

Original Article

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Cognitive-behavioral therapy for patients with post-COVID-19 condition (CBT-PCC): a feasibility trial

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Abstract

Background. The post-COVID-19 condition describes the persistence or onset of somatic symptoms (e.g. fatigue) after acute COVID-19. Based on an existing cognitive-behavioral treatment protocol, we developed a specialized group intervention for individuals with post-COVID-19 condition. The present study examines the feasibility, acceptance, and effectiveness of the program for inpatients in a neurological rehabilitation setting.

Methods. The treatment program comprises eight sessions and includes psychoeducational and experience-based interventions on common psychophysiological mechanisms of persistent somatic symptoms. A feasibility trial was conducted using a one-group design in a naturalistic setting. $N = 64$ inpatients with a history of mild COVID-19 that fulfilled WHO criteria for post-COVID-19 condition were enrolled. After each session, evaluation forms were completed and psychometric questionnaires on somatic and psychopathological symptom burden were collected pre- and post-intervention.

Results. The treatment program was well received by participants and therapists. Each session was rated as comprehensible and overall satisfaction with the sessions was high. Pre-post effect sizes (of standard rehabilitation incl. new treatment program; intention-to-treat) showed significantly reduced subjective fatigue ($p < 0.05$, $d_{av} = 0.33$) and improved disease coping ($ps < 0.05$, $d_{av} = 0.33–0.49$).

Conclusions. Our results support the feasibility and acceptance of the newly developed cognitive-behavioral group intervention for individuals with post-COVID-19 condition. Yet, findings have to be interpreted cautiously due to the lack of a control group and follow-up measurement, the small sample size, and a relatively high drop-out rate.

Background

In addition to the health threat posed by the acute coronavirus disease 2019 (COVID-19), long-term consequences present as another major health concern of the COVID-19 pandemic. Whereas most cases fully recover from acute illness, a considerable proportion reports the persistence of multiple physical and mental complaints. The post-COVID-19 condition (PCC) is defined as the experience of symptoms at least 12 weeks after a SARS-CoV-2 infection that developed during acute COVID-19 or after initial recovery, persist for at least two months, interferes with everyday functioning, and cannot be explained by an alternative diagnosis (Soriano, Murthy, Marshall, Relan, & Diaz, 2022). Common symptoms include fatigue, headache, cognitive impairments, or dyspnea, but overall, PCC can affect multiple organ systems resulting in a variety of associated symptoms and different phenotypes (Groff et al., 2021; Lopez-Leon et al., 2021; Reese et al., 2023). A meta-analysis estimated the global pooled prevalence to be 43% of people with confirmed COVID-19 diagnosis, but prevalence estimates vary widely by study procedure (Chen et al., 2022). More conservative estimates suggest that approximately 1–5% develop somatic complaints in accordance with PCC criteria (Thompson et al., 2022). Either way, given the number of people infected with SARS-CoV-2 worldwide, PCC affects a significant number of people, resulting in increased health care burden and socioeconomic costs (Tartof et al., 2022; Williamson, Tydeman, Miners, Pyper, & Martineau, 2022).

So far, the pathogenesis of PCC is unknown. It is most probably multifactorial and differs between patients. Several biomedical explanation attempts are currently discussed (Merad, Blish, Sallusto, & Iwasaki, 2022), although a considerable proportion of patients do not exhibit biomedical abnormalities (Fleischer et al., 2022; Reese et al., 2023; Sneller et al., 2022). Persistent somatic symptoms (PSS) that cannot be sufficiently explained by biomedical factors

are common across other health conditions and often better represented by biopsychosocial models (Engel, 1977; Van den Bergh, Witthöft, Petersen, & Brown, 2017). Interactions between biological and psychosocial factors also seem relevant in PCC (Lemogne, Gouraud, Pitron, & Ranque, 2023; Saunders, Sperling, & Bendstrup, 2023). For example, elevated psychological distress was seen to be both a symptom and a risk factor of PCC (Dong, Liu, Dai, Yang, & Liu, 2021; Magnúsdóttir et al., 2022). Further, observational studies have shown that individuals with PCC are at risk for DSM-5 Somatic Symptom Disorder (SSD) indicating the presence of psychobehavioral features (e.g. catastrophizing thoughts, health anxiety, specific illness behaviors) that might interfere with successful coping of PCC and thus contribute to somatic symptom distress (Horn et al., 2023; Kachaner et al., 2022; Schneider et al., 2023; Willis & Chalder, 2021).

