



## **The roles of Neutrophils in pregnancy**

**\*Emmanuel Ifeanyi Obeagu<sup>1</sup>, Solomon Matthias Gamade<sup>2</sup> and  
Getrude Uzoma Obeagu<sup>3</sup>**

<sup>1</sup>Department of Medical Laboratory Science, Kampala International University, Uganda,  
<https://orcid.org/0000-0002-4538-0161>

<sup>2</sup>Department of Medical Laboratory Science, Faculty of Allied Health Sciences, Bingham  
University Karu, Nasarawa State, Nigeria, <http://orcid/0000-0002-7631-8782>

<sup>3</sup>School of Nursing Science, Kampala International University, Uganda,

### **Abstract**

Neutrophils are a type of white blood cell that play an important role in the immune system's response to infection and inflammation. During pregnancy, the immune system undergoes significant changes to tolerate the growing fetus, and neutrophils have been shown to contribute to this process in several ways. One of the most important roles of neutrophils in pregnancy is to help maintain a delicate balance between immune tolerance and protection against infection. Neutrophils play a crucial role in controlling the growth of harmful bacteria that can lead to preterm labor, and also participate in the formation of the placenta and fetal membranes. Neutrophils can help regulate the inflammatory response during pregnancy, which is critical to prevent excessive inflammation and tissue damage. Neutrophils have also been shown to contribute to the development of immune tolerance, which is essential for the survival of the fetus. However, while neutrophils play many important roles in pregnancy, they can also contribute to complications such as preeclampsia, preterm labor, and fetal growth restriction when their activity is dysregulated. It is important to continue research into the mechanisms by which neutrophils contribute to pregnancy outcomes, as well as to develop new therapies that can target these cells to prevent or treat pregnancy complications.

**Keywords:** neutrophils, pregnancy, inflammation, cytokines

### **Introduction**

Pregnancy is the state of carrying a developing fetus within the female reproductive system, typically lasting for around 40 weeks [1-4]. During pregnancy, the body undergoes significant physiological changes, including changes in hormone levels, metabolism, cardiovascular system, and immune system. These changes are

necessary to support the growth and development of the fetus, as well as prepare the body for childbirth and postpartum recovery [5-9].

Neutrophils are known to produce various cytokines and growth factors that are essential for implantation and placental development. Studies have shown that neutrophils produce granulocyte-macrophage colony-stimulating factor (GM-CSF),

which promotes trophoblast differentiation and invasion [10]. Additionally, neutrophils produce vascular endothelial growth factor (VEGF), which is involved in angiogenesis and placental development [11].

During pregnancy, the maternal immune system undergoes significant changes to accommodate the developing fetus. Neutrophils play a crucial role in modulating the maternal immune response by regulating the production of cytokines and chemokines. Studies have shown that neutrophils produce interleukin-10 (IL-10), which is an anti-inflammatory cytokine that helps to suppress the maternal immune response and prevent fetal rejection [12-14].

Also, during pregnancy, the risk of infection is increased due to changes in the immune system and hormonal fluctuations. Neutrophils play a critical role in protecting against infections by phagocytizing and killing invading pathogens. Studies have shown that neutrophils produce various antimicrobial peptides, such as defensins and cathelicidins, which are effective against a wide range of pathogens [15].

## **Pregnancy**

Pregnancy is a unique and transformative experience in a woman's life that involves physical, emotional, and social changes [16].

During the first trimester of pregnancy, the fertilized egg implants in the uterus, and the body undergoes significant changes to support fetal development [17]

As the pregnancy progresses, the fetus undergoes significant growth and development, and the mother's body continues to adapt to support this process. For example, during the second trimester, the fetus develops organs such as the lungs, brain, and liver, and the mother's body undergoes physical changes such as weight gain and the expansion of the uterus [18].

The third trimester is characterized by increased fetal growth and development, as well as the preparation for labor and delivery. During this

time, the mother may experience physical discomfort due to the size of the fetus and the pressure on her organs [19].

## **Neutrophils**

Neutrophils are the most abundant type of white blood cells (WBCs) in the human body and play a crucial role in innate immunity against infections [20]. These cells are produced in the bone marrow and circulate in the blood, where they can quickly migrate to sites of infection or tissue damage [21]. Neutrophils are characterized by their multi-lobed nucleus and the presence of granules containing enzymes and other substances that help them to kill invading microorganisms. Neutrophils use a variety of mechanisms to eliminate pathogens, including phagocytosis, the release of antimicrobial peptides, and the formation of neutrophil extracellular traps (NETs) [22].

One of the key functions of neutrophils is phagocytosis, the process by which they engulf and digest invading microorganisms. Neutrophils use surface receptors to recognize and bind to pathogens, and then internalize them within a membrane-bound vesicle called a phagosome. The phagosome then fuses with lysosomes, which contain enzymes that break down the pathogen [23].

In addition to phagocytosis, neutrophils can also release antimicrobial peptides and proteins that kill bacteria and fungi. For example, neutrophils can release defensins, small cationic peptides that disrupt bacterial membranes [24].

Finally, neutrophils can also form NETs, which are web-like structures composed of DNA, histones, and other antimicrobial proteins. NETs can trap and kill bacteria, fungi, and other pathogens, but can also contribute to tissue damage in some conditions [25].

## **Roles of neutrophils in pregnancy**

Neutrophils play important roles in pregnancy by contributing to immune tolerance, protecting against infections, and promoting tissue remodeling. Here are some relevant studies discussing these roles [26]

## Immune tolerance

During pregnancy, the maternal immune system must tolerate the semi-allogeneic fetus to prevent rejection. Neutrophils may contribute to this tolerance by promoting the generation of regulatory T cells (Tregs), which can suppress immune responses [27]. Protection against infections: Neutrophils are important in protecting against infections during pregnancy, which can be particularly dangerous for the developing fetus [28].

## Tissue remodeling

Neutrophils can also contribute to tissue remodeling during pregnancy by secreting enzymes that break down extracellular matrix proteins. This process is important for placental development and remodeling of the cervix in preparation for delivery [29].

Regulation of inflammation: Neutrophils also play a critical role in regulating inflammation during pregnancy. Inflammation is a double-edged sword that can protect against infections, but also induce tissue damage and preterm labor. Neutrophils can secrete cytokines and chemokines that recruit other immune cells to the site of infection and initiate the inflammatory response. However, neutrophils can also release anti-inflammatory molecules, such as interleukin-10, that dampen inflammation and promote tissue repair [30].

## Conclusion

Neutrophils are a type of white blood cells that play an essential role in the immune system. They are the first cells to respond to infection and inflammation and are involved in tissue repair and removal of debris. During pregnancy, the immune system undergoes significant changes to accommodate the growing fetus, and neutrophils' role in this process is maintaining pregnancy by regulating the inflammatory response and preventing preterm birth. They also contribute to placental development and fetal growth by promoting angiogenesis and providing nutrients. However, an excessive or dysregulated neutrophil response can lead to adverse pregnancy outcomes,

such as preterm labor, preeclampsia, and fetal growth restriction.

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