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Mental Health Outcomes After the Acute Phase of COVID-19: Factors Identified in a Korean Public Mental Health Service

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ABSTRACT

Background: Sequelae following coronavirus disease 2019 (COVID-19) frequently include lasting neuropsychiatric symptoms; however, identifying predictors from the acute phase remains challenging due to limitations in collecting prospective data during that time.
Methods: Data were obtained from electronic counseling records of 515 COVID-19 patients who received free services from the Korean National Center for Disaster and Trauma. The Clinical Global Impression Severity Scale (CGI-S) was used to repeatedly assess mental health at each counseling session. Baseline predictors included demographic characteristics, psychiatric and medical comorbidities, and psychological response, which was further divided into four sub-factors via factor analysis. Multivariate mixed effect models were used to explore the relationship between these predictors and mental health following the acute phase of COVID-19, with analyses stratified by gender.
Results: The most common post-COVID psychological responses were anxiety, depression, and sleep problems, with CGI-S scores dropping from 2.83 initially to 1 by the last observed session and averaging 2.38 at the third follow-up. Four sub-factors were identified through exploratory factor analysis, namely cognitive and physical exhaustion, emotional distress, self-destructive coping, and somatized anxiety. Baseline psychological responses ($\beta = 0.06$, $P < 0.001$) and pre-existing psychiatric disorders ($\beta = 0.37$, $P < 0.001$) were significantly associated with higher CGI-S scores over time; among psychological sub-factors, cognitive-physical exhaustion ($\beta = 0.28$, $P < 0.001$), emotional distress ($\beta = 0.32$, $P < 0.001$), and self-destructive coping ($\beta = 0.12$, $P < 0.001$) were significant predictors, with emotional distress significant in men ($\beta = 0.26$, $P = 0.001$) and both cognitive-physical exhaustion ($\beta = 0.36$, $P < 0.001$) and emotional distress ($\beta = 0.36$, $P < 0.001$) significant in women.
Conclusion: Baseline psychological responses predict persistent mental health symptoms, and identified profiles may help early identification of high-risk groups during acute COVID-19.

Keywords: Longitudinal Studies; COVID-19; Long COVID; Mental Health; Preventive Psychiatry; Public Health; Clinical Global Impression Severity Scale

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Disclosure
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Data Sharing Statement
The patient-level data utilized in this study are not publicly accessible due to privacy considerations, as participants are safeguarded under the Personal Information Protection Act of South Korea. Nonetheless, researchers associated with recognized institutions may apply for access to the anonymized aggregate data by submitting a research proposal to the National Center for Mental Health in South Korea.

Author Contributions
Conceptualization: Kim H, Baik M, Paik JW, Sim M, Jung SJ. Data curation: Kwak E, Lee S, Lee D,[1] Ko SJ. Formal analysis: Kim H. Funding acquisition: Jung SJ. Investigation: Kim H, Kwak E, Lee S, Lee D,[1] Ko SJ. Methodology: Kim H. Project administration: Baik M, Paik JW, Sim M, Jung SJ. Resources: Sim M, Jung SJ. Software: Kim H. Supervision: Baik M, Paik JW, Sim M, Jung SJ. Validation: Kwak E, Lee S, Lee D,[2] Sim M. Visualization: Kim H. Writing - original draft: Kim H, Kwak E, Lee S. Writing - review & editing: Kim H, Lee D,[2] Sim M, Jung SJ.

INTRODUCTION

While the coronavirus disease 2019 (COVID-19) pandemic has been officially declared over by the World Health Organization, a significant number of survivors continue to experience long COVID, or post-COVID syndrome, a condition marked by diverse and persistent post-acute symptoms.[1] Neuropsychiatric symptoms such as chronic fatigue, cognitive impairment, and depression were common among long COVID symptoms and often lasted for several months.[2] Although mood or anxiety symptoms following COVID-19 was reported to be temporary,[3,4] the development of long COVID and its contributing factors are not yet fully clarified, particularly regarding which psychological responses during the acute phase may predict subsequent mental health.

Previous longitudinal studies have focused primarily on baseline depression, anxiety, or pre-existing psychiatric disorders as psychological predictors of long COVID.[5-9] However, these studies primarily used retrospective assessments of baseline psychological symptoms, raising concerns about recall bias and compromising result accuracy due to the absence of data collected during the acute stage of the disease. Understanding the psychological symptoms experienced by patients during the acute phase of COVID-19, marked by isolation and severe illness, and how these are linked to future psychological sequelae, could inform evidence-based public mental health services in the event of a future infectious disease pandemic. This study directly tackles the challenge of identifying acute-phase psychological predictors of long COVID–related mental health outcomes.

