



PREVALENCE AND TREATMENT PATTERNS OF DYSLIPIDEMIA IN CARDIOMETABOLIC PATIENTS AT A TERTIARY CARE CENTER IN AHMEDABAD

General Medicine

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ABSTRACT

Background: Dyslipidemia in Indian patients rarely looks like the textbook picture of very high LDL cholesterol. It usually shows up as a low HDL and a high triglyceride level sitting alongside diabetes, hypertension or central obesity. How often it is picked up, and how well it is treated, is still poorly described in western Indian hospital practice. **Objectives:** To measure the prevalence and pattern of dyslipidemia in patients attending a tertiary care medicine outpatient department in Ahmedabad with an established cardiometabolic diagnosis, and to describe the lipid lowering drugs they receive and the LDL cholesterol goals they achieve. **Methods:** A hospital based cross sectional study of 68 consecutive adults with type 2 diabetes, hypertension, metabolic syndrome or established coronary artery disease. Fasting lipid profile, anthropometry and glycaemic indices were recorded. Risk categories and LDL cholesterol goals followed the Lipid Association of India 2023 consensus. Prescription details and self reported adherence were collected from case records and patient interview. **Results:** Dyslipidemia was present in 62 of 68 patients (91.2%). Low HDL cholesterol was the commonest single abnormality (67.6%), followed by raised non-HDL cholesterol (57.4%) and triglycerides above 150 mg/dL (54.4%). A mixed pattern involving all three components was seen in 26.5%. Only 44 patients (64.7%) were on any lipid lowering drug, almost always a moderate intensity statin. Just 11 patients (16.2%) met their LDL cholesterol goal, and none of the untreated patients did ($p = 0.006$). Mean LDL cholesterol was 117.0 mg/dL in poorly adherent patients against 82.1 mg/dL in adherent ones ($p = 0.004$). **Conclusion:** Nine out of ten cardiometabolic patients in this clinic had dyslipidemia, yet fewer than one in five reached goal. The gap was driven by undertreatment and low drug intensity rather than by failure of diagnosis.

KEYWORDS

Dyslipidemia, Type 2 Diabetes Mellitus, Statins, LDL Cholesterol Goal Attainment, Cardiometabolic Risk

INTRODUCTION

India carries a lipid problem that is both large and quietly ignored. The ICMR-INDIAB survey put the prevalence of any dyslipidemia at close to eight in ten adults, with low HDL cholesterol and high triglycerides doing most of the damage rather than very high LDL levels [1]. The most recent national analysis from the same cohort confirmed that the burden has not shifted downward, and that abnormal lipids now cluster tightly with dysglycaemia and abdominal obesity [2]. The wider metabolic report from that study estimated 101 million people with diabetes and 136 million with prediabetes, which gives some sense of the population in whom lipids matter most [3].

What makes the Indian phenotype awkward is its shape. Reviews of national trend data describe a pattern of borderline total cholesterol, unimpressive LDL values and markedly low HDL, which means a patient can look reassuring on a routine report and still carry substantial atherogenic risk [4]. In diabetes the same picture becomes sharper, with small dense LDL particles and raised remnant cholesterol adding risk that a standard LDL measurement underestimates [5].

Indian guidance has responded by tightening targets. The Lipid Association of India 2023 consensus statement sets an LDL cholesterol goal below 70 mg/dL for high risk patients and below 50 mg/dL for those at very high or extreme risk, and it treats non-HDL cholesterol as a co-primary target [6]. The 2024 key messages from the same group pushed for earlier risk stratification and wider use of combination therapy instead of endless statin up-titration [7]. Earlier expert statements had already argued for these lower thresholds in secondary prevention and in familial hypercholesterolemia [8].

Practice has not caught up. A nationwide study of Indian patients with coronary artery disease found that only a minority reached the recommended LDL cholesterol level despite being on treatment [9]. A cross sectional audit from Mumbai showed much the same thing, with moderate intensity statins dominating prescriptions and combination therapy used rarely [10]. Data from Gujarat, and from Ahmedabad in particular, are thin. This study was done to describe what actually happens in one tertiary care medicine clinic: how many cardio-

metabolic patients have dyslipidemia, what shape it takes, what they are prescribed, and how often they reach goal.

MATERIALS AND METHODS

Study Design and Setting

This was a hospital based, observational, cross sectional study carried out in the Department of Medicine at HCG Hospital, Ahmedabad, over a period of nine months. The design followed the approach used in earlier Indian drug utilisation studies of hypolipidemic agents in tertiary care [11].

