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Prevalence, Predictors, and Treatment Gaps of Dyslipidemia in Patients with Type 2 Diabetes Mellitus: A Narrative Review

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ABSTRACT
The Indonesian pharmaceutical industry faces significant challenges related to dependence on imported raw materials, exchange rate volatility, production costs, and the need to strengthen research and development (R&D). These conditions highlight the importance of evaluating financial performance through distinct dimensions of efficiency and effectiveness. This study aims to analyze the production cost efficiency and asset utilization effectiveness of six pharmaceutical companies listed on the Indonesia Stock Exchange in fiscal year 2025 and to examine operational and financial factors associated with differences in their performance. A descriptive quantitative approach with a cross-sectional comparative design was employed using audited annual reports and financial statements for 2025. Financial ratios were analyzed alongside pharmaceutical industry management considerations, including production costs, asset utilization, productivity, R&D investment, human resource management, capital structure, and foreign exchange exposure. The findings indicate that Darya-Varia Laboratoria Tbk (DVLA) and Phapros Tbk (PEHA) recorded the highest gross profit margins, at 54.34% and 52.35%, respectively. Meanwhile, Merck Indonesia Tbk (MERK), Kalbe Farma Tbk (KLBF), and Tempo Scan Pacific Tbk (TSPC) achieved the highest returns on assets, at 19.17%, 12.20%, and 11.32%, respectively. However, the multidimensional assessment produced different overall rankings, demonstrating that strong production cost efficiency does not necessarily correspond to superior asset utilization effectiveness. Although PEHA achieved the second-highest gross profit margin, its overall performance was constrained by weaker results in other dimensions and a high debt-to-equity ratio of 224.51%. The study also identifies limitations in the comparability of nonfinancial disclosures concerning R&D, production capacity utilization, and foreign exchange exposure. In conclusion, pharmaceutical companies should evaluate cost efficiency and asset utilization effectiveness separately to obtain a more comprehensive understanding of managerial performance. These findings are limited to six profitable listed companies and should not be generalized to the entire Indonesian pharmaceutical industry.
Keyword: *Type 2 diabetes mellitus; Dyslipidemia; Predictors; Treatment gaps*

Introduction

Type 2 diabetes mellitus (T2DM) is a major global health challenge and is associated with a substantial burden of cardiovascular morbidity and mortality (Beshyah, 2025; Das et al., 2021; Gyldenkerne et al., 2023; Unnikrishnan et al., 2022). Cardiovascular disease remains one of the principal causes of morbidity and mortality among patients with T2DM, particularly in individuals with multiple metabolic and cardiovascular risk factors (Cebrián-Cuenca et al., 2021; Kassam et

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al., 2023; Koohi et al., 2022; Luca et al., 2024; Metsärinne et al., 2022). Among the metabolic abnormalities accompanying T2DM, dyslipidemia is particularly important because it contributes to the development and progression of atherosclerotic cardiovascular disease (ASCVD) (Abdallah et al., 2024; Kaze et al., 2021). Diabetic dyslipidemia is commonly characterized by elevated triglycerides (TG), reduced high-density lipoprotein cholesterol (HDL-C), and increased concentrations of atherogenic low-density lipoprotein (LDL) particles (Abbas et al., 2023; Haile & Timerga, 2020; Kaze et al., 2021). These lipid abnormalities are associated with endothelial dysfunction, inflammation, and accelerated atherosclerosis, thereby increasing cardiovascular risk (Abdallah et al., 2024; Kaze et al., 2021; Koohi et al., 2022). The high cardiovascular risk associated with diabetic dyslipidemia highlights the importance of early identification, cardiovascular risk assessment, and appropriate lipid management in patients with T2DM (Choi et al., 2023; Davies et al., 2022; Patel et al., 2025).

