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Assessment of dyslipidemia management in Turkey using a Delphi panel

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This study evaluated the management of dyslipidemia in Turkey with the goal of understanding current diagnosis and treatment patterns, as well as identifying unmet needs in achieving effective low-density lipoprotein cholesterol (LDL-C) targets. Using a Delphi panel consisting of nine expert cardiologists, the study reveals key gaps in dyslipidemia management, particularly in the underutilization of combination therapies, such as statins and PCSK9 inhibitors, which are crucial for achieving LDL-C targets in high-risk patients. The findings indicate that while many patients with very high cardiovascular risk are diagnosed, a significant proportion do not receive optimal treatment to reach LDL-C levels recommended by European guidelines. Addressing these gaps could lead to more effective management of dyslipidemia and reduce the burden of cardiovascular disease in Turkey. The study's insights provide critical recommendations for clinicians and policymakers to improve clinical practice and health outcomes through more aggressive lipid-lowering strategies.

Non-communicable diseases, particularly cardiovascular diseases (CVDs), are currently the primary causes of mortality and morbidity worldwide. The Global Burden of Disease study revealed that 523 million individuals suffered from CVDs, and 18.6 million lost lives due to these diseases in 2019[1]. Given these significant figures, controlling these disorders is critical, and the United Nations (UN) and the World Health Organization (WHO) set in Sustainable Development Goal 3 to achieve a 30% reduction in premature mortality due to non-communicable diseases by 2030[2].

Dyslipidemia is a modifiable risk factor for CVDs[3], which is mainly an imbalance between circulating levels of apoprotein B (apo B), non-high-density lipoprotein (HDL) cholesterol, low-density lipoprotein (LDL), and HDL cholesterols and/ or triglycerides, in which this imbalance is towards raised plasma concentrations of total cholesterol, LDL cholesterol, triglycerides, or decreased HDL cholesterol levels, or a combination of them[4,5]. Dyslipidemia can result from a variety of secondary predisposing conditions particularly obesity and type 2 diabetes, metabolic syndrome, hepatosteatosis and fat-soluble vitamin deficiencies, or genetic characteristics but can result in severe CVD regardless of the etiology[6,7]. The adverse effects due to these imbalances are accumulative and play a crucial role in the progression of atherosclerosis. The World Heart Federation's Cholesterol Roadmap 2022 underlines the importance of life-long management for the prevention and treatment of atherosclerotic CVDs, which includes primary and secondary prevention measures against development, early intervention, and associated medications to treat dyslipidemia[8]. Identifying the epidemiological characteristics, risk factors, and clinical management of patients is needed in populations to achieve these aims.

Currently, lipid-lowering interventions cover a wide range of approaches including dietary modifications, weight control, physical exercise, and medications to control serum cholesterol levels, which can be applied in the primary and secondary prevention of cardiovascular (CV) events[9].

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Turkey's unique healthcare challenges, including varying access to advanced therapies like PCSK9 inhibitors and conservative treatment approaches, contrast with Western European practices where more aggressive lipid-lowering strategies are implemented.

This study evaluated the current treatment approaches, links between treatment methods and LDL cholesterol levels, the proportion of patients who reached LDL cholesterol levels targeted in guidelines, and treatment methods and unmet needs among patients who failed to achieve LDL cholesterol target levels using a Delphi panel approach.

Methods

This study was based on Delphi technique to seek for expert consensus on the management of dyslipidemia in Turkey. It was paid attention to the centers of the participant expert cardiologists to be diverse (such as university hospitals, city hospitals, training and research hospitals, and branch hospital). A baseline questionnaire including 19 items was prepared and circulated among 9 expert cardiologists in the first round of the discussions, and expert panel reviewed and maturated the questions on the first diagnosis, follow up, management, and prognosis of dyslipidemia. The second round of discussions established the final questionnaire structure, which then used in the final round of discussions to seek consensus outputs. The experts provided their answers to each question as percent values that represented their agreement with each answer, and the final scoring was calculated and presented as the mean of these percent values. The Delphi method was chosen for its utility in synthesizing expert opinions in the absence of strong clinical guidelines. The iterative rounds allowed for independent feedback, with disagreements resolved through anonymized voting until a consensus was reached. A total of three rounds were conducted. All physicians provided written informed consent for their participation in the study. All methods were carried out in accordance with relevant guidelines and regulations. No human patients or animals were involved in the study. The Delphi panel involved only expert cardiologists, all of whom provided written informed consent for their participation. As the study did not involve clinical trials or patient data, institutional ethical approval was not required. All methods were carried out in accordance with relevant guidelines and regulations, and the study adhered to the ethical standards for research involving expert panels.

