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Study of the Correlation Between Multiple Chemical Sensitivity and Personality Using the Quick Environmental Exposure Sensitivity Inventory Questionnaire and the Temperament and Character Inventory

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Objective: We conducted an analysis using the Quick Environmental Exposure Sensitivity Inventory to examine the correlation between multiple chemical sensitivity (MCS) and personality traits by using temperament and character inventory, and environmental exposures. **Methods:** An anonymous questionnaire was distributed to 667 employees working at an IT manufacturing plant in Japan. Variables including chemically sensitive population (CSP), personality, and environmental chemical exposure were individually evaluated using *U*-test, chi-squared test, and correlation analyses. We also did covariance structure analysis to build a structural equation model. **Results:** There was little direct impact of temperament on the CSP, while there was a significant impact of character on the CSP. Women were more likely to exhibit symptoms of CSP. **Conclusion:** MCS is correlated with personality, impacted more by character acquired later in life than innate temperament. There were sex differences in the incidence of MCS.

Keywords: environmental exposure sensitivity inventory, multiple chemical sensitivity, personality, sex differences

I n recent years, a health impairment known as "multiple chemical sensitivity" (MCS) has become an international concern. MCS is caused by chronic exposure to various chemicals in low concentrations, and presents as multiorgan and psychological symptoms, its symptoms are common, vague, and non-specific to the condition, which creates difficulties regarding diagnosis.[1–3] The most frequently observed are fatigue, "brain fog" (short-term memory problems, difficulty concentrating), gastrointestinal problems, headaches, and muscle pain.[4] Additional symptoms include difficulty breathing; pain in the throat, chest, or abdominal region; skin

Highlights
- The personality aspect "character" has a significant impact on MCS.
- Chemical exposure is predicted by high temperament and high character scores.
- Women showed the highest prevalence of symptom severity and intolerance.
- Overall, 1.8% of the study population were chemically sensitive.

irritation; headache; neurological symptoms; tendonitis; seizures; visual disturbance; anxiety; panic; anger; sleep disturbance; and suppression of the immune system.[2,4,5]

The etiology of MCS, however, remains unclear. Further, it is difficult to estimate its prevalence because the presence of the condition is derived from self-reports, which differ from case rates diagnosed by medical staff (and occupational physicians in particular). Almost all studies that have considered sex-based differences in the prevalence of MCS and chemical intolerance have reported rates to be higher among women than men.[6–8] The prevalence of chemical intolerance has also been found to vary with age, with adults showing a higher prevalence when compared with seniors and youths.[6,9] A previous study performed by the present authors found the prevalence of MCS in the Japanese work force to be 7.5%.[10] Considering this potentially high prevalence, and the gaps in the existing medical literature, it is clear that further research into the diagnostic assessment and treatment of patients with MCS is needed to understand their actual condition and possible causes of the condition.

Many studies have identified an association between mental illness and various forms of chemical intolerance, including MCS.[11–19] Further, some research has shown that MCS patients have significantly higher rates of depression and anxiety when compared with individuals without MCS.[11,20] Katerndahl et al,[19] examining a sample of 400 adults in primary care, found that, of those who met the criteria for chemical intolerance, 85% and 78% satisfied the criteria for major depressive disorder and generalized anxiety disorder, respectively. Similarly, in another study 68% of chemically intolerant women reported a past diagnosis of depression, anxiety, or panic disorder[21] (Bell et al, 1995), which was a significantly higher percentage than that reported by women who did not have chemical intolerance (20%). These results support the association between chemical intolerance and mental illness.