Available evidence indicates that dyslipidemia and specific lipid abnormalities are highly prevalent among patients with T2DM, although reported estimates vary substantially across populations and clinical settings (Abdissa & Hirpa, 2022; Addis et al., 2024; Ahmmed et al., 2021; Haile & Timerga, 2020; Hyassat et al., 2022). Hyassat et al., reported a high prevalence of dyslipidemia among patients with T2DM in Jordan, while Khadka et al., reported a similarly high burden in Nepal (Hyassat et al., 2022; Khadka et al., 2023). High frequencies of dyslipidemia or lipid abnormalities have also been reported in Saudi Arabia, Ethiopia, South Africa, and Indonesia (Abukhelaif et al., 2024; Addis et al., 2024; Masal, 2023; Parak et al., 2025). Across these studies, reported estimates ranged from approximately 61% to more than 95% (Addis et al., 2024; Haile & Timerga, 2020; Hyassat et al., 2022; Khadka et al., 2023; Parak et al., 2025). However, this variation may reflect differences in population characteristics, healthcare settings, diagnostic criteria, lipid thresholds, and definitions of dyslipidemia (Abdissa & Hirpa, 2022; Addis et al., 2024; Ahmmed et al., 2021; Hyassat et al., 2022). Some studies assessed overall dyslipidemia, whereas others reported individual abnormalities such as elevated LDL-C, hypertriglyceridemia, or reduced HDL-C (Abukhelaif et al., 2024; Ahmmed et al., 2021; Haile & Timerga, 2020). Therefore, direct comparisons across studies should be made cautiously, and geographically diverse evidence needs to be synthesized within its methodological context (Addis et al., 2024; Hyassat et al., 2022; Parak et al., 2025).

In addition to prevalence, identifying factors associated with dyslipidemia is clinically important for cardiovascular risk stratification and targeted intervention (Addis et al., 2024; Haile & Timerga, 2020; Hyassat et al., 2022). Poor glycemic control, particularly elevated glycated hemoglobin (HbA1c), has frequently been associated with adverse lipid parameters among patients with T2DM (Adam, 2025;

Kelnerin et al., 2024; Kidwai et al., 2020; Pasinggi & Baharuddin Pakki, 2025; Sharahili et al., 2023). Obesity and increased body mass index may further contribute to dyslipidemia through insulin resistance and increased free fatty acid availability (Addis et al., 2024; Ahmmed et al., 2021). Older age, hypertension, longer diabetes duration, smoking, physical inactivity, metabolic syndrome, chronic kidney disease, and established cardiovascular disease have also been reported as relevant associated factors in different populations (Abdissa & Hirpa, 2022; Addis et al., 2024; Haile & Timerga, 2020; Hyassat et al., 2022; Kassam et al., 2023; Parak et al., 2025). Nevertheless, because the magnitude and significance of these associations vary across study populations and methodologies, these factors should be interpreted as frequently reported associated factors rather than uniformly ranked predictors (Addis et al., 2024; Ahmmed et al., 2021; Haile & Timerga, 2020; Mochu et al., 2025).

Despite the availability of effective lipid-lowering therapies and contemporary clinical guidelines, important treatment gaps remain in routine clinical practice (Das et al., 2021; Davies et al., 2022; Dhaba et al., 2025; Patel et al., 2025; Vrablík et al., 2023). Failure to achieve recommended LDL-C targets has been documented across different populations (Çiçekli & Sağlan, 2026; Das et al., 2021; Vrablík et al., 2023). Das et al., reported limited LDL-C target attainment, while Vrablík et al., found that only 20.5% of very-high-risk patients achieved guideline-recommended LDL-C targets (Das et al., 2021; Vrablík et al., 2023). Underutilization of statin therapy is another important concern; Dhaba et al., reported that only 53.8% of eligible patients received statins for primary cardiovascular prevention, while Ratnasari et al., documented low statin utilization among Indonesian patients with diabetic cardiovascular complications (Bui et al., 2026; Dhaba et al., 2025; Ratnasari et al., 2019). Inappropriate statin intensity, therapeutic inertia, poor medication adherence, and drug-related problems may further contribute to persistent treatment gaps (Bakhtiar et al., 2023; Bui et al., 2026; Fildza et al., 2025; Makhmudova et al., 2023; Wati & Mutmainah, 2026). Collectively, these findings indicate that the burden of diabetic dyslipidemia is determined not only by its prevalence and associated factors but also by limitations in screening, prescribing, treatment intensification, monitoring, and medication management (Das et al., 2021; Dhaba et al., 2025; Patel et al., 2025; Vrablík et al., 2023).

