MULTIPLE CHEMICAL SENSITIVITY

Canadian Environmental Law Association
Brantford
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Multiple Chemical Sensitivities and the Legal System

1. Does MCS exist?

2. Does the patient/client have it?

3. How credible is the medical practitioner who made the diagnosis?
MCS case criteria

1. The symptoms are reproducible with [repeated chemical] exposure.
2. The condition is chronic.
3. Low levels of exposure [lower than previously or commonly tolerated] result in manifestations of the symptom(s).
4. The symptoms improve or resolve when the incitants are removed.
5. Responses occur to multiple chemically unrelated substances.
6. Symptoms involve multiple organ systems.

1999 Consensus on Multiple Chemical Sensitivity. Archives of Environmental Health, May/June 1999, Vol. 54, No. 3,

Environmental Hypersensitivity Unit
University of Toronto

Validated the consensus case criteria

Also found 4 distinct CNS symptoms:

1. Have a stronger sense of smell than others.
2. Difficulty concentrating.
3. Feel dull or groggy.
4. Feel spacey.

Common Triggers

Volatile Organic Compounds (VOC’s)

– Fragrances – scented laundry products, “air fresheners”
– Solvents – paints, glues, renovation products
– Cleaning products
– Carpets
– Building materials
– Furnishings
– Pesticides
– Vehicle exhaust fumes
MCS a.k.a.
ENVIRONMENTAL HYPERSENSITIVITY

80% are middle-aged women (30 – 55 yrs.)
Polysystem symptom complex:

- Brain is most common system involved
  - Cognition complaints most common
  - Fatigue very common
  - Chronic pain common
  - Mood change
  - Very acute sense of smell
  - Migraine common
- Respiratory system very common
- Irritable bowel syndrome very common
- Allergies more common
- Frequently have food sensitivities
Environmental hypersensitivity

- No biological markers ("objective proof")
- Defies traditional dose-response toxicology
- Show marked avoidance behaviours
- Mood alterations
- Autonomic nervous system symptoms
Increased incidence

- Unexplained pain
- Disturbed sleep
- Unexplained chronic fatigue
- More physical symptoms without medical explanation
- Psychiatric diagnosis more likely
Psychiatric diagnoses more common

- Anxiety disorder
- Major depression
- Panic disorder
- Somatization disorder
- More likely to have psychiatric diagnosis if onset is gradual
“It must be stress”

Is it physical or mental?
Is it physical or mental?

YES
Psychiatry 2010

1. Cartesian mind-body dualism is false

2. Acceptance of bidirectional causality
   ✓ Mind → Brain
   ✓ Brain → Mind

3. Integration of biopsychosocial model
Psychiatric vs. MCS

• No biological markers
• Affects ........
  – behaviour
  – mood
  – sleep
  – pain
  – cognition
  – autonomic function
• Increased incidence ........
  – migraine
  – IBS
  – idiopathic urticaria (hives)
Is MCS a psychiatric illness?

• Symptoms overlap with anxiety, depression, panic and somatoform disorders
• There are no biological markers
• There is an increased frequency of previously diagnosed psychiatric illness
• The doses which purportedly provoke symptoms are very low and tolerated by most others
• The syndrome does not fit the toxicology paradigm ("the dose makes the poison")
Psychiatric vs. MCS

There is no published evidence in the peer-reviewed medical literature demonstrating a therapeutic response in MCS patients from psychotherapeutic medications and/or psychotherapy.
“It must be stress”
STRESS

A pathological process resulting from the reaction of the body to external forces and abnormal conditions that tend to disturb the organism's homeostasis (balance).
STRESS

The biological response to noxious, demanding, or unpleasant bodily or mental tension and may be a factor in disease causation.
STRESSOR

A physical, chemical, or emotional factor that causes the emotional, psychological, or physical effects as well as the sources of agitation, strain, tension, or pressure.
THE PHYSIOLOGIC RESPONSE TO STRESS

- HPA axis (hypothalamus – pituitary – adrenal)
- Sympathoadrenal system (adrenalin, cortisol)
- CRF (corticotrophin releasing factor) initiates HPA axis response to stress
- CRF increased in depression
- Extrahypothalamic CRF in limbic system also plays role in stress response
What’s the limbic system?

