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Lipid Panel Predictors of Urinary Incontinence in Elderly in Bina Bakti Nursing

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Abstract. *Urinary incontinence (UI) significantly impacts the quality of life in older adults, often resulting from multifactorial causes, including age-related changes and systemic health issues. Emerging evidence highlights the role of lipid metabolism in influencing bladder and pelvic floor function through vascular integrity, inflammation control, and tissue repair. Lipid parameters, such as apolipoproteins, HDL, LDL, total cholesterol, triglycerides, and their ratios, provide insights into metabolic health and its association with UI. This study aims to identify specific lipid-related predictors, advancing the understanding of metabolic factors in UI and informing targeted prevention and management strategies for aging populations. This study used multiple linear regression analysis to assess the relationship between lipid panel predictors and urinary incontinence in 93 elderly respondents at Bina Bakti Nursing Home. The analysis identifies apolipoprotein B, Apo B/Apo A ratio, total cholesterol, and triglyceride-to-HDL ratio as significant predictors. These variables actively influence urinary incontinence through metabolic and vascular pathways, with both positive and negative associations. Apolipoprotein B, Apo B/Apo A ratio, total cholesterol, and triglyceride-to-HDL ratio predict urinary incontinence, highlighting lipid-related impacts on vascular health, inflammation, and tissue integrity for improved risk stratification.*

Keywords: *Elderly; Lipid panel; Urine incontinence*

Abstrak. Inkontinensia urin (IU) secara signifikan memengaruhi kualitas hidup pada lansia, sering kali disebabkan oleh faktor multifaktorial, termasuk perubahan terkait usia dan masalah kesehatan sistemik. Bukti terkini menunjukkan peran metabolisme lipid dalam memengaruhi fungsi kandung kemih dan dasar panggul melalui integritas vaskular, pengendalian inflamasi, dan perbaikan jaringan. Parameter lipid, seperti apolipoprotein, HDL, LDL, kolesterol total, trigliserida, dan rasio-rasionya, memberikan wawasan tentang kesehatan metabolik dan hubungannya dengan IU. Penelitian ini bertujuan mengidentifikasi prediktor spesifik yang terkait dengan lipid, untuk memperdalam pemahaman tentang faktor metabolik dalam IU serta menyusun strategi pencegahan dan pengelolaan yang lebih terarah bagi populasi lansia. Penelitian ini menggunakan analisis regresi linier berganda untuk menilai hubungan antara prediktor panel lipid dan inkontinensia urin pada 93 responden lansia di Panti Werdha Bina Bakti. Analisis mengidentifikasi apolipoprotein B, rasio Apo B/Apo A, kolesterol total, dan rasio trigliserida terhadap HDL sebagai prediktor signifikan. Variabel-variabel ini secara aktif memengaruhi inkontinensia urin melalui jalur metabolik dan vaskular, dengan asosiasi positif maupun negatif. Apolipoprotein B, rasio Apo B/Apo A, kolesterol total, dan rasio trigliserida terhadap HDL memprediksi inkontinensia urin, menyoroti dampak terkait lipid terhadap kesehatan vaskular, inflamasi, dan integritas jaringan untuk perbaikan stratifikasi risiko.

Kata kunci: Inkontinensia urin; Lansia; Panel lipid

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1. INTRODUCTION

Urinary incontinence (UI) significantly affects the quality of life and health outcomes of older adults. (Grimby et al., 1993) This condition, characterized by the involuntary leakage of urine, often stems from complex, multifactorial causes, including age-related urinary tract changes, pelvic floor dysfunction, and systemic health issues.(Wyman, 1998) While researchers have established traditional risk factors such as age, gender, and comorbidities like diabetes and obesity, they have started exploring the role of metabolic and lipid profiles in UI development. (Kane & Xu, 2013)

Lipid metabolism plays a vital role in maintaining vascular integrity, controlling inflammation, and supporting tissue repair, all of which directly influence bladder and pelvic floor function. (Mass & Levin, 2003) Specific lipid parameters, such as apolipoproteins (Apo A and Apo B) and their ratios, high-density lipoprotein (HDL), low-density lipoprotein (LDL), total cholesterol, triglycerides, and lipid ratios (e.g., triglyceride-to-HDL and LDL-to-Apo A), offer critical insights into metabolic health. (Xiang et al., 2024) Apolipoprotein ratios, especially Apo A/Apo B, reliably indicate cardiovascular risk and systemic inflammation, which can impact urinary function through microvascular damage and weakened tissue support. (Mass & Levin, 2003) Similarly, altered HDL and triglyceride levels link to metabolic syndrome, a condition that promotes systemic inflammation and impairs muscle function, potentially contributing to UI. (Peng et al., 2021)

The aim of this study is to identify specific lipid-related predictors, and to enhance the understanding of metabolic factors influencing UI and contribute to the development of targeted strategies for prevention and management in the aging population.

