the weight (Kg) divided by the height square (m^2) and classified based on international conventions (WHO, 2016). In addition, waist circumference (WC) of the individuals was measured at the navel using a non-stretched tape (to the nearest 0.1 cm) with standing position.

Overnight fasting 4-5 ml of venous blood sample was collected from each study subjects and then serum was obtained and analyzed for determination of lipid profile and uric acid using A25^{TM} BioSystem Random Access chemistry analyzer in the Hawassa

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University Comprehensive specialized hospital laboratory. While, TC/HDL-c ratio was calculated from TC and HDL-c.

Definition of dyslipidemia

According to National Cholesterol Education Program Adult Treatment Panel III (NCEP-ATP-III,) Guideline, individuals should have at least one of the following lipid parameters abnormal to be categorized under the presence of dyslipidemia: TC ≥200 mg/dl, HDL-c (<40 mg/dl in men and <50mg/dl in women), LDL-c ≥ 130 mg/dl, TG ≥150mg/dl and TC/HDL-c ratio ≥5 (NCEP III, 2002) whereas hyperuricemia was assessed based on uric acid levels ≥7.2 mg/dl in males and ≥6.0 mg/dl in females (Sui et al., 2008).

Statistical analysis

All questionnaires were checked and entered into epidata version 3.1 Statistical Package for Social Sciences (SPSS version 20) was used for statistical analysis. Categorical variables were summarized as frequencies and percentages, while mean values and standard deviations were tabulated for normally distributed quantitative continuous variables. In addition, median values and interquartile range (IQR) were tabulated for skewed variables. Chi-square was used for categorical variables. Furthermore, bivariate and multivariate binary logistic regression analysis was used to evaluate study groups variations in the distribution of categorical variables. Finally, in all cases, alpha level was set at 0.05 at 95% confidence interval (CI) for statistical significance.

RESULTS

Socio-demographic and other features of the study participants

From 248 study subjects, about 238 participated in this study with 96% (238/248) response rate. Of whom, 44.1% (105/238) were men and 55.9% (133/238) were women with a mean age of 53.2 (±14.5) years. Majority, 226 (95%) of the patients had been using at least one anti-hypertensive agents. About 26.1, 7.6, and 24.4% of the study participants were rural residents, non-married and educationally unable to read and write, respectively. In addition, 17.2% of the study participants had BMI ≥ 30 Kg/m^2 (obese). The prevalence of lipid derangements (TC ≥ 200 mg/dl, TGs ≥150 mg/dl, LDL-c ≥ 130 mg/dl and low HDL-c) was 38.7, 62.2, 21 and 60.9%, respectively. Further, 73.1% of the participants had no trends of doing regular physical exercises and 39.9% of the study subjects had hyperuricemia (Table 1).

Pattern of dyslipidemia in relation to different variables

The prevalence of low HDL-c and TC ≥ 200 mg/ dl were significantly higher in females when compared to males, (45.1% vs. 30.5%, P=0.02) and low HDL-c (70.7% vs. 48.6%, P=0.001), respectively. The raised TC was significantly higher among patients older than >45 years when compared to ≤45 years (43.3% vs. 24.8 %; p=0.03), respectively. As well, raised TC, TGs and TC/HDL-c were significantly higher among patients with BMI ≥ 25 Kg/m^2 (overweight to obese) when compared to patients with BMI<25 Kg/m^2 (45.3% vs. 30.9%, p=0.02; 67.7% vs. 53.1%, p=0.01 and 44.5% vs. 26.4%, P=0.004), respectively. Moreover, patients who have no current history of performing of regular exercise had significantly raised TC and raised LDL-c (44.3% vs. 23.4%, P=0.003; and 26.4%vs. 6.2%, P= 0.001) when compared to those patients having experiences of performing regular physical exercise. Furthermore, the prevalence of hyperuricemia was 95 (39.9%) and abnormal levels of TC, TGs, HDL-c and TC/HDL-c were higher among patients with hyperuricemia (Table 2). About 90.8% of the study population had at least one lipid profile abnormal that is compatible with the diagnosis of dyslipidemia and 61.8% of the study participants had greater than or equal to two lipid profiles abnormal (dyslipidemia) (Figure 1).

Patients with a single profile derangement: reduced HDL-c was 37 (15.5%), two-profile derangement: raised TG-HDL-c was 23 (11.8%), three-profile derangement: raised TG-HDL-TC/HDL was 28 (11.8%) and four profile derangement: raised TC-TG-HDL-TC/HDL-c was 16 (6.7%).