During the COVID-19 pandemic, the Republic of Korea (South Korea) government implemented a nationwide mental health initiative aimed at evaluating and addressing psychological distress in infected individuals. Once patients were diagnosed and their data shared by the Korea Disease Control and Prevention Agency, the National Center for Disaster and Trauma (NCT) sent text messages directing patients to online mental health screening tools and follow-up telephone counseling. This allowed for the prospective collection of baseline and follow-up psychological data.

Using these data, our longitudinal study examined baseline predictors of persistent mental health symptoms in COVID-19 patients. We identified psychological response profiles at baseline using post-disaster psychological response data that could predict persistent mental health symptoms over time. We also performed gender-stratified analyses to investigate potential gender differences in predictors and post-acute mental health outcomes of COVID-19. Prior studies consistently reported that women experienced higher risks and longer persistence of psychological symptoms following COVID-19 and other disasters compared to men.[10-12] These studies highlight sex-specific trajectories in long-term mental health outcomes, with women showing greater vulnerability to depression, anxiety, and other post-acute sequelae.

METHODS

Study design and population

Between March 9, 2020 and July 26, 2022, while providing mental health services, the NCT collected real-world data from electronic records of counseling sessions. All individuals diagnosed with COVID-19 were invited to participate, though actual inclusion was limited

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to those who chose to engage. Mental health professionals—including psychiatrists, psychologists, nurses, and social workers—delivered psychological first aid and evaluations to patients who opted in. All providers were trained in disaster mental health and certified through Ministry of Health and Welfare-designated programs. The counseling continued by phone as long as both therapist and client agreed.

A total of 547 COVID-19 patients received the counselling and provided their data. To ensure a valid analysis, we used data from adults aged 20 to 80 years, leading to a final sample size of 515 (**Supplementary Fig. 1**). Of these, 442 (85%) underwent their initial counselling session (baseline) within one month of diagnosis. The counselling services for the participants were delivered by 35 staff therapists, each serving an average of 15 patients. All participants gave informed consent for the use of their data in research.

Outcome measure

Mental health symptoms were assessed using the Clinical Global Impression Severity Scale (CGI-S), which was administered during each session by a staff counsellor. The CGI-S is a clinician-rated scale for assessing the severity of mental health symptoms over the past seven days based on both patient-reported symptoms and observed behaviors.[13,14] The CGI-S used is a 7-point scale ranging from 1 being 'normal, not at all ill' to 7 being 'the most extremely ill patients.'[15] The CGI-S was initially incorporated into a U.S. government-issued manual designed to facilitate research on psychotropic drugs and has since become widely used in psychiatric practice and clinical studies, and the scale has demonstrated good inter-rater reliability.[14-17] A score of 4, indicating moderate illness, reflects observable symptoms with mild functional impairment and has been validated as a threshold linked to psychiatric treatment and admission.[15,16,18]

Measures of baseline predictors

The post-disaster psychological responses at the baseline were assessed using the modified version of Post-disaster Psychological Responses-Checklist consisting of 34 items.[19,20] Participants were interviewed regarding the type and severity of the psychological responses they had experienced right after the COVID-19 diagnosis, at the first counselling session. Although the scale was not yet validated, it is frequently used in public post-traumatic practice in South Korea.[21] The severity of these responses was measured on a four-point scale (0 = none to 3 = severe), with total scores ranging from 0 to 105.

We examined several baseline factors, including age group (< 50 or ≥ 50), gender, assigned staff therapist, baseline year, residence (metropolitan city, local city, or abroad), household composition (living alone vs. with family), pre-existing psychiatric disorders, pre-existing physical illnesses, and COVID-19 stage. Pre-existing psychiatric and physical illnesses were assessed with the question, 'Have you ever been diagnosed with a mental or physical illness before COVID-19?' COVID-19 stages were classified as follows: acute if the first counselling session occurred within one month of diagnosis, subacute if between 1–3 months, and chronic if more than three months. Since all covariates were categorical variables, missing values were coded as a separate 'missing' category and included in the model. Missing values in the outcome variable (CGI-S scores), primarily due to censoring, were handled using listwise deletion.

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Statistical analysis

Baseline characteristics were compared by presence of post-disaster psychological responses at baseline using independent *t*-tests and χ^2 tests; continuous variables are presented as mean and standard deviation, and categorical variables as counts and percentages, with corresponding *P* values We plotted CGI-S scores over time with dots and a locally weighted smoothing curve, summarizing the number of sessions, participants, and mean scores at each time point.