Although previous studies and reviews have addressed individual aspects of diabetic dyslipidemia, evidence concerning its epidemiological burden, associated factors, and deficiencies in clinical management is often discussed separately. The specific knowledge gap addressed by this review is the limited integration of evidence on the prevalence of dyslipidemia, its frequently reported predictors, and persistent treatment gaps within a single clinically oriented synthesis. Previous studies have predominantly focused on individual domains,

including the prevalence and associated factors of dyslipidemia (Addis et al., 2024; Haile & Timerga, 2020; Hyassat et al., 2022), the relationship between glycemic control and lipid abnormalities (Kidwai et al., 2020; Sharahili et al., 2023), or gaps in LDL-C target attainment and lipid-lowering therapy (Das et al., 2021; Dhaba et al., 2025; Vrablík et al., 2023). Therefore, integrating these domains is clinically relevant because the burden of dyslipidemia cannot be fully understood without considering both the factors associated with its occurrence and the extent to which recommended lipid management is implemented in clinical practice (Kaze et al., 2021; Patel et al., 2025). The novelty of this narrative review lies in integrating three interrelated domains—prevalence, predictors, and treatment gaps—within a single clinically oriented framework. By examining these domains together, this review provides a broader perspective on how variations in disease burden and associated factors intersect with persistent deficiencies in contemporary lipid management.

Therefore, this narrative review aims to synthesize current evidence on the prevalence, predictors, and treatment gaps of dyslipidemia among patients with T2DM, with particular emphasis on variations in reported prevalence, frequently identified associated factors, and persistent gaps in guideline-directed lipid management.

Methods

Study Design

This study was conducted as a narrative review to synthesize contemporary evidence concerning the prevalence, predictors, and treatment gaps of dyslipidemia among patients with T2DM. The review was organized according to these three predefined domains to integrate epidemiological, clinical, and therapeutic evidence.

Literature Search Strategy

A structured literature search was conducted to identify relevant publications from January 2020 to April 2026. Electronic searches were performed using PubMed, PubMed Central (PMC), ScienceDirect, and Google Scholar.

Search terms were developed according to the main review domains and included combinations of *"type 2 diabetes mellitus," "T2DM," "dyslipidemia," "diabetic dyslipidemia," "lipid profile," "prevalence," "predictors," "risk factors," "HbA1c," "obesity," "LDL-C," "statin," "lipid management," "treatment gap," "LDL-C target,"* and *"cardiovascular risk."*

Boolean operators were applied where appropriate. A representative search combination was:

("type 2 diabetes mellitus" OR "T2DM") AND ("dyslipidemia" OR "diabetic dyslipidemia" OR "lipid profile") AND ("prevalence" OR "predictors" OR "risk factors" OR "treatment gap" OR "LDL-C target" OR "statin therapy").

Providing an explicit search strategy is appropriate even for a narrative review because it improves transparency and allows readers to understand how the literature underpinning the synthesis was identified.

Eligibility Criteria

Publications were considered relevant when they: (1) were published between January 2020 and April 2026; (2) involved adults with T2DM or provided evidence directly relevant to dyslipidemia in T2DM; (3) reported evidence concerning prevalence or lipid abnormalities, associated factors or predictors, cardiovascular risk, lipid-lowering treatment, statin utilization, LDL-C target attainment, or treatment gaps; and (4) provided sufficient information to contribute to the narrative synthesis.

Observational, cross-sectional, cohort, and relevant clinical studies were considered, together with selected contemporary clinical guidelines and reviews required to contextualize clinical management. Publications unrelated to the principal review domains, containing insufficient relevant information, or representing duplicate evidence were not prioritized.

Study Selection and Evidence Synthesis

Titles and abstracts were initially assessed for relevance, followed by assessment of potentially relevant full-text publications. Evidence was subsequently organized into three principal domains: (1) prevalence and patterns of dyslipidemia, (2) predictors and associated factors, and (3) treatment gaps in lipid management.

Pathophysiological evidence was used primarily to provide biological context for the identified associations rather than as an independent primary outcome of the review.

Because this study was designed as a narrative review rather than a systematic review, no meta-analysis was performed, and prevalence estimates were not statistically pooled. Differences in populations, clinical settings, diagnostic criteria, lipid thresholds, and definitions of dyslipidemia were considered when interpreting findings across studies.

