

Acne



Archie: Betty, let's go for movies tomorrow



Betty: Mom!!!! I can't go. Look at me...

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Acne

Storyline

The biggest challenge children face when entering puberty is the onset of acne, a common skin condition among teenagers. Regardless of community, geographical location, race, or colour all adolescents across the globe undergo hormonal, neural, and social changes which have emotional and psychological effects. Good Health and well-being include the physical and emotional health of present and future generations., which is one of the goals of UN Sustainable Development Goals (SDGs).

As young minds try to adapt to bodily changes, the appearance of zits, redness and swelling on the face becomes an added challenge. These little bumps can affect confidence and self-esteem and at times may times contribute to psychological disorder such as depression. Although the exact cause of acne remains elusive, the connection between skin microbes, immunity, the gut microbiome, diet, and exercise cannot be overlooked. A healthy body supported. By a balanced diet is key to maintaining healthy and acne-free skin.

The Microbiology and Societal Context.

The Microbiology; Microbes: Skin Microbiome, gut Microbiome, cutaneous dysbiosis. skin homeostasis, acne treatment, pathogenic strains, commensal strains, ecological treatments.

Societal context: Mental health and well-being, childhood development



Fig 1. Acne and SDGs involved; 3: Good Health and Well-being, 4: Quality Education, 5: Gender Equality

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Acne and Microbiome

Human skin is the largest organ of the body which act as a barrier against the entry of microbes. However, it is also home to many microbes belonging to different genera such as *Propionibacterium*, *Staphylococcus*, *Corynebacterium*, *Streptococcus*, *Malassezia* and others

An imbalance in the proportion of these microbes may lead to various skin disorders. For instance, *Propionibacterium acnes* is an important bacterium that occupies ecological niches on the skin that might otherwise be colonised by some pathogenic bacteria. Thus, its role in maintaining the skin health is evident and its reduction has been linked to the development of chronic skin diseases like atopic dermatitis and psoriasis.

Other bacteria also play critical roles in maintaining skin homeostasis, including *Cutibacterium acnes* and *Staphylococcus epidermis*. Diversity in their phylotypes may trigger innate immune responses, leading to inflammation leading to severe acne condition. Thus, maintaining microbial balance is critical for healthy skin.

Diet and Acne

The food choices of many teenagers often include processed carbohydrates, fried and greasy snacks, alcohol, and chocolates, which may contribute to hormonal imbalances. Spikes in blood insulin levels can trigger inflammatory responses and affect the population of beneficial bacteria in the gut. Such dietary habits may increase the risk of conditions such as obesity, atherosclerosis, diabetes, cancer and even Alzheimer's disease.

Acne has also been linked to the gastrointestinal tract, and several studies suggest that the gut microbiota is involved in the formation of active skin breakouts. Emotional states such as anxiety, and stress may further influence acne through mechanisms including alteration in the gut microbiota, increased in intestinal permeability and skin inflammation,. Intestinal health is directly related to skin health. When the intestinal barrier is disturbed, metabolites produced by gut microbes can disturb skin homeostasis. Under psychological stress conditions, microbes in the gut produce neurotransmitters such as serotonin, acetylcholine, and norepinephrine, which may contribute to systemic inflammation. Therefore, a nutritious diet including essential components such as fibres, probiotics, vitamins, minerals, adequate water intake, along with a healthy mindset, is important for maintaining healthy microbes in the brain-gut-skin axis.

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Types of Acne

Dermatologists divide acne into four different categories. Grade 1 is the mildest among all, including mostly whiteheads and blackheads, with a few instances of papules and pustules. Grade 2 is the moderate grade, which includes multiple papules and pustules, which are mostly located on the face. Grade 3 is characterized as moderately severe, in which numerous papules and pustules are present along with occasionally inflamed nodules on the face and may be present on the back and chest. Grade 4 is the severe most grade of nodulocystic acne, which includes numerous large and inflamed pustules and nodules that are painful. According to the grade of infection, dermatologists prescribe treatment to infected individuals. A balanced and healthy diet along with the treatment in order to get good and faster results.

