

The Synergistic Roles of Vitamin C, Vitamin D and Zinc in Immune Functions

Defense	Vitamin C	Vitamin D	Zinc
Skin and mucosal barriers	Collagen synthesis (improved strength)	Proliferation / maturation of keratinocytes	Cellular proliferation (thickness maintenance)
		Formation of permeability barrier in the skin	
Neutrophils, Monocytes, Macrophages	Protection of neutrophils against oxidative stress-induced damage	Improved chemotaxis and phagocytic capabilities	Deficiency impairs phagocytosis
	Improved motility and chemotaxis		
	Enhanced killing	Production of antimicrobial proteins (defensin β 2, cathelicidin)	
	Overall improvement of phagocytosis		
Antigen Presenting Cells		Cytokine modulation	
		Promotion of more toleragenic state	
		Induction of regulatory T-cells	
B-Lymphocytes and T-lymphocytes	Proliferation	Control of B-cell activation and proliferation, of clinical importance for autoimmune diseases	Proliferation of stem cells
		Direct and indirect effects on T-cells	Proliferation and appropriate response B and T-cell differentiation and interaction
		Cytokine modulation	Balance of Th1 and Th2
		Shift from pro-inflammatory to a more tolerogenic status	Antibody production by B-cells
			Destruction of infected tissue cells and tumors
Interferon	Production enhanced		

