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How Do Omega-3 and Omega-6 Fatty Acids Influence the Development of Common Acne?

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Abstract:**Introduction:**

Acne is one of the most common skin problems affecting people worldwide, especially young individuals. Despite many years of research into the etiology of acne, its exact causes remain a subject of debate. In recent years, increasing scientific interest has focused on the role of diet in shaping skin health, including the influence of omega-3 and omega-6 fatty acids on the severity of acne symptoms.

Objective:

The aim of this study is to review the scientific literature regarding the relationship between a diet rich in omega-3 and omega-6 fatty acids and the reduction of acne. We will analyze available scientific evidence and attempt to determine whether dietary changes to increase the intake of these fatty acids may have a beneficial impact on skin condition and reducing the severity of acne symptoms.

Methods:

We searched the PubMed and Google Scholar databases using various combinations of keywords such as "acne," "diet," "omega-3," "omega-6" to identify scientific articles related to our topic. We then analyzed selected articles for research methodologies, results, and conclusions.

Results:

Several studies suggest that a diet rich in omega-3 fatty acids, especially eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), and relatively low in omega-6 fatty acids may be associated with a reduction in acne severity. Some clinical studies have shown that supplementation with omega-3 fatty acids can lead to a reduction in the number of comedones and inflammatory skin lesions in acne patients.

Conclusions:

Our literature review suggests that a diet rich in omega-3 fatty acids and lower in omega-6 fatty acids may be beneficial for individuals struggling with acne. However, further clinical research is needed to confirm these observations and better understand the mechanisms of action of fatty

acids on skin health. In the meantime, a balanced diet rich in omega-3-containing foods such as fatty fish, nuts, and seeds is recommended as a potential adjunct to acne treatment.

Keywords: common acne, diet, fatty acids, Omega-3 and Omega-6

Introduction

1. Common Acne

Common acne (*Acne vulgaris*) is one of the most prevalent dermatological diseases, primarily resulting from sebum overproduction [1, 2]. It affects both women and men, though more severe cases are more common in men. The peak incidence in women occurs between the ages of 14-17, and in men between 16-19. Acne lesions are increasingly appearing in adults as well. Areas rich in sebaceous glands, such as the face (T-zone), back, and chest, are most susceptible to acne [3]. Acne manifests as comedones, papules, pustules, inflammatory nodules, nodules, and cysts [4].

Epidemiology

Acne is one of the most common skin conditions, affecting 83-95% of individuals aged 16-19 years [1, 4]. The first symptoms typically appear 1-2 years earlier in girls than in boys. A mild form of acne affects around 85% of individuals, while severe cases constitute 15% [1, 4]. Acne is increasingly prevalent in adults as well, even in individuals aged 40-50 years, a condition referred to as late-onset acne [5].

Etiopathogenesis

Acne results from disturbances in sebum secretion and the inflammatory state of the pilosebaceous unit. There are three main pathogenic factors:

- 1) Excessive Sebaceous Gland Activity: Stimulation of androgenic hormones causes enlargement of sebaceous glands and increased sebum production [7].
- 2) Disorders of the Keratinization Process in Sebaceous Gland Ducts: Excessive keratinization and adherence of keratinized scales lead to the narrowing of the sebaceous duct, resulting in the formation of microcomedones, which can evolve into open and closed comedones [6, 7].
- 3) Colonization of Hair Follicles by Bacteria: Aerobic cocci colonize superficial parts of the glands, while *Propionibacterium acnes* inhabits deeper structures of the sebaceous glands. *Propionibacterium acnes* secretes enzymes and chemotactic factors that attract polymorphonuclear leukocytes, leading to the release of hydrolytic enzymes and exacerbation of the inflammatory process [6-8].

Clinical Forms of Acne:

1.Mild Forms of Acne

- Comedonal, Non-inflammatory Acne (*Acne comedonica*): Mainly located on the face, forehead, and cheeks, characterized by numerous open and closed comedones. Open comedones have a dark color due to oxidation of their contents, while closed ones are non-penetrable [4, 7, 9].
- Papular Acne (*Acne papulosa*): Dominated by papules, often coexisting with comedones and pustules [1, 9].
- Papular-pustular, Inflammatory Acne (*Acne papulo-pustulosa*): The most common form of acne, occurring on the face, back, shoulders, and chest. In addition to comedones, papules and pustules appear [4, 7, 9].