Parts of the brain linked to survival

It’s where the stress response takes place

Includes the hypothalamus and pituitary (HPA axis)
Chronic increases of CRF in limbic system

Leads to hypervigilance

Leads to increased sensitization to other stressors
Reptilian brain

• Innate or instinctive behaviours

• Regulates primitive survival issues
  • Heart rate, breathing, body temperature and balance

• Crucial in basic hunting, feeding and reproductive behaviours

• Analogous to the entire brain of reptiles
Limbic system
(old mammalian brain)

• Seat of motives and emotions

• Capable of responding to present information using memories of past information

• It evolved from structures previously associated just with the sense of smell
  – also known as rhinencephalon
Neocortex

• Developed first in primates

• Predominant in humans

• Responsible for the development of human language, abstract thought, imagination, learning and consciousness.
Cortex and Neocortex
Limbic system

- Frontal lobe
- Thalamus
- Hippocampus
- Amygdala
- Hypothalamus
- Olfactory bulb
LIMBIC SYSTEM

SURVIVAL

ADAPTATION TO THE ENVIRONMENT

Influences endocrine system

Associated with olfaction, autonomic functions, and certain aspects of emotion and behavior.
Limbic system reads environment

- Prefrontal cortex (psychosocial perception)
- Light (migration, SAD)
- Sound (Brahms vs. rap)
- Touch (pain)
- Smell
- Taste
- Immune system
Limbic system function

- Autonomic nervous system
- Aggression and fear
- Pleasure, reward and addiction
- Sexuality
- Cognition
- Attention processing
- Decision making
- Short term memory
- Storage into long term memory
- Spatial memory (e.g. finding your way home)
- Sleep/wake cycle
- Pain
Hypervigilance

- Childhood trauma
- Generalized anxiety
- Chronic stress
- Depression
- Post Traumatic Stress Disorder
- Borderline Personality Disorder
- Chronic pain
- Chemical exposures

- Interchangeability of stressors
Chemical exposures

MCS

• Polysystem involvement

• CNS is most commonly involved:
  – decreased cognition ("brain fog")
  – pain (headache, myalgia)
  – sleep disturbance
  – mood change

• Fatigue
SENSITIZATION to STRESSORS
(or how to make someone crazy)

SENSITIZATION occurs from
TOXIC or
REPEATED EXPOSURE in
SUSCEPTIBLE individuals
Limbic system sensitization

Animal studies demonstrate that repeated exposure to chemicals, which can cause changes in brain function at higher doses, can cause sensitization in the CNS, so that a lower threshold to provoke symptoms is established.

Fungicides
Herbicides
Insecticides
Solvents (VOCs)
Formaldehyde
Animal models of MCS

Rats genetically programmed to be sensitive to organophosphate pesticides are also more easily sensitized to other chemicals, and show hypersensitive receptors in the respiratory and gastrointestinal system, similar to patients with central sensitization and/or MCS.

Animal studies of MCS

Animals sensitized to a chemical are more easily sensitized to other chemically unrelated substances


Beyer CE. Repeated exposure to inhaled toluene induces behavioral and neurochemical cross-sensitization to cocaine in rats. Psychopharmacology (Berl). 2001 Mar 1;154(2):198-204.
Environmental hypersensitivity

- 80% are middle-aged women (30 – 55 yrs.)
- sensitive to many, chemically unrelated substances
- multiple system involvement

- genotype different for detoxification
  - poor detoxifiers
“Canaries in the coal mine”

Genotype for detoxification is abnormal

521 patients:

203 patients:
McKeown-Eyssen GE. Case-control study of genotypes in multiple chemical sensitivity: CYP2D6, NAT1, NAT2, PON1, PON2 and MTHFR. Int J Epidemiol. 2004 Oct;33(5):971-8

