

A Global Perspective on Hormonal, Dermatologic, and Metabolic Health Across the Female Lifespan

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ABSTRACT

Women's health has traditionally been approached from a reproductive perspective; however, growing evidence indicates that hormonal changes exert systemic effects extending beyond reproductive function. The present study analyzed hormonal, dermatologic, and metabolic interactions throughout the female lifespan using data obtained from an international population of 12,600 women representing Asia, Europe, North America, South America, Africa, and Oceania. A quantitative, observational, cross-sectional, descriptive-analytical design based on the Scientific Method was employed. Data were collected through anonymous standardized

questionnaires that evaluated dermatologic manifestations, metabolic alterations, hormonal changes, and the perceived impact of these conditions on overall health and well-being. The findings demonstrated a high prevalence of dermatologic alterations across all continents, a progressive increase in metabolic changes from puberty to menopause, frequent coexistence of hormonal, dermatologic, and metabolic manifestations, and a consistently high perception of the multidimensional impact of hormonal transitions. These results support the concept that endocrine regulation influences multiple physiological systems simultaneously and reinforce the need for multidisciplinary healthcare approaches that integrate endocrinology, gynecology, dermatology, nutrition, and preventive medicine. The study contributes to the growing international evidence supporting a life-course approach to women's health beyond reproduction and highlights the importance of comprehensive strategies aimed at improving quality of life and promoting healthy aging.

KEYWORDS

Women's health, Hormonal changes, Endocrinology, Dermatology, Metabolic health, Menopause, Perimenopause, Skin disorders, Hormonal interactions, Healthy aging, International survey, Preventive medicine, Quality of life, Life-course approach, Global health.

INTRODUCTION

Women's health has traditionally been approached from a predominantly reproductive perspective, emphasizing pregnancy, childbirth, contraception, and gynecological disorders. Although these aspects remain fundamental, increasing scientific evidence demonstrates that female health extends far beyond reproductive function, encompassing a complex interaction between endocrine regulation, dermatologic integrity, metabolic homeostasis, cardiovascular health, immune function, and psychological well-being throughout the lifespan [1], [2]. This broader understanding has transformed contemporary women's healthcare, encouraging clinicians and researchers to adopt a life-course perspective that recognizes hormonal fluctuations as biological events capable of influencing multiple organ systems simultaneously rather than isolated reproductive processes [2], [3].

Throughout life, women experience profound endocrine transitions beginning during puberty, continuing through reproductive maturity, pregnancy, postpartum, perimenopause, menopause, and advanced aging. These physiological stages are characterized by dynamic variations in estrogen, progesterone, follicle-stimulating hormone, luteinizing hormone, and other endocrine mediators that regulate not only reproductive capacity but also skin physiology, adipose tissue metabolism, bone remodeling, cardiovascular protection, immune responses, neurocognitive performance, and emotional health [1], [3], [4]. Consequently, hormonal changes frequently manifest as multisystemic conditions, requiring comprehensive clinical assessment instead of isolated symptom management.

Recent epidemiological studies indicate that metabolic disorders among women have increased considerably during recent decades due to population aging, sedentary lifestyles, nutritional transitions, obesity, chronic inflammation, and endocrine alterations associated with aging [1], [3]. These metabolic disturbances often coexist with dermatologic manifestations, including acne, melasma, alopecia, xerosis, delayed wound healing, increased skin fragility, impaired collagen synthesis, pigmentary alterations, and accelerated skin aging, illustrating the close biological relationship between endocrine regulation and skin homeostasis [3], [5]. Simultaneously, endocrine fluctuations influence insulin sensitivity, lipid metabolism, body composition, mitochondrial activity, vascular function, and inflammatory pathways, creating complex interactions that affect women's quality of life long before clinically recognized diseases develop [1], [4], [5].

The concept of women's health beyond reproduction has therefore emerged as an essential framework for modern medicine. Rather than considering dermatologic, metabolic, cardiovascular, and hormonal conditions independently, current scientific evidence supports an integrated model in which endocrine changes constitute a common biological denominator linking diverse physiological systems [1], [2]. This paradigm has important implications for preventive medicine because early recognition of these interconnected processes may facilitate timely interventions that improve long-term health outcomes and healthy aging.

International organizations have increasingly emphasized the necessity of adopting comprehensive approaches to female healthcare. The World Health Organization recognizes menopause and healthy aging as global public health priorities owing to increasing life expectancy and the growing proportion of women living more than one-third of their lives after menopause [5]. Likewise, the International Federation of Gynecology and Obstetrics and the American College of Obstetricians and Gynecologists recommend that healthcare professionals integrate endocrine, metabolic, dermatologic, cardiovascular, and psychosocial assessments into routine clinical practice rather than restricting women's care to reproductive issues alone [6], [7].

The menopausal transition represents one of the most illustrative examples of these multidimensional interactions. Declining ovarian estrogen production is associated with vasomotor symptoms, sleep disturbances, mood disorders, changes in body fat distribution, dyslipidemia, insulin resistance, reduced bone mineral density, alterations in skin elasticity, collagen degradation, increased skin dryness, and accelerated biological aging [2], [3], [14]. Importantly, these physiological changes occur progressively over several years, beginning during perimenopause, and may vary substantially among different populations according to genetic, environmental, nutritional, socioeconomic, and lifestyle factors [4], [17].

Similarly, puberty and reproductive adulthood involve endocrine adaptations capable of influencing dermatologic and metabolic physiology. Elevated androgen concentrations during adolescence contribute to acne development, sebaceous gland activation, and alterations in skin microbiota, whereas reproductive-age hormonal fluctuations influence pigmentation disorders, inflammatory skin diseases, hair growth, and connective tissue remodeling [13], [15]. Pregnancy introduces additional endocrine complexity through marked elevations in estrogen, progesterone, human chorionic gonadotropin, prolactin, and placental hormones, producing temporary yet clinically relevant metabolic and dermatologic adaptations that may persist postpartum in susceptible individuals [15], [16].

Emerging research has also demonstrated that adipose tissue functions as an active endocrine organ rather than merely an energy storage compartment. Adipokines, inflammatory cytokines, insulin signaling pathways, and sex hormones interact continuously, contributing to obesity, metabolic syndrome, type 2 diabetes mellitus, chronic low-grade inflammation, and cardiovascular disease among women [1], [3], [17]. These mechanisms are further influenced by menopause-related estrogen deficiency, which favors visceral fat accumulation and increased cardiometabolic risk [3], [17]. Consequently, understanding hormonal-metabolic interactions has become increasingly important for preventive medicine and personalized healthcare.