Results and Discussion

1.1 Prevalence of Dyslipidemia in Type 2 Diabetes Mellitus

Dyslipidemia and specific lipid abnormalities are frequently reported among patients with type 2 diabetes mellitus (T2DM), although the magnitude varies considerably across studies (Addis et al., 2024; Ahmmed et al., 2021; Haile & Timerga, 2020; Hyassat et al., 2022; Khadka et al., 2023). Reported estimates range from approximately 61% to 95%, demonstrating substantial geographical and methodological heterogeneity (Addis et al., 2024; Haile & Timerga, 2020; Hyassat et al., 2022). Hyassat et al., reported an overall dyslipidemia prevalence of 95.4%

among patients with T2DM in Jordan, while Parak et al., reported a prevalence of approximately 93.0% among patients with uncontrolled T2DM in South Africa (Hyassat et al., 2022; Parak et al., 2025). Similarly, Khadka et al., reported dyslipidemia in 87.9% of patients with T2DM in Nepal, whereas Abukhelaif et al., reported a prevalence of 82.7% in Saudi Arabia (Abukhelaif et al., 2024; Khadka et al., 2023). Lower prevalence estimates have been reported in other populations, including studies by Haile and Timerga, Mehta et al., and Addis et al.. The manuscript source likewise documents wide variation across populations, including 95.4% in Jordan, 82.7% in Saudi Arabia, 87.9% in Nepal, and lower estimates in other settings (Addis et al., 2024; Haile & Timerga, 2020; Mehta et al., 2021).

Importantly, these estimates should not be interpreted as directly comparable measures of country-level prevalence because substantial methodological differences exist across studies. Variations in study population, healthcare setting, sample size, diagnostic criteria, lipid thresholds, and definitions of dyslipidemia may influence the reported prevalence (Addis et al., 2024; Ahmmed et al., 2021; Haile & Timerga, 2020; Hyassat et al., 2022). Some studies evaluated overall dyslipidemia, whereas others focused on specific lipid abnormalities, including elevated triglycerides (TG), reduced high-density lipoprotein cholesterol (HDL-C), elevated low-density lipoprotein cholesterol (LDL-C), or mixed dyslipidemia (Abukhelaif et al., 2024; Ahmmed et al., 2021; Hyassat et al., 2022; Khadka et al., 2023). Therefore, differences in the operational definition of dyslipidemia should be considered when interpreting and comparing prevalence estimates across populations.

Masal, reported elevated LDL-C in 85.5% of patients with T2DM in Indonesia. This estimate reflects the prevalence of a specific lipid abnormality, namely elevated LDL-C, rather than the prevalence of overall dyslipidemia (Masal, 2023). The distinction is important because the manuscript's Table 1 specifically identifies the Indonesian 85.5% estimate as being based on elevated LDL-C. Consequently, this estimate should not be directly compared with studies reporting overall dyslipidemia prevalence. Accordingly, the approximately 61–95% range should be interpreted as a descriptive range derived from heterogeneous studies rather than as a pooled global prevalence estimate (Addis et al., 2024; Haile & Timerga, 2020; Hyassat et al., 2022).

The pattern of lipid abnormalities also differs considerably among populations. Hypertriglyceridemia and reduced HDL-C are frequently reported manifestations of diabetic dyslipidemia, whereas other studies identify elevated LDL-C or mixed dyslipidemia as prominent abnormalities (Abukhelaif et al., 2024; Ahmmed et al., 2021; Haile & Timerga, 2020; Hyassat et al., 2022; Khadka et al., 2023). The manuscript similarly identifies high TG, low HDL-C, mixed

dyslipidemia, and elevated LDL-C as differing predominant lipid patterns across the reviewed populations. These differences further emphasize that prevalence data should be interpreted within the specific diagnostic criteria and lipid abnormalities assessed in each study rather than treated as directly interchangeable estimates.

The geographical variation in reported dyslipidemia prevalence and lipid abnormalities among patients with T2DM is summarized in Table 1.