Acne vulgaris is primarily observed in adolescents. Nearly 85% of people who suffer from acne are adolescents. Acne, as mentioned, is a result of overactive sebaceous glands which secrete excess oil. During puberty, excess secretion of the sex hormones, or androgens, enhances the secretion of sebaceous glands or sebum. The high oil content causes the skin pores to become blocked with dead cells. These dead cells further become sites of bacterial infection and inflammation, which eventually cause redness. Other factors that contribute to acne development are climate changes, stress, and family history. Also, excessive consumption of fatty and oily foods indirectly contributes to the development of acne. Age and secretion of the sebaceous glands due to adolescence are uncontrollable but can be modified. A healthy lifestyle is key to solving acne problems. One can also include regular exercise, yoga practices, meditation etc. to control stress levels, which in turn help in balancing the hormonal levels.

Acne and self-confidence

Acne breaks the morale of youngsters. People who suffer from acne often avoid going out with peers as they are ashamed of the lesions. They usually try to hide the acne with makeup or with hair. Use of cosmetics, however, can worsen the acne condition. Young boys who develop acne on the shoulders, chest and back often avoid taking part in sports where they are supposed to change clothes in public. Generally, a person suffering from acne feels unattractive to others and thus, lacks self-confidence, especially when talking to or making friends with the opposite sex. They may encounter bullying from their peers who lack the courtesy to appreciate their character instead of their appearance. Most people have observed that others consider them dirty because

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of acne on their faces. In extreme cases, a person may develop social phobia and thus tend to stay at home more and more. Children may avoid going to school or may face incidents of bullying due to taunts about their appearance. Even adults avoid going to interviews for jobs that demand a perfect appearance, and even if they go, they lack self-confidence. The repeated incidence of disgrace may bring a condition of depression in these individuals. Symptoms of depression range from poor academic performance, loss of appetite, loss of interest in activities, sleep disturbances and mood changes. Depression should be considered as serious as the symptoms of acne and should be treated with the help of others.

Causes of Acne

The risk factors for acne development may be divided into four different categories. The first category is of individual's socio-economic status and biological factors. This basically includes gender, age, hereditary problem, economic level, skin type, obesity or likelihood of consuming oily foods, proper menstrual cycle, cosmetics used, habits like smoking and drinking, diet and psychological well-being. First risk factor is the most deciding and impactful factor for acne development. The second type of risk factor includes natural environmental conditions like temperature, sun exposure, humidity, exposure to skin colonizing harmful bacteria and pollution. Third risk factor is related to social media and social networks, and the fourth factor is the built environment factor, which includes population density, green space, and food stores. Certain characteristics negatively affect acne development, such as oily skin, obesity, smoking habits, stress, poor sleep quality, excessive gadget and electronics use, high temperature, halogenated hydrocarbons.

Ethnic groups are the main determinant of the severity of acne. In recent population survey-based studies, it has been found that calling acne '*the disease of the West*' will not be an exaggeration. The subjects included in the study were from a fully modernized population and countryside non-westernized population of the Kitavan Islanders of Papua New Guinea and the Aché hunter-gatherers of Paraguay. These individuals were critically examined for acne encounters. A striking difference was observed between both populations where non-westernized was found to have rare cases of acne from grade 1-4, while there was a higher incidence of acne in westernized society. Food habits, lack of physical exercise, pollution, stress, inability of sleep,

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etc. are mainly the contributors of this difference. This represents environment and habits as the major factors for acne development, surpassing the genetic factors.

The aetiology of acne is multifactorial.

This includes an increase in sebum production, hyper cornification of the pilosebaceous duct, colonization by *P. acnes*, and the production of inflammation. Extracellular products produced by the acne-causing organism, *P. acnes*, cause the activation of both humoral and cell-mediated immunity. These products include hyaluronidases, lipases, proteases, and chemotactic factors, which attract neutrophils, lymphocytes, and macrophages.

Humoral and Cell-mediated Immunity Activation in Acne

Acne patients develop immune responses to *P. acnes*. The degree of inflammation and immune response depends upon the severity of the infection. Antibodies released against *P. acnes* are largely believed to be of the IgG class. Cell-mediated immunity is mainly responsible for the inflammatory reaction, which might be caused by activation of the complement system through antigen-antibody interactions. In one study, patients who were injected or skin-tested with *P. acnes* were found to develop hypersensitive reactions. In another study, heat-killed *P. acnes*, when injected, led to delayed responses in patients.