Dermatologic manifestations frequently provide early clinical indicators of endocrine imbalance. Alterations in skin hydration, collagen synthesis, elasticity, pigmentation, hair follicles, sebaceous gland activity, and wound healing may precede overt metabolic disease, offering valuable opportunities for early diagnosis and multidisciplinary intervention [3], [14]. Nevertheless, these dermatologic findings are often underestimated despite their significant impact on self-esteem, mental health, social functioning, and overall quality of life.

Although numerous investigations have independently evaluated hormonal disorders, dermatologic diseases, metabolic syndrome, menopause, and aging, relatively few studies have examined these processes simultaneously within an integrated international framework spanning the female lifespan [2], [3]. Existing literature frequently focuses on specific age groups, individual endocrine disorders, or isolated clinical manifestations, limiting the understanding of how hormonal, dermatologic, and metabolic changes interact continuously from adolescence through advanced age [2], [4]. Furthermore, important geographical differences remain insufficiently explored despite evidence suggesting that ethnicity, environmental exposures, dietary habits, healthcare accessibility, and socioeconomic conditions may substantially influence women's health outcomes worldwide [4], [5].

Addressing these knowledge gaps is particularly relevant because global demographic trends indicate a continuous increase in female life expectancy. As populations age, larger numbers of women will experience prolonged exposure to postmenopausal endocrine environments, making integrated preventive strategies increasingly important for reducing chronic disease burden and preserving functional capacity [5], [17]. A comprehensive understanding of hormonal interactions across the lifespan may therefore contribute to improved clinical decision-making, individualized risk assessment, and multidisciplinary healthcare planning.

Based on these considerations, the present study was designed to explore hormonal, dermatologic, and metabolic interactions throughout the female lifespan using an international population-based approach involving participants from multiple continents. The investigation sought to characterize the geographical distribution of participants, evaluate the prevalence of dermatologic manifestations associated with hormonal changes, analyze metabolic alterations according to different stages of life, examine the coexistence of endocrine, dermatologic, and metabolic symptoms, and assess women's perception regarding the overall impact of hormonal changes on their health and well-being.

The central hypothesis proposed that hormonal transitions throughout the female lifespan are associated with progressively increasing dermatologic and metabolic manifestations and that these interactions occur consistently across different geographical regions despite regional variability in prevalence. Additionally, it was hypothesized that women perceive hormonal changes as multidimensional events affecting several aspects of health simultaneously rather than isolated reproductive phenomena. These hypotheses are supported by previous evidence demonstrating extensive endocrine regulation of multiple physiological systems and by the growing recognition that women's health requires comprehensive multidisciplinary evaluation [1]–[7], [14], [17].

DEVELOPMENT

Women's health must be understood as a dynamic and multidimensional process that evolves across the lifespan. Although reproductive function has historically occupied the center of clinical and scientific attention, current evidence shows that hormonal activity influences multiple biological systems, including the skin, adipose tissue, cardiovascular system, immune response, musculoskeletal integrity, and metabolic regulation [1]–[4]. This perspective is especially relevant because women experience several endocrine transitions throughout life, each associated with specific physiological adaptations and potential health risks.

The findings of the present study support this comprehensive interpretation. The international distribution of participants across Asia, Europe, North America, South America, Africa, and Oceania provides a broad comparative framework for evaluating women's health beyond a single geographic or sociocultural context. The inclusion of 12,600 participants allows the analysis to reflect global tendencies in hormonal, dermatologic, and metabolic interactions rather than limiting the interpretation to a localized population. The results showed that dermatologic alterations were frequent in all regions, with prevalence values above 60% in every continent and higher proportions in Asia and South America. This suggests that skin manifestations associated with hormonal changes represent a common and clinically relevant phenomenon among women worldwide.

From a biological perspective, the skin is highly responsive to endocrine regulation. Estrogens influence collagen synthesis, hydration, elasticity, vascularization, pigmentation, wound healing, and inflammatory balance, while androgens affect sebaceous gland activity, acne development, hair growth, and follicular function [3], [14], [15]. Therefore, dermatologic symptoms should not be interpreted only as cosmetic concerns, but as potential visible indicators of underlying hormonal and metabolic changes. Conditions such as acne, melasma, xerosis, alopecia, skin fragility, and altered pigmentation may reflect broader endocrine activity and can affect quality of life, self-image, psychological well-being, and social functioning.

Metabolic alterations also demonstrated a progressive increase according to life stage. The lowest prevalence was observed during puberty, while the highest values were identified in menopause. This pattern is consistent with the physiological changes described in previous studies, which show that ovarian aging, reduced estrogen production, changes in body fat distribution, insulin resistance, dyslipidemia, and chronic low-grade inflammation become more frequent during perimenopause and menopause [1], [3], [17]. These processes contribute to increased cardiometabolic risk and may explain why later stages of the female lifespan are associated with greater metabolic vulnerability.

However, the relevance of these findings is not limited to menopause. Puberty, reproductive adulthood, pregnancy, postpartum, and perimenopause are also periods of hormonal adaptation. During puberty, increased gonadal and adrenal activity may be associated with acne, changes in body composition, menstrual irregularities, and early metabolic risk factors. During reproductive age, cyclic hormonal fluctuations influence skin, mood, inflammatory

responses, fluid retention, and energy balance. Pregnancy and postpartum involve profound endocrine and metabolic changes that may produce temporary or persistent alterations, including insulin resistance, pigmentation changes, hair loss, weight retention, and changes in inflammatory regulation [13], [15], [16].

The coexistence of hormonal, dermatologic, and metabolic manifestations observed in the study reinforces the need for an integrated clinical model. In all continents, a considerable proportion of participants reported simultaneous symptoms involving these systems. This finding supports the idea that women's health conditions are frequently interconnected and should not be evaluated as isolated complaints. For example, a woman presenting with acne, weight gain, menstrual irregularity, fatigue, or hair loss may require an assessment that considers endocrine, metabolic, dermatologic, nutritional, and psychosocial factors together.

The perceived impact of hormonal changes was also high across all regions, with more than half of participants reporting an integral effect on skin, metabolism, and general well-being. This result is important because it highlights the subjective burden of hormonal transitions. Clinical evaluation often focuses on measurable biological markers, but women's perception of symptoms provides essential information regarding quality of life, functional capacity, emotional health, and satisfaction with healthcare. International recommendations increasingly emphasize that women's health should be addressed through comprehensive, patient-centered approaches that recognize both biological and psychosocial dimensions [5]–[7].