Factors associated with lipid derangements

Bivariate analysis, model was applied to assess the independent risk factors for each lipid profile derangements. Being a female, the crude odds ratio [COR (95% CI): 1.9(1.1-3.2), P=0.02 for TC; 2.1(1.1-4.2), P=0.02 for LDL-c and 2.5(1.5-4.3), p=0.001 for HDL-c]. Hyperuricemia [COR (95% CI): 2.0(1.2-3.4, P=0.001) for TC: 2.8(1.5-4.9, P=0.001) for TGs; 2.5(1.4-4.4, P=0.001) for HDL-c; and 3.3(1.9-5.7, P<0.0001) for TC/HDL-c]. In addition, BMI and physical activity were significantly associated with TC, while the duration of HTN since its diagnosis and physical activity were significantly associated with LDL-c. However, multivariate analysis, was adjusted for independent factors and being a female, the adjusted odds ratio [AOR (95% CI): 2.1(1.2 3.9), P=0.01 for TC; 2.4(1.1-4.9), P=0.02 for LDL-c; and 2.9(1.6-5.4), P<0.0001 for HDL-c]. Hyperuricemia [AOR (95% CI): 1.8(1.1-3.1), P=0.047; for TC; 2.6(1.4-4.8), P=0.001 for HDL-c; and 3.1(1.7-5.4), P<0.0001 for TC/HDL-c].

In addition, experiences of performing physical exercise and the duration of HTN were significantly associated with LDL-c (Table 3).

Table 1. Socio-demographic and other characteristics of hypertensive patients.

Variables		N=238	Variable	N=238
Gender :	Female	133(55.9%)	WC, cm (mean ±SD)	89.7(12)
	Male	105(44.1%)	SBP, mmHg (mean ±SD)	134(18.1)
Age in years (mean ±SD)		53.2(14.5)	DBP, mmHg (mean ±SD)	84.9(12.1)
	≤45 years	74(31.1%)	HDL-c, mg/dl (median, IQR)	41.0(34-51)
	46-60 years	88(37.0%)	TGs, mg/dl (median, IQR)	175(129-256)
	>60 years	76(31.9%)	TC, mg/dl (median, IQR)	188(153-216)
Residence:	Rural	62(26.1%)	LDL-c, mg/dl (median, IQR)	103.7(76.8-125)
	Urban	176(73.9%)	TC/HDL-c (median, IQR)	4.4(3.5-5.7)
Marital status:	Single	18(7.6%)	TG/HDL(Log^{10}) (mean ±SD)	0.64(0.28)
	Married	214(89.9%)	BMI, kg/m^2 (mean ±SD)	25.4(5)
	Divorced/widow	6(2.5%)	<18.5 kg/m^2	15(6.3%)
Occupation	Employed	75(31.5%)	18.5-24.9 kg/m^2	99(41.6%)
	Unemployed	163(68.5%)	25-29.9 kg/m^2	83(34.9%)
Educational status:	Illiterate	58(24.3%)	≥30 kg/m^2	41(17.2%)
	Primary	87(36.6%)	MetS (by IDF)	145(60.9%)
	Secondary and above	93(39.1%)	Low HDL-c	145(60.9%)
Ways of transportation:	Foot/bicycle	185(77.7%)	TC (≥200 mg/dl)	92(38.7%)
	Motorized vehicles	53(22.3%)	LDL-c (≥130 mg/dl)	50(21.0%)
Doing regular physical exercise:	Yes	64(26.9%)	TC/HDL-c (≥5)	86(36.1%)
	No	174(73.1%)	TGs (≥150 mg/dl)	148(62.2%)
Ever drink alcohol	Yes	3(1.3%)	Uric acid, mg/dl (mean ±SD)	6.1(1.9)
	No	235(98.7%)	Hyperuricemia	95(39.9%)

IQR, interquartile range; BMI, body mass index; DBP, diastolic blood pressure; HDL-c, high density lipoprotein cholesterol; SD, standard deviation; WC, waist circumference; SBP, systolic blood pressure; TGs, triglycerides; TC, total cholesterol; MetS, metabolic syndrome; IDF, international diabetes federation.

