

Original Research Article

Dyslipidaemia among diabetes and hypertensive patients in a remote rural area of South India, in comparison with ICMR-InDiab study

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ABSTRACT

Background: The aim of the study was to find out the prevalence and determinants of dyslipidaemia among DM and HT group in a remote rural area of India and comparing with ICMR-InDiab study.

Methods: We screened high risk individuals (hypertension and diabetes patients) for dyslipidemia covering ten villages surrounding a Rural Health Training Centre (RHTC) located in South India, in August-September 2017. Participants were line listed from the electronic data base maintained in RHTC and were screened at their door step by visiting their house.

Results: Mean values of all lipids among the high-risk population were increased significantly ($p < 0.01$). Prevalence of hypercholesterolemia was three times more, hypertriglyceridemia was 1.3 times higher, high LDL cholesterol was 3.3 times higher, high cholesterol HDL ratio was 1.5 times higher and isolated hypercholesterolemia was 3.6 times higher among the high-risk population. On the other hand, isolated hypertriglyceridemia has 30% less likely and isolated low HDL was 40% less likely among high risk populations in comparison to ICMR-InDiab study. Female gender [low HDL- aOR 2.1(1.1-4.2)], [high LDL- aOR 2.2(1.3-3.7)] and hypothyroidism [hypercholesterolemia- aOR 10.1(1.1-89)] were directly associated and; underweight [hypercholesterolemia- adjusted Odds ratio (aOR)- 0.4(0.2-0.9)], [hypertriglyceridemia 0.4(0.1-1.0)], and anaemia [hypertriglyceridemia aOR- 0.5(0.3-0.8)] were inversely associated with dyslipidemia.

Conclusions: Dyslipidaemia was higher among the DM and HT participants in a remote rural area of South India.

Keywords: Cholesterol, Triglycerides, LDL, HDL, Dyslipidaemia, Lipid profile

INTRODUCTION

Cardiovascular disease (CVDs) is the top most reason for mortality globally as well as in India.¹ Dyslipidemia is one of the major modifiable risk factors for CVD along with physical inactivity and behavioural risk factors like smoking and alcohol.² High blood cholesterol increases the risk for CVDs and stroke. Globally, nearly one third of the CVDs is attributed to high cholesterol.³ In total, raised cholesterol was estimated to cause 2.6 million deaths (4.5% of total) and 29.7 million DALYs loss (2% of

DALYs loss) globally.³ Asians tend to have a unique pattern of dyslipidemia with low HDL-C, high portions of small density LDL cholesterol.⁴ Unlike the general population, people with diabetes (DM) and hypertension (HT) are at higher risk for CVDs.⁵ Few available studies from India, mainly concentrated on prevalence of dyslipidemia among the general population.⁴⁻⁶ Even though studies on the general population have epidemiological value, screening the high risk group at the population level have both epidemiological as well as programmatic interest. By this the functioning of the

existing National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS) at the village level could be strengthened.² Moreover, high risk population screening is appropriate and cost effective in a 'highly populated middle-income country' like India. India is taking earnest steps to prevent and treat Non-Communicable Diseases at population level (NCDs). Through National Health Policy (NHP), India committed to reverse the NCD incidence and through Sustainable Development Goals (SDGs) India is committed to reduce the premature death by NCDs by one third before 2030.⁷⁻⁹ At present there is a dearth of data on population-based studies on dyslipidemia among the high-risk individuals (DM and HT) that too from a rural area. The aim of the study was to investigate the prevalence and determinants of dyslipidemia among these high-risk individuals by screening at their door steps, so that appropriate interventions and policy recommendations could be made.

METHODS

This was a cross sectional study. This study was conducted in a remote rural area named Chunampet located in South India. Adjoining twenty villages surrounding the Rural Health Training Centre (RHTC) of Pondicherry Institute of Medical Sciences was selected.