2. LITERATURE REVIEW

Urinary incontinence (UI) commonly affects the elderly population and significantly impacts quality of life. Various risk factors contribute to this condition, including metabolic factors linked to the body’s lipid profile. Recent studies indicate that lipid imbalances, such as altered levels of apolipoprotein A (Apo-A), apolipoprotein B (Apo-B), low-density lipoprotein (LDL), high-density lipoprotein (HDL), triglycerides, and total cholesterol, influence the physiological function of the urinary system. Each lipid component likely contributes to incontinence mechanisms by affecting pelvic floor muscles, blood supply, and systemic inflammation. (Abushamma, 2024; Dumitrașcu et al., 2019; Matthews et al., 2013)

Apo-A serves as the primary component of high-density lipoprotein (HDL) and facilitates cholesterol transport from peripheral tissues back to the liver for elimination.

Several studies have shown that high HDL levels, primarily driven by Apo-A, provide protective effects against various cardiovascular diseases. Poor cardiovascular health often correlates with vascular impairments that affect organ perfusion, including the urinary system. Reduced Apo-A or HDL levels can disrupt circulation in the pelvic region and pelvic floor muscles, contributing to urinary incontinence mechanisms. Research has linked low HDL levels to decreased pelvic floor muscle function, a key risk factor for urinary incontinence. (Ferreira et al., 2020; Gontard et al., 2020; Wang et al., 2023)

Apo-B serves as the primary component of low-density lipoprotein (LDL) and facilitates cholesterol distribution to peripheral tissues. Elevated Apo-B levels strongly correlate with an increased risk of atherosclerosis, which leads to plaque buildup in blood vessels and disrupts blood flow to various organs, including pelvic floor muscles. This dysfunction weakens the ability to control urinary flow. Additionally, atherosclerosis affecting renal blood vessels can trigger kidney issues that exacerbate urinary incontinence symptoms. Therefore, high Apo-B levels represent a potential risk factor that directly and indirectly affects urinary system function. (AlAsmi et al., 2022; Ferreira et al., 2020; Shang, 2023)

High LDL levels and low HDL levels often increase the risk of cardiovascular and metabolic diseases. Excess LDL promotes cholesterol buildup in blood vessel walls, leading to vascular dysfunction that negatively impacts kidney function and the urinary system. Additionally, an imbalance between LDL and HDL reduces the elasticity and strength of pelvic floor muscles, increasing the risk of urinary incontinence. Several studies have demonstrated that high LDL levels contribute to pelvic muscle dysfunction, a key factor in the pathogenesis of urinary incontinence. (Ackah et al., 2022; Chen et al., 2023; Shang, 2023)

Triglycerides circulate widely in the blood and play a crucial role in energy metabolism. High triglyceride levels strongly correlate with systemic inflammation, which affects vital organs, including pelvic floor muscles and the urinary tract. Chronic inflammation caused by elevated triglycerides disrupts the function of supportive muscles in the pelvic area, contributing to urinary incontinence. Additionally, high triglyceride levels often associate with metabolic syndrome, which further increases the prevalence of urinary incontinence among the elderly population. (Ferreira et al., 2020; Loposso, 2023; Martinez et al., 2022)

Total cholesterol includes all types of cholesterol in the blood, including LDL and HDL. Elevated total cholesterol levels increase the risk of atherosclerosis and other metabolic disorders, which directly impact kidney function and pelvic floor muscles. Dysfunction in these systems increases the risk of urinary incontinence. Additionally, high total cholesterol levels impair blood supply to pelvic tissues, reducing the strength and elasticity of pelvic floor muscles essential for urinary continence. (Gontard et al., 2020; Kim et al., 2021; Mainu et al., 2023)

3. METHOD

This cross-sectional analytic study was conducted at Bina Bakti Nursing Home. The subjects included those who met the following inclusion criteria: willing to take part in the research by signing informed consent, and age above 60 years. The exclusion criteria included individuals with recent surgery, acute illnesses, or use of cholesterol-lowering drugs.