Based on treatment suggestions for PSS (e.g. Henningsen, Zipfel, & Herzog, 2007), guidelines for PCC mostly recommend multidisciplinary rehabilitation strategies focusing on self-management (Koczulla et al., 2022; Shah, Hillman, Playford, & Hishmeh, 2021). In Germany, existing rehabilitation programs have been adapted to the treatment of PCC and are currently evaluated (Kupferschmitt et al., 2022). So far, these programs have been shown to be beneficial for PCC patients, and effects may be comparable to those of other rehabilitation cohorts (e.g. psychocardiology patients; Kupferschmitt et al., 2023). A common component of multidisciplinary rehabilitation programs, particularly those aimed at self-management of PSS, are psychological interventions such as cognitive-behavioral therapy (CBT). CBT protocols for PSS typically include interventions that address common psychophysiological interactions and promote adaptive coping strategies (e.g. stress management, cognitive restructuring, behavioral activation; Witthöft & Hiller, 2010), yielding small to medium-sized effects on the reduction of somatic symptom severity including fatigue (Ingman, Smakowski, Goldsmith, & Chalder, 2022; Kleinstäuber, Witthöft, & Hiller, 2011; Price, Mitchell, Tidy, & Hunot, 2008; Van Dessel et al., 2014). Despite promising first results (Frisk et al., 2023; Kuut et al., 2023), the application of CBT principles for the treatment of PCC is still under research.

The present study aims to examine the feasibility of a specific CBT protocol for the treatment of PCC. Therefore, we developed a comprehensive CBT-based group therapy program (CBT-PCC) that addresses common challenges of coping with PSS. The feasibility, acceptance, and effectiveness were evaluated in a cohort of inpatients fulfilling PCC criteria in a neurological rehabilitation setting.

Methods

Participants and procedure

Participants were recruited during inpatient neurological rehabilitation for PCC between February and July 2022 in the Kliniken Schmieder Konstanz and Gailingen, Germany. On admission, patients were screened for eligibility (including PCC assessment) and informed about CBT-PCC by a clinic physician during a medical interview. Inclusion criteria were the fulfillment of PCC criteria according to the WHO (i.e. history of probable or confirmed SARS-CoV-2 infection, at least one symptom after ≥ 3 months post-infection, symptom persistence for ≥ 2 months, symptom(s) cannot be explained by an alternative diagnosis, impact on everyday functioning; Soriano et al., 2022), age of at least 18 years, literacy in German, and written informed consent. History of SARS-CoV-2 infection was confirmed based on

medical documentation by the referring physician. Exclusion criteria were mechanical ventilation or admission to an intensive care unit during acute COVID-19 and a diagnosis of schizophrenia spectrum disorders or acute substance addiction.

This study was conducted as a single-group, uncontrolled clinical trial. After each session, participants and therapists completed session evaluation questionnaires. Psychometric assessment of somatic and psychopathological symptom burden occurred pre- and post-intervention (i.e. after a maximum of four weeks or at discharge from inpatient rehabilitation). Additionally, a structured clinical diagnostic interview to examine mental disorders was added to pre-intervention assessment. Post-intervention assessment contained a standardized measure to examine adverse events.

The trial was retrospectively registered at the German Clinical Trials Register (www.drks.de, DRKS00031219). The study protocol was reviewed and approved by the ethics board of the University of Konstanz (approval number 44/2021, December 13, 2021). All participants provided written informed consent prior to the initiation of any study procedures. Refusal to participate or discontinuation of the study did not result in any negative consequences for the inpatient rehabilitation treatment.

Treatment

The group intervention comprised eight modules (à 60 min, over four weeks) and was offered additionally to routine inpatient neurological rehabilitation (e.g. medical consultation, physiotherapy, medical training therapy, occupational therapy, cognitive training, individual psychotherapeutic sessions). The treatment protocol was based on an established CBT manual for SSD (Kleinstäuber, Thomas, Witthöft, & Hiller, 2018), which has been shown to effectively reduce somatic symptom distress in recent trials (Hennemann et al., 2022; Kleinstäuber et al., 2019). The suggested interventions of the treatment protocol were reviewed in advance by practitioners from PCC rehabilitation and transcribed in a study manual that was provided to the study therapists. Modules were included in the following order: (1) introduction and goal setting, (2) psychoeducation, (3) stress education and relaxation, (4) attention modification, (5) cognitive restructuring, (6) balancing physical activity, (7) stress management, and (8) summary and transfer. Each module began with a breathing exercise and ended with the assignment of homework. Because the original treatment manual was not tailored to a specific somatic symptom cluster, we largely maintained the transsyndromic character to ensure appropriateness for a wide range of PCC phenotypes and other treatment settings during the development of CBT-PCC. Nonetheless, PCC-specific modifications were implemented to some extent, most notably through a particular emphasis on breathing exercises, PCC-specific psychoeducation (e.g. appearance, course, epidemiology), and session modalities (i.e. duration, amount of content). Content and therapeutic strategies of CBT-PCC are shown in Table 1.