Interestingly, psychosocial factors, including personality, have been found to be related to physical and mental illness,[21–24] and interest in this topic is growing. Early studies in this regard involved utilizing Cloninger psychobiological model,[25,26] which involves a multidimensional approach to personality structure. According to Cloninger theory, personality comprises 2 main domains: temperament (which is considered to be biologically based and refers to inherited traits) and character (which develops as a consequence of interactions between the environment and heritable factors). The temperament and character inventory (TCI), based on Cloninger model,[25,26] is used to evaluate personality traits. The temperament

dimensions are considered to be heritable and manifest in early life, and are defined as individual differences in associative learning in response to novelty, danger or punishment, and reward. The temperament dimension assesses four temperament dimensions: novelty seeking (NS), harm avoidance (HA), reward dependence (RD), and persistence (P). The character dimensions self-directedness, cooperativeness, and self-transcendence are defined in terms of aspects of self-concept such as humanistic, transpersonal, and development factors, assesses by self-directedness (SD), cooperativeness (C), and self-transcendence (ST).[25,26]

Previous studies have shown that a high HA score may be related to the presence of anxiety and depressive mood.[21–29] Meanwhile, high ST (which is linked to tolerance of ambiguity and blurring of the boundaries of the self), together with reduced SD (which is regarded as a manifestation of immaturity), may constitute personality-based risk factors for psychotic disorders.[30,31]

In summary, existing findings suggest that there is a link between personality and several mental-health problems (such as anxiety and depressive and other psychotic disorders), and that there is also a correlation between chemical intolerance and mental illness. Therefore, we suspect that there is a connection between personality and MCS. However, to date, no study has examined the role of personality in MCS.

In the present study, we conducted an analysis, using the Quick Environmental Exposure Sensitivity Inventory,[32] to examine the correlation between MCS and personality traits, as well as risk factors such as exposure to environmental chemicals and work-related burdens. The main aim of this study was to investigate possible associations between personality traits (assessed using the TCI) and MCS. Since the data we analyzed were sourced from a normal population based in the same regional area (employees of a single company, normal healthy population), the TCI was selected as an appropriate measurement tool for this study.

MATERIALS AND METHODS

Participants

An anonymous questionnaire was distributed to 667 employees of an information-technology manufacturing plant in Kyushu, Japan, during the company's medical examination from June to July, 2015. We start our statistical analysis after approved by the Ethical Committee of Kumamoto University in 2017. Excluding invalid responses, 431 (65%) valid questionnaires were returned. The valid respondents comprised 272 men and 159 women, and their mean age (standard deviation) was 37.6 years (SD = 10.02). The characteristics of the entire sample and the distribution of the subscale scores are presented in Table 1.

Measurements

Temperament and Character Dimensions

The temperament includes NS, HA, RD, and P. Novelty seeking consists of four subscales, which describe exploratory excitability versus stoic rigidity, impulsiveness versus reflection, extravagance versus reserve, and disorderliness versus orderliness. The Harm Avoidance subscales are worry and pessimism versus uninhibited optimism, fear of uncertainty, shyness versus gregariousness, and fatigability versus vigor. The three facets of Reward Dependence are sentimentality versus tough mindedness, attachment versus detachment, and dependence versus independence. Finally, the fourth temperament dimension is a single trait describing industrious and diligent versus inactive and indolent. The

TABLE 1. Sex Different About Characteristics of the Subjects and Distribution of QEESI Subscale Points

