

Insulin Function: Receptors

Insulin is a peptide hormone that regulates various metabolic processes in the body. It binds to insulin receptors, which are receptor tyrosine kinases, and activates key signaling pathways, such as the PI3K and MAPK pathways. These pathways help regulate glucose uptake, glycogen synthesis, protein synthesis, and cell growth.



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Receptors

Tyrosine Kinase Receptor

Tire Kite-ace Receptor

The insulin receptor (IR) is a transmembrane receptor belonging to the receptor tyrosine kinase (RTK) family. It is a heterotetramer composed of two extracellular alpha subunits and two transmembrane beta subunits. The alpha subunits serve as the binding site for insulin, while the beta subunits span the membrane and contain intracellular tyrosine kinase domains. Insulin binding to the alpha subunits induces autophosphorylation of tyrosine residues on the intracellular domains of the beta subunits, which activates two major signaling pathways. The first is the phosphatidylinositol 3-kinase (PI3K) pathway, which mediates insulin's metabolic effects, such as glucose uptake via GLUT4 translocation, glycogen synthesis, and inhibition of gluconeogenesis. The second is the mitogen-activated protein kinase (MAPK) pathway, which is involved in mitogenesis and growth.

Growth Factor

Growth-fertilizer Factory

Growth factors (GFs) are signaling molecules, often proteins, that bind to specific receptors on the surface of target cells and, in doing so, initiate downstream signaling. Insulin, a peptide hormone with growth-promoting effects, functions similarly to GFs by binding to a receptor tyrosine kinase and activating downstream signaling pathways, including MAPK (Mitogen-Activated Protein Kinase) and PI3K (Phosphoinositide 3-Kinase). GFs regulate several cell processes, such as proliferation, differentiation, and migration. There are many families of GFs. Some examples include the epidermal growth factor (EGF) family, vascular endothelial growth factor (VEGF) family, platelet-derived growth factor (PDGF) family, and others. Additionally, certain cytokines, such as those in the tumor necrosis factor (TNF) superfamily, have overlapping functions with growth factors.

Stimulates IGF-1

Insect-syringe-like Growth with (1) Wand

Insulin-like growth factor (IGF), formerly called somatomedin C, is a peptide hormone that primarily functions to stimulate growth. There are two IGFs: IGF-1 and IGF-2. Despite the similarity of their names, these two peptides have different, specific actions on tissues. IGF-2 is primarily involved in fetal growth. IGF-1, however, is active postnatally. IGF-1 acts on almost every tissue in the body to promote hypertrophy and hyperplasia via the upregulation of anabolic processes. Both insulin and pituitary growth hormone (GH) stimulate hepatic IGF-1 synthesis and secretion. IGF-1 can activate both its own IGF receptor and the insulin receptor and, thus, has some ability to decrease blood glucose levels as well. However, IGF-1 is far less potent than insulin in decreasing blood glucose concentrations.