Indonesian Journal of Cardiology
Indonesian J Cardiol 2025:46:51-63
pISSN; 2830-3105 / eISSN: 2964-7304
doi: 10.30701/ijc.1880

Original Article

Dyslipidemia management among patients with high and very high cardiovascular risk in Indonesia: a multi-center registry

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Abstract

Background: Indonesia, the world's largest archipelago, faces significant challenges in equitable healthcare delivery due to its geographical and infrastructural disparities. Atherosclerotic Cardiovascular Disease (ASCVD) remains the leading cause of mortality, with over 659,000 deaths recorded in 2019. Effective dyslipidemia management is crucial for preventing adverse ASCVD events. Unfortunately, the lack of implementation of an updated national lipid management registry might hinder an optimal strategy for the adverse events. This study evaluated dyslipidemia cholesterol management practices among high- and very high-risk patients across the country.

Methods: The study recruited 322 patients from eight centers across six provinces in Indonesia between May 2022 and March 2023. Patients were stratified based on the ASCVD risk and followed over three visits. Baseline clinical characteristics, lipid profiles, and treatment regimens were analyzed. Descriptive statistics summarized continuous and categorical variables, and low-density lipoprotein cholesterol (LDL-C) achievement was assessed.

Results: Of the 322 patients, 98.8% were very high-risk, with only 4.9% achieving <55 mg/dL and 21.2% achieving <70 mg/dL. Moderate-intensity statins were the most prescribed (51.2%), followed by high-intensity (36.6%). LDL-C reduction was most pronounced in private insurance patients, achieving a mean LDL-C of 69.8 mg/dL at the third visit compared to 98.9 mg/dL in National Health Insurance (*Jaminan Kesehatan Nasional*/JKN) participants. Missed visit rates increased over time, with 57.5% of patients missing the third visit, predominantly among JKN participants and low-income groups.

Conclusions: The majority of the population failed to achieve the recommended target of LDL-C levels. Dyslipidemia management in Indonesia remains suboptimal, with disparities driven by socioeconomic factors. Improved policies addressing medication availability, national lipid registry establishment, and equitable healthcare access are essential to enhance lipid management and reduce the burden of ASCVD in Indonesia.

(Indonesian J Cardiol, 2025;46;51-63)

Keywords: *Cholesterol, LDL-C, ASCVD, Indonesia.*

Introduction

Indonesia, the world's largest archipelago, consists of over 17,000 islands spreading across its vast territory with a population measuring up to 282 million people by mid-2024.[1] The geographical uniqueness and the country's still-developing infrastructure present a significant challenge in ensuring equitable healthcare access across the nation. Healthcare services, including specialized care for Atherosclerotic cardiovascular disease (ASCVD), remain largely centralized in urban centers in Java Island. The Central Bureau of Statistics reported that in 2015, Indonesia had more than 9,000 primary healthcare facilities. One-third of these hospitals are located within Java Island; meanwhile, eastern regions like Papua only have 200 hospitals covering the entire island.[2] Consequently, residents of remote and underdeveloped regions face considerable difficulties in accessing adequate healthcare facilities, which has a direct impact on the management of chronic diseases, including dyslipidemia and ASCVD.

ASCVD remains a leading cause of morbidity and mortality in Indonesia. The prevalence of ASCVD in Indonesia reveals a threefold increase from 0.5% in 2013 to 1.5% in 2018.[3-4] Despite the seemingly low prevalence, ASCVD remains the leading cause of death in Indonesia, with 659,000 deaths recorded in 2019 according to the Institute for Health Metrics and Evaluation, a significant increase compared to 20 years ago (292,000 deaths recorded).[5] Patients at high and very high ASCVD risk, as per the guideline, require optimal dyslipidemia management as part of their treatment strategy. Effective lipid management plays a pivotal role in preventing major adverse ASCVD events; however, the lack of a comprehensive national lipid registry in Indonesia hampers the monitoring and evaluation of cholesterol management practices across the country. Without such information, identifying gaps in care, assessing treatment adherence, and formulating evidence-based policies become increasingly challenging.

Further complicating the issue is the limited coverage of statin drugs under Indonesia's National Health Insurance (*Jaminan Kesehatan Nasional*/JKN), particularly in primary healthcare settings. High-intensity statins, which are recommended as first-line therapy for patients with high and very high cardiovascular risk,[6-7] are often under-prescribed or inconsistently available due to financial constraints and limited formulary access within the JKN framework. This limitation disproportionately affects patients in rural and underserved areas, where primary healthcare facilities serve as the first and gatekeepers for medical care.

Given these challenges, there is an urgent need to evaluate and address dyslipidemia management practices among patients with high and very-high ASCVD risk in Indonesia. This study aims to understand the current gaps in dyslipidemia management in Indonesia in patients with high and very high cardiovascular risk, and to explore the clinical and non-clinical factors that may be related to the gaps.