DISCUSSION

We found that the prevalence of raised TC and low HDL-c were significantly higher in women when compared to men, and thus indicating the influence of gender in lipid derangement. In addition, we found that the prevalence of dyslipidemia (TC ≥ 200 mg/dl, TGs ≥150 mg/dl, LDL-c ≥130 mg/d l and low HDL-c) was 38.7, 62.2, 21 and 60.9%, respectively. Besides, the majority of hypertensive patients (90.8%) had at least one dyslipidemia and the mixed type of dyslipidemia (greater than or equal to two lipid profile derangements) was 61.8%. Moreover, female gender was associated with raised levels of TC, LDL-c and reduced HDL-c, while hyperuricemia was associated with abnormal level of TC, TGs, HDL-c and TC/HDL-c. Studies reported that the prevalence of dyslipidemia was 52.7% and 68.7% (Luo et al., 2014; Yu et al., 2015), respectively. In addition, Framingham Heart Study indicated that more than 80% of hypertensive patients had at least one additional cardiovascular disease risk factor and mainly these risk factors were atherogenic in nature. Also, frequently co-existence of hypertension and altered lipids cause a dyslipidemic hypertension (Kannel et al., 2000). This indicates the described lipid derangements (TC, LDL-c, HDL-c and TG) are atherogenic (NCEP 2002; Sudano et al., 2006), and suggest a possible risk for the increasing of cardiovascular diseases in a significant proportion among hypertensive patients in the near future.

In the present study, majority of hypertensive patients (90.8%) had at least one laboratory abnormality that is compatible with the diagnosis of dyslipidemia. Similarly, Pramiladevi et al. (2011) reported that the incidence of the overall forms of dyslipidemia was 90%. However, other two studies reported that low rate of dyslipidemia, was 50.8% (Osuji et al., 2012) and 41.2% (Iloh et al., 2012). Moreover, the altered levels of serum cholesterols are known to increase the risk of developing macrovascular complications such as coronary heart disease (CHD) and stroke (Albucher et al., 2000; Rader, 2002).

Our study indicated that the prevalence of raised TC

Table 2. Patterns of lipid derangements in relation to different variables.

Variable		Outcome variables				
		TC ≥200 mg/dl: 92(%)	**LDL-c ≥130 mg/dl: 50(%)**	**TGs ≥150 mg/dl: 148(%)**	**Low HDL-c : 145(%)**	**TC/HDL-c ≥5: 86(%)**
Gender	Male	32(30.5)	15(63.8)	67(63.8)	51(48.6)	38(36.2)
	Female	60(45.1)	35(60.9)	81(60.9)	94(70.7)	48(36.1)
	P-value	**0.02**	**0.02**	0.64	**0.001**	0.99
Age in years	≤45	21(24.8)	14(18.9)	43(58.1)	48(64.9)	26(35.1)
	>45	71(43.3)	36(22.0)	105(64.0)	97(59.1)	60(36.6)
	p-value	**0.03**	0.59	0.38	0.40	0.83
Hyperuricemia	No	46(32.2)	31(21.7)	76(53.1)	75(52.4)	36(25.2)
	Yes	46(48.4)	19(20.0)	72(75.8)	70(73.7)	50(52.6)
	p-value	**0.01**	0.75	**<0.0001**	**0.001**	**<0.0001**
Occupation	Unemployed	64(39.3)	34(20.9)	95(58.3)	96(58.9)	59(36.2)
	Employed	28(37.3)	16(21.3)	53(70.7)	49(65.3)	27(36.0)
	p-value	0.77	0.93	0.07	0.34	0.98
BMI (kg/m^2)	<25	34(30.9)	18(16.4)	59(53.6)	63(57.3)	29(26.4)
	≥25	58(45.3)	32(25.0)	89(69.5)	82(64.1)	57(44.5)
	p-value	**0.02**	0.10	**0.01**	0.28	**0.004**
HTN duration (years)	≤5	56(36.8)	24(15.8)	97(63.8)	96(63.2)	57(37.5)
	>5	36(41.9)	26(30.2)	51(59.3)	49(57.0)	29(33.7)
	p-value	0.44	**0.009**	0.49	0.35	0.56
Doing regular exercise	Yes	15(23.4)	4(6.2)	36(56.2)	44(68.8)	18(28.1)
	No	77(44.3)	46(26.4)	112(64.4)	101(58.0)	68(39.1)
	p-value	**0.003**	**0.001**	0.13	0.13	0.12
FHCD	No	72(38.3)	42(22.3)	115(61.2)	112(59.6)	68(36.2)
	Yes	20(40.0)	8(16.0)	33(66.0)	33(66.0)	18(36.0)
	p-value	0.82	0.33	0.53	0.41	0.98
MetS (IDF)	No	31(33.3)	17(18.3)	31(33.3)	32(34.4)	14(15.1)
	Yes	61(42.1)	33(22.8)	117(80.7)	113(77.9)	72(49.7)
	p-value	0.18	0.41	**<0.0001**	**<0.0001**	**<0.0001**

BMI, body mass index; HDL-c, high density lipoprotein cholesterol; TGs, triglycerides; TC, total cholesterol; MetS, metabolic syndrome; IDF, international diabetes federation.

was 38.7%. The finding is comparable with the rate reported by Osuji et al. (2012), which was 35.6%.