Table 1. Summary of Reported Dyslipidemia Prevalence and Lipid Abnormalities Among Patients with T2DM

Study	Country	Reported Finding	Interpretation
Hyassat et al. (2022)	Jordan	95.4%	Overall dyslipidemia
Parak et al. (2025)	South Africa	93.0%	Dyslipidemia in uncontrolled T2DM
Khadka et al. (2023)	Nepal	87.9%	Mixed dyslipidemia
Masal (2023)	Indonesia	85.5%	Elevated LDL-C; not equivalent to overall dyslipidemia
Abukhelaif et al. (2024)	Saudi Arabia	82.7%	High TG and low HDL-C prominent
Ahmmed et al. (2021)	Bangladesh	71.2%	High TG and low HDL-C prominent
Haile and Timerga (2020)	Ethiopia	68.1%	Low HDL-C prominent
Mehta et al. (2021)	Nepal	63.1%	Mixed dyslipidemia
Addis et al. (2024)	Ethiopia	61.3%	High TG and low HDL-C prominent

As shown in Table 1, the reported prevalence of dyslipidemia and lipid abnormalities among patients with T2DM varied substantially across studies, ranging from approximately 61% to 95% (Addis et al., 2024; Haile & Timerga, 2020; Hyassat et al., 2022). Higher prevalence was reported in Jordan (95.4%), South Africa (93.0%), and Nepal (87.9%) (Hyassat et al., 2022; Khadka et al., 2023; Parak et al., 2025), whereas Addis et al., reported 61.3% in Ethiopia (Addis et al., 2024). The 85.5% reported by Masal, specifically represented elevated LDL-C rather than overall dyslipidemia (Masal, 2023). Therefore, these findings should be interpreted cautiously because differences in study populations, diagnostic criteria, lipid

thresholds, and definitions of dyslipidemia limit direct comparisons across studies (Addis et al., 2024; Haile & Timerga, 2020; Hyassat et al., 2022). The reported 61–95% range consequently represents a descriptive range across heterogeneous studies rather than a pooled global prevalence estimate.

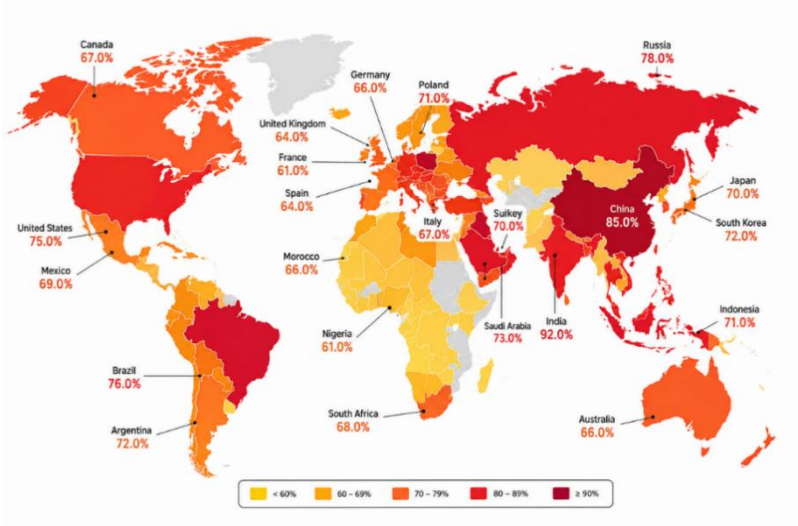


Figure 1. Selected country-specific estimates of dyslipidemia and lipid abnormalities among patients with T2DM.

Source: Developed by the authors based on (Abukhelaif et al., 2024; Addis et al., 2024; Hyassat et al., 2022; Khadka et al., 2023; Masal, 2023; Parak et al., 2025), and other studies included in this narrative review.

Figure 1 illustrates substantial variation in the reported prevalence of dyslipidemia and lipid abnormalities across countries (Abukhelaif et al., 2024; Addis et al., 2024; Haile & Timerga, 2020; Hyassat et al., 2022; Khadka et al., 2023; Parak et al., 2025). However, these estimates should be interpreted cautiously because differences in dyslipidemia definitions, lipid thresholds, study populations, and healthcare settings limit direct comparisons (Addis et al., 2024; Ahmmed et al., 2021; Haile & Timerga, 2020; Hyassat et al., 2022). The figure therefore provides a descriptive overview rather than a pooled global prevalence estimate (Addis et al., 2024; Hyassat et al., 2022; Khadka et al., 2023; Parak et al., 2025).

1.2 Pathophysiological Context of Diabetic Dyslipidemia

Diabetic dyslipidemia is closely linked to insulin resistance and altered lipoprotein metabolism. Reduced insulin-mediated suppression of adipose tissue lipolysis increases circulating free fatty acids and hepatic triglyceride synthesis, promoting very-low-density lipoprotein (VLDL) production. Subsequent lipid exchange and remodeling contribute to hypertriglyceridemia, reduced HDL-C, and the formation of small dense LDL particles, which have greater atherogenic potential (Abbas et al., 2023; M. Abdallah et al., 2021; Kaze et al., 2021).