Participants

Sixty eight consecutive adults aged 30 years or above attending the medicine outpatient department were enrolled. Each had at least one documented cardiometabolic condition: type 2 diabetes mellitus, hypertension, metabolic syndrome by modified NCEP ATP III criteria with Asian Indian waist cut offs, or angiographically established coronary artery disease. Patients with chronic kidney disease stage 4 or worse, untreated hypothyroidism, active liver disease, pregnancy, nephrotic syndrome or a current course of oral corticosteroids were left out, since these conditions distort the lipid profile.

Measurements

Weight, height and waist circumference were recorded using standard technique. Blood pressure was taken as the mean of two seated readings. A venous sample was drawn after a 12 hour overnight fast for total cholesterol, triglycerides and HDL cholesterol by enzymatic colorimetric assay on an automated analyser. LDL cholesterol was calculated by the Friedewald equation, and it was measured directly when triglycerides exceeded 400 mg/dL. Non-HDL cholesterol was total cholesterol minus HDL cholesterol. The atherogenic index of plasma was calculated as the base 10 logarithm of the molar triglyceride to HDL cholesterol ratio.

Definitions

Dyslipidemia was taken as any one of total cholesterol at or above 200 mg/dL, LDL cholesterol at or above 100 mg/dL, triglycerides at or above 150 mg/dL, or HDL cholesterol below 40 mg/dL in men and

below 50 mg/dL in women. Risk category and the corresponding LDL cholesterol goal were assigned using the Lipid Association of India 2023 consensus, so the goal was below 50 mg/dL for very high and extreme risk, below 70 mg/dL for high risk and below 100 mg/dL for moderate risk [6].

Treatment Data

The drug name, molecule, daily dose and any non-statin add on were copied from the prescription. Statin intensity was graded as moderate or high in the conventional way. Adherence over the preceding three months was estimated by pill count and patient recall and graded as good above 80 percent, partial between 50 and 80 percent, and poor below 50 percent. This classification of prescription patterns mirrors that used in large retrospective analyses of lipid modifying therapy [12].

Statistical Analysis

Continuous variables are given as mean with standard deviation, categorical variables as number and percentage. Groups were compared using one way analysis of variance for continuous data and the chi square or Fisher exact test for proportions. A p value below 0.05 was taken as significant. Analysis was done in Python 3.11 using pandas and SciPy. The institutional ethics committee approved the protocol and every participant gave written informed consent.

RESULTS

Sixty eight patients completed the study. Forty three were men (63.2%) and 25 were women (36.8%), with a mean age of 54.9 years. Three quarters of the group had a body mass index at or above 25 kg/m² and the mean waist circumference was already above the Asian Indian cut off in both sexes. Baseline details are in Table 1.

Table 1: Demographic and Clinical Profile of the Study Population

Variable	Value (n = 68)
Age, years (mean ± SD)	54.9 ± 10.3
Age 30–39 / 40–49 / 50–59 / ≥60 years, n	5 / 16 / 27 / 20
Male : Female, n (%)	43 (63.2) : 25 (36.8)
Body mass index, kg/m ²	27.8 ± 3.6
Body mass index ≥25 kg/m ² , n (%)	51 (75.0)
Waist circumference, cm	95.7 ± 7.8
Systolic / diastolic blood pressure, mmHg	132.5 ± 14.3 / 82.5 ± 8.1
Fasting plasma glucose, mg/dL	130.2 ± 33.0
HbA1c, %	7.2 ± 1.7
Duration of cardiometabolic illness, years	6.5 ± 4.7
Current smoker, n (%)	13 (19.1)
Current alcohol use, n (%)	8 (11.8)
Family history of premature CVD, n (%)	25 (36.8)
Type 2 diabetes with hypertension, n (%)	21 (30.9)
Type 2 diabetes alone, n (%)	16 (23.5)
Hypertension alone, n (%)	13 (19.1)
Metabolic syndrome, n (%)	10 (14.7)
Established coronary artery disease, n (%)	8 (11.8)
LAI risk category: high / moderate / very high or extreme, n (%)	49 (72.1) / 11 (16.2) / 8 (11.8)

SD, standard deviation; CVD, cardiovascular disease; LAI, Lipid Association of India.