Results

Consensus statements about the first diagnosis and follow-up are summarized in Table 1. Accordingly, the expert panel reported that 50% of patients were diagnosed during laboratory controls for dyslipidemia in patients with atherosclerotic cardiovascular disease (ASCVD), diabetes mellitus (DM), etc. The majority of the patients (66%) were diagnosed in outpatient settings. The most frequent setting of first diagnosis was state hospitals (38%) and followed up mainly again in state hospitals (40%). These patients were most frequently diagnosed and follow-up by cardiology departments (36% and 62%), followed by internal medicine (24% and 15%) and endocrinology (16% and 13%) departments, respectively (Table 1).

According to consensus statements, which reflected the average consent percent of the expert panel, the CV risk distribution in dyslipidemia patients under routine follow-up was 43% very high risk, 25.6% high risk, 18.6% moderate risk, and 12.8% low risk. Three-quarters of high CV risk patients consisted of secondary prevention cases and a-quarter of them was primary prevention cases. About one-third of secondary prevention cases had recurrent CV events. In the very high-risk primary prevention group (23.6% of patients with very high risk), 11.3% had both familial hypercholesterolemia and diabetes, 17.1% had only familial hypercholesterolemia, 34.6% had only DM, and 37% had neither of these disorders (Table 2).

According to consensus statements, the LDL cholesterol levels were $\geq$ 190 mg/dL in 3.7% of patients in the secondary prevention group, 4.6% of patients in the recurrent CV event group, and 7.9% of patients in the primary prevention group and with very high CV risk, and 8% of patients with high CV risk. The proportion of patients with LDL cholesterol $\leq$ 55 mg/dL in these groups were 5.1%, 6%, 1.7%, and 1.4%, respectively. Primary prevention patients with very high CV risk have higher LDL-cholesterol levels than those with high CV risk. When both very high and high CV risk patients are considered, it is estimated that 4.5% of all dyslipidemia patients have an LDL cholesterol level of 190 mg/dL or higher, and 11.5% have an LDL cholesterol level below 70 mg/dL (Fig. 1).

According to consensus statements, high risk secondary prevention patients (based on the 2019 European Society of Cardiology (ESC)/European Atherosclerosis Society (EAS) guidelines) have their first control visit on average 1.1 months after hospital discharge and follow-up by 3.7-month intervals. High risk and very high-risk primary prevention patients have their first control visit on average 2.0–2.1 months after hospital discharge and follow-up by 5.3-month intervals.

In very high-risk secondary prevention group, 67.7% of patients with low LDL cholesterol levels (below 55 mg/dL) are estimated to be monitored without treatment, while the remaining 32.3% started on statin therapy. For patients with LDL cholesterol levels of 190 mg/dL or higher, it is estimated that 8.6% are started on the maximum dose of statin and ezetimibe therapy, and 2.6% are started on a protein convertase subtilisin/kexin type 9 (PCSK9) inhibitor treatment. Proportions of patients monitored without treatment and started on statin therapy for patients with LDL cholesterol levels below 55 mg/dL were; 62.1%, 37.3% among patients with very high risk and recurrent CV events; 73.2%, 26.8% among primary prevention patients with very high CV risk; and, 81.7%, 18.3% among high CV risk patients, respectively (Fig. 2). Proportions of patients started on the maximum dose of statin and ezetimibe therapy and started on a PCSK9 inhibitor treatment for patients with LDL cholesterol levels of 190 mg/dL or higher were; 8.6%, 2.6% among secondary prevention patients with very high risk; 6.9%, 1.7% among patients with very high risk and recurrent CV events; 6.0%, 1.2% among primary prevention patients with very high CV risk; and , 3.6%, 0.1% among high CV risk patients, respectively (Fig. 2).

