

Dermatological alterations induced by gynecological hormonal imbalances: Acne, hirsutism and alopecia

Diana Patricia Vargas Viquez ¹, María José Solís Marín ², Manuel Alejandro Ramírez Solano ³, Karina Sandoval González ⁴, Karina de Los Ángeles Montero Salazar ⁵ and Daniela Consumi Cordero ^{5,*}

¹ Forensic Medicine Resident Physician / Fellow, at Poder Judicial, Heredia, Costa Rica.

² Medical Doctor at Tony Facio Castro Hospital, Limón, Costa Rica.

³ Medical Doctor, at Caja Costarricense de Seguro Social, Cartago, Costa Rica.

⁴ Medical Doctor, at Monseñor Sanabria Marttínez Hospital, Puntarenas, Costa Rica.

⁵ Medical Doctor, Independent Researcher, San José, Costa Rica.

World Journal of Biology Pharmacy and Health Sciences, 2025, 24(01), 408-416

Publication history: Received on 20 September 2025; revised on 26 October 2025; accepted on 29 October 2025

Article DOI: <https://doi.org/10.30574/wjbphs.2025.24.1.0929>

Abstract

Sex hormones play a fundamental role in regulating skin physiology, influencing collagen synthesis, wound healing, immune modulation, and barrier function. Estrogens and progesterone, through their respective receptors, modulate gene expression in cutaneous structures. Hormonal fluctuations throughout the female lifespan such as those occurring during puberty, pregnancy, and menopause affect dermatological conditions including psoriasis, xerosis, and age-related thinning. Disorders characterized by androgen excess, particularly polycystic ovary syndrome, are strongly associated with acne, excessive terminal hair growth, and hormonally mediated hair loss. In these cases, elevated androgen levels and insulin resistance act synergistically to worsen clinical manifestations. Other endocrine disorders, such as non-classic congenital adrenal hyperplasia and estrogen deficiency during menopause, also contribute to cutaneous alterations.

Hormonal acne, often concentrated in the lower facial region, is linked to elevated androgens and requires targeted therapies such as combined hormonal contraceptives, antiandrogenic medications like spironolactone, or isotretinoin in resistant cases. Excessive terminal hair growth is evaluated using standardized scoring systems and treated with hormonal therapies and cosmetic procedures. Hormonal hair loss includes female pattern hair thinning and telogen effluvium, the latter often triggered by estrogen withdrawal or thyroid dysfunction. Diagnosis includes trichoscopy and comprehensive hormonal profiling.

Key hormonal tests such as total and free testosterone, dehydroepiandrosterone sulfate, seventeen-hydroxyprogesterone, thyroid-stimulating hormone, prolactin, and the luteinizing hormone to follicle-stimulating hormone ratio aid in identifying endocrine dysfunction. A multidisciplinary approach that integrates dermatological, gynecological, and endocrine care is essential. Given the significant psychological burden of these conditions, holistic strategies that incorporate mental health support are necessary to improve both physical and emotional outcomes.

Keywords: Hormonal Imbalance; Acne; Hirsutism; Female Hair Loss; Polycystic Ovary Syndrome; Psychosocial Impact

* Corresponding author: Daniela Consumi Cordero

1. Introduction

Hirsutism, acne, and alopecia are common dermatological manifestations observed in women with polycystic ovary syndrome (PCOS), carrying a substantial physical, emotional, and social burden. Among these, hirsutism has the highest prevalence, affecting up to 77.9% of women who present with aesthetic concerns related to PCOS. Acne and alopecia are also highly prevalent, with rates of 66.2% and 43.9%, respectively, among women diagnosed with this syndrome (1). Beyond the physical impact, these conditions often exert a profound psychological toll. Women with PCOS, especially those aged 20 to 29 years, have been shown to exhibit a higher incidence of psychiatric disorders, underscoring the importance of addressing mental health alongside physical symptoms (2).

The underlying mechanism that drives these dermatological alterations is hyperandrogenism, which is characterized by elevated circulating androgen levels. This hormonal imbalance is commonly associated not only with PCOS but also with idiopathic hirsutism and other hyperandrogenic syndromes. In the context of PCOS, a reduced concentration of sex hormone-binding globulin (SHBG) and an increased free androgen index (FAI) contribute significantly to the clinical presentation. These hormonal abnormalities enhance androgenic activity at the level of the skin, influencing sebaceous gland function and hair follicle dynamics, which in turn lead to conditions such as severe acne, excessive hair growth, and androgenic-pattern hair loss (3).