The main focus of dermatologists in the treatment of acne is to treat acne, reduce scars, and minimize the possibility of scarring. For treatment, oral antibiotics are given to patients. If the problem in females is due to the menstrual cycle, oral contraceptives are prescribed. There are also drugs that can shrink the size of oil glands. The most common side effects of these drugs are dryness, ulcerative colitis, and depression. Depending upon the condition, therapies may also be advised along with medications. Other treatment methods include the use of steroids or lasers, which remove defective collagen and allow healthy collagen to grow. Chemical peeling of the skin's top layer can also be done, allowing new skin to grow.

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Role of Gut Microbiota in Skin Homeostasis

The connection between the skin and gut microbiota has been studied by different research groups, and interestingly, a similar gut microbial profile has been observed in acne patients. For instance, a study by Deng et al. showed a higher *Bacteroidetes-to-Firmicutes* ratio in the gut of acne patients. Another study by Yan et al. showed a decrease in certain probiotic species in the gut of acne patients, such as *Bifidobacterium* and *Lactobacillus*, which normally ferment oligosaccharides in the upper gut and maintain intestinal microbiota. Other useful species that declined in acne patients included *Butyricoccus*, which generates butyrate and prevents mucosal barrier damage and inflammation.

The gut microbiome produces nearly 30 compounds, such as short-chain fatty acids (SCFAs), cortisol, secondary bile acids, and neurotransmitters such as serotonin, gamma-aminobutyric acid (GABA), tryptophan, and dopamine. These hormone-like compounds are released into the bloodstream and act on different organs, one of which is the skin. Thus, changes in gut microbiota also alter skin homeostasis by changing the composition of commensal skin microbiota. This alteration may affect the integrity of the skin barrier, which in turn leads to skin problems such as acne. Thus, external factors like stress and diet not only affect gut health but also affect skin health, which remains associated with the hypothalamic-pituitary axis (HPA).