However, low prevalence was reported from a resource poor West-African setting (Iloh et al., 2012) and the rate in this study was 17.2%. The possible explanations for the variation could be genetic disparities between populations, ethnicity, and lifestyle, duration of hypertension and experiences of antihypertensive agents. Based on HDL-c cut off value, we found that the prevalence of reduced HDL-c was 60.9%. However, the low rate was reported from Nigeria (Osuji et al., 2012), and India (Akintunde et al., 2010), which was 21.6% and 47.9%, respectively. The differences may be attributed to the reality that only newly identified hypertensive participants were included in these two studies. The prevalence of raised LDL-c in our study was 21%. This rate is lower than the studies reported by Iloh et al. (2012) and Unniachan et al. (2014). The prevalence rate in these two studies was 23.8% and 86.2%, respectively. However, these studies used the cutoff >100 mg/dl; and this cutoff is lower than that of NCEP criteria (≥130) as used in our study.

The prevalence of raised TG in the present study was 62.2%. This is not in line with the prevalence reports of two Nigerian studies of (Osuji et al., 2012; Iloh et al., 2012) and North-west Ethiopia (Tachebele et al., 2014). The prevalence rate in these three studies was 6.4%, 14.8%, and 27.3%, respectively. However, there are suggestions that evidenced the magnitude of lipid derangements could show variation with the duration of

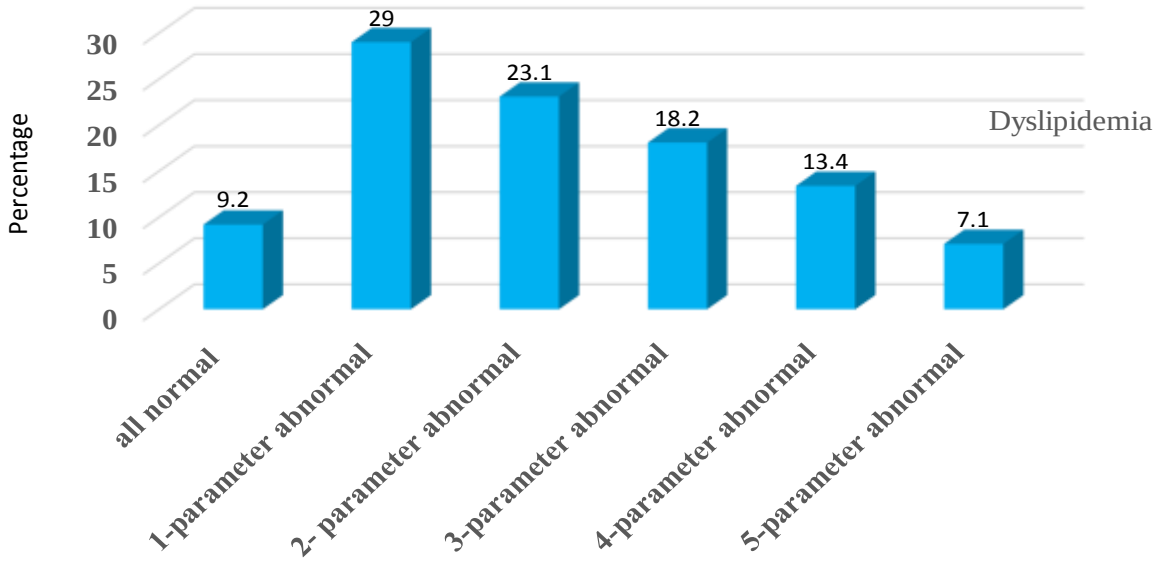

Figure 1. Trends of lipid profiles derangement within a single individual of hypertensive patients.

treatment, across populations and settings.