Sixty two patients (91.2%) had at least one lipid abnormality. Low HDL cholesterol was the single commonest finding, seen in just over two thirds of the group. Raised non-HDL cholesterol and hypertriglyceridemia came next. Frank hypercholesterolemia was uncommon by comparison, with only a quarter of patients crossing a total cholesterol of 200 mg/dL. Table 2 and Figure 1 set out these findings.

Table 2: Prevalence of Individual Lipid Abnormalities and of Dyslipidemia Patterns

Lipid abnormality or pattern	n	%
Any dyslipidemia	62	91.2
Low HDL-C (men <40, women <50 mg/dL)	46	67.6
Non-HDL-C ≥130 mg/dL	39	57.4
Triglycerides ≥150 mg/dL	37	54.4
Triglycerides ≥200 mg/dL	14	20.6
LDL-C ≥100 mg/dL	35	51.5

LDL-C ≥130 mg/dL	16	23.5
Total cholesterol ≥200 mg/dL	17	25.0
TC / HDL-C ratio >4.5	30	44.1
Atherogenic index of plasma >0.21	31	45.6
Pattern: mixed, all three components	18	26.5
Pattern: high triglycerides with low HDL-C	11	16.2
Pattern: isolated low HDL-C	11	16.2
Pattern: combined, any two components	9	13.2
Pattern: isolated high LDL-C or total cholesterol	8	11.8
Pattern: isolated hypertriglyceridemia	5	7.4
No dyslipidemia	6	8.8

HDL-C, high density lipoprotein cholesterol; LDL-C, low density lipoprotein cholesterol; TC, total cholesterol. Categories in the upper block overlap.

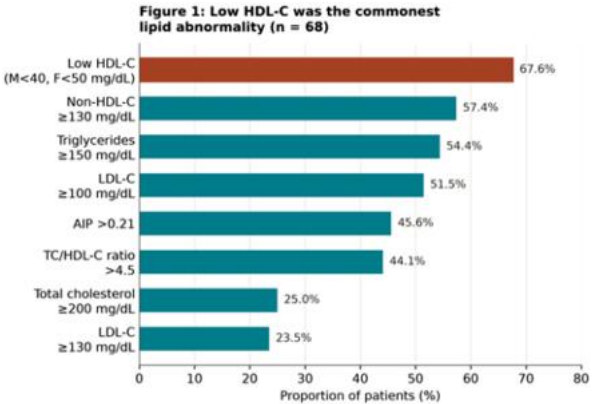


Figure 1: Prevalence of Individual Lipid Abnormalities in the Study Population (n = 68). Low HDL Cholesterol was the Dominant Abnormality, While Frank Hypercholesterolemia was Comparatively Uncommon.

Lipid values differed across the diagnostic groups. Patients with diabetes alone had the highest mean triglycerides and non-HDL cholesterol. Those with established coronary disease had the lowest mean LDL cholesterol, which is expected since all of them were already on a statin, but their triglycerides remained high and their mean value still sat well above the goal set for their risk band. The difference in mean LDL cholesterol across groups reached statistical significance (Table 3).

Table 3: Mean Lipid Parameters (mg/dL) Across Cardiometabolic Diagnostic Groups

Diagnostic group	n	TC	TG	HDL-C	LDL-C	Non-HDL-C
Type 2 diabetes alone	16	193.9	205.9	39.1	113.7	154.8
Type 2 diabetes with hypertension	21	173.2	181.0	37.9	99.2	135.3
Hypertension alone	13	184.3	127.8	42.8	116.1	141.5
Metabolic syndrome	10	170.2	131.8	40.7	103.1	129.5
Established coronary artery disease	8	153.2	171.5	43.6	75.2	109.6
Whole cohort (mean ± SD)	68	177.4 ± 38.2	168.3 ± 87.5	40.2 ± 7.3	103.6 ± 32.7	137.2 ± 36.7
p value (one way ANOVA)	—	0.121	0.089	0.200	0.039	0.059

TC, total cholesterol; TG, triglycerides; ANOVA, analysis of variance. Values are group means unless stated otherwise.

Only 44 patients (64.7%) were taking any lipid lowering drug at the time of assessment. The other 24 had been given lifestyle advice alone. Atorvastatin 10 mg and rosuvastatin 10 mg together accounted for exactly half of all prescriptions. High intensity statin therapy was used in only seven patients, and a non-statin add on in seven more. Table 4 gives the full breakdown.