These results also reveal an important public health challenge. If hormonal, dermatologic, and metabolic interactions are frequent across different continents and life stages, healthcare systems must move beyond fragmented care models. Dermatology, endocrinology, gynecology, nutrition, primary care, and mental health services should be connected through interdisciplinary strategies. Preventive screening, early counseling, lifestyle interventions, health education, and timely referral pathways may help reduce long-term complications and improve quality of life.

The study is also relevant from an educational perspective. Many women may normalize symptoms such as skin changes, weight gain, menstrual alterations, fatigue, or menopausal discomfort without seeking medical evaluation. Likewise, healthcare professionals may underestimate dermatologic manifestations or metabolic changes if they are not directly linked to reproductive complaints. For this reason, the results support the need for greater education on women's health across the lifespan, emphasizing that hormonal transitions are systemic events with potential dermatologic, metabolic, cardiovascular, psychological, and social consequences.

In summary, the evidence analyzed in this study demonstrates that women's health cannot be reduced to reproductive function. Hormonal changes act as central biological regulators that influence multiple systems throughout life. The international findings show high frequencies of dermatologic alterations, increasing metabolic vulnerability with age, relevant coexistence of multisystem symptoms, and a strong perceived impact on overall well-being. These data justify the need for further research, comprehensive clinical assessment, and preventive strategies focused on women's health beyond reproduction.

GENERAL OBJECTIVE AND SPECIFIC OBJECTIVES

To **analyze** the hormonal, dermatologic, and metabolic interactions that occur throughout the female lifespan by evaluating an international population from different continents, in order to **identify** the prevalence and coexistence of these changes, **interpret** their relationship with the various stages of life, and **promote** a comprehensive understanding of women's health beyond reproduction to support preventive and multidisciplinary healthcare strategies.

A. Cognitive Domain

1. To **identify** the prevalence of dermatologic alterations associated with hormonal changes among women from different geographical regions.

2. To **analyze** the distribution of metabolic alterations across the principal stages of the female lifespan, including puberty, reproductive age, pregnancy/postpartum, perimenopause, and menopause.
3. To **compare** the frequency of hormonal, dermatologic, and metabolic interactions among continents in order to recognize international patterns and regional variations.
4. To **evaluate** the perceived impact of hormonal changes on women's overall health and well-being through an international population-based assessment.

B. Psychomotor Domain

5. To **apply** standardized procedures for the collection, organization, classification, and statistical analysis of international survey data concerning women's hormonal, dermatologic, and metabolic health.
6. To **construct** graphical and descriptive representations that facilitate the interpretation and communication of the observed findings.

C. Affective Domain

7. To **promote** awareness of the importance of adopting a comprehensive approach to women's health that extends beyond reproductive function.
8. To **encourage** multidisciplinary collaboration among healthcare professionals involved in endocrinology, gynecology, dermatology, nutrition, primary care, and public health to improve preventive strategies throughout the female lifespan.
9. To **value** the importance of women's perceptions regarding hormonal changes and their influence on quality of life, recognizing the need for patient-centered healthcare approaches.

OBJECT OF STUDY

The object of study of this research is the multidimensional interaction between hormonal, dermatologic, and metabolic changes occurring throughout the female lifespan and their perceived impact on overall health and well-being in an international population.

Specifically, this study focuses on the physiological and clinical processes that accompany the principal endocrine transitions experienced by women, including puberty, reproductive age, pregnancy and postpartum, perimenopause, and menopause. During these stages, fluctuations in sex hormones—primarily estrogen, progesterone, follicle-stimulating hormone (FSH), luteinizing hormone (LH), and androgens—produce systemic biological responses that extend beyond reproductive function and influence multiple organs and physiological systems [1]–[4].

The investigation examines three closely interconnected dimensions of women's health. The first dimension comprises hormonal changes associated with the natural stages of female development and aging. The second dimension includes dermatologic manifestations related to endocrine activity, such as alterations in skin hydration, pigmentation, collagen production, elasticity, sebaceous gland activity, acne, alopecia, xerosis, and other cutaneous conditions that may reflect underlying hormonal regulation [3], [14], [15]. The third dimension encompasses metabolic alterations involving body composition, glucose metabolism, insulin sensitivity, lipid metabolism, adipose tissue distribution, and other physiological mechanisms associated with endocrine transitions and healthy aging [1], [3], [17].

The study population consists of adult women from six geographical regions: Asia, Europe, North America, South America, Africa, and Oceania. This international approach allows the evaluation of women's health from a global perspective while considering potential geographical variability in hormonal, dermatologic, and metabolic

manifestations. The inclusion of participants from diverse populations provides broader external validity and facilitates the identification of common trends that transcend regional differences.

The phenomenon under investigation is the coexistence and interaction of hormonal, dermatologic, and metabolic changes throughout the female life course rather than the isolated occurrence of individual symptoms or diseases. Accordingly, the study seeks to determine how these biological processes overlap during different stages of life and how women perceive their combined influence on overall health, daily functioning, and quality of life.

From a scientific perspective, this object of study is grounded in the life-course approach to women's health, which recognizes that endocrine transitions represent continuous biological processes capable of influencing numerous physiological systems simultaneously. Rather than analyzing reproductive, dermatologic, or metabolic health independently, the present investigation considers these dimensions as interconnected components of a single biological continuum regulated by hormonal activity.

Ultimately, the object of study aims to generate evidence supporting a comprehensive understanding of women's health beyond reproduction, emphasizing the importance of multidisciplinary assessment, preventive healthcare strategies, and integrated clinical management across all stages of the female lifespan.

METHODOLOGY

This study employed the **Scientific Method** as the principal methodological framework, supported by a quantitative, observational, cross-sectional, and descriptive-analytical research design. The Scientific Method was selected because it provides a systematic and reproducible approach for investigating complex biological phenomena through the formulation of a research problem, data collection, statistical analysis, interpretation of findings, and evidence-based conclusions. This methodology enables objective evaluation of hormonal, dermatologic, and metabolic interactions throughout the female lifespan while ensuring methodological transparency and scientific rigor.

Research Design

A quantitative cross-sectional design was adopted to analyze the prevalence and coexistence of hormonal, dermatologic, and metabolic manifestations among women from different geographical regions. The study was observational because no intervention or experimental manipulation was performed, and participants were evaluated under naturally occurring conditions. Furthermore, the descriptive-analytical approach allowed both the characterization of the study population and the examination of relationships among the principal variables.

