

EFFECTS OF PSYCHOLOGICAL SYMPTOMS ON LIFE ADJUSTMENT AMONG SURVIVORS OF HUMIDIFIER DISINFECTANTS

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Abstract

Objectives: The humidifier disinfectant catastrophe in South Korea was a social disaster caused by toxic chemical substances. The present study aimed to examine the relationships between psychological symptoms and adaptive life functioning in survivors of humidifier disinfectants. This study examined the differential effects of psychological symptoms on life adjustment between survivors of humidifier disinfectant and the general population. **Material and Methods:** A total of 452 individuals (228 general and 224 survivor groups) participated in this research. This study utilized the *Adult Self-Report*, one of the most widely used comprehensive mental health scales for measuring both psychological symptoms (e.g., anxiety/depression) and life adjustment functioning (e.g., interpersonal relationship). For the data analysis, multi-group structural equation modeling analysis was conducted using AMOS 21.0 program. **Results:** The results of this study indicated that attention problems out of 8 psychological symptoms was the only significant factor related to life adjustment in both general and survivor groups. In addition, there was a significant 2-way interaction effect of group status and somatic complaints on life adjustment. **Conclusions:** When the somatic complaint symptom was higher, participants in the survivor group were less likely to adjust in life than the general group. Taken together, the somatic complaints of the survivors more strongly influence the life adjustment than the general population. Finally, the authors discuss practical implications for survivors of humidifier disinfectants for designing suitable intervention strategies. *Int J Occup Med Environ Health.* 2023;36(5):596–605

Key words:

survivors, psychological symptoms, adaptive life functioning, humidifier disinfectant, social disaster, somatic complaints

INTRODUCTION

The humidifier disinfectant catastrophe in South Korea was a social disaster caused by toxic chemical substances. The humidifier disinfectant products sold in Korea were developed to suppress bacterial growth and were widely used in homes with infants and hospitals with older adults. Humidifier disinfectants contained chemicals of polyhexamethylene guanidine phosphate (PHMG-P), polyhexamethylene guanidine hydrochloride (PHMG-H), oligo(2-[2-ethoxy]ethoxyethyl) guanidinium (PGH), chloromethyliso-

thiazolinone (CMIT), methylisothiazolinone (MIT), etc. [1]. These chemicals were found to cause fatal respiratory disease, lung diseases, and other physical diseases. Thirty-seven types of products, including those chemicals, were sold in Korea in 1994–2011. As of November 2021, 1740 deaths [2] were reported, and 7642 individuals applied as survivors of humidifier disinfectants.

In 2011, the Korea Center for Disease Control and Prevention (KCDC) and the Korean Ministry of Environment (KME) started identifying victims and collecting

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information. The investigations have been conducted and various support procedures for survivors focusing on physical injury have been provided. A large body of disaster research [3–4] pointed out that bodily harm was linked to psychological responses such as posttraumatic stress disorder (PTSD), anxiety, and depression in the aftermath of disasters. Survivors were continuously reporting psychological difficulties along with physical challenges [5]. A recent study [6] showed that survivors of humidifier disinfectants have severe psychological problems compared to the general population. In particular, results showed that the survivor group had higher anxiety/depression, withdrawal, somatic complaints, thought problems, attention problems, aggressive behavior, and rule-breaking behavior than the general group.

When individuals have physical and psychological difficulties, they experience life adjustment problems. Psychological and physical problems affect adaptive functioning in survivors' lives. Researchers expected that psychological symptoms affecting the adaptation functioning would have different patterns in the humidifier survivor group compared with the general population. Till date, most studies have focused on physical damage and diseases of survivors of humidifier disinfectants.

The objective of the present study was to investigate the relationship between psychological symptoms and adaptive life functioning in survivors of humidifier disinfectants by comparing them with the general population. Specifically, this study identified the most significant psychological symptoms affecting life adjustment in humidifier disinfectant survivors and the general population. Next, this study examined the differential effects of psychological symptoms on life adjustment between survivors of humidifier disinfectant and the general population.