Selection criteria

Individuals with HT and DM were listed from an electronic data base called Community Health Information Management System (CHIMS), maintained at the RHTC for these twenty villages. These high-risk individuals were approached by house to house visits. Data was collected in a pretested questionnaire. All the eligible individuals were invited to participate (universal sampling method).

Biological samples were collected at their doorstep and transported to the main campus which is an NABL accredited lab. (National Accreditation for Testing and Calibration Laboratories). Sample size was calculated to be 318, assuming the prevalence of common CVD risk factors (HT, DM & Hypercholesterolemia) to be above 25%, absolute precision of 5% and 10% attrition. Data collection was done from August-September 2017. Data was collected with the help of medical interns and medical social workers, under the direct supervision of faculty from the department of community medicine. Data was entered using EpiData software version 3.1 and analysed using Stata 14.^{10,11} In Table 1, mean value of lipids and prevalence of dyslipidaemia were compared with a similar population-based large-scale study among the general population (ICMR-InDiab 2010- Tamilnadu rural population data). We have also used the same definition and classifications as ICMR-InDiab study.¹² Adjusted Odds ratio (aOR) for risk factors associated with hypercholesterolemia, hypertriglyceridemia, low HDL and high LDL were calculated by including those variables which have shown near significance in Chi-square ($p < 0.2$).

Ethical committee clearance for this study was obtained from the Institute Ethics Board. Detailed description on methods of screening procedure described elsewhere.¹³

Operational definitions

normal values for waist hip ratio are <0.85 for women and <0.95 for men and normal values for salt intake per day, per capita of <6 g.²

Current alcoholic

One who consumes alcohol for at least once in the last one year.¹⁴

Dyslipidemia

Defined based on National Cholesterol Education Programme (NCEP) guidelines, where Hypercholesterolemia is defined as serum cholesterol levels ≥ 200 mg/dl (≥ 5.2 mmol/l), hypertriglyceridemia is defined as serum triglyceride levels ≥ 150 mg/dl (≥ 1.7 mmol/l), low HDL cholesterol is defined as HDL cholesterol levels <40 mg/dl (<1.04 mmol/l) for men and <50 mg/dl (<1.3 mmol/l) for women, high LDL cholesterol is defined as LDL cholesterol levels ≥ 130 mg/dl (≥ 3.4 mmol/l), isolated hypercholesterolemia is defined as serum cholesterol ≥ 200 mg/dl and triglycerides <150 mg/dl, isolated hypertriglyceridemia is defined as serum triglycerides ≥ 150 mg/dl and cholesterol <200 mg/dl and isolated low HDL-C is defined as HDL-C ≤ 40 mg/dl (male) and ≤ 50 mg/dl (female) without hypertriglyceridemia or hypercholesterolemia.^{12,15-17} Estimated Glomerular filtration rate (eGFR) was calculated using Chronic kidney disease epidemiology collaboration (CKD-EPI) equation and the participants having eGFR ≤ 60 ml/min/1.73m² were classified as having CKD.¹⁸ As per American Thyroid Association and American Association of Clinical Endocrinologists (ATA/AACE) guideline, hypothyroidism was classified as TSH (Thyroid stimulating hormone) level in μ IU/ml (TSH ≥ 10 -overt hypothyroidism, 4.5-9.0- highly abnormal TSH, 2.5-4.4- intermediate abnormal and <2.5 as normal).¹⁹ Anaemia is defined as haemoglobin <13 mg/dl for men and <12 mg/dl for women (WHO criteria).²⁰

RESULTS

The total sample size achieved was 303. Mean values of all lipids among the high risk were increased significantly ($p < 0.01$). Risk of hypercholesterolemia was three times more among these high-risk patients than normal patients [Prevalence ratio (PR) 2.9 (2.3-3.7)]. The risk of hypertriglyceridemia was 1.3 times higher, the risk of high LDL Cholesterol was 3.3 times higher, the risk of high cholesterol HDL ratio was 1.5 times higher and the isolated hypercholesterolemia was 3.6 times higher among the high-risk population. On the other hand, isolated hypertriglyceridemia was 30% less likely and isolated low HDL was 40% less likely among high risk populations.

