ROLE OF DERMATOPOROSIS AS MEDIATING FACTORS: IMPACT OF SYSTEMIC HEALTH PARAMETERS ON DERMATOLOGY LIFE QUALITY INDEX IN THE ELDERLY

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Disubmit: 24 Mei 2025 Diterima: 21 Januari 2026 Diterbitkan: 01 Februari 2026
Doi: https://doi.org/10.33024/mahesa.v6i2.20813

ABSTRACT

Dermatoporosis, an emerging concern in geriatric dermatology characterized by pronounced skin fragility and chronic skin atrophy, significantly impacts the quality of life among the elderly. This study delves into the complex interactions between various health parameters such as albumin, glucose, lipid profiles, uric acid, vitamin D, insulin resistance, uric acid, renal functions, and liver functions, assessing their cumulative effect on the Dermatology Life Quality Index (DLQI) in an elderly population, with dermatoporosis serving as a pivotal mediating factor. This study included 31 individuals who met the specified inclusion criteria. The selection process was designed to ensure the relevance of analyzed health parameters and to minimize selection bias, thereby enhancing the validity and applicability of the findings. Descriptive and inferential statistical methods were employed, along with Partial Least Squares (PLS) path modeling, to control for potential confounding variables and explore the multifactorial relationships among the measured variables. Regression analysis indicated that dermatoporosis significantly mediates the relationship between these health parameters and the DLQI, evidenced by R^2 values of 0.691 for dermatoporosis and 0.842 for DLQI. This study confirms that skin health in the elderly is multifactorial and strongly influenced by systemic health parameters. A multidisciplinary approach is essential to holistically manage dermatological conditions, addressing not only skin symptoms, but also systemic health factors that exacerbate skin disorders and diminish the quality of life in older adults.

Keywords: Dermatoporosis, Dermatology Life Quality Index (DLQI), Geriatric Dermatology, Health Parameters, Systemic Health Influences.

INTRODUCTION

Dermatoporosis is recognized as a chronic skin syndrome marked by increased fragility and insufficiency of the skin. It manifests in two forms, distinguished by their causal mechanisms. The primary form is more prevalent and stems from the natural aging process, prolonged and unprotected exposure to sunlight, and potentially genetic contributors, which remain to be fully elucidated. The secondary form is attributed to the persistent use of both topical and systemic corticosteroids.(Kaya et al., 2019; Villeneuve et al., 2020)

Dermatoporosis presents several clinical features, including thinning of the skin, easy bruising, known as senile purpura, the formation of star-shaped pseudoscars, susceptibility to skin tears, slow healing of wounds, and the development of dissecting blood clots beneath the skin. No marked clinical distinctions are noted between the primary form and the secondary form, which is induced by medical treatments.

Recent epidemiological studies across different populations have provided insights into the prevalence and risk factors associated with dermatoporosis, highlighting its significance as a dermatological concern in the geriatric demographic. In Mexico, a study showed a dermatoporosis prevalence of 29% among geriatric patients, with advanced age (over 75 years), sun exposure, medication use, and reproductive history emerging as pivotal influences on its occurrence.(Castillo-Cruz et al., 2023) This aligns with findings from a Finnish study among dermatology outpatients aged 60 and above, where the prevalence was slightly higher at 30.7%, with corticosteroid use, older age, anticoagulant therapy, and chronic renal failure identified as key risk factors. In France, a prevalence of 37.5% was reported among individuals aged 65 years and older, with a noted higher prevalence in females and those with a history of eczema.(J.-H. Saurat et al., 2017) Furthermore, another study in France focusing on elderly hospital in-patients revealed a prevalence of 32%, with the highest risk associated with being over 85 years and having severe chronic renal failure.(Klassen et al., 2016) These epidemiological findings underscore the widespread nature of dermatoporosis across diverse populations and age groups, emphasizing the need for heightened awareness and targeted interventions to mitigate its impact on the aging population's quality of life.

The Dermatology Life Quality Index (DLQI), as the foremost standardized measure of the impact of skin diseases on patients' lives, has emerged as an indispensable tool in both clinical practice and research. It quantifies the influence of dermatological conditions on an individual’s well-being, encompassing symptoms, feelings, daily activities, leisure, work, school, personal relationships, and treatment.(Dyer & Miller, 2018; Mellody et al., 2016) In the intricate relationship between dermatoporosis and quality of life as assessed by DLQI, the mediating role of dermatoporosis is critical. It is essential to discern not only the direct effects of dermatoporosis on the DLQI but also to understand how the progressive nature of skin fragility, compounded by other health variables such as blood pressure, glucose levels, and lipid profiles, interacts with and potentially exacerbates the reduction in life quality.(Behera et al., 2022; Oberoi et al., 2024) The research objectives outlined for this investigation into dermatoporosis and its impact on the quality of life among the elderly are developed from a comprehensive background context. The primary goal is to quantify the effect of dermatoporosis on the quality of life using the Dermatology Life Quality Index (DLQI). This index will serve to precisely assess how dermatoporosis influences the daily activities, emotional well-being, and social interactions of elderly individuals, thereby establishing a clear link between the severity of dermatoporosis and declines in quality-of-life measures.

The research question of this study was “How do various health parameters such as albumin, glucose, lipid profile, uric acid, vitamin D, insulin resistance, renal function, and liver function, by assessing their cumulative impact on Dermatology Life Quality Index (DLQI) in an elderly population, with dermatoporosis as the main mediating factor?”. Understanding how these factors exacerbate the condition will enhance our understanding of its complex nature. Collectively, these objectives are designed to deepen our understanding of dermatoporosis as a critical health problem in the elderly population, thereby informing future research and clinical practice aimed at improving the quality of life for this vulnerable group. Therefore, the aim of this study was to explore the influence of various health and lifestyle factors, including glucose levels, lipid profile, and chronic renal failure, on the development of dermatoporosis”.