Methods

Study design and population

This was an observational, prospective cohort study enrolling patients with high and very high cardiovascular risk who were stratified according to the 2019 European Society Guidelines (ESC) guideline.[7] Patients were recruited from eight centers spread across six provinces in Indonesia. Centers in Java Island were from Jakarta (National Cardiovascular Center Harapan Kita, Pertamina Center Hospital); West Java (University of Indonesia Hospital, Dr. Hasan Sadikin General Hospital); and Banten (Siloam Hospital Lippo Village). Centers from other islands were from Aceh (Dr. Zainoel Abidin General Hospital), East Nusa Tenggara (Prof. Dr. W.Z. Johannes General Hospital), and West Nusa Tenggara (NTB Province General Hospital). The recruitment period lasted from May 2022 to March 2023.

Inclusion and exclusion criteria

Inclusion criteria were patients ≥18 years old and had low-density lipoprotein cholesterol (LDL-C) levels recorded within the last three months. Pregnant, breastfeeding patients, or patients currently involved in interventional research impacting LDL-C were excluded.

Data collection

Baseline characteristics data were obtained from the first outpatient visit through direct interview by study coordinators or research assistants from respective sites. Laboratory measurements were collected from electronic medical records. Follow-up data were obtained from two different outpatient visits, with a one-month interval from the first (baseline) to the second visit, and a three-month interval from the second to the third visit. An electronic data capture system with REDCap (project-redcap.org) was utilized for data entry from each center.

Statistical analysis

Continuous data with normal distribution were reported using mean and standard deviation; meanwhile, skewed continuous data were reported as median and interquartile range. Categorical data were reported as frequencies and percentages. Missing data were shown as frequencies.

Results

A total of 324 patients were screened, and two were ineligible for the study. This study finally enrolled 322 eligible patients, categorized into very high-risk (n = 318) and high-risk (n = 4) ASCVD groups. Patient recruitment flow during the study is shown in Figure 1. Overall baseline characteristics were presented according to ASCVD risk stratification in Table 1. A majority of the participants were male (77.6%). This study included a variety of Asian ethnicities, which were predominantly Malayan.

Payment for healthcare was primarily through the national health insurance or JKN (78.6%). A smaller portion used private insurance (6.8%) or paid out-of-pocket (9.3%). All very high-risk patients had a history of ASCVD. Average LDL-C levels in both groups were high, at 107.6 ± 45.1 mg/dL and 237 ± 37 mg/dL, respectively. Moderate-intensity statins were most prescribed (51.2%), while only 36.6% were on high-intensity statins.

Characteristics of the population with ASCVD were presented in Table 2. Coronary-related ASCVD was the most prevalent, found in 89.4% of the population. The mean age varied by group, with the coronary group having a mean age of 58.9 years, while the polyvascular group showed the highest mean age of 61.4 years. Hypertension and diabetes were the most prevalent comorbidities in the coronary group.

The population with ASCVD was mostly coronary-related, with male gender being more prevalent. The mean age varied by group, with the coronary group having a mean age of 58.9 years.

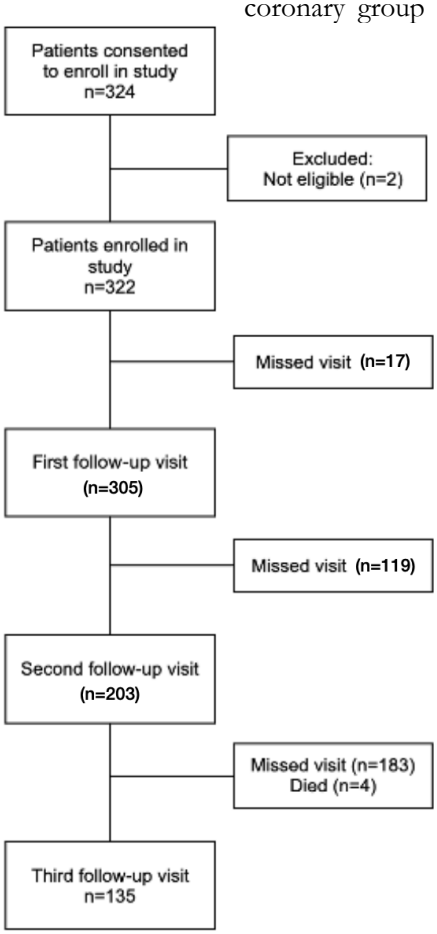

Figure 1. Recruitment and follow-up flowchart.

Table 1. Baseline characteristics according to risk stratification.

