Introduction

The term immunity is derived from the Latin word "*immunis*"
The main function of the immune system is to **prevent or limit infections**, bacteria, fungi,Virus and parasites, such as protozoa and Worms.The first line of defense against microorganisms the **innate arm** of the immune system is available to destroy the invaders. Because the components of the innate arm are preformed and fully active ,they can function immediately upon entry of the microorganisms. The ability of the innate arm to kill microorganisms **is not specific**. For example, a neutrophil can ingest and destroy many different kinds of bacteria .**Highly specific** protection is provided by the **adaptive(acquired)** arm of the immune system , but it takes several days for this arm to become fully functional .

Types of Immunity

The recognition of microorganisms and foreign substances is the first event in immune responses of a host.The body's defense mechanisms can be divided into: **(*a*) innate (natural) immunity and (*b*) acquired (adaptive) immunity.**

Factors influencing innate immunity

I-Age: Extremes of age make an individual highly susceptible to various infections. This is explained in part by the immature immune system in very young children and waning immunity in older individuals. The fetus-in-utero is usually protected from maternal infections by the placental barrier. However, human immunodeficiency virus (HIV), rubella virus, cytomegalovirus, and Toxoplasma gondii cross the placental barrier and cause congenital infections. Very old people are susceptible to suffer more than young people from a disease (e.g., pneumonia) and have high mortality.

II-Nutritional status: Nutritional status of the host plays an important role in innate immunity.. Examples are:

■ Neutrophil activity is reduced, interferon response is decreased, and C3 and factor B of the complement are decreased in protein–calorie malnutrition.

■ Deficiency of vitamin A, vitamin C, and folic acid makes an individual highly susceptible to infection by many microbial pathogens.

III-Hormonal levels: Individuals with certain hormonal disorders become increasingly susceptible to infection. For example, individuals suffering from diabetes mellitus, hypothyroidism, and adrenal dysfunction are increasingly susceptible to staphylococcal infection, streptococcal infection, candidiasis, aspergillosis, and many other microbial infections. Similarly, pregnant women are more susceptible to many infections due to higher level of steroid during pregnancy.

Mechanisms of innate immunity

Innate immunity of the host performs two most important functions: **it kills invading microbes and it activates acquired (adaptive) immune processes.** Innate immunity unlike adaptive immunity, however, **does not have any memory and does not improve after re-exposure to the same microorganism**.

The innate immunity is primarily dependent on four types of defens ive barriers: **(*a*) anatomic barriers, (*b*) physiologic barriers, (*c*) phagocytosis, and (*d*) inflammatory responses.**

A-Anatomic barriers: Anatomic barriers include skin and mucous membrane. They are the most important components of innate immunity.They act as mechanical barriers and prevent entry of microorganisms into the body. The intact skin prevents entry of microorganisms. For example, breaks in the skin due to scratches, wounds, or abrasion cause infection. Bites of insects harboring pathogenic organisms (e.g., mosquitoes, mites, ticks, fleas, and sandflies), introduce the pathogens into the body and transmit the infection. **Skin secretes sebum,** which prevents growth of many microorganisms. **The sebum consists of lactic acid and fatty acids that maintain the pH of skin between 3 and 5, and this pH inhibits the growth of most microorganisms.** Mucous membranes form a large part of outer covering of gastrointestinal, respiratory, genitourinary, and many other tracts of human host. A number of nonspecific defense mechanisms act to prevent entry of microorganisms through mucous membrane.

■ **Saliva, tears, and mucous** secretions tend to wash away potential invading microorganisms, thereby preventing their attachment to the initial site of infections. These secretions also contain antibacterial or antiviral substances that kill these pathogens.

■ **Mucus** is a viscous fluid secreted by the epithelial cells of mucous membranes that entraps invading microorganisms.

■ **In lower respiratory tract, mucous membrane is covered by cilia**, the hair-like protrusions of the epithelial cell membranes. The synchronous movement of cilia propels mucus entrapped microorganisms from these tracts.

B-Physiologic barriers: The physiologic barriers that contribute to innate immunity include the following:

■ **Gastric acidity is an innate physiologic barrier** to infection because very few ingested microorganisms can survive the low pH of stomach contents.

