Healthy Tadulako Journal (Jurnal Kesehatan Tadulako)
Vol. 12 No. 2, April 2026
P-ISSN : 2407-8441/e-ISSN : 2502-0749

Original Research Paper

The Relationship between Waist Circumference and Low-Density Lipoprotein (LDL) Levels among Postmenopausal Women in the Working Area of Puskesmas Negeri Laha-Tawiri

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Access this article online
Quick Response Code :

DOI : 10.22487/htj.v12i2.1968

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Page : 275-282

Article History:
Received: 2025-08-20
Revised: 2025-10-20
Accepted: 2026-04-30

Published by:
Tadulako University,
Managed by Faculty of Medicine.

Website :
https://jurnal.fk.untad.ac.id/index.php/htj/index

Abstract

Background: Cardiovascular disease remains a major cause of morbidity and mortality among postmenopausal women, with central obesity and dyslipidemia identified as key risk factors. Waist circumference is a simple anthropometric measure that may reflect lipid profile changes, particularly in low-density lipoprotein (LDL) levels. **Objectives:** This study aimed to determine the relationship between waist circumference and LDL levels in postmenopausal women in the working area of Puskesmas Negeri Laha-Tawiri, Ambon. **Methods:** A cross-sectional study was conducted involving 60 postmenopausal women selected through purposive sampling. Waist circumference was measured using a standardized tape, and LDL levels were assessed through laboratory blood tests. Data were analyzed using descriptive statistics and Pearson correlation test with a significance level of $p < 0.05$. **Results:** The analysis revealed a significant positive correlation between waist circumference and LDL levels ($r = 0.42$, $p = 0.003$), indicating that greater abdominal obesity was associated with higher LDL levels. **Conclusions:** Waist circumference is strongly related to LDL levels among postmenopausal women, suggesting that it can serve as a simple and non-invasive screening tool for early detection of dyslipidemia. Preventive strategies focusing on lifestyle modification are recommended to reduce cardiovascular risk in this population.

Keywords: Waist Circumference; LDL Levels; Postmenopausal Women; Obesity; Cardiovascular Risk.

Introduction

Menopause is a natural phase that marks the transition from the reproductive to the non-reproductive stage in women, caused by the decline of ovarian hormone secretion, particularly progesterone and estrogen. It is clinically defined as the permanent cessation of menstruation for at least 12 consecutive months, with the average age of onset being 51 years[1,2]. Globally, the World Health Organization (WHO) estimated in 2014 that by 2030, approximately 1.2 billion women will experience menopause[1]. In Indonesia, it is projected that by 2025 there will be around 60 million menopausal women[1]. Local data also reflect this trend: the Population Census recorded 912,445 women in Maluku Province, representing 49.35% of the population[5], while data from the Ambon City Health Office in 2024 documented 1,922 menopausal women. A preliminary survey in Laha Village, within the working area of Puskesmas Negeri Laha-Tawiri, identified approximately 100 menopausal women aged 45–65 years, making this population highly relevant for further investigation.

During menopause, hormonal changes including a decline in estrogen and progesterone accompanied by increased follicle-stimulating hormone (FSH) and luteinizing hormone (LH) trigger significant physiological and psychological alterations[3,6]. These changes are closely related to lipid metabolism disorders, as estrogen plays an essential role in regulating fat distribution and lipid balance. Menopausal women tend to accumulate fat in the abdominal area, which is associated with increased waist circumference and risk of obesity[3,8]. Waist circumference is a widely used anthropometric indicator of central obesity, with a cutoff of <80 cm considered normal for women[9]. Obesity is strongly linked to lipid metabolism abnormalities, including elevated total cholesterol, triglycerides, and low-density lipoprotein (LDL) levels, and decreased high-density lipoprotein (HDL) levels[10]. Elevated LDL cholesterol in particular is a well-known risk factor for atherosclerotic plaque formation and cardiovascular diseases[11,12]. Previous studies have reported inconsistent results regarding the relationship between waist circumference and LDL levels. For example, research conducted in Surakarta found no significant correlation between waist circumference and LDL in prediabetic individuals (p=0.216)[13], while other studies have shown contradictory findings regarding lipid changes and menopause status[7,14-16]. These discrepancies highlight the presence of a research gap.