Table 4: Lipid Lowering Treatment Patterns in the Study Population

Treatment variable	n	%
On any lipid lowering drug	44	64.7
No lipid lowering drug (lifestyle advice only)	24	35.3

Atorvastatin 10 mg	12	17.6
Rosuvastatin 10 mg	10	14.7
Atorvastatin 20 mg	6	8.8
Rosuvastatin 20 mg	3	4.4
Rosuvastatin 10 mg with fenofibrate 145 mg	3	4.4
Atorvastatin 40 mg	2	2.9
Atorvastatin 80 mg	2	2.9
Rosuvastatin 5 mg	2	2.9
Rosuvastatin 10 mg with ezetimibe 10 mg	2	2.9
Atorvastatin 20 mg with ezetimibe 10 mg	2	2.9
Statin intensity (of 44 treated): moderate	30	68.2
Statin intensity (of 44 treated): high	7	15.9
Statin intensity (of 44 treated): moderate plus non-statin	7	15.9
Statin monotherapy (of 44 treated)	37	84.1
Adherence (of 44 treated): good, above 80%	19	43.2
Adherence (of 44 treated): partial, 50 to 80%	16	36.4
Adherence (of 44 treated): poor, below 50%	9	20.5

Percentages for individual molecules are of the whole cohort (n = 68); intensity and adherence percentages are of treated patients (n = 44).

Goal attainment was poor. Eleven patients in the whole cohort (16.2%) had an LDL cholesterol below the level their risk category demanded. Among the 44 treated patients the figure was 25.0%, and among the untreated it was zero, a difference that was statistically significant ($p = 0.006$, Fisher exact test). Patients in the very high or extreme risk band fared worst in absolute terms, with one of eight reaching a target of 50 mg/dL, even though every one of them was on a statin. Adherence mattered a great deal. Mean LDL cholesterol was 82.1 mg/dL in the adherent group, 86.8 mg/dL with partial adherence and 117.0 mg/dL when adherence was poor ($p = 0.004$). Table 5 and Figure 2 summarise these results.

Table 5: LDL Cholesterol Goal Attainment by Risk Category, Treatment and Adherence

Subgroup	n	Goal attained, n (%)	Mean LDL-C (mg/dL)
Whole cohort	68	11 (16.2)	103.6
On lipid lowering therapy	44	11 (25.0)	91.0
Not on lipid lowering therapy	24	0 (0.0)	126.7
Moderate risk (goal <100 mg/dL)	11	3 (27.3)	118.5
High risk (goal <70 mg/dL)	49	7 (14.3)	104.9
Very high or extreme risk (goal <50 mg/dL)	8	1 (12.5)	75.2
Treated, moderate intensity statin	30	7 (23.3)	97.7
Treated, high intensity statin	7	1 (14.3)	81.6
Treated, statin plus non-statin	7	3 (42.9)	71.3
Treated, good adherence	19	5 (26.3)	82.1
Treated, partial adherence	16	6 (37.5)	86.8
Treated, poor adherence	9	0 (0.0)	117.0

Goals as per Lipid Association of India 2023 consensus. Therapy versus no therapy for goal attainment, $p = 0.006$ (Fisher exact test). Mean LDL cholesterol across adherence groups, $p = 0.004$ (one way ANOVA).

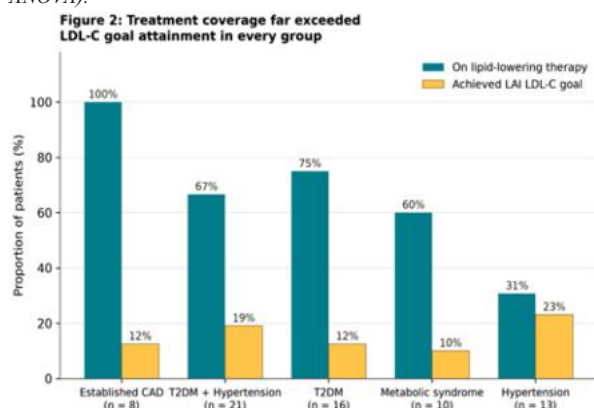


Figure 2: Proportion of Patients on Lipid Lowering Therapy Compared with the Proportion Reaching their LDL Cholesterol Goal, by Diagnostic Group. Coverage was Highest in Coronary Artery Disease But Goal Attainment Stayed Low in Every Group.

DISCUSSION

The headline finding is simple. Nine of every ten cardiometabolic patients walking into this clinic had abnormal lipids, but only about one in six was at goal. The same disconnect has been reported before. The LEADD study, a large real world cross sectional survey of Indian patients with type 2 diabetes, found wide gaps between guideline recommendations and what clinicians actually prescribed [13]. A structured review of Indian dyslipidemia guidance came to a similar conclusion and pointed out how little Indian outcome data exists to support target setting [14].

