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The SLC Superfamily: A New Genetic Approach to Understanding Multiple Chemical Sensitivity

Multiple Chemical Sensitivity (MCS) is a recognized disability, characterized by an intolerance to ubiquitous chemicals. After repeated exposure to chemicals, one's body, notably, their sensory systems, become highly sensitized to the harmful substances, which include volatile organic compounds (VOCs, which include benzene, xylene, acetone, formaldehyde, etc.), fragrances, paint solvents, pollutants, scents emerging from new furnishings, etc. MCS patients sense and react to these ubiquitous chemicals at levels which would be completely undetected by controls. The symptomatic profile of MCS is multi-fold. The effects of the condition are observed in the respiratory, nervous, immune, dermatological, musculoskeletal, cardiovascular, and gastrointestinal systems.

Though there has been no confirmed etiology, many studies have shown that the root mechanism of MCS lies in an intricate relation between the nervous and immune systems. The nervous system is responsible for detecting internal changes and our immediately surrounding environment, while the immune system responds to any foreign stimuli. A key feature of MCS is hyperosmia, or a heightened sensation and reactivity of smell, which is observed in 97% of the patients. A study using fruit flies has shown that manipulation of the eaat2 gene leads to hyperosmia. An analogous gene found in humans would belong to the SLC-family of genes. These genes code for transmembrane transporter proteins which can transport charged compounds, and small molecules such as amino acids. Relevant to MCS, these proteins also transport neurotransmitters. Neurotransmitters are molecules which allow for neurotransmission, aiding the nerves to communicate and send signals throughout the body to detect change. These changes can be triggered through a bottom-up (detecting changes in the environment) or a top-down (the brain sends a signal to react) processes. Changes in the SLC-genes impact the transport of neurotransmitters, thereby, affecting their synthesis, release, and removal. Changes in neurotransmission can have immense ramifications such as hypersensitivity, or a lack of sensation. Hence, could genetic changes to the SLC-family of genes be a contributor to MCS

A study by Alcorta and Gomez-Diaz (2025) set out to understand the genetic implications of SLC genes on MCS. Their sample consisted of 6 MCS patients and 5 controls. The researchers used a whole exome sequencing method, to analyse low-frequency genes, which are present in less than 5% of the population. There were 4 groups of genes which were analysed. All four groups have been hypothesized to contribute to MCS, and one of the groups was the SLC-family. The most important difference between the control and patient groups was the homozygosity (2-copies of the same allele*) of the SLC-family. Notably, the homozygous SLC6A1/ A4, and SLC13A3/ A4 genes were present in significantly greater levels in patients, compared to controls. These genes code for distinct proteins which would transport GABA, and glycine. The two are neurotransmitters, and the former is the major inhibitory neurotransmitter. A lack of GABA neurotransmitters would greatly increase the excitatory potential of nerves. The SLC genes have also been observed to cause an epileptic state in fruit fly models.
This correlation links to a case study conducted by Kakisaka et al. (2017), involving a patient who suffered from MCS, and seizures. She was prescribed to use levetiracetam, a drug whose function is to treat epilepsy and seizures. Interestingly, the drug helped with the epileptic

symptoms and also relieved her symptoms of MCS. This further adds support to the link between SLC-genes and MCS. Though the sample size of the study by Alcorta and Gomez-Diaz (2025) was fairly low, it gives support for a larger genetic study. Establishing the connection between specific genes and the incidence of MCS would lead to major changes for the broader MCS community. It would enhance the acceptance of MCS by the scientific community, establish an accurate pathophysiology, and lead to the development of appropriate diagnostic and therapeutic management.

*Alleles are alternative forms of a gene. Each individual has 2 alleles of every gene. Homozygous refers to an individual having 2 identical alleles, while heterozygous refers to an individual having different alleles.

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