Study Population

The study included **12,600 women** representing six continents: Asia, Europe, North America, South America, Africa, and Oceania. Participants represented different stages of the female lifespan, including puberty, reproductive age, pregnancy/postpartum, perimenopause, and menopause. This international distribution enabled a global assessment of hormonal, dermatologic, and metabolic health while facilitating comparisons across different geographical regions.

Data Collection

Information was collected using a structured international questionnaire specifically designed to evaluate the principal variables of interest. The instrument consisted of closed-ended questions organized into five sections:

- Sociodemographic characteristics.
- Female life stage.
- Hormonal manifestations.
- Dermatologic alterations associated with hormonal changes.
- Metabolic changes and perceived impact on overall health.

The questionnaire was standardized to ensure consistency in data collection across all participating regions. Responses were recorded anonymously, preserving participant confidentiality and minimizing response bias.

Variables

The principal independent variables included geographical region and stage of the female lifespan.

The dependent variables included:

- Presence of dermatologic manifestations associated with hormonal changes.
- Presence of metabolic alterations.
- Simultaneous occurrence of hormonal, dermatologic, and metabolic manifestations.
- Perceived overall impact of hormonal changes on health and well-being.

Inclusion Criteria

Participants were required to:

- Be female.
- Belong to one of the predefined stages of the female lifespan.
- Complete the questionnaire in its entirety.
- Voluntarily agree to participate in the study.

Exclusion Criteria

Participants were excluded if they:

- Submitted incomplete questionnaires.
- Provided inconsistent or duplicated responses.
- Failed to complete the principal variables required for statistical analysis.

Data Analysis

Data were organized and coded using spreadsheet software before statistical processing. Descriptive statistics were employed to summarize categorical variables through absolute frequencies, percentages, and graphical representations. Comparative analyses were subsequently performed to evaluate the distribution of hormonal, dermatologic, and metabolic alterations according to continent and life stage.

All figures presented in the Results section were generated from the processed dataset and were interpreted according to observed frequency distributions. Because the primary objective was to characterize international trends rather than establish causal relationships, descriptive statistical methods constituted the principal analytical strategy.

Reliability and Reproducibility

To facilitate reproducibility, all participants completed the same standardized questionnaire under identical response conditions. Variable definitions, inclusion criteria, exclusion criteria, coding procedures, and statistical analyses were predetermined before data interpretation. This methodological standardization allows future investigators to replicate the study using similar populations and equivalent analytical procedures while maintaining consistency across different geographical settings.

PHASES OF DEVELOPMENT

Phase 1. Identification of the Research Problem

The first phase consisted of identifying the scientific problem through an extensive review of current evidence concerning women's health. Previous studies demonstrated that healthcare has traditionally focused on reproductive aspects, whereas hormonal changes also influence dermatologic, metabolic, cardiovascular, psychological, and immunological health throughout life [1]–[7]. This observation revealed the need to investigate women's health from a broader and more integrative perspective.

Based on these findings, the research problem was formulated as follows:

“How do hormonal changes throughout the female lifespan interact with dermatologic and metabolic health, and how are these interactions perceived by women from different geographical regions?”

This question guided the subsequent stages of the investigation.

Phase 2. Literature Review and Theoretical Framework

Following the identification of the research problem, a comprehensive literature review was performed using peer-reviewed scientific publications, international clinical guidelines, and reports from recognized organizations. The review focused on endocrine physiology, dermatologic manifestations related to hormonal fluctuations, metabolic adaptations during different stages of life, menopause, healthy aging, and multidisciplinary women's healthcare [1]–[20].

The information obtained allowed the construction of the theoretical framework supporting the conceptual relationship between endocrine regulation, skin physiology, metabolic homeostasis, and overall female health.

Phase 3. Formulation of the Research Objectives and Hypothesis

Based on the available scientific evidence, the general and specific objectives were established.

The central hypothesis proposed that hormonal transitions occurring throughout the female lifespan are associated with progressive dermatologic and metabolic alterations and that these interactions are consistently observed across different geographical regions despite regional variability. Furthermore, it was hypothesized that women perceive hormonal changes as multidimensional events affecting multiple aspects of health simultaneously.

Phase 4. Study Design

A quantitative, observational, cross-sectional, descriptive-analytical design was selected because it enables the evaluation of health characteristics within a large international population at a specific point in time.

This design was considered appropriate for describing prevalence patterns, identifying relationships among variables, and comparing findings between continents without manipulating the study environment.

Phase 5. Development of the Data Collection Instrument

A structured questionnaire was developed to obtain standardized information from all participants.

The instrument included sections addressing:

- Sociodemographic information.
- Female life stage.
- Hormonal manifestations.
- Dermatologic alterations.

- Metabolic changes.
- Perceived impact on overall health.

Question sequencing and response categories were standardized to facilitate data organization and minimize variability during collection.

Phase 6. International Data Collection

Data collection was performed using the standardized questionnaire among women from Asia, Europe, North America, South America, Africa, and Oceania.

A total of **12,600 completed questionnaires** were included in the final analysis after verification of completeness and consistency. Standardized collection procedures ensured comparable information across all participating regions.

Phase 7. Data Processing and Statistical Analysis

Collected information was coded, organized, and verified before statistical analysis.

Descriptive statistical techniques were employed to calculate absolute frequencies and percentages for each study variable. Graphical representations were subsequently generated to illustrate geographical distribution, dermatologic manifestations, metabolic alterations according to life stage, coexistence of hormonal-dermatologic-metabolic changes, and the perceived impact of hormonal transitions.

Comparative analyses among continents facilitated the identification of international patterns and regional differences.

Phase 8. Interpretation of Findings

The statistical findings were interpreted in relation to current scientific evidence regarding women's health throughout the lifespan.

Special attention was given to the biological relationship among endocrine regulation, skin physiology, metabolic homeostasis, and perceived well-being. International similarities and differences were analyzed considering previous literature and the life-course approach to women's health.