The shape of the dyslipidemia we saw is worth dwelling on. Low HDL cholesterol was present in 67.6% of patients while total cholesterol above 200 mg/dL was present in only 25%. Misra and colleagues described this phenotype in Asian Indians two decades ago, linking it to insulin resistance, truncal adiposity and a genetic tendency toward small dense LDL particles [15]. In diabetes the mechanism is better worked out. Insulin resistance drives hepatic overproduction of very low density lipoprotein, which then feeds cholesteryl ester transfer protein mediated remodelling and leaves the patient with low HDL and small dense LDL [16].

A patient with this profile can be missed if LDL cholesterol alone is used to judge risk. Our data make the point quantitatively. Non-HDL cholesterol was raised in 57.4% while LDL cholesterol reached 130 mg/dL in only 23.5%. Non-HDL cholesterol captures every apolipoprotein B carrying particle, needs no extra test and does not require a fasting sample, which is why it has been proposed as the better everyday marker in mixed dyslipidemia [17]. Danish cohort work confirmed that apolipoprotein B and non-HDL cholesterol reflect residual risk in statin treated patients better than LDL cholesterol does [18].

Our participants were more obese and more hyperglycaemic than the general Indian adult. A multistate survey of rural, urban and urban slum populations recorded lower mean adiposity than we found, which is unsurprising in a self selected tertiary care group [19]. Gujarat specific studies add useful context. A study of young asymptomatic Gujaratis reported metabolic syndrome in a sizeable minority well before any clinical event [20], and a community survey from Surendranagar district in Saurashtra found the same clustering in adults [21]. Together they suggest the cardiometabolic pipeline feeding clinics like ours is already full at a young age.

The treatment findings are the ones that should change practice. Just under two thirds of patients were on any lipid lowering drug, and moderate intensity statin monotherapy accounted for 68.2% of all treatment. Combination therapy was used in seven patients. That is out of step with the evidence. IMPROVE-IT showed that adding ezetimibe to simvastatin after an acute coronary syndrome reduced cardiovascular events further, with no safety penalty [22]. The RACING trial then showed that a moderate intensity statin combined with ezetimibe was non-inferior to high intensity statin monotherapy and was tolerated better, an argument that fits Indian patients who often struggle with high statin doses [23]. In our small combination therapy subgroup the mean LDL cholesterol was 71.3 mg/dL and goal attainment was 42.9%, the best of any treatment stratum.

Low goal attainment is not unique to India. The DA VINCI study across 18 European countries found that only a third of patients on lipid lowering therapy reached their guideline target, and far fewer met the stricter 2019 goals [24]. What differs here is the reason. In our cohort the largest single contributor was simply not being on a drug at all, since none of the 24 untreated patients was at goal. Adherence was the second problem. Poor adherence was linked to a mean LDL cholesterol 35 mg/dL higher than in adherent patients. An Indian cross sectional study of statin users reported that poor understanding of why the drug had been started was one of the strongest predictors of stopping it [25]. That is a counselling failure, not a pharmacological one.

Limitations. This was a single centre study with 68 patients, so the confidence around subgroup percentages is wide, and the eight patients with coronary disease cannot support firm conclusions. The cross sectional design records association and not cause. Adherence was self reported and pill counted, which tends to flatter the patient. Lipoprotein(a) and apolipoprotein B were not measured, and both would have been informative in this phenotype. Patients attending a private tertiary hospital in Ahmedabad are not representative of the district as a whole.

CONCLUSION

Dyslipidemia was almost universal in this cardiometabolic clinic population, and it took the atherogenic Indian form of low HDL cholesterol with raised triglycerides rather than isolated hypercholesterolemia. Detection was not the problem. Treatment was. A third of patients were on no lipid lowering drug at all, moderate intensity statin monotherapy was the default, and fewer than one in five patients reached the LDL cholesterol goal set for their risk. Three practical steps follow from this. Report non-HDL cholesterol alongside LDL cholesterol on every lipid profile. Start a statin in every high risk cardiometabolic patient rather than waiting for a high LDL value. Move to statin plus ezetimibe early instead of accepting a moderate dose that leaves the patient short of goal. A structured counselling visit at the time of the first prescription would probably do more for adherence than any change in molecule.