Characteristics	Overall (n = 322)	Cardiovascular risk	
		Very high-risk (n = 318)	High-risk (n = 4)
Male sex, n (%)	250 (77.6)	250 (78.6)	0 (0)
Age (years), mean ± SD	58.8 ± 10	58.7 ± 10	68.2 ± 8.3
Race, n (%)			
Proto-Malay	40 (12.4)	40 (12.5)	0 (0)
Deutro-Malay	128 (39.7)	128 (40.2)	0 (0)
Chinese	31 (9.6)	31 (9.7)	0 (0)
Weddoid	2 (0.6)	2 (0.6)	0 (0)
Others	88 (27.3)	86 (27)	2 (50)
Payment status, n (%)			
National health insurance (JKN)	253 (78.5)	251 (78.9)	2 (50)
Private insurance	22 (6.8)	22 (6.9)	0 (0)
Out-of-pocket	30 (9.3)	30 (9.4)	0 (0)
Estimated monthly income, n (%)			
>25 million IDR	21 (6.5)	21 (6.6)	0 (0)
5-25 million IDR	86 (26.7)	86 (26.7)	0 (0)
<5 million IDR	113 (35)	111 (34.9)	2 (50)
No income	49 (15.2)	49 (15.4)	0 (0)
Recruitment center, n (%)			
Java island	151 (46.9)	150 (47.1)	1 (25)
Other islands	171 (53.1)	168 (52.8)	3 (75)
Previous ASCVD, n (%)*	318 (98.7)	318 (100)	0 (0)
Acute coronary syndrome	221 (68.6)	221 (68.6)	0 (0)
Stable angina	108 (33.5)	108 (33.5)	0 (0)
Coronary revascularization	145 (45)	145 (45)	0 (0)
Stroke or transient ischemic attack	18 (55.9)	18 (56.6)	0 (0)
Peripheral arterial disease	1 (0.3)	1 (0.3)	0 (0)
Documented plaque from imaging	95 (29.5)	95 (29.8)	0 (0)
Hypertension, n (%)	183 (56.8)	179 (56.2)	4 (100)
Diabetes, n (%)	111 (34.4)	110 (34.6)	1 (25)

Characteristics	Overall (n = 322)	Cardiovascular risk	
		Very high-risk (n = 318)	High-risk (n = 4)
with target organ damage, n (%)	48 (14.9)	48 (15)	0 (0)
BMI (kg/m^2), mean ± SD	25 ± 3.7	25 ± 3.6	21.5 ± 1.7
Familial hypercholesterolemia, n (%)			
Definite	1 (0.3)	1 (0.3)	0 (0)
Probable	4 (1.2)	4 (1.2)	0 (0)
Possible	42 (13)	41 (12.8)	1 (25)
History of smoking, n (%)			
Active	29 (9)	29 (9.1)	0 (0)
Former	120 (37.2)	120 (37.7)	0 (0)
Never	152 (47.2)	149 (46.8)	3 (75)
Smoking duration (years), mean ± SD	32.9 ± 13.7	32.9 ± 13.7	N/A
Achieved recommended daily physical activity, n (%)+	67 (20.8)	66 (20.7)	1 (25)
LDL-C (mg/dL), mean ± SD	108.4 ± 46.3	107.6 ± 45.1	237 ± 37
non-HDL (mg/dL), mean ± SD	137.8 ± 84.7	137.5 ± 23.5	214 ± 0
Total cholesterol (mg/dL), mean ± SD	176.7 ± 85.1	176.4 ± 34.1	256 ± 0
HDL (mg/dL), mean ± SD	40.3 ± 14.1	40.3 ± 11.6	42 ± 0
Triglyceride (mg/dL), mean ± SD	154 ± 105.6	136.2 ± 23.4	171 ± 46
Lp(a) (mg/dL), mean ± SD	7.65 ± 0.2	7.65 ± 0.2	N/A
ApoB (mg/dL), mean ± SD	54.5 ± 14.8	54.5 ± 14.8	N/A
Systolic BP (mmHg), mean ± SD	124 ± 19	124 ± 19	135 ± 5.7
Diastolic BP (mmHg), mean ± SD	75 ± 12	75 ± 11	84 ± 4.9
Statin intensity, n (%)			
High	118 (36.6)	118 (37.1)	0 (0)
Moderate	165 (51.2)	165 (51.8)	0 (0)
Low	4 (1.2)	4 (1.2)	0 (0)
No previous statin use, n (%)	19 (5.9)	17 (5.3)	2 (50)
Use of other LLTs, n (%)			
Ezetimibe	5 (1.5)	5 (1.5)	0 (0)
Fenofibrate	12 (3.7)	12 (3.7)	0 (0)

*Some patients may receive multiple diagnoses

+Recommended
ASCVD, Atherosclerotic Cardiovascular Disease; BMI, Body Mass Index; HDL, High-Density Lipoprotein; JKN, Jaminan Kesehatan Nasional (National Health Insurance); LDL-C, Low-Density Lipoprotein Cholesterol; LLT, Lipid-Lowering Therapy; Lp(a), Lipoprotein(a); ApoB, Apolipoprotein B.

Table 2. Baseline characteristics of patients with ASCVD.