Urinary incontinence (UI) was measured using the International Consultation on Incontinence - Short Form for Urinary Incontinence (ICIQ-UI-SF). This validated instrument assesses the severity of urinary incontinence, including aspects of frequency, volume, impact on lifestyle, and self-rating, with a score range of 0-21, where higher scores indicate more severe incontinence and greater impact on quality of life. The study included the following independent variables: High-Density Lipoprotein (HDL) (mg/dL), Low-Density Lipoprotein (LDL) (mg/dL), Triglycerides (mg/dL), Total Cholesterol (mg/dL) was measured using enzymatic assay; Apolipoprotein A (Apo-A) (mg/dL) and Apolipoprotein B (Apo-B) (mg/dL) was assessed using the immunoturbidimetric method. Venous blood samples were collected according to standard protocols, ensuring accuracy and reliability of the measurements for lipid panel parameters.

The statistical analysis was performed using SPSS version 26. Data were analyzed quantitatively through the following steps: the Kolmogorov-Smirnov test was used to assess data normality. Spearman's Rho was employed for nonparametric correlation analysis, with statistical significance set at $p < 0.05$. Correlation strength was categorized as negligible (0.00-0.10), weak (0.10-0.39), moderate (0.40-0.69), strong (0.70-0.89), and very strong (0.90-1.00). Respondent characteristics were summarized using mean and standard deviation. Spearman's Rho and Multiple Regression analyses were conducted to evaluate the roles of lipid panel components as predictors of urinary incontinence, and the predictive equation was interpreted using the unstandardized beta (β) value, indicating the extent of the effect of each predictor on the dependent variable.

4. RESULT AND DISCUSSION

This study population comprised 93 older adults, with majority of the respondents being women (79.6%). The mean age of participants was 74.19 years, reflecting an older demographic. The lipid panel results revealed a mean apolipoprotein A level of 155.59 mmol/L and a mean apolipoprotein B level of 93.20 mmol/L. The mean ratio of Apo B to Apo A was 0.60, indicating a favorable balance between these key apolipoproteins.

Participants had an average HDL level of 44.70 mg/dL and a total cholesterol level of 160.19 mg/dL, both of which fall within the expected ranges for older adults. The mean LDL level was 95 mg/dL, while the average level of triglyceride is 100.40 mg/dL. Mean triglyceride-to-HDL ratio of 2.40 and a mean LDL-to-Apo A ratio of 0.62. (Table 1)

Table 1. Respondents Characteristics

Variables	Results
Gender: (%)	
- Men	19 (20.4)
- Women	74 (79.6)
Age, mean (SD) years	74.19 (7.96)
Apolipoprotein A, mean (SD) mmol/L	155.59(15.67)
Apolipoprotein B, mean (SD) mmol/L	93.20 (12.56)
Ratio Apo B / Apo A, mean (SD)	0.60 (0.10)
HDL, mean (SD) mg/dL	44.70 (12.12)
Total Cholesterol, mean (SD) mg/dL	160.19 (29.28)
LDL, mean (SD) mg/dL	95 (27.96)
Triglyceride, mean (SD) mg/dL	100.40 (29.51)
Ratio Triglyceride / HDL, mean (SD)	2.40 (0.89)
Ratio LDL / Apolipoprotein A, mean (SD)	0.62 (0.2)

The results reveal several notable correlations between lipid parameters and urinary incontinence, as assessed by the International Consultation on Incontinence Questionnaire - Short Form (ICIQ-UI-SF) score. Age exhibits a weak positive correlation ($r = 0.115$; $p = 0.274$), indicating correlation between the age and the urinary incontinence.

Apolipoprotein A (Apo A) demonstrates a significant negative correlation with the ICIQ-UI-SF score ($r = -0.352$; $p < 0.001$). Apolipoprotein B (Apo B) also shows a negative correlation and non-significant correlation ($r = -0.202$; $p = 0.052$).

The ratio of Apo B to Apo A exhibits a weak and non-significant positive correlation ($r = 0.099$; $p = 0.343$), indicating no substantial impact on urinary incontinence. Similarly, HDL shows a weak positive correlation ($r = 0.125$, $p = 0.232$), suggesting minimal direct influence on urine incontinence.