	Mean Percent, %	
First diagnosis and follow-up		
Time of the first diagnosis		
Laboratory controls for patients with dyslipidemia (ASCVH, DM, etc.)	50	
Laboratory controls for patients without dyslipidemia	28	
Routine controls for healthy individuals (check-up)	21	
Other	1	
Admission at first diagnosis		
Outpatient	66	
Inpatient	34	
Healthcare setting at first diagnosis/routine follow-up	**First Diagnosis**	**Follow-up**
State hospital	38	40
University hospital	26	27
Family medicine center	16	13
Private hospital	13	12
Private practice	7	8
Department at first diagnosis/routine follow-up		
Cardiology	36	62
Internal medicine	24	15
Endocrinology	16	13
Family medicine	14	7
CV surgery	4	2
Neurology	3	1
Other internal specialties	3	-
Department of first diagnosis for patients being followed up at cardiology		
First diagnosis: Cardiology, routine follow-up: Cardiology	45	
First diagnosis: Internal medicine, routine follow-up: Cardiology	17	
First diagnosis: Family medicine, routine follow-up: Cardiology	13	
First diagnosis: Endocrinology, routine follow-up: Cardiology	9	
First diagnosis: CV surgery, routine follow-up: Cardiology	7	
First diagnosis: Neurology, routine follow-up: Cardiology	6	
First diagnosis: Other internal specialties, routine follow-up: Cardiology	3	

Table 1. Diagnosis and follow-up of patients with dyslipidemia. ASCVD: Atherosclerotic cardiovascular disease; DM: diabetes mellitus CV: Cardiovascular.

According to consensus statements, Table 3 summarizes the risk of CV events, hospitalization, and mortality for patients with CV risk categories. In the very high CV risk category (secondary prevention), patients with documented ASCVD have a 54.4% overall risk of percutaneous coronary intervention (PCI), 38.1% risk of CV event, and 13.8% risk of death in 10 years. In the very high CV risk category (primary prevention), patients without documented ASCVD have 21.3% overall risk of PCI, 18.6% risk of coronary event event, and 8.3% risk of death in 10 years. In the high CV risk category, patients with high CV risk have 14.8% overall risk of PCI, 12.7% risk of a coronary event, and 4.8% risk of death in 10 years.

Discussion

This study evaluated the current approaches for the management of dyslipidemia in secondary and primary prevention patients with very high and high CV risk from a real-world scenario perspective and used a Delphi approach to determine the practice patterns and unmet needs in these patients. The results suggested that dyslipidemia is frequently diagnosed during routine laboratory tests for ASCVD, DM, etc. In addition, most patients are diagnosed and followed up in outpatient settings of state hospitals and, most frequently, by cardiology departments. The CV risk distribution in dyslipidemia patients shows that 76.4% of those with very high CV risk are secondary prevention cases, and one-third have recurrent CV events.

Our study provides valuable insights into the management of dyslipidemia among both primary and secondary prevention patients in Turkey. The results reveal distinct challenges in each group, which are important for understanding the specific needs and treatment gaps. In the secondary prevention group, patients are typically those who have already experienced cardiovascular (CV) events, such as myocardial infarction or stroke, and are at very high risk of recurrence. According to the consensus reached by the expert panel, approximately 76.4% of secondary prevention patients were classified as very high risk. However, despite this classification, the proportion of patients achieving the LDL-C target of < 55 mg/dL, as recommended by European guidelines, remained low. Specifically, only 5.1% of secondary prevention patients with LDL-C ≥ 190 mg/dL were receiving intensive treatment, including statin and PCSK9 inhibitor therapy. The underutilization of these therapies,

	Mean percent, %
CV risk in routine follow-up patients	
Very high risk	43.0
High risk	25.6
Moderate risk	18.6
Low risk	12.8
CV risk categories	
Very high—Secondary prevention	
Secondary prevention patients	76.4
With recurrent CV event	36.7
Without recurrent CV event	63.3
Very high—Primary prevention	
Primary prevention patients	23.6
With familial hypercholesterolemia AND diabetes	11.3
With only familial hypercholesterolemia	17.1
With only diabetes	34.6
Without familial hypercholesterolemia AND diabetes	37.0
High risk	
High risk patients	
With only familial hypercholesterolemia	24.8
With only diabetes	46.1
Without familial hypercholesterolemia AND diabetes	29.1

Table 2. Assessment of CV risks in patients with dyslipidemia. CV: Cardiovascular.