LITERATURE REVIEW

Dermatoporosis constitutes a syndrome predominantly observed in the geriatric population, marked by pronounced skin fragility. Despite being the largest and most visible organ, the skin did not have a comparable term until recently. In 2007, Kaya and Saurat introduced the term "dermatoporosis" to describe the chronic fragility of aging skin.(Kaya & Saurat, 2007) This condition manifests through a trio of characteristic changes: chronic skin atrophy, a propensity for easy bruising, and the emergence of pseudoscars. Chronic skin atrophy is defined by a significant thinning of the skin layers, leading to a translucent appearance and diminished structural resilience. This atrophy is primarily attributed to the degradation of key dermal constituents, namely collagen and elastin, which are integral to maintaining skin elasticity and tensile strength. Concurrently, the phenomenon of easy bruising, or senile purpura, highlights the skin's compromised ability to resist even minor traumas, resulting in blood extravasation from fragile vessels into the interstitial spaces, presenting as conspicuous bruises. Additionally, pseudoscars, which are atrophic white bands resembling scars without a preceding history of trauma, further delineate the clinical spectrum of dermatoporosis.(Dyer & Miller, 2018; Mellody et al., 2016)

Risk factors for dermatoporosis primarily include advancing age. Additional risk factors are chronic exposure to sunlight (actinic damage), genetic factors, and prolonged use of both topical and systemic corticosteroids. One study showed that chronic renal failure increases the risk of dermatoporosis by five times, regardless of age. Patients with chronic obstructive pulmonary disease are also more prone to senile purpura, potentially confounded by systemic corticosteroid use.(Mengeaud et al., 2012) Primary factors include aging, while secondary factors encompass exposure to UVA and UVB, genetic predisposition, usage of topical and systemic corticosteroids, chronic renal failure, anticoagulant use, chronic obstructive pulmonary disease, use of EGFR inhibitors, and lack of exercise.(Gerber et al., 2016; J. -H. Saurat et al., 2017) In addition to these, factors such as impaired mental status, nutritional deficiencies, and a history of skin tears also contribute to the risk. A study in Japan using a 20-MHz ultrasound scanner to measure forearm dermal thickness in

individuals aged 65 and older identified a dermal thickness of 0.80mm as a significant threshold, above which there is a heightened risk of skin tears in the elderly.(Dyer & Miller, 2018; Koyano et al., 2017)

Serum albumin is an important indicator to assess nutritional status and the level of systemic inflammation. Hypoalbuminemia which is common in the elderly often indicates poor nutritional status which can affect the structure and function of the skin. Hypoalbumin affects skin hydration and dermis elasticity, increases air loss through the skin and eliminates its barrier function. This condition is the beginning of the symptoms of dermatoporosis, such as senile purpura, star-shaped pseudoscars, and slow wound healing. Therefore, low albumin levels are often associated with increased DLQI scores due to symptoms of fragile skin, easy injury, and psychological stress.(Jiang et al., 2023)

The liver is the main organ that plays a role in the emergence of various skin manifestations outside the hepatic system. Changes in the skin, nails, and hair are often early signs of liver dysfunction, especially in cases of cirrhosis and portal hypertension. Some manifestations such as spontaneous bruising (ecchymosis), petechiae, spider angiomas, thin skin with superficial blood vessels (paper money skin), and leg ulcers indicate skin fragility that leads to dermatoporosis. This is triggered by metabolic and hormonal disorders due to liver dysfunction, including increased estrogen, impaired circulation, and decreased protein synthesis, which damage the structure and strength of the skin. Other symptoms such as chronic pruritus, hyperpigmentation, and xanthelasma reflect more severe liver disorders and have a significant impact on quality of life that will affect the DLQI.(Liu et al., 2022)

The kidneys play an important role in eliminating toxins and regulating electrolyte balance, both of which play a crucial role in maintaining skin integrity. In individuals with chronic kidney disease (CKD), especially those undergoing hemodialysis, skin manifestations such as pruritus and hyperpigmentation are often associated with increased blood creatinine and urea levels. Impaired kidney excretory function will lead to the accumulation of toxins and electrolyte imbalances that can adversely affect the structure and repair mechanisms of the skin, leading to decreased skin health and increased susceptibility to conditions such as dermatoporosis.(Curry et al., 2012; Pradhan et al., 2018)

Dyslipidemia also affects the lipid composition in the outermost layer of the skin (stratum corneum) which is important in maintaining intercellular cohesion and the skin's protective function. Irregular lipid metabolism can trigger oxidative stress and blood vessel dysfunction, leading to decreased skin elasticity and strength and increasing the risk of dermatoporosis.(Nicolaou & Kendall, 2023)

Glucose and galactose in glucose metabolism are directly linked to skin aging, and issues with glucose metabolism can hasten the aging of the skin. They noted that the aging of the skin can slow down glucose metabolism, leading to the accumulation of skin glycation products that exacerbate the aging process. The study also highlighted that reduced collagen synthesis and altered protein metabolism contribute to accelerated skin aging. This worsens the symptoms of dermatoporosis such as purpura, bruising (ecchymosis), and skin

tears. Therefore, poor glycemic control is closely related to increased DLQI scores in elderly with fragile skin.(He et al., 2023)

Hyperuricemia is a condition characterized by elevated uric acid levels exceeding physiological norms. Increased serum uric acid contributes to oxidative stress and systemic inflammation, which in turn may lead to dermal tissue degradation and reduced collagen synthesis. These processes accelerate cutaneous aging, compromise the structural integrity of the extracellular matrix, and diminish skin elasticity. Moreover, hyperuricemia is frequently associated with comorbidities such as metabolic syndrome are known to negatively impact skin health, particularly in the elderly. Consequently, this condition may contribute to a decline in dermatological quality of life, as reflected in lower scores on the *Dermatology Life Quality Index* (DLQI), given the chronic, progressive, and cosmetically distressing nature of the associated skin manifestations.(Zhang et al., 2021)

Vitamin D deficiency is a common condition in the elderly, usually due to reduced synthesis in the skin and low exposure to sunlight. Vitamin D (cholecalciferol) functions in regulating epidermal cell growth, antimicrobial peptide production, and balancing the skin's immune system. Deficiency of this vitamin is correlated with increased dermal inflammation, impaired wound healing, and impaired skin barrier function. This can increase the risk of dermatoporosis in the elderly.(Baciur et al., 2022; Goyal & Kedia, 2022).

METHODS

The study population comprises individuals aged 60 years and above, reflecting the targeted elderly demographic essential to the objectives of this research. Both male and female participants are included, ensuring a gender-balanced representation that enriches the dataset and analysis reliability. All participants reside at Panti Lansia Santa Anna, providing a specific community setting that offers a unique contextual background for the study. This setting not only facilitates easier access to the target group but also enhances the relevance of the findings to similar institutional settings.

The selection criteria for this study are carefully delineated to ensure the inclusion of a representative and appropriate sample. Inclusion criteria require participants to be aged 60 years or older, accommodating a diverse range of the elderly demographic. Both male and female participants are eligible, promoting gender inclusivity. Crucially, all participants must provide informed consent, a standard which not only upholds ethical principles but also ensures that participants are cognitively able to understand and agree to the study’s procedures and aims. Conversely, the exclusion criteria are designed to safeguard the integrity of the data and the welfare of the participants. Individuals with diagnosed mental disorders are excluded to prevent potential complications associated with their participation, ensuring that all participants can provide genuine, informed consent and of following the study protocols. Non-Indonesian speakers are also excluded to avoid language barriers that might impede understanding of the study's requirements and affect the

reliability of the data collected. Furthermore, individuals who decline to participate are excluded, affirming that participation is voluntary and that the data collected will be from individuals who are fully willing and informed. These criteria collectively ensure the scientific rigor and ethical standards of the study are maintained.

