



WHAT IS ACNE AND WHAT CAUSES IT?

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YOUNG REVIEWERS



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PILOSEBACEOUS UNIT

Hair follicle with
surrounding
sebaceous gland.

SEBACEOUS

Glands present in the
skin which produce an
oil called sebum and
release the oil onto the
skin surface.

Most people have experienced waking up with a bright red pimple on their faces. Pimples can be painful, embarrassing, and downright annoying! But what causes these pesky blemishes known as acne? And is there anything we can do to treat or prevent them? This article explores the common types of acne found in adolescents and what causes them. It also discusses treatments for acne and the impact of acne on a person's mental health and self-esteem.

WHAT IS ACNE?

Acne, which is formally called acne vulgaris, is the most common skin condition in the world. In fact, the word "vulgaris" is Latin for "common"! It is estimated that 85–90% of all adolescents (teenagers) experience acne at some point, so chances are almost everyone you know has dealt with acne in one form or another. Acne is a disease of the **pilosebaceous unit**, which is a hair follicle surrounded by an oil-producing (**sebaceous**) gland.

As you might have noticed on yourself, acne can show up on the skin in a few different forms (Figure 1). One way acne shows up is

COMEDONES

Skin pore or hair follicle clogged with oil, dead skin cells, or bacteria.

PAPULES

Deep inflammatory acne lesions that appear as red bumps on the surface of skin.

PUSTULES

Deep inflammatory acne lesions that appear as red bumps with a yellow or white pus-filled tip.

Figure 1

Acne forms within the pilosebaceous unit, and it can take on different forms. Pictured here are four different acne lesions (A) from the top and (B) in cross-section. Both whiteheads and blackheads are non-inflammatory keratin-clogged pores. Open comedones become black because the clogs react to oxygen in the air. Papules and pustules are both inflammatory acne, so they appear red on the skin and are often more painful than comedones. When inflammation occurs, immune cells collect in the pilosebaceous unit. Pustules are more severe and inflamed than papules. This figure was created using Notability.

as **comedones**, small bumps that happen when the hair follicle gets clogged with oil, dead skin cells, or bacteria. Comedones can either be open, which are commonly called blackheads, or closed, which are known as whiteheads. Blackheads appear black because, when the clogged pore becomes open to air, the clog reacts with oxygen and darkens. Blackheads and whiteheads tend to be fairly painless! If the comedones move deeper into the skin and become inflamed, acne can present on the skin as **papules** or **pustules**. Both are usually red and painful but the difference between them is that pustules will have a pus-filled tip that appears white or yellow on the skin's surface, whereas papules will not have this visible pus-filled tip. Cells of the immune system collect in the hair follicle and form pus, which is the yellow-white substance that can come out of papules and pustules if popped. Often, people with acne have a mix of these types of blemishes [1].

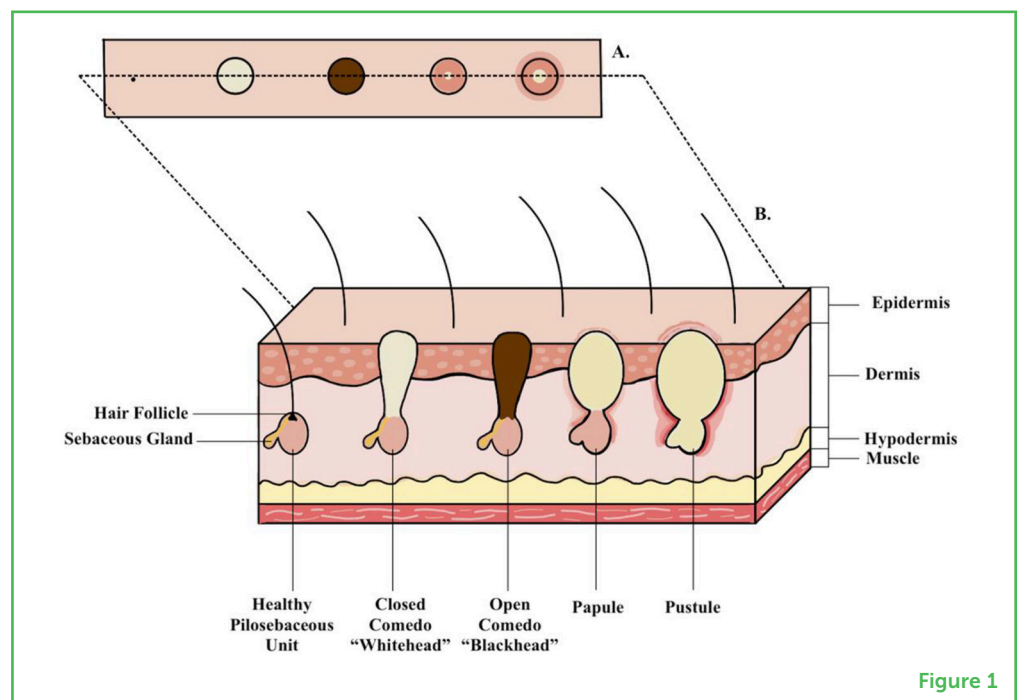


Figure 1

Other people may have what is called cystic acne, which is the most severe type of acne. Cystic acne occurs when inflammation becomes so severe that it extends beyond the pilosebaceous unit and moves deeper into the skin. Because cystic acne is so deep in the skin, it can present as large red bumps rather than the typical comedones of less severe acne. These cysts contain large amounts of pus, which makes them very painful and prone to scarring.