Variables	Total $N = 431$	Male (%) $N = 272$	Female (%) $N = 159$	P
Age($\pm$SD)	37.6 ($\pm$10.02)	39.5 ($\pm$10.12))	34.4 ($\pm$8.96))	<0.001
Job type				
Manufacturing work	199 (46.2%)	141 (51.8%)	58 (36.5%)	<0.001
Clerical work	159 (36.9%)	71 (26.1%)	88 (55.3%)	
Research and development work	73 (16.9%)	60 (22.1%)	13 (8.2%)	
QEESI score				
Chemical sensitivity				
<40	412 (95.6%)	262 (96.3%)	150 (94.3%)	0.33
≥40	19 (4.4%)	10 (3.7%)	9 (5.7%)	
Total point (mean $\pm$ SD)	9.57 ($\pm$13.48)	8.08 ($\pm$12.07)	12.11 ($\pm$15.31)	<0.01
Symptom severity				
<20	256 (59.4%)	175 (64.3%)	81 (50.9%)	<0.01
≥20	175 (40.6%)	97 (35.7%)	78 (49.1%)	
Total point (mean $\pm$ SD)	17.77 ($\pm$14.98)	16.04 ($\pm$14.30)	20.74 ($\pm$15.69)	<0.01
Life impact				
<10	352 (81.7%)	229 (84.2%)	123 (77.4)	0.08
≥10	79 (18.3%)	43 (15.8%)	36 (22.6)	
Total point (mean $\pm$ SD)	4.91 ($\pm$7.99)	3.98 ($\pm$7.09)	6.50 ($\pm$9.14)	<0.01
CSP cases				
−	423 (98.1%)	268 (98.5%)	155 (97.5)	0.44
+	8 (1.9%)	4 (1.5%)	4 (2.5)	
Chemical explore experience				
0	61 (14.2%)	42 (15.4%)	19 (11.9%)	0.37
1	107 (24.8%)	62 (22.8%)	45 (28.3%)	
2	96 (22.3%)	57 (21.0%)	39 (24.5%)	
3	109 (25.3%)	74 (27.2%)	35 (22.0%)	
4	46 (10.7%)	28 (10.3%)	18 (11.3%)	
More than 5	12 (2.8%)	9 (3.3%)	3 (1.9%)	

C, cooperativeness; HA, harm avoidance; MCS, multiple chemical sensitivity; NS, novelty seeking; P, persistence; RD, reward dependence; SD, self-directedness; T, self-transcendence; TCI, temperament and character inventor.

character dimensions include self-directedness (SD), cooperativeness (C), and self-transcendence (ST). The SD includes five subscales describing responsibility versus blaming, purposefulness versus lack of goal direction, resourcefulness versus inertia, self-acceptance versus selfstriving, and congruent nature versus bad habits. The five aspects of the C dimension are social acceptance versus social intolerance, empathy versus social disinterest, helpfulness versus egoistic and self-centered, compassion versus revengefulness, and principled versus self-serving. Finally, the ST subscales are self-forgetfulness versus selfconsciousness, transpersonal identification versus selfisolation, and spiritual acceptance versus rational materialism.[25−27]

The TCI[26] has previously been translated into Japanese,[33] with the permission of Professor Cloninger, who also confirmed the accuracy of the translation. The TCI and its predecessor, the Tridimensional Personality Questionnaire, have been widely used among both Japanese patient and non-patient populations.[24,25] There have been several previous studies of the internal consistencies and factor structures of the Japanese versions of these scales, which showed good reliability and validity.[34,35,36]

Multiple Chemical Sensitivity

Quick Environment Exposure Sensitivity Inventory

The QEESI[33] comprises five subscales:

(1) "Chemical intolerances," for which respondents are asked to rate the degree to which various types of chemical exposure cause them to feel ill, and also to list any other chemicals that cause this reaction.
(2) "Other intolerances," which concern odors/exposures, other than chemical inhalants, that cause respondents to feel ill. The items included here relate to various triggers, skin irritations, medical drugs and devices, and allergens for which classical allergic responses have been noted.
(3) "Symptom severity," which concerns symptoms that may be commonly experienced, such as muscle or joint problems (eg, aches and pains, headaches, a feeling of pressure or fullness in the face or head) and skin problems (eg, rashes, hives, or dry skin).
(4) "Masking index," which assesses the extent to which respondents are experiencing ongoing exposures. These items investigate whether subjects regularly use or are exposed to tobacco products, alcoholic beverages, certain drugs, and caffeine, and also measure daily exposure (eg, "are you exposed to chemicals at work?" "Do you live with a smoker?" "Do you use propane or gas for cooking?" "Yes" = 1, "no" = 0).
(5) "Life impact," which investigates whether subjects are sensitive to certain chemicals or foods, and if these sensitivities affect any aspects of their life, such as diet, ability to attend work or school, and choice of clothing.[33]

The QEESI has been translated into several languages, and has been used in many countries. We used the Japanese version of the QEESI which was translated by Ishikawa and Miyata[37] and its reliability and validity was confirmed by Hojo et al.[38] Hojo et al[39] described the Japanese original cut-off value (meeting conditions of chemical intolerances ≧40, symptom severity ≧20, and life impacts ≧ 10). In this study, we defined individuals who exceeded the Japanese original cut-off as "chemically sensitive population (CSP)." And in our SR model, instead of using cut-off values, we evaluated MCS by using continuous variables of three metrics (chemical intolerances, symptom severity, and life impact).