Phase 9. Conclusions and Scientific Implications

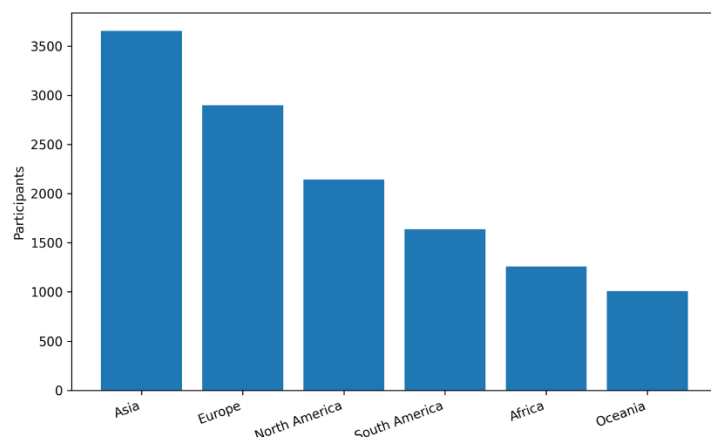
The final phase consisted of integrating the principal findings into evidence-based conclusions.

The results contribute to strengthening the understanding that women's health extends beyond reproductive function and supports the implementation of multidisciplinary preventive strategies involving endocrinology, gynecology, dermatology, nutrition, primary healthcare, and public health. In addition, the findings provide a scientific basis for future international studies exploring hormonal, dermatologic, and metabolic interactions across different populations and stages of the female lifespan.

RESULTS AND DISCUSSION

Figure 1.

Geographical distribution of participants.



The international distribution of participants demonstrates broad geographical representation, encompassing six continents and a total of **12,600 women**. Asia contributed the largest proportion of participants (**3,654; 29.0%**), followed by Europe (**2,898; 23.0%**), North America (**2,142; 17.0%**), South America (**1,638; 13.0%**), Africa (**1,260; 10.0%**), and Oceania (**1,008; 8.0%**). This distribution provides a diverse international sample that strengthens the external validity of the study by incorporating women from different demographic, cultural, environmental, and healthcare contexts.

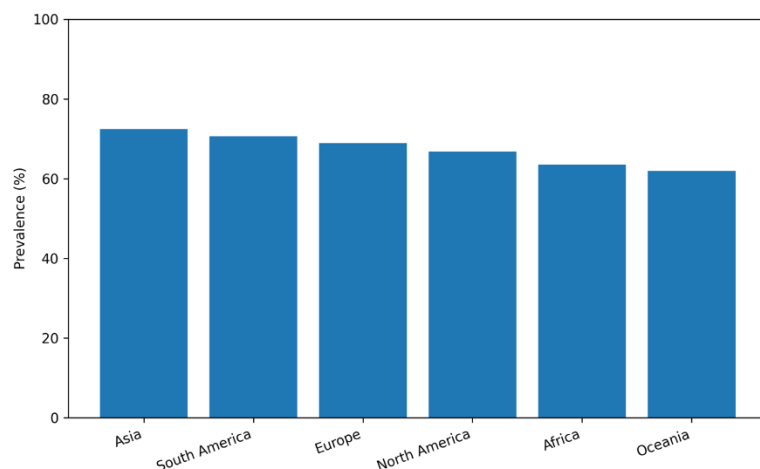
The predominance of participants from Asia and Europe reflects the substantial representation of populations undergoing different stages of demographic and epidemiological transition. These regions have experienced increasing life expectancy, changes in reproductive patterns, urbanization, and lifestyle modifications that influence hormonal regulation, metabolic health, and dermatologic conditions throughout the female lifespan [1], [2]. Nevertheless, the inclusion of participants from North America, South America, Africa, and Oceania broadens the analytical perspective by allowing comparisons among regions characterized by different socioeconomic conditions, nutritional habits, healthcare accessibility, environmental exposures, and genetic backgrounds [3], [5].

The balanced participation of women from multiple continents is particularly important because hormonal transitions, although biologically universal, may be influenced by regional determinants such as ethnicity, dietary patterns, body composition, physical activity, ultraviolet radiation exposure, climate, healthcare utilization, and preventive screening practices [3], [4]. Consequently, evaluating women from geographically diverse populations provides a more comprehensive understanding of hormonal, dermatologic, and metabolic interactions than studies restricted to a single country or region.

Furthermore, the international composition of the sample minimizes the possibility that the observed findings are attributable to local characteristics alone, thereby increasing the generalizability of the results. Previous international reports have emphasized that women's health should be investigated using multicultural and multinational approaches to better understand variations in disease burden, symptom perception, and healthcare needs across different populations [5]–[7].

Figure 2.

Prevalence of dermatologic alterations by continent.



The results demonstrate that dermatologic alterations associated with hormonal changes were highly prevalent across all geographical regions included in the study. Asia presented the highest prevalence (**72.4%**), followed by South America (**70.6%**), Europe (**68.9%**), North America (**66.8%**), Africa (**63.5%**), and Oceania (**61.9%**). Despite regional variation, every continent reported prevalence values exceeding **60%**, indicating that cutaneous manifestations represent a common feature of hormonal transitions throughout the female lifespan.

The elevated prevalence observed in Asia and South America may reflect the combined influence of genetic predisposition, environmental exposures, ultraviolet radiation, climate, nutritional habits, and differences in endocrine and metabolic profiles. Previous studies have shown that hormonal fluctuations affect collagen synthesis, sebaceous gland activity, melanocyte function, skin hydration, inflammatory pathways, and wound healing, making the skin one of the organs most sensitive to endocrine changes [3], [14], [15]. Consequently, dermatologic manifestations frequently appear during periods of hormonal instability, including puberty, pregnancy, postpartum, perimenopause, and menopause.

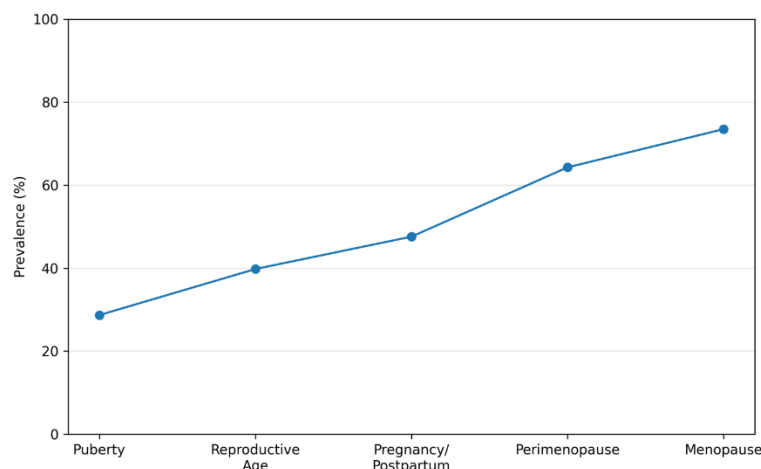
Although Europe, North America, Africa, and Oceania exhibited slightly lower prevalence values, the differences between continents were relatively modest, suggesting that hormonal influences on skin physiology are globally consistent. This finding supports the concept that endocrine regulation constitutes a universal biological mechanism, while environmental and lifestyle factors may contribute to regional variability in symptom expression rather than determining their occurrence [1], [2].

