Review article / Artykuł przeglądowy

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Changes in the appearance of the skin and its appendages in women during menopause

Zmiany w wyglądzie skóry i jej przydatków u kobiet w okresie menopauzy

ABSTRACT

During menopause, women experience various changes in the appearance of their skin and its appendages, such as hair and nails. These alterations are a direct result of a decrease in estrogen and other hormone levels, which significantly affects the functioning of the skin as a protective, sensory, and metabolic organ. Reduced hormonal activity decreases the synthesis of key structural proteins such as collagen and elastin, resulting in a loss of firmness, elasticity, and overall deterioration of the skin's structure.

This study aimed to present the physiological and aesthetic changes occurring in female bodies during menopause, with particular emphasis on their impact on the condition of the skin, hair, and nails.

Although these processes are inevitable and progressive, proper hormonal balance and appropriate skin care can significantly delay skin aging and maintain its healthy appearance.

Keywords: menopause, skin, hair, aging, hormones, skin changes, collagen

STRESZCZENIE

W okresie menopauzy kobiety doświadczają licznych zmian w wyglądzie skóry oraz jej przydatków, takich jak włosy i paznokcie. Wynikają one bezpośrednio ze spadku poziomu estrogenów oraz innych hormonów, co znacząco wpływa na funkcjonowanie skóry jako narządu ochronnego, zmysłowego i metabolicznego. Obniżona aktywność hormonalna prowadzi do zmniejszenia syntezy kluczowych białek strukturalnych: kolagenu i elastyny, co skutkuje utratą jędrności, elastyczności oraz ogólnym pogorszeniem struktury skóry.

Celem pracy było przedstawienie fizjologicznych i estetycznych zmian zachodzących w organizmie kobiet w okresie menopauzy, ze szczególnym uwzględnieniem ich wpływu na stan skóry, włosów i paznokci.

Choć procesy te są nieuniknione i mają charakter postępujący, to prawidłowa równowaga hormonalna oraz odpowiednia pielęgnacja skóry mogą znacząco wpłynąć na opóźnienie starzenia się skóry i utrzymanie jej zdrowego wyglądu.

Słowa kluczowe: menopauza, skóra, włosy, starzenie się, hormony, zmiany skórne, kolagen

INTRODUCTION

Menopause, also known as puberty, is a period when many hormonal changes occur in the body of a mature woman. As a result, ovarian hypothyroidism permanently ceases menstrual cycles, and hormonal changes lead to an accelerated rate of aging of the body. It is a time that often causes concern in many women and is a change that generates a lot of stress [1].

Menopause is a physiological stage in a woman's life, related to the transition from the procreative to the postmenopausal period. This process is due to the natural extinction of ovarian hormonal function, leading to permanent stoppage of menstruation. Menopause is not pathological condition, but a biological phenomenon that does not require causal

treatment. In medical management in the peri-menopausal period, the focus is on alleviating the symptoms accompanying during hormonal changes, improving patients' quality of life and preventing long-term the effects of estrogen deficiency, such as osteoporosis or cardiovascular disease. Although menopause is a natural biological process, its symptoms can significantly affect a woman's quality of life. It is impossible to stop this process and it may occur at different ages. It usually appears between the ages of 45 and 55, however, usually falls on average around 50 years of age. In contrast, disorders associated with menopause may appear even a few years before and after the onset of the last menstruation. In some women who have been diagnosed with a risk of developing ovarian cancer and as a result have had their ovaries removed long before the age of natural menopause, there is a sudden and premature transition to what is known as surgical menopause [2].

Understanding menopause is essential for every cosmetologist as beauty salon clients often seek to expand their knowledge of skin care, skin disease prevention, and skin care during menopause. In addition, the modern cosmetologist should apply all their skills and resources to properly manage many problems that plague women in menopause. Expanding knowledge of the mechanisms of aging in women during menopause and prevention, in the broadest sense, allows to create effective procedures that delay the adverse processes occurring in the female body during this period. Cosmetological treatments should focus on slowing down the mechanisms of the physiological factors associated with aging. The therapy plan for women during menopause should take into account the repair and regeneration of damage at the epidermal level, neutralization of the free radicals and inhibition of cell membrane oxidation, stimulating fibroblasts to produce collagen and elastin and moisturising. Daily care is also very important, after treatments and lifestyle, including circadian rhythm, diet and coping with stress. The most important thing, however, is to accept aging as a natural process [3].

MENOPAUSE - COURSE AND SYMPTOMS

The World Health Organization defines menopause as "the permanent cessation of spontaneous menstruation, caused by the loss of ovarian follicle activity, followed by no further bleeding for 12 months." In medical terminology, it simply means the last normal menstrual bleeding in a woman's life. The process of reproductive aging in women naturally proceeds in three phases: reproductive, transitional and the period after the last menstrual period (fig. 1). Each is characterised by specific hormonal changes [4].

Menopause, perimenopause (the transition period of menopause), and postmenopause (the period after menopause) are stages that usually manifest between the ages of 45 and 54. If menopause begins before the age of 45, it is then said to be early menopause. Late menopause, on the other hand, is defined as that which begins after age 54 (fig. 2). Premature ovarian failure is the loss of normal ovarian function before the age of 40. It affects about 1% of women under 40 and 0.1% of women under 30. It causes irregular periods and pregnancy failure. Premature menopause can also occur due to surgical procedures or can be caused by the treatment of certain medical conditions. Removal of both ovaries leads to a sudden and premature transition into so-called "surgical menopause" long before the age of natural menopause [6-8].