2. Severe Forms of Acne

- Pustular, Nodular-cystic Acne (*Acne nodulocystica*): Characterized by numerous comedones, nodules, and cysts, which can lead to the formation of channels and fistulas from which purulent or bloody secretions emerge. After the lesions resolve, atrophic scars and keloids may appear [1, 4, 7, 9].
- Conglobate Acne (*Acne conglobata*): More common in men and characterized by the presence of cysts and deep abscesses, which heal by forming bridges, leading to hypertrophic and atrophic scars [1, 9].
- Keloidal Acne (*Acne keloidalis*): Tendency to develop hypertrophic scars [1, 9].

3. Other Forms of Acne

- Cosmetic Acne (*Acne cosmetica*): Resulting from the use of cosmetics containing comedogenic substances [7, 8].
- Drug-induced Acne (*Acne postmedicamentosa*): Caused by medications such as corticosteroids, lithium, phenytoin, niacinamide, bromide, and androgenic hormones [7].
- Occupational Acne (*Acne professionalis*): Induced by contact with chemical compounds such as oily lubricants or volatile chlorine compounds, often occurring on skin areas in contact with work clothing [7, 11].
- Infantile Acne (*Acne neonatorum*): Occurs on the faces of newborns and infants in the form of inflammatory nodules and cysts, caused by maternal hormones [7].

- Self-inflicted Acne (*Acne excoriata*): Particularly seen in young girls, resulting from chronic picking of minor acne lesions on the face, leading to numerous scabs and discolorations [1, 7].

2.Fatty Acids

Fats are macronutrients that, along with proteins and carbohydrates, are responsible for the proper nutrition and functioning of the body. The definition of fats includes glycerol esters and fatty acids, which are characterized by diverse structures and lack of solubility in organic substances and water [12]. Polyunsaturated fatty acids from the omega-3 and -6 families are not synthesized *de novo* in the human body, therefore they must be provided to the body through food [30-32].

- **Impact on the Skin**

The condition of human skin is particularly influenced by vitamin F, which includes Omega-3 and Omega-6 fatty acids, mainly essential polyunsaturated fatty acids (PUFAs): linoleic acid (LA) and α -linolenic acid (ALA) [13,14]. The human body cannot synthesize these acids, so they must be obtained from food. Linoleic acid is a precursor to eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), while α -linolenic acid is a precursor to arachidonic acid [12,13]. Good dietary sources of EPA and DHA include oily fish such as salmon, mackerel, cod, and fish oil, while ALA sources include flaxseeds, chia seeds, walnuts, and plant oils such as olive oil and rapeseed oil.

- **Dietary Recommendations**

According to the recommendations of the FAO and WHO, the daily intake of saturated fatty acids (SFAs) should be 7% of total energy intake, while the intake of polyunsaturated fatty acids (PUFAs) should be between 6-10% (including n-6 fatty acids: 5-8% and n-3 fatty acids: 1%). Monounsaturated fatty acids (MUFAs) should contribute to 10-15% of daily energy intake, and trans fats should be limited to around 1% due to their harmful effects [13-16].

- **Influence of Fatty Acids on the Skin**

Scientific research indicates that fatty acids positively impact skin health by reducing inflammation and allergic reactions, as well as inhibiting immune responses. They also have the ability to reduce the intensity of inflammatory and bacterial processes [14,15]. Additionally, fatty acids exhibit photoprotective and anti-inflammatory properties, similar to vitamin A [17]. Deficiency in PUFAs can lead to reduced sebum fluidity, resulting in the closure of sebaceous gland ducts, disruptions in the skin's keratinization process, and the formation of comedones [13]. The use of products containing Omega-3 and Omega-6 fatty acids may increase resistance to fatigue and improve skin hydration, density, and elasticity [13]. The ratio between the amounts of Omega-3 and Omega-6 fatty acids consumed should be 1:3-1:5 [13,15,18]. Increasing the intake of Omega-6 fatty acids may contribute to the development of pro-inflammatory factors, thereby contributing to the development of acne.