We found that the prevalence of raised TC/HDL-c was 36.1%. This rate is lower and not in line with the prevalence reported by Pramiladevi et al. (2011), which was 50%. In addition, the variation possibly could be the small number of the study participants and the TC/HDL-c cutoff (>4.5) was used in this study; and the cutoff is lower than that of NCEP (≥5), as used in our study. Further, the increasing pattern of TC and decrement in HDL-c level in relation to age in both sex may have an impact to increase TC/HDL-c ratio.

According to O'Meara et al (2004) report, the prevalence of dyslipidemia was significantly higher among men when compared to women in both black and whites ethic groups. Conversely, our study indicated that female sex was significantly associated with dyslipidemia and this in line with the other report of studies (Yu et al., 2015; Choudhury et al., 2014). Furthermore, menopause age in women predisposes them to develop dyslipidemia as well as MetS, because HDL-c (good lipid) starts to decline following menopause and this consequences other lipid profiles derangement.

Several studies reported that BMI has a positive correlation with dyslipidemia (Iloh et al., 2012), and it is an independent risk factor of dyslipidemia (Yu et al., 2015); however, except TC/HDL-c our study indicates no association in between BMI and dyslipidemia after adjusting for confounding factors.

Hyperuricemia is significantly associated with raised TC, TGs, TC/HDL-c and low HDL-c in the current study. Similarly, studies reported that hyperuricemia was a significant predictor of dyslipidemia (Vekic et al., 2009; Peg et al., 2014). Besides, one study revealed that a significant correlation of uric acid with all components of MetS, as well as other risk factors in hypertensive patients (Papavasileiou et al., 2016). Furthermore, these depicted abnormal lipids highlight the complex interaction between serum uric acid and lipids, and this might have an impact on CVDs.

Furthermore, this study showed that physical activity was significantly associated with dyslipidemia. In consistent, several studies pointed out that the relation of increased physical activity with improved (lowered) the rate of cardiovascular risks, including with arterial blood pressure levels (Carnethon et al., 2003 and Hambrecht et al., 2000). However, one study forwarded that an acute physical exercise encourages the oxidative stress in untreated and mild hypertensive patients who have raised atherogenic lipids (Čaparević et al., 2009). In addition, the study highlights the requirement of pharmacological correction for those patients with atherogenic lipid profiles in order to prevent high peroxidation of lipids through severe exercise (Čaparević et al., 2009).

Limitation of the study

The study design was a cross-sectional that only approximates a single point in time. In addition, our study included only hypertensive patients and no control group, and this made the study not comprehensive. Regardless

Table 3. Factors associated with dyslipidemia among hypertensive patients.