Poor glycemic control and obesity may further aggravate these abnormalities through increased hepatic lipid production, oxidative stress, inflammation, and insulin resistance (Addis et al., 2024; Ahmmed et al., 2021; Kidwai et al., 2020; Sharahili et al., 2023). These mechanisms provide biological context for the associations identified in the predictor studies but are not independently ranked in this narrative review.

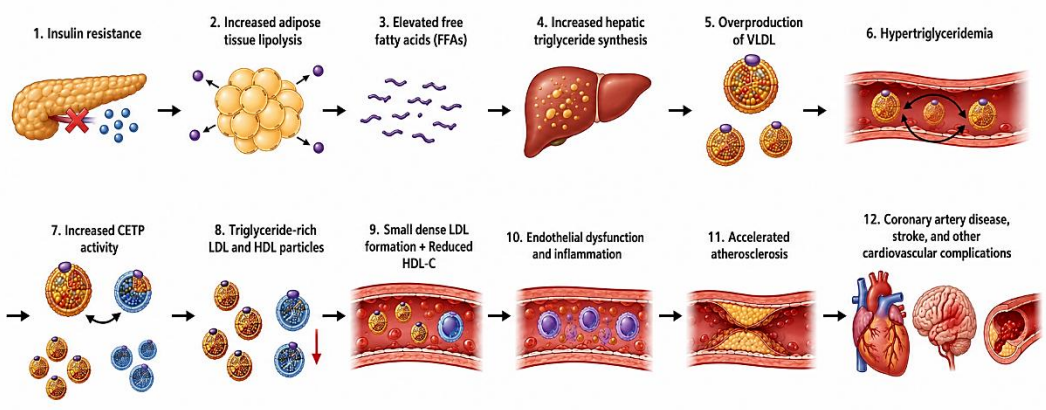


Figure 2. Pathophysiological mechanisms contributing to diabetic dyslipidemia.
Source: Developed by the authors based on (Abbas et al., 2023; M. Abdallah et al., 2021; Gyldenkerne et al., 2023; Kaze et al., 2021; Koohi et al., 2022)

1.3 Predictors of Dyslipidemia in Type 2 Diabetes Mellitus

Dyslipidemia in patients with T2DM is influenced by multiple demographic, metabolic, clinical, and lifestyle factors. Across the reviewed studies, frequently reported associated factors included poor glycemic control, obesity or increased BMI, older age, hypertension, longer diabetes duration, smoking, physical inactivity, and relevant comorbidities. Because this narrative review did not perform a quantitative synthesis, these factors should be interpreted as frequently reported associations rather than hierarchically ranked predictors.

Poor Glycemic Control

Poor glycemic control was frequently associated with adverse lipid profiles. Kidwai et al., identified HbA1c as a predictor of dyslipidemia in T2DM, while Sharahili et al., evaluated the relationship between HbA1c and lipid profiles. Kelnerin et al., and Pasinggi and Baharuddin Pakki, similarly reported associations between HbA1c and dyslipidemia or lipid parameters (Kelnerin et al., 2024; Kidwai et al., 2020; Pasinggi & Baharuddin Pakki, 2025; Sharahili et al., 2023). Collectively, these findings indicate that poor glycemic control is among the frequently reported factors associated with dyslipidemia in T2DM. However, its relative strength compared with other predictors cannot be established without quantitative synthesis.

Obesity and Increased BMI

Obesity and increased BMI were also frequently associated with adverse lipid profiles. Excess adiposity promotes insulin resistance and increased free fatty acid availability, contributing to elevated triglycerides and altered lipoprotein metabolism. Associations between obesity or increased BMI and dyslipidemia have been reported by (Addis et al., 2024; Ahmmed et al., 2021; Mochu et al., 2025).

Other Associated Factors

Older age, hypertension, and longer duration of diabetes were also reported as relevant factors in several populations (Addis et al., 2024; Haile & Timerga, 2020; Hyassat et al., 2022; Kassam et al., 2023; Parak et al., 2025).