This study used the *Adult Self-Report* (ASR) [7]. Along with *Minnesota Multiphasic Personality Inventory* (MMPI), the ASR is one of the most widely used comprehensive mental health scales for measuring both psychological symptoms

(e.g., anxiety/depression) and life adjustment functioning (e.g., interpersonal relationship). Furthermore, it is normed for Korean adults ages 18–59 years to evaluate their psychological symptoms and adaptive functioning with a standardized self-reported rating form [8]. Therefore, by using ASR, it was expected that the results of this study would explore the most significant problem among various psychological symptoms, which affect adaptive functioning in the life of survivors of humidifier disinfectants. In addition, by examining how survivors' mental health problems are manifested in social functioning, essential factors can be identified to help them function when designing intervention strategies for survivors of humidifier disinfectants.

MATERIAL AND METHODS

Participants

The present study was conducted after obtaining ethical approval from the National Institute of Environmental Research (NIER) in South Korea. The government support program collected the data of humidifier disinfectant survivors using the ASR. A total of 224 survivors participated in this survey; the age range of the survivors was 18–73 years ($M \pm SD$ 42.20 \pm 10.89 years), 37.1% ($N = 83$) were men and 62.9% ($N = 141$) were women. In the case of the general population, random sampling was used to select 228 participants from 1003 in the norming sample of the general population provided by HUNO Inc. (ASR Provider Company in South Korea). The age range of the general population was 19–59 years ($M \pm SD$ 37.86 \pm 9.71 years), 52.6% ($N = 120$) were men and 47.4% ($N = 108$) were women. More demographic information of the sample is described in Table 1.

Measures

Psychological symptoms

The ASR of The Achenbach System of Empirically Based Assessment (ASEBA) is a self-report survey that assesses

participants' behavioral and psychological symptoms [7]. The Korean version of the ASR provided by HUNO Inc. was used to measure the level of psychological symptoms of the participants. In this study, only 8 symptom scales consisting of 99 out of 120 items, excluding "other problems" that do not fall under any symptom, were used. Each item of the ASR is explained by 1 of 8 symptom subscales that are divided into 3 internalizing problem subscales: *Anxious/Depressed* (18 items), *Withdrawal* (9 items), and *Somatic Complaints* (12 items), 3 externalizing problem subscales: *Aggressive Behavior* (15 items), *Rule-Breaking Behavior* (14 items) and *Intrusive Behavior* (6 items), and 2 thought and attention problem subscales: *Thought Problems* (10 items) and *Attention Problems* (15 items). *Anxiety/Depression* subscale assesses symptoms of anxiety and depression, such as feelings of sadness, hopelessness, or excessive worry, and the example items are "I cry a lot," "I worry about my future." *Withdrawn* subscale measures social withdrawal and a lack of engagement in social activities, and the example items are "I prefer to be alone rather than with others," "I have trouble making friends." *Somatic Complaints* subscale evaluates physical symptoms that may be related to emotional distress or psychological issues, such as headaches, stomachaches, or dizziness, and the example items are "I have unexplained pains or aches," "I feel tired without a good reason." *Thought Problems* subscale assesses unusual thoughts, beliefs, or perceptions, such as hallucinations, delusions, or obsessions, and the example items are "I have thoughts that others find strange," "I feel that my mind is not as clear as it used to be." *Attention Problems* measures difficulties with concentration, attention, and focus, and the example items are "I have trouble paying attention," "I have a hard time staying on task." *Rule-Breaking Behavior* subscale assesses behaviors that involve breaking rules or engaging in anti-social activities, such as lying, stealing, or vandalism, and the example items are "I have lied to others to avoid getting in trouble," "I have stolen things that did not belong

Table 1. Demographic information of the sample of general and survivor groups in the study conducted in January 2018–December 2021, South Korea