Chemical Exposure Experience

One question was used to measure chemical exposure experience: "Have you experienced any of the following within the last 10 years?" This was accompanied by the following list (scores for responses are indicated in parentheses): (1) construction of a new home or renovation ("yes" = 1); (2) installation of new furniture, carpets, curtains, etc ("yes" = 1); (3) purchase of a new car ("yes" = 1); (4) moving home (zero to one time = 1; three to four times = 2; more than five times = 3); (5) none of the above ("yes" = 0). If a subject chose option 5, their score was zero; for subjects who chose one or more of options 1 to 4, we summed their scores and considered the result to represent their chemical exposure experience.

Statistical Analysis

The subjects' personality traits were categorized into those representing innate nature (temperament) and those acquired after birth (character). Variables, including being a member of the CSP, personality, and chemical exposure experience, were individually evaluated using *U* tests, chi-squared tests, and correlation analyses. *U* tests and chi-squared tests were conducted to examine the sex differences and correlation analysis was conducted to examine the correlation between variables. Finally, we performed covariance structure analysis to build a structural regression model (SR model). The fit of the model to the data was examined using a chi-squared test (CMIN/DF, Chi-square Mean/Degree of Freedom), several studies have suggested the use of this ratio as a measure of fit; comparative fit index [CFI], comparative fit index, a revised form of NFI and compares the fit of a target model to the fit of an independent, or null, model; root mean square error of approximation (RMSEA) as a way of evaluating fit of data to the model, and Akaike information criterion (AIC), an estimator of out-of-sample prediction error and thereby relative quality of statistical models for a given set of data.

We use these parameter for estimates the quality of our SR model. In our SR model, we set paths from TCI to work related burdens, chemical explore experience, and MCS (Fig. 1). We posited three latent variables: temperament, character and MCS, set paths as (1) the temperament would be predicted by NS, HA, RD, and P, (2) character dimension would be predicted by SD, CO, and ST. (3) MCS would be influenced by temperament, character, sex, and chemical exposure; (4) MCS would also predict symptom severity, life impact, and symptom sensitivity; (5) chemical exposure would be predicted by sex, temperament, and character.

According to conventional criteria, a CMIN/DF of less than 3, a CFI of more than 0.95, a RMSEA of less than 0.08, and a relatively small AIC represent acceptable fit; meanwhile, a good fit is indicated by a CMIN/DF of less than 2, a CFI of more than 0.97, and a RMSEA of less than 0.05. Data were analyzed using IBM SPSS Statistics, version 24.0, and AMOS version 24.0, for Microsoft Windows (IBM, Armonk, NY).

RESULTS

The subjects' characteristics and the distribution of the scores for the QEESI subscales and work-related burden are shown in Table 1. Our respondents comprised 272 men (63.1%) and 159 women (36.9%). Of these, 199 performed manufacturing work (46.2%), 159 performed clerical work (36.9%), and 73 performed research and development work (16.9%). Analysis in terms of sex showed that most men performed manufacturing work (51.8%), followed by clerical work (26.1%), and research and development work (22.1%), respectively; on the other hand, most women performed clerical work (55.3%), followed by manufacturing work (36.5%), and research and development work (8.2%), respectively.