- **Structure of Fatty Acids**

Fatty acids consist of a hydrocarbon chain, terminated by a methyl group at one end and a carboxyl group at the other. Two main types of fatty acids are distinguished: saturated and unsaturated. In saturated fatty acids, only single bonds occur between carbon atoms. In unsaturated fatty acids, one or more double bonds are present between carbon atoms. The number of these double bonds determines the degree of fatty acid saturation: monounsaturated fatty acids have one double bond, while polyunsaturated fatty acids have two or more [23]. Omega-3 and omega-6 fatty acids are examples of polyunsaturated fatty acids, differing in the position of the first double bond from the methyl group end. In omega-3 fatty acids, the first double bond is located at the third carbon atom, while in omega-6 fatty acids, it is at the sixth carbon atom, counting from the end of the chain furthest from the carboxyl group, denoted as omega [29].

- **Types of Omega-3 and Omega-6 Fatty Acids**

Omega-3 fatty acids include:

- Alpha-linolenic acid (ALA)
- Eicosapentaenoic acid (EPA)
- Docosahexaenoic acid (DHA)

Omega-6 fatty acids include:

Linoleic acid (LA)

Arachidonic acid (AA)

- **Occurrence of Fatty Acids**

Omega-3 and omega-6 fatty acids are essential for the proper functioning of the human body. The main sources of omega-3 fatty acids are fatty fish such as salmon, mackerel, tuna, and herring, as well as seafood [23, 24]. These organisms contain eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), while alpha-linolenic acid (ALA) is of plant origin and is found in rapeseed grains, walnut oil, green leafy vegetables, and almonds [23,25,26]. Omega-6 fatty acids are found in soybean, corn, and sunflower oil, as well as in egg yolks, fatty fish, and seafood [23,27,26]. Dietary supplements and fortified foods containing omega-3 and omega-6 fatty acids can also serve as sources, ensuring their proper concentration in the body [25, 28].

Conclusions:

Acne vulgaris is one of the most common dermatological conditions affecting both adolescents and adults. This condition is primarily associated with sebum overproduction, which is stimulated by androgen hormones. Elevated levels of androgens contribute to increased sebaceous gland activity, leading to the formation of skin lesions such as comedones, papules, pustules, nodules, and cysts.

A diet rich in omega-3 and omega-6 fatty acids can significantly impact the skin condition of individuals with acne. Omega-3 fatty acids, such as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), exhibit anti-inflammatory properties, which may help reduce skin inflammation. Sources of these fatty acids include fatty fish such as salmon, mackerel, tuna, and herring.

Omega-3 (ALA, EPA, DHA) and omega-6 (LA, AA) fatty acids are essential for proper body function. Deficiency in polyunsaturated fatty acids (PUFAs) may lead to reduced sebum fluidity, thereby promoting the closure of sebaceous gland ducts, disruption of skin keratinization, and the formation of comedones.

Supplementation with omega-3 and omega-6 fatty acids may improve skin hydration, density, and elasticity, as well as increase resistance to fatigue. However, it is important to maintain the proper ratio between omega-3 and omega-6 fatty acids, which should be in the range of 1:3 to 1:5. An excess of omega-6 fatty acids in the diet may contribute to the development of pro-inflammatory factors, exacerbating acne symptoms.

Scientific studies suggest that a diet rich in fish and seafood may reduce typical acne symptoms. Supplementation with omega-3 fatty acids, zinc, selenium, chromium, and green tea extract for two months has shown significant reduction in acne lesions in individuals with acne.

Acne treatment should be tailored to the individual needs of the patient, considering both pharmacological therapy and dietary changes. Incorporating dietary sources of omega-3 and omega-6 fatty acids, such as fatty fish, flaxseeds, walnuts, and plant oils, can be an important supportive element in acne therapy.

In summary, both hormonal and dietary factors play a key role in the pathogenesis and treatment of acne vulgaris. Optimizing the diet, particularly by increasing the intake of omega-3 and omega-6 fatty acids, may benefit in reducing acne symptoms and improving overall skin condition.

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Author's contribution

Conceptualization: M.P. Methodology: P.R. Software: Katarzyna M. Validation: V.C. Formal analysis: Katarzyna M. Investigation: P.R. Resources: P.R. Data curation: M.P. Writing original draft preparation: M.P. P. R. Katarzyna M. V.C. Karolina M. Writing review and editing: M.P. Katarzyna M. P.R. V.C. Karolina M. Visualization: V.C. Supervision: Katarzyna M. M.P. Project administration: M.P.

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