Characteristics	ASCVD category*				
	Coronary (n = 288)	Cerebral (n = 8)	Imaging (n = 11)	Peripheral (n = 1)	Polyvascular (n = 10)
Male sex, n (%)	225 (78.1)	8 (100)	10 (91)	0 (0)	5 (50)
Age (years), mean ± SD	58.9 ± 9.8	55.7 ± 8.2	50.7 ± 8.8	62 ± 0	61.4 ± 15.3
Hypertension, n (%)	160 (55.5)	6 (75)	5 (45.4)	0 (0)	7 (70)
Diabetes, n (%)	100 (34.7)	4 (50)	1 (9)	0 (0)	5 (50)
BMI (kg/m^2), mean ± SD	24.9 ± 3.5	26.1 ± 7	27 ± 2.1	N/A	26.1 ± 5.6
Familial hypercholesterolemia, n (%)	1 (0.3)	0 (0)	0 (0)	0 (0)	0 (0)
LDL-C (mg/dL), mean ± SD	104.2 ± 43.1	190.5 ± 79.3	159.6 ± 33.9	137 ± 0	107 ± 29.9
non-HDL (mg/dL), mean ± SD	134.7 ± 86.7	207 ± 83	170 ± 37	N/A	144.7 ± 30.7
Recruitment center, n (%)					
Java Island	127 (44.1)	8 (100)	10 (90)	1 (100)	4 (40)
Other islands	161 (55.9)	0 (0)	1 (9)	0 (0)	6 (60)

*Coronary = ACS, stable angina, coronary revascularizations; cerebral = stroke, TIA; clinical = did not fall into any diagnoses but presence of atherosclerotic plaques confirmed by imaging; peripheral = PAD; polyvascular = diagnoses involving more than one category from coronary, cerebral, or peripheral.

In the coronary-related group, one-third of the population had diabetes, and hypertension was present in more than half of them. LDL-C level averaged more than 100 mg/dL in all ASCVD groups, with higher average LDL-C observed in non-coronary related ASCVD.

Table 3 provides baseline characteristics in accordance with payment status. Mean age was highest in the out-of-pocket group (62.4 years), followed by JKN (59 years) and private insurance (49.9 years), suggesting that privately insured patients may represent a younger cohort. JKN patients were predominantly recruited from public hospitals, such as Prof. Dr. W.Z. Johannes General Hospital (31.2%) and Zainoel Abidin General Hospital (22.5%). Private insurance patients were concentrated at Pertamina Hospital Center (68.2%), whereas out-of-pocket patients were largely recruited from Siloam Hospital Lippo Village (83.3%). High-intensity statin use was reported in 88 (34.8%) of JKN patients, 17 (77.3%) of private insurance patients, and 13 (43.3%) of out-of-pocket patients. Use of other LLTs (e.g., ezetimibe) was exclusively seen in the out-of-pocket group, with 5 patients (16.7%) using ezetimibe and 1 (3.3%) using fenofibrate.

The recommended duration for repeat LDL-C measurement is 4-12 weeks after statin is initiated or an adjustment in dosage is made, followed by 3 to 12 months as needed. Assessment is required to measure LDL-C percentage changes from baseline in response to LLT to achieve LDL goals in accordance with the patient's cardiovascular risk.[6] Tables 4 to 6 provide LDL-C achievements over the visiting period in the outpatient clinic. At the first visit, most patients with ASCVD (78.8%) had LDL-C levels above 70 mg/dL, with a mean LDL-C of 108.4 mg/dL. Only 4.9% achieved LDL-C levels below 55 mg/dL. High-intensity statin users had the highest mean LDL-C (115.9 mg/dL), with 32% having levels above 70 mg/dL. Moderate-intensity users had a lower mean LDL-C (98.7 mg/dL), while low-intensity users exhibited the highest mean LDL-C (140.2 mg/dL), though they constituted a small subgroup.

Patients with private insurance showed the highest mean LDL-C (138.9 mg/dL), with 5.6% above 70 mg/dL. National health insurance (JKN) participants had a lower mean LDL-C (105.8 mg/dL), with a slightly better achievement of <55 mg/dL (4.2%). Patients with higher income levels (>25 million IDR) had a higher mean LDL-C (126.8 mg/dL) than middle-income (113.9 mg/dL) and low-income groups (107.3 mg/dL). Recruitment centers on Java Island had a slightly higher mean LDL-C (111.1 mg/dL) compared to other islands (105.5 mg/dL).

At the second outpatient visit (Table 5), moderate-intensity statin users showed a mean LDL-C of 91.4 mg/dL, while high-intensity users had a comparable mean of 90.6 mg/dL. No data were available for low-intensity statin users. The mean LDL-C was lowest among out-of-pocket payers (75 mg/dL), followed by JKN participants (93.5 mg/dL) and private insurance holders (92.1 mg/dL). High-income patients had the lowest mean LDL-C (82 mg/dL), followed by low-income (91.2 mg/dL) and middle-income groups (98.1 mg/dL). LDL-C levels were similar between Java Island (mean: 90.4 mg/dL) and other islands (mean: 91.8 mg/dL), with a slightly higher proportion of patients achieving <55 mg/dL on Java (3.6% vs. 4.5%).

Table 3. Baseline characteristics according to payment status.