Clinically, hirsutism manifests as excessive terminal hair growth in androgen-dependent areas such as the face, chest, and back, and is strongly associated with PCOS and other conditions characterized by hyperandrogenism (3). Acne is another frequent cutaneous manifestation in PCOS and often necessitates systemic treatments such as isotretinoin for effective management. In addition to its Sebo suppressive and anti-inflammatory effects, isotretinoin has demonstrated efficacy in lowering androgen levels in women with PCOS, contributing to a broader improvement in cutaneous symptoms (4). Although less prevalent, alopecia remains a significant concern for many women with PCOS due to its negative impact on body image and overall quality of life (1).

This review aims to examine the dermatological manifestations that arise from gynecological hormonal imbalances, with a particular focus on acne, hirsutism, and alopecia. It seeks to explore the underlying hormonal mechanisms such as hyperandrogenism and alterations in SHBG that contribute to these conditions, especially in the context of PCOS.

2. Methodology

For the development of this review on dermatological alterations induced by gynecological hormonal imbalances specifically acne, hirsutism, and alopecia—a comprehensive literature search was conducted with the aim of analyzing the pathophysiological mechanisms, clinical manifestations, hormonal underpinnings, and therapeutic approaches related to these conditions. Special emphasis was placed on their association with hyperandrogenic syndromes, particularly PCOS, and on their psychological and quality-of-life implications for affected women.

The review was based on the consultation of well-established scientific databases, including PubMed, Scopus, and Web of Science, selected for their relevance in dermatology, gynecology, endocrinology, and women's health. Rigorous inclusion and exclusion criteria were applied to ensure the scientific validity and clinical relevance of the data. Only peer-reviewed articles published between 2020 and 2025, in English or Spanish, were included. Eligible studies addressed one or more of the following aspects: the hormonal basis of dermatological alterations in women, clinical prevalence in disorders such as PCOS, the psychosocial impact of these conditions, and current or emerging therapeutic strategies. Articles lacking full text, duplicated publications, or those not meeting methodological quality standards were excluded. Keywords used for the search included: Hormonal imbalance, Acne, Hirsutism, Female hair loss, Polycystic ovary syndrome, Psychosocial impact.

An initial screening yielded 33 relevant sources, comprising original research articles, systematic reviews, clinical trials, and consensus guidelines from professional societies in dermatology and gynecology. From these, a qualitative and thematic analysis was conducted to identify recurrent clinical patterns, hormonal correlations, treatment outcomes, and psychosocial considerations. This analytical framework allowed the construction of a comprehensive and integrated synthesis of current knowledge on the topic, highlighting key challenges in diagnosis and management, as well as areas in need of further research.

3. Female Hormonal Physiology and Cutaneous Regulation

Sex hormones play a fundamental role in the maintenance of skin health, influencing not only its structural integrity but also its regenerative capacity and immune responses. Among these, estrogens are particularly critical. They contribute significantly to collagen synthesis, wound healing, and the maintenance of the skin's barrier function. These hormones undergo natural fluctuations throughout different stages of a woman's life such as puberty, pregnancy, and menopause which in turn affect the clinical course of dermatological conditions including psoriasis, xerosis, and age-related skin thinning (6; 7).

Progesterone also participates in cutaneous homeostasis, particularly in the regulation of skin differentiation and the integrity of the barrier function. Its effects are mediated by the expression of specific progesterone receptors in cutaneous structures. Studies have suggested a correlation between the expression of these receptors and the development of certain skin conditions, such as neurofibromas (8; 9).

The influence of these hormones on the skin is mediated through a variety of receptors located within different cutaneous cell types. Estrogen receptors (ERs) are widely distributed throughout the skin and modulate gene expression patterns associated with tissue repair, inflammation control, and aging processes (7; 9). In addition to classical estrogen receptors, the G protein-coupled estrogen receptor 1 (GPER-1) has emerged as a key mediator in noncanonical estrogen signaling pathways, contributing to diverse aspects of skin physiology including vascular regulation and cellular proliferation. Likewise, progesterone receptors (PRs) are present in various dermal and epidermal structures, and their density and activation appear to be linked to specific cutaneous pathologies (9).

Hormonal interaction further modulates the expression of differentiation markers and enzymes critical for maintaining skin barrier integrity. For instance, the estrogen-to-progesterone ratio has been shown to influence the gene expression of loricrin and transglutaminase proteins essential for epidermal maturation and cohesive barrier formation (8). Estrogen signaling is vital for efficient wound healing and tissue repair, especially in estrogen-deficient states such as menopause (7; 10).