Regarding QEESI scores, overall 19 (4.4%) respondents exceeded the cutoff score for chemical intolerances (more than or equal to 40), 175 (40.6%) exceeded the cutoff score for symptom severity (more than or equal to 20), and 79 (18.3%) exceeded the cut-off score for life impact (more than or equal to 10). The
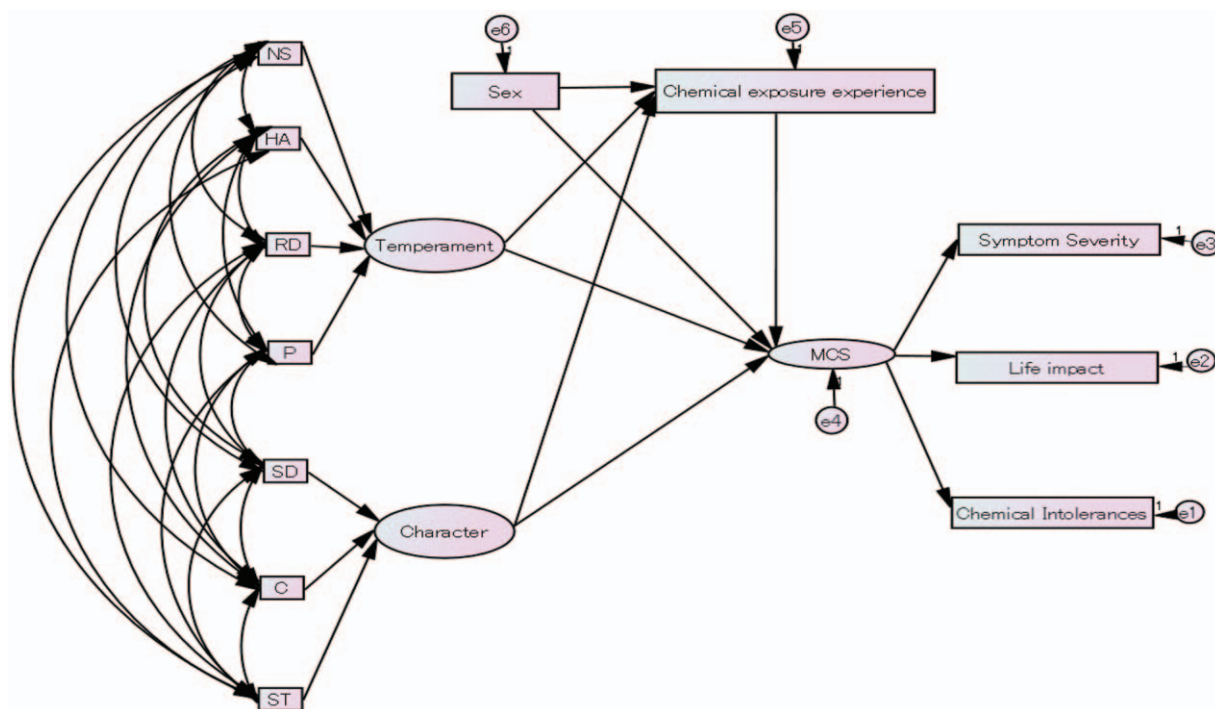
FIGURE 1. An original SR path model to estimate correlations between all variables. C, cooperativeness; HA, harm avoidance; MCS, multiple chemical sensitivity; NS, novelty seeking; P, persistence; RD, reward dependence; SD, self-directedness; T, self-transcendence; TCI, temperament and character inventor.

prevalence of CSP among our study population was 1.9% ($N = 8$). Regarding chemical exposure experience, "14.2%" for zero points, "24.8%" for one point, "22.3%" for two points, "25.3%" for three points, "10.7%" for four points, and "2.8%" for five points.

In terms of sex, for the male subjects 10 (3.7%) exceeded the cutoff score for chemical intolerances (more than or equal to 40), 97 (35.7%) exceeded the cutoff score for symptom severity (more than or equal to 20), and 43 (15.8%) exceeded the cutoff score for life impact (more than or equal to 10). Regarding chemical exposure experience, 42 (15.4%) scored zero points, 62 (22.8%) scored one point, 57 (21.0%) scored two points, 74 (27.2%) scored three points, 28 (10.3%) scored four points, and nine (3.3%) scored over five points.

