

## **Immunotherapy of chronic fatigue syndrome: therapeutic interventions aimed at modulating the Th1/Th2 cytokine expression balance.**

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### Abstract

Based on the postulates of viral and autoimmune aetiologies of CFS, several interventions have been designed and tested by different research groups around the world, including the United States, Sweden, United Kingdom, Italy, and Japan. This review addresses those interventions aimed at altering the balance of certain cytokines, the mediators of immune responses.

Patients with CFS who show evidence of activation of the immune system have poor immune cell function and a predominance of what is called a T-helper (Th)2-type cytokine response when their lymphocytes are activated. A Th2-type response, which is characterized by production of cytokines such as interleukin (IL)-4, -5, and -10, favours the function of B lymphocytes, the cellular factories of immunoglobulins. A predominance of a Th2-type response is therefore consistent with pathologies, such as autoimmunity and atopy, which are based on inappropriate production of immunoglobulins.

Many of the CFS therapies discussed decrease the Th2-type predominance seen at baseline in CFS patients, thereby allowing a greater predominance of a Th1-type response, which favours the function of macrophages and natural killer cells. The function of the latter cells, which have the natural ability of directly destroying invading microbes and cancer cells, is defective in untreated CFS patients. Typical Th1-type cytokines include IL-2 and interferon-gamma, and some of the therapies induce their production.

The interventions discussed in this review cover a wide spectrum of therapeutic tools ranging from lymph node cell immunotherapy, herbal products, and small molecules to vaccines. Despite the controversies on the aetiology of CFS, immunotherapy research is useful and necessary.