Although the focus of current research has largely centered on the beneficial roles of sex hormones in skin physiology, it is crucial to acknowledge the heterogeneity of individual hormonal responses. Hormonal fluctuations can have variable effects, either alleviating or exacerbating conditions such as psoriasis, depending on the patient's hormonal profile and immunogenetic background (6). This variability highlights the need for personalized treatment approaches that consider hormonal status, age, and comorbidities. Moreover, while hormone-based therapies offer promising outcomes in improving skin health particularly in aging or estrogen-deficient individuals their long-term safety and efficacy remain areas requiring further investigation (7; 10).

4. Gynecological Disorders with Dermatological Manifestations

PCOS is the most prevalent endocrine disorder among women of reproductive age and is strongly associated with multiple dermatological manifestations. One of its hallmark features is hyperandrogenism, which plays a central role in the development of clinical signs such as hirsutism and acne. Oral contraceptive pills (OCPs) and insulin-sensitizing agents like metformin are among the most frequently prescribed treatments. Notably, OCPs have demonstrated greater efficacy in reducing hirsutism in specific body mass index (BMI) subgroups, suggesting that treatment response may be influenced by metabolic factors (11; 12).

In addition to elevated androgen levels, insulin resistance is a key pathophysiological mechanism in PCOS. It contributes to the exacerbation of hyperandrogenism by increasing ovarian androgen production and reducing hepatic synthesis of SHBG, thereby elevating free testosterone levels. Metformin, widely used to improve insulin sensitivity, has shown effectiveness in reducing dermatological symptoms; however, its efficacy compared to OCPs appears to vary based on individual metabolic profiles and the specific clinical manifestation targeted (13; 14).

Another condition that shares overlapping dermatological features with PCOS is non-classic congenital adrenal hyperplasia (NCAH). Although less common, NCAH is also characterized by hyperandrogenism and presents with similar cutaneous symptoms, particularly hirsutism. The pathogenesis in NCAH stems from partial enzymatic deficiencies in adrenal steroidogenesis, resulting in excess adrenal androgens that contribute to the dermatologic phenotype (3).

Beyond reproductive-age disorders, menopause and perimenopause represent another spectrum of hormonal imbalance with distinct dermatological implications. The marked decline in estrogen levels during these stages leads to increased skin dryness, reduced elasticity, and progressive hair thinning. In this context, hormone replacement therapy (HRT) is often employed to alleviate symptoms and improve skin and hair quality. Nevertheless, the use of HRT is not without controversy, as potential cardiovascular and oncologic risks must be carefully weighed against its dermatologic benefits (14).

In addition to these major hormonal transitions, other endocrine disorders such as hyperprolactinemia and hypothyroidism can also produce significant dermatological changes. These may include diffuse hair loss, dry or coarse skin, and alterations in pigmentation or texture. Such conditions require targeted hormonal treatments to achieve clinical resolution, underscoring the importance of comprehensive endocrine evaluation in patients presenting with unexplained dermatologic symptoms (14).

5. Hormonal Acne

Hormonal acne is a dermatological condition primarily driven by increased sebum production and follicular hyperkeratinization, both of which are often exacerbated by hormonal fluctuations. These hormonal shifts can be cyclical, related to the menstrual cycle, or chronic, as seen in conditions such as PCOS. Clinically, hormonal acne tends to manifest predominantly in the mandibular and lower facial regions and is especially common among adult women (4).

A strong association exists between hormonal acne and PCOS—a condition marked by hyperandrogenism, chronic anovulation, and irregular menstrual cycles. Women with PCOS often experience more severe and persistent forms of acne due to elevated levels of circulating androgens, which stimulate sebaceous gland activity and promote inflammation (4).

The diagnostic evaluation of hormonal acne involves a thorough clinical assessment supported by hormonal profiling. Measurement of serum androgens, such as total and free testosterone, along with anti-Müllerian hormone (AMH), can aid in identifying underlying disorders such as PCOS or non-classic congenital adrenal hyperplasia. The inclusion of hormonal markers is essential not only for differential diagnosis but also for guiding therapeutic decisions, distinguishing hormonally driven acne from other variants that may not respond to endocrine-based therapies (15).