The target population for this study includes all elderly individuals, with a primary focus on residents of Panti Lansia Santa Anna. The accessible population, a subset of the target group, comprises only those residents who are directly available for recruitment and participation, thereby providing a practical framework for the study's execution. Out of this accessible group, while initially selecting a sample of 70 participants through total sampling, only 31 individuals ultimately met the predefined inclusion criteria for the study. This selection process, which involves including all eligible individuals within the accessible population, ensures comprehensive coverage and aims to minimize selection bias. This is crucial for maintaining the validity and applicability of the research outcomes in medical studies, especially given the focused nature of the health parameters being examined. (Figure 1)

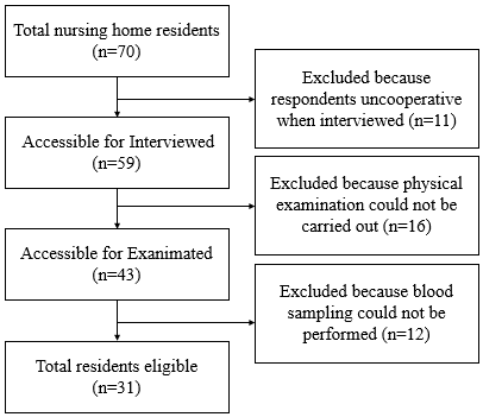

Figure 1. Study Population Analysis

The anamnesis examination is conducted using the Skin Demographic Questionnaire and the Dermatology Life Quality Index (DLQI), which are essential tools for assessing the impact of skin conditions on patients' quality of life. The "Dermatoporosis Scale" questionnaire was utilized to evaluate the skin health of participants and identify potential dermatological issues associated with skin fragility and related symptoms. Structured to capture a comprehensive dataset, the questionnaire comprised several distinct sections: General Skin Condition, which probed perceptions of skin fragility including susceptibility to bruising and sensitivity to external stimuli; Skin Appearance, where participants described characteristics such as transparency, thinness, ease of wrinkling, and velvet-like texture, with an additional category for unlisted attributes; Skin Symptoms, addressing sensations such as tingling, warmth, stinging, itching, blistering, burning, pain, redness, and dryness; Dermatological Procedures, documenting treatments like laser therapy, dermabrasion, peeling, surgical

interventions, fillers, and Botox received within the past two years; and Skin Diseases, inquiring about the presence of conditions like acne, eczema, psoriasis, and age spots. The questionnaire required participants to provide "Yes" or "No" responses based on their current condition, designed for self-administration with instructions to ensure completeness and accuracy even in instances of uncertainty about certain responses. Data collection occurred over a three-month period at a dermatology clinic, where participants provided informed consent and were assured of the anonymity and confidentiality of their responses. The collected data were statistically analyzed to discern correlations between dermatological conditions and reported symptoms, as well as the influence of environmental factors such as air conditioning on skin health, thus offering a nuanced understanding of dermatoporosis and related skin conditions within the population studied.

The "Dermatology Life Quality Index" (DLQI) designed to quantitatively assess the impact of skin conditions on the quality of life of affected individuals over the preceding week. The questionnaire comprises ten items, each targeting specific dimensions of the burden imposed by dermatological disorders. These dimensions include the intensity of symptoms such as itchiness and pain, the psychological impact manifesting as embarrassment or discomfort due to the skin's appearance, and the interference with daily activities including shopping, household chores, social engagements, and physical activities like sports. Additionally, the DLQI evaluates the effect of skin conditions on personal relationships and sexual life, as well as the practical challenges posed by treatment regimens, such as the time spent on treatment and its intrusiveness into daily life. Respondents are instructed to circle one of five graded responses for each item, ranging from 'Not at all' to 'Very much,' with assigned scores from 0 to 3. The total score, which can range from 0, indicating no impact on life quality, to 30, indicating maximum impact, is derived by summing the scores across all questions. This scoring system facilitates a structured evaluation of the extent to which skin conditions disrupt various facets of an individual’s life, thereby providing a comprehensive measure that can be used in clinical assessments and research to gauge treatment efficacy and understand the broad impacts of dermatological conditions.

Physical skin examinations focus on identifying features characteristic of fragile skin, which is prone to injuries, bruising, and rapid reactions to external stimuli. Key attributes assessed include the skin's transparency, thinness, ease of wrinkling, and a velvety texture. Additionally, the Right Arm Skin Analysis and Left Arm Skin Analysis are performed to evaluate parameters such as oil content, water content, and hydration levels. These assessments are crucial for understanding the physiological state of the skin and guiding appropriate dermatological treatments. The physical examination in this study encompasses a set of indicators crucial for assessing elderly health. Demographic information plays a pivotal role, with age being recorded to explore correlations between age-related physiological changes and health conditions. Gender-specific data is meticulously gathered to examine the differential prevalence and impact of health issues across

males and females, providing insight into potential gender-based health disparities. Additionally, marital status is considered to evaluate the influence of social support structures on health outcomes, acknowledging that marital companionship can significantly affect mental and physical health. Educational background is also documented to assess its effect on health management and awareness, recognizing that higher levels of education might correlate with better health behaviors and access to healthcare resources. Further emphasizing the study's holistic approach, skin health is rigorously assessed using the Dermatology Life Quality Index (DLQI). This index serves as a critical tool to measure the impact of skin conditions on the participants' quality of life, encompassing aspects such as symptom severity, psychological distress, and social functioning disruptions caused by dermatological issues. The inclusion of these indicators ensures that the study not only captures the physical manifestations of health conditions but also the socio-economic and psychological dimensions that play essential roles in the overall health and well-being of the elderly.