To analyze the longitudinal association between baseline predictors and CGI-S scores over time, we used multivariate mixed-effects models. Random intercepts and slopes were included to capture individual differences in baseline CGI-S scores and their changes over time. Four models were evaluated using the Akaike information criterion (AIC), with lower scores indicating better fit. The first model included time and intercept as fixed and random effects. The second incorporated baseline psychological responses to explore unadjusted effects. The third adjusted for demographic and clinical covariates, including year, gender, age group, household type, location, pandemic phase, and existing psychiatric and physical conditions. The fourth model tested the interaction between time and baseline psychological response scores. We applied a cluster-robust (sandwich) estimator to standard error calculations to minimize bias arising from potential covariance structure misspecifications.[22]

We conducted an exploratory factor analysis because the underlying factor structure of post-disaster psychological responses at baseline had not been previously characterized. Identifying these latent factors allowed us to group highly correlated symptoms into distinct psychological response profiles, reducing dimensionality and mitigating multicollinearity in subsequent analyses. This approach also provided clinically meaningful subdomains that could better capture heterogeneity in acute psychological reactions and improve prediction of long-term mental health outcomes. Using maximum likelihood estimation and Promax rotation, factor analysis was performed on 33 post-disaster psychological response items, with drug use excluded as no participants endorsed it. The Heywood option was applied to address potential communality issues. We assessed sampling adequacy using the Kaiser-Meyer-Olkin test, tested correlations with Bartlett's test of sphericity, and calculated the variance explained by the factors. Then, we created a heatmap showing factor loading for post-disaster psychological responses across identified factors. Items with loadings of 0.3 or higher in absolute value were flagged to aid interpretation. Factor scores were subsequently computed and saved for downstream analyses. These scores were used as independent variables in separate mixed-effects models to assess their longitudinal association with CGI-S scores. The analysis strategy was the same as previously described, and we presented results using fully adjusted models only. Additionally, all models were stratified by gender to evaluate whether the association between psychological response sub-factors and CGI-S scores differed between men and women. Detailed information on the statistical modeling is provided in the Supplementary Method (**Supplementary Data 1**).

Sensitivity analyses included 200-time bootstrapping for small-sample instability, right truncation at the third follow-up session with > 50% participant retention, inclusion of baseline CGI-S as a covariate, and ordinal mixed-effects regression with a cumulative logit link and multinomial distribution to model the CGI-S outcome. The bootstrap resamples with replacement from the original data to estimate variability, allowing reliable inference even with small sample sizes. All the statistical analyses were performed using SAS version 9.4 (SAS Institute, Cary, NC, USA), and graphical visualization was conducted using the *ggplot2* package in R (R Foundation for Statistical Computing, Vienna, Austria).

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Ethics statement

The present study was conducted as a part of the NCT research project, which was reviewed and approved by the Institutional Review Board (IRB) of the National Center for Mental Health (IRB approval No. 116271-2022-26), and all participants provided written informed consent.

RESULTS

Descriptive analyses

Table 1 summarizes the baseline characteristics of participants based on the presence of post-disaster psychological responses at baseline. Among 515 participants, 395 (76.7%) had one or more psychological responses at baseline. These participants had a significantly higher baseline CGI-S score compared to those without psychological responses (2.85 vs. 2.75, $P < 0.001$). They were also more likely to live in metropolitan areas ($P = 0.003$) and to live with family ($P < 0.001$). No significant differences were found in age, gender, or other clinical variables between the groups. The ten most frequently reported post-disaster psychological responses following a COVID-19 diagnosis were anxiety (52.8%), depression (39%), sleep problems (32%), fear (19.2%), anger (18.8%), sadness (16.3%), chest tightness

Table 1. Baseline characteristics of participants stratified by presence of any psychological responses

Variables	No PR (n = 120)	Any PR (n = 395)	*P* value
Continuous variables			
Time	11.5 ± 6.9	11.5 ± 6.9	0.989
Baseline CGI-S	2.75 ± 1.1	2.85 ± 0.9	0.317
Age	43.1 ± 13.7	44.4 ± 14.1	0.369
Categorical variables			
Baseline year			0.284
2020	25 (20.8)	111 (28.1)	
2021	89 (74.2)	267 (67.6)	
2022	6 (5.0)	17 (4.3)	
Gender			0.719
Men	41 (34.2)	128 (32.4)	
Women	79 (65.8)	267 (67.6)	
Age group, yr			0.913
< 50	76 (63.3)	248 (62.8)	
≥ 50	44 (36.7)	147 (37.2)	
Residence[a]			0.003
Metropolitan city	59 (49.2)	214 (54.2)	
Local city	1 (0.8)	34 (8.6)	
Abroad	1 (0.8)	8 (2.0)	
Household composition[a]			< 0.001
Living alone	17 (14.2)	75 (19.0)	
Living with family	21 (17.5)	143 (36.2)	
Pre-existing psychiatric disorders			0.724
No	101 (84.2)	327 (82.8)	
Yes	19 (15.8)	68 (17.2)	
Pre-existing physical illnesses			0.055
No	110 (91.7)	335 (84.8)	
Yes	10 (8.3)	60 (15.2)	
COVID-19 phase			0.328
Acute	98 (81.7)	344 (87.1)	
Subacute	18 (15.0)	42 (10.6)	
Chronic	4 (3.3)	9 (2.3)	