Details of lipid profile and prevalence of dyslipidaemia in comparison to ICMR-InDiab study is given in Table 1. Female gender [low HDL- aOR 2.1(1.1-4.2)], [high LDL- aOR 2.2(1.3-3.7)] and hypothyroidism [hypercholesterolemia- aOR 10.1(1.1-89)] were directly associated and underweight [hypercholesterolemia-

adjusted Odds ratio (aOR)- 0.4(0.2-0.9)], [hypertriglyceridemia- 0.4(0.1-1.0)], and anaemia [hypertriglyceridemia aOR- 0.5(0.3-0.8)] were inversely associated with dyslipidemia. Association between dyslipidemia and its related risk factors are shown in Table 2.

Table 1: Mean values and proportions of lipids and dyslipidaemia in a remote rural area of South India, in 2018 among high risk individuals in comparison with InDiab study.¹²

	Hypertension only N=102	Diabetes only N=76	Hypertension and diabetes N=125	All N=303	InDiab TN Rural N=463	t test mean difference, p value*
Lipid profile	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean SD	
Total cholesterol	199 (47)	199 (38)	201 (44)	200 (43)	165 (37)	35, <0.01
High density lipoprotein	45 (23)	44 (21)	43 (14)	44 (19)	40 (12)	4, <0.01
Low density lipoprotein	131 (43)	123 (38)	126 (38)	127 (39)	98 (30)	29, <0.01
Triglycerides	128 (60)	170 (120)	160 (103)	152 (97)	114	38 ^{\$}
Cholesterol HDL ratio	4.9 (1.6)	5.0 (1.6)	5.2 (2.1)	5 (1.8)	4.4 (1.5)	0.6, <0.01
Dyslipidaemia	Proportions (95% CI)					Prevalence ratio*
Hypercholesterolemia	43 (34-53)	51 (40-63)	46 (37-55)	47 (41-52)	16.0	2.9 (2.3-3.7)
Hypertriglyceridemia	32 (24-42)	43 (33-55)	44 (35-53)	40 (35-46)	29.6	1.3 (1.1-1.6)
Low HDL cholesterol	74 (64-81)	68 (57-78)	65 (56-73)	69 (63-74)	67.6	1.0 (0.9-1.1)
High LDL cholesterol	44 (35-54)	43 (33-55)	42 (33-51)	43 (37-49)	13.2	3.3 (2.5-4.3)
High cholesterol HDL ratio	58 (48-67)	61 (49-71)	59 (50-68)	59 (53-65)	39.7	1.5 (1.3-1.7)
Isolated hypercholesterolemia	25 (17-34)	22 (14-33)	17 (11-25)	21 (17-26)	5.8	3.6 (2.4-5.5)
Isolated hypertriglyceridemia	14 (08-22)	14 (08-25)	14 (09-22)	14 (11-19)	19.4	0.7 (0.5-0.9)
Isolated low HDL	30 (22-40)	24 (15-35)	24 (17-32)	26 (21-31)	41.0	0.6 (0.5-0.8)

*t test and prevalence ratio between All (HT, DM, both) and InDiab values, \$- SD was not reported in InDiab study and hence significance could not be calculated.

Table 2: Association between dyslipidaemia and its related risk factors among high risk individuals in a remote rural area of south India in 2018.