The methodology for data collection is rigorously structured to maintain uniformity across all study participants. Skin analysis is conducted in a controlled environment to limit external factors affecting skin properties. Before measurements, a standardized cleaning process is applied to participants' skin to eliminate any residues of lotions or contaminants. Trained dermatological technicians then conduct measurements using the specified equipment on both arms to ensure consistent data collection. This detailed protocol aids in reducing data variability and increasing the reliability of the results. Upon gathering the data, a range of analytical techniques is applied to interpret the outcomes from both skin and organ function assessments. For skin health, analysis software processes the data from skin analyzers, quantifying alterations in skin elasticity and hydration, thereby providing an intricate evaluation of skin aging and condition. For organ function assessments, liver and kidney function tests are analyzed using conventional biochemical techniques to measure levels of specific enzymes, proteins, creatinine, and urea, indicating organ health. Gout assessments measure uric acid levels and compare them to established clinical benchmarks to diagnose or evaluate gout risk. Lipid profiles are examined using lipidometry to ascertain the concentrations of different cholesterol fractions and triglycerides, vital for evaluating cardiovascular risk. Glucose profiles are assessed using metrics such as fasting blood sugar and HbA1c levels. Furthermore, Vitamin D levels are determined through immunoassay methods, which are crucial for evaluating bone health and immune function in the elderly population. This comprehensive approach ensures that the analyses are robust, scientifically valid, and capable of providing insights necessary for targeted health interventions in the elderly.

The statistical analyses for this study are meticulously designed to unravel the complex interactions between various health indicators and their impact on the elderly population. Using a robust dataset comprising demographic variables, skin health assessments, organ function tests, and metabolic and nutritional evaluations, a multi-

faceted analytical approach was adopted. Prior to their application in the study, both the Skin Demographic Questionnaire and the Dermatology Life Quality Index (DLQI) underwent a rigorous validation process employing Cronbach's alpha and Pearson's correlation coefficient tests. This validation is essential to ensure the reliability and accuracy of these instruments in measuring the impact of skin conditions on quality of life within the specified elderly population. Cronbach's alpha was utilized to assess the internal consistency of the questionnaires, confirming that the items within each questionnaire are sufficiently correlated to provide a stable and consistent measure of the constructs they are intended to evaluate. Meanwhile, Pearson's correlation coefficient was used to validate the construct validity, determining the degree to which these tools are correlated with other established measures of similar constructs, thereby confirming their validity. This rigorous approach to validation supports the integrity of the data collected, enabling confident analysis of the interplay between dermatological health and overall life quality, as mediated by factors such as skin fragility and other demographic and physiological parameters assessed in the study.

Descriptive statistical methods were employed to summarize the demographic and clinical characteristics of the participants, providing a detailed overview of the sample population. Mean values, standard deviations, and ranges were calculated for continuous variables such as age, skin hydration levels, elasticity, liver and kidney function tests, lipid and glucose levels, and Vitamin D. Categorical data, such as the presence of conditions like gout, were analyzed using frequencies and percentages to provide a foundational understanding of the distribution within the population. For inferential analysis, multivariable regression analysis and Partial Least Squares (PLS) path modeling were utilized. These methods are ideal for handling the multifaceted nature of the data, adjusting for potential confounders such as age and gender, and exploring complex model structures even with non-normal data distributions. The PLS method proved robust in modeling latent constructs derived from multiple indicators, essential for assessing constructs like dermatoporosis and the Dermatology Life Quality Index (DLQI). Correlation coefficients, either Pearson’s or Spearman’s, were employed to explore the relationships between demographic factors and health outcomes. Group comparisons were conducted using the Partial Least Squares Structural Equation Modeling (PLS-SEM) method. This approach facilitated a deeper understanding of the dynamics across different subgroups within the elderly population by assessing the strength and significance of hypothesized paths between demographic segments and health indicators. Logistic regression models were further utilized to evaluate the risk factors associated with significant health conditions, pinpointing which demographic or physiological factors contribute to higher risk profiles.

The statistical significance and model fit were assessed by calculating R-squared (R^2) and Adjusted R-squared values, which helped determine the proportion of variance in the DLQI scores explained by the independent variables. Discriminant validity of the constructs was evaluated using the Heterotrait-Monotrait ratio (HTMT), ensuring the measures used

to represent different concepts were indeed capturing distinct phenomena. All data analyses were conducted using a statistical analyzing program for general statistics and a partial least squares program for structural equation modeling. Data cleaning procedures included checks for normality, outliers, and missing values, with appropriate transformations or imputations applied as needed to prepare the data for analysis. This comprehensive approach ensures that the study's findings are based on rigorous, scientifically valid methods, enabling precise interpretations and the formulation of effective interventions to improve the health and well-being of the elderly population. Ethical approval was secured, and informed consent was obtained from all participants, ensuring adherence to ethical standards and participant confidentiality throughout the study.

RESULT

Based on the predefined inclusion and exclusion criteria established for this study, 31 respondents were identified as meeting these criteria and were subsequently included in the analysis. These criteria were meticulously designed to ensure that the sample accurately and relevantly represents the population of elderly individuals residing at Panti Lansia Santa Anna. This data provides a detailed summary of the selected respondents' demographic, health, and clinical characteristics, enabling a comprehensive investigation into various health aspects and their impact on the quality of life within this group. (Table 1)

Table 1. Descriptive Parameters of DLQI

Description	Category	N (%)	Mean (SD)
Age			73.06 (9.65)
Gender	Man	9 (29%)	
	Woman	22 (71%)	
Marital Status	Married	15 (48.4%)	
	Not married yet	12 (38.7%)	
	Divorced	4 (12.9%)	
Education	Elementary school	9 (29%)	
	Junior high school	5 (16.1%)	
	Senior high school	16 (51.6%)	
	Bachelor Degree	1 (3.2%)	
Skin Demographic Questionnaire			4 (2.08)
Dermatology Life Quality Index (DLQI)			31.97 (4.69)
Right Arm Skin Analysis	Oil		5.46 (0.49)
	Water		12.63 (1.34)
	Hydration		56.68 (5.35)

Left Arm Skin Analysis	Oil	5.34 (0.54)
	Water	12.42 (1.43)
	Hydration	58.19 (5.47)
Liver Function	Albumin	3.73 (0.38)
	SGOT	26.06 (13.62)
	SGPT	23.16 (13.45)
Kidney Function	Urea	24.39 (6.52)
	Creatinine	0.81 (0.23)
GOUT		5.66 (1.54)
Lipid Profile	Total cholesterol	183.06 (21.87)
	Triglycerides	85.35(26.23)
	HDL	52.83 (11.89)
	LDL	102.06 (21.86)
Glucose Profile	GDP	94 (34.96)
	HbA1c	6 (0.82)
	Insulin Resistance	14.53 (7.73)
Vitamin D		15.74 (1.61)