Total cholesterol and LDL levels reveal significant negative correlations with the ICIQ-UI-SF score ($r = -0.294$; $p = 0.004$ and $r = -0.300$; $p = 0.003$). These findings highlight that lower levels of total cholesterol and LDL are associated with greater urinary incontinence. Triglycerides, the triglyceride-to-HDL ratio, and the LDL-to-Apo A ratio display weak negative correlations with urinary incontinence scores (r = -0.173; p = 0.228, r = -0.158; p = 0.097, and p = 0.130), none of which reach statistical significance. (Table 2)

Table 2. Lipid Panel Correlation with Urine Incontinence Based on International Consultation on Incontinence -Short Form for Urinary Incontinence (ICIQ-UI-SF)

Parameter N=93	**International Consultation on Incontinence – Short Form for Urinary Incontinence (ICIQ-UI-SF) score**	
	r-correlation (spearman)	**p**
Age	0,115	0,274
Apolipoprotein A (Apo A)	-0,352	<0,001*
Apolipoprotein B (Apo B)	-0,202	0,052
Ratio Apo B/Apo A	0,099	0,343
High Dense Lipoprotein (HDL)	0,125	0,232
Total Cholesterol	-0,294	0,004*
Low Dense Lipoprotein (LDL)	-0,300	0,003*
Triglyceride	-0,125	0,228
Ratio Triglyceride/HDL	-0,173	0,097
Ratio LDL/Apo A	-0,158	0,130

**, Correlation is significant at the 0.01 level (2-tailed)

*, Correlation is significant at the 0.05 level (2-tailed)

The multiple linear regression analysis identified four variables significantly associated with the dependent variable. Apolipoprotein B demonstrated a negative and significant relationship, indicating its inverse association with the outcome (Beta = -0.537; p = 0.001). The Ratio of Apo B/Apo A exhibited a strong positive impact, reflecting its substantial influence on the dependent variable (Beta = 0.734; p = 0.000). Total cholesterol displayed a negative association, with statistical significance (Beta = -0.269; p = 0.017), highlighting its potential role in influencing the outcome. Lastly, the triglyceride-to-HDL ratio showed a negative and significant effect, further emphasizing its relevance (Beta = -0.285; p = 0.003). (Table 3)

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Table 3. Multiple Linear Regression of Lipid Panel with Urine Incontinence based on International Consultation on Incontinence – Short Form for Urinary Incontinence (ICIQ-UI-SF)

MODEL		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	SIG.
1	(Constant)	15.805	37.267		0.424	0.673
	Age	0.049	0.095	0.054	0.518	0.606
	Apolipoprotein A	-0.026	0.266	-0.056	-0.098	0.922
	Apolipoprotein B	-0.216	0.544	-0.371	-0.397	0.692
	Ratio Apo B/Apo A	43.525	76.928	0.572	0.566	0.573
	High Dense Lipoprotein (HDL)	-0.002	0.206	-0.004	-0.011	0.992
	Total cholesterol	-0.048	0.115	-0.192	-0.417	0.678
	Low Dense Lipoprotein (LDL)	-0.067	0.349	-0.258	-0.193	0.848
	Triglyceride	0.023	0.071	0.092	0.323	0.748
	Ratio triglyceride/HDL	-2.750	3.039	-0.335	-0.905	0.368
	Ratio LDL/ApoA	5.412	49.741	0.145	0.109	0.914
7	(Constant)	18.194	5.161		3.525	0.001
	Apolipoprotein B	-0.312	0.095	-0.537	-3.303	0.001
	Ratio Apo B/Apo A	55.873	11.577	0.734	4.826	0.000
	Total cholesterol	-0.067	0.028	-0.269	-2.438	0.017
	Ratio triglyceride/HDL	-2.341	0.780	-0.285	-3.001	0.003

COEFFICIENTS[A]

A. Dependent variable: ICIQ-UI

The multiple linear regression analysis identified apolipoprotein B, the ratio of apolipoprotein B to apolipoprotein A (Apo B/Apo A), total cholesterol, and the triglyceride-to-HDL ratio as the only significant predictors of urinary incontinence based on the International Consultation on Incontinence Questionnaire-Short Form (ICIQ-UI-SF). These variables emerged as significant in the seventh step of the model, after excluding non-contributory predictors.