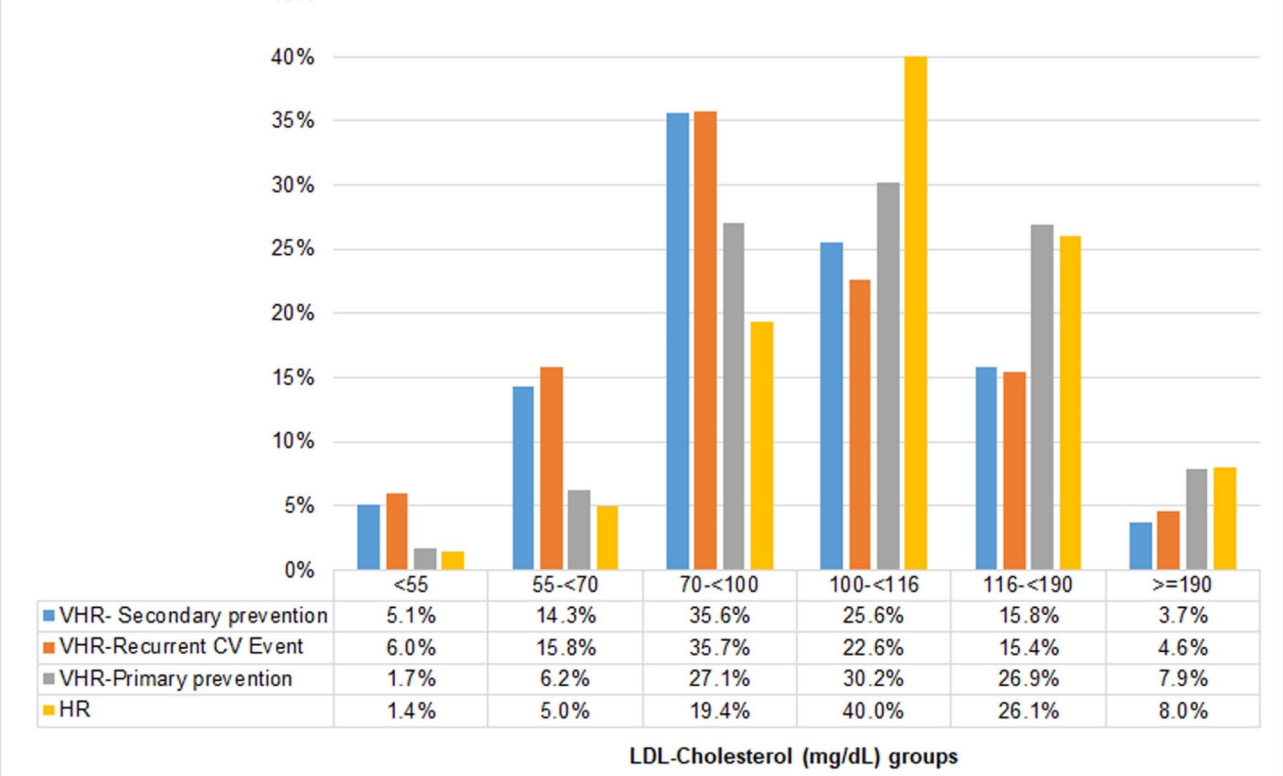


Fig. 1. CV risks in LDL cholesterol categories. VHR: Very-high risk, CV: Cardiovascular, HR: High-risk, LDL: Low-density lipoprotein.