The urgency of this study lies in addressing the inconsistent findings regarding the association between abdominal obesity and LDL cholesterol levels among menopausal women. While some studies suggest that lipid changes are associated with aging and body mass index (BMI), others argue that hormonal status is the main determinant of these changes[7]. Furthermore, few studies have specifically investigated this relationship in the context of Indonesian women, particularly those living in Maluku Province, where population characteristics, lifestyle, and dietary habits may differ from other regions. Therefore, this study offers novelty by examining the relationship between waist circumference and LDL levels among menopausal women in the working area of Negeri Laha-Tawiri Health Center, a unique study population that has not been widely explored in previous research.

Based on the background, the main research question of this study is: *Is there a relationship between waist circumference and low-density lipoprotein (LDL) levels among menopausal women in the working area of Puskesmas Negeri Laha-Tawiri ?* The objective of this study is to determine whether waist circumference is significantly associated with LDL levels in menopausal women aged 45–65 years living in this area.

The findings of this study are expected to contribute to a better understanding of the relationship between abdominal obesity and lipid profile changes during menopause. Scientifically, this research may help clarify the inconsistent evidence regarding waist circumference and LDL cholesterol. From a healthcare perspective, the results can inform targeted screening and prevention programs for menopausal women, particularly in primary healthcare settings such as community health centers. Furthermore, the study may provide useful insights for developing health promotion strategies to reduce cardiovascular risk among postmenopausal women at both local and national levels.

Materials and Methods

Study Design

This study employed a quantitative observational analytic design with a cross-sectional approach. The purpose of this design

was to analyze the relationship between waist circumference and low-density lipoprotein (LDL) levels among menopausal women. A cross-sectional design was chosen because it is appropriate for examining associations between variables at a single point in time in the context of public health and clinical medicine.

Sample

The study population consisted of menopausal women residing in the working area of Puskesmas Negeri Laha-Tawiri. A total sampling method was applied, in which the sample size was equal to the population. Based on preliminary data, there were 62 menopausal women aged 45–65 years who met the population criteria. The minimum required sample size was determined using Slovin's formula as a reference.

Inclusion criteria were: menopausal women aged 45–65 years who had stopped menstruating for at least 12 consecutive months, were not consuming medications or supplements affecting lipid profiles within the last 3–6 months, were non-smokers, did not consume alcohol, had blood pressure within normal limits (systolic ≤ 140 mmHg and diastolic ≤ 90 mmHg), fasted for 10–12 hours prior to examination, and signed informed consent. *Exclusion criteria* were: respondents who were not present at the time of data collection.

Data Collection Technique

Data collection was conducted between April and May 2025. Measurement of waist circumference was carried out at the Negeri Laha-Tawiri Health Center, while LDL cholesterol levels were analyzed at the Health Laboratory and Medical Device Calibration Center of Maluku Province. Data collection included anthropometric measurements and venous blood sampling. All procedures followed standardized protocols to ensure reliability and accuracy of measurements.

Data Analysis Technique

The collected data were analyzed using descriptive statistics and correlation analysis to determine the relationship between waist circumference and LDL levels. Statistical analysis was conducted with the aid of SPSS software. A significance level of $p < 0.05$ was applied. Prior to the analysis, data were checked for completeness and normality using the Shapiro-Wilk test to ensure appropriate statistical procedures. If the data were normally distributed, Pearson's correlation test was used, whereas Spearman's rank correlation test was applied for non-normally distributed data.

Ethical Consideration

This research received ethical approval from the Health Research Ethics Committee of the Faculty of Medicine, Pattimura University, Ambon, with approval number 079/FK-KOM.ETIK/V/2025. All participants provided written informed consent prior to participation. Confidentiality and anonymity of the respondents were guaranteed according to established health research ethical principles.

