

# Multiple chemical sensitivity syndrome, an integrative approach to identifying the pathophysiological mechanisms

## KEY MESSAGES AND SUMMARY

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Gaétan Carrier, Marie-Ève Tremblay and Rollande Allard

**What is the etiology of SCM syndrome? This is the question that many international scientists have tried to answer. With this report and with the scientific progress made since the 2000s, the following questions have been answered: Is there a link with exposure to odorants? Are there biological alterations that explain the symptoms? Is chemical sensitivity really the cause of this syndrome?**

### Key messages

Multiple chemical sensitivity syndrome (MCS) is a chronic disorder characterized by multiple recurrent non-specific symptoms triggered or exacerbated by exposure to odours present in the environment at low concentrations—concentrations tolerated by most people.

People who are the most severely affected suffer from a chronic impairment that prevents them from functioning normally in their social and professional lives.

Various epidemiological studies have found different levels of prevalence of MCS in the general population, ranging from 0,5% to 3% for cases diagnosed by a doctor. This figure can be as high as 32% when self-diagnosed cases are included.

In Canada, the number of annual medical consultations for individuals suffering from MCS greatly exceeds that of a comparable control population.

Against this backdrop, Québec's ministry of health and social services, Ministère de la Santé et des Services sociaux (MSSS), entrusted Québec's public health institute, Institut national de santé publique du Québec (INSPQ), with a mandate to formulate a scientific opinion on the current state of knowledge concerning the scientific and medical aspects of MCS.

An exhaustive analysis of more than 4 000 articles in the scientific literature led to the following findings:

- Over the past two decades advances in neuroscience and the availability of new techniques for measuring biological parameters and performing functional brain imaging have shed light on the pathophysiological mechanisms underlying MCS. These developments confirm that the psychological, biological, and social aspects of MCS are inextricably linked.

- Affected individuals perceive odours as a threat to their health. When they detect odours, they experience acute stress symptoms that manifest as ailments that they attribute to the chemical products associated with these odours.
- This cascade of reactions triggers and perpetuates biological changes in the normal functioning of the individuals' immune, endocrine, and nervous systems.
- The nervous system is impacted mainly at the level of the limbic system structures involved in emotion, learning, and memory.
- Collectively, the observed alterations explain the chronic and polysymptomatic experience reported by those suffering from MCS, which includes alterations in mood and cognitive functions, sleep disturbances, fatigue, loss of motivation, and the inability to feel pleasure. As a result, affected individuals are also more susceptible to the development of a variety of physical and psychological problems.
- These alterations are not specific to MCS. They are also reported for chronic fatigue syndrome, post-traumatic stress disorder, electromagnetic hypersensitivity, fibromyalgia, depression, somatization disorder, phobias, and panic disorder. All of these disorders have in common is the presence of chronic anxiety.
- Chronic anxiety helps explain all of the symptoms of SCM syndrome. The same alterations and dysfunctions are found and measured there.
- Over the long term, the nearly unavoidable recurrence of these acute stress episodes in these individuals leads them to develop neuroinflammation, oxidative stress, and, inevitably, chronic anxiety.
- Based on these new insights, the authors of this report rebut the hypothesis that there is a relationship between MCS and the toxicity of chemicals present at normal concentrations. Nonetheless, the chronic biological disturbances observed with this syndrome, the severity of the symptoms experienced, the social and professional repercussions, and the high prevalence of MCS in the population, qualify it as a real health issue.
- Given that those suffering from MCS are, to varying degrees, genuinely ill and that their condition would justify appropriate medical and social support; the authors favor the establishment of centres of expertise specializing in MCS, as well as the continuation of the scientific monitoring of this syndrome.
- This scientific advisory report is intended for physicians and healthcare professionals who will encounter MCS cases, for researchers in this field, and for MCS patients and their families.

## Summary

### Context

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Multiple chemical sensitivity syndrome (MCS) is a chronic disorder characterized by multiple non-specific recurring symptoms. MCS symptoms are poorly defined and are associated with various organ systems. They are thought to be caused or exacerbated when susceptible individuals are exposed to odours in their everyday environment at low concentrations that are generally tolerated by most people. In the most severely affected, these symptoms cause chronic impairment that prevents them from functioning normally in their social and professional lives. Various epidemiological studies have found different levels of prevalence of MCS in the general population, ranging from 0,5% to 3% for cases diagnosed by a doctor. This number can be as high as 32% when self-diagnosed cases are included. Over a twelve-month period, the number of medical consultations for individuals suffering from MCS greatly exceeds that of a comparable Canadian control population (6,7 consultations with a family doctor compared to 2,9 for the control group, and 16,1 consultations with other doctors compared to 0,79 for the control group). Against this backdrop, Québec's ministry of health and social services, Ministère de la Santé et des Services sociaux (MSSS), entrusted Québec's public health institute, Institut national de santé publique du Québec (INSPQ), with a mandate to formulate a scientific opinion on the current state of knowledge concerning the scientific and medical aspects of MCS.