For the female subjects, nine (5.7%) exceeded the cutoff score for chemical intolerances (more than or equal to 40), 78 (49.1%) exceeded the cutoff score for symptom severity (more than or equal to 20), and 36 (22.6%) exceeded the cutoff score for life impact (more than or equal to 10). For chemical exposure experience, 19 (11.9%) scored zero points, 45 (28.3%) scored one point, 39 (24.5%) scored two points, 35 (22.0%) scored three points, 18 (11.3%) scored four points, and three (1.8%) scored over five points. Significantly more women than men showed high symptom severity, and women also showed significantly higher total scores for the three QEESI subscales. However, we did not find any significant sex-based differences regarding the prevalence of CSP (Table 1).

Next, we estimated correlations among scores for the TCI and QEESI subscales and chemical exposure experience. Consequently, younger age was found to be associated with higher scores for NS and HA and higher chemical exposure experience; meanwhile, older age was associated with high P, SD, C, and ST scores. Women showed older age, and higher HA, RD, C, and QEESI subscale scores. As expected, almost all of the TCI subscales were significantly correlated with each other, except RD with NS and HA, and ST with RD and C. We also found a similar result for the QEESI

subscales: all were correlated with each other. Chemical exposure experience was significantly correlated with symptom severity and life impact (Table 2).

To examine the relationship between MCS and personality and temperament, we used an SR model. In the SR model, we set paths from TCI to chemical exposure experience and MCS; to test for sex-based differences we also added a sex-related factor (Fig. 2). The model fit the data: CMIN/DF = 2.66, CFI = 0.95, RMSEA = 0.06 (90% confidence interval = 0.046–0.079).

The standardized regression coefficients of the variables obtained using the final SR model are shown in Table 3. In this SR model, chemical exposure experience was predicted by high temperament and high character scores ($\beta = 0.17$; 0.19). Temperament had little direct impact on MCS ($\beta = 0.02$), but character had a significant impact on MCS ($\beta = 0.45$). We also found that being women predicted high MCS scores ($\beta = 0.20$), but did not significantly predict chemical exposure ($\beta = 0.10$). Path without statistical significance ($P > 0.05$) are shown in Black letters, thin lines (Fig. 2).

DISCUSSION

To the best of our knowledge, this is the first study to examine the differential associations between TCI subscales and the different syndromes of MCS. In our research, we also took the proposal of Cloninger[25] into account: that character develops based on temperament. The present study also investigated associations between work-related burdens and MCS among Japanese employees of an IT company. Consequently, we found every subscale of temperament and character to be associated with each other, and these results are consistent with those of previous studies.[23,25]

In our study population, the prevalence of chemical sensitivity was 1.8% ($N = 8$). In a telephone survey conducted in the United States, the self-reported prevalence of MCS was 12.6% to 15.9%.[40] Meanwhile, in Japan, a survey conducted by the National Public Health Institute (now the National Health Science Medicine

TABLE 2. Correlations Between the Subscales of the TCI, QEESI, and Chemical Exposure Experience Points

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Age	—												
2. Sex	−0.25**	—											
3. TCI NS	−0.16**	−0.09											
4. TCI HA	−0.25**	0.14**	−0.26**	—									
5. TCI RD	−0.01	0.21**	−0.02	−0.03									
6. TCI P	0.12*	−0.02	−0.18**	−0.26**	0.21**	—							
7. TCI SD	0.30**	−0.02	−0.21**	−0.48**	0.11**	0.23**	—						
8. TCI C	0.11*	0.15**	−0.27**	−0.12**	0.52**	0.26**	0.32**	—					
9. TCI ST	0.12*	0.02	0.23**	−0.29**	0.08	0.31**	−0.10*	−0.04	—				
10. MCS chemical intolerance	0.04	0.15**	−0.01	0.05	0.03	0.04	−0.13**	−0.13**	0.23**	—			
11. MCS symptom severity	−0.05	0.15**	0.06	0.23**	−0.02	−0.01	−0.36**	−0.18**	0.21**	0.46**	—		
12. MCS life impact	−0.07	0.15**	0.03	0.13**	−0.02	0.02	−0.23**	−0.11*	0.19**	0.47**	0.61**	—	
13. Chemical exposure experience	−0.10*	−0.02	−0.05	−0.04	−0.02	0.09*	−0.11*	−0.08	0.00	0.05	0.12**	0.14**	—

Significant correlation coefficients are in bold.