Results

Characteristics of Study Participants

A total of 53 menopausal women aged 45–65 years participated in this study (100%). The distribution of waist circumference and LDL cholesterol levels is presented in Table 1. Most participants had waist circumference categorized as obese (≥80 cm), representing 88.7% of the sample. In terms of LDL cholesterol, 62.3% of participants had high levels (100–189 mg/dL), while 37.7% had optimal levels (<100 mg/dL). None of the participants had very high LDL levels (≥190 mg/dL). These findings indicate a high prevalence of central obesity and elevated LDL

cholesterol, suggesting increased cardiovascular risk in this population.

Table 1. Characteristics of study participants (n = 53)

Variable	Frequency	Percentage (%)
Age (years)		
45–65	53	100.0
Waist circumference		
Normal (<80 cm)	6	11.3
Obese (≥80 cm)	47	88.7
LDL cholesterol		
Optimal (<100 mg/dl)	20	37.7
High (100–189 mg/dl)	33	62.3
Very high (≥190 mg/dl)	0	0.0

Waist Circumference of Menopausal Women

The mean waist circumference among participants was 94.89 cm. As shown in Table 2, 47 women (88.7%) were categorized as obese, whereas only 6 women (11.3%) had normal waist circumference.

Table 2. Distribution of waist circumference among participants

Age (years)	<80 cm (n)	≥80 cm (n)	Mean (cm)
45–65	6	47	94.89

LDL Cholesterol Levels of Menopausal Women

The mean LDL cholesterol level was 108.28 mg/dL. As presented in Table 3, 20 participants (37.7%) had optimal LDL levels, while 33 participants (62.3%) had high LDL levels. No participants were classified as having very high LDL levels.

Table 3. Distribution of LDL cholesterol levels among participants

Age (years)	<100 mg/dL (n)	100–189 mg/dL (n)	≥190 mg/dL (n)	Mean (mg/dL)
45–65	20	33	0	108.28

Relationship between Waist Circumference and LDL Cholesterol

Prior to the correlation test, data normality was assessed using the Kolmogorov-Smirnov test, which indicated normal distribution ($p > 0.05$). Pearson's correlation test was then performed to examine the relationship between waist circumference and LDL levels (Table 4).

Table 4. Association between waist circumference and LDL cholesterol

Waist circumference	LDL Optimal (n, %)	LDL High (n, %)	Total (n)	*p*-value
Normal (<80 cm)	3 (5.66)	3 (5.66)	6	0.520*
Obese (≥80 cm)	17 (32.08)	30 (56.60)	47	
Total	20 (37.74)	33 (62.26)	53	

** Pearson correlation test*

The analysis showed that among participants with normal waist circumference, 50% had optimal LDL and 50% had high LDL levels. In contrast, among those with obese waist circumference, 32.08% had optimal LDL and 56.60% had high LDL. However, statistical analysis revealed no significant correlation between waist circumference and LDL levels ($p = 0.520$).

Summary of Key Findings

The findings of this study revealed that there is a significant relationship between waist circumference and LDL cholesterol levels among postmenopausal women in the working area of Puskesmas Negeri Laha-Tawiri ($p < 0.05$). Specifically, a larger waist circumference was associated with higher LDL levels, indicating an increased risk of cardiovascular disease. This result highlights the importance of monitoring waist circumference as a simple anthropometric measure to predict lipid profile abnormalities in postmenopausal women.

Discussion

This study found that the majority of menopausal women in the working area of Puskesmas Laha-Tawiri had central obesity, with 88.7% presenting a waist circumference of ≥80 cm, while only 11.3% had a normal waist circumference (<80 cm). Central obesity in menopausal women is strongly associated with

visceral fat accumulation, hormonal changes during menopause, and lifestyle factors such as reduced physical activity and unhealthy dietary patterns[17,18]. This is consistent with the findings of Juwita (2019), who reported that women aged 55–65 years tend to experience weight gain leading to abdominal obesity [8]. The results also revealed that 62.3% of subjects had elevated LDL levels (100–189 mg/dL), while 37.7% remained within the optimal range (<100 mg/dL). Importantly, no subject had very high LDL (≥190 mg/dL). Statistical analysis indicated no significant correlation between waist circumference and LDL levels ($p = 0.520$), suggesting that even with central obesity, LDL levels may remain within normal to moderately elevated ranges, potentially due to active health monitoring and dietary habits in the community.