Values are presented as number (%) or mean ± standard deviation.
PR = post-disaster psychological responses at baseline, CGI-S = Clinical Global Impression Scale-Severity, COVID-19 = coronavirus disease 2019.
[a]We excluded missing data.

(16.1%), guilt (15.7%), changes in appetite (14.2%), and lethargy (12.6%) (**Fig. 1**). On average, CGI-S scores decreased from 2.83 at baseline to 1 by the 23rd session, with a score of 2.36 observed at the median session (**Supplementary Fig. 2**). More than half of the participants were followed up through the third session, at which point the average CGI-S score was 2.38.

Factor structure of post-disaster psychological responses at baseline

The exploratory factor analysis yielded four distinct factors, with detailed findings and the scree plot provided in **Supplementary Fig. 3**. As shown in the **Fig. 2**, the first factor, reflecting cognitive and physical exhaustion, explained 43.1% of the total variance, showing high loadings for poor concentration (0.58), memory loss (0.58), and wariness or doubt (0.41). The second factor, associated with emotional distress, explained 24.6%, with high loadings on sadness (0.54), depression (0.52), and anxiety (0.46). The third factor, indicative of self-destructive coping, accounted for 17.7%, with high loadings for misery (0.76), shame (0.6), and drinking alcohol (0.42). The fourth factor, related to somatized anxiety, explained 14.6%, characterized by high loadings for tension (0.51), hyperventilation (0.5), and chest tightness (0.46).

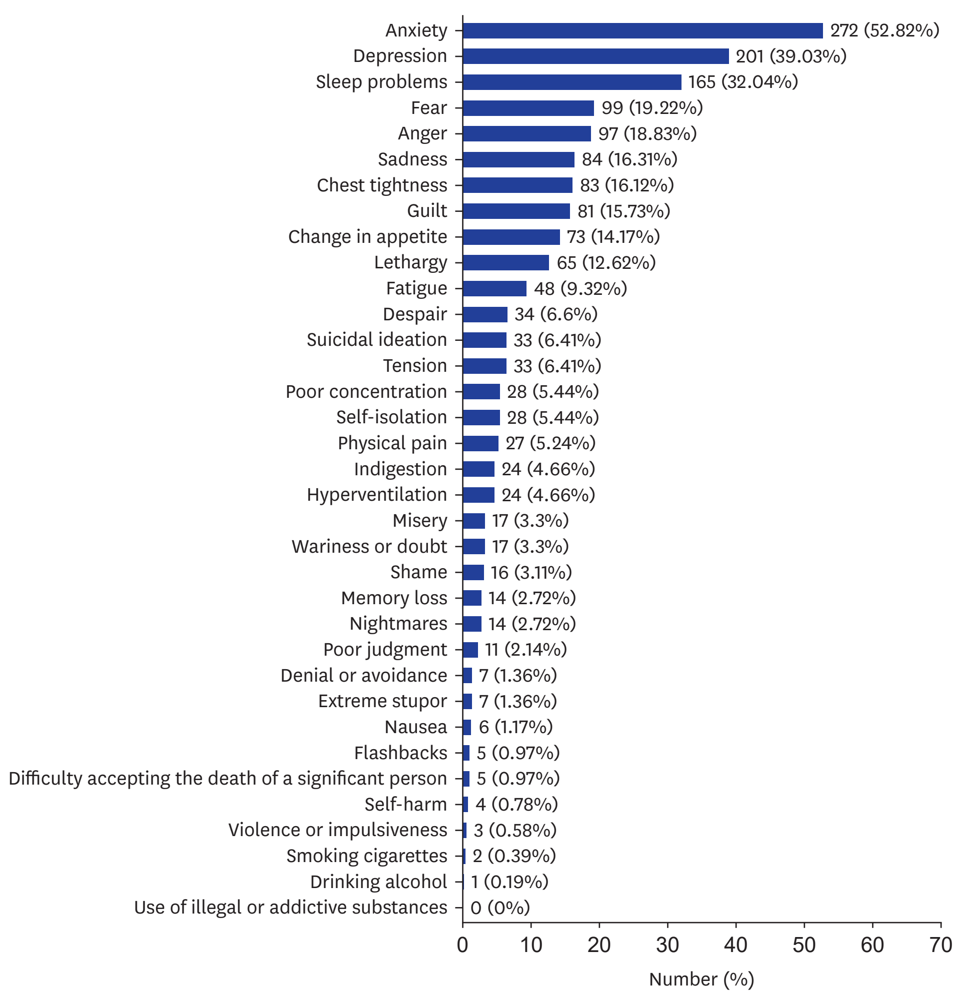

Fig. 1. Frequency histogram of each item in post-disaster psychological responses at baseline (N = 515).