Several therapeutic strategies have proven effective in the management of hormonal acne. Hormonal therapies, particularly OCPs, remain a mainstay in treatment, as they help reduce androgen production and regulate hormonal fluctuations. Additionally, antiandrogens such as spironolactone have shown significant efficacy in reducing sebum production and improving acne lesions, particularly in adult women (16; 17). Spironolactone has been demonstrated to outperform doxycycline in randomized clinical trials evaluating adult female acne, further supporting its role as a first-line agent in hormonally mediated cases (18).

For more severe or recalcitrant cases, isotretinoin remains an effective option. Its use in hyperandrogenic women, including those with PCOS, has shown substantial clinical benefit. However, its potential effects on ovarian function and the hormonal axis necessitate careful patient selection and close monitoring during treatment (4; 15).

6. Hirsutism

Hirsutism is defined as the presence of excessive terminal hair growth in women, following a male-pattern distribution, and is one of the most visible and distressing dermatologic manifestations of androgen excess. Clinical assessment is most performed using the Ferriman–Gallwey score, a semi-quantitative tool that evaluates hair growth across 11 body areas including the upper lip, chin, chest, abdomen, and thighs (19). This scoring system provides a standardized means to quantify the severity of hirsutism, enabling both diagnostic precision and therapeutic monitoring. Threshold values vary across populations, but a score above 8 is generally indicative of clinically significant hirsutism (20).

The pathophysiology of hirsutism is primarily driven by androgenic stimulation of terminal hair follicles. Androgens—particularly testosterone and its more potent metabolite, dihydrotestosterone—induce the transformation of vellus hairs into thicker, pigmented terminal hairs in androgen-sensitive areas. In the context of PCOS, hyperandrogenism is a cardinal feature and plays a pivotal role in the development of hirsutism alongside other symptoms such as acne, menstrual irregularities, and ovarian dysfunction (21).

Among the etiologies of hirsutism, PCOS remains the most prevalent, affecting approximately 6% to 20% of women of reproductive age worldwide (21). However, other important causes must also be considered in the differential diagnosis, including non-classic congenital adrenal hyperplasia, androgen-secreting tumors, and drug-induced hyperandrogenism particularly from medications such as danazol, anabolic steroids, or certain progestins (20).

The diagnostic workup for hirsutism involves a combination of clinical evaluation and biochemical testing. Measurement of total and free testosterone, SHBG, and calculation of the free androgen index (FAI) are central to identifying androgen excess. In patients suspected of having PCOS, pelvic ultrasound may be performed to evaluate ovarian morphology, although diagnosis does not require ultrasound findings if clinical and biochemical criteria are met (19).

Treatment strategies for hirsutism focus on both reducing androgen levels and managing hair growth. First-line pharmacologic therapies include OCPs particularly those containing antiandrogenic progestins and antiandrogens such as spironolactone, cyproterone acetate, or finasteride. These agents act by either suppressing ovarian androgen production or blocking androgen receptors at the hair follicle level. In addition, non-pharmacological interventions, including laser hair removal and electrolysis, offer effective cosmetic improvement, especially when combined with medical therapy. Lifestyle modifications, particularly weight loss and insulin-sensitizing strategies, may also be beneficial in women with obesity-related PCOS, as insulin resistance contributes to hyperandrogenism (19).

7. Hormonal Alopecia

Hormonal alopecia in women encompasses a spectrum of hair loss disorders that are closely linked to fluctuations or imbalances in endocrine function. Among the most common forms is female pattern hair loss (FPHL), also referred to as androgenetic alopecia (AGA), which is characterized by diffuse thinning over the crown and vertex of the scalp. This condition results from follicular miniaturization, a process driven by increased sensitivity of hair follicles to circulating androgens in genetically predisposed individuals (22).

In contrast, telogen effluvium is a non-scarring, diffuse shedding of hair triggered by a sudden shift in the hair growth cycle, often as a response to physiological stress or hormonal changes. Common hormonal triggers include the postpartum period, menopause, discontinuation of oral contraceptives, or underlying thyroid disorders. Unlike FPHL, telogen effluvium does not involve follicular miniaturization and is usually reversible once the underlying cause is addressed (23).

Hormonal regulation plays a central role in the pathogenesis of both conditions. Androgens, particularly dihydrotestosterone (DHT), bind to androgen receptors in the dermal papilla, shortening the anagen (growth) phase of the hair cycle and promoting follicular miniaturization, which ultimately leads to progressive thinning in AGA (22). In contrast, estrogens are thought to exert protective effects on the hair cycle by prolonging the anagen phase. Estrogen deficiency or abrupt hormonal withdrawal can thus precipitate a shift toward telogen, contributing to hair shedding observed in telogen effluvium (23).