■ **Lysozyme, interferon , and complement** are some of the soluble mediators of innate immunity. **Lysozyme** has antibacterial effect due to its action on the bacterial cell wall. **Interferons** are secreted by cells in response to products of viral infected cells. These substances have a general antiviral effect by preventing the synthesis of viral structural proteins. **Complement** is a group of serum-soluble substances that when activated damage the cell membrane.

C-Phagocytosis: Phagocytosis is another important defense mechanism of the innate immunity. Phagocytosis is a process of ingestion of extracellular particulate material by certain specialized cells, **such as blood monocytes, neutrophils, and tissue macrophages.**

D-Inflammatory responses: Tissue damage caused by a wound or by an invading pathogenic microorganism induces a complex sequence of events, collectively known as the inflammatory responses.

Adaptive (Acquired) Immunity

Adaptive immunity is also called acquired immunity. Active immunity is mediated by **humoral immunity and cell-mediated immunity**. These two types of immunities are mediated by different components of the immune system and function in different ways to kill different types of pathogens.

I- Humoral immunity: It is mediated by molecules in the blood and mucosal secretions **called antibodies.** The antibodies are secreted by a subset of lymphocytes **known as B cells**. The antibodies recognize microbial antigens, combine specifically with the antigens, neutralize the infectivity of microbes, and target microbes for elimination by various effector mechanisms. Humoral immunity is the principal defense mechanism against extracellular microbes.

II- Cell-mediated immunity: It is mediated by both activated **helper T(TH) cells and cytotoxic T lymphocytes/ cells (CTLs).** Cytokines secreted by TH cells activate various phagocytic cells, enabling them to phagocytose and kill microorganisms. This type of cell-mediated immune response is especially important against a host of bacterial and protozoal pathogens. CTLs play an important role in killing virus-infected cells and tumor cells.

Types of acquired immunity

It is of two types: active immunity and passive immunity.

I- Active immunity

The immunity induced by exposure to a foreign antigen is called active immunity. Active immunity is the resistance developed by an individual after contact with foreign antigens, e.g., microorganisms

The active immunity is of two types**: natural active immunity and artificial active immunity.**

A- Natural active immunity: It is acquired by natural clinical or subclinical infections. Such natural immunity is long lasting. For example, individuals suffering from smallpox become immune to second attack of the disease.

B- Artificial active immunity: It is induced in individuals by vaccines.

II-Passive immunity

When immunity is conferred by transfer of serum or lymphocyte from a specifically immunized individual, it is known as passive immunity. Passive immunity may be **natural or artificial.**

A-Natural passive immunity: It is observed when IgG is passed from mother to fetus during pregnancy. Natural passive immunity is also observed by passage of IgA from mother to newborn during breast feeding.

B-Artificial passive immunity: It is induced in an individual by administration of preformed **antibodies**, generally in the form of antiserum, raised against an infecting agent. Administration of these antisera makes large amounts of antibodies available in the recipient host to neutralize the action of toxins.

Important Features of Innate and Adaptive Immunity

Type of Immunity	Specificity	Effective Immediately After Exposure to Microbe	Improves After Exposure	Has Memory
Innate	Nonspecific	Yes—acts within minutes	No	No
Adaptive	Highly specific	No—requires several days before becoming effective	Yes	Yes

Differences between passive and active immunity

Passive immunity	Active immunity
No active host participation; received passively	Produced actively by host's immune system
Antibodies transferred directly	Antibodies induced by infection or by immunogens
Passive immunity is due to readymade antibodies	Active immunity often involves both the cell-mediated and humoral immunity
Types: *Natural*—transfer of maternal antibodies through placenta; *Artificial*—injection of immunoglobulins	Types: *Natural*—clinical or inapparent infection; *Artificial*—induced by vaccines
Immediate immunity; no lag period	Immunity effective only after lag period
Applicable even in immunodeficient	Not applicable in immunodeficient
No immunological memory	Immunological memory present
Subsequent dose less effective due to immune elimination	Booster effect on subsequent dose