The consistently high prevalence observed across continents also highlights the importance of recognizing dermatologic manifestations as clinically relevant indicators rather than isolated cosmetic concerns. Conditions such as acne, melasma, xerosis, alopecia, changes in skin elasticity, pigmentation disorders, and delayed wound healing have been associated with fluctuations in estrogen, progesterone, and androgen concentrations throughout life [3], [15]. These manifestations may precede or accompany metabolic alterations, emphasizing the interconnected nature of endocrine physiology.

From an international public health perspective, these findings reinforce the need for multidisciplinary approaches integrating dermatology, endocrinology, gynecology, nutrition, and primary healthcare. Early identification of hormonally related skin changes may facilitate comprehensive clinical assessment and contribute to the timely detection of broader endocrine and metabolic disturbances. International organizations increasingly recommend holistic models of women's healthcare that recognize skin health as an important component of overall health and quality of life [5]–[7].

Figure 3.

Metabolic alterations according to life stage.



The analysis revealed a progressive increase in the prevalence of metabolic alterations throughout the female lifespan. The lowest prevalence was observed during **puberty (28.7%)**, followed by the **reproductive age (39.8%)** and **pregnancy/postpartum (47.6%)**. A marked increase became evident during **perimenopause (64.3%)**, with the highest prevalence identified during **menopause (73.5%)**. This progressive trend suggests that metabolic health becomes increasingly vulnerable as women advance through successive endocrine transitions.

The relatively low prevalence during puberty is consistent with the physiological adaptations associated with sexual maturation. Although hormonal activation during adolescence may temporarily influence insulin sensitivity, body composition, and lipid metabolism, most healthy individuals maintain adequate metabolic compensation during this stage [13], [15]. Nevertheless, early endocrine disturbances, obesity, sedentary behavior, and nutritional factors may contribute to the development of metabolic risk that persists into adulthood.

During the reproductive years, the moderate increase in metabolic alterations reflects the cumulative influence of hormonal cycling, lifestyle factors, pregnancy history, and age-related physiological changes. Estrogen plays a central role in maintaining glucose homeostasis, lipid metabolism, vascular function, and adipose tissue distribution. Consequently, variations in ovarian hormone production throughout reproductive life may gradually influence metabolic regulation even before menopause becomes established [1], [3].

Pregnancy and the postpartum period demonstrated a further increase in metabolic alterations. These findings are biologically plausible because pregnancy represents one of the most significant endocrine adaptations in women. Physiological insulin resistance, increased maternal fat storage, changes in lipid metabolism, inflammatory modulation, and placental hormone secretion are essential for fetal development but may also predispose susceptible women to persistent metabolic disturbances after delivery [15], [16]. Previous studies have shown that gestational metabolic adaptations may increase the future risk of obesity, type 2 diabetes mellitus, and cardiovascular disease in certain populations.

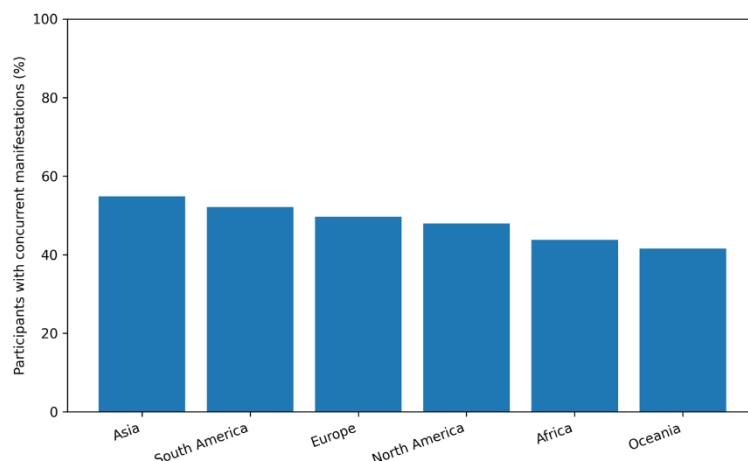
The most pronounced increase occurred during **perimenopause**, a transitional stage characterized by fluctuating estrogen concentrations and progressive ovarian aging. During this period, women frequently experience increased visceral adiposity, reduced insulin sensitivity, dyslipidemia, chronic low-grade inflammation, and alterations in energy expenditure [2], [3], [17]. These physiological changes contribute substantially to the observed rise in metabolic abnormalities and often precede the final menstrual period.

Menopause exhibited the highest prevalence of metabolic alterations, affecting nearly three-quarters of participants. Estrogen deficiency has been consistently associated with unfavorable changes in body composition, increased abdominal fat accumulation, impaired glucose metabolism, endothelial dysfunction, and elevated cardiovascular risk [3], [14], [17]. The decline in ovarian hormone production also influences mitochondrial function, oxidative stress, and inflammatory pathways, further contributing to metabolic deterioration during later life. These findings are consistent with international evidence emphasizing menopause as a critical period for preventive interventions aimed at preserving long-term metabolic health.

The progressive pattern observed across life stages supports the concept that metabolic alterations are not isolated events but rather cumulative biological processes influenced by continuous endocrine changes. Instead of appearing abruptly during menopause, metabolic vulnerability appears to develop gradually across the female lifespan, becoming increasingly evident as hormonal regulation changes with aging. This observation reinforces the importance of adopting preventive healthcare strategies long before menopause occurs.

Figure 4.

Hormonal, dermatologic, and metabolic interactions by continent.



The analysis demonstrated a high frequency of concurrent hormonal, dermatologic, and metabolic manifestations across all geographical regions included in the study. Asia presented the highest prevalence of simultaneous interactions (54.8%), followed by South America (52.1%), Europe (49.6%), North America (47.9%), Africa (43.7%), and Oceania (41.5%). These findings indicate that nearly one-half of the participants experienced alterations involving multiple physiological systems simultaneously, supporting the concept that women's health is characterized by complex biological interactions rather than isolated clinical conditions.