## Objective

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The objective of this report is to identify the pathophysiological mechanisms that underlie MCS using an approach that considers all the research conducted on the hypotheses put forward to date.

The research that went into creating this report relied on various theories put forth since the 1950s—theories that had yet to be validated—that reflected the perspectives of researchers working within their own disciplines, e.g., immunology, neurology, biology, biochemistry, genetics, psychiatry, psychology.

Considering the chronic polysymptomatic nature of MCS and other related syndromes (chronic fatigue syndrome, post-traumatic stress disorder, electromagnetic hypersensitivity, fibromyalgia, chronic anxiety, depression, somatization disorder, phobias, and panic disorder), the authors of this report hypothesize that recent research on MCS, as well as on other related health conditions, may help to explain the origin of the observed symptoms. Over the past two decades, advances in neuroscience, in particular in psychoneuroimmunology, and the availability of new techniques for measuring biological parameters and performing functional brain imaging have shed light on the pathophysiological mechanisms underlying MCS. These scientific advances confirm that the psychological, biological, and social aspects of this syndrome are inextricably linked.

## Results

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Studies have found the following changes in all the syndromes and pathologies studied: a disruption of the hypothalamic-pituitary-adrenal axis, an increase in inflammatory cytokines, a disruption in oxidative homeostasis, a chronic decrease in neuromodulator levels (serotonin, dopamine, norepinephrine). In addition, using brain imaging, alterations in brain function and structure were observed that affect the limbic system circuits (emotions, memory, learning) and the prefrontal cortex (attention, reasoning, strategic thinking, judgment).

Collectively, these changes help to explain all the acute symptoms (those observed at the time of exposure to odours) and chronic symptoms reported by people with MCS. As a consequence of these alterations, MCS-affected individuals develop neuronal sensitization. This makes them more vulnerable to subsequent episodes of stress triggered by the perception of odours, which they consider a threat to their health. Chronic anxiety is an element common to all the syndromes studied and its main feature is the *anticipation of danger*, i.e., feeling a persistent, excessive, and inappropriate concern about one's day-to-day activities. A number of factors may be involved, e.g., an individual's temperament, personal history, and psychosocial makeup. The severity of the syndrome depends on its duration and the comorbidity that MCS patients frequently experience, i.e. chronic fatigue syndrome, electromagnetic hypersensitivity, fibromyalgia, and depression, etc.

What is more, olfactory studies have demonstrated that there is no absorption of odorous substances at the low ambient concentrations to which people with MCS are exposed. These individuals have a normal capacity for detecting odours, while exhibiting reduced, rather than increased, activation in the brain regions that process these signals. This reduced activation points to the suppression of activity in olfactory pathway structures by regions within the neocortex. If, indeed, people with MCS are hypersensitive to odours, one would expect to see increased, not decreased, brain activity when compared with control subjects.

## Conclusion

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The authors of this report conclude that, based on the available data, there is no evidence to support the hypothesis of a relationship between MCS and the toxicity of chemicals at their usual concentrations in the environment. People with MCS, therefore, are not hypersensitive to chemical substances. Nonetheless, the chronic biological disturbances observed, the severity of the symptoms experienced, the impact on the social and professional lives of affected individuals, and the high prevalence of MCS in the population qualify it as a real health issue.

The full report, a summary and appendices (in French only) complementary to this summary are available at:

[www.inspq.qc.ca/publications/2729](http://www.inspq.qc.ca/publications/2729)

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### AUTHORS

Gaétan Carrier, ing., Ph. D. en santé publique, option toxicologie  
Médecin spécialiste, Unité Évaluation et soutien à la gestion des risques  
Direction de la santé environnementale et de la toxicologie  
Institut national de santé publique du Québec  
Médecin spécialiste en médecine du travail  
Professeur associé, École de santé publique de l'Université de Montréal

Marie-Ève Tremblay, Ph. D.  
Professeure associée  
Canada Research Chair (Tier II) of Neurobiology of Aging and Cognition  
Division of Medical Sciences, Université de Victoria

Rollande Allard, M.D., B. Sc. en biochimie, Certificat en santé au travail  
Médecin-conseil, Unité Évaluation et soutien à la gestion des risques  
Direction de la santé environnementale et de la toxicologie  
Institut national de santé publique du Québec

### UNDER THE COORDINATION OF

Gaétan Carrier, ing., Ph. D. en santé publique, option toxicologie  
Médecin spécialiste, Unité Évaluation et soutien à la gestion des risques  
Direction de la santé environnementale et de la toxicologie  
Institut national de santé publique du Québec  
Médecin spécialiste en médecine du travail  
Professeur associé, École de santé publique de l'Université de Montréal

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