

Difference Between Primary and Secondary Immune Response

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Key Difference – Primary vs Secondary Immune Response

Humans and other animals live in an environment that is heavily populated by microorganisms. Some microbes are pathogenic and cause various types of [infections](#). The [immune system](#) is the natural defense system of our body and the first line of defense designed to fight off against all potential risks that make us sick. It is made up of a network of cells, tissues and organs working together for the protective function. [White blood cells](#) are the most important defense cells found in the blood stream and [lymphoid](#). There are different types of white blood cells such as [T cells](#), [B cells](#), [macrophages](#), and [neutrophils](#). When an [antigen](#) ([bacteria](#), [virus](#), [parasites](#), [fungi](#), [toxin](#), etc.) enters our body, the immune system reacts against the foreign particle and prevents the initiation of an infection. The reaction of the cells and fluids of the immune system against the foreign invading particle or [pathogen](#) is known as an immune response. There are two types of immune responses named primary immune response and secondary immune response. **Primary immune response occurs when an antigen contacts immune system for the first time. Secondary immune response occurs when the immune system is exposed to the same antigen for the second and subsequent times.** This is the key difference between primary and secondary immune response.

What is Primary Immune Response?

The immune system is evolved to combat various types of infections using diverse mechanisms. These mechanisms work together to respond to the invading pathogen or the antigen. When the antigen meets the immune system for the first time, the reaction that results from the immune cells and fluids is the primary immune response. Here, the immune system is exposed to the threat for the first time. Hence, it takes a longer time to recognise the antigen and react against it. In general, the lag phase of the primary immune response goes several days to weeks without producing antibodies against the pathogen.

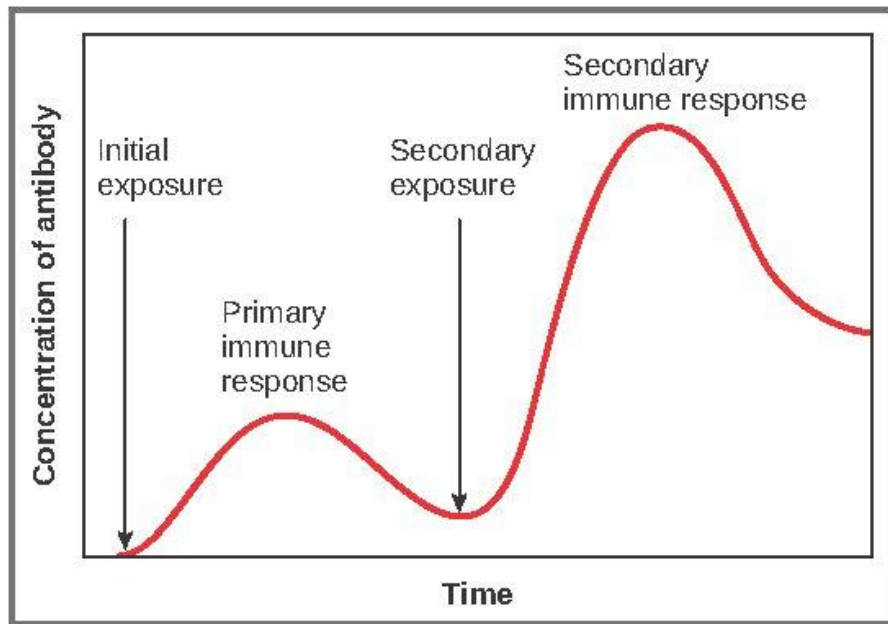


Figure 01: Primary and Secondary Immune Responses

The duration of the lag phase depends on the nature of the antigen it encounters and the site of antigen entry. A low amount of antibodies is produced during the primary immune response by the naive B cells and T cells. The primary immune response appears mainly in [lymph nodes](#) and [spleen](#). First antibodies produced are [IgMs](#). Compared to [IgG](#), IgM antibodies are produced more, and these antibodies drastically decline with time.

What is Secondary Immune Response?

The secondary immune response is the reaction of the immune system when an antigen contacts with it for the second and subsequent times. Since the immune cells have been exposed to the antigen previously, the establishment of immunity against the antigen is quick and strong. With the previous immunological memory, the immune response occurs immediately and starts making antibodies. Hence, the lag phase is very short in secondary immune response due to the presence of memory cells produced by B cells. The amount of produced antibodies is high in secondary immune response, and they remain for a longer time, providing a good protection to the body. Within a short time, the level of the antibody rises to the peak. The main type of antibody produced is IgG. However, a small amount of IgM is also produced during the secondary immune response.