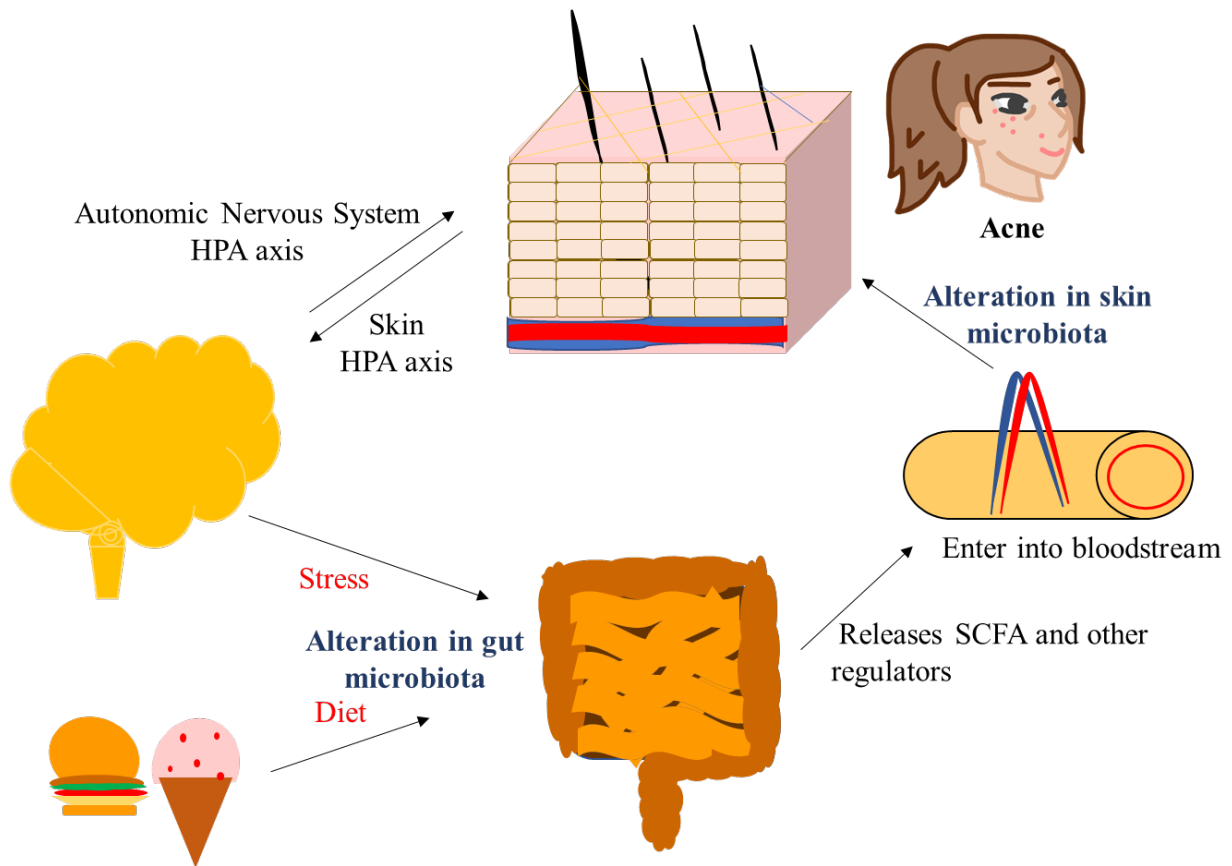


Fig 2: The proposed gut-brain-skin axis by Lee et al. (2019).

Relevance for Sustainable Development Goals and Grand Challenges

Non-communicable skin health conditions such as acne vulgaris can be discussed under Goal 3 of SDGs, which aims to ensure healthy lives and promote well-being for all age groups. The target also includes reducing mortality from non-communicable diseases through prevention and treatment, and promoting mental health and well-being by 2030.

During adolescence and adulthood, acne prevention and treatment can help individuals maintain physical and mental health, improve social behaviour, and help prevent youth suicides thereby contributing to a healthy society. It has been reported that more than 90% of the human population is affected by acne at some time in life. The cost of treating acne in the United States has been reported to exceed 3 billion dollars per year. By the end of the year 2026, it has been estimated that the Indian population affected by acne will reach 23 million.

In adolescence having serious skin conditions such as acne can increase the risk of physical, emotional, psychiatric and psychological challenges, affecting multiple dimensions of health-

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related quality of life (HRQoL). Moreover, the psychological impacts have been estimated to be similar to many diseases such as diabetes, arthritis, epilepsy or asthma.

Adolescence is a critical stage of psychological development, and individuals suffering from acne may experience reduced self-confidence, feel socially unattractive, and avoid social interactions with friends, peers, and surrounding social groups. A study published in the *Journal of Dermatology* reported such cases during the first year following acne diagnosis. Teenagers also tend to associate skin conditions such as eczema, warts, vitiligo, psoriasis and acne with poor hygiene, diet, and infections. A nationally representative dataset from the *National Longitudinal Study of Adolescent to Adult Health* provided evidence linking acne with education and labour market outcomes. Acne was shown to induce a shift from participation in social clubs towards higher intellectual pursuits, which may lead to higher grades and higher educational achievements.

Microbial literacy and Prevention of Acne in adolescents

Adopting healthy lifestyle choices early in life can help future generations and contribute to a healthier community. Microbial literacy is a step towards building a sustainable world of disease-free citizens. Awareness of the association between microbes and the human body is necessary for children to understand the role of diet, hygiene, exercise, and mental well-being.

Glossary

Balanced diet: a diet consisting of a variety of different types of food and providing adequate amounts of the nutrients necessary for good health.

Cutaneous dysbiosis: alteration in skin microbiota. This happens due to some external and internal factors.

Emotional: relating to a person's emotions.

Gut microbiome: communities of microorganisms that reside in the gut.

Halogenated hydrocarbons: also known as halocarbons, are hydrocarbons in which at least one hydrogen atom is replaced by a halogen atom, such as bromine, fluorine, or chlorine.

Hygiene: conditions or practices conducive to maintaining health and preventing disease, especially through cleanliness.

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Hyper cornification: an early feature of acne and usually precedes inflammation. It is associated with ductal hyperproliferation.

Puberty: the period during which adolescents reach sexual maturity and become capable of reproduction.

Sebaceous glands: small oil-producing glands in the skin dermis of mammals.

Skin homeostasis: skin homeostasis is achieved through protection, regulation of body temperature, sensory reception, water balance, synthesis of vitamins and hormones, and absorption of materials.

Skin microbiome: communities of microorganisms that reside on the skin.

Sustainable: able to be maintained at a certain rate or level.

The Evidence Base, Further Reading and Teaching Aids

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Suggested Readings :

1. <https://my.clevelandclinic.org/health/diseases/12233-acne>
2. <https://www.healthxchange.sg/head-neck/skin-health/acne-pimples-teenagers-causes>
3. <https://www.webmd.com/skin-problems-and-treatments/acne/what-is-acne>