C, cooperativeness; HA, harm avoidance; MCS, multiple chemical sensitivity; NS, novelty seeking; P, persistence; RD, reward dependence; SD, self-directedness; T, self-transcendence; TCI, temperament and character inventor.

*$P < 0.05$.
**$P < 0.01$.

Institute) in 2000 reported that 0.74% of adults had MCS.[40] Further, in a previous study by the present authors, also based in Japan, 3.3% and 4.3% of employees were members of the CSP in 2006 and 2011, respectively.[10] The prevalence of MCS in identified in the present study is lower than that reported in the large-scale survey in the United Sates, but approximately the same as the percentages reported in the Japan-based surveys.

It is widely accepted that MCS in humans may be an acquired disorder, with certain individuals becoming increasingly sensitive to chemicals in the environment[41]; however, the TCI provides, from a psychobiological perspective, insight into the combination of traits

that predict this condition, differentiating aspects of personality that are relatively stable (temperament traits) from those that are more amiable to change through sociocultural learning (character traits).[26] Our study findings suggest that MCS is correlated with personality, being more strongly impacted by character acquired later in life than by innate temperament. Heritable influences (ie, genetically inherited qualities) have an equally strong impact on temperament and character, but character plays a self-regulatory role.[42] To adapt to internal or external challenges, the individual traits of a person must interact in a complex, dynamic way.[43,44] This result suggests that MCS is more strongly predicted by character
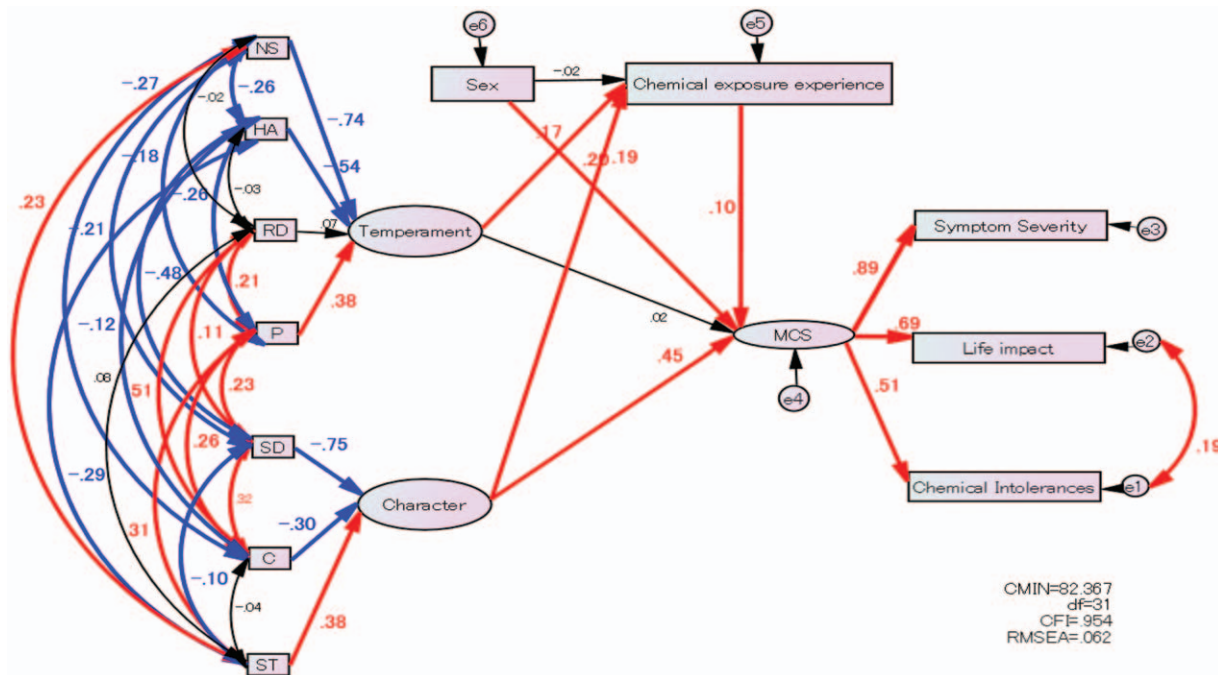