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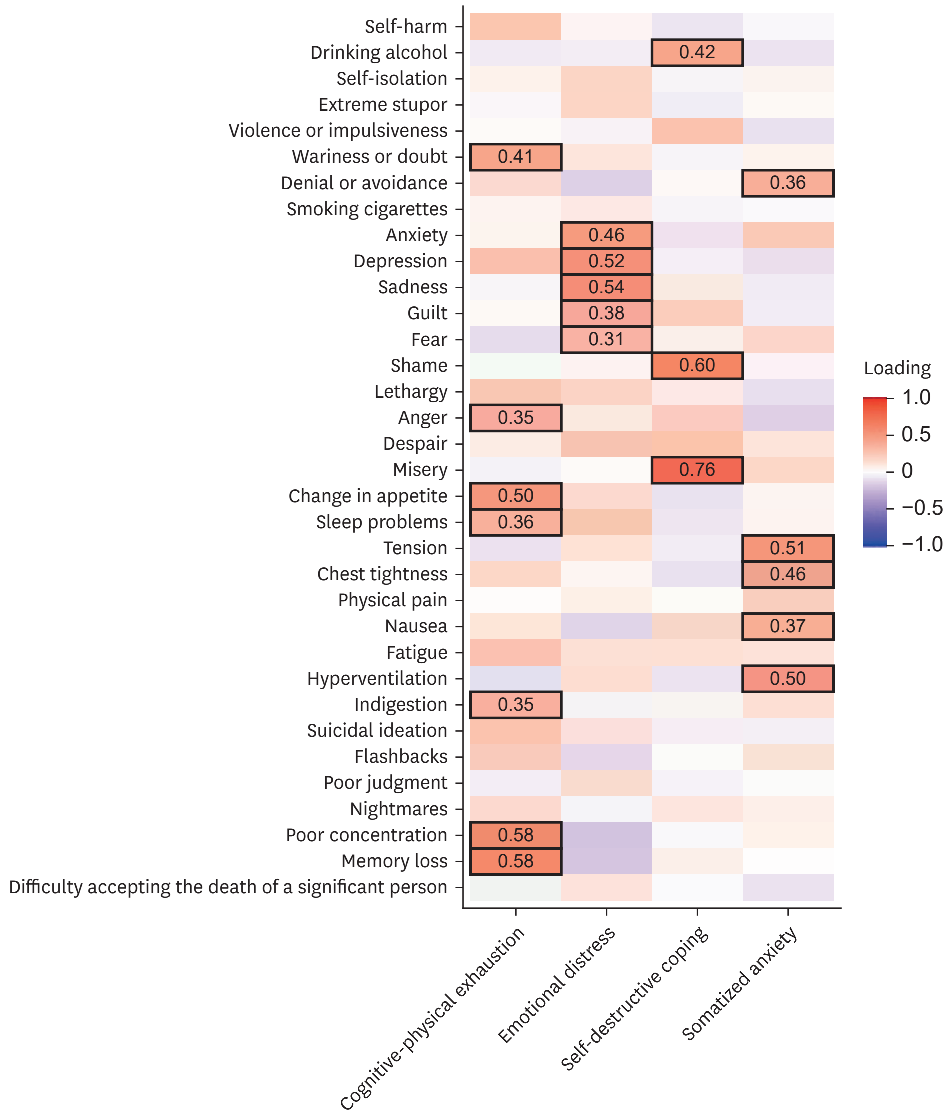

Fig. 2. Heatmap of factor loadings for post-disaster psychological responses at baseline across four factors. Key loadings (|loading| ≥ 0.3) and highest-loading factors per item are highlighted. These factors were identified through exploratory factor analysis and represent distinct domains of post-disaster mental health response. Factor loadings are based on promax-rotated principal axis factoring. Total variance explained = 62.4%; Kaiser-Meyer-Olkin = 0.88; Bartlett's test of sphericity, $\chi^2(561)$ = 2,304.6, P < 0.001.