The age at which a woman reaches menopause is important for her health. Menopause at a young age means premature aging and is a factor that increases the risk of cardiovascular disease, stroke and osteoporosis. Research

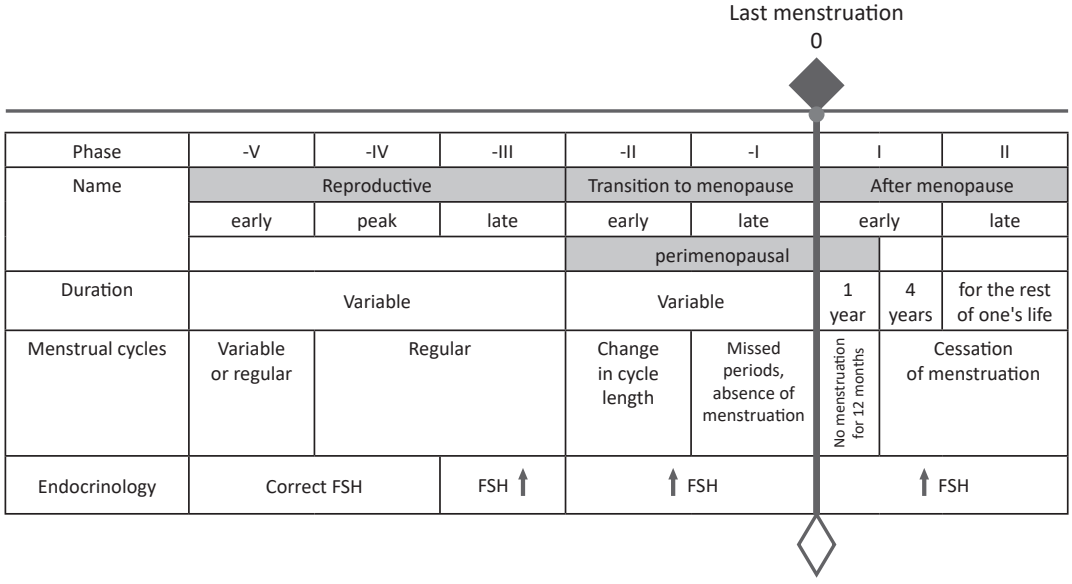

Fig. 1 Phases of reproductive aging **Source:** [5]

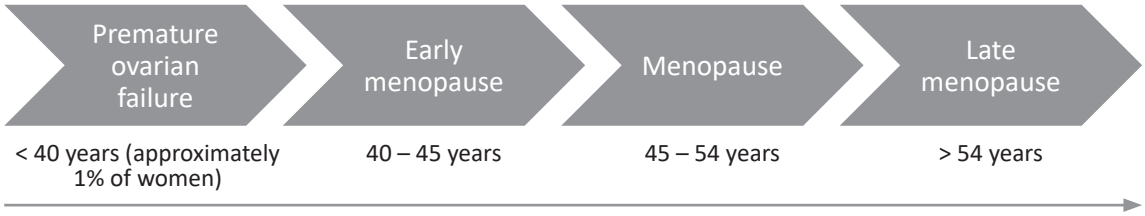

Fig. 2 Age of women during menopause **Source:** [9]

from the University of Colorado in Bulder indicated that women who went through menopause at a later age had healthier blood vessels, which could affect overall health and risk of cardio-metabolic diseases. A woman going through menopause at an older age is at a higher risk of developing breast and uterine cancer. Most menopausal women remain economically and socially active [10].

HORMONE MANAGEMENT DURING MENOPAUSE

Adequate concentrations of the steroid hormones, estrogen and progesterone, during the menstrual cycle affect women's fertility and many aspects of their health. Women experience significant differences in steroid hormone concentrations with age. The lowest levels are observed just after puberty and before menopause, and the highest between the ages of 25 and 35. One of the phenomena that characterizes the aging process of a woman is menopause. It is the result of several changes that have begun in the bodies of women. Hormonal imbalance is an important and a relatively well-known factor of a huge impact on the skin aging process. Special attention was paid to the role of estrogens, as during menopause, levels of estrogen decrease, accelerating the aging process. Estrogens are primarily synthesized from cholesterol in the ovaries of premenopausal women, but also in skin, bones, brain, and adipose tissue, with the involvement of the enzyme aromatase. Estrogens are a group of steroid sex hormones that play a key role in regulating reproductive function as well as maintaining the homeostasis of the female body. There are three main forms of estrogen: estradiol (E2), estrone (E1), and estriol (E3), which differ in chemical structure, biological potency, and physiological dominance [11, 12].

Estradiol

Estradiol (17β-estradiol) is the most biologically active estrogen, prevalent in women of childbearing age. Its main site of synthesis is the granulosa cells of the ovaries, in which it is formed under the influence of folliculotropin (FSH, follicle-stimulating hormone). Estradiol is responsible for the development of secondary sexual characteristics, cyclic changes in the endometrium as well as regulating the menstrual cycle. In addition, it shows a protective effect on the skeletal system, preventing osteoporosis, and supports the functioning of the cardiovascular system through beneficial effects on lipid profile and participates in the regulation of central nervous system functions, affecting mood, memory and thermoregulation. It also plays an important role in maintaining the condition of the skin, by stimulating fibroblasts to synthesize collagen and elastin, which translates into its firmness and elasticity [13].

Estrone

It shows weaker estrogenic activity compared to estradiol, and becomes the dominant estrogen after menopause. Its synthesis occurs mainly in adipose tissue by aromatization of androstendione. Although its action is less severe, estrone can be metabolised to estradiol and act as its reservoir. The presence of estrone determines the basal level of estrogen in the body of postmenopausal women, affecting bone metabolism, among other things, lipid metabolism and nervous system function. It is worth noting that increased concentrations of estrone, especially in the context of obesity, may be associated with increased risk of hormone-dependent cancers, such as breast or endometrial cancer [14].

Estriol

It is the weakest of the estrogens, and its dominant role is revealed during pregnancy. It is produced mainly by the placenta, involving the adrenal glands of the fetus. Although its systemic effects is limited, estriol plays an important role in maintaining the pregnancy, as well as in protecting the mucous membranes of the urogenital system. Due to its low estrogenic activity and minimal risk of proliferative effects, it is sometimes used in vaginal preparations in the treatment of symptoms of urogenital atrophy in postmenopausal women. Estriol may also exhibit antagonistic effects relative to estradiol, competing with it for estrogen receptors in some tissues [15, 16].