Variables	Total	Hypercholesterolemia		Hypertriglyceridemia		Low HDL		High LDL	
		N (%)	aOR (95%CI)	N (%)	aOR (95%CI)	N (%)	aOR (95%CI)	N (%)	aOR (95%CI)
BMI									
Under weight	37	10 (27)	0.4 (0.2-0.9)	05 (14)	0.4 (0.1-1.0)	21 (57)	1.0 (0.4-2.4)	10 (27)	0.4 (0.2-1.0)
Normal	87	47 (54)	Ref	31 (36)	Ref	51 (59)	Ref	39 (45)	Ref
Over-weight	52	19 (37)	0.4 (0.2-0.9)	29 (56)	1.8 (0.8-3.9)	43 (83)	2.4 (0.9-6.1)	18 (35)	0.5 (0.3-1.1)
Obese	127	65 (51)	0.7 (0.4-1.3)	56 (44)	1.0 (0.5-1.9)	93 (73)	1.4 (0.7-3.0)	63 (50)	1.1 (0.6-1.1)
Age (years)									
30-40	43	20 (47)	Ref	21 (49)	Ref	29 (67)	Ref	17 (40)	-
41-50	72	38 (53)	1.2 (0.6-2.8)	36 (50)	1.1 (0.5-2.4)	51 (71)	0.8 (0.3-2.2)	34 (47)	-
51-60	86	42 (49)	1.0 (0.5-2.3)	34 (40)	0.8 (0.3-1.7)	65 (76)	1.1 (0.4-2.9)	37 (43)	-
61-70	75	33 (44)	0.1 (0.4-2.2)	24 (32)	0.8 (0.3-1.8)	51 (68)	0.8 (0.3-2.2)	32 (43)	-
≥71	27	08 (30)	0.5 (0.2-1.7)	06 (22)	0.5 (0.2-1.8)	12 (44)	0.4 (0.1-1.3)	10 (37)	-
Gender ^{\$}									

Continued.

Variables	Total	Hypercholesterolemia		Hypertriglyceridemia		Low HDL		High LDL	
		N (%)	aOR (95%CI)	N (%)	aOR (95%CI)	N (%)	aOR (95%CI)	N (%)	aOR (95%CI)
Male	103	41 (40)	Ref	40 (39)	-	49 (48)	Ref	32 (31)	Ref
Female	200	100 (50)	1.2 (0.7-2.2)	81 (41)	-	159 (80)	2.1 (1.1-4.2)	98 (49)	2.2 (1.3-3.7)
WHR									
Abnormal	169	53 (40)	1.6 (0.9-2.6)	47 (35)	-	132 (78)	1.6 (0.9-2.1)	79 (47)	-
Normal	134	88 (52)	Ref	74 (44)	-	76 (57)	Ref	51 (38)	-
TSH levels									
≥10	09	08 (89)	10.1 (1.1-89)	05 (56)	-	04 (44)	-	07 (78)	-
4.5-9.9	29	16 (55)	1.5 (0.7-3.6)	09 (31)	-	18 (62)	-	15 (52)	-
2.5-4.4	88	39 (44)	0.1 (0.6-1.8)	30 (34)	-	64 (73)	-	39 (44)	-
<2.5	128	56 (44)	Ref	51 (40)	-	86 (67)	-	50 (39)	-
Not tested	49	22 (45)	1.1 (0.6-2.2)	26 (53)	-	36 (74)	-	19 (39)	-
CKD									
Yes	41	15 (37)	0.8 (0.3-1.7)	16 (39)	-	24 (59)	-	14 (34)	-
No	262	126 (48)	Ref	105 (40)	-	184 (70)	-	116 (44)	-
Abd obesity									
Abnormal	179	83 (46)	-	81 (45)	1.5 (0.8-2.7)	137 (77)	1.1 (0.6-2.3)	79 (44)	-
Normal	124	58 (47)	-	40 (32)	Ref	71 (57)	Ref	51 (41)	-
Education									
Illiterate	159	75 (47)	-	55 (35)	0.8 (0.5-1.3)	109 (69)	-	71 (45)	-
Literate	144	66 (46)	-	66 (46)	Ref	99 (69)	-	59 (41)	-
Anaemia									
Yes	207	98 (47)	-	71 (34)	0.5 (0.3-0.8)	146 (71)	-	94 (45)	-
No	96	43 (45)	-	50 (52)	Ref	62 (65)	-	36 (38)	-
Occupation									
Farming OL	73	37 (51)	-	32 (44)	-	42 (58)	Ref	33 (45)	-
Farming DW	109	43 (39)	-	43 (39)	-	70 (64)	1.3 (0.6-2.5)	41 (38)	-
Others	121	61 (50)	-	46 (38)	-	96 (79)	2.5 (1.2-5.1)	56 (46)	-
Current alcoholic									
Yes	32	16 (50)	-	12 (38)	-	12 (38)	0.4 (0.8-1.1)	10 (31)	-
No	271	125 (46)	-	109 (40)	-	196 (72)	Ref	120 (44)	-
High salt intake									
Yes	227	37 (49)	-	90 (40)	-	150 (66)	0.7(0.4-1.3)	93 (41)	-
No	76	104 (46)	-	31 (41)	-	58 (76)	Ref	37 (49)	-
HT and DM									
HT only	102	44 (31)	-	33 (27)	Ref	75 (36)	-	45 (35)	-
DM only	76	39 (28)	-	33 (27)	1.3 (0.7-2.5)	52 (25)	-	33 (25)	-
HT and DM	125	58 (41)	-	55 (45)	1.8 (1.0-3.2)	81 (39)	-	52 (40)	-