Characteristics	Payment Status		
	JKN (n = 253)	**Private insurance (n = 22)**	**Out-of-pocket (n = 30)**
Male sex, n (%)	190 (75)	20 (91)	25 (83.3)
Age (years), mean ± SD	59 ± 9.8	49.9 ± 9.9	62.4 ± 9.2
Hypertension, n (%)	135 (53.3)	14 (63.6)	20 (0.67)
Diabetes, n (%)	84 (33.2)	7 (31.8)	11 (36.6)
Smoker, n (%)	136 (53.7)	10 (45.4)	7 (23.3)
LDL-C (mg/dL), mean ± SD	105.8 ± 42.3	138.9 ± 74.8	108.2 ± 40.2
Cardiovascular risk, n (%)			
Very high-risk	251 (99.2)	22 (100)	30 (100)
High-risk	2 (0.8)	0 (0)	0 (0)
Recruitment center, n (%)			
Java Island	88 (34.7)	22 (100)	30 (100)
Other islands	165 (65.2)	0 (0)	0 (0)
Statin intensity, n (%)			
High	88 (34.7)	17 (77.2)	13 (43.3)
Moderate	142 (56.1)	5 (22.7)	17 (56.7)
Low	4 (1.5)	0 (0)	0 (0)
No previous statin use, n (%)	2 (0.7)	0 (0)	0 (0)
Use of other LLTs, n (%)			
Ezetimibe	0 (0)	0 (0)	5 (16.7)
Fenofibrate	10 (3.9)	1 (4.5)	1 (3.3)

Table 4. Baseline LDL-C level at first visit.

Characteristics	n	LDL-C level (mg/dL)			
		<55	55-70	>70	Mean ± SD
With ASCVD, n (%)	302	15 (4.9)	49 (16.2)	238 (78.8)	108.4 ± 46.3
Statin intensity, n (%)					
High		7 (2.4)	18 (6.2)	92 (32)	115.9 ± 53.2
Moderate	287	8 (2.7)	29 (10.1)	127 (44.2)	98.7 ± 33.9
Low		0 (0)	1 (0.3)	3 (1)	140.2 ± 105.2
Payment status, n (%)					
National health insurance (JKN)		13 (4.2)	40 (13.1)	200 (65.7)	105.8 ± 42.3
Private insurance	304	2 (0.6)	3 (0.9)	17 (5.6)	138.9 ± 74.8
Out-of-pocket		0 (0)	6 (1.9)	23 (7.5)	108.2 ± 40.2
Monthly income, n (%)					
High (>25 million IDR)		0 (0)	0 (0)	9 (3.3)	126.8 ± 37.9
Middle (5-25 million IDR)	269	1 (0.3)	9 (3.3)	51 (18.9)	113.9 ± 47.9
Low (<5 million IDR)		12 (4.4)	34 (12.6)	153 (56.8)	107.3 ± 47.1
Location of recruitment center, n (%)					
Java Island	304	5 (1.6)	19 (6.2)	115 (37.8)	111.1 ± 49.7
Other islands		10 (3.2)	30 (9.8)	125 (41.1)	105.5 ± 43.7

*% is calculated from the total population per subgroup instead of the overall population due to missing data.

Table 5. LDL-C level at the second visit.

Characteristics	n per subgroup	LDL-C level (mg/dL)			
		<55	55-70	>70	Mean ± SD
Risk stratification					
Very high-risk	110	9 (8.1)	20 (18.1)	81 (73.6)	92.6 ± 34.3
High-risk		N/A**	N/A**	N/A**	N/A**
Statin intensity, n (%)					
High		1 (0.9)	9 (8.7)	22 (21.3)	90.6 ± 34.7
Moderate	103	7 (6.8)	10 (9.7)	54 (52.4)	91.4 ± 29.2
Low		N/A**	N/A**	N/A**	N/A**
Payment status, n (%)					
National health insurance (JKN)	110	9 (8.1)	12 (10.9)	72 (65.4)	93.5 ± 33.6
Private insurance		0 (0)	5 (4.5)	3 (2.7)	92.1 ± 53.5

Characteristics	n per subgroup	LDL-C level (mg/dL)			
		<55	55-70	>70	Mean ± SD
Out-of-pocket		0 (0)	3 (2.7)	6 (5.4)	75 ± 32.1
Monthly income, n (%)					
High (>25 million IDR)		0 (0)	1 (1)	2 (2)	82 ± 25.7
Middle (5-25 million IDR)	99	2 (2)	8 (8)	17 (17.1)	98.1 ± 47.3
Low (<5 million IDR)		7 (7)	9 (9)	53 (53.5)	91.2 ± 30.2
Location of recruitment center, n (%)					
Java Island	110	4 (3.6)	13 (11.8)	49 (44.5)	90.4 ± 37.8
Other islands		5 (4.5)	7 (6.3)	32 (29)	91.8 ± 33.7

*% is calculated from the total population per subgroup instead of the overall population due to missing data.
**N/A: No patients had LDL-C checked during the visit.

Table 6. LDL-C level at the third visit.