The three main forms of estrogen differ not only in strength of action, but also the period of physiological dominance and the extent of the biological functions. Their mutual proportions and activity reflect the hormonal state of a woman's body, conditioning numerous metabolic, reproductive and somatic processes at different stages of life.

During menopause, first of all, the level of estradiol changes, which is the most potent and active estrogen hormone that regulates the menstrual cycle and is responsible for the maintenance and development of female sex characteristics. Estrone shows less biological activity, and estriol remains the least active. Their biological significance defines the effects of estrogen on cell division, differentiation, maturation and

death. Estrogens affect the function of organs such as the brain, coil urinary tract, vulva, vagina, vascular system and skin. Physiological functions of estrogen in women include the development of secondary sexual characteristics, regulation of secretion of gonadotropins and ovulation, preparing tissues to receive progesterone, maintaining bone mass, regulating the synthesis of lipoproteins and tissue responses to insulin, and the urogenital system [17-18].

During premenopause (perimenopause) the maturation of Graaf follicles and ovulation are inhibited. The function of the corpus luteum is reduced and it leads to its insufficiency. There is a deficiency and then a lack of progesterone. Another change in ovarian function is hypoestrogenism, ovarian inhibin deficiency and hypergonadotropinemia, that is an increase in folliculotropic hormone. During this period, there is also a reduction in androgen production. Hormonal menopause is when a concentration of serum FSH is above 30 IU/l and estradiol is below 30 pg/ml. The postmenopausal period begins when estrogen production falls below 10 µg per day. Hormonal balance is achieved (low estrogen levels and high levels of gonadotropins) (fig. 3).

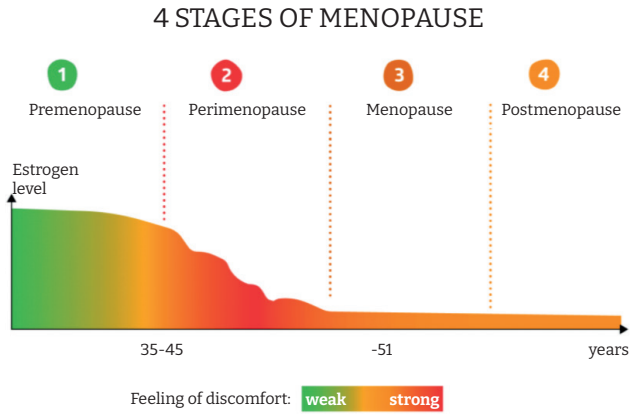

Fig. 3 Perceived discomfort and changes in estrogen levels during the 4 stages of menopause
Source: [19]

Estrogen and progesterone stimulate the development of ovarian follicles, ovulation and the growth and reduction of the mucosa. Estrogens are responsible for about 400 processes that occur in the female body. A decrease in the amount of sex hormones causes a marked increase in the secretion of FSH hormones and lutotropin (LH, luteinizing hormone) that stimulate the ovaries to to produce sex hormones at their current level. Less sex hormones and more FSH and LH secreted by the pituitary gland, causes the typical complaints of the pubertal period. Another reason of many ailments is a sharp drop in progesterone. Progesterone production during menopause is reduced almost to zero, while estrogen continues to be produced. That results in estrogen-progesterone imbalance [19-23].

FACTORS DETERMINING THE AGE OF NATURAL MENOPAUSE

The age of natural menopause varies and depends on many factors. They can be divided into environmental and genetic ones. Genetic factors have major influence on the age of the appearance of the last menstrual period. Heritability in this area is estimated at 31% to 87%. Many data confirms that women with late age of first menstrual pariod had menopause later than women whose first menstrual period occurred under the age of 12 [24].

Ovarian aging is influenced by environmental factors i.e., contraception used, occupation, level of education (table 1).

Long-term exposure to tobacco smoke or ultraviolet (UV) radiation also have adverse effects on female fertility. Heavy metals, pesticides and chemicals accelerate ovarian aging. In addition, diet plays a huge role in this issue. Most of the authors in their study found that excessive daily caloric intake (exceeding nutritional standards established by nutritionists) leads to a prolonged period of reproductive health, and thus to a delay in the onset of menopause. The impact of individual dietary components on the age of the last menstruation is also being considered. Research showed that consuming large amounts of fruits and protein products may delay menopause. The effects of vegetables containing phytoestrogens, which are believed to be responsible for the deficiencies in endogenous hormone compensation, was also intensively studied in relation to the age at which the last menstrual period occurred. However, the results in this case were very different. It has also been shown that the body mass index (BMI) is of great importance. The higher BMI, the longer the reproductive period and the later the menopause occurs. This phenomenon can be explained by higher estrogen concentrations serum in women with higher BMI. BMI plays an important role in hormonal regulation in women, affecting the age of onset of menopause. Studies have shown, that higher BMI correlates with later onset of menopause, which is explained by a greater amount of adipose tissue capable of producing estrogen through androgen aromatization [25].

In contrast, a low BMI, especially below 18.5 kg/m², is associated with an earlier onset of menopause. Underweight women are more prone to estrogen deficiency, which can lead to early extinction of ovarian function. Studies show that women with a BMI of less than 18.5 kg/m² have a 30% higher risk of early menopause compared to women with a BMI in the range of 18.5-22.4 kg/m². In addition, weight loss at a young age, especially rapid weight loss during adolescence, may increase the risk of premature menopause by up to 50%. Maintaining normal BMI is therefore important for hormonal balance and delaying the natural process of menopause [26].