Three licensed psychotherapists and two psychologists in neuropsychological training that were trained in a 1-day workshop (provided by DH and MW) delivered the intervention. In addition, a training cycle of the group program was conducted prior to data collection.

Measures

Session evaluations

For session evaluations, we used the Group Therapy Session Evaluation form (GTS; Rief, Bleichhardt, & Timmer, 2002;

Table 1. Content and therapeutic strategies of the group program

Modules	Content and therapeutic strategies
1. Introduction and goal setting	Overview of contents and study procedure, history of symptom development and influencing factors, goal setting
2. Psychoeducation	Psychoeducation on appearance and epidemiology of PCC, association of breathing and bodily sensations, interoceptive exposure (i.e. hyperventilation)
3. Stress education and relaxation	Psychoeducation on stress reaction, sympathetic and parasympathetic nervous system, progressive muscle relaxation
4. Attention modification	Association of selective attention and bodily sensations, attention shift techniques (e.g. sensory training)
5. Cognitive restructuring	Identifying and questioning dysfunctional symptom-related thoughts (e.g. ABC model), strategies of reappraisal
6. Balancing physical activity	Collection of previous behavioral coping attempts, vicious cycle of avoidance and endurance, reestablishing positive activities
7. Stress management	Psychoeducation on the transactional stress model, collection of various stress management techniques, acceptance-based strategies
8. Summary	Summary of intervention contents in a biopsychosocial explanatory model of symptom persistence, transfer, and relapse prevention

Note. PCC, Post-COVID-19 condition.

Zoubek, 2013). The GTS is a German self-report instrument to assess evaluations of therapeutic processes such as satisfaction, personal involvement, perceived usefulness, atmosphere, and comprehensibility in patients (GTS-P) and therapists (GTS-T). The patient version comprises eight items that are rated on a 5-point scale (0 = 'disagree' to 4 = 'agree'). In the study sample, the GTS-P showed high internal consistencies across sessions ($\alpha = 0.85\text{--}0.94$). For the therapist version, items were reformulated in terms of how therapists rate patients' perceptions of the same aspects. In addition, items are included to assess therapists' satisfaction with the session, as well as ratings of how well the protocol is applicable and meets patients' needs. The GTS-T comprises 12 items, each rated on the same 5-point scale and showed high internal consistencies ($\alpha = 0.85\text{--}0.96$) as well. Higher scores reflect a more positive judgment of the session, except for item 9 of the GTS-T, which is inverted.

Adverse events

Adverse events during the intervention were monitored using the Unwanted Events in Group Therapy Scale (UE-G; Linden, Walter, Fritz, & Muschalla, 2015). It includes 47 events regarding different domains (i.e. room situation, session content, participant behavior, therapist behavior, undesirable long-term effects, global evaluation) that are rated on a 5-point scale (0 = 'did not occur' to 4 = 'did occur and was extremely burdensome').

Somatic symptom distress and fatigue

Somatic symptom distress was measured using the somatic symptom scale of the Patient Health Questionnaire (PHQ-15; Kroenke,

Spitzer, & Williams, 2002) and the Somatic Symptom Disorder – B criteria scale (SSD-12; Toussaint et al., 2016). The PHQ-15 is a validated self-report screening that assesses the severity of 15 common somatic symptoms during the last four weeks on a 3-point scale (0 = 'not bothered at all' to 2 = 'bothered a lot'). The total score ranges between 0 and 30 points and scores ≥ 5 , ≥ 10 , and ≥ 15 can be considered cut-off points for mild, medium, and severe somatic symptom severity, respectively. The SSD-12 measures psychobehavioral features of somatic symptom distress according to the B criterion of SSD. The 12 items are rated on a 5-point scale (0 = 'never' to 4 = 'very often') and can be aggregated to a global sum score (range 0–48).