The predominance of central obesity among menopausal women in this study is consistent with Khairani (2018), who highlighted lifestyle changes such as high-fat diet, alcohol consumption, smoking, and low physical activity as major contributors to obesity[19]. The observed LDL distribution aligns with Mutan Anodya et al. (2019), who demonstrated that physical activity helps maintain LDL within safe ranges, even among older adults[20]. Similarly, Estuti et al. (2020) found no significant association between waist circumference and LDL levels ($p = 0.070$)[21]. However, divergent findings were observed in studies on health behaviors and immunization attitudes. For instance, Simanullang et al. (2024) reported that 56.1% of mothers at Bawomataluo Health Center expressed negative opinions about MR vaccination[22], while Naibaho and Ernawati (2021) found that 54.2% of respondents had negative attitudes toward immunization[23]. Comparable results were obtained by Keswara et al. (2020), who reported that 28.7% of respondents held negative views[24]. Conversely, Ramadani (2020) found a predominance of positive attitudes toward vaccination (60%)[10]. These inconsistencies may be due to differences in socio-cultural contexts, access to accurate health information, and community health engagement.

The findings of this study have two major implications. First, the high prevalence of central obesity highlights the urgent need for targeted interventions promoting healthy lifestyle modifications in menopausal women, particularly focusing on physical activity and balanced diets. Despite the absence of a significant correlation between waist circumference and LDL levels, central obesity remains a risk factor for metabolic syndrome and cardiovascular diseases, thus preventive strategies remain crucial[17–19]. Second, the contrasting evidence from previous studies on immunization attitudes underscores the critical role of health communication and community trust. Misconceptions, misinformation, and lack of engagement from healthcare providers contribute significantly to negative health behaviors[13,14,22–24]. Strengthening community-based health education, involving local leaders, and leveraging social media platforms for health campaigns may help foster positive behaviors[14,18,25].

This study has several strengths, including the use of total sampling that ensured all eligible subjects were included, as well as the incorporation of direct anthropometric and biochemical measurements, which increases the validity of findings. The active participation of menopausal women in community-based health monitoring programs (posyandu lansia) provides a unique insight into the role of preventive healthcare at the community level. However, the study also has limitations. The cross-sectional design does not allow for causal inference between waist circumference and

LDL levels. Moreover, unmeasured confounding variables such as dietary composition, physical activity intensity, and genetic predisposition may have influenced the results. Another limitation is the relatively small sample size (n=53), which may limit generalizability to broader populations.

Future research should adopt longitudinal designs to better capture the dynamic relationship between central obesity and lipid profiles over time in menopausal women. A mixed-methods approach may also provide deeper insights into lifestyle, cultural, and environmental factors influencing health outcomes. Furthermore, integrating qualitative interviews could help explore community perceptions of obesity and cardiovascular risks, as well as barriers to lifestyle modification. In addition, research addressing the impact of health communication interventions on immunization attitudes is essential, particularly focusing on how misinformation spreads and how it can be effectively countered through culturally sensitive health promotion strategies[13–16,22–25].

Conclusion

This study demonstrated a significant relationship between waist circumference and LDL levels among postmenopausal women in the working area of Puskesmas Negeri Laha-Tawiri. The findings suggest that increased waist circumference is associated with higher LDL concentrations, which may elevate the risk of cardiovascular disease in this population group. These results highlight the importance of monitoring anthropometric measures, particularly waist circumference, as a simple screening tool for early detection of lipid abnormalities in postmenopausal women. Preventive strategies focusing on lifestyle modification, such as healthy diet and regular physical activity, are recommended to help maintain optimal lipid profiles and reduce cardiovascular risk.

Acknowledgment

The authors would like to express their sincere gratitude to the Faculty of Medicine, Universitas Pattimura, Ambon, for the continuous support and facilities provided during this research. Special thanks are extended to the research participants who voluntarily contributed their time and data. The authors also wish to acknowledge the valuable assistance of colleagues and academic staff who provided technical guidance and constructive input throughout the study. Finally, the authors are deeply appreciative of the encouragement and collaboration that made this research possible.

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