FIGURE 2. SR model of TCI, MCS, sex, and chemical expose. Red line: positive correlation; blue line: negative correlation; black line: no statistical correlation. C, cooperativeness; HA, harm avoidance; MCS, multiple chemical sensitivity; NS, novelty seeking; P, persistence; RD, reward dependence; SD, self-directedness; T, self-transcendence; TCI, temperament and character inventor.

TABLE 3. Standardized Regression Coefficients of Variables Obtained Using the SR Model

Dependent Variables	Independent Variable	β^a	SE	P^b
Temperament	TCI NS	−0.74	0.01	**
	TCI HA	−0.54	0.01	**
	TCI RD	0.07	0.01	NS
	TCI P	0.38	0.02	**
Character	TCI SD	−0.75	0.01	***
	TCI C	−0.30	0.01	**
	TCI ST	0.38	0.01	**
Chemical exposure experience	Sex	−0.02	0.13	NS
	Temperament	0.17	-	*
	Character	0.19	-	*
MCS	Sex	0.20	1.31	*
	Temperament	0.02	-	NS
	Character	0.45	0.61	***
	Chemical Exposure Experience	0.10	-	*

NS, not statistically significant, − , no statistically significant result because the independent variable was a latent factor.
^aSE standard error a standardized regression coefficients.
^bP value <0.05 was regarded as statistically significant.
*P < 0.05.
**P < 0.01.
***P < 0.0001.

traits than temperament traits; further, this indicates that certain personality profiles (character) are prone to being more or less vulnerable to adapting to and coping with certain exposures, changes, and challenges,[45] such as those associated with MCS.

Our findings indicate that more chemical exposure is associated with higher MCS scores, which is consistent with the findings of previous studies.[6,41] In a notable experiment, Winneke et al[46,47] found that persons who felt high levels of annoyance regarding either noise or odor in their residential areas reacted more strongly to both noise and unpleasant odor stimuli in a laboratory setting when compared with persons who were only slightly annoyed by such stimuli in their residential areas. This may be an explanation for the etiology of MCS. Both temperament and character showed positive effect on chemical exposure experience, this is also an interesting finding. We believe that people's personality and characteristics affect their activities, which may lead to the amount of chemical exposure.

Regarding sex-based differences, almost all studies that have considered such differences in relation to MCS and chemical intolerance have found the rates to be higher in women than in men.[6,18,48] Notably, Hojo et al[49−51] reported that over 75% of MCS patients in Japan are women. This sex-based characteristic of MCS has been reported in studies around the world.[7,48,52,53] A possible reason more women than men have MCS is that women are more prone to hormonal fluctuations; female hormones are involved in the growth of hippocampal neural networks, with the hypothalamus being associated with hippocampal circuits. Additionally, the pituitary−adrenal system is more sensitive in women than in men.[54]

LIMITATION

Although we have demonstrated that aspects of personality have an impact on MCS, this study has limitations that suggest that further work would yield useful and interesting data. One such limitation of this study is that the sample of participants is restricted to a single company; thus, considerable caution should be taken when generalizing the present findings to other populations. Another limitation is we didn't examine other factors that have been reported to be related to MCS (such as psychological stress, economic status, medical history, smoking, lifestyle, etc). One more limitation is the cross-sectional design of our study. Although it is reasonable to argue, based on our SR model, that MCS is impacted more by character than innate temperament, follow-up research, with a longitudinal design, is necessary to study the associations between personality, work-related burdens, and chemical exposure.

Nevertheless, the present results support our hypothesis that personality is associated with MCS.

CONCLUSION

Our findings suggest that MCS is correlated with personality, and is impacted more by character, acquired later in life, than innate temperament. Women are more likely to exhibit symptoms of chemical sensitivity.

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