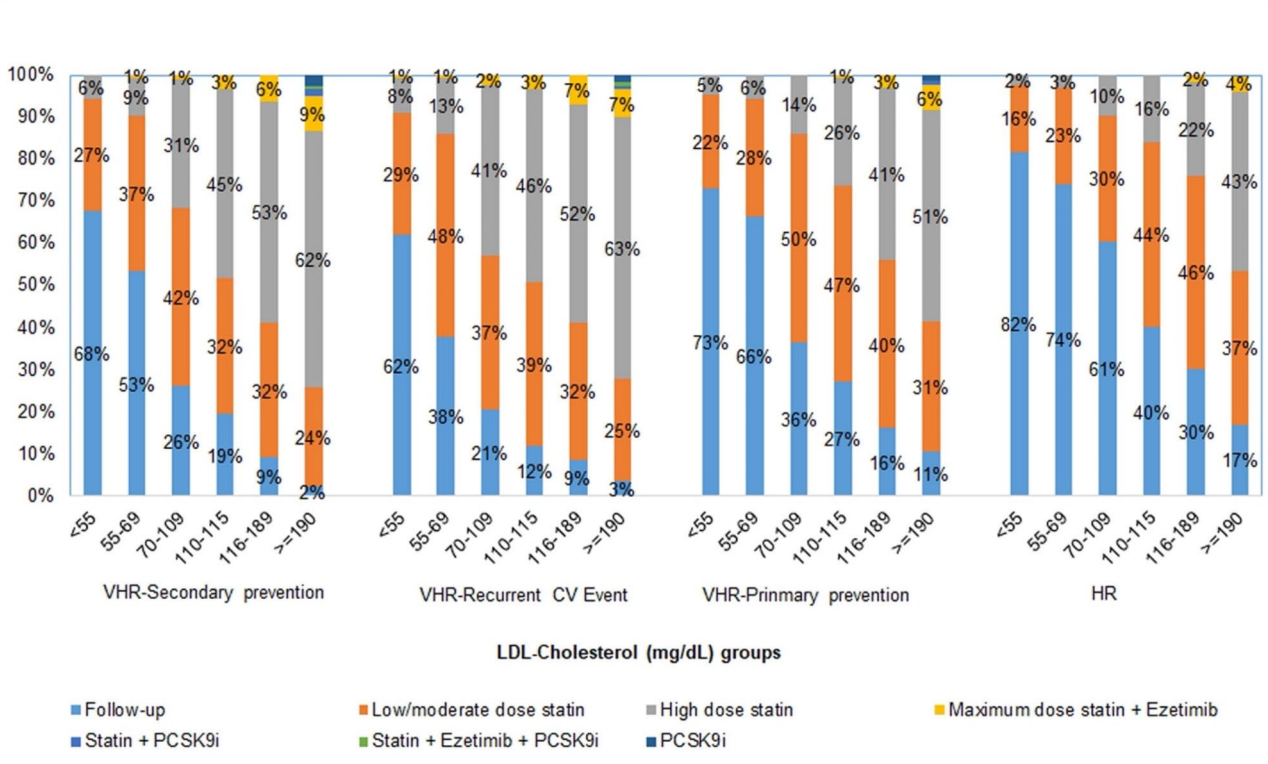


Fig. 2. Treatment approaches in CV risk and LDL cholesterol categories. VHR: Very-high risk, CV: Cardiovascular, HR: High-risk, LDL: Low-density lipoprotein, PCSK9i: Protein convertase subtilisin/kexin type 9 inhibitor.

	CV event-related hospitalization (coronary, cerebrovascular, peripheral vascular events)				Mean percent, %					
	Only inpatient hospitalization		Only ICU hospitalization		Coronary bypass	PCI	Coronary event	Cerebro vascular event	Peripheral vascular event	Death
	Number of hospitalizations	Duration of hospitalization	Number of hospitalizations	Duration of hospitalization	Probability of at least one-time occurrence					Overall risk
	in 10 years	per hospitalization	in 10 years	per hospitalization	in 10 years					
Very high CV risk patients—Secondary prevention										
Patients with documented ASCVD	9.8	3.2	7.2	2.3	10	54	38.1	8.8	8.9	13.8
Patients with recurrent CV events	14.4	3.9	10.2	3.2	14.8	65.0	50.0	11.4	12.3	19.1
Very high CV risk patients—Primary prevention										
Patients without documented ASCVD (overall)	6.8	3.0	4.8	2.2	5.1	21	18.6%	6.3%	5.7	8.3
Patients with familial hypercholesterolemia AND diabetes	9.4	4.0	6.2	3.0	8.9	33.9	27.6	10.2%	11.4	13.1
Patients with ONLY familial hypercholesterolemia	5.7	3.4	4.3	2.4	6.4	26.9	20.2	6.9	6.7	8.4
Patients with ONLY diabetes	4.3	3.7	3.1	2.3	7.0	22.8	19.0	6.0	6.2	7.6
High CV risk patients										
Patients with high CV risk (overall)	5.9	3.0	4.3	2.3	3.8	14.8	12.7	4.6	4.0	4.8
Patients with ONLY familial hypercholesterolemia	4.6	3.2	3.6	2.1	5.6	16.9	17.9	5.0	4.2	6.1
Patients with ONLY diabetes	3.2	3.3	2.4	2.2	5.8	15.7	17.1	4.2	4.1	5.4

Table 3. Prognosis in CV risk categories of patients with dyslipidemia. CV: Cardiovascular, ICU: Intensive care unit, PCI: Percutaneous coronary intervention, ASCVD: Atherosclerotic cardiovascular disease.