Other factors that accelerate menopause include childlessness. The results obtained indicate that birth delays

Table 1 Environmental factors affecting the age of onset of menopause in women

environmental factors			
demographic	reproductive	health	lifestyle
– race – origin – occupation – siblings – education – marital status – income – place of residence – socioeconomic status – marital status – religion – date of birth	– *menarche* – regularity and course of menstrual cycles – number of pregnancies – number of children – age at birth of first live child – age at birth of last live child – number of abortions – breastfeeding – miscarriages	– past illnesses (including hypertension, cardiovascular disease, diabetes, cancer) – stress – medications – oral contraceptives – chemotherapy and radiation therapy – BMI – depression – post-traumatic stress disorder – birth weight	– physical activity – diet – smoking – alcohol consumption – drug use – excessive amounts of coffee/tea – consumption of certain nutrients

Source: [30]

the onset of the last menstrual period. Some authors have also found a statistically significant positive correlation between age at birth of the first living child and the age of birth of the last living child and subsequent menopause. Factors delaying the age of natural menopause is to give birth before the age of 25 and having multiple children. Length and the course of menstrual cycles can also affect the age of onset of the last menstrual period. Most studies suggest, that women whose menstrual cycles last longer than 28 days, go through menopause later than women who menstruate for shorter periods. Factors such as demographic variables, place of origin and race of the woman are also important in determining the age of beginning of menopause. Factors affecting the age of onset of the last menstrual periods also include those related to lifestyle. Research clearly show that women who smoke cigarettes enter the into menopause 0.5 to 2 years earlier than non-smokers [27-29].

SYMPTOMS OF MENOPAUSE

Most women experience symptoms of menopause. The symptoms can appear during or after menopause and can last from three to more than eleven years. The menopause syndrome is a characteristic group of complaints during this period. The earliest to appear are menstrual cycle disorders. Menopause is caused by a decline in estrogen levels, which regulate the reproductive process and give women feminine characteristics. The maximum production of estrogens occurs between the ages of 20 and 30, and after the age of 30 their levels drop. The first sign of impending menopause is a change in the menstrual cycle. Cycles may become shorter or longer, and bleeding may increase or decrease. Sometimes there is a break of several months, after which several periods occur 2-3 weeks apart. In addition to the loss of menstruation, menopause causes a variety of physical and psychological changes. To determine whether the symptoms are clearly due to menopause, physician may order a test for the hormone FSH, which is secreted by the pituitary gland and stimulates the maturation of ovarian follicles. The pituitary releases more FSH when estrogen levels drop. Therefore, FSH levels can indicate the onset of menopause. Blood and urine hormone tests can determine whether a woman is still ovulating, which is important for women who want to avoid pregnancy. Symptoms of menopause include hot flashes, sleep disturbances, mood swings, night sweats, cognitive changes, urinary and genital discomfort, and low sex drive. Symptoms characteristic of women during menopause are urinary and genital complaints. Other problems include vaginal dryness, recurrent urinary tract infections, urinary incontinence, and even prolapse of the reproductive organs. Libido disorders also occur. The long-term consequences of premature loss of ovarian function increase the risk of skeletal fragility. These include conditions such as osteopenia and postmenopausal osteoporosis. The rate of bone loss increases in the 5 to 10 years after menopause. During menopause, psychological disorders include sudden mood swings, irritability, fatigue, and even full-blown depression. The course of menopause also depends on the presence of accompanying diseases. These diseases include metabolic disorders, obesity, cardiovascular diseases, and cancer. In the serum of menopausal women, the concentration of total cholesterol and triglycerides increase. During menopause, there is a change in the distribution of body fat. Excess fat accumulates in the subcutaneous tissue of the abdomen. Menopausal deficit in sex hormones are the cause of the increase in morbidity of women to diseases such as vascular atherosclerosis, coronary artery disease, hypertension and thromboembolic diseases. Menopausal women have an increased risk of incidence of breast cervical lung, stomach endometrial and ovarian cancer. Cancer causes 20% of deaths among women in Poland [31-33]. Symptoms of menopause are shown in table 2.

Table 2 Symptoms of menopause.

Symptoms of menopause	
Psychic	Sleep and concentration disorders
	Feeling of fatigue
	Mood volatility
	Irritability
	Memory impairment
	Dizziness
	Decreased libido
	Sexual dysfunction
Reproductive organs	Dyspareunia
	Atrophic vaginitis
	Vaginal dryness
	Recurrent urinary tract inflammation
	Pruritus
	Vaginal bleeding
	Watery discharge
	Static disorder of the reproductive organs
	Urinary incontinence
Skeletal system	Osteoporosis
	Pain in the lumbosacral region of the spine
	Bone and joint pain
Cardiovascular system	Ischemic heart diseases
	Hypertension
	Disorders of the coagulation system
Skin symptoms	Thin skin
	Reduced flexibility
	Tingling sensation
	Atrophy of the mammary gland
	Reduced activity of sebaceous and sweat glands
Vascular	Headaches
	Night sweats and hot flashes

Source: [34]

CHANGES IN THE APPEARANCE OF THE SKIN AND ITS APPENDAGES

The skin is one of the organs most affected by sex hormones such as estrogen and testosterone. Estrogen receptors are found throughout the skin, but the highest concentrations are found in the skin of the face, genitals and lower limbs. Menstruation, pregnancy and menopause can affect the appearance and properties of the skin, but particularly significant changes occur during menopause. The profound hormonal changes that occur in a woman's body during menopause lead to physiological changes in many internal organs and the skin. When the concentration of estrogen and progesterone drops significantly, the properties of the skin deteriorate quite rapidly, causing in few years atrophy, excessive dryness, laxity, and even many accompanying diseases considered characteristic of this period. During menopause, the skin loses its density, becomes thin and less elastic, wrinkles of varying depth appear, the oval of the face changes, and there is increased dryness, visible changes in skin color, and telangiectasia, hypo- and hyperpigmentation appear. The skin is easily irritated. During menopause, some women experience increased keratosis in the plantar and palmar areas. The onset of menopause significantly accelerates the development of natural changes in the skin aging process. Tissue atrophy and intensification of degenerative changes occur. The number of collagen and elastic fibers decreases rapidly, causing thinning of the skin. In contrast, a decrease in hydroxyproline in type I collagen, a decrease in the amount of immature cross-links and glycosaminoglycans leads to poorer hydration of the skin. In the stratum corneum, cell adhesion is reduced and the skin-epidermis boundary is flattened, which in turn leads to a weakening of the exchange of nutrients and metabolites between the dermis and the epidermis. The changes occurring in the dermis result in a reduction in the size and function of the skin appendages. This leads to a reduction in the amount of sweat and sebum produced. Hirsutism on the face, diffuse alopecia, and frontal scarring often appear in women during menopause [35-37].