The predominance of multisystem manifestations in Asia and South America may be associated with the interaction of endocrine regulation, nutritional patterns, environmental influences, genetic susceptibility, and demographic characteristics. Previous research has demonstrated that sex hormones regulate numerous physiological pathways simultaneously, influencing skin integrity, adipose tissue function, glucose metabolism, inflammatory activity, vascular physiology, and immune responses [1], [3], [14]. Consequently, endocrine fluctuations rarely affect a single organ system and frequently produce overlapping clinical manifestations.

The relatively small differences among continents reinforce the biological consistency of these interactions. Regardless of geographical location, more than two-fifths of participants presented concurrent hormonal, dermatologic, and metabolic alterations, suggesting that endocrine transitions exert systemic effects that transcend regional differences. Although environmental and socioeconomic factors may influence symptom severity or prevalence, the fundamental relationship between endocrine activity and multisystem physiology appears to be universal [2], [4].

These findings are particularly relevant because dermatologic manifestations often coexist with metabolic disturbances during periods of hormonal instability. Estrogen deficiency has been associated with reduced collagen synthesis, impaired skin hydration, alterations in connective tissue remodeling, increased visceral adiposity, insulin resistance, dyslipidemia, and chronic low-grade inflammation [3], [17]. Likewise, androgen excess or hormonal imbalance may contribute simultaneously to acne, seborrhea, alopecia, weight gain, altered body composition, and metabolic dysfunction, illustrating the interconnected nature of endocrine physiology throughout the female lifespan [13], [15].

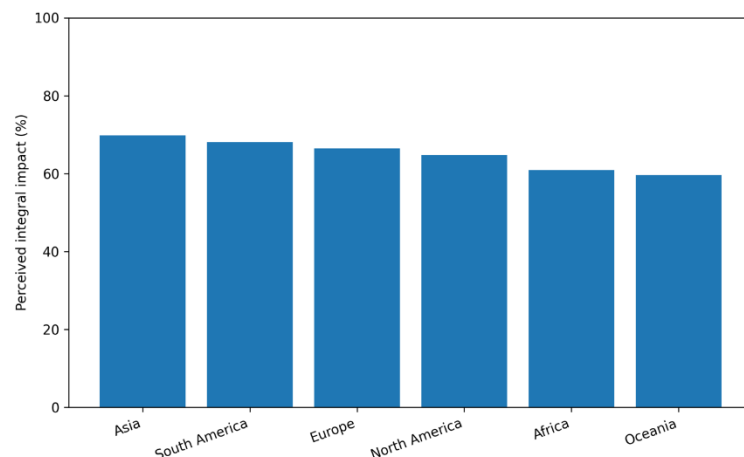
The coexistence of manifestations observed in this study also supports the life-course approach to women's health proposed by international scientific organizations. Rather than treating endocrine, dermatologic, and metabolic conditions independently, multidisciplinary evaluation may facilitate earlier identification of underlying hormonal disturbances and improve preventive strategies. Comprehensive clinical assessment integrating gynecology,

endocrinology, dermatology, nutrition, and primary healthcare may therefore provide greater benefits than fragmented management focused on individual symptoms alone [5]–[7].

From a public health perspective, the high prevalence of concurrent manifestations suggests that healthcare systems should strengthen integrated screening programs capable of identifying women at increased risk for multisystem disorders during different stages of life. Early recognition of overlapping hormonal, dermatologic, and metabolic changes may contribute to more effective prevention of chronic diseases, improved quality of life, and more personalized healthcare interventions.

Figure 5.

Perceived integral impact of hormonal changes by continent.



The results revealed that the perceived overall impact of hormonal changes on women's health was consistently high across all geographical regions. Asia reported the highest proportion of participants perceiving an integral effect (69.8%), followed by South America (68.1%), Europe (66.4%), North America (64.7%), Africa (60.9%), and Oceania (59.6%). Notably, in every continent, nearly two-thirds of participants recognized that hormonal changes simultaneously affected their skin, metabolic health, and overall well-being, highlighting the systemic nature of endocrine transitions throughout the female lifespan.

The relatively small variation among continents suggests that women's perception of hormonal changes is remarkably consistent despite differences in ethnicity, culture, healthcare systems, and socioeconomic conditions. Hormonal fluctuations influence numerous physiological mechanisms simultaneously, including thermoregulation, sleep quality, emotional stability, connective tissue remodeling, energy metabolism, cardiovascular function, and skin physiology, which together contribute to an overall perception of health changes rather than isolated symptoms [1], [2], [3].

The highest percentages observed in Asia and South America may reflect differences in symptom awareness, health-seeking behavior, environmental exposures, dietary patterns, and cultural perceptions regarding hormonal health. However, because all continents demonstrated prevalence values approaching or exceeding 60%, the findings suggest that endocrine transitions are universally recognized by women as multidimensional experiences rather than events restricted to reproductive function alone. Previous international studies have similarly emphasized that hormonal changes influence physical, psychological, metabolic, and dermatologic health simultaneously, particularly during perimenopause and menopause [2], [4], [17].

An important aspect of these findings is the recognition that subjective perception represents a valuable component of clinical evaluation. While laboratory biomarkers and objective clinical measurements provide essential diagnostic information, patients' perceptions frequently reflect the cumulative burden of multiple physiological alterations affecting daily activities, social participation, emotional health, work performance, and overall quality of life. International organizations, including the World Health Organization, the International Federation of Gynecology and Obstetrics, and the American College of Obstetricians and Gynecologists, increasingly recommend incorporating

patient-reported outcomes into comprehensive women's healthcare because these measures complement objective clinical findings and improve patient-centered decision-making [5]–[7].

The high prevalence of perceived integral impact also supports the concept that hormonal changes extend beyond isolated endocrine events. Declining estrogen levels, alterations in progesterone and androgen balance, and age-related endocrine adaptations have been associated with changes in collagen synthesis, skin hydration, body fat distribution, insulin sensitivity, inflammatory regulation, vascular function, and neuropsychological well-being [1], [3], [14]. Consequently, women often experience these biological processes as interconnected manifestations that collectively influence their health status.

From a public health perspective, these observations emphasize the importance of adopting comprehensive healthcare models that integrate endocrinology, gynecology, dermatology, nutrition, psychology, and primary care. The consistent perception of multisystem effects across all continents indicates that preventive strategies should address hormonal health using interdisciplinary approaches capable of simultaneously managing metabolic risk, dermatologic manifestations, and quality-of-life concerns. Such strategies may facilitate earlier intervention, improve patient education, and contribute to healthier aging among women worldwide.