REFERENCES

- Joshi, S. R., Anjana, R. M., Deepa, M., Pradeepa, R., Bhansali, A., Dhandania, V. K., Joshi, P. P., Unnikrishnan, R., Nirmal, E., Subashini, R., Madhu, S. V., Rao, P. V., Das, A. K., Kaur, T., Shukla, D. K., Mohan, V., & ICMR-INDIAB Collaborative Study Group. (2014). Prevalence of dyslipidemia in urban and rural India: The ICMR-INDIAB study. *PLoS ONE*, 9(5), e96808. <https://pubmed.ncbi.nlm.nih.gov/24817067/>
- Deepa, M., Pradeepa, R., Anjana, R. M., Venkatesan, U., Rao, P. V. P., Bhansali, A., Kumar, A., Nirmal, E., Joshi, P. P., Gupta, A., Suokhrrie, V., Subashini, R., Reang, T., Lakshmy, R., Jampa, L., Vijayachari, P., Gupta, R. K., Ganie, M. A., Sudha, V., Unnikrishnan, R., Kaur, T., Dhaliwal, R. S., Mohan, V., Das, A. K., & ICMR-INDIAB Study Group. (2026). Prevalence of dyslipidemia in India: The ICMR-INDIAB National Study (ICMR-INDIAB-25). *Journal of Clinical Lipidology*. <https://pubmed.ncbi.nlm.nih.gov/42547322/>
- Anjana, R. M., Unnikrishnan, R., Deepa, M., Pradeepa, R., Tandon, N., Das, A. K., Joshi, S., Bajaj, S., Jabbar, P. K., Das, H. K., Kumar, A., Dhandania, V. K., Bhansali, A., Rao, P. V., Desai, A., Kalra, S., Gupta, A., Lakshmy, R., Madhu, S. V., Elangovan, N., Chowdhury, S., Venkatesan, U., Subashini, R., Kaur, T., Dhaliwal, R. S., Mohan, V., & ICMR-INDIAB Collaborative Study Group. (2023). Metabolic non-communicable disease health report of India: The ICMR-INDIAB national cross-sectional study (ICMR-INDIAB-17). *The Lancet Diabetes & Endocrinology*, 11(7), 474–489. <https://pubmed.ncbi.nlm.nih.gov/37301218/>
- Sharma, S., Gaur, K., & Gupta, R. (2024). Trends in epidemiology of dyslipidemias in India. *Indian Heart Journal*, 76(Suppl 1), S20–S28. <https://pubmed.ncbi.nlm.nih.gov/38360457/>
- Kalra, S., & Raizada, N. (2024). Dyslipidemia in diabetes. *Indian Heart Journal*, 76(Suppl 1), S80–S82. <https://pubmed.ncbi.nlm.nih.gov/37956957/>
- Puri, R., Bansal, M., Mehta, V., Duell, P. B., Wong, N. D., Iyengar, S. S., Kalra, D., Nair, D., Nanda, N. C., Narula, J., Deedwania, P., Yusuf, J., Dalal, J. J., Shetty, S., Vijan, V. M., Agarwala, R., Kumar, S., Vijay, K., Khan, A., Wander, G. S., Manoria, P. C., Wangnool, S. K., Mohan, V., Joshi, S. R., Singh, B., Kerkar, P., Rajput, R., Prabhakar, D., Zargar, A. H., Saboo, B., Kasliwal, R. R., Ray, S., Bansal, S., Rabbani, M. U., Chhabra, S. T., Chandra, S., Bardoloi, N., Kavalipati, N., Sathyamurthy, I., Mahajan, K., Pradhan, A., Khanna, N. N., Khadgawat, R., Gupta, P., Chag, M. C., Gupta, A., Murugathan, A., Narasingan, S. N., Upadhyaya, S., Mittal, V., Melinkeri, R. P., Yadav, M., Mubarak, M. R., Pareek, K. K., Dabla, P. K., Nanda, R., & Mohan, J. C. (2024). Lipid Association of India 2023 update on cardiovascular risk assessment and lipid management in Indian patients: Consensus statement IV. *Journal of Clinical Lipidology*, 18(3), e351–e373. <https://pubmed.ncbi.nlm.nih.gov/38485619/>
- Puri, R., Mehta, V., Bansal, M., Shetty, S., Yusuf, J., Agarwala, R., Vijan, V. M., Murugathan, A., Tiwaskar, M., Narasingan, S. N., & Iyengar, S. S. (2024). Navigating cardiovascular risk and lipid management in Indian patients: Key messages from the Lipid Association of India 2024 consensus statement IV. *Journal of the Association of Physicians of India*, 72(8), 80–82. <https://pubmed.ncbi.nlm.nih.gov/39163073/>