Because fatigue represents a core symptom of PCC, subjective fatigue was measured more specifically using the Fatigue Severity Scale (FSS; Krupp, LaRocca, Muir-Nash, & Steinberg, 1989). The FSS is a self-report questionnaire and comprises nine statements that are rated on a 7-point scale (1 = 'does not apply' to 7 = 'does fully apply') and averaged for a composite score. The proposed cut-off for clinically relevant fatigue severity is ≥ 4 . The internal consistencies in this study were Cronbach's $\alpha = 0.77$, 0.89, and 0.94 for PHQ-15, SSD-12, and FSS, respectively.

Depression and anxiety

Depressive symptoms were measured using the depression scale of the Patient Health Questionnaire (PHQ-9; Kroenke and Spitzer, 2002) that includes nine symptoms of depression that are rated for the last two weeks on a 4-point scale (0 = 'not at all' to 3 = 'nearly every day', range 0–27). The proposed cut-off for screening for depression is ≥ 10 . Anxiety symptoms were measured with the Generalized Anxiety Disorder Questionnaire (GAD-7; Spitzer, Kroenke, Williams, & Löwe, 2006) that includes seven symptoms of general anxiety that are rated for the last two weeks on a 4-point scale (0 = 'not at all' to 3 = 'nearly every day', range 0–21). The proposed cut-off for screening for anxiety disorders is ≥ 10 . Internal consistencies in the present study were Cronbach's $\alpha = 0.80$ and 0.92 for PHQ-9 and GAD-7, respectively.

Illness-related cognitions

For the assessment of illness-related cognitions, the Illness Cognition Questionnaire (ICQ; Evers et al., 2001) was administered. The ICQ comprises 18 statements regarding cognitions of helplessness, acceptance, and perceived benefits of chronic diseases that are rated on a 4-point scale (1 = 'not at all' to 4 = 'completely'; subscale range 6–24). Further, illness-related self-efficacy was measured using the self-efficacy module of the Hamburg Modules for the Assessment of Psychosocial Health in Clinical Practice (HEALTH-49; Rabung et al., 2009). It comprises five items that are rated for the last two weeks on a 5-point scale (0 = 'not at all' to 4 = 'very much') and are averaged for a composite score. In the current study, the internal consistencies of the ICQ subscales varied between Cronbach's $\alpha = 0.80$ and 0.91. For the self-efficacy module of the HEALTH-49, internal consistency was Cronbach's $\alpha = 0.85$.

Additional measures

Additional measures included a sociodemographic questionnaire assessing age, gender, education, and employment status at baseline. COVID-19-related information such as infection date was retrieved from baseline medical documentation. Because symptom onset was not reported, the difference between infection date and study enrollment served as a proxy for PCC duration. Diagnoses of mental disorders were assessed using the German

version of the Structured Clinical Interview for DSM-5 Disorders (SCID-5; Beesdo-Baum, Zaudig, & Wittchen, 2019).

Statistical analyses

We used IBM SPSS version 23 (SPSS Inc., Chicago, Illinois) for data analysis. For session evaluations, we calculated item means and standard deviations of both GTS versions for every session. For pre-post comparisons of somatic and psychopathological symptom burden, we conducted paired samples *t* tests and calculated within-group effects as d_{av} (Lakens, 2013) with the intention-to-treat (ITT) sample and a per-protocol subsample of participants who completed pre- and post-intervention assessments and were adherent to the treatment (i.e. attended ≥ 6 sessions). Missing data at post-intervention assessment were handled using the last observation carried forward (LOCF) method. For adverse events, frequencies and item means of the UE-G were calculated. All tests were two-sided with a significance level of 0.05.