The dataset provides a comprehensive overview of demographic, health, and clinical characteristics of an elderly cohort with an average age of 73.06 years (SD = 9.65), predominantly composed of females (71%). Marital status distribution indicates a majority of participants are married (48.4%), with single and divorced individuals constituting 38.7% and 12.9%, respectively. In terms of education, most participants have completed high school (51.6%), followed by those with primary education (29%), junior high education (16.1%), and a minority holding a bachelor's degree (3.2%). The mean score on the Skin Demographic Questionnaire is 4 (SD=2.08), and the mean Dermatology Life Quality Index (DLQI) score is 31.97 (SD=4.69), which might suggest a moderate to severe impact on the quality of life due to skin conditions. Skin analysis of the right arm reveals a mean oil content of 5.46 (SD=0.49), water content of 12.63 (SD=1.34), and a hydration level of 56.68 (SD=5.35). The left arm shows similar results with a mean oil content of 5.34 (SD=0.54), water content of 12.42 (SD=1.43), and a slightly higher hydration level of 58.19 (SD=5.47). Liver function tests indicate an average albumin level of 3.73 (SD=0.38), SGOT of 26.06 (SD=13.62), and SGPT of 23.16 (SD=13.45). The mean urea level for kidney function is 24.39 (SD=6.52) and creatinine is 0.81 (SD=0.23). The gout indicator, presumably uric acid, has a mean value of 5.66 (SD=1.54). The lipid profile data show an average total cholesterol level of 183.06 (SD=21.87), triglycerides of 85.35 (SD=26.23), high-density lipoprotein (HDL) of 52.83 (SD=11.89), and low-density lipoprotein (LDL) of 102.06 (SD=21.86). Glucose profile metrics include a glucose (GDP) mean of 94 (SD=34.96), HbA1c average at 6 (SD=0.82), and a mean insulin resistance score of 14.53 (SD=7.73). Lastly, the average level of Vitamin D is 15.74 (SD=1.61), which may be

clinically considered on the lower side.

The R-squared and adjusted R-squared parameters for the Dermatology Life Quality Index (DLQI) and dermatoporosis offering insights into the models used to analyze their respective datasets. For DLQI, the R Square value is 0.842, indicating that the independent variables included in the model can explain approximately 84.2% of the variance in the quality of life outcomes. The Adjusted R Square, which accounts for the number of predictors in the model, is slightly lower at 0.763. This still signifies a strong explanatory power, suggesting that the variables chosen for the model are highly relevant and collectively provide a substantial explanation of the variations observed in dermatological quality of life. In the case of dermatoporosis, the R Square value is 0.691, which implies that about 69.1% of the variance in dermatoporosis outcomes can be accounted for by the predictors in the model. The Adjusted R Square for dermatoporosis is 0.558, indicating a reasonable fit but pointing to a somewhat less efficient model than DLQI's. This reduction in the Adjusted R Square value suggests that while significant, the model for dermatoporosis may benefit from including additional relevant variables or adjusting existing ones to capture the variance in dermatoporosis outcomes better. These statistics highlight the robustness of the models used in analyzing the impacts on quality of life and dermatoporosis, with both models showing substantial explanatory power, though the model for DLQI demonstrates a higher level of fit relative to the number of variables included. (Table 2)

Table 2. R Squared Parameters of DLQI

	R Square	R Square Adjusted
DLQI	0.842	0.763
Dermatoporosis	0.691	0.558

The matrix presented delineates the inter-correlations among various medical constructs, such as age, dermatoporosis, glucose profile, lipid profile, liver function, renal function, uric acid, and vitamin D, which are instrumental in assessing discriminant validity through the Heterotrait-Monotrait (HTMT) ratio. The Heterotrait-Monotrait (HTMT) ratio analysis offers significant insights into how various variables correlate with the Dermatology Life Quality Index (DLQI) and dermatoporosis, respectively, facilitating a deeper understanding of their interdependencies. For the DLQI, the HTMT ratios reveal substantial correlations with several key health indicators. Notably, the Lipid Profile exhibits a strong correlation (HTMT = 0.813), suggesting that alterations in lipid metabolism might directly impact dermatological quality of life. Similarly, Liver Function (HTMT = 0.714) and Glucose Profile (HTMT = 0.711) demonstrate significant associations with DLQI, indicating that systemic metabolic conditions play a crucial role in influencing dermatological health perceptions. These correlations may reflect how metabolic dysfunctions, such as those observed in liver and glucose metabolism, can exacerbate skin conditions or negatively affect skin-related quality of life. In the context

of dermatoporosis, the analysis indicates that Age (HTMT = 0.832) strongly correlates with the severity of dermatoporosis, underscoring the progressive nature of skin degeneration with advancing age. The Glucose Profile also shows a notable correlation (HTMT = 0.629), pointing towards the potential impact of glycemic control on the progression of dermatoporosis. Further, the relationship between Liver Function and dermatoporosis (HTMT = 0.574) suggests that liver health, possibly reflecting overall metabolic health, could influence the structural integrity of the skin. These HTMT ratios thus highlight critical intersections between systemic health factors and both dermatological quality of life and the pathophysiology of dermatoporosis. Understanding these relationships is pivotal for developing comprehensive management strategies that address not only the dermatological symptoms but also the underlying systemic conditions that may contribute to dermatoporosis and diminish quality of life. (Table 3)

Table 3. Heterotrait-Monotrait Parameters of DLQI

	Age	Albumin	Cholecalciferol	DLQI	Dermato Porosis	Glucose Profile	Insulin Resistance	Lipid Profile	Liver Function	Renal Function	Uric Acid
Age											
Albumin	0.460										
Cholecalciferol	0.307	0.462									
DLQI	0.494	0.481	0.550								
Dermatoporosis	0.832	0.539	0.366	0.885							
Glucose Profile	0.430	0.527	0.388	0.711	0.629						
Insulin Resistance	0.502	0.012	0.176	0.404	0.510	0.347					
Lipid Profile	0.572	0.463	0.302	0.813	0.720	0.541	0.090				
Liver Function	0.297	0.218	0.195	0.714	0.574	0.575	0.208	0.314			
Renal Function	0.364	0.060	0.160	0.603	0.358	0.459	0.295	0.318	0.269		