As with many skin conditions, acne can look different on people with different skin types (Figure 2). The Fitzpatrick skin types is a system that defines the six most common skin types, based on skin color and the tendency of skin to burn when exposed to UV light from the sun. The

Fitzpatrick skin types range from Type 1 (pale skin with a high tendency to burn), to Type 6 (dark skin with a lower tendency to burn) [2].

Figure 2

Examples of what different forms of acne might look like on each of the six Fitzpatrick skin types. The Fitzpatrick skin types are defined based on skin color and the tendency of skin to burn when exposed to UV light from the sun. In patients with skin type 6, acne can present as hyperpigmentation, which means the skin with the acne lesion will become darker than the surrounding skin. This figure was created using Notability.

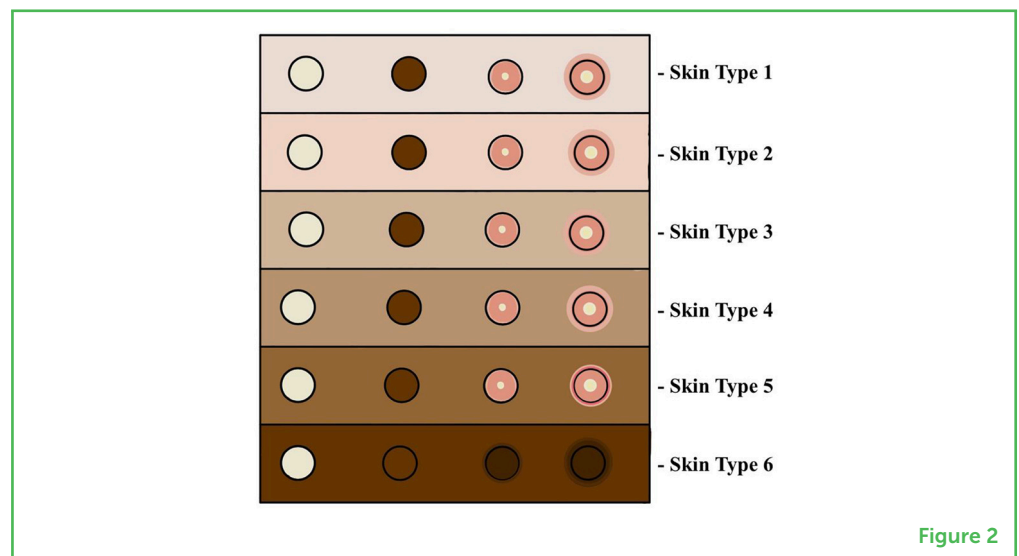


Figure 2

KERATINOCYTES

Cells that make up the epidermis, which is the top layer of the skin.

SEBUM

Oil produced by the skin that helps to maintain keratinocytes, but also serves as food for skin bacteria.

WHAT CAUSES ACNE VULGARIS?

What causes the pilosebaceous units to become clogged, inflamed, and form acne? There are four known factors that contribute to the development of acne in adolescents (Figure 3). The top layer of the skin, the epidermis, is made up of cells called **keratinocytes**. Normally, humans replace their entire epidermis every month! People with acne often have differences in skin turnover—their dead keratinocytes do not shed off like they are supposed to, and instead the keratinocytes build up and cause a keratin plug to form around the hair follicle. As adolescents go through puberty, their bodies produce higher levels of hormones, which tell the sebaceous glands surrounding the hair follicles to produce more of an oil called **sebum**. This combination of keratin plugs and increased sebum production can easily trap dirt and bacteria around the hair follicle, which forms comedones. A type of bacteria called *Propionibacterium acnes* normally lives on the skin, and these bacteria use sebum as their food source. The more sebum, the faster the bacteria can grow and divide. The increase in bacteria around the hair follicle can cause inflammation and lead to the production of pustules and papules. In summary, keratin plugs, increased sebum production, high levels of *P. acnes*, and inflammation are the best understood causes of acne in adolescents. There are also other components that can affect whether a person develops acne, such as genetics and diet [1, 3].

Some people might develop a specific type of acne known as hormonal acne, which is caused by the surge in hormones that occurs during the menstrual cycle. These people might find that the amount of acne they have correlates with the part of their cycle they are in.

Figure 3

Four main factors work together to cause acne.