Results

Participant characteristics

Figure 1 shows the flow of participants through the trial. Between February 1, 2022, and July 7, 2022, 90 patients admitted to neurological inpatient rehabilitation for PCC were screened for eligibility, of which 64 patients were positively screened and gave informed consent to participate in the study. One participant did not complete pre-intervention assessment and 22 participants did not complete post-intervention assessment. Participants who attended at least one session ($n = 51$ [79.7%]) completed on average 6.43 (s.d. = 1.80) out of eight modules. Thirteen (20.3%) participants did not attend any session of CBT-PCC. The most common dropout reasons were scheduling conflicts with other treatment components and early discharge from inpatient rehabilitation. Regarding baseline sociodemographic and clinical characteristics, participants who adhered to the study protocol ($n = 32$ [50.0%]; i.e. completion of pre- and post-intervention assessments and attendance of ≥ 6 sessions) reported significantly less somatic (PHQ-15; M (s.d.)_{Per-protocol} = 11.88 (4.69), M (s.d.)_{Drop-out} = 14.74 (4.96), $t(61) = 2.36$, $p = 0.022$), depressive (PHQ-9; M (s.d.)_{Per-protocol} = 9.31 (4.65), M (s.d.)_{Drop-out} = 13.32 (4.96), $t(61) = 3.31$, $p = 0.002$), and anxiety symptoms (GAD-7; M (s.d.)_{Per-protocol} = 4.84 (4.77), M (s.d.)_{Drop-out} = 7.48 (5.30), $t(61) = 2.08$, $p = 0.042$), as well as less helplessness (ICQ; M (s.d.)_{Per-protocol} = 14.13 (3.26), M (s.d.)_{Drop-out} = 16.50 (4.46), Welch's $t(53.05) = 2.36$, $p = 0.022$) than participants who discontinued study and/or intervention participation. No further significant differences were observed between per-protocol participants and dropouts in terms of baseline characteristics ($ps > 0.05$; see online Supplementary Table A.1).

Participants ($n = 63$) were predominantly female (51 [81.0%]) with a mean age of 47.05 years (s.d. = 11.45, range 22–63). At baseline, symptom prevalence measured with the PHQ-15 (ratings ≥ 1) was highest for feeling tired or having low energy (96.8%), headaches (88.8%), trouble sleeping (84.1%), pain in arms, legs, or joints (80.7%), and shortness of breath (79.4%). Forty-seven (74.6%) participants experienced medium-to-high levels of somatic symptom severity, and 31 (49.2%) participants were at risk for SSD using a combined cutoff score of PHQ-15 (≥ 9) and SSD-12 (≥ 23 ; Toussaint, Hüsing, Kohlmann, and Löwe, 2020). Moreover, 57 (90.5%), 37 (58.7%), and 14 (22.2%)

showed clinically relevant levels of fatigue, depressive, and anxiety symptoms, respectively. The mean time between first SARS-CoV-2 infection and study participation was 62.45 weeks (s.d. = 27.67, range 13.29–121.14). Table 2 summarizes sociodemographic and clinical characteristics of the sample.

The SCID-5 was conducted with 61 participants. Thirty-three (54.1%) participants were diagnosed with at least one current mental disorder. The most frequent disorder categories were depressive disorders ($n = 16$), somatic symptom and related disorders ($n = 15$) and anxiety disorders ($n = 11$). A single mental disorder was diagnosed in 20 (32.8%) participants. A second comorbidity was present in ten (16.4%), and a third or fourth comorbidity was present in three (4.9%) participants. When past mental disorders are also considered, the proportion of participants with at least one mental disorder during lifetime increases to 60.7% ($n = 37$). Frequencies of all assigned SCID-5 diagnoses are depicted in online Supplementary Table A.2.

Session evaluations

Session evaluations by the participants (GTS-P) are listed in Table 3. The mean ratings per session were high across all sessions (all total means ≥ 3 , possible range 0–4) and varied from 3.01 (s.d. = 0.95, module 8) to 3.49 (s.d. = 0.58, module 6). Satisfaction with the session was high for every session (item 8: all means ≥ 3). Participants were actively engaged (items 1–2: all means ≥ 3) and rated every session as comprehensible (item 3: all means ≥ 3). The perceived usefulness for disease coping, especially for modules 1, 2, and 8, was rated on average slightly lower (see items 4–6).

The average session evaluation ratings by the therapists (GTS-T) varied more between sessions compared to participants, ranging from 2.08 (s.d. = 0.56) in module 3 to 3.54 (s.d. = 0.48) in module 8. Therapists' ratings of their satisfaction were comparatively lower for sessions 1 to 3 (item 12: each mean < 3), but eventually increased to an equivalent level for sessions 4 to 8 (each mean ≥ 3). Therapists' ratings of comprehensibility (item 3) and applicability (item 10) of each module followed a similar trend. Detailed GTS-T ratings are shown in online Supplementary Table A.3.

Adverse events

At least one adverse event was reported by 85.4% of the participants (i.e. at least one UE-G item ≥ 1), 29.3% reported severe and extremely distressing events (i.e. at least one UE-G item ≥ 3). The highest item mean scores were observed for 'I realized how complicated everything is' ($M = 1.10$, s.d. = 1.24), 'I was afraid not to know how to proceed in the future' ($M = 0.78$, s.d. = 1.11), and 'I felt that my problems are more severe than I thought before' ($M = 0.71$, s.d. = 1.17). Results for all events are shown in online Supplementary Table A.4.