Variable	Participants (N = 452) [n (%)]	
	general group (N = 228)	survivor group (N = 224)
Gender		
male	108 (47.4)	141 (62.9)
female	120 (52.6)	83 (37.1)
Age (years)		
<30 years	44 (19.3)	33 (14.7)
30–39 years	89 (39.0)	41 (18.3)
40–49 years	63 (27.6)	100 (44.6)
50–59 years	32 (14.0)	42 (18.8)
≥60 years	–	8 (3.6)
Socio-economic status		
low	61 (26.8)	59 (26.3)
middle	97 (42.5)	91 (40.6)
high	70 (30.7)	74 (33.0)
Education level		
lower secondary or below	2 (0.9)	3 (1.3)
upper secondary	85 (37.3)	41 (18.3)
undergraduate	125 (54.8)	152 (67.9)
graduate	16 (7.0)	27 (12.1)
missing value	–	1 (0.4)
Tobacco smoking consumption		
0 cigarettes	167 (73.2)	201 (89.7)
1–5 cigarettes	8 (3.5)	6 (2.7)
6–10 cigarettes	17 (7.5)	8 (3.6)
11–20 cigarettes	30 (13.2)	9 (4.0)
>20 cigarettes	6 (2.6)	–
Drinking frequency		
0	89 (39.0)	132 (58.9)
<once/week	54 (23.7)	47 (21.0)
once/week	25 (11.0)	17 (7.6)
2–3 days/week	46 (20.2)	15 (6.7)
4–5 days/week	9 (3.9)	8 (3.6)
>6 days/week	3 (1.3)	5 (2.2)
missing value	2 (0.9)	–

Tobacco smoking consumption indicates the number of cigarettes smoked on average per day during the past 6 months.

** $p < 0.01$; *** $p < 0.001$.

to me.” *Aggressive Behavior* subscale evaluates aggressive behaviors, such as verbal or physical aggression, bullying, or cruelty to others, and the example items are “I get into physical fights,” “I tease or bully others.” *Intrusive* subscale measures behaviors that involve intruding on others’ personal space or privacy, or excessive social engagement that may be perceived as annoying or inappropriate, and the example items are “I butt into other people’s conversations,” “I have difficulty respecting other people’s privacy.” In this study, the internal consistency of the subscales was ranged 0.88–0.92.

Life adjustment

The ASR includes life adjustment subscales (*Spouse/Partner*, *Family*, *Job*, *Education*, and *Friends*) that are rated to represent the degree of life adjustment of the participants. In this study, 2 subscales of life adjustment were used, *Spouse/Partner* (8 items) and *Job* (9 items), to see how behavioral and psychological problems are related to life adjustment and whether a pattern of relationships between behavioral and psychological issues and life adjustment is significantly differentiated by the groups. The example item of *Spouse/Partner* subscale is “I get along well with my spouse/partner.” The example item of *Job* subscale is “I am satisfied with my job.” The internal consistency of *Spouse/Partner* and *Job* were 0.83 and 0.63, respectively.

Data analysis

Descriptive statistics, bivariate correlations, and reliability were analyzed using SPSS 21.0. Means, standard deviations, and correlations among variables were calculated for groups, and the reliability of the measures was reported as Cronbach’s α . Then, the hypothetical model fit test and multi-group analysis were conducted in structural equation modeling (SEM) using AMOS 21.0 program. First, the measurement model was tested to examine whether the observed variable properly mea-

sured the corresponding latent variable. Then the paths between variables were analyzed in the structural model test. The fit of the model was comprehensively evaluated by the values of comparative fit index (CFI), Tucker Lewis index (TLI), and root mean square error of approximation (RMSEA). The CFI and TLI >0.95 were interpreted as a very good fit [9]. The RMSEA <0.05 indicates a very good fit and <0.08 indicates a good fit [10]. Second, measurement invariance, an essential prerequisite for the multi-group SEM, was tested to verify equivalent construct measurement across different groups. Measurement invariance is satisfied when the χ^2 difference ($\Delta\chi^2$) between the unconstrained and constrained model is insignificant [11]. Lastly, a multi-group analysis was conducted to examine whether the relationship between each psychological symptom and life adjustment differs across the general and survivor groups. The authors specifically investigated which path had differences between the general and survivor groups using the χ^2 difference test.