Diagnostic evaluation of hormonal alopecia involves both clinical examination and complementary tools. Trichoscopy, a non-invasive dermoscopic technique, allows for detailed visualization of hair shafts, follicular openings, and scalp conditions. It is useful in differentiating FPHL from other causes of alopecia by revealing features such as hair shaft variability, peripolar signs, and reduced follicular density. In addition, hormonal assays are crucial for identifying underlying endocrine abnormalities. Serum levels of androgens, including total and free testosterone, DHEA-S, and SHBG, as well as thyroid function tests, may be warranted depending on the clinical presentation (24).

Management strategies for hormonal alopecia are multifaceted and tailored to the specific type and underlying etiology. Minoxidil, available in both topical and oral formulations, remains the first-line treatment for FPHL. It acts by prolonging the anagen phase and enlarging miniaturized follicles, thereby promoting hair regrowth (24; 25). In patients with evidence of androgen excess, antiandrogen therapy is particularly beneficial. Spironolactone, a potassium-sparing diuretic with antiandrogenic properties, has shown efficacy in reducing hair loss by blocking androgen receptors and inhibiting androgen production, especially in women with concurrent signs of hyperandrogenism (26).

Hormonal therapy may also be indicated in cases where hair loss is driven by underlying endocrine disorders, such as PCOS or menopause-related estrogen deficiency. In these situations, combined oral contraceptives or hormone replacement therapy can help restore hormonal balance and support hair regrowth. Additionally, nutritional support, including supplementation with iron, vitamin D, biotin, and other micronutrients, may contribute to overall hair health, although the evidence supporting their efficacy remains mixed (24).

8. Multidisciplinary Diagnostic Approach

A comprehensive hormonal evaluation is essential in patients presenting with dermatological manifestations suggestive of underlying endocrine disorders. Several key laboratory tests aid in identifying hormonal imbalances, guiding both diagnosis and treatment strategies. Among these, total and free testosterone levels are fundamental markers for assessing hyperandrogenism, a hallmark of PCOS. Elevated testosterone contributes significantly to the development of acne, hirsutism, and androgenic alopecia in women with PCOS (3; 21).

In addition to ovarian androgens, DHEA-S serves as a marker of adrenal androgen production. Elevated DHEA-S levels are frequently observed in women with PCOS and may further exacerbate the clinical expression of hyperandrogenism. To differentiate PCOS from other causes of androgen excess, particularly NCAH, measurement of 17-hydroxyprogesterone (17-OHP) is recommended. Increased 17-OHP suggests a partial enzymatic defect in adrenal steroidogenesis, which can clinically overlap with PCOS (3).

Beyond androgen markers, thyroid function testing is critical in the differential diagnosis of hormonal dermatoses. Thyroid-stimulating hormone (TSH) levels help identify underlying hypothyroidism or hyperthyroidism, both of which can manifest with symptoms such as hair thinning, dry skin, or menstrual irregularities. Similarly, serum prolactin should be evaluated to rule out pituitary abnormalities, which may contribute to amenorrhea, galactorrhea, and secondary skin changes (27).

Another important hormonal parameter in the evaluation of PCOS is the luteinizing hormone (LH) to follicle-stimulating hormone (FSH) ratio. An elevated LH/FSH ratio is characteristic of PCOS and reflects dysregulation of the hypothalamic-pituitary-ovarian axis, leading to anovulation and sustained androgen production (27).

Effective diagnosis and management of hormonally driven dermatological disorders require multidisciplinary collaboration among healthcare professionals. Dermatologists play a central role in evaluating cutaneous symptoms, initiating symptomatic treatments, and recognizing patterns suggestive of systemic hormonal dysfunction. Endocrinologists are responsible for the comprehensive assessment and regulation of hormonal imbalances, particularly in conditions such as PCOS, NCAH, and thyroid or pituitary disorders. Meanwhile, gynecologists address menstrual irregularities, fertility concerns, and reproductive planning, providing holistic care for women affected by hyperandrogenic syndromes (19; 28).

9. Psychosocial Impact and Quality of Life

Hormonal dermatological conditions such as acne, hirsutism, and hair loss are not solely physical ailments; they also impose a substantial psychological and emotional burden on affected individuals. Among these, acne has been extensively studied for its psychosocial impact, which includes high rates of depression, anxiety, and stress, all of which contribute to diminished self-esteem and overall quality of life (29; 30).