Longitudinal associations between CGI-S scores and baseline post-disaster psychological responses and their sub-factors

Table 2 presents the associations between baseline predictors and CGI-S scores. In the crude model, CGI-S scores declined by an average of 0.2 points over time (P < 0.001). In the fully adjusted model (Model 3), which had the lowest AIC value, revealed that psychological responses at baseline (β = 0.06, P < 0.001) and pre-existing psychiatric disorders (β = 0.37, P < 0.001) were associated with the CGI-S scores over time. In the interaction model (Model 4), the interaction between time and psychological responses at baseline was not significantly associated with the CGI-S scores. Significant associations were found between CGI S scores and baseline psychological responses for both sexes (men: β = 0.04, P = 0.004, women: β = 0.07, P < 0.001).

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Table 2. Associations between baseline predictors and CGI-S scores among COVID-19 patients (participants n = 515, observations n = 2,219)

Variables	Model 1			Model 2			Model 3			Model 4		
	β or variance	SE	*P*	β or variance	SE	*P*	β or variance	SE	*P*	β or variance	SE	*P*
Fixed effect												
Intercept	2.822	0.038	< 0.001	2.14	0.177	< 0.001	2.231	0.279	< 0.001	2.224	0.278	< 0.001
Time (per 1 session)	−0.195	0.012	< 0.001	−0.196	0.013	< 0.001	−0.196	0.013	< 0.001	−0.189	0.019	< 0.001
PR (per 1 score)				0.058	0.007	< 0.001	0.057	0.006	< 0.001	0.058	0.007	< 0.001
Year (ref = 2020)												
2021							−0.002	0.104	0.986	−0.002	0.104	0.986
2022							0.462	0.190	0.015	0.462	0.189	0.015
Women (ref = men)							−0.061	0.062	0.327	−0.061	0.062	0.328
Age over 50s (ref = under 50s)							−0.120	0.060	0.045	−0.120	0.060	0.045
Living alone (ref = living with family)							0.035	0.108	0.745	0.035	0.108	0.747
Residence (ref = metropolitan city)												
Local city							−0.063	0.116	0.591	−0.063	0.116	0.590
Abroad							−0.193	0.123	0.118	−0.193	0.123	0.117
COVID-19 stage (ref = chronic)												
Acute phase							−0.137	0.160	0.392	−0.137	0.160	0.393
Subacute phase							0.019	0.198	0.925	0.019	0.198	0.923
Psychiatric disorders (ref = none)							0.368	0.091	< 0.001	0.368	0.091	< 0.001
Physical illnesses (ref = none)							0.168	0.087	0.053	0.168	0.087	0.053
Time × PR interaction										−0.001	0.002	0.615
Random effect												
Intercept variance	0.5198	0.04128	< 0.001	0.323	0.030	< 0.001	0.296	0.029	< 0.001	0.296	0.029	< 0.001
Time variance	0.0236	0.0046	< 0.001	0.026	0.005	< 0.001	0.026	0.005	< 0.001	0.027	0.005	< 0.001
Residual variance	0.3378	0.01336	< 0.001	0.335	0.013	< 0.001	0.334	0.013	< 0.001	0.333	0.013	< 0.001
Model fit												
AIC	5,178.7			4,995.6			4,989.5			5,005.5		

For all analyses, a cluster-robust (sandwich) estimator was used for standard error calculations to control for interfamilial correlations within the data. Model 1: Random and fixed models of intercept and time. Model 2: Added fixed effects of PR and assigned therapist. Model 3: Added fixed effects of baseline year, gender, age, household composition, residence, COVID-19 phase, pre-existing psychiatric disorders, and physical illnesses. Model 4: Added fixed effect of the interaction between time and PR.
CGI-S = Clinical Global Impression Scale-Severity, COVID-19 = coronavirus disease 2019, SE = standard error, PR = post-disaster psychological responses at baseline, AIC = Akaike information criterion.

Fig. 3 presents the associations between baseline psychological response sub-factors and the CGI-S scores, shown for the total population and stratified by sex. Among the four sub-factors of the psychological responses, cognitive-physical exhaustion ($\beta = 0.28$, $P < 0.001$), emotional distress ($\beta = 0.32$, $P < 0.001$), and self-destructive coping ($\beta = 0.12$, $P < 0.001$) were associated with CGI-S scores. In men, only emotional distress was associated with CGI-S scores ($\beta = 0.26$, $P = 0.001$). In women, cognitive-physical exhaustion ($\beta = 0.36$, $P < 0.001$) and emotional distress ($\beta = 0.36$, $P < 0.001$) were associated with CGI-S scores.