particularly in patients with recurrent CV events (36.7% of this group), highlights a critical gap in the management of these high-risk individuals. In contrast, primary prevention patients, who have not yet experienced a major CV event but are at high or very high risk due to conditions such as familial hypercholesterolemia or diabetes, also face challenges in achieving LDL-C targets. Approximately 23.6% of primary prevention patients were classified as very high risk, with only 11.5% reaching LDL-C levels below 70 mg/dL. Among these patients, the use of combination therapies, including statins and ezetimibe or PCSK9 inhibitors, was even lower compared to secondary prevention patients. The lack of aggressive lipid-lowering therapy in this group may stem from a more conservative approach to treatment in patients who have not yet experienced a CV event, despite their elevated risk. The distinction between these two groups is critical in understanding the unmet needs in dyslipidemia management. While both groups show significant gaps in reaching LDL-C targets, the failure to intensify treatment in secondary prevention patients—who are at the highest risk of recurrent events—represents a particularly urgent issue. Conversely, primary prevention patients are not receiving the proactive treatment necessary to prevent their initial CV event, suggesting a need for earlier intervention and stricter adherence to treatment guidelines in this population.

The management of dyslipidemia in patients with very high and high CV risk is a crucial aspect of preventing recurrent CV events. Timely diagnosis of dyslipidemia during routine checkups without the onset of CV or atherosclerotic disease should prevent negative consequences; however, patients are generally diagnosed with dyslipidemia during assessments for another disorder. A previous systematic review and meta-analysis study reported that one-third of the adult population in Turkey had dyslipidemia (defined as a LDL cholesterol > 130 and/or ≥ 130 mg/dL) and/or high triglyceride levels (> 150 mg/dL), and about half of the adults had low HDL cholesterol levels (≤ 50 mg/dL for females and ≤ 40 mg/dL for males)[10]. Despite this abundance, these patients are primarily diagnosed in cardiology departments and during the management of CV or atherosclerotic diseases, as shown by the result of this study. These figures also emphasize the importance of the necessity of effective screening policies for earlier diagnosis of dyslipidemia before these patients develop the atherosclerotic vascular disease for preventive efforts to be more successful.

The risk categorization by the expert panel showed that nearly half of the patients had very high and about one-third had high CV risk, which is a remarkable outcome to underline the burden of CV outcomes in patients with dyslipidemia. Among patients with very high CV risk, almost 80% were secondary prevention cases, of which one-third had recurrent CV events. Given these significant figures, effective management of these patients gains higher importance. Current guidelines of the ESC recommend a target LDL cholesterol level < 55 mg/dL and < 40 mg/dL for patient with recurrent events as a therapeutic objective[11]; however, our results showed that the majority of the patients in Turkey had LDL cholesterol levels higher than this threshold. This pitfall in reaching the target LDL cholesterol goals in patients with significant CV risks was also reported in previous studies, such as the EUROASPIRE IV survey, which investigated lipid-lowering therapy in coronary heart disease patients in 24 European countries, and reported that despite the established benefits of statins in secondary prevention efforts, a substantial number of dyslipidemia patients still receive inadequate treatment and a significant proportion of those using lipid-lowering therapies fail to achieve the recommended LDL cholesterol targets[12].

The unmet need for achieving the management goals also seems to be related to the treatment approaches of the clinicians. Our results showed that about 95% of very high-risk secondary prevention patients had LDL-C > 55 mg/dL and did not receive optimal treatment, which is a remarkably high proportion. The motives for this management approach should be evaluated to overcome the limitations to achieve treatment goals, but it might be associated with the physicians' interpretation that the treatment goals of both achieving an LDL level < 55 mg/dL and a 50% decrease to baseline levels as either one of them could be targeted instead of both.

Our results showed that the treatment approaches were also disproportional with the targets in patients with higher LDL cholesterol levels. The preferred treatment for patients with LDL cholesterol levels > 190 mg/dL was high-dose statins, which can only achieve a 50% decrease in LDL levels, a decrease far from reaching the < 55 mg/dL target. The ezetimibe combination was preferred in only 2% of patients, and combination with PCSK9 inhibitor in only 1%, which are needed for achieving even lower targets (40 mg/dL) in secondary prevention patients with recurrent events. All of these management strategies revealed in this study show the more flexible or liberal approaches in Turkey, which would be evaluated in detail to prevent the burden of significantly prevalent dyslipidemia in our population. The underutilization of combination therapies, particularly the use of statins in conjunction with PCSK9 inhibitors, is a critical gap identified in this study. Despite the proven efficacy of these therapies in achieving LDL-C target levels, our results suggest that a conservative approach predominates in Turkey. This finding aligns with prior studies, such as the EPHESUS study, which highlighted low attainment of LDL-C targets in Turkish patients, particularly in secondary prevention cases[13].