Interestingly, evidence indicates that female patients, despite often presenting with less clinically severe acne, report higher levels of psychological distress compared to males. This includes increased anxiety, heightened concern over appearance, and greater perceived stigmatization (31). A large-scale European study further underscored this burden, reporting that 40.6% of acne patients expressed significant concern about their skin condition, with some individuals even experiencing suicidal ideation (30).

Given the interconnected nature of physical and mental health in hormonal skin disorders, there is a growing consensus on the need for a multidisciplinary and empathetic approach. Clinicians are increasingly encouraged to incorporate psychological screening and support into their management strategies. Mental health assessments alongside dermatological evaluations can facilitate early identification of psychological distress, allowing for timely intervention and improved long-term outcomes (32; 33).

10. Conclusion

Hormonal regulation plays a central role in female dermatological health, with imbalances—particularly involving androgens, estrogens, and progesterone—contributing to the development of acne, excessive terminal hair growth, and hormone-related hair loss. Understanding the cutaneous effects of sex hormones is essential for accurate diagnosis and effective management.

Polycystic ovary syndrome, menopause, and other endocrine disorders are frequently associated with dermatological manifestations that require an integrated, multidisciplinary approach. Hormonal profiling including testosterone, dehydroepiandrosterone sulfate, thyroid-stimulating hormone, and prolactin is crucial for guiding personalized therapy.

Beyond physical symptoms, hormonal skin disorders have a substantial psychosocial impact, particularly in women. Incorporating mental health evaluation and supportive interventions into routine dermatologic care is key to improving patients' overall quality of life and treatment adherence.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

- [1] Estermann J, Bitterlich N, Weidlinger S, Bachmann A, Sourouni M, Stute P. Unmet Clinical Needs in Women with Aesthetic Manifestations of Polycystic Ovary Syndrome: A Cross-Sectional Study. *Journal Of Women S Health* [Internet]. 5 de septiembre de 2023;32(11):1241-8. Disponible en: <https://doi.org/10.1089/jwh.2022.0497>
- [2] Wang T, Chou C, Lee Y, Chung C, Huang Y, Lai X, et al. Clinical Characteristics of Hyperandrogenism Include Hirsutism, Polycystic Ovary Syndrome, and Acne: Association with Psychiatric Disease in Women -A Nationwide Population-Based Cohort Study in Taiwan. *International Journal Of Women S Health* [Internet]. 1 de agosto de 2022;Volume 14:1173-89. Disponible en: <https://doi.org/10.2147/ijwh.s376244>
- [3] Pinto J, Cera N, Camerino C, Beires J, Pignatelli D. Androgens and Hirsutism in a Large Cohort of Portuguese Women. *Journal Of Clinical Medicine* [Internet]. 21 de enero de 2025;14(3):673. Disponible en: <https://doi.org/10.3390/jcm14030673>
- [4] Elnagar HI, Hashem OA, Aboelwafa HO, Elhelw E, Elsaie ML. The impact of oral isotretinoin on ovarian functions of acne patients complaining of polycystic ovarian syndrome: a prospective study. *Journal Of Ovarian Research* [Internet]. 20 de enero de 2024;17(1). Disponible en: <https://doi.org/10.1186/s13048-024-01347-x>
- [5] Tan K, Coster T, Mousa A, Mar A, Piltonen T, Boyle JA, et al. Laser and Light-Based Therapies for Hirsutism Management in Women With Polycystic Ovarian Syndrome. *JAMA Dermatology* [Internet]. 17 de abril de 2024;160(7):746. Disponible en: <https://doi.org/10.1001/jamadermatol.2024.0623>
- [6] Cassalia F, Lunardon A, Frattin G, Danese A, Caroppo F, Fortina AB. How Hormonal Balance Changes Lives in Women with Psoriasis. *Journal Of Clinical Medicine* [Internet]. 17 de enero de 2025;14(2):582. Disponible en: <https://doi.org/10.3390/jcm14020582>
- [7] Lephart ED, Naftolin F. Menopause and the Skin: Old Favorites and New Innovations in Cosmeceuticals for Estrogen-Deficient Skin. *Dermatology And Therapy* [Internet]. 26 de noviembre de 2020;11(1):53-69. Disponible en: <https://doi.org/10.1007/s13555-020-00468-7>
- [8] Murakami K, Sawada A, Mori T, Sakuyama S, Tokudome Y. Effect of estrogen/progesterone ratio on the differentiation and the barrier function of epidermal keratinocyte and three-dimensional cultured human epidermis. *Life Sciences* [Internet]. 23 de enero de 2022;293:120356. Disponible en: <https://doi.org/10.1016/j.lfs.2022.120356>
- [9] Rozza R, Almeida L, Andrade R, De Souza Vieira G, Siqueira O, Brum C, et al. A Clinicopathologic Study on the Role of Estrogen, Progesterone, and Their Classical and Nonclassical Receptors in Cutaneous Neurofibromas of Individuals With Neurofibromatosis 1. *American Journal Of Clinical Pathology* [Internet]. 28 de agosto de 2020;155(5):738-47. Disponible en: <https://doi.org/10.1093/ajcp/aqaa186>
- [10] Zomer H, Cooke P. Targeting estrogen signaling and biosynthesis for aged skin repair. *Frontiers In Physiology* [Internet]. 31 de octubre de 2023;14. Disponible en: <https://doi.org/10.3389/fphys.2023.1281071>
- [11] Fraison E, Kostova E, Moran LJ, Bilal S, Ee CC, Venetis C, et al. Metformin versus the combined oral contraceptive pill for hirsutism, acne, and menstrual pattern in polycystic ovary syndrome. *Cochrane Library* [Internet]. 13 de agosto de 2020;2020(8). Disponible en: <https://doi.org/10.1002/14651858.cd005552.pub3>