RESULTS

Preliminary analysis

Table 2 summarizes each variable’s means, standard deviations, and bivariate correlations. For the general group, anxious/depressed symptoms showed the strongest correlation with attention problems ($r = 0.757$, $p < 0.01$) and the second strongest with aggressive behavior ($r = 0.714$, $p < 0.01$). In the survivor group, anxious/depressed symptoms were also strongly correlated with attention problems ($r = 0.737$, $p < 0.01$), followed by somatic symptoms ($r = 0.712$, $p < 0.01$). Attention problems demonstrated strong correlations with other psychological symptoms: anxiety/depression, rule-breaking, and job adjustment in both groups. Each symptom’s mean score for the survivor group was higher than that found in the general group except for the *Intrusive* subscale. Particularly, the scores of *Anxiety/Depression*, *Withdrawal*, and *Somatic Symptoms* showed the largest difference. In addition, each

Table 2. Descriptive statistics and correlations among the variables of general and survivor groups in the study conducted in January 2018–December 2021, South Korea

Variable	Correlation															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Anxious/Depressed	1	0.65**	0.71**	0.71**	0.74**	0.65**	0.53**	0.33**	-0.53**	-0.41**	-0.10	-0.05	-0.03	-0.21**	0.01	0.01
2. Withdrawn	0.66***	1	0.59**	0.63**	0.60**	0.59**	0.55**	0.20**	-0.49**	-0.39**	-0.05	-0.05	-0.14*	-0.09	-0.01	-0.08
3. Somatic complaints	0.51***	0.41**	1	0.72**	0.59**	0.56**	0.48**	0.25**	-0.50**	-0.33**	-0.08	0.11	-0.09	-0.14*	0.00	-0.04
4. Thought problems	0.63***	0.52**	0.54**	1	0.67**	0.61**	0.60**	0.41**	-0.50**	-0.30**	-0.02	-0.09	-0.19**	-0.12	0.02	-0.03
5. Attention problems	0.76***	0.61**	0.47**	0.55**	1	0.60**	0.67**	0.39**	-0.57**	-0.40**	-0.06	-0.09	-0.12	-0.18**	0.02	0.02
6. Aggressive behavior	0.71***	0.44**	0.48**	0.60**	0.66**	1	0.62**	0.52**	-0.44**	-0.46**	-0.10	-0.11	-0.08	-0.11	0.03	0.02
7. Rule-breaking behavior	0.54***	0.38**	0.36**	0.48**	0.65**	0.66**	1	0.45**	-0.45**	-0.40**	0.04	-0.13*	-0.13	-0.10	0.15*	0.16*
8. Intrusive behavior	0.36***	0.11	0.24**	0.39**	0.42**	0.53**	0.53**	1	-0.27**	-0.18*	-0.07	-0.18**	-0.09	0.03	0.01	0.04
9. Job adjustment	-0.43***	-0.38**	-0.13	-0.35**	-0.48**	-0.32**	-0.40**	-0.16*	1	-0.32**	-0.08	-0.13	0.10	-0.02	-0.09	-0.03
10. Spouse/partner relationship	-0.31***	-0.25**	-0.18*	-0.18*	-0.33**	-0.34**	-0.27**	-0.11	0.29**	1	0.15	-0.03	0.05	0.17*	-0.07	-0.04
11. Gender	-0.01	-0.03	-0.18**	-0.07	0.02	-0.08	0.16*	0.14*	-0.08	0.04	1	0.09	-0.07	-0.02	0.32***	0.33***
12. Age	-0.24***	-0.12	0.02	-0.20**	-0.18**	-0.22**	-0.10	-0.33***	0.11	-0.09	-0.01	1	0.00	-0.10	-0.08	-0.12
13. SES	0.22**	0.19**	0.01	0.06	0.16*	0.02	0.04	-0.05	-0.09	-0.14	0.08	-0.01	1	0.14*	-0.11	-0.05
14. Education level	0.10	0.05	0.01	0.08	0.08	0.10	0.02	0.06	0.05	0.00	0.16*	-0.28***	-0.07	1	-0.16*	-0.08
15. Smoking tobacco consumption	0.05	-0.06	0.00	-0.01	0.03	-0.01	0.15*	0.19**	-0.01	-0.08	0.51***	0.00	0.06	0.02	1	0.39***
16. Drinking frequency	0.00	-0.10	0.00	0.00	0.04	-0.02	0.21**	0.15*	0.05	-0.11	0.39***	0.07	0.12	-0.04	0.37***	1
Group (M±SD)																
general (G1)	0.43±0.31	0.32±0.33	0.25±0.27	0.19±0.18	0.42±0.30	0.34±0.31	0.16±0.19	0.31±0.33	1.47±0.24	1.39±0.40	0.53±0.50	37.86±9.71	1.96±0.76	2.68±0.61	3.86±7.48	3.73±5.16
survivor (G2)	0.86±0.43	0.75±0.42	0.68±0.49	0.40±0.30	0.65±0.38	0.63±0.37	0.22±0.24	0.31±0.33	1.37±0.32	1.09±0.40	0.37±0.48	42.20±10.9	1.93±0.77	2.91±0.59	1.13±3.95	2.49±5.66