DISCUSSION

The present study provides an international overview of the interactions among hormonal, dermatologic, and metabolic changes throughout the female lifespan, reinforcing the concept that women's health extends well beyond reproductive function. The findings demonstrated a high prevalence of dermatologic manifestations, a progressive increase in metabolic alterations with advancing life stages, frequent coexistence of hormonal, dermatologic, and metabolic symptoms, and a consistently high perceived impact of hormonal changes across all continents. Collectively, these observations support current evidence indicating that endocrine transitions influence multiple physiological systems simultaneously and should be addressed through comprehensive healthcare approaches rather than isolated clinical perspectives [1]–[7].

One of the principal strengths of this investigation is its broad international representation, including participants from Asia, Europe, North America, South America, Africa, and Oceania. The geographical diversity of the sample allowed the identification of common biological patterns despite regional variability, suggesting that hormonal regulation exerts universal effects on skin physiology, metabolic homeostasis, and overall health. Although differences in genetics, environmental exposures, dietary habits, healthcare accessibility, and socioeconomic conditions may influence the prevalence of individual manifestations, the overall consistency observed across continents reinforces the biological interdependence of endocrine, dermatologic, and metabolic processes [2], [3], [17].

The progressive increase in metabolic alterations from puberty to menopause is consistent with previous investigations describing the cumulative effects of ovarian aging and declining estrogen concentrations on body composition, insulin sensitivity, lipid metabolism, chronic inflammation, and cardiovascular risk [1], [3], [17]. These findings highlight the importance of considering metabolic health as a lifelong process rather than a condition limited to postmenopausal women. Early preventive interventions focusing on healthy lifestyles, nutritional counseling, physical activity, and regular clinical assessment may reduce the long-term burden of chronic diseases associated with endocrine aging.

Similarly, the high prevalence of dermatologic manifestations observed in every continent confirms that the skin represents one of the most responsive organs to hormonal fluctuations. Alterations in collagen synthesis, skin hydration, pigmentation, sebaceous gland activity, elasticity, and hair growth have been consistently associated with endocrine changes occurring during puberty, reproductive life, pregnancy, postpartum, perimenopause, and menopause [3], [14], [15]. Consequently, dermatologic findings should be recognized as clinically meaningful indicators that may facilitate the early identification of underlying hormonal and metabolic disturbances.

An additional contribution of this study is the evaluation of participants' perceptions regarding the overall impact of hormonal changes. More than half of the women from every continent reported that endocrine transitions simultaneously affected their skin, metabolism, and general well-being. These findings emphasize the importance of patient-reported outcomes in women's healthcare and support current recommendations advocating patient-centered

clinical practice. Perceived health status complements objective clinical indicators and contributes to a more comprehensive understanding of women's experiences during different hormonal transitions [5]–[7].

The methodology adopted in this investigation also represents an important strength. Data were obtained through **anonymous, voluntary, and standardized online questionnaires**, allowing participants to provide information confidentially and without personal identification. The use of anonymous electronic forms reduced the likelihood of social desirability bias and encouraged honest responses regarding hormonal symptoms, dermatologic manifestations, metabolic changes, and perceived health status. Furthermore, the standardized questionnaire ensured that all participants answered the same set of questions using identical response formats, thereby improving data consistency and facilitating comparisons across different geographical regions.

Because no personally identifiable information was collected, participant confidentiality and privacy were preserved throughout the research process. The anonymous nature of the survey also minimized interviewer influence and enabled efficient participation from women residing in different continents under comparable conditions. These characteristics contribute to the methodological robustness of the study and increase the reliability of the descriptive findings.

Nevertheless, several limitations should be acknowledged. The cross-sectional design does not permit the establishment of causal relationships between hormonal changes and the observed dermatologic or metabolic manifestations. Additionally, the questionnaire-based methodology relies on participants' self-reported information, which may be influenced by recall bias or individual symptom perception. Although the large international sample strengthens external validity, future longitudinal studies incorporating clinical examinations, laboratory biomarkers, hormonal measurements, and objective dermatologic and metabolic assessments would provide additional evidence regarding the temporal evolution of these interactions.

Future investigations should also explore regional differences in greater depth, considering factors such as ethnicity, socioeconomic status, dietary patterns, physical activity, environmental exposures, and access to healthcare services. Integrating biological, clinical, behavioral, and psychosocial variables may further improve the understanding of women's health across the lifespan and facilitate the development of personalized preventive strategies.

CONCLUSION

The present study demonstrates that women's health should be understood through a comprehensive life-course perspective rather than being limited exclusively to reproductive function. The findings revealed that hormonal changes are closely associated with dermatologic and metabolic manifestations throughout the different stages of the female lifespan, emphasizing the systemic nature of endocrine regulation and its influence on overall health and well-being.

The international analysis showed that dermatologic alterations were highly prevalent across all continents, while metabolic alterations progressively increased from puberty to menopause. Furthermore, the frequent coexistence of hormonal, dermatologic, and metabolic manifestations supports the concept that endocrine transitions affect multiple physiological systems simultaneously. The consistently high perception of the overall impact of hormonal changes among participants reinforces the importance of considering patient experiences alongside clinical assessment when evaluating women's health.

The broad geographical representation of participants strengthens the external relevance of the findings and suggests that these biological interactions are common across diverse populations despite regional differences in environmental, socioeconomic, and cultural characteristics. These observations support current international recommendations advocating multidisciplinary approaches involving gynecology, endocrinology, dermatology, nutrition, primary healthcare, and public health in order to promote preventive care throughout the female lifespan.

An additional strength of the study lies in the use of anonymous and standardized electronic questionnaires, which facilitated confidential participation from women across multiple continents while ensuring methodological

consistency during data collection. This approach enabled the acquisition of comparable information regarding hormonal, dermatologic, and metabolic health within a large international population.

Although the cross-sectional design does not permit causal inference and the results are based on self-reported information, the study provides valuable evidence regarding the global distribution and coexistence of these health-related manifestations. Future longitudinal investigations incorporating clinical examinations, biochemical markers, hormonal profiles, and objective dermatologic and metabolic assessments are warranted to further clarify the temporal relationships among these variables and identify potential predictive factors.

In conclusion, the evidence generated by this investigation supports the growing recognition that women's health extends beyond reproduction and should be approached as an integrated interaction among endocrine, dermatologic, metabolic, and psychosocial processes. Strengthening multidisciplinary preventive strategies, promoting early identification of hormonal-related changes, and encouraging comprehensive healthcare throughout the female lifespan may contribute to improving women's quality of life, reducing the burden of chronic diseases, and supporting healthy aging at the global level.

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