Apolipoprotein B (ApoB) plays a crucial role in lipid transport and metabolism, as it is a structural component of atherogenic lipoproteins such as low-density lipoproteins (LDL), very low-density lipoproteins (VLDL), and intermediate-density lipoproteins (IDL). (Morita, 2016) Each ApoB molecule is essential for the formation and stability of these lipoproteins, facilitating their transport of cholesterol and triglycerides throughout the body. (Behbodikhah et al., 2021) The notable influence of ApoB on urinary incontinence, as indicated in the regression analysis, likely stems from its impact on vascular health and systemic inflammation, both of which are closely linked to urinary tract function. (Olofsson & Boren, 2005)

Elevated ApoB levels indicate an increased number of atherogenic lipoproteins in circulation, which can promote the development of atherosclerosis. Atherosclerosis, characterized by plaque formation and vascular narrowing, impairs endothelial function and reduces blood flow. (Handayani & Sargowo, 2017) This may cause poor vascular supply to the pelvic region, including the bladder and sphincter muscles, which could compromise their structural integrity and function. As a result, this may lead to weakened muscle control and increased susceptibility to incontinence. (Glavinovic et al., 2022)

Additionally, ApoB-associated lipoproteins contribute to chronic low-grade inflammation, a condition that exacerbates tissue damage and disrupts normal cellular repair processes. (Mazidi et al., 2022) Inflammation in the pelvic region could directly affect the detrusor muscle of the bladder or the urethral sphincter, further compromising urinary control. Chronic exposure to inflammatory markers may also alter nerve signaling pathways, leading to overactive bladder symptoms or reduced sphincter efficiency. (Villarreal-Calderon et al., 2021)

The Apo B/Apo A ratio is a crucial marker for assessing the balance between atherogenic and anti-atherogenic lipoproteins in the body. Apolipoprotein B (ApoB) is primarily found in atherogenic lipoproteins, such as low-density lipoproteins (LDL), which contribute to plaque formation in arteries and are associated with increased cardiovascular risk. (Walldius & Jungner, 2006) On the other hand, apolipoprotein A (ApoA) is predominantly found in high-density lipoproteins (HDL), which are protective against atherosclerosis and cardiovascular disease due to their roles in reverse cholesterol transport and anti-inflammatory effects.(Dorobanțu et al., 2023) A higher Apo B/Apo A ratio indicates a greater predominance of atherogenic lipoproteins, signifying increased metabolic stress and potential dysfunction in various tissues, including those involved in urinary control. (Soffer et al., 2024)

Metabolic stress, driven by an imbalance in lipoprotein ratios, has far-reaching effects on vascular health and tissue function. The Apo B/Apo A ratio reflects this imbalance by highlighting the increased presence of atherogenic particles, which can lead to endothelial dysfunction and impaired microvascular circulation. (Saputri et al., 2017) Vascular impairments can negatively affect the pelvic region, including the bladder and sphincter muscles. These tissues require optimal blood flow to maintain their structural integrity and function, and any disruption in vascular health can lead to weakened muscle control, reduced responsiveness, and an increased likelihood of incontinence. (Lima et al., 2007)

Furthermore, a higher Apo B/Apo A ratio contributes to chronic systemic inflammation, a factor known to aggravate tissue dysfunction and decrease the ability of muscles and nerves to recover from stress or injury. (Wu et al., 2019) In the case of the bladder and sphincter muscles, inflammation can disrupt the normal regulation of urinary control, leading to symptoms of overactive bladder, reduced sphincter strength, or involuntary leakage. The ratio also reflects overall metabolic stress, which may further impair the efficiency of the nervous system and disrupt normal signaling between the bladder, sphincter muscles, and brain. (Thompson & Danesh, 2006)

Total cholesterol plays a pivotal role in overall metabolic health, influencing various physiological processes, including cellular function, hormone production, and vascular health. (Huang et al., 2022) As a composite measure of all lipoprotein cholesterol fractions, including both atherogenic and anti-atherogenic particles, total cholesterol serves as an indicator of lipid balance in the body. (Gaghauna et al., 2023) However, its direct impact on urinary function is less well understood and can be attributed to its broader effects on metabolic processes that influence vascular health, tissue function, and inflammatory responses. (Oktaviana et al., 2022)

Total cholesterol's influence is often linked to its role in contributing to lipid-related metabolic disorders. (Feng et al., 2017) High levels of total cholesterol, particularly when associated with an imbalance favoring atherogenic lipoproteins such as low-density lipoproteins (LDL), can lead to the development of atherosclerosis. (Kitahara et al., 2011) Atherosclerosis, the buildup of plaques in arterial walls, can compromise vascular health, leading to endothelial dysfunction and reduced blood flow to peripheral tissues, including the pelvic region. Impaired circulation in this area can negatively affect the bladder and sphincter muscles, resulting in issues related to urinary control and function. (Tozawa et al., 2002)