Pre-post comparisons

Results of the ITT analysis ($n = 63$) are depicted in Table 4. Pre-post differences showed a significant reduction in subjective fatigue (FSS: $t(62) = -2.60$, $p = 0.012$, $d_{av} = 0.33$), and helplessness (ICQ: $t(60) = -2.99$, $p = 0.004$, $d_{av} = 0.39$), as well as increased acceptance (ICQ: $t(60) = 3.31$, $p = 0.002$, $d_{av} = 0.43$), perceived benefits ratings (ICQ: $t(60) = 3.78$, $p < 0.001$, $d_{av} = 0.49$), and illness-related self-efficacy (HEALTH-49: $t(61) = 2.61$, $p = 0.011$,

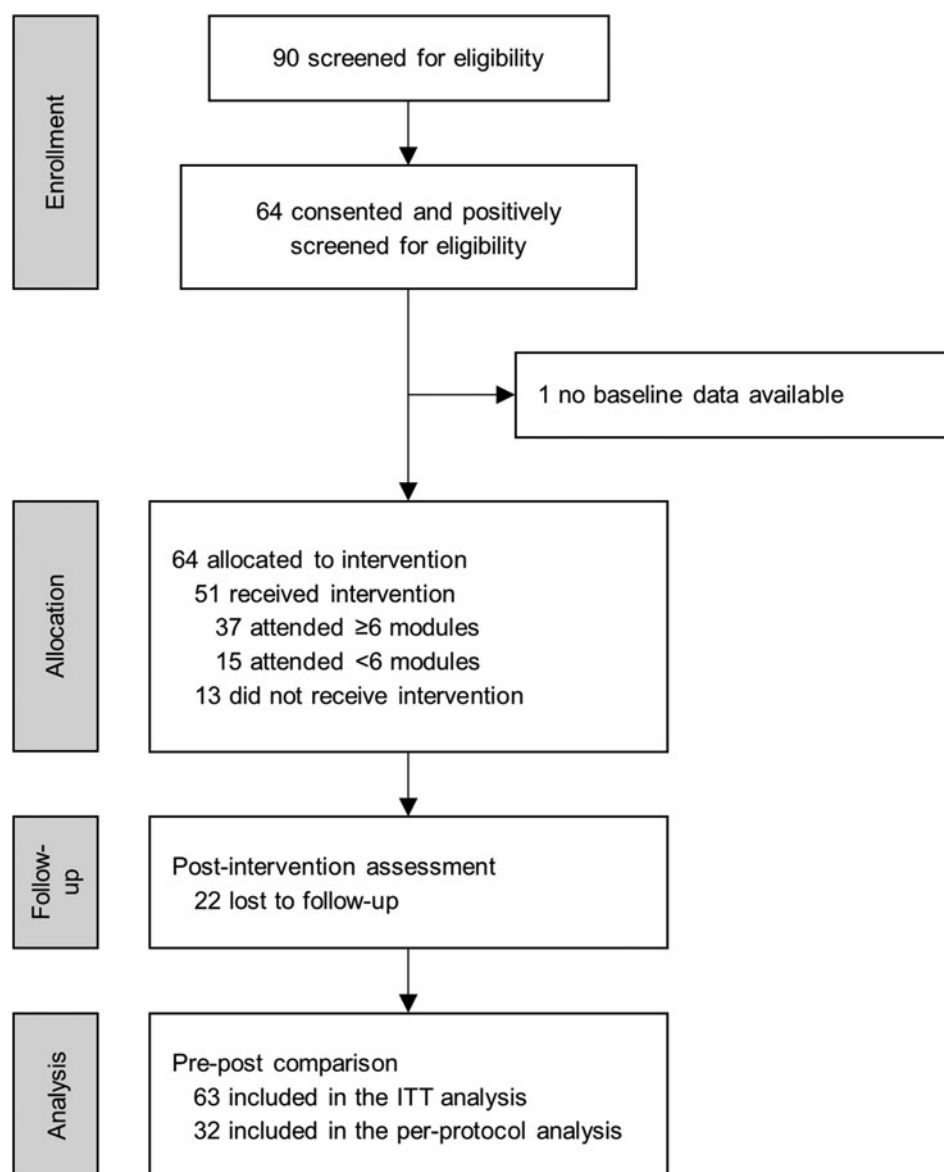


Figure 1. Participant flow. ITT, intention-to-treat. Participants were included in the per-protocol analysis if they completed pre-post assessments and attended ≥6 sessions.