Characteristics	n	LDL-C level (mg/dL)			
		<55	55-70	>70	Mean ± SD
Risk stratification					
Very high-risk	94	5 (5.3)	15 (15.9)	73 (77.6)	96.9 ± 33.1
High-risk		0 (0)	0 (0)	1 (1)	122 ± 0
Statin intensity, n (%)					
High		2 (2.3)	4 (4.7)	41 (48.2)	92.6 ± 29.2
Moderate	85	2 (2.3)	6 (7)	29 (34.1)	104.3 ± 36.6
Low		0 (0)	1 (1.1)	0 (0)	57 ± 0
Payment status, n (%)					
National health insurance (JKN)		5 (5.3)	10 (10.6)	64 (68)	98.9 ± 32.8
Private insurance	94	0 (0)	4 (4.2)	2 (2.1)	69.8 ± 12.2
Out-of-pocket		0 (0)	1 (1)	8 (8.5)	107.6 ± 37.7
Monthly income, n (%)					
High (>25 million IDR)		0 (0)	0 (0)	2 (2.3)	101.5 ± 19
Middle (5-25 million IDR)	85	3 (3.5)	4 (4.7)	18 (21.1)	92.8 ± 39.3
Low (<5 million IDR)		2 (2.3)	9 (10.5)	47 (55.2)	98.2 ± 29.7
Location of recruitment center, n (%)					
Java Island	89	2 (2.2)	4 (4.5)	47 (52.8)	96.7 ± 30.2
Other islands		3 (3.3)	6 (6.7)	27 (30.3)	97.8 ± 37.7

*% is calculated from the total population per subgroup instead of the overall population due to missing data

Table 7. Missed visits within each follow-up.

Characteristics	First visit	Second visit	Third visit
Missed visits, n (% per total population)	17 (5.2)	119 (36.9)	183 (57.5)
Age, mean ± SD	60.2 ± 9.3	59.2 ± 10.4	58.7 ± 9.9
Payment status, n (%)			
National health insurance (JKN)	N/A	76 (63.8)	118 (64.4)
Private insurance	N/A	11 (9.2)	6 (3.2)
Out-of-pocket	N/A	15 (12.6)	11 (6)
Monthly income, n (%)			
High (>25 million IDR)	N/A	6 (5)	7 (3.8)
Middle (5-25 million IDR)	N/A	17 (14.2)	32 (17.4)
Low (<5 million IDR)	N/A	60 (50.4)	107 (58.4)
Location of recruitment center, n (%)			
Java island	11 (3.6)	59 (49.5)	90 (49.1)
Other islands	6 (1.9)	60 (50.4)	93 (50.8)

Table 8. LDL-C level trend during visits.

Characteristics	LDL-C level (mg/dL), mean ± SD		
	First visit	Second visit	Third visit
Overall	108.1 ± 46.6	92.6 ± 34.3	97.2 ± 33.1
Payment status			
JKN	105.8 ± 42.3	93.5 ± 33.6	98.9 ± 32.8
Non-JKN	121.5 ± 59.1	87.4 ± 38.3	92.5 ± 35.1
ASCVD type			
Coronary	104.4 ± 42.7	91.3 ± 33.2	96.5 ± 33.6
Non-coronary	228.6 ± 26.6	63 ± 0	77 ± 0
Geographical location			
Java Island	111.1 ± 49.7	90.4 ± 37.8	96.7 ± 30.2
Other islands	105.5 ± 43.7	91.8 ± 33.7	97.8 ± 37.7

At the third outpatient visit (Table 6), patients on high-intensity statins had a mean LDL-C of 92.6 mg/dL, while those on moderate-intensity regimens had a higher mean of 104.3 mg/dL. No patients on low-intensity statins had LDL-C measured. Out-of-pocket payers had the highest mean LDL-C (107.6 mg/dL) compared to JKN participants (98.9 mg/dL) and private insurance holders (69.8 mg/dL). The mean LDL-C was highest in high-income patients (101.5 mg/dL), followed by low-income (98.2 mg/dL) and middle-income (92.8 mg/dL) groups. Java Island centers

had a slightly lower mean LDL-C (96.7 mg/dL) compared to other islands (97.8 mg/dL).

Missed outpatient visit rates increased progressively over the follow-ups, from 5.2% at the first visit to 36.9% at the second visit, and 57.5% at the third visit. Patients covered by the National Health Insurance (JKN) accounted for the majority of missed visits at both the second (63.8%) and third (64.4%) follow-ups. Patients with low income (<5 million IDR) consistently constituted the largest proportion of missed visits, comprising 50.4% at the second visit and 58.4% at the third visit. High-income patients (>25 million IDR) had the lowest rates of missed visits, contributing to 5% and 3.8% at the second and third visits, respectively. Missed visits were nearly evenly distributed between Java Island and other islands at both the second (49.5% vs. 50.4%) and third follow-ups (49.1% vs. 50.8%).

Discussion

In adherence to Indonesian recent guidelines for dyslipidemia management, very high-risk patients should aim to achieve an LDL-C level lower than 55 mg/dL, while high-risk patients should achieve an LDL-C of 70 mg/dL or lower.[8] In this study, only 4.6% of the population managed to achieve LDL-C below 55 mg/dL, and 19.8% achieved LDL-C 70 mg/dL or lower, exhibiting that the overall proportion of patients achieving target LDL-C was persistently low. The low rate of LDL-C target achievement in the very high-risk population is consistent with findings from other observational studies. OneACS registry in Indonesia reported that only half of the study population (54.7%) received high-intensity statin as part of routine medication despite being stratified as very high-risk and having g high LDL-C baseline at a median of 115 mg/dL.[9] Lp(a) and ApoB were only measured in a small subset of patients. Despite playing a role in determining cardiovascular risk, both parameters are not affected by LLTs and are not part of lipid therapy targets, hence the lack of need for evaluation. Unavailability of Lp(a) and ApoB standardized assays in public laboratories service covered by JKN also contributed to this, as most of the subjects utilize JKN.