- [12] Planey T, Grosel J. Polycystic ovary syndrome. JAAPA [Internet]. 16 de octubre de 2024;37(11):23-30. Disponible en: <https://doi.org/10.1097/01.jaa.0000000000000141>
- [13] Chang K, Chen J, Chen K. The Pathophysiological Mechanism and Clinical Treatment of Polycystic Ovary Syndrome: A Molecular and Cellular Review of the Literature. International Journal Of Molecular Sciences [Internet]. 20 de agosto de 2024;25(16):9037. Disponible en: <https://doi.org/10.3390/ijms25169037>
- [14] Armanini D, Boscaro M, Bordin L, Sabbadin C. Controversies in the Pathogenesis, Diagnosis and Treatment of PCOS: Focus on Insulin Resistance, Inflammation, and Hyperandrogenism. International Journal Of Molecular Sciences [Internet]. 8 de abril de 2022;23(8):4110. Disponible en: <https://doi.org/10.3390/ijms23084110>
- [15] Haroun A, Ibrahim M, Soliman A, Abdel-Ghaffar A, Shams G. Systemic isotretinoin for acne treatment: Ovarian reserve is safe with the low dose. Dermatologic Therapy [Internet]. 10 de septiembre de 2022;35(11). Disponible en: <https://doi.org/10.1111/dth.15811>
- [16] Roberts E, Nowsheen S, Davis M, McEvoy M, Newman C, Valinotti J, et al. Treatment of acne with spironolactone: a retrospective review of 395 adult patients at Mayo Clinic, 2007–2017. Journal Of The European Academy Of Dermatology And Venereology [Internet]. 20 de febrero de 2020;34(9):2106-10. Disponible en: <https://doi.org/10.1111/jdv.16302>
- [17] Renz S, Chinnery F, Stuart B, Day L, Muller I, Soulsby I, et al. Spironolactone for adult female acne (SAFA): protocol for a double-blind, placebo-controlled, phase III randomised study of spironolactone as systemic therapy for acne in adult women. BMJ Open [Internet]. 1 de agosto de 2021;11(8):e053876. Disponible en: <https://doi.org/10.1136/bmjopen-2021-053876>
- [18] Dréno B, Nguyen JM, Hainaut E, Machet L, Leccia MT, Beneton N, et al. Efficacy of Spironolactone Compared with Doxycycline in Moderate Acne in Adult Females: Results of the Multicentre, Controlled, Randomized, Double-blind Prospective and Parallel Female Acne Spironolactone vs doxyCycline Efficacy (FASCE) Study. Acta Dermato Venereologica [Internet]. 21 de febrero de 2024;104:adv26002. Disponible en: <https://doi.org/10.2340/actadv.v104.26002>
- [19] Persson S, Ubhayasekera KA, Bergquist J, Turkmen S, Poromaa IS, Elenis E. Hyperandrogenic Symptoms Are a Persistent Suffering in Midlife Women with PCOS; a Prospective Cohort Study in Sweden. Biomedicines [Internet]. 30 de diciembre de 2022;11(1):96. Disponible en: <https://doi.org/10.3390/biomedicines11010096>
- [20] Teede H, Tay C, Laven J, Dokras A, Moran L, Piltonen T, et al. Recommendations from the 2023 international evidence-based guideline for the assessment and management of polycystic ovary syndrome. European Journal Of Endocrinology [Internet]. 1 de agosto de 2023;189(2):G43-64. Disponible en: <https://doi.org/10.1093/ejendo/lvad096>
- [21] Wang K, Li Y, Chen Y. Androgen excess: a hallmark of polycystic ovary syndrome. Frontiers In Endocrinology [Internet]. 13 de diciembre de 2023;14. Disponible en: <https://doi.org/10.3389/fendo.2023.1273542>
- [22] Ntshingila S, Oputu O, Arowolo AT, Khumalo NP. Androgenetic alopecia: An update. JAAD International [Internet]. 22 de julio de 2023;13:150-8. Disponible en: <https://doi.org/10.1016/j.jdin.2023.07.005>
- [23] Devjani S, Ezemma O, Kelley KJ, Stratton E, Senna M. Androgenetic Alopecia: therapy update. Drugs [Internet]. 11 de mayo de 2023;83(8):701-15. Disponible en: <https://doi.org/10.1007/s40265-023-01880-x>
- [24] Ly N, Fruechte S, Hordinsky MK, Sadick N, Arruda S, Farah RS. Medical and procedural treatment of androgenetic alopecia – Where are we? Journal Of The American Academy Of Dermatology [Internet]. 1 de agosto de 2023;89(2):S36-9. Disponible en: <https://doi.org/10.1016/j.jaad.2023.05.004>
- [25] Vastarella M, Cantelli M, Patrì A, Annunziata MC, Nappa P, Fabbrocini G. Efficacy and safety of oral minoxidil in female androgenetic alopecia. Dermatologic Therapy [Internet]. 2 de septiembre de 2020;33(6). Disponible en: <https://doi.org/10.1111/dth.14234>
- [26] James J, Jamerson T, Aguh C. Efficacy and safety profile of oral spironolactone use for androgenic alopecia: A systematic review. Journal Of The American Academy Of Dermatology [Internet]. 2 de agosto de 2021;86(2):425-9. Disponible en: <https://doi.org/10.1016/j.jaad.2021.07.048>
- [27] Yang J, Chen C. Hormonal changes in PCOS. Journal Of Endocrinology [Internet]. 29 de enero de 2024;261(1). Disponible en: <https://doi.org/10.1530/joe-23-0342>
- [28] Kempegowda P, Melson E, Manolopoulos KN, Arlt W, O'Reilly MW. Implicating androgen excess in propagating metabolic disease in polycystic ovary syndrome. Therapeutic Advances In Endocrinology And Metabolism