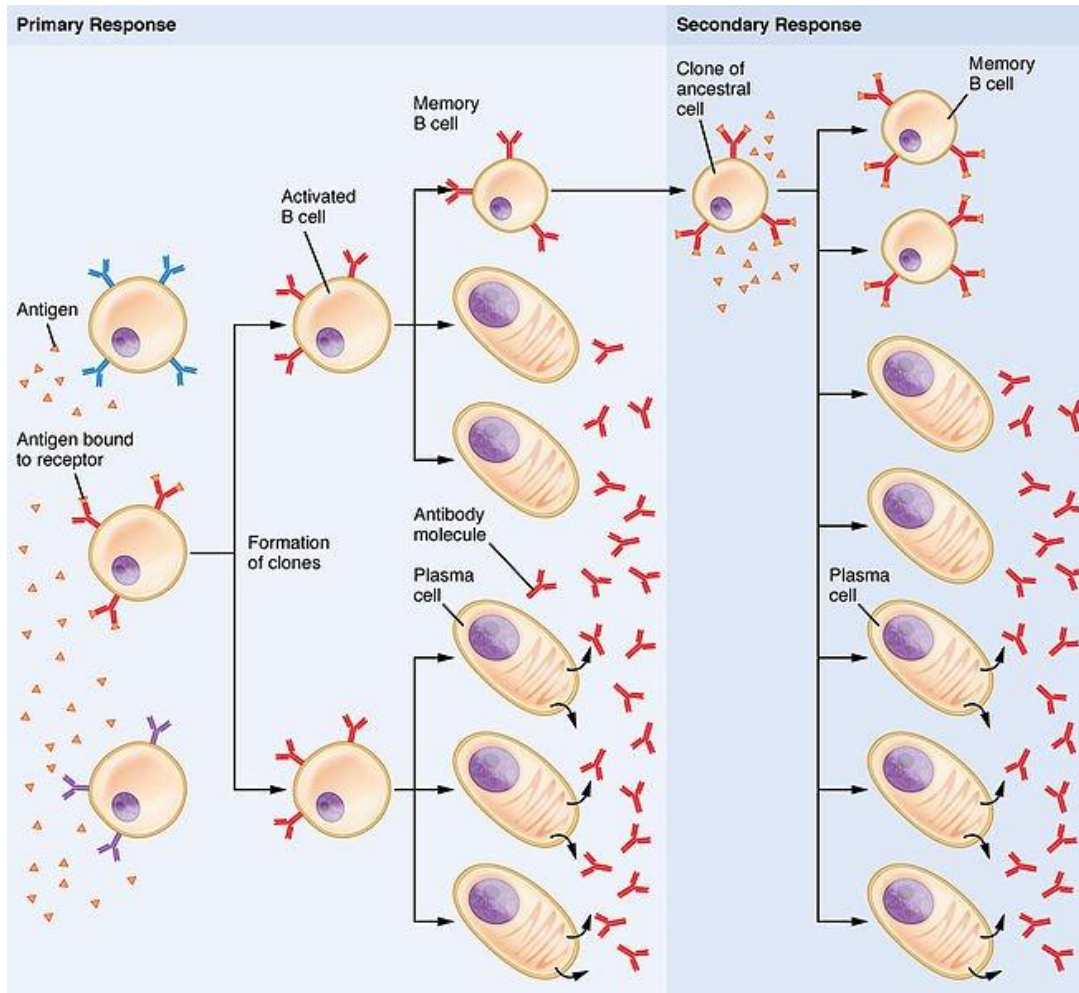


Figure 02: Memory cells involved in Immune Response

Secondary immune response is mainly carried out by memory cells. Hence, the specificity is high, and the antibody affinities with antigens are also high in secondary immune response. Therefore, secondary immune response is considered to be more effective and stronger than primary immune response.

What is the difference between Primary and Secondary Immune Response?

Primary vs Secondary Immune Response

Primary Immune Response is the reaction of the immune system

Secondary Immune Response is the reaction of the immune system when it

when it contacts an antigen for the first time.

contacts an antigen for the second and subsequent times.

Responding Cells

B cells and T cells are the responding cells of the primary immune response.

Memory cells are the responding cells of the secondary immune response.

Time Taken to Establish Immunity

Primary immune response takes a longer time to establish immunity.

Secondary immune response takes a shorter time to establish immunity.

Amount of Antibody Production

Generally, low amounts of antibodies are produced during the primary immune response.

Generally, high amounts of antibodies are produced during the secondary immune response.

Type of Antibodies

IgM antibodies are mainly produced during this immune response. A small amount of IgG is also produced.

IgG antibodies are mainly produced during this immune response. Small amounts of IgM are also produced.

Antibody Affinity for Antigen

Affinity of the antibodies towards antigens is less.

Affinity of the antibodies towards antigens is high.

Antibody Level

Antibody level declines rapidly during primary immune response.

Antibody level remains high for a longer period during the secondary

	immune response.
Location	
Primary immune response appears mainly in lymph nodes and spleen.	Secondary immune response appears mainly in bone marrows, then in lymphs and spleen.
Strength of the Response	
Primary immune response is usually weaker than secondary immune response.	Secondary immune response is stronger.

Summary – Primary vs Secondary Immune Responses

Immune responses can be categorized as primary and secondary immune responses. Primary immunity response occurs when an antigen contacts the immune system for the first time. Primary immune response takes a longer time to establish immunity over the antigen. Secondary immune response occurs when the same antigen contacts the immune system for the second and subsequent occasions. Due to immunological memory, secondary response rapidly establishes the immunity over those antigens. Primary immune response is done by naïve B cells and T cells. Secondary immune response is done by memory cells. This is the difference between primary and secondary immune response.

References:

1. Chaplin, David D. "Overview of the Immune Response." The Journal of allergy and clinical immunology. U.S. National Library of Medicine, Feb. 2010. Web. [Available here](#). 12 July 2017.
- 2."Primary Immune Response and Secondary Immune Response." New Health Advisor. N.p., 28 Oct. 2015. Web. [Available here](#). 13 July 2017.

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