$d_{av} = 0.33$). Per-protocol analysis ($n = 32$; see online Supplementary Table A.5) showed similar results with descriptively slightly larger effect sizes for these measures (FSS: $t(31) = -2.70$, $p = 0.011$, $d_{av} = 0.48$; ICQ_{Helplessness}: $t(30) = -3.53$, $p = 0.001$, $d_{av} = 0.64$; ICQ_{Acceptance}: $t(30) = 3.97$, $p < 0.001$, $d_{av} = 0.72$; ICQ_{Benefits}: $t(30) = 4.13$, $p < 0.001$, $d_{av} = 0.75$; HEALTH-49: $t(30) = 2.41$, $p = 0.022$, $d_{av} = 0.43$). The other measures did not yield any significant changes in any of the analyses.

Discussion

Identifying effective treatments is important to reduce somatic symptom burden and restore premorbid levels of functioning of people who developed long-term health sequelae of COVID-19. So far, non-pharmacological interventions including psychological interventions are among the most promising treatment options and are currently implemented by health care providers based on existing multidisciplinary rehabilitation approaches (Kupferschmitt et al., 2022). However, the evidence on the efficacy, acceptability, and safety of specific treatment options is

scarce. The present study examined the feasibility of a comprehensive CBT-based group therapy program targeting psychophysiological mechanisms of somatic symptom distress in a sample of inpatients with PCC.

Most importantly, our results support that CBT-PCC is feasible, well accepted, and potentially effective as part of inpatient neurological rehabilitation. In particular, participants' evaluations of the therapeutic process were on average very positive across all sessions and the module completion rate among those who received the intervention was substantial. Participants' ratings of the comprehensibility and atmosphere of the sessions were consistently positive, and their active engagement was high. Similarly, the assessment of the sessions' usefulness for disease coping was good. The fact that ratings were comparatively lower for sessions 1, 2, and 8 is in line with the structure of the treatment protocol, which promotes adaptive coping strategies particularly in sessions 3 to 7. The therapists' evaluations of the treatment protocol varied more between sessions, starting at a moderate level until eventually matching the participants' evaluations from mid-intervention onward. For adverse effects, we chose

Table 2. Sociodemographic and clinical characteristics of the sample at baseline

Variable	Participants (<i>n</i> = 63)
<i>Sociodemographic characteristics</i>	
Age, <i>M</i> (<i>s.d.</i>)	47.05 (11.45)
Gender, <i>n</i> (%)	
Female	51 (81.0)
Male	12 (19.0)
Education, <i>n</i> (%)	
Secondary school degree or lower	32 (50.8)
Higher education entrance qualification	7 (11.1)
University degree	24 (38.1)
Employment status, <i>n</i> (%)	
Unemployed	6 (9.5)
Employed, currently working	20 (31.7)
Employed, on sick leave	34 (54.0)
Other (e.g. parental leave, retired)	3 (4.8)
<i>Clinical characteristics</i>	
Somatic symptom distress (PHQ-15), <i>M</i> (<i>s.d.</i>)	13.29 (5.00)
Psychobehavioral features (SSD-12), <i>M</i> (<i>s.d.</i>)	23.22 (9.93)
Fatigue (FSS), <i>M</i> (<i>s.d.</i>)	5.93 (1.30)
Depression (PHQ-9), <i>M</i> (<i>s.d.</i>)	11.29 (5.18)
Anxiety (GAD-7), <i>M</i> (<i>s.d.</i>)	6.14 (5.17)
Self-efficacy (HEALTH-49) ^a , <i>M</i> (<i>s.d.</i>)	1.83 (0.91)
Illness cognitions (ICQ) ^b , <i>M</i> (<i>s.d.</i>)	
Helplessness	15.29 (4.05)
Acceptance	13.05 (4.24)
Perceived benefits	14.16 (4.10)
Time since first SARS-CoV-2 infection, weeks ^c , <i>M</i> (<i>s.d.</i>)	62.45 (27.67)

Note. ^a*n* = 62, ^b*n* = 61, ^c*n* = 60. PHQ-15, Patient Health Questionnaire – somatic symptom scale; SSD-12, Somatic Symptom Disorder – B criteria scale; FSS, Fatigue Severity Scale; PHQ-9, Patient Health Questionnaire – depression scale; GAD-7, General Anxiety Disorder Scale; HEALTH-49, Hamburg Modules for the Assessment of Psychosocial Health; ICQ, Illness Cognition Questionnaire.

a rather sensitive measure resulting in higher rates of unwanted events at first sight. However, rates are comparable to other trials evaluating CBT-based group therapy programs with the same instrument (Linden, Muschalla, & Walter, 2020). Also, the most frequently reported events may reflect to some point common psychotherapeutic processes (e.g. problem actuation) that are not inherently unwanted (Grawe, 1997). Thus, the presented treatment protocol can be regarded as safe.