There are many receptors for estrogen, androgen, and progesterone in the skin. There are two types of estrogen receptors: alpha and beta. These are nuclear receptors. The distribution of both types of receptors in the body and the interactions between them largely determine the effect of estrogen on individual tissues. The two receptors are not functionally equivalent and are expressed differently in tissues. Beta receptors dominate in the skin and are present in the cells of the epidermis and dermis. Nuclear alpha receptors are present in fibroblasts and macrophages, but have not been found in keratinocytes. Melanocytes, dendritic cells, and cells of the vascular endothelium are sites of activation of these receptors. As a result of the loss of ovarian follicular activity and the lack of stimulation of estrogen receptors during menopause, the skin aging process intensifies. Estrogen-dependent cells are found in individual layers of the skin, and estrogen deficiency negatively affects the processes occurring in them. This results in a combination of chronological aging, hormonal aging, and photoaging caused by external factors such as UV radiation [38-41].

Sex hormones are associated with a wide range of immunological phenomena in the skin. Estrogens are

particularly involved in angiogenesis, apoptosis, antigen presentation and wound healing. Estrogens have been shown to affect not only the keratinocyte/fibroblast population, but also T lymphocytes, dendritic cells, macrophages, and endothelial cells. Studies on the effects of estrogens on the body have confirmed the active role of sex hormones in preventing hormonal aging [42].

A decrease in estrogen levels during menopause and the resulting lack of stimulation of estrogen-dependent receptors in the epidermis leads to an increase in the amount of intracellular cytokines, which causes disturbances in the proliferation of epidermal cells. Estrogen deficiency during menopause leads to a slowdown in cell division in the basal layer of the epidermis, thinning of the epidermis, atrophy of the spinous and granular layers, and slowing of epidermal lipid synthesis, including ceramides. The cells of the basal layer flatten and assume a resting position. The function of the lipid barrier of the epidermis is impaired. The skin becomes dry and poorly moisturized. At the cellular level, there is a weakening of keratinocyte proliferation and an increase in atrophic processes. This leads to atrophy of the epidermis. Atrophy of the granular and spinous layers causes the epidermis to become thinner. The boundary between the dermis and the epidermis becomes flat. The epidermis begins to separate from the substrate, and the number of skin papillae decreases by half, resulting in a reduction and limitation of metabolic and nutritional exchange between these layers. In the basal layer of the epidermis, there is a gradual, irregular distribution of melanocytes. This causes pigment spots on the skin. Their activity and density may also decrease, causing paleness and discoloration of the skin. The darker shade of aging skin is also caused by thinning of the epidermis and degraded collagen fibers. A decrease in the number of melanocytes reduces the body's protective properties against UV radiation. From a cosmetologist's point of view, the changes described are crucial for planning and conducting mature skin therapy. A thinner and less well-supplied epidermis is characterized by a lower regenerative capacity, which prolongs the healing process after invasive and semi-invasive treatments. Reduced lipid synthesis and a weakened hydrolipid barrier increase the skin's susceptibility to irritating cosmetic ingredients, allergens, and environmental factors. At the same time, limited exchange substances between the epidermis and the dermis reduces the effectiveness of the absorption of active substances contained in cosmetic preparations. Therefore, it is necessary to use mild formulas with regenerating, protective and strongly moisturizing properties and to adapt treatments to the condition and state of menopausal skin [43-46].

Skin changes

The dermis consists of connective tissue and, unlike the epidermis, its main mass is the extracellular matrix. The structure of the skin matrix is based on two components: fibers and amorphous base substance. The characteristic cells of the dermis are fibroblasts and their mature forms, fibrocytes, which are responsible for the synthesis and degradation of collagen, elastin, and glycosaminoglycans. Estrogens in the dermis influence the functioning of fibroblasts and also increase the production of glycosaminoglycans and proteoglycans, which are the basic building blocks of the extracellular matrix. Glycosaminoglycans play a role in maintaining skin homeostasis, while proteoglycans are responsible for proper wound healing and angiogenesis and play an important role in cell adhesion, migration and differentiation. Hyaluronic acid-bound proteoglycans have a high water-binding capacity. Hyaluronic acid produced by fibroblasts and keratinocytes is responsible for skin cohesion, hydration, and firmness. It is easily broken down by hyaluronidase, and its amount decreases with age during menopause. Studies conducted with estrogen have shown its effectiveness in stimulating fibroblasts to synthesize extracellular matrix components at the skin level. During menopause, due to a decrease in estrogen levels, fibroblast activity is disrupted. Cells within the dermis show characteristics of cells in a resting state. In the first 6 months after the end of menstruation, there is a rapid decline in the content and quality of collagen in the skin. Available studies suggest that during the first five years after menopause, women may lose about 30% of their skin collagen [47-52]. During this period, the activity of collagenase responsible for collagen breakdown increases. Elastin fibers become thinner and significantly dehydrated and form irregular structures. The amount of hyaluronic acid decreases, while its sensitivity to UV radiation increases. A decrease in the amount of hygroscopic substances, such as amino acids of the natural moisturizing factor (NMF), hyaluronic acid and urea, significantly increases skin dryness, which is one of the most common problems reported by women in the perimenopausal and postmenopausal period. The loss of these components is directly related to a decrease in the level of estrogen, which regulate skin metabolism, lipid synthesis and hydration of the epidermis [53].