- Puri, R., Mehta, V., Duell, P. B., Nair, D., Mohan, J. C., Yusuf, J., Dalal, J. J., Mishra, S., Kasliwal, R. R., Agarwal, R., Mukhopadhyay, S., Wardhan, H., Khanna, N. N., Pradhan, A., Mehrotra, R., Kumar, A., Puri, S., Murugathan, A., Sattur, G. B., Yadav, M., Singh, H. P., Agarwal, R. K., & Nanda, R. (2020). Proposed low-density lipoprotein cholesterol goals for secondary prevention and familial hypercholesterolemia in India with focus on PCSK9 inhibitor monoclonal antibodies: Expert consensus statement from the Lipid Association of India. *Journal of Clinical Lipidology*, 14(2), e1–e13. <https://pubmed.ncbi.nlm.nih.gov/32089456/>
- Puri, R., Bansal, M., Mahajan, K., Gupta, R., Mehta, V., Iyengar, S. S., Prabhakar, D., Agarwala, R., Khan, A., Bardoloi, N., Desai, N., George, S., Majumder, B., Shrivastava, S., Vijan, V., Mahilmaran, A., Jain, D., Shetty, S. R., Duell, P. B., Wong, N. D., & LAL-CARE Study Investigators. (2026). Low-density lipoprotein cholesterol goal attainment in Indian patients with coronary artery disease: A nationwide study. *JACC: Asia*, 6(8 Pt 2), 1865–1875. <https://pubmed.ncbi.nlm.nih.gov/42376721/>
- Shah, V. T. (2024). Lipid response to statins ± ezetimibe in Mumbai (LIRIM): A cross-sectional observational study. *Journal of the Association of Physicians of India*, 72(9), 64–72. <https://pubmed.ncbi.nlm.nih.gov/39291519/>
- Khot, S., Chakraborty, A., & Vijaykumar, S. (2023). Utilization of hypolipidemic drugs, patterns, and factors affecting dyslipidemia among type 2 diabetes mellitus at a tertiary care teaching hospital in South India. *Cureus*, 15(2), e34748. <https://pubmed.ncbi.nlm.nih.gov/36909102/>
- Hassan, A., Keshk, M. A., Reyad, M., Ahmed, N., Nassar, O., Siraj, A., Badr, S., Eltwassy, S., Misra, A., Essibayi, M. A., Azzam, A. Y., Nassar, M., & Hakim, D. (2026). Bridging the gap between evidence and practice: Nationwide retrospective analysis of lipid-modifying therapy prescription patterns in 5 million patients with type 2 diabetes mellitus. *ASIDE Internal Medicine*, 2(2), 6–11. <https://pubmed.ncbi.nlm.nih.gov/40949177/>
- Das, A. K., Saboo, B., & Unnikrishnan, A. G. (2021). Current practices and gaps in management of dyslipidemia in type 2 diabetes mellitus in accordance with American Diabetes Association guidelines: A subset analysis from a real-world, cross-sectional observational study (LEADD study). *Diabetes, Metabolic Syndrome and Obesity*, 14, 2693–2700. <https://pubmed.ncbi.nlm.nih.gov/34163197/>
- Misra, S., Lyngdoh, T., & Mulchandani, R. (2022). Guidelines for dyslipidemia management in India: A review of the current scenario and gaps in research. *Indian Heart Journal*, 74(5), 341–350. <https://pubmed.ncbi.nlm.nih.gov/35940234/>
- Misra, A., Luthra, K., & Vikram, N. K. (2004). Dyslipidemia in Asian Indians: Determinants and significance. *Journal of the Association of Physicians of India*, 52, 137–142. <https://pubmed.ncbi.nlm.nih.gov/15656049/>
- Hirano, T. (2018). Pathophysiology of diabetic dyslipidemia. *Journal of Atherosclerosis and Thrombosis*, 25(9), 771–782. <https://pubmed.ncbi.nlm.nih.gov/29998913/>
- Raja, V., Aguiar, C., Alsayed, N., Chibber, Y. S., ElBadawi, H., Ezhov, M., Hermans, M. P., Pandey, R. C., Ray, K. K., Tokgözoğlu, L., Zambon, A., Berrou, J. P., & Farnier, M. (2023). Non-HDL-cholesterol in dyslipidemia: Review of the state-of-the-art literature and outlook. *Atherosclerosis*, 383, 117312. <https://pubmed.ncbi.nlm.nih.gov/37826864/>