No evidence for elevated xenobiotics

Total = 724
Negative gene studies

9/22 patients

Genes associated with panic disorder


59 patients:

Negative detox gene studies, positive panic


Nevertheless, there is evidence for deficient detoxification

Other positive detox studies show susceptibility

- La Du BN. Serum paraoxonase (PON1) isozymes: the quantitative analysis of isozymes affecting individual sensitivity to environmental chemicals. Drug Metab Dispos. 2001;29:566-569.
Negative genetic study
Positive oxidative stress study

196 patients:
• No genotype abnormality
• Suppressed antioxidant defense system
• Evidence for oxidative stress
  – enhanced peroxynitrite formation
  – accelerated lipid peroxidation
  – low-level systemic inflammation
  – can be driven by pollutants

• Conclusion: Genetic variants are of less importance
• May reflect:
  – the presence of gene-environment interactions influenced by different chemical exposures
  – significant degree of genetic heterogeneity in MCS

DeLuca C. Biological definition of multiple chemical sensitivity from redox state and cytokine profiling and not from polymorphisms of xenobiotic-metabolizing enzymes. Toxicol Appl Pharmacol. 2010 Apr 27 (ahead of print)
Challenge studies reviewed

37 studies identified:
• 3 studies using olfactory masking were negative
• 7 studies using chemicals below odour threshold were negative
• Criticized the other 27 studies

Author’s conclusion:
• no evidence to suggest that people reporting chemical sensitivities were able to differentiate active over sham exposures compared with chance.
• responses reported by people with MCS are not associated with biological properties of implicated chemicals.

However (the other 27 ....) :
  – 8/13 double-blind with no masking agent were positive
    • Not really double-blind
  – Majority of 14 single-blind with no masking agent were positive
  – Poor design; no masking

Criticism of challenge studies

• Difficult to test blindly
• Masking chemicals was done with other chemicals
• Some studies only challenged one chemical
• There was no washout period between challenges
• Studies were not done in de-adapted state
Further criticism of challenge study review

• Selection of studies was biased because:
  ❖ 5 studies were not part of the review by Das-Munshi.
  ❖ these 5 challenge studies also help to understand the possible mechanisms involved in MCS.
Capsaicin challenge

• heat producing ingredient in hot peppers
• well known cough inducer when inhaled
• stimulates vanilloid-sensitive receptors in the bronchial tubes
• MCS patients with respiratory symptoms, even without asthma, are hypersensitive to inhalation of capsaicin, when compared to controls, and this has been demonstrated after double-blind challenge in 5 different studies
Capsaicin challenge

• Receptor hypersensitivity demonstrated
• More likely to have multiple system involvement
• Faster CNS processing of other chemosomatosensory substances
• Demonstrated in perfume sensitivity
• One study followed pts for 5 years:
  – persistent symptoms
  – reduced health related QOL
  – persistent hypersensitivity
Vanilloid receptors

• Also found in limbic system

• Chemicals can enter brain from circulation,
  – if they can pass through the blood brain barrier (BBB)
  – the weakest part of the BBB is in the limbic system

• Chemical pollutants also enter brain directly via olfactory nerve to olfactory bulb
  – animal studies
  – human study
SPECT brain scans
Chemical challenge produces measurable change in limbic system different from controls


Hillert L. Odor processing in multiple chemical sensitivity. Hum Brain Mapp. 2006 Jun 9

Female predominance

• Sex and gender differences

• Sex differences are biological

• Gender differences are social influences
Sex differences

• Hormonal influences
• Limbic system responses differ
• More sensory sensitive
• Different body burden
  – Women have more pollutants
    • PBDE
    • Phthalate
    • Cadmium
    • cobalt
More sex differences

• Higher uptake on inspiration (2-propanol)
• Transport chemicals from the liver more slowly
• Hormone fluctuations may alter rate of pharmacokinetics
• Slower creatinine clearance (kidney)
• Differences in body mass and % body fat
Gender differences