Lack of adequate hydration leads to a weakening of the protective barrier function of the epidermis, an increase in transepidermal water loss (TEWL) and greater susceptibility of the skin to external factors. The skin becomes thinner, tighter, rougher and prone to microdamage and redness. Women often complain of a feeling of tightness, burning, and itching of the skin. These symptoms significantly affect daily comfort and self-esteem.

Skin dryness during this period does not only affect the face. It often also affects the lower limbs, forearms, and even the scalp and mucous membranes. It is a chronic problem that worsens during the winter months and as a result of using aggressive cleansers and inappropriate skin care products. From a cosmetological, dry skin during menopause requires the use of products that not only moisturize, but

also regenerate and occlude. Ingredients such as ceramides, hyaluronic acid, glycerin, vegetable oils and panthenol support the reconstruction of the hydrolipid coat and reduce water evaporation. Regular use of mild emollients and dermocosmetics is crucial for maintaining proper moisture levels and improving skin comfort in this age group [54].

The above process is characterized by the appearance of a large number of small lines and wrinkles, which are considered the first signs of skin aging. However, it should be noted that wrinkles caused by endogenous mechanisms of aging are significantly shallower than those that appear on skin exposed to the external factors. Estrogens dilate the blood vessels, and affect angiogenesis. Reduced estrogen levels reduce tissue nutrition and the supply of oxygen, resulting in pale skin [54].

Changes in the subcutaneous tissue and skin appendages

The basis of subcutaneous tissue is adipocytes, which are arranged in larger lobular clusters. Between the accumulated fat cells are septa made of connective tissue rich in nerve fibers and blood vessels. At the same time, the secretory parts of the hair follicle and sweat glands penetrate the subcutaneous tissues.

Changes in the subcutaneous tissue take the form of breakdown and atrophy of adipose tissue. Due to changes in the synthesis of proteins necessary for lipogenesis, differentiation of adipocytes and their ability to accumulate fat, adipose tissue is unable to give the face its normal lipostructure. In the areas around the eye sockets, cheekbones, mouth and chin, its thickness decreases. It ceases to play a supporting role for the skin, which begins to move downward. The result of this action is a change in the oval of the face. As a result of estrogen loss, collagen and elastic fibers degrade and subcutaneous fat tissue disappears, which leads to a weakening of the skin's support structure. This manifests itself in a loss of firmness, sagging tissues, and a downward shift of fat pads towards the lower part of the face. These changes result in sunken cheeks, deepening of the nasolabial folds and marionette lines, as well as blurring of the jawline and the formation of so-called "hamster cheeks". All of this leads to a significant reduction in facial aesthetics, giving it a sad, tired expression and making it look older.

During menopause, estrogen deficiency also affects the skin appendages. The sebaceous glands gradually disappear, the amount of sweat and sebum secreted decreases, which weakens the lipid coat and the epidermal barrier, causing dry skin. In the vascular system of the skin, the vessel walls become thickened and their number decreases, causing reduced blood supply, nutrition and hypoxia of the skin, which in turn leads to increased trans-epidermal water loss. The structure of hair deteriorates during menopause. It becomes weaker and less dense. Hair follicles in the area chin, upper lip, chest, lower abdomen, and pubic area become hypertrophied. In the armpits and pubic area, hair becomes thinner. The hair growth period shortens and the root diameter decreases. The color of the hair also changes due to the disappearance of melanocyte activity [55].

SUMMARY

During menopause, significant changes occur in skin function, primarily due to a decrease in estrogen levels. These hormones play an important role in regulating skin metabolism, and their deficiency leads to disturbances in the synthesis of structural components of the extracellular matrix, such as type I and III collagen and elastin. As a result, a decrease in skin elasticity and firmness is observed, as well as thinning and dryness, which is associated with a weakening of the barrier functions of the epidermis and a reduced ability to retain water.

These disorders also result in increased susceptibility of the skin to wrinkles, loss of structural integrity and the occurrence of discoloration, including *lentigo senilis* (age spots), which are the result of uneven melanocyte activity. A decrease in fibroblast activity in the dermis translates into limited production of components necessary to maintain its proper structure and function.

These processes are progressive, but proper hormonal balance and adequate skin care during menopause can significantly delay their development. In terms of aesthetic cosmetology, a holistic approach to skin care during menopause, taking into account both daily home care and specialized treatments, is a key element in preventing skin aging and maintaining its healthy appearance.

REFERENCES / LITERATURA

1. Bodera P, Poznański S, Dobrzański P. Menopauza – fizjologiczny okres w życiu kobiety. *Przew Lekarza*. 2005;5:74-77.
2. Merzel Šabović EK, Kocjan T, Zalaudek I. Treatment of menopausal skin: a narrative review of existing treatments, controversies, and future perspectives. *Post Reprod Health*. 2024;30(2):85-94. https://www.doi.org/10.1177/20533691241233440
3. Dębska O, Śpiewak R. Znaczenie terminu „kosmetologia" oraz zakres zadań i kompetencji kosmetologa w opinii studentów kosmetologii. *Estetol Med Kosmetol*. 2013;3(1):1-16.
4. Harlow SD, Gass M, Hall JE, et al. Executive summary of the Stages of Reproductive Aging Workshop + 10: Addressing the unfinished agenda of staging reproductive aging. *Menopause*. 2012;19(4):387-395. https://www.doi.org/10.1097/gme.0b013e31824d8f40
5. Steiner AZ. Przewidywanie wieku wystąpienia menopauzy: hormonalne, rodzinne i miesiączkowe czynniki determinujące. *Ginekol Dyplom*. 2011;19:63-66.
6. Nelsona LM. Praktyka kliniczna. Pierwotna niewydolność jajników. *N Engl J Med*. 2009;360(6):606-614. https://www.doi.org/10.1056/NEJMcp0808697
7. Santoro N, Kravitz HM, eds. *Perimenopause, An Issue of Obstetrics and Gynecology Clinics*. Philadelphia, PA: Elsevier; 2012.
8. Rocca WA, Grossardt BR, Shuster LT. Oophorectomy, estrogen, and dementia: A 2014 update. *Mayo Clin Proc*. 2014;89(9):1205-1213. https://www.doi.org/10.1016/j.mce.2014.01.020
9. Rzewuska N. Okres przekwitania u kobiet. Hormonalna terapia wieku menopauzalnego. www.endogin.wum.edu.pl/sites/endogin.wum.edu.pl/files/okres_przekwitania_u_kobiet._hormonalna_terapia_wieku_menopauzalnego._.pdf. Accessed 13.09.024.
10. Moreau KL, Hildreth KL, Meditz AL, et al. Endothelial function is impaired across the stages of the menopause transition in healthy women. *J Clin Endocrinol Metab*. 2012;97(12):4692-4700. https://www.doi.org/10.1210/jc.2012-2244
11. Diaz-Ruano AB, Martinez-Alarcon N, Perán M, et al. Estradiol and Estrone Have Different Biological Functions to Induce NF-κB-Driven Inflammation, EMT and Stemness in ER+ Cancer Cells. *Int J Mol Sci*. 2023;24(2):1221. https://www.doi.org/10.3390/ijms24021221

