The association between multiple chemical sensitivity and mental illness: Evidence from a nationally representative sample of Canadians

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ABSTRACT

Objective: The goal of the present study was to investigate the association between multiple chemical sensitivity (MCS) and major depressive disorder (MDD), generalized anxiety disorder (GAD), MDD and GAD comorbidity (MDD + GAD), severe distress, and positive mental wellbeing.
Methods: This cross-sectional investigation was carried out using the 2012 Canadian Community Health Survey – Mental Health Component. The study population consisted of 21,977 individuals aged 20 and older, from Canada's ten provinces. Odds ratios were computed using multinomial logistic regression to calculate estimates of the association between MCS and mental illness. All analyses were weighted to take into account the complex survey design.
Results: Individuals with MCS had 2.37 (1.55, 3.64) times greater odds of MDD, 3.09 (1.80, 5.30) times greater odds of MDD + GAD, and 2.60 (1.67, 4.07) times greater odds of severe distress. No association between MCS and GAD was observed. A sex difference was observed with males with MCS having lower odds of positive mental wellbeing, whereas no association was observed in females.
Conclusions: The present study findings supported an association between MCS and mental illness. The causal mechanism supporting this association remains unclear.

1. Introduction

Chemical intolerance refers to nonspecific symptoms that occur when exposed to a variety of chemicals that others in the general population do not find averse [1,2]. The symptoms experienced by these individuals can be exhibited throughout the body, including respiratory, gastrointestinal, cognitive, and cranial systems [3]. Of the chemicals reported to elicit symptoms, some of the commonly endorsed sources include car exhausts (73.8%), fragrances worn by others (68.8%), cleaning products (60.3%), and freshly printed documents (53.9%) [4]. The focal point of the present investigation, Multiple Chemical Sensitivity (MCS), falls under the umbrella term of chemical intolerance and is generally used to describe severe cases of the condition [5].

1.1. Defining MCS

A wide range of terms have been used to describe sensitivity to environmental factors [6–8]. Due to the fact that the illness is not always in response to a chemical (e.g. radio signals, loud noises), a more inclusive term, idiopathic environmental intolerance has also been

commonly used [7,8]. Other terms such as multiple chemical syndrome, central sensitivity syndrome and environmental annoyance have also been used to describe similar constructs that relate to chemical intolerance [9–11].

Although a wide range of MCS definitions have been put forward, one of the most commonly used definitions of MCS was proposed by Cullen in 1987 [6]. This definition states that MCS is an acquired disorder characterized by recurrent symptoms, referable to multiple organ systems, occurring in response to demonstrable exposure to many chemically unrelated compounds at doses far below those established in the general population to cause harmful effects. No single widely accepted test of physiologic function can be shown to correlate with symptoms [6]. Definitions of MCS and idiopathic environmental intolerance vary in what is considered a low level exposure, as well as the temporal distance between exposure and symptoms [12]. There is also mixed agreement on how long the symptoms should persist in order for the pathology to be determined [11,13].

1.2. Epidemiology of MCS

Although a wide variety of definitions have been applied, many

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studies have described the prevalence of individuals who report a clinical diagnosis of MCS. The prevalence has been reported as 0.9–2.9% in Australia [14,15], 2.4% in Canada [16], and 2.5–3.9% in the USA [17]. When individuals self-report on symptoms that correspond to MCS, rather than a clinical diagnosis, rates of MCS have been reported as high as 12.6% [17]. Nearly all studies that have looked at sex differences of MCS and chemical intolerance have found the rates to be higher in females than in males [4,17–20]. The prevalence of chemical intolerance has also been shown to vary by age and that adults report higher prevalence compared to seniors and youth [4,21]. There is also evidence showing that chemical intolerance is most prevalent in low socioeconomic groups [16].

1.3. MCS and mental illness

Many studies have identified an association between mental illness and various forms of chemical intolerance, including MCS [22–36]. Some research has estimated that approximately half of MCS subjects meet the criteria for a lifetime axis 1 disorder [23,35,37]. This research has also shown that MCS patients have significantly higher rates of depression and anxiety, relative to those without MCS [23,35]. Further support for this comes from a study that investigated the association between chemical intolerance and mental illness, using a sample of 400 adults in primary care [33]. This study found that of those who met the criteria for chemical intolerance, 85% and 78% met the criteria for MDD and GAD, respectively. Chemically intolerant individuals had a respective 11– and 13– fold increase in the odds of MDD and GAD, relative to those who were chemically tolerant. A study conducted by Bell et al. assessed 28 adult women and found similar findings in that 68% of chemically intolerant women reported a past diagnosis of depression, anxiety, or panic disorder [22]. This was significantly higher than those without chemical intolerance, who only reported a 20% rate of previous psychopathology. Although most research supports an association between chemical intolerance and mental illness, a study conducted by Hausteiner found that individuals with and without idiopathic environmental intolerance did not differ significantly on either lifetime affective or anxiety disorders [38].