A previous national multicenter observational study in Turkey, the EPHESUS study, evaluated the adherence to dyslipidemia guidelines in secondary prevention patients in Turkey, and reported that only 18% of the secondary prevention patients were below the target LDL cholesterol levels of 70 mg/dL, and the attainment from this target is significantly associated with the physician perceptions for LDL cholesterol goals[13]. These results are also accordant with our findings that the liberal approaches to guideline recommendations might be the underlying causes for unmet needs in the management of these patients in Turkey.

In contrast, studies conducted in European countries have shown significantly higher adherence to aggressive lipid-lowering therapies, especially the use of PCSK9 inhibitors. For example, a recent study demonstrated that early initiation of PCSK9 inhibitors in high-risk patients during the acute phase of cardiovascular events significantly improved LDL-C target achievement[14]. Furthermore, in a broader European context, PCSK9 inhibitors are used more frequently as a combination therapy, leading to higher LDL-C target attainment and better clinical outcomes[15].

The gaps identified may be attributed to several factors, including limited access to advanced therapies due to reimbursement issue, clinical inertia, the patients in-adherence to lipid lowering treatments due to negative

news in written, visual and social media and systemic challenges in ensuring consistent follow-up care. To bridge the identified gaps, clinicians should be trained in the use of combination therapies, and healthcare policies must focus on reimbursement of PCSK9 inhibitors, especially for high-risk patients.

Although this study provided beneficial insights about the management and prognosis of dyslipidemia, and unmet needs of these patients in Turkey, the limitations also should be considered when evaluating the results. First, there is the potential for selection bias, as the method relies on a limited number of experts, which may not fully represent all perspectives. In our study, we included nine cardiologists from various institutions in Turkey to ensure a broad range of opinions. However, the relatively small number of participants may limit the generalizability of the findings. Second, the iterative nature of the Delphi method can introduce a certain level of bias due to the possibility of groupthink, where participants may converge toward a consensus that does not fully reflect individual opinions. While we attempted to mitigate this by anonymizing responses and encouraging independent input in each round, this bias remains a potential limitation. Lastly, the lack of standardized guidelines for the Delphi method can lead to variability in its implementation, including differences in how consensus is defined and how responses are interpreted. Despite these limitations, we believe the method provided valuable insights into the real-world management of dyslipidemia in Turkey, particularly in identifying gaps in diagnosis and treatment.

Conclusion

Effective management of dyslipidemia is crucial for decreasing the burden of mortality and morbidity associated with the CV consequences in these patients. Current ESC guidelines define a robust structure in patient management with lipid-lowering therapies including statins, ezetimibe, and PCSK9 inhibitor. However, real-life scenarios in patient management deviate from the recommendations and result with increased burden of CV risks among these patients. This study evaluated recent evidence regarding treatment preferences, which should be considered for improving the practice patterns among physicians regarding dyslipidemia management. Future research should prioritize investigating the long-term cardiovascular outcomes of combination therapies, particularly in secondary prevention patients. Additionally, studies should focus on identifying and overcoming the barriers to adopting advanced lipid-lowering therapies in Turkey.

Data availability

All data generated or analyzed during this study are included in this published article.