Uric Acid	0.222	0.230	0.042	0.366	0.553	0.185	0.333	0.157	0.101	0.471

The variance Inflation Factor (VIF) parameters for the Dermatology Life Quality Index (DLQI) and dermatoporosis, providing a precise measure of multicollinearity among the predictors in statistical models analyzing these variables. The VIF for Age is relatively high for both DLQI (4.216) and dermatoporosis (2.980), indicating a considerable degree of multicollinearity, which suggests that age shares a substantial amount of variance with other variables in both models. This could potentially complicate interpretations of age's independent effects on DLQI and dermatoporosis without careful statistical control. For Albumin, the VIF is slightly above 2 (2.019 for DLQI and 2.010 for dermatoporosis), suggesting moderate multicollinearity. This indicates that albumin levels are somewhat linearly dependent on other variables but not excessively so, which still allows for reasonable interpretation of its effects in both models. Cholecalciferol (Vitamin D) shows a VIF close to 1 (1.440 for DLQI and 1.411 for dermatoporosis), reflecting minimal multicollinearity. This lower VIF suggests that cholecalciferol can be considered fairly independent from other variables, providing a cleaner evaluation of its impact on DLQI and dermatoporosis. Other variables, such as the Glucose Profile, Insulin Resistance, Lipid Profile, Liver Function, Renal Function, and Uric Acid, also exhibit VIFs that generally hover around 2. These values indicate a mild to moderate level of multicollinearity. While they suggest that these variables share some variance with others in the model, the level is not so high as to severely undermine their statistical validity in predicting DLQI and dermatoporosis outcomes. Specifically, for DLQI and dermatoporosis as variables, Dermatoporosis shows a VIF of 3.235 when predicting DLQI. Although higher than most other predictors, this value is still within an acceptable range, suggesting that while dermatoporosis correlates with other predictors, it remains a distinct factor in influencing DLQI. (Table 4; Figure 4)

Table 4. Variance Inflaction Factor Parameters of DLQI

	DLQI	Dermatoporosis
Age	4.216	2.980
Albumin	2.019	2.010
Cholecalciferol	1.440	1.411
Dermatoporosis	3.235	
Glucose Profile	1.920	1.905
Insulin Resistance	2.136	2.113
Lipid Profile	2.123	2.032
Liver Function	1.698	1.641
Renal Function	1.737	1.669
Uric Acid	1.845	1.828

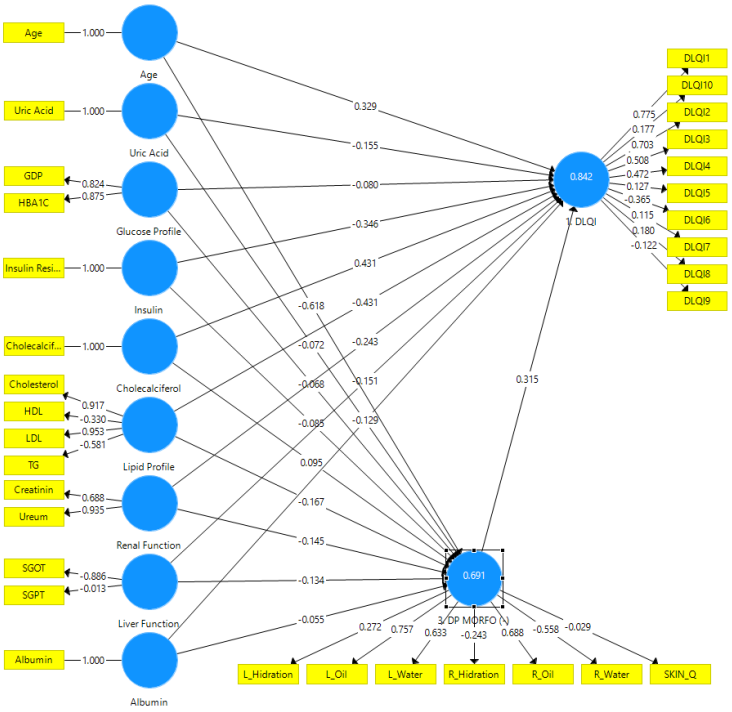

Figure 4. PLS-SEM Parameters of DLQI

The data presented in the diagram appears to be from a statistical analysis investigating the relationships between various health parameters, dermatoporosis, and the Dermatology Life Quality Index (DLQI). It provides coefficients representing standardized regression weights or correlations between these variables. (Table 5).

Table 5. Path Coefficients Parameters of DLQI

	DLQI	Dermatoporosis
Age	0.329	-0.618
Albumin	-0.129	-0.055
Cholecalciferol	0.431	0.095
Dermatoporosis	0.315	
Glucose Profile	-0.080	-0.068
Insulin Resistance	-0.346	-0.085
Lipid Profile	-0.431	-0.167
Liver Function	-0.151	-0.134
Renal Function	-0.243	-0.145
Uric Acid	-0.155	-0.072

Table 5 presents the path coefficients for various variables influencing the Dermatology Life Quality Index (DLQI) and dermatoporosis, illustrating the direct effects each variable has within the respective models.

1. Age
   a) DLQI: Positive coefficient (0.329) implies that as age increases, dermatological quality of life tends to improve.
   b) Dermatoporosis: Negative coefficient (-0.618) indicates

that increasing age is associated with higher severity of dermatoporosis, reflecting age-related skin degradation.

2. Albumin
   a) DLQI: Negative coefficient (-0.129) suggests higher albumin levels might improve dermatological quality of life.
   b) Dermatoporosis: Negative coefficient (-0.055) suggests that higher albumin levels might also reduce the severity of dermatoporosis.
3. Cholecalciferol (Vitamin D)
   a) DLQI: Positive coefficient (0.431) shows that higher levels of Vitamin D are associated with better dermatological quality of life.
   b) Dermatoporosis: Positive but smaller coefficient (0.095) indicates a modest benefit in reducing the severity of dermatoporosis.
4. Glucose Profile
   a) DLQI: Negative coefficient (-0.080) suggests that disturbances in glucose metabolism correlate with poorer dermatological quality of life.
   b) Dermatoporosis: Negative coefficient (-0.068) suggests that glucose metabolism disturbances also increase the severity of dermatoporosis.
5. Insulin Resistance
   a) DLQI: Notably negative coefficient (-0.346) highlights the detrimental effects of insulin resistance on dermatological quality of life.
   b) Dermatoporosis: Negative coefficient (-0.085) suggests that higher insulin resistance contributes to the severity of dermatoporosis.
6. Lipid Profile
   a) DLQI: Strongest negative impact among all variables (-0.431) indicates significant worsening of dermatological quality of life due to lipid dysregulation.
   b) Dermatoporosis: Negative coefficient (-0.167) indicates that lipid dysregulation also increases the severity of dermatoporosis.
7. Liver Function
   a) DLQI: Negative coefficient (-0.151) implies that poorer liver function is associated with worse dermatological quality of life.
   b) Dermatoporosis: Negative coefficient (-0.134) suggests that poorer liver function also affects dermatoporosis severity.
8. Renal Function
   a) DLQI: Negative coefficient (-0.243) indicates that poorer renal function correlates with worse dermatological quality of life.
   b) Dermatoporosis: Negative coefficient (-0.145) suggests poorer renal function is also linked to increased severity of dermatoporosis.
9. Uric Acid
   a) DLQI: Negative coefficient (-0.155) indicates that higher uric acid levels correlate with poorer dermatological quality of life.
   b) Dermatoporosis: Negative coefficient (-0.072) suggests that higher uric acid levels might also increase the severity of dermatoporosis.