*p < 0.05, **p < 0.01, ***p < 0.001.

Table 3. Results of the structural model predicting life adjustment for the general and survivor groups in the study conducted in January 2018–December 2021, South Korea

Psychological symptom	Participants (N = 452)							
	general group (N = 228)				survivor group (N = 224)			
	B	β	SE	CR	B	β	SE	CR
Anxious/Depressed	−0.12	−0.19	0.11	−1.06	−0.10	−0.22	0.07	−1.35
Withdrawn	−0.04	−0.07	0.08	−0.52	−0.11	−0.24	0.06	−1.78
Somatic complaints	0.14	0.18	0.09	−1.55	−0.06	−0.15	0.06	−1.07
Thought problems	−0.08	−0.12	0.09	−0.87	0.03	0.08	0.06	0.54
Attention problems	−0.24	−0.44	0.10	−2.51*	−0.16	−0.38	0.07	−2.40*
Aggressive behavior	−0.05	−0.10	0.09	−0.60	−0.07	−0.15	0.06	−1.03
Rule-breaking	−0.13	−0.25	0.07	−1.77	−0.08	−0.20	0.06	−1.46
Intrusive	0.11	0.24	0.06	1.93	0.02	0.04	0.05	0.35

CR – critical ratio.

* $p < 0.05$.**Table 4.** Results of the measurement invariant model of general and survivor groups in the study conducted in January 2018–December 2021, South Korea

Model	χ^2	df	CFI	TLI	RMSEA
Baseline	21.011	14	0.997	0.976	0.033
Measurement Invariance	21.892	15	0.997	0.978	0.032

df – degree of freedom; CFI – comparative fit index; RMSEA – root mean square error of approximation; TLI – Tucker-Lewis index.

mean score of life adjustment in the survivor group was lower than that of the general group.

Tests of the measurement and structural models

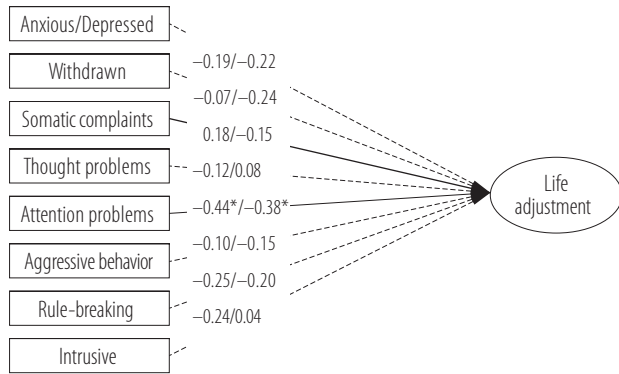
The model fit indices of the measurement model were acceptable ($\chi^2 = 21.682$, $df = 7$, $p = 0.003$, $CFI = 0.995$, $TLI = 0.958$, $RMSEA = 0.068$). The CFI and TLI were >0.95 [9] and RMSEA was > 0.08 [10], meeting the criteria of all goodness of fit indices. The factor loadings of life adjustment to spouse/partner and job were 0.558 and 0.634, respectively.

The paths through which 8 psychological symptoms affect life adjustment was examined in detail. The fitness of the structural model was the same as the measurement

model. Table 3 shows the path coefficients between variables for each group. Attention problem was the only significant psychological symptom related to life adjustment in both groups.