WHR- waist hip ratio, CKD- chronic kidney disease, Abd- abdominal, farming OL- own land, DW- daily wage.

DISCUSSION

This was one of the very few studies done in remote rural areas of South India. It was a unique study in the following ways, first, this is a population based screening programme at grass root level (village level), second it is done among the high risk group, third this high risk group could be routinely accessed through NCD clinic under NPCDCS in PHCs, fourth, this study compares the dyslipidaemia prevalence among these high groups with the existing data in details and provides valuable information for clinical management, public health and primary care physicians.

Our study has shown the mean values of lipids and dyslipidemia are few folds higher among DM and HT individuals when compared to normal, this justifies the screening among high risk populations. A population based study from Punjab, North India also found the prevalence of dyslipidemia among DM and HT was high, but their detailed description was not highlighted.⁵ Studies were also shown that both in general population as well as in our study females were shown higher association with dyslipidemia.¹² Anaemia and underweight in the risk group were less likely to be associated with dyslipidemia, is also similar to the other few general population based

studies.^{5,12} One of the notable findings in our study was odds of overt hypothyroidism among hypercholesterolemia was 10 times higher. Association of thyroid dysfunction and dyslipidemia was reported in many studies all over the world and the recommendation is to screen for thyroid dysfunction among dyslipidemic patients.²¹⁻²⁶ In our study even though we have tested TSH, this may not be possible in a public health setup, due to cost factor, but the treating physician should keep in mind while managing dyslipidemia. Apart from this hypothyroidism is also reported to be one of the risk factor for heart diseases.²⁷

This study had few important programmatic implications. At present lipid profile testing facility under NPCDCS Programme is available at the Community Health Centre (CHCs) level, which covers the population of 1,20,000 (4-5 PHCs).² This facility could be made available at least to all the high-risk participants, belonging to the PHCs coming under every CHCs through a systematic manner which we have demonstrated. This testing could be coordinated through NCD clinic and the samples could be collected and transported to CHCs, as described in our study. Second, India has more than 600 medical colleges and each medical college has one RHTC serving the rural community. Screening and providing appropriate management of dyslipidaemia among DM and HT through these centres will improve the health status of DM and HT patients, which has been demonstrated in our study.

Few limitations in our study were, our study was done in a particular rural area, multi centric study with a similar screening protocol may provide more evidence. Ours was conducted with the help of an RHTC functioning under a Medical College, in which manpower and resources are higher when compared to a PHC, anyhow in India more than 600 medical colleges are there; and this study is easily replicable in such setting, more over this study could also be replicated in PHC setting, provided if appropriate essential support is given to them through CHCs. Without a systematic testing and service to the socioeconomically deprived high-risk population, India may not be able to achieve National goals of NCD prevention and SDG goal of reducing premature mortality due to NCDs.

CONCLUSION

Dyslipidaemia was higher among the DM and HT participants in a remote rural area of South India.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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