. Lifestyle factors, including smoking and physical inactivity, may further contribute to adverse lipid profiles through their relationships with oxidative stress, obesity, and insulin resistance (Addis et al., 2024; Ahmmed et al., 2021). CKD, established cardiovascular disease, and metabolic syndrome may additionally identify patients with greater metabolic and cardiovascular risk.

1.4 Treatment Gaps in Dyslipidemia Management

Despite the availability of effective lipid-lowering therapies and contemporary clinical guidelines, substantial treatment gaps persist among patients with T2DM (Das et al., 2021; Dhaba et al., 2025; Patel et al., 2025; Vrablík et al., 2023). The principal gaps identified across the reviewed literature include failure to achieve LDL-C targets, underutilization of statins, inadequate statin intensity, therapeutic inertia, inadequate lipid monitoring, limited treatment intensification, and medication-related problems (Bakhtiar et al., 2023; Bui et al., 2026; Das et al., 2021; Dhaba et al., 2025; Ratnasari et al., 2019; Vrablík et al., 2023; Wati & Mutmainah, 2026).

Failure to achieve recommended LDL-C targets has been repeatedly reported among patients with T2DM and those at high or very high cardiovascular risk (Çiçekli & Sağlan, 2026; Das et al., 2021; Vrablík et al., 2023). Das et al., reported that only 30.6% of patients achieved LDL-C <100 mg/dL, indicating that a substantial proportion remained above the recommended lipid target. Vrablík et al., similarly reported that only 20.5% of patients at very high cardiovascular risk achieved guideline-recommended LDL-C targets. Çiçekli and Sağlan, also reported substantial failure to achieve LDL-C goals among patients receiving statin therapy. These findings indicate that inadequate LDL-C goal attainment remains an important clinical problem and may contribute to persistent cardiovascular risk despite the availability of effective lipid-lowering therapies (Çiçekli & Sağlan, 2026; Das et al., 2021; Vrablík et al., 2023).

Underutilization and insufficient intensity of statin therapy represent additional important treatment gaps in patients with T2DM (Bui et al., 2026; Dhaba

et al., 2025; Fildza et al., 2025; Ratnasari et al., 2019). Dhaba et al., reported that only 53.8% of eligible patients with T2DM received statin therapy for the primary prevention of cardiovascular disease. Ratnasari et al., reported statin use in only 38.1% of Indonesian patients with diabetic cardiovascular complications. Bui et al., further identified inadequate use of high-intensity statin therapy among patients who met the criteria for intensive lipid-lowering treatment. Collectively, these findings demonstrate a persistent gap between guideline-recommended lipid management and real-world statin prescribing practices (Bui et al., 2026; Dhaba et al., 2025; Fildza et al., 2025; Ratnasari et al., 2019).

Therapeutic inertia and limited treatment intensification may further contribute to inadequate lipid control when LDL-C levels remain above recommended targets (Makhmudova et al., 2023; Patel et al., 2025; Vrablík et al., 2023). Failure to initiate or intensify lipid-lowering therapy in patients who remain above LDL-C targets may prolong exposure to elevated atherogenic cholesterol and contribute to residual cardiovascular risk (Çiçekli & Sağlan, 2026; Patel et al., 2025; Vrablík et al., 2023). Regular assessment of treatment response and timely intensification of lipid-lowering therapy are therefore important components of guideline-directed dyslipidemia management (Makhmudova et al., 2023; Patel et al., 2025).

Medication adherence and drug-related problems may also compromise the effectiveness and safety of lipid-lowering therapy (Bakhtiar et al., 2023; Wati & Mutmainah, 2026). Bakhtiar et al., documented medication-related problems among patients with diabetes, while Wati and Mutmainah, reported drug-related problems associated with statin therapy. These findings highlight the potential importance of medication review, adherence assessment, patient counseling, and multidisciplinary management in addressing treatment-related barriers and optimizing lipid-lowering therapy (Bakhtiar et al., 2023; Wati & Mutmainah, 2026).