• More cosmetics
• More scented products
• More exposure to cleaning products
• Safety/exposure studies in industry were on healthy young males
**Medical Legal**

- Inadequate studies for safety
- IAQ based on comfort for 80% of healthy people
- Future studies should separate female cohort
- Medical bias in diagnosis
  - depends on the physician’s “belief system”
  - Labeled as “psychological” or “toxic”
  - LTD
  - CPP
- CHRC lists environmental hypersensitivity as disability
Environmental Hypersensitivity
Canadian Human Rights Commission Policy

“This medical condition is a disability and those living with environmental sensitivities are entitled to the protection of the Canadian Human Rights Act, which prohibits discrimination on the basis of disability.”
Environmental Hypersensitivity
Canadian Human Rights Commission
Policy

“Those living with environmental hypersensitivities have the right to be accommodated at work, up to undue hardship.”
CHRC and ACCOMMODATION

“Successful accommodation for persons with environmental sensitivities requires innovative strategies to minimize or eliminate exposure to triggers in the environment.”

“Such measures can prevent injuries and illnesses, and reduce costs and health and safety risks.”
Accommodation may include:

- “Developing and enforcing fragrance free and chemical avoidance policies
- Undertaking educational programs to increase voluntary compliance with such policies
- Minimizing chemical use
- Purchasing less toxic products
- Notifying employees and clients in advance of construction, re-modeling and cleaning activities”

CHRC 2007
Accommodation

- Workplace
- Public buildings
- Public transportation
- Hospitalization
- Education
  - in schools
What about CELA?
Environmental Sensitivities and Housing

• Two studies at Environmental Health Clinic (EHC)
  – lack of affordable, safe housing is one of the most common and difficult problems people with MCS encounter
  – remediation to housing often necessary to relieve MCS symptoms, however:
    • difficult (and costly) to remove “pervasive exposures” caused by poor ventilation and off-gassing from building materials
Rental Housing and Human Rights

People with MCS experience lack of housing:

– Carpeting, other exposures from building materials
– Second-hand smoke
– Lack of understanding re: duty to accommodate
  – legal responsibility
– Lack of resources – governments have role
– Low socioeconomic groups have less choice and options

Air quality 8.1

— **Building Materials** – Inert (No or Lowest VOC)
  - All building materials - doors and cabinetry; floor surfaces; wall surfaces and finishes; caulking; insulation; and furnishings and fixtures


— **Ventilation** - Building Code clause 8.1.7.1 (ASHRAE) **at minimum**
  - need optimized filtration of air flow & moisture control
  - set to meet needs of 80% of population only
  - based on human comfort
  - not based on health, productivity or learning
Standard for Built Environment

Air quality 8.2

– Air Exchangers and HEPA filters
  • Installed in all new buildings

– Products: Cleaning and Renovation
  • fragrance-free and contain no or low VOCs
  • Stored in separately vented room

– Materials: Maintenance
  • Select products requiring minimum maintenance
Canadian Human Rights Commission

Environmental Sensitivities & Accommodation


Perfume

- Approximately 1/3 of Canadian population is bothered by fragrances (complain of symptoms from exposure) (Sears, M, 2007)
- 16 – 33% of U.S population “especially sensitive” to chemicals, including perfume (Bell, 1996, 1998; Meggs, 1996)
- 30 % of US population finds fragrance on others irritating (adverse reactions) (Caress, S.M. and Steinemann, A.C. 2004, 2009)
- Danish study - ~42% of the population surveyed had at least one eye or airway symptom associated with perfume exposure (Elberling, J. et al.,2004)
Adverse Health Effects From Perfumes

- Asthma
- Migraine
- Allergic respiratory symptoms
- Contact dermatitis
- Major trigger for MCS
Chemical components of Perfumes

Up to 2,600 ingredients documented for use in fragrances – organic and non-organic chemicals, known respiratory irritants