Additionally, cholesterol is essential for the formation of cell membranes and the production of certain hormones, such as estrogen and testosterone, both of which influence bladder and sphincter function. (Cenedella & Belis, 1981) Elevated total cholesterol levels can disrupt normal lipid metabolism and lead to hormonal imbalances, which may impair the regulation of urinary function. (Feng et al., 2017) For example, higher cholesterol levels have been linked to decreased estrogen, which plays a role in maintaining the elasticity and strength of bladder and pelvic floor muscles. This hormonal disruption can lead to weakened muscle tone and an increased susceptibility to urinary incontinence, particularly in older individuals. (Kikuchi et al., 2013)

Moreover, total cholesterol's association with systemic inflammation can also contribute to urinary dysfunction. Chronic inflammation, often driven by high cholesterol levels, has been shown to impair the function of smooth muscle and nerve cells, including those involved in bladder control. (Tish & Geerling, 2020) Inflammatory mediators can damage the tissue of the bladder wall, reduce bladder capacity, and disrupt the coordinated contractions needed for proper voiding. This can result in symptoms such as urgency, frequency, and incontinence. (Wagg et al., 2024)

Total cholesterol's influence on urinary function is linked to its broader metabolic effects, particularly in relation to vascular health, hormonal regulation, and inflammation, all of which can impact bladder and urinary system integrity. (Bruger, 1943) Cholesterol, as a fundamental component of cell membranes and a precursor for vital hormones, plays a critical role in maintaining cellular and tissue function. However, when dysregulated, especially at elevated levels, it can contribute to systemic issues that affect various bodily functions, including urinary health. (Si-Tayeb et al., 2016)

One of the primary pathways through which total cholesterol can affect urinary function is through its impact on vascular health. High levels of total cholesterol, particularly in the form of low-density lipoprotein (LDL), can lead to the buildup of cholesterol plaques in the arteries, a condition known as atherosclerosis. (Daniels et al., 2009) As atherosclerosis progresses, it can impair blood flow to key regions, including the pelvic area, reducing oxygen and nutrient delivery to tissues critical for urinary control. (Singh et al., 2020) This reduced circulation can affect the bladder and surrounding muscles, leading to a weakened pelvic floor, reduced bladder capacity, and less efficient sphincter control, all of which contribute to urinary incontinence. (Thayer & Fischer, 2013)

Moreover, cholesterol also plays a crucial role in hormone synthesis. For example, cholesterol is a precursor to sex hormones like estrogen and testosterone, which influence the function of the urinary system, including bladder muscle tone and the integrity of the pelvic floor muscles. (Jones et al., 1996) Estrogen, in particular, is vital for maintaining the strength and elasticity of these muscles, and a disruption in cholesterol metabolism can lead to imbalances in estrogen levels. This hormonal dysregulation can weaken the pelvic floor muscles, making them less capable of maintaining bladder control, especially in postmenopausal women, where lower estrogen levels are a common factor contributing to urinary incontinence. (Hu et al., 2024)

In addition to its effects on vascular and hormonal health, total cholesterol is also associated with systemic inflammation. Elevated cholesterol levels, particularly when combined with other metabolic risk factors, contribute to chronic low-grade inflammation throughout the body. (Chidambaram et al., 2021) This inflammation can affect the nerves and smooth muscles of the bladder, impairing their ability to function properly. Inflammatory processes can damage the bladder lining, making it less compliant and more prone to dysfunction. Chronic inflammation is also linked to conditions such as overactive bladder syndrome, which can lead to symptoms like urgency, frequency, and incontinence. (Liu et al., 2004)

5. CONCLUSION

The study identified apolipoprotein B, the Apo B/Apo A ratio, total cholesterol, and the triglyceride-to-HDL ratio as significant predictors of urinary incontinence based on the ICIQ-UI-SF. These findings highlight the critical role of lipid-related variables in influencing vascular health, systemic inflammation, and tissue integrity, which are essential for maintaining urinary function. Elevated apolipoprotein B and unfavorable lipoprotein ratios contribute to metabolic stress, atherosclerosis, and chronic inflammation, leading to compromised blood flow and tissue resilience in the pelvic region. Addressing lipid imbalances through targeted interventions may enhance urinary function and reduce the risk of incontinence. These markers provide valuable insights for improving risk stratification and guiding preventive strategies.

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