12. Kaczmarek M. Określenie wieku menopauzy naturalnej w populacji polskich kobiet. *Prz Menopauzalny*. 2007;2:77-82.
13. Simpson ER. Sources of estrogen and their importance. *J Steroid Biochem Mol Biol*. 2023;86(3-5):225-230. https://www.doi.org/10.1016/S0960-0760(03)00360-1
14. Hetemäki N, Robciuc A, Vihma V, et al. Adipose tissue sex steroids in postmenopausal women with and without menopausal hormone therapy. *J Clin Endocrinol Metab*. 2024;110(2):511-522. https://www.doi.org/10.1210/clinem/dgae458
15. Holtorf K. The Bioidentical Hormone Debate: Are Bioidentical Hormones (Estradiol, Estriol, and Progesterone) Safer or More Efficacious than Commonly Used Synthetic Versions in Hormone Replacement Therapy? *Postgrad Med*. 2009;121(1):73-85. https://www.doi.org/10.3810/pgm.2009.01.1949
16. Melamed M, Castaño E, Notides AC, Sasson S. Molecular and kinetic basis for the mixed agonist/antagonist activity of estriol. *Mol Endocrinol*. 1997;11(12):1868-1878. http://www.doi.org/10.1210/mend.11.12.0025
17. Nelson LR, Bulun SE. Estrogen production and action. *J Am Acad Dermatol*. 2001;45(3 Suppl):116-124. https://www.doi.org/10.1067/mjd.2001.117432
18. Wojnowska D, Juszkiewicz-Borowiec M, Chodorowska G. Wpływ menopauzy na starzenie się skóry. *Post Dermatol Alergol*. 2006;23:149-156.
19. Kiedy rozpoczyna się menopauza i jak długo trwa? MyNaturalnie.pl. https://www.mynaturalnie.pl/kiedy-rozpoczyna-sie-menopauza-i-jak-dlugo-trwa/. Accessed 23.062024.
20. Delamater L, Santoro N. Management of the Perimenopause. *Clin Obstet Gynecol*. 2018;61(3):419-432. http://www.doi.org/10.1097/GRF.0000000000000389
21. Santoro N, Randolph JF Jr. Reproductive hormones and the menopause transition. *Obstet Gynecol Clin North Am*. 2011;38(3):455-466. https://www.doi.org/10.1016/j.ogc.2011.05.004
22. Motlani V, Motlani G, Pamnani S, et al. Endocrine Changes in Postmenopausal Women: A Comprehensive View. *Cureus*. 2023;15(12):e51287. https://www.doi.org/10.7759/cureus.51287
23. Besong C, Philippeaux S, Bham A, et al. Zarządzanie menopauzą: ewoluująca rola estrogenów, selektywnych inhibitorów wychwytu zwrotnego serotoniny i fitoestrogenów w równoważeniu wahań hormonalnych. *Cureus* (*Kureusz*). 2024;16(9):e70440. https://www.doi.org/10.7759/cureus.70440
24. Murabito JM, Yang Q, Fox C, et al. Odziedziczalność wieku w naturalnej menopauzie w badaniu Framingham Heart Study. *J Clin Endocrinol Metab*. 2005;90(6):3427-3430. https://www.doi.org/10.1210/JC.2005-0181
25. Gold EB, Bromberger J, Crawford S, et al. Factors associated with age at natural menopause in a multiethnic sample of midlife women. *Am J Epidemiol*. 2001;153(9):865-874. https://www.doi.org/10.1093/aje/153.9.865
26. Zhu D, Chung HF, Pandeya N, et al. Body mass index and age at natural menopause: an international pooled analysis of 11 prospective studies. *Eur J Epidemiol*. 2018;33(8):699-710. http://www.doi.org/10.1007/s10654-018-0367-y
27. Powell-Wiley TM, Poirier P, Burke LE, et al. Obesity and cardiovascular disease: A scientific statement from the American Heart Association. *Circulation*. 2021;143(21):e984-e1010. https://www.doi.org/10.1161/CIR.0000000000000973
28. Peycheva D, Sullivan A, Hardy R, et al. Risk factors for natural menopause before the age of 45. *BMC Womens Health*. 2022;22(1):438. https://www.doi.org/10.1186/s12905-022-02021-4
29. Langton CR, Whitcomb BW, Purdue-Smithe AC, et al. Association of in utero exposures with risk of early natural menopause. *Am J Epidemiol*. 2022;191(5):775-786. https://www.doi.org/10.1093/aje/kwab301
30. Rumianowski B, Brodowska A, Karakiewicz B, et al. Czynniki środowiskowe wpływające na wiek wystąpienia naturalnej menopauzy u kobiet. *Prz Menopauzalny*. 2012;5:412-416.
31. Santoro N, Randolph JF. Reproductive hormones and the menopause transition. *Obstet Gynecol Clin North Am*. 2011;38(3):455-466. https://www.doi.org/10.1016/j.ogc.2011.05.004
32. Portman DJ, Gass MLS. Genitourinary syndrome of menopause: New terminology for vulvovaginal atrophy. *Menopause*. 2014;21(10):1063-1068. https://www.doi.org/10.1097/GME.0000000000000329
33. Greendale GA, Lee NP, Arriola ER. The menopause. *Lancet*. 1999;353(9152):571-580. http://www.doi.org/10.1016/S0140-6736(98)05352-5