Sensitivity analyses

Sensitivity analyses using bootstrapping and right-truncation supported the original results, with the somatized anxiety and CGI-S association in men reaching significance (**Supplementary Tables 1** and **2**). Including baseline CGI-S as a covariate produced more conservative yet consistent findings (**Supplementary Table 3**). The ordinal mixed-effects approach treating CGI-S score as an ordinal outcome showed similar but stronger effects (**Supplementary Table 4**).

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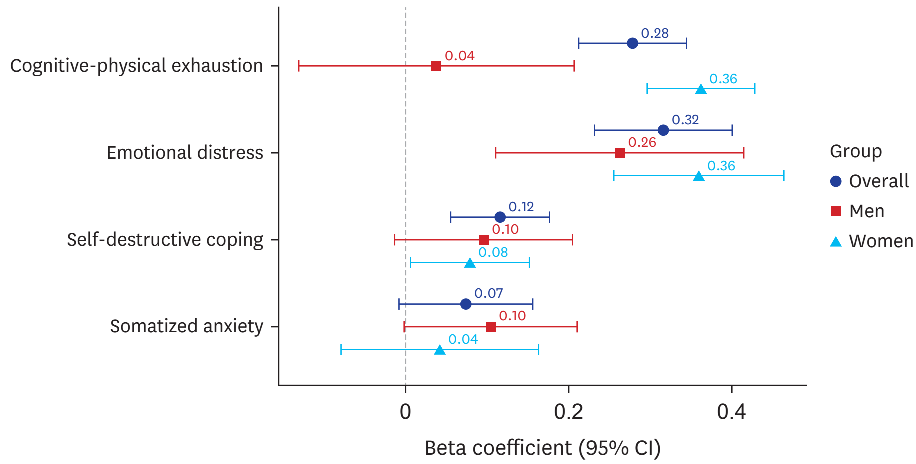

Fig. 3. Forest plot of beta coefficients and 95% CIs of four post-disaster psychological response factors at baseline. We fitted a separate model for each of the four psychological response factors. A cluster-robust (sandwich) estimator was used for the standard error calculations to control for interfamilial correlations within the data.
CI = confidence interval.

DISCUSSION

Leveraging real-world data from the nationwide mental health program, we prospectively collected early psychological data from 515 COVID-19 patients (84% within one month of diagnosis), providing insights for timely identification of psychiatric high-risk groups in future respiratory pandemics. We found longitudinal associations between elevated psychological responses at baseline and CGI-S scores, suggesting that individuals with stronger initial responses may continue to experience mental health challenges. We also found that pre-existing psychiatric disorders were linked to CGI-S scores over time.
From a clinical perspective, although the baseline PR beta coefficient ($\beta = 0.06$) reached statistical significance, its small magnitude indicates limited clinical impact. Conversely, the larger effect of pre-existing psychiatric disorders ($\beta = 0.37$) reflects a more substantial association with clinical severity. Among the four sub-factors of psychological responses at baseline, emotional distress, comprising sadness, depression, and anxiety, was the factor most associated with poor mental health over time both in men and women.
In the sex-stratified analysis, cognitive physical exhaustion, characterized by poor concentration, memory loss, and wariness or doubt, exhibited the largest sex difference, showing a nonsignificant association with CGI-S in men but an association of similar magnitude to emotional distress in women. While the original analysis indicated a marginally significant association, the sensitivity analysis revealed a link between somatized anxiety and CGI-S in men, highlighting its potential importance for future studies.

Our findings align with previous prospective studies tracking mental health in COVID-19 patients. While this study did not specifically evaluate the intervention effect of the NCT, the observed decrease in CGI-S scores corresponds with reports of gradual mental health improvement in most patients.[23,24] However, we also found that the COVID-19 patients with pre-existing psychiatric disorders or higher psychological responses at baseline were more likely to be at risk of persistent mental health problems. Previous studies have found that the individuals with pre-existing psychiatric disorders were associated with persistent COVID-19 symptoms.[7,25,26] While fewer participants reported baseline psychological symptoms in more recent baseline years (**Table 1**), the association analysis highlighted that those who diagnosed

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with COVID-19 in 2022 exhibited greater CGI-S scores than individuals diagnosed in 2020 (**Table 2**). This observation not only supports previous studies highlighting early pandemic mental health burdens but also raises the possibility that sustained psychological challenges may persist into the later pandemic period.[3,24]