Table 3. Major Treatment Gaps, Supporting Evidence, Clinical Implications, and Potential Strategies

Major treatment gap	Supporting evidence	Clinical implication	Potential strategy
Failure to achieve LDL-C targets	Das et al. (2021); Vrablík et al. (2023); Çiçekli & Sağlan (2026)	Persistent residual ASCVD risk	Regular lipid monitoring and timely treatment intensification
Underutilization of statins	Ratnasari et al. (2019); Dhaba et al. (2025); Bui et al. (2026)	Eligible patients remain undertreated	Strengthen guideline implementation and cardiovascular risk assessment
Inadequate statin intensity	Bui et al. (2026); Fildza et al. (2025)	Insufficient LDL-C reduction	Match statin intensity to individual ASCVD risk
Therapeutic inertia	Vrablík et al. (2023); Patel et al. (2025)	Delayed achievement of lipid targets	Scheduled treatment review and timely escalation
Limited combination therapy	Makhmudova et al. (2023); Patel et al. (2025)	Persistent LDL-C elevation despite statin therapy	Consider guideline-directed add-on therapy when indicated
Inadequate lipid monitoring	Das et al. (2021); Beshyah (2025)	Delayed detection and treatment adjustment	Standardized lipid screening and follow-up
Medication adherence/DRPs	Bakhtiar et al. (2023); Wati & Mutmainah (2026)	Reduced treatment effectiveness	Pharmacist-led medication review and adherence support

Table 3 demonstrates that treatment gaps occur across multiple stages of dyslipidemia management, from screening and cardiovascular risk assessment to prescribing, treatment intensification, and medication adherence (Bakhtiar et al., 2023; Bui et al., 2026; Das et al., 2021; Dhaba et al., 2025; Vrablík et al., 2023). Collectively, these gaps may contribute to inadequate LDL-C control and persistent cardiovascular risk among patients with T2DM (Das et al., 2021; Kaze et al., 2021; Vrablík et al., 2023). Strengthening guideline implementation, regular lipid

monitoring, appropriate statin intensity, timely treatment intensification, and pharmacist-supported medication management may help reduce these gaps (Bakhtiar et al., 2023; Bui et al., 2026; Patel et al., 2025; Wati & Mutmainah, 2026).

Conclusion

This narrative review concludes that dyslipidemia represents a substantial clinical burden among patients with type 2 diabetes mellitus (T2DM). First, the reported prevalence of dyslipidemia and lipid abnormalities varied considerably across the reviewed studies, ranging approximately from 61% to 95%. However, this range should be interpreted descriptively rather than as a pooled global prevalence because the studies differed in populations, clinical settings, lipid thresholds, and definitions of dyslipidemia.

Second, dyslipidemia in patients with T2DM was associated with multiple demographic, metabolic, clinical, and lifestyle factors. Poor glycemic control, obesity or increased body mass index, older age, hypertension, longer duration of diabetes, smoking, physical inactivity, and relevant comorbidities were frequently reported as associated factors. Because no quantitative synthesis was performed, their relative predictive strength cannot be definitively ranked.

Third, substantial treatment gaps persist in dyslipidemia management, including inadequate LDL-C target attainment, underutilization or insufficient intensity of statin therapy, therapeutic inertia, inadequate lipid monitoring, limited treatment intensification, and medication-related problems. Overall, the findings demonstrate that dyslipidemia in T2DM is characterized by a high but heterogeneous burden, multiple associated factors, and persistent gaps between guideline recommendations and clinical practice.

Recommendations

Based on the findings of this narrative review, healthcare providers should strengthen routine lipid profile monitoring and cardiovascular risk assessment in patients with type 2 diabetes mellitus, particularly among patients with poor glycemic control, obesity, hypertension, and other cardiovascular risk factors. Lipid-lowering therapy should be regularly evaluated and intensified when clinically indicated to improve LDL-C target attainment.

Healthcare institutions should strengthen the implementation of standardized, guideline-directed dyslipidemia management, including appropriate statin prescribing according to individual cardiovascular risk, regular evaluation of LDL-C targets, and timely consideration of treatment intensification when lipid goals are not achieved.

Pharmacists should contribute through medication review, identification and prevention of drug-related problems, assessment of medication adherence, and

patient counseling to support the safe and effective use of lipid-lowering therapy. These measures are particularly relevant because medication-related problems and suboptimal adherence were identified as important components of the treatment gap in the reviewed evidence.

Finally, healthcare managers and policymakers should support standardized lipid screening and treatment protocols, improve access to appropriate lipid-lowering therapies, and promote multidisciplinary care. These strategies may help reduce the persistent gaps between guideline recommendations and clinical practice and improve cardiovascular risk management among patients with T2DM.

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