Using a large cross-sectional design, the present study aimed to provide further evidence on the association between MCS and mental illness. This was done using a national, population-based survey of Canadians to investigate the association between MCS, major depressive disorder (MDD), generalized anxiety disorder (GAD), comorbid MDD and GAD (MDD + GAD), severe distress, and positive mental wellbeing. Age, income, education, asthma, and chronic fatigue syndrome have all been shown to be associated with mental illness and MCS, and were therefore included as covariates in the present study [4,16,21,37,39–44]. A history of physical, as well as sexual abuse in childhood and adolescence has been shown to be related to mental illness [45]. There is also evidence to suggest that early life events can contribute to neural sensitization, which has been suggested to play a role in MCS, as well as mental illness [46]. Due to the potential confounding nature of these traumas in both MCS and mental illness, they were also included as covariates. Due to differential prevalence rates across sexes for both MCS and mental illness, sex was explored as a potential effect modifier in the present investigation [4,17–20]. It was expected that MCS would be positively associated with all outcomes of interest, with the exception of positive mental wellbeing, which was expected to have a negative association with MCS.

2. Materials and methods

2.1. Study population

Participants were selected from the Canadian Community Health Survey – Mental Health Component 2012 (CCHS-MH 2012; [47]). The CCHS-MH is a large, cross-sectional survey completed by individuals from all provinces of Canada (excluding territories) between January 2012 and December 2012. Individuals living on reserves, full-time members of the Canadian Armed Forces, and those institutionalized were not sampled in the CCHS-MH (comprising approximately 3% of the Canadian population). A three-stage design was administered for data collection. First, geographical clusters were highlighted, then households were randomly selected within each geographical cluster, and lastly one member was randomly selected from each household to be interviewed. The overall person-level response rate for the survey was 86.3% and most of the survey interviews were conducted in person (87%). Participants ranged from 15 to 80 or more years of age and the total source population was 25,113 participants. Individuals under 20 years of age did not report on an important covariate of interest (history of abuse) and were therefore excluded. The missing data on other covariates of interest appeared to be missing at random and the amount was deemed small enough that cases with missing data were also removed, leaving a final study population of 21,977 individuals.

2.2. Multiple chemical sensitivity

Prior to questions about MCS in the CCHS-MH, participants were told, "remember, we're interested in conditions diagnosed by a health professional and are expected to last or have already lasted 6 months or more." Participants were then asked to respond to the question, "do you have multiple chemical sensitivities?" with a "yes" or "no" response. For all subsequent analyses, a response of "no" was used for the reference category. No elaboration was provided within the survey on which definition of MCS was used in the health care provider's diagnosis.

2.3. Mental illness and mental wellbeing

Outcomes of interest included whether the individual had MDD only, GAD only, or both MDD and GAD. MDD and GAD, along with the comorbidity between them, were both determined using a modified version of the World Mental Health-Composite International Diagnostic Interview (CIDI) [48]. The CIDI is based on the Diagnostics and Statistics Manual – 4th edition (DSM-IV) and the International Statistical Classification of Diseases and Related Health Problems – tenth revision (ICD-10) criteria for mental illness, but can be conducted without clinical expertise [49,50]. Reliability and validity assessments have found the CIDI to be a reliable tool for the identification of psychopathology in both clinical and non-clinical settings [51]. MDD and GAD were both determined based on their occurrence in the past 12 month period. Determination of MDD was based on the following: criteria for lifetime major depressive episode met, occurrence of a major depressive episode in the 12 months prior to the interview, and clinically significant distress impairing social and occupational functioning. Similarly, determination of GAD was based on the following: all CIDI criteria for 12 month GAD being met, having an episode of GAD lasting at least 6 months within the 12 month period prior to the interview, and clinically significant distress impairing social and occupational functioning.

Additionally, psychological distress was assessed using the Kessler Psychological Distress Scale (K6). The K6 is a 6-item measure used to assess common symptoms of depression and anxiety over the past 30 days [52]. Each item is responded to on a 5-point Likert scale ranging from 0 ("*none of the time*") to 4 ("*all of the time*"). An example of one of the questions is, "*During the past 30 days, how often did you feel so depressed that nothing could cheer you up*?". The K6 score is the sum of each item score with a minimum score of 0 and a maximum score of 24. Previous literature has demonstrated that a cut-off of 13 and above is associated with severe distress [52], therefore the scale was dichotomized and individuals were described as being severely distressed (score of 13 and above) or having low to moderate levels of distress (score of < 13).