The COVID-19 diagnosis commonly triggers acute stress reactions due to its association with threats to survival, enforced social isolation, and economic hardship.[27] These acute stress reactions have been shown to significantly predict the development of post-traumatic stress disorders, major depressive disorders, and anxiety disorders.[28,29] Among various aspects of psychological responses after the COVID-19 diagnosis, our findings indicate that both male and female COVID-19 patients with higher levels of emotional distress are at increased risk for persistent mental health issues, consistent with earlier studies.[8-10,30] Prior studies have identified emotional distress, including depression and anxiety, as a frequently observed stress reaction during the early phase of COVID-19.[31,32] Furthermore, gender-specific analysis revealed that cognitive-physical exhaustion was also linked to CGI-S scores in women, in agreement with prior research identifying female gender as a risk factor for post-COVID cognitive impairment.[33-35] During the COVID-19 pandemic, patients may experience emotional distress due to social isolation from quarantine measures and inflammatory responses caused by COVID-19 infection.[36] In such cases, this distress can lead to persistent mental health problems, highlighting the need for interventions that address anxiety and depression in patients during isolation. The gender-specific association between cognitive physical exhaustion and CGI-S in women may reflect a higher burden of persistent neurological symptoms of COVID-19 in women, indicating the importance of tailored post-COVID cognitive support.[37]

Our results should be interpreted with caution owing to certain limitations. First, the data collection in this study was not conducted for research purposes but rather for administrative purposes to document the progress of counselling provided to individuals in need owing to COVID-19. Moreover, because of the quarantine policy during the pandemic, the assessment and intervention could not be conducted face-to-face; therefore, assessment and intervention were conducted via telephone. Consequently, certain essential information, such as treatment progress and comprehensive mental health assessments, could not be obtained. Second, there may have been measurement errors in the results because the assessments and counselling were conducted by the same mental health professional. It was not possible to conduct a double-blind procedure to separate the assessment of mental health status from the provision of the intervention because of the limited number of resources and data available to us. As a result, early impressions formed by therapists may have shaped subsequent evaluations of psychiatric symptom severity, potentially contributing to observer bias in our results. Third, it is important to note that the operational concept of psychological responses used in this study has not been validated by empirical studies. Although we addressed this limitation by performing exploratory factor analysis to empirically derive four sub-factors and reduce reliance on predefined categories, further validation against established instruments or through external comparisons is needed to strengthen the robustness and generalizability of these findings. Additionally, although we referred to previous studies, there is no officially established cut-off for the CGI-S score, and such clinician-rated scales may be more sensitive to symptom changes compared to patient-rated scales.[38] The CGI-S may have been unsuitable for assessing clinical changes in this general population as the baseline mean CGI-S score was below 3 (**Table 1**).[39] Fourth, without a control group, the case-only nature of this study prevents direct comparison with untreated or naturally recovering individuals, limiting causal inference. Fifth, the study did not monitor whether participants received medical care outside of NCT counseling, introducing a potential unmeasured confounder. As isolated COVID-19 patients were closely monitored by public health authorities and might have been treated for severe symptoms, this could have impacted the observed results. Additionally, the study population may have been biased toward individuals with greater interest in mental health screening, which could limit the generalizability of the findings.

Despite these limitations, this study leveraged the nationwide epidemiologic surveillance system in conjunction with the public mental health center to enable swift and efficient data collection and intervention of COVID-19 patients. As COVID-19 patients typically undergo treatment and recovery in isolation, previous studies have primarily gathered data after the acute phase, when the psychological impact of the disease is less pronounced. These findings highlight the critical role of assessing psychological responses during the acute phase and provide valuable insights for enhancing the efficiency of public mental health services in future pandemics beyond COVID-19.

Although the World Health Organization declared the end of the COVID-19 pandemic on May 5, 2023, concerns remain regarding its long-term mental health consequences. In the context of an infectious disease pandemic, it is crucial for public mental health services to allocate human resources and budgets efficiently in response to rapidly evolving needs. This study provides empirical evidence linking pre-existing psychiatric disorders and heightened psychological responses at the baseline to unfavorable mental health outcomes. Emotional distress and cognitive-physical exhaustion were identified as key factors of prolonged mental health symptoms. In conclusion, COVID-19 patients who were psychologically vulnerable before or shortly after infection exhibited persistent mental health symptoms, underscoring the need for more advanced interventions tailored to this high-risk population.

SUPPLEMENTARY MATERIALS

Supplementary Data 1
Supplementary Method. Details of statistical analysis

Supplementary Table 1
Sensitivity analysis with bootstrapped samples (iteration: 200)

Supplementary Table 2
Sensitivity analysis with right-truncated follow-up at session 3

Supplementary Table 3
Sensitivity analysis with adjustment for baseline CGI-S score

Supplementary Table 4
Sensitivity analysis with ordinal mixed-effect models treating CGI-S score as an ordinal outcome

Supplementary Fig. 1
Flow chart of the study population.

Supplementary Fig. 2
CGI-S scores over time and the number of participants at each time.

Supplementary Fig. 3
Scree plot of factor analysis for 33 post-disaster psychological responses at baseline.

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