Socioeconomic disparities significantly influenced LDL-C outcomes. Socio-economic factors should be considered in issuing public health policy, in addition to ASCVD traditional risk factors.[10] Private insurance patients demonstrated the most notable improvements, achieving an average LDL-C reduction of 61.2 mg/dL by the third visit compared to 33.7 mg/dL in JKN patients and 41.8 mg/dL in out-of-pocket patients. This group showed a nearly fourfold reduction at the second visit compared to JKN participants and a 1.5 times greater reduction than out-of-pocket patients. By the third visit, private insurance patients achieved a mean LDL-C level of 69.8 mg/dL, successfully meeting the high-risk LDL target, while JKN patients remained at 98.9 mg/dL on average.

In contrast, JKN patients exhibited slower, more gradual improvements. While LDL-C levels decreased modestly across visits, 82.2% of this group failed to achieve LDL-C <70 mg/dL by the third visit. These outcomes reflect systemic barriers within the national health insurance system, which may include limited access to high-intensity statins and restricted availability of statin adjuvants. Out-of-pocket patients showed inconsistent LDL-C control, with a mean LDL-C reduction of 41.8 mg/dL by the third visit. Despite this improvement, financial constraints likely contributed to poor adherence to medications and follow-up care, as evidenced by the highest rate of missed visits in this group.

Patients from islands outside Java were prescribed fewer high-intensity statins. Report from the Indonesian Ministry of Health showed uneven distribution of utilization of cardiovascular specialist services, mostly concentrated in West, East, and Central Java, while Papua, North Borneo, West Sulawesi, and Maluku have a low number of service users. Cardiovascular specialist services were only available in some secondary and tertiary healthcare facilities, indicating that the eastern region had very limited access to such care and relied heavily on primary healthcare facilities.[4] Despite the limitations, patients from islands outside Java achieved slightly higher proportions of LDL-C <55 mg/dL at all visits compared to those on Java Island, showing a slight difference in LDL-C achievement between these two geographical areas.

Statin intensity was closely linked with LDL-C outcomes. Patients receiving high-intensity statins achieved better results, with LDL-C reductions averaging 60.5 mg/dL by the third visit, compared to 34.7 mg/dL for moderate-intensity statins and 20.1 mg/dL for low-intensity regimens. Among patients achieving LDL-C <55 mg/dL, 20% were on high-intensity statins, underscoring their importance in achieving guideline-recommended targets.

However, access to high-intensity statins was uneven across socioeconomic groups. Only 15.6% of JKN patients and 20% of out-of-pocket patients

were prescribed high-intensity statins, compared to 33.3% of private insurance patients. This disparity highlights the systemic barriers within the JKN framework, and the financial challenges faced by out-of-pocket patients. Previous data have revealed that guideline-directed medical treatment can mitigate ASCVD risk for future events.[11]

Missed visits increased substantially over time, with 57.5% of patients failing to attend the third visit. This trend was most pronounced among JKN patients and those with low monthly incomes, suggesting systemic inefficiencies and financial constraints. For instance, missed visits in JKN patients rose from 37.4% at the second visit to 64.4% at the third visit, compared to private insurance patients, where missed visits were consistently lower (9.2% and 6%, respectively).

Geographical barriers also contributed, as patients from islands outside Java had higher missed visit rates, particularly at the third visit (50.8% versus 49.1% for Java). Limited healthcare infrastructure and long travel distances likely exacerbated this issue.

Interestingly, higher-income groups exhibited poorer LDL-C control despite access to better resources. These patients showed less pronounced LDL-C reductions, potentially reflecting differences in adherence, dietary habits, or prioritization of preventive care. In contrast, lower-income patients on JKN coverage demonstrated gradual but consistent LDL-C reductions, averaging 33.7 mg/dL by the third visit. This paradox highlights the complex interplay between socioeconomic status, behavior, and healthcare outcomes.

Study limitations

Several limitations were identified in this study. First, the geographical scope only included 6 out of 34 provinces in Indonesia, covering only Java, Sumatra, and several eastern small islands, which may not represent the actual diversity of healthcare practices and patient populations across the entire country. The relatively small sample population also limited the statistical power of the study and may impact the reliability of subgroup analyses. Some patients were lost to follow-up during the study. There was also an imbalance in the number of patients after being classified into several factors. This disparity may have affected the analysis and the ability to draw definitive conclusions about differences between these compared groups. Moreover, intergroup statistical analyses were not performed due to the study's descriptive design and limited sample size.

Conclusion

The majority of the population failed to achieve the recommended target LDL-C levels. There is a significant gap in statin prescription contributed by socioeconomic factors for cholesterol management in Indonesia. These findings underscore the need for comprehensive efforts to improve LDL-C goal attainment, optimize the use of high-intensity statin therapy and its adjuvants by formulating strategies in consideration of the JKN framework and healthcare access. Such measures are crucial to enhancing outcomes and reducing cardiovascular burden for high-risk populations in Indonesia.