34. Olszewska J, Czerwińska-Osipiak A, Łukaszuk K, et.al. Problemy kobiet w okresie okołomenopauzalnym. *Pielęgniarstwo Polskie*. 2015;1:93-97.
35. Brincat M, Pollacco J. Menopauza i wpływ hormonalnej terapii zastępczej na starzenie się skóry: krótki przegląd. *GREM Endokrynologia Ginekologiczna i Reprodukcyjna oraz Metabolizm*. 2024;5(1):34-37. http://www.doi.org/10.53260/grem.2450106
36. Zouboulis CC, Makrantonaki E. Hormonal therapy of intrinsic aging. *Rejuvenation Res*. 2012;15(3):302-312. http://www.doi.org/10.1089/rej.2011.1249
37. Ganceviciene R, Liakou AI, Theodoridis A, et al. Skin anti-aging strategies. *Dermatoendocrinol*. 2012;4(3):308-319. http://www.doi.org/10.4161/derm.22804
38. Lephart ED, Naftolin F. Factors Influencing Skin Aging and the Important Role of Estrogens and Selective Estrogen Receptor Modulators (SERMs). *Clin Cosmet Investig Dermatol*. 2022;15:1695-1709. http://www.doi.org/10.2147/CCID.S333663
39. Thornton MJ. Estrogens and aging skin. *Dermatoendocrinol*. 2013;5(2):264-270. http://www.doi.org/10.4161/derm.23872
40. Lephart ED, Naftolin F. Menopause and the Skin: Old Favorites and New Innovations in Cosmeceuticals for Estrogen-Deficient Skin. *Dermatol Ther (Heidelb)*. 2021;11(1):53-69. http://www.doi.org/10.1007/s13555-020-00468-7
41. Hall G, Phillips TJ. Estrogen and skin: the effects of estrogen, menopause, and hormone replacement therapy on the skin. *J Am Acad Dermatol*. 2005;53(4):555-572. http://www.doi.org/10.1016/j.jaad.2004.08.039
42. Kanda N, Watanabe S. Regulatory roles of sex hormones in cutaneous biology and immunology. *J Dermatol Sci*. 2005;38(1):1-7. http://www.doi.org/10.1016/j.jdermsci.2004.10.011
43. Zegarska B, Woźniak M. The influence of estrogen on skin changing. *Prz Menopauzalny*. 2007;4:233-238.
44. Zegarska B. Skóra w okresie menopauzy i jej pielęgnacja. Forum Ginekologii. https://www.forumginekologii.pl/artykul/skora-w-okresie-menopauzy-i-jej-pielegnacja. Accessed 12. 09. 2024.
45. Menopauza: wszystko na temat skóry i zmian hormonalnych. Vichy 2025. https://www.vichy.pl/blog/menopauza-wszystko-na-temat-skory-i-zmian-hormonalnych/vmag76434.aspx. Accessed 21.10.2024.
46. Barańska A. Zmiany w wyglądzie i pielęgnacja skóry w okresie menopauzy. Biotechnologia.pl. https://biotechnologia.pl/kosmetologia/zmiany-w-wygladzie-i-pielegnacja-skory-w-okresie-menopauzy,20772. Accessed 11.10.2024.
47. Brincat M, Moniz CJ, Studd JW, et al. Long-term effects of the menopause and sex hormones on skin thickness. *Br J Obstet Gynaecol*. 1985;92(3):256-259. http://www.doi.org/10.1111/j.1471-0528.1985.tb01091.x
48. Ashcroft GS, Mills SJ. Androgen receptor-mediated inhibition of cutaneous wound healing. *J Clin Invest*. 2002;110(5):615-624. http://www.doi.org/10.1172/JCI15704
49. Sator PG, Schmidt JB, Sator MO, et al. The influence of hormone replacement therapy on skin ageing: a pilot study. *Maturitas*. 2001;39(1):43-55. http://www.doi.org/10.1016/s0378-5122(00)00225-5
50. Brincat MP, Baron YM, Galea R. Estrogens and the skin. *Climacteric*. 2005;8(2):110-123. http://www.doi.org/10.1080/13697130500118100
51. Shuster S, Black MM, McVitie E. The influence of age and sex on skin thickness, skin collagen and density. *Br J Dermatol*. 1975;93(6):639-643. https://www.doi.org/10.1111/j.1365-2133.1975.tb05113.x
52. Brincat M, Pollacco J. Menopause and the effects of Hormone Replacement Therapy on skin aging: A Short Review, *GREM Gynecological and Reproductive Endocrinology & Metabolism*. 2024;5(1):34-37 http://www.doi.org/10.53260/grem.2450106
53. Lephart ED, Naftolin F. Factors Influencing Skin Aging and the Important Role of Estrogens and Selective Estrogen Receptor Modulators (SERMs). *Clin Cosmet Investig Dermatol*. 2022;15:1695-1709. http://www.doi.org/10.2147/CCID.S333663
54. Kendall AC, Pilkington SM, Wray JR, et al. Menopause induces changes to the stratum corneum ceramide profile, which are prevented by hormone replacement therapy. *Sci Rep*. 2022;12(1):12345. http://www.doi.org/10.1038/s41598-022-26095-0
55. Thornton MJ. Estrogens and aging skin. *Dermatoendocrinol*. 2013;5(2):264-270. http://www.doi.org/10.4161/derm.23872

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