[Internet]. 1 de enero de 2020;11:204201882093431. Disponible en: <https://doi.org/10.1177/2042018820934319>

- [29] Morshed A, Noor T, Ahmed MAU, Mili FS, Ikram S, Rahman M, et al. Understanding the impact of acne vulgaris and associated psychological distress on self-esteem and quality of life via regression modeling with CADI, DLQI, and WHOQoL. *Scientific Reports* [Internet]. 30 de noviembre de 2023;13(1). Disponible en: <https://doi.org/10.1038/s41598-023-48182-6>
- [30] Altunay I, Özkur E, Dalgard F, Gieler U, Aragones L, Lien L, et al. Psychosocial Aspects of Adult Acne: Data from 13 European Countries. *Acta Dermato Venereologica* [Internet]. 1 de enero de 2020;0. Disponible en: <https://doi.org/10.2340/00015555-3409>
- [31] Szepietowska M, Stefaniak AA, Krajewski PK, Matusiak L. Females May Have Less Severe Acne, but They Suffer More: A Prospective Cross-Sectional Study on Psychosocial Consequences in 104 Consecutive Polish Acne Patients. *Journal Of Clinical Medicine* [Internet]. 19 de diciembre de 2023;13(1):4. Disponible en: <https://doi.org/10.3390/jcm13010004>
- [32] Hughes O, Bewley A. Is it really ever 'just acne'? Considering the psychodermatology of acne. *British Journal Of Dermatology* [Internet]. 19 de julio de 2023;189(Supplement_1):i11-6. Disponible en: <https://doi.org/10.1093/bjd/ljad251>
- [33] Leskelä M, Jokelainen J, Huilaja L, Sinikumpu SP. Adult Acne in Middle-age: Effects on Mental Health in General Population of the Northern Finland Birth Cohort 1966. *Acta Dermato Venereologica* [Internet]. 25 de enero de 2024;104:adv14733. Disponible en: <https://doi.org/10.2340/actadv.v104.14733>