- Johannessen, C. D. L., Mortensen, M. B., Langsted, A., & Nordestgaard, B. G. (2021). Apolipoprotein B and non-HDL cholesterol better reflect residual risk than LDL cholesterol in statin-treated patients. *Journal of the American College of Cardiology*, 77(11), 1439–1450. <https://pubmed.ncbi.nlm.nih.gov/33736827/>
- Meshram, I. I., Sunu, P. V., Sreeramakrishna, K., Neeraja, G., Stephen, G. L., Narasimulu, D., Sengupta, S., Kurpad, A., Raman, R., Jainik, C., Sachdev, H. S., Laxmaiah, A., & Chandak, G. (2025). Cardiometabolic risk factors among adults in rural, urban, and urban slum population in eight states of India. *Indian Heart Journal*, 77(5), 337–347. <https://pubmed.ncbi.nlm.nih.gov/40456313/>
- Jain, S. R., Shah, K. H., Acharya, H. N., Barot, K., & Sharma, K. H. (2015). Prevalence and predictors of metabolic syndrome in young asymptomatic Gujarati population. *International Journal of Chronic Diseases*, 2015, 365217. <https://pubmed.ncbi.nlm.nih.gov/26464869/>
- Chinawale, C. G., Parmar, D. V., Kavathia, P., Rangnani, T., Thakkar, J., & Kartha, G. (2018). Metabolic syndrome among adults of Surendranagar district of Saurashtra, Gujarat: A cross-sectional study. *Indian Journal of Community Medicine*, 43(1), 24–28. <https://pubmed.ncbi.nlm.nih.gov/29531434/>
- Cannon, C. P., Blazing, M. A., Giugliano, R. P., McCagg, A., White, J. A., Theroux, P., Darius, H., Lewis, B. S., Ophuis, T. O., Jukema, J. W., De Ferrari, G. M., Ruzyllo, W., De Lucca, P., Im, K., Bohula, E. A., Reist, C., Wiwiot, S. D., Tershakovec, A. M., Musliner, T. A., Braunwald, E., Califf, R. M., & IMPROVE-IT Investigators. (2015). Ezetimibe added to statin therapy after acute coronary syndromes. *New England Journal of Medicine*, 372(25), 2387–2397. <https://pubmed.ncbi.nlm.nih.gov/26039521/>
- Kim, B. K., Hong, S. J., Lee, Y. J., Hong, S. J., Yun, K. H., Hong, B. K., Heo, J. H., Rha, S. W., Cho, Y. H., Lee, S. J., Ahn, C. M., Kim, J. S., Ko, Y. G., Choi, D., Jang, Y., Hong, M. K., & RACING investigators. (2022). Long-term efficacy and safety of moderate-intensity statin with ezetimibe combination therapy versus high-intensity statin monotherapy in patients with atherosclerotic cardiovascular disease (RACING): A randomised, open-label, non-inferiority trial. *The Lancet*, 400(10349), 380–390. <https://pubmed.ncbi.nlm.nih.gov/35863366/>
- Ray, K. K., Molemans, B., Schoonen, W. M., Giovias, P., Bray, S., Kiru, G., Murphy, J., Banach, M., De Servi, S., Gaita, D., Gouni-Berthold, I., Hovingh, G. K., Jozwiak, J. J., Parkema, J. W., Kiss, R. G., Kownator, S., Iversen, H. K., Maher, V., Masana, L., Pukhomienko, A., Peeters, A., Clifford, P., Raslova, K., Siostrzonek, P., Romeo, S., Tousoulis, D., Vlachopoulos, C., Vrablik, M., Catapano, A. L., Poulter, N. R., & DA VINCI study. (2021). EU-wide cross-sectional observational study of lipid-modifying therapy use in secondary and primary care: The DA VINCI study. *European Journal of Preventive Cardiology*, 28(11), 1279–1289. <https://pubmed.ncbi.nlm.nih.gov/33580789/>
- Umarje, S., James, N. M., Dave, P., Raut, A., & Pandey, N. (2021). Impact of adherence, patient perception, and knowledge to statin therapy: A cross-sectional study. *Indian Journal of Endocrinology and Metabolism*, 25(3), 206–210. <https://pubmed.ncbi.nlm.nih.gov/34760675/>