95% are petroleum-based

Fixatives often used to cause the scent to persist

Can bioaccumulate
Most common chemicals in fragrance products

- Ethanol
- Limonene
- Linalol
- Beta-phenethyl alcohol
- Beta-myrcene
- Benzyl acetate
- Benzyl alcohol
- Benzaldehyde
- Alpha-terpineol
- Alpha Pinene
- Beta-citronellol
- Acetone
- Ethyl acetate
- y-terpinene
- 1,8 – cineole
- Nerol
- Camphor
- Methylene Chloride

Lessenger, J. JABFP, 14 (2) 2001
Fragrance industry

Modern fragrances are primarily synthetic materials, developed since World War II (80-90%).

Regulation is done by the industry itself – perfumes have a “trade secret status” - therefore government regulation is limited (proprietary)

There are few industry studies on inhaling fragrance chemicals; they are not tested for chronic neurotoxic and systemic effects.

Some chemicals used are linked to neurotoxicity.
Scent free policy

- hospitals
- schools
- theatres
- government buildings
- places of worship
Scent free policy

• How to implement a scent free policy in the workplace.
  • The Canadian Centre for Occupational Health and Safety provides advice on ...
    (http://www.ccohs.ca/oshanswers/hsproms/latent_free.html)

• Assistance in education and development of a scent-free policy
  – Nancy Bradshaw, Community Outreach Coordinator, at the Environmental Health Clinic at Women’s College Hospital.
    (nancy.bradshaw@wchospital.ca)
Prevalence

Statistics Canada’s 2003 National Population Health Survey (N=135,573) = 2.9% doctor-diagnosed MCS

The 2005 National Survey of the Work and Health of Nurses (N=18,676) = 3.6% of all Canadian nurses

American population ranges from

• 3.1% doctor-diagnosed MCS in Atlanta, Georgia (N=1,582)
• 6.3% doctor-diagnosed chemical sensitivity in a large California survey (N=4,046)
What can CELA do?
What can CELA do?

Educate legal profession
  • personal injury lawyers and judges
  • WSIB, CPP, other insurance

Advise re enforcement of scent-free policies

Advocate for improved standards for IAQ

Advocate for more available housing for MCS patients on social assistance

Partner with EHC-WCH and/or OCFP (Env Health Committee)
Resources

Environmental Health and Environmental Sensitivities

• Women’s Health Matters – Environmental Health Centre
  www.womenshealthmatters.ca/centres/environmental/index.html

• Environmental Health Association of Ontario
  http://ehaontario.ca/

• Environmental Health Association of Nova Scotia
  www.environmentalhealth.ca/

Nancy Bradshaw, Community Outreach Coordinator at EHC, Women’s College Hospital
Resources

Environmental Sensitivities & Accommodation/Housing


• Ministry of Community and Social Services. *Accessible Built Environment Standards Development Committee, initial proposed Accessible Built Environment Standard, June 2009* [http://www.mcss.gov.on.ca/mcss/english/pillars/accessibilityOntario/accesson/business/environment/]


Nancy Bradshaw, Community Outreach Coordinator at EHC, Women’s College Hospital
Resources

Environmental Sensitivities & Accommodation/Housing

• Canadian Mortgage and Housing Corporation. Building Materials for the Environmentally Hypersensitive. 2005 [https://www03.cmhc-schl.gc.ca/b2c/b2c/init.do?language=en&shop=Z01EN&areaID=0000000016&productID=00000000160000000007](https://www03.cmhc-schl.gc.ca/b2c/b2c/init.do?language=en&shop=Z01EN&areaID=0000000016&productID=00000000160000000007)

• Collette, Stephen, Your Healthy House ([http://www.yourhealthyhouse.ca/yourhealthyhouse.ca/Your_Healthy_House.html](http://www.yourhealthyhouse.ca/yourhealthyhouse.ca/Your_Healthy_House.html))


Nancy Bradshaw, Community Outreach Coordinator at EHC, Women’s College Hospital