Our results are in line with previous studies examining acceptability of CBT for PSS in other clinical populations, e.g. SSD, migraine, chronic fatigue (Adamson, Ali, Santhouse, Wessely, & Chalder, 2020; Klan, Liesering-Latta, Gaul, Martin, & Witthöft, 2019; Sharpe et al., 2011; Verdurmen, Videler, Kamperman, Khasho, & van der Feltz-Cornelis, 2017). Developing interventions that are feasible and accepted by the target population

seems important as such factors may positively influence therapeutic outcomes and the implementation of new treatment options under naturalistic conditions (Proctor et al., 2009). In fact, positive evaluations of general (e.g. alliance; Flückiger, Del Re, Wampold, & Horvath, 2018) and group-specific therapeutic processes (e.g. cohesion; Burlingame, McClendon, & Yang, 2018) have been shown to be positively related with the outcome of psychological interventions. For disorders that are marked by the presence of PSS, observational studies indicate that patients benefit more from biopsychosocial interventions when they are satisfied with treatment or perceive the intervention as helpful and appropriate for their symptoms (Beehler et al., 2021; Nees et al., 2020; Rief et al., 2002). In comparison, less is known about the influence of therapists' evaluations of the therapeutic process. Similar to our results, therapists' evaluations have been more critical compared with those of participants in previous studies (Puschner, Bauer, Kraft, & Kordy, 2015; Viefhaus et al., 2019), but process-outcome relationships may be weaker for therapist ratings (Horvath & Symonds, 1991). In general, health care providers may be more critical regarding delivered treatments due to their professional background, enabling them to reflect more in depth on an intervention. Upon study completion, we offered a feedback session to the study therapists to better understand the relatively lower satisfaction with the initial sessions and to identify potential needs for modification of the treatment protocol. Feedback was mostly related to a discrepancy between the time available and the proposed schedule of the sessions while generally being satisfied with content and interventions. We addressed the therapists' feedback by shortening and further manualizing the schedule of the initial sessions in a modified version of the treatment protocol.

In addition, pre-post comparisons suggest that the treatment program may reduce subjective fatigue and improve disease coping on a cognitive level with small- to medium-sized within-group effects. This is consistent with previous studies showing that CBT effectively reduces fatigue severity in chronic fatigue syndrome and fatigue related to other diseases such as multiple sclerosis (Harrison et al., 2021; Price et al., 2008). Moreover, the observed changes in illness cognitions may be of particular relevance. In a recent meta-analysis, differences in pre-treatment cognitive characteristics have been shown to predict patients' outcome in CBT for PSS suggesting that illness cognitions represent important features that should be addressed by psychological interventions (Sarter et al., 2021). In line with that, CBT indirectly reduced fatigue severity in cancer patients by changing fatigue self-efficacy (Poort et al., 2021). Contrary to previous results (Kleinstäuber et al., 2011), we did not find significant reductions of somatic and psychopathological symptom burden, but at the descriptive level differences tended in the expected direction. Interpretation of these results should consider a potentially inadequate treatment dose. Previous work has proposed a positive dose-response relationship for psychological interventions for somatic symptoms (Glombiewski et al., 2010; Kleinstäuber et al., 2011). In contrast, CBT-PCC comprised eight sessions delivered within four weeks. Considering the short period of time while simultaneously providing a broad variety of novel interventions, increasing the treatment dose to more sessions may be more helpful for participants to adopt the newly learned coping strategies. However, because CBT-PCC was embedded in routine inpatient rehabilitation and additional treatment components mostly complemented the cognitive-behavioral approach (e.g. physiotherapy, individual psychotherapeutic sessions, relaxation training), we assume the

Table 3. Session evaluation by participants

Items (GTS-P)	Modules															
	No. 1 Introduction and goal setting		No. 2 Psycho- education		No. 3 Stress education and relaxation		No. 4 Attention modification		