Descriptive variables		Outcome variables (at 95% CI)				
		TC≥200 mg/dl	LDL-c≥130 mg/dl	TG≥150 mg/dl	HDL-c<40mg/dl	TC/HDL-c ratio≥ 5
Gender: Female	COR	1.9(1.1-3.2)	2.1(1.1-4.2)	0.9(0.52-1.5)	2.5(1.5-4.3)	1.0(0.6-1.7)
	AOR	2.1(1.2-3.9)	2.4(1.1-4.9)	0.91(0.50-1.6)	2.9(1.6-5.4)	0.83(0.45-1.5)
	P-value	**0.02*; 0.01†**	**0.02*; 0.02†**	0.64*; 0.74†	**0.001*; <0.0001†**	0.99*;0.54†
Hyperuricemia: Yes	COR	2(1.2-3.4)	0.9(0.5-1.7)	2.8(1.5-4.9)	2.5(1.4-4.4)	3.3(1.9-5.7)
	AOR	1.8(1.1-3.1)	0.82(0.41-1.6)	2.6(1.4-4.8)	2.7(1.5-4.8)	3.1(1.7-5.4)
	P-value	**0.01*; 0.047†**	0.76*; 0.58†	**0.001*; 0.001†**	**0.001*; 0.001†**	**<0.0001*; <0.0001†**
Age: >45 years	COR	1.9(1.1-3.5)	1.2(0.6-2.4)	1.3(0.73-2.2)	0.78(0.44-1.4)	1.1(0.6-1.9)
	AOR	2.2(1.2-4.5)	1.3(0.60-2.8)	1.3(0.71-2.5)	0.98(0.51-1.9)	0.84(0.44-1.6)
	P-value	**0.03*; 0.01†**	0.59*; 0.49†	0.38*; 0.37†	0.4*; 0.95†	0.83*; 0.62†
Occupation: Employed	COR	0.92(0.52-1.6)	1.0(0.53-2.0)	1.7(0.96-3.1)	1.3(0.74-2.3)	0.99(0.56-1.7
	AOR	1.3(0.7-2.5)	1.4(0.62-3.0)	1.8(0.92-3.6)	1.7(0.85-3.3)	0.87(0.44-1.7)
	P-value	0.77*; 0.46†	0.93*; 0.44†	0.07*; 0.08†	0.34*;0.13†	0.98*;0.69†
BMI: ≥25 kg/m²	COR	1.8(1.1-3.1)	1.7(0.9-3.2)	1.9(1.2-3.3)	1.3(0.8-2.2)	2.2(1.3-3.9)
	AOR	1.5(0.83-2.3)	1.6(0.77-3.2)	1.5(0.85-2.6)	1.0(0.57-1.9)	2.2(1.2-4.0)
	P-value	**0.02***; 0.17†	0.1*; 0.21†	**0.01***; 0.15†	0.28*;0.91†	**0.004*;0.01†**
HTN duration: >5 years	COR	1.2(0.72-2.1)	2.3(1.2-4.3)	0.83(0.5-1.4)	0.77(0.45-1.3)	0.85(0.49-1.5)
	AOR	1.1(0.63-2.0)	2.3(1.1-4.5)	0.77(0.43-1.4)	0.84(0.47-1.5)	0.85(0.47-1.5)
	P-value	0.44*; 0.67†	**0.01*; 0.02†**	0.49*; 0.39†	0.35*; 0.57†	0.56*; 0.60†
Doing regular physical exercise: No	COR	2.6(1.3-4.9)	5.4(1.8-15.7)	1.4(0.78-2.5)	0.63(0.34-1.1)	1.6(0.88-3.1)
	AOR	2.6(1.3-5.1)	5.2(1.7-15.4)	1.5(0.81-2.8)	0.54(0.28-1.05)	1.6(0.83-3.2)
	P-value	**0.004*;** 0.07†	**0.002*; 0.003†**	0.25*; 0.19†	0.13*; 0.07†	0.12*; 0.15†
FHCD: Yes	COR	1.1(0.57-2.0)	0.67(0.29-1.5)	1.2(0.64-2.4)	1.3(0.68-2.5)	0.99(0.52-1.9)
	AOR	0.98(0.49-1.9)	0.59(0.24-1.44)	1.1(0.52-2.1)	1.0(0.49-2.0)	0.82(0.4-1.7)
	P-value	0.83*; 0.95†	0.33*; 0.25†	0.53*; 0.87†	0.41*; 0.98†	0.98*; 0.59†

AOR, adjusted odds ratio; BMI, Body Mass Index; CI, Confidence Interval; COR, crude odds ratio; FHCD, family history of chronic diseases; *,P-value of crude odds ratio;†, P-value of Adjusted odds ratio. Reference category: male, normouricemia, age≤45 years, unemployed, BMI<25 kg/m², HTN duration ≤5 years, doing regular physical exercise, no FHCD.

of these limitations, the study eventually increases evidence to the limited data situations.

Conclusion

Our study showed a high prevalence of dyslipidemia in hypertensive patients. Some of the non-modifiable risk factors like age, gender, and duration of hypertension were associated with dyslipidemia. In addition, some of the modifiable risk factors like BMI and experiences of physical exercise were significant with lipid derangements. This may indicate that a significant proportion of hypertensive patients are at risk of developing atherosclerosis and CVDs related morbidity and mortality.

Therefore, lipid profiles should be performed at baseline prior to receiving any anti-hypertensive agents and then periodically through treatment follow-up to manage any increasing trends.

In addition, National level of polices are required regarding awareness creation, life style modification and physical exercises. Furthermore, controlled cohort studies are also required to assess other risk factors of atherogenic dyslipidemia as well as cardiovascular risks including genetic variation.

ABBREVIATIONS

AOR, adjusted odds ratio; **BMI,** body mass index; **BP,** blood pressure; **CI,** confidence interval; **CVD,** cardiovascular diseases; **CHD,** coronary heart disease; **COR,** crude odds ratio; **HDL-c,** high density lipoprotein-cholesterol; **TC,** total cholesterol; **LDL-c,** low density lipoprotein-cholesterol; **HTN,** hypertension; **WHO,** World Health Organization; **TG,** Triglycerides; **SPSS,** Statistical package for Social Sciences; **NCEP-ATP,** National

Cholesterol Education Program-Adult Treatment Panel; **MetS,** metabolic syndrome.

CONFLICT OF INTERESTS

The authors declare that they have no conflict of interests.

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