DISCUSSION

The clinical implications of dermatoporosis on skin integrity are profound, primarily manifesting as increased skin vulnerability and compromised wound healing capabilities. Dermatoporosis leads to a significant reduction in skin elasticity and resilience, making the skin more susceptible to tears, cuts, and bruises even from minor traumas. This heightened vulnerability is a direct consequence of the structural weakening of the skin, characterized by thinning of the dermal and epidermal layers, and a reduction in the essential components such as collagen and elastin that provide mechanical strength and elasticity to the skin.(Bruckner-Tuderman, 2020; Castillo-Cruz et al., 2023)

Albumin levels are negatively correlated with both the Dermatology Life Quality Index (DLQI) and dermatoporosis, exhibiting coefficients of -0.129 and -0.055 respectively, which suggests that higher albumin may enhance dermatological quality of life and lessen the severity of dermatoporosis. This outcome aligns with findings reported by Jiang et al. (2023), who demonstrated that elevated serum albumin helps to increase plasma colloid osmotic pressure. This increase in colloid osmotic pressure is crucial for maintaining fluid balance within the vascular and interstitial spaces, thereby preventing tissue edema. Such stability is vital for preserving skin integrity and resilience, thereby improving skin quality. Moreover, higher albumin levels, reflecting good nutritional status and overall health, are fundamental for supporting the skin's structural elements and function. These properties explain why sufficient albumin levels a mitigating effect on the symptoms and progression of dermatoporosis have, supporting overall skin health and countering the decline in skin quality associated with the condition.(Jiang et al., 2023)

Cholecalciferol (Vitamin D) exhibits a positive coefficient of 0.431 with DLQI, demonstrating that higher Vitamin D levels correlate with improved dermatological quality of life. Its impact on dermatoporosis is also positive but more modest (0.095), suggesting that Vitamin D may have a protective effect against the progression of dermatoporosis. This finding is consistent with recent studies that underscore the crucial role of vitamin D in skin health. El Mongy et al. (2023) report that higher levels of vitamin D offer protective benefits against various dermatological conditions and emphasize the importance of supplementation for the prevention and management of skin diseases.(El Mongy & Hilal, 2023) Similarly, Baciur et al. (2022) finding shows vitamin D can influences immune cells and regulates inflammation, providing therapeutic benefits for inflammatory skin.(Baciur et al., 2022) Kristanti et al. (2023) finds that maintaining adequate vitamin D levels can help improve skin health by reducing inflammation and collagen breakdown while enhancing barrier repair processes, which may slow the aging process of the skin.(Kristianti, Maria T. F.; Goenawan, Hanna; Achadiyani, Achadiyani; Sylviana, Nova; Lesmana, 2023)

Glucose Profile has negative impacts on both DLQI (-0.080) and dermatoporosis (-0.068), indicating that disturbances in glucose metabolism are associated with poorer outcomes in both dermatological quality of life and increased severity of

dermatoporosis. This reflects the broader impact of metabolic health on skin conditions. Similarly, research by Zheng et al. (2022) detailed how elevated glucose contributes to skin aging by enhancing the process of glycation, which involves the stiffening of collagen and other structural proteins through cross-linking. This process not only accelerates cellular senescence but also impairs wound healing, ultimately leading to decreased skin elasticity and the formation of wrinkles.(Zheng et al., 2022)

Insulin resistance (IR) has been identified as having a substantial negative impact on the Dermatology Life Quality Index (DLQI), evidenced by a significant negative effect score of -0.346, and a lesser but still noteworthy negative influence on dermatoporosis with a score of -0.085. These findings highlight the detrimental effects of insulin resistance on dermatological health and the progression of dermatoporosis. Napolitano et al. (2015) report that insulin resistance is associated with an increased incidence of skin diseases such as acanthosis nigricans, acne, and psoriasis. The study details how elevated levels of insulin-like growth factor (IGF), triggered by insulin resistance, enhance keratinocyte proliferation, contributing to the development of hyperkeratosis in acne. Additionally, through the effects of adipocytokines, insulin resistance is linked to the development of psoriasis associated with excess adipose tissue.(Napolitano et al., 2015) Pulungan et al. (2013) reports a 71.4% prevalence of acanthosis nigricans (AN), this significantly points to a potential connection between AN and insulin resistance in this demographic.(Pulungan et al., 2013)

Lipid Profile presents the strongest negative impact on DLQI among all variables (-0.431) and negatively affects dermatoporosis (-0.167), suggesting that lipid dysregulation significantly worsens dermatological quality of life and contributes to the severity of dermatoporosis. This underscores the findings of Kim et al. (2022) which highlighted that secondary dyslipidemia can manifest as skin conditions like eruptive xanthomas, emphasizing the importance of timely detection to mitigate broader health impacts such as atherosclerosis.(Kim et al., 2022) Complementing this, Ikeda el al (2022) identified that the synergistic effects of obesity and dyslipidemia exacerbate psoriatic skin inflammation by increasing pro-inflammatory cytokines and activating keratinocytes, highlighting the critical role of metabolic disorder management in dermatological health.(Ikeda et al., 2022) Further supporting this, Alkammaz et al. (2020) delineated how dyslipidemia contributes to the pathogenesis of psoriasis through disruptions in lipid profiles, leading to enhanced inflammation and atherogenesis by modulating immune responses and inducing oxidative stress. The link between lipid profiles and skin conditions extends to affecting skin fragility and dermatoporosis, suggesting that dysregulated lipid metabolism may contribute to decreased skin elasticity and strength, thereby increasing the risk of dermatoporosis and underscoring the need for targeted interventions to normalize lipid levels as part of a broader strategy to enhance skin health and resilience.(Alkammaz & Stepanenko, 2020)

Liver function shows negative coefficients for both DLQI (-0.151) and dermatoporosis (-0.134),

indicating that poorer liver function is associated with decreased dermatological quality of life and greater severity of dermatoporosis, likely reflecting the liver's crucial role in regulating various biochemical pathways affecting skin health. Considering this, Bhandari et al. (2022) and Liu eat al. (2022) collectively emphasize the profound impact of liver cirrhosis on skin health, outlining how deteriorating liver function leads to a range of dermatological issues such as pruritus, spider telangiectasia, palmar erythema, and xanthomas. These conditions serve not only as markers of liver dysfunction but also contribute to skin fragility and potentially dermatoporosis, illustrating the liver's critical role in synthesizing proteins and regulating hormones essential for maintaining skin integrity. Highlighted within both reviews, metabolic and hormonal imbalances caused by liver dysfunction disrupt the skin's structural integrity and repair mechanisms, increasing susceptibility to injuries and chronic conditions such as dermatoporosis.(Bhandari & Mahajan, 2022; Liu et al., 2022)