List of Abbreviations

ASCVD	Atherosclerotic cardiovascular disease
BPS	*Badan Pusat Statistik* (Central Bureau of Statistics)
CVD	Cardiovascular disease
ESC	European Society of Cardiology
IDR	Indonesian Rupiah
JKN	*Jaminan Kesehatan Nasional* (National Health Insurance)
LDL-C	Low-density lipoprotein cholesterol
LLT	Lipid-lowering therapy

Ethical Clearance

The study was approved by the Ethics Board Committee of all respective centers where the research was conducted. Informed consent in written form was obtained from each participant prior to the data collection.

Publication Approval

All authors consent to the publication of this manuscript.

Authors' Contributions

All authors contributed to the study development, data collection, data analysis, and manuscript development.

Acknowledgments

This study acknowledged Rizkania Ikhsani, Jessica Wiryanto, Batara Poetra, Muhammad Haris Ramadhan, Fahmi Abdullah Kusyanto, Jesslyn Natalie Hariyanto, Jessica Anastasia Setiawan, Thomas Riki, Ketut Angga Aditya Putra Pramana, Zahara Bunga, Hana Mutia, Damar Mawaddanto, Stefi Geovani, and Muhammad Farhan Maruli for their contributions as research assistants in their respective centers; Grace Wangge as the consultant

for early study design; Yuriawati Hendrawan, Desti Nur Aini, Yohanes Jafar, Rachmawati, and Artnice Mega Fathima as affiliations from Novartis Indonesia.

Conflict of Interest

The authors declared that they have no competing interests.

Availability of Data and Materials

Datasets are owned and kept by the Indonesian Heart Association's (PERKI) Working Group of Atherosclerosis, Thrombosis, Lipidology, and Regenerative Therapy (ATLR).

Funding

This study was funded by Novartis Indonesia and the Working Group of Atherosclerosis, Thrombosis, Lipidology, and Regenerative Therapy (ATLR).

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References

1. *Badan Pusat Statistik*. Mid-Year Population – Indonesia. 2025. Available at: https://www.bps.go.id/en/statistics-table/2/MTk3NSMy/mid-year-population--thousand-people-.html. Accessed 26 February 2025.
2. *Badan Pusat Statistik. Jumlah Rumah Sakit Umum, Rumah Sakit Khusus, dan Puskesmas*. 2015. Available at: https://www.bps.go.id/id/statistics-table/2/MjMyIzI=/jumlah-rumah-sakit-umum-rumah-sakit-khusus-dan-puskesmas.html. Accessed 21 December 2024.
3. National Institute of Health Research and Development of The Indonesia Ministry of Health. The 2018 Indonesia Basic Health Survey (Riskesdas): National Report. Jakarta; 2019.
4. Indonesia Ministry of Health (*Kementerian Kesehatan RI*). National Guidelines for Non-communicable Diseases Prevention and Control. Jakarta, Indonesia: Directorate General of Disease Prevention and Control; 2023. https://p2p.kemkes.go.id/wp-content/uploads/2023/12/FINAL_231123_Layout-PTM_Bahasa-Inggris.pdf. Accessed 21 December 2024.
5. GBD 2019 Universal Health Coverage Collaborators. Deaths due to cardiovascular diseases in Southeast Asia, 2019. Lancet Glob Health. 2019;8:e321–e431.
6. Grundy SM, Stone NJ, Bailey AL, Beam C, Birtcher KK, Blumenthal RS, et al. 2018 guideline on the management of blood cholesterol. Journal of the American College of Cardiology. 2018;73(24).
7. Reiner Z, Catapano AL, G. De Backer, Graham I, Taskinen MR, Wiklund O, et al. ESC/EAS Guidelines for the management of dyslipidaemias: The Task Force for the management of dyslipidaemias of the European Society of Cardiology (ESC) and the European Atherosclerosis Society (EAS). European Heart Journal. 2011;32(14):1769–818.
8. Erwinanto et al. *Panduan Tata Laksana Dislipidemia*. Jakarta: *Perhimpunan Dokter Spesialis Kardiovaskular Indonesia*; 2022.
9. Juzar DA, Muzakkir AF, Ilhami YR, Taufiq N, Kusmana D, Astiawati T, et al. Management of Acute Coronary Syndrome in Indonesia: Insight from One ACS Multicenter Registry. Indones J Cardiol. 2022; 43:45–55.
10. Valee A. Association between socio-economic status - and estimated atherosclerotic cardiovascular risk: results from a middle-aged population-based study. Public Health 2023 Aug: 221: 1-9. Doi: 10.1016/puhe.2023.05.014. Epub 2023 Jun 16.
11. Task Force Members, Montalescot G, Sechtem U, Achenbah S, Andreotti F, Arden C. et al. 2013 ESC guidelines on the management of stable coronary artery disease: The Task Force on the management of stable coronary artery disease of the European Society of Cardiology. Eur Heart J 2013; 34(7): 2949-3003.