Multi-group model

A multi-group analysis was conducted to examine whether the relationship between psychological symptoms and life adjustment differs across the general and survivor groups. Table 4 and Figure 1 presents these results. As shown in Table 4, the measurement invariance model, which constrained the factor loadings to be equal between the 2 groups, was homogeneous with the baseline model ($\Delta_{\chi^2} = 0.88$, $df = 1$, $p = 0.348$). Thus, the measurement



Structural model with standardized coefficients for each group. The paths show associations between 8 psychological symptoms and life adjustment. The dotted line indicates insignificant results ($p > 0.05$), while the solid line indicates significant results ($p < 0.05$). The path with a significant difference between the 2 groups is presented in bold.

* $p < 0.05$.

Figure 1. Structural model of the association between psychological symptoms and life adjustment for the general/survivor groups in the study conducted in January 2018–December 2021, South Korea

invariance, a prerequisite for comparing path coefficients between groups, was satisfied. Subsequently, the χ^2 difference test was performed to compare the path coefficients across the groups. The results revealed that the path from somatic complaints to life adjustment differed significantly between the 2 groups ($\Delta_{\chi^2} = 3.89, df = 1, p = 0.49$). In addition, somatic complaints were negatively associated with adaptive functioning in the survivor group ($\beta = -0.15$) but not in the general group ($\beta = 0.18$). Figure 1 depicts the relationship between psychological symptoms and life adjustment for each group. Figure 2 shows the significant 2-way interaction effect of group status and somatic complaints on life adjustment. When the somatic complaint symptom was higher, survivors were less likely to adjust in life than the general group.

DISCUSSION

Through comparison with the general population, the unique effects of psychological symptoms on life adjustment in the sample of survivors were explored. There are

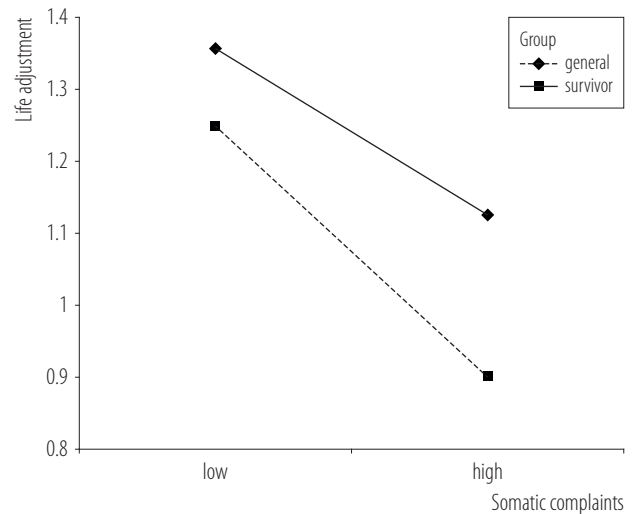


Figure 2. Moderating role of group status in the association between somatic complaints and life adjustment of general and survivor groups in the study conducted in January 2018–December 2021, South Korea

3 main points to be discussed in this regard. First, the psychological distress scores of the survivors were much higher than those of the general population. The results of this study are consistent with Ko et al. [6]. Their findings revealed that 7 psychological symptoms of the survivor group were more significant than that of the general group: somatic complaints, withdrawal, thought problems, attention problems, rule-breaking behavior, and aggressive behavior. In this study, the humidifier disinfectant survivors showed much higher scores on anxiety/depression, withdrawal, and somatic symptoms than the general population. These 3 subscales all belong to internalizing symptom categories. The results of this study imply that the survivors are more vulnerable to internalized issues.

Next, out of 8 psychological symptoms, the *Attention* subscale was the only significant variable related to life adjustment in survivors and the general population. Lee et al. [12] stated that attention problems could appear at work, disrupting overall life adaptation. In other words, an individual's attention issues are closely related to daily adaptive functioning. That is, attention problems create

maladaptive behavioral patterns at work, which can significantly affect life adaptation. In the study of Sigurdson et al. [13], attention problems were positively related to emotional and interpersonal distress, and individuals who have attention problems experienced considerable emotional and interpersonal difficulties in their daily life. Attention problems cause emotional confusion [13,14]. Therefore, counselors must capture the interpersonal and work patterns when both survivors and the general population have attention issues.