(A) Keratin buildup causes a plug to form in the pilosebaceous unit. **(B)** Bacteria such as *P. acnes* live on the skin surface and cause infection and inflammation. **(C)** Increased hormone production during puberty can increase sebum production. **(D)** Inflammatory cells of the immune system come to the pilosebaceous unit and can cause papules and pustules to form. This figure was created using Notability.

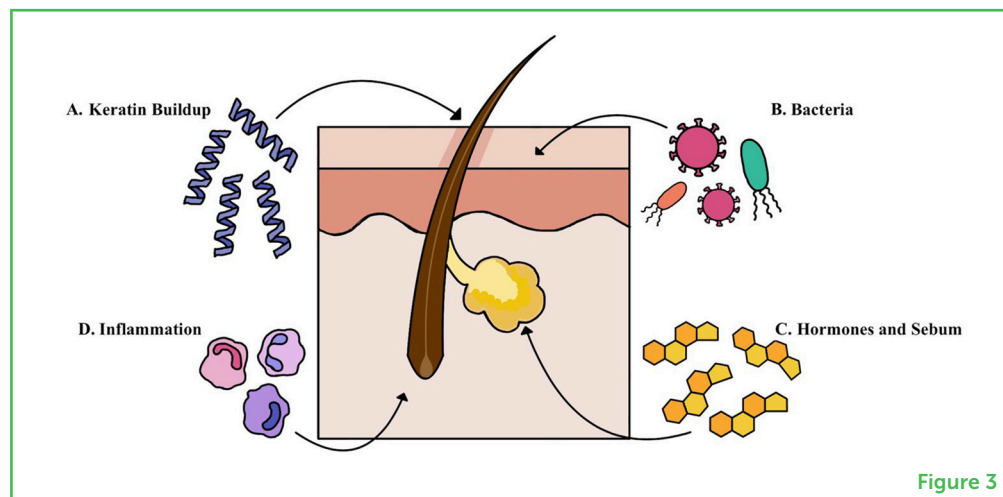


Figure 3

Hormonal acne can persist into adulthood and can sometimes be a symptom of underlying hormonal imbalances [1].

HOW DO DOCTORS TREAT ACNE?

There are many different treatments available for managing acne. Depending on how severe the acne is, treatments can range from washes and creams to oral antibiotics or vitamin A derivatives. Washes help to remove some of the sebum that builds up on the skin, which reduces the food available for *P. acnes*. Creams usually contain anti-inflammatory medicines, to reduce redness and swelling. Antibiotics kill acne-causing bacteria like *P. acnes* [1, 4]. Vitamin A derivatives, also known as **retinoids**, stimulate keratinocyte turnover and shedding, so that keratin plugs do not form. Retinoids can also decrease sebum production on the skin, and studies show that they may also decrease inflammation [4].

Antibiotics and retinoids are just two examples of common acne treatments, but there are many more! Dermatologists (doctors who specialize in treating skin conditions) can help their patients to figure out the best treatment plan. Even with treatment, some patients still struggle with acne into adulthood. Everyone's skin and genetics are different and, for some people, acne can be a life-long condition. Cystic acne usually requires treatment with oral medications, so be sure to talk to your dermatologist if you think you might have this severe type of acne. No matter what treatment a doctor recommends, it is important not to pop or pick at acne because this can introduce new bacteria into the skin and cause long-term scarring! Most treatments can take a few months to fully work, so patience and consistency are necessary.

RETINOIDS

Vitamin A derivatives that are used to treat acne by promoting keratinocyte turnover, decreasing sebum production, and lowering inflammation.

HOW DOES ACNE IMPACT A PERSON'S LIFE?

To summarize, acne vulgaris is a very common chronic skin condition in people of all ages, but it is especially common in adolescents. It is characterized by a variety of blemishes including open and closed comedones, and inflamed papules and pustules. Acne is caused by several factors including keratin plugs, sebum, bacteria, and inflammation, and there are many different ways to treat acne depending on the severity and individual preferences.

Acne generally appears on the face, chest, back, or shoulders—areas of the body that are easily visible. Because of this visibility, it is common for people with acne to feel insecure about their appearance. For some people, acne can cause anxiety, depression, and decreased self-esteem [5]. We should never negatively comment on someone's skin or make them feel bad for something that is out of their control. Almost everyone will struggle with acne at some point in their lives, so we must remember to treat others with the kindness we would want to be treated with in a similar situation.

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CONFLICT OF INTEREST: JR is an inventor on patents targeting CXCR3 and IL15 for the treatment of vitiligo.

The remaining author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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We are a group of 20 13-year-olds who attend the sixth grade. In addition to feeling good and having fun together, we share a curiosity for science and research. Our favorite subjects are maths, physics, science and English.



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Jenna Mulhearn is a third-year medical student at the University of Massachusetts. She earned her B.S. in nursing from Boston College and spent 3 years working as a nurse before starting medical school. Jenna currently hopes to work as a dermatologist someday, but she is excited to learn about many different fields in medicine. When not studying, you can find Jenna running, hiking, or spending time at the beach with her family and friends. *jenna.mulhearn@umassmed.edu



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