Renal function shows negative coefficients of -0.243 for the Dermatology Life Quality Index (DLQI) and -0.145 for dermatoporosis, suggesting that compromised kidney function is associated with both poorer dermatological outcomes and increased severity of dermatoporosis. This correlation likely stems from the kidneys' critical roles in removing toxins and regulating electrolytes, which are essential for maintaining skin integrity. Research by Pradhan et al. (2018) found that in patients undergoing hemodialysis for CKD, skin manifestations such as pruritus and pigmentation are significantly associated with elevated serum creatinine and blood urea levels, underscoring the impact of renal dysfunction on specific skin conditions. This suggests a direct link between deteriorating renal function and various dermatological issues.(Pradhan et al., 2018) Complementing this, Curry et al. (2012) reported that critically ill adults with creatinine levels greater than 1.5 mg/dL are more susceptible to skin failure, highlighting how impaired renal function can lead to increased skin fragility, likely due to the accumulation of metabolic wastes that the kidneys fail to eliminate. These insights collectively underscore the necessity of addressing both renal and dermatological health to enhance patient outcomes, particularly in populations at risk for or currently experiencing renal impairment.(Curry et al., 2012; Pradhan et al., 2018)

Uric Acid levels are negatively correlated with both DLQI (-0.155) and dermatoporosis (-0.072), indicating that higher levels of uric acid are associated with poorer dermatological quality of life and increased severity of dermatoporosis, potentially reflecting inflammatory processes that impair skin function and health. The relationship between serum uric acid levels and psoriasis, as noted in studies by Sayami et al. (2021) and Collazo et al. (2019), suggests broader implications for how uric acid may influence skin health, particularly in terms of skin fragility and potentially dermatoporosis. Elevated uric acid levels are linked with increased severity of psoriasis, reflecting broader disruptions in skin integrity and function, as psoriasis is characterized by cycles of rapid skin cell production and inflammation, which can compromise skin's mechanical properties and

resilience.(Hernández-Collazo et al., 2023; Sayami et al., 2021) Further support for the influence of uric acid on skin health comes from Shalaby et al. (2020), who observed that treatment effectively reducing psoriasis symptoms also lowered serum uric acid levels, suggesting that uric acid plays a role in the pathophysiology of skin conditions that lead to fragility. The accumulation of uric acid could contribute to oxidative stress and inflammation, well-known factors that impair skin barrier function and could accelerate the process leading to dermatoporosis.(Shalaby et al., 2020) Moreover, Ahmed et al. (2019) demonstrated the utility of measuring serum uric acid to assess the severity of chronic plaque psoriasis, a condition that inherently involves the degradation of dermal and epidermal structures, which can be seen as a precursor to or a component of skin fragility, where the skin loses its elasticity and resilience, becoming more prone to damage from minor trauma.(Ahmed et al., 2019)

Age has a positive coefficient of 0.329 with DLQI, indicating that older individuals tend to report better dermatological quality of life. In contrast, age shows a negative coefficient of -0.618 with dermatoporosis, suggesting that as age increases, the severity of dermatoporosis also increases, which is consistent with the expected progression of skin degradation with aging. This outcome aligns with research conducted by Guadanhim et al. (2022), who reported that patients over the age of 85 are at more than double the risk of developing dermatoporosis compared to younger individuals.(Guadanhim et al., 2023) Further corroborating the impact of age on dermatoporosis, Kluger et al. (2019) conducted a prospective observational study at a Finnish tertiary care hospital. Their research quantitatively assessed the prevalence and risk factors for dermatoporosis among dermatology outpatients. The findings indicated a significant association between higher age and the incidence of dermatoporosis, with the odds of developing the condition increasing by 1.05 for each year of age, a statistic that was statistically significant (95% CI 1.01-1.10, P = 0.0016). These studies collectively emphasize the critical role age plays in the epidemiology of dermatoporosis, offering quantifiable insights that can guide the formulation of age-specific therapeutic interventions in clinical dermatology.(Kluger & Impivaara, 2019)

The context of aging and its impact on the Dermatology Life Quality Index (DLQI), give an interesting perspective on the observed negative correlation between age and DLQI. As individuals age, they are likely to experience a variety of physiological changes, including those affecting skin health, such as the development of dermatoporosis. The initial reaction to the changes in skin condition and associated health challenges might follow the trajectory laid out by Kübler-Ross, leading ultimately to the acceptance stage. Acceptance, in this framework, is characterized by a state of coming to terms with one's reality and a reconciliation with the circumstances at hand.(FINLAY & KHAN, 1994; Yang et al., 2014) The negative correlation between age and DLQI could potentially be explained by the hypothesis that older individuals have navigated through the earlier stages of the Kübler-Ross model and have reached a level of acceptance regarding their aging skin and its implications. This acceptance might

buffer the psychological and emotional impact of dermatological conditions, leading to a less pronounced decline in the quality of life as measured by DLQI. In essence, the maturity and psychological resilience built over years may enable older individuals to adapt better to their changing dermatological health, thus mitigating the potential negative impact on their quality of life.(Avis et al., 2021; Tyrrell et al., 2023) This interpretation aligns with broader observations in gerontology that suggest older adults often demonstrate increased life satisfaction and emotional well-being, despite facing the physical challenges of aging. It highlights the importance of considering psychological development and coping mechanisms when assessing the impact of health conditions on quality of life in the elderly population. Further research is needed to explore how age-related psychological adaptations influence perceptions and reporting of dermatological quality of life, in order to gain a deeper understanding of the subjective dimensions of skin experience in the older population. Similar result in a study by Kalinkara (2023) indicates that older adults who have a heightened perception of aging tend to experience increased life satisfaction, highlighting the psychological impact of how aging is perceived among the elderly. This suggests that a positive outlook on aging can significantly enhance overall well-being and contentment in later life.(Kalinkara, 2023; Tyrrell et al., 2023)

CONCLUSION

This study emphasizes the strong influence of systemic health indicators, such as liver, kidney, metabolic function, lipid profiles, and uric acid levels, on skin integrity, particularly in relation to dermatoporosis and dermatological quality of life (DLQI). Dysfunction in these systems is significantly associated with more severe dermatoporosis and poorer skin-related outcomes. The findings highlight the need for a holistic management approach that integrates both dermatological and systemic care. Additionally, while aging correlates with increased dermatoporosis severity, older individuals often report better dermatological quality of life, likely due to psychological adaptation. These insights support the development of age-specific therapeutic strategies to improve skin health in the elderly.

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