Finally, the results of SEM analysis indicated that the somatic complaints of survivors were negatively related to life adjustment. In contrast, the general population group has a positive relationship between somatic complaints and life adjustment. The higher the somatic complaints in the survivors' group, the more likely survivors have difficulty in their daily lives. Taken together, the somatic complaints of the survivors more strongly influence the life adjustment than the general population. It is not surprising that humidifier disinfectant survivors are more vulnerable to somatic symptoms. The somatic problems occurred because the humidifier disinfectant incident is closely related to physical problems. Humidifier disinfectant products contain many chemicals, such as PHMG-P, PHMG-H, CMIT, MIT, and PGH, which generate various physical problems, mainly lung-related damage [15]. Leem et al. [16] reported that physical problems lead to psychological symptoms among survivors of social disasters. Several studies [17–19] indicated that physical symptoms influenced psychological symptoms and vice versa. In addition, physical pains proceed inside the body, and there is a risk that psychological distress may be accompanied by physical suffering [16,20]. This internal attribution about the problem acts as a factor within the individual, suggesting that the humidifier disinfectant victims can internalize psychological problems instead of expressing them. Therefore, when designing psychological

interventions for survivors, it is important to include somatic complaints as one of the critical elements for the intervention program. For clients presenting with somatic complaints related to psychological symptoms, practitioners may consider the following interventions: cognitive behavioral therapy (CBT), mindfulness-based stress reduction (MBSR), and mindfulness-based cognitive therapy (MBCT). The CBT helps clients identify and change negative thought patterns and behaviors that may be contributing to somatic complaints. The MBCT and MBSR help clients develop an awareness of their thoughts, emotions, and physical sensations, fostering a non-judgmental attitude and promoting relaxation [21,22]. Practicing relaxation techniques, such as progressive muscle relaxation, deep breathing exercises, and guided imagery, can help clients reduce stress and alleviate somatic symptoms.

This study has several limitations. First, all humidifier disinfectant survivors were adults. Although this sample is representative of humidifier disinfectant survivors, it is essential to generalize this result to children and older populations. Therefore, it is necessary to use data from various age groups to generalize the results for future studies. Second, the data were obtained from a cross-sectional design. Considering that humidifier disinfectant survivors appear over a long period, a longitudinal study can examine the causal relationship between psychological symptoms and life adjustment. Therefore, it is necessary to explore the longitudinal changes of the psychological symptoms and their effects on survivors' life adjustment. Third, the current research results are limited to the intra-psychological data reported by victims. In addition to individuals' internal characteristics, the results of the study could be influenced by potential confounders. Various demographic, systematic, and environmental factors such as employment status and social support network should be considered in future research. Thus, it is necessary to conduct future research

tailored to the comprehensive characteristics of the survivors by carefully understanding the extent of the damage to their mental health. Fourth, there is a high correlation between the 8 psychological symptom scales, which indicates that each subscale has high validity as a factor measuring psychological symptoms. A high correlation between subscales indicates that the subscales are effectively measuring the intended psychological symptoms, thus demonstrating high validity. However, when items are highly correlated, there is a risk that they may overlap or explain the same underlying factor. In such cases, it is essential to be cautious when interpreting the results, as these overlapping items might lead to a redundancy in the assessment or an overemphasis on certain aspects of the symptoms being measured. This careful interpretation helps ensure that the practitioner does not overemphasize or misinterpret specific symptoms due to the strong relationships among the other subscales. Additionally, it is crucial to consider each client's unique context, history, and presenting concerns to provide a comprehensive and accurate assessment.

CONCLUSION

Despite these limitations, the results of this study are meaningful in that it reveals the core psychological symptoms of humidifier disinfectant victims and examines the symptoms that relate to life adjustment. Furthermore, by comparing these victims with the general population, an important starting point to identify differential psychological elements for designing the intervention program for the survivors is established. Finally, the findings of this study could be the basis for better life adjustment and mental health promotion of survivors in the future.

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Author contributions

Research concept: Min Joo Lee, Sang Min Lee

Research methodology: Soeun Hong

Collecting material: Hun-Ju Lee

Statistical analysis: Yubin Jung

Interpretation of results: Min Joo Lee, Hun-Ju Lee

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