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References

1. Roth, G. A. et al. Global burden of cardiovascular diseases and risk factors, 1990–2019: Update from the GBD 2019 study. *J. Am. Coll. Cardiol.* **76**, 2982–3021. https://doi.org/10.1016/j.jacc.2020.11.010 (2020).
2. World Health Organization (WHO). Targets of sustainable development goal 3. https://www.who.int/europe/about-us/our-work/sustainable-development-goals/targets-of-sustainable-development-goal-3 (2015).
3. Sandesara, P. B., Virani, S. S., Fazio, S. & Shapiro, M. D. The forgotten lipids: Triglycerides, remnant cholesterol, and atherosclerotic cardiovascular disease risk. *Endocr. Rev.* **40**, 537–557. https://doi.org/10.1210/er.2018-00184 (2019).
4. Pappan N. & Rehman A. Dyslipidemia. https://www.ncbi.nlm.nih.gov/books/NBK560891/ (2001).
5. Pirillo, A., Casula, M., Olmastroni, E., Norata, G. D. & Catapano, A. L. Global epidemiology of dyslipidaemias. *Nat. Rev. Cardiol.* **18**, 689–700. https://doi.org/10.1038/s41569-021-00541-4 (2021).
6. Quispe, R. et al. Remnant cholesterol predicts cardiovascular disease beyond LDL and ApoB: A primary prevention study. *Eur. Heart J.* **42**, 4324–4332. https://doi.org/10.1093/eurheartj/ehab432 (2021).
7. Berberich, A. J. & Hegele, R. A. A modern approach to dyslipidemia. *Endocr. Rev.* **43**, 611–653. https://doi.org/10.1210/endrev/bnab037 (2022).
8. Ray, K. K. et al. World Heart Federation Cholesterol Roadmap 2022. *Glob. Heart* **17**, 75. https://doi.org/10.5334/gh.1154 (2022).
9. Chhetry M. & Jialal I. Lipid lowering drug therapy. https://www.ncbi.nlm.nih.gov/books/NBK541128/ (2022).
10. Kayikçioğlu, L. M. et al. Systematic review and meta-analysis of epidemiological studies for cardiovascular risk factors conducted in Turkey: Prevelance of dislipidemias and lipid data. *Arch. Turk. Soc. Cardiol.* **46**, 556–574 (2018).
11. Knuuti, J. et al. 2019 ESC Guidelines for the diagnosis and management of chronic coronary syndromes. *Eur. Heart J.* **41**, 407–477. https://doi.org/10.1093/eurheartj/ehz425 (2020).
12. Reiner, Ž et al. Lipid lowering drug therapy in patients with coronary heart disease from 24 European countries–findings from the EUROASPIRE IV survey. *Atherosclerosis* **246**, 243–250. https://doi.org/10.1016/j.atherosclerosis.2016.01.018 (2016).
13. Mert, G. Ö. et al. The reasons of poor lipid target attainment for secondary prevention in real life practice: Results from EPHESUS. *Int. J. Clin. Pract.* **73**, 1–9. https://doi.org/10.1111/ijcp.13358 (2019).
14. Gargiulo, P., Basile, C., Galasso, G. et al. Strike early–strike strong lipid-lowering strategy with proprotein convertase subtilisin/kexin type 9 inhibitors in acute coronary syndrome patients: Real-world evidence from the AT-TARGET-IT registry. *Eur. J. Prevent. Cardiol.* (2024).
15. Gargiulo, P. et al. Efficacy, safety, adherence and persistence of PCSK9 inhibitors in clinical practice: A single country, multicenter, observational study (AT-TARGET-IT). *Atherosclerosis* **366**, 32–39 (2023).

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Author contributions

UYS, MBY, AT, UCY, BG, TKO, OO, MKayikcioglu, and LT were contributed to the conception and design of the study. UYS, MKus, and OO participated in the manuscript drafting. Lale Tokgozoglu provided critical com-

ments to the manuscript. All authors approved the final version of the manuscript and approved its submission. All authors agreed to be accountable for all aspects of the study in ensuring that questions related to the accuracy. Integrity of any part of the study are appropriately investigated and resolved by all authors.

Declarations

Competing interests

UYS, MBY, AT, UCY, BG report no conflict of interest. TKO is an unpaid president of Global Society of Cardiology, and has received consultant honorarium from Menarini. MKus receives a salary from Novartis where he is the Sr. Medical Lead. OO has received grants from Abbot, Daiichi Sankyo, Pfizer, Servier, Bayer, Astra Zeneca, Menarini, Abdi Ibrahim, and Recordati outside the submitted work. MKayikcioglu has received research grants for investigator-initiated trials from a variety of companies including Amgen, Amryt Pharma, and AstraZeneca, investigator fees for RCTs from Sanofi, Esperion, and Amgen, honorarium for advisory boards of Amgen, and Novartis via her institution. LT has received consulting fees from Abbott, Amgen, Bayer, MSD, Mylan, Novartis, Sanofi, and Daiichi Sankyo, payment or honoraria from Abbott, Janssen, Amgen, Bayer, Daiichi Sankyo, MSD, Mylan, Novartis, Novo Nordisk, Sanofi, Servier, Pfizer, and Recordati Abdi-Ibrahim, support for attending meetings for Servier and has participated on a data safety monitoring board or advisory board for Abbott, Amgen, Novartis, Sanofi, Daiichi-Sankyo, Mylan, and Pfizer, and was the past president of European Atherosclerosis Society and Turkish Society of Cardiology.

Ethical approval

Not applicable. All methods were carried out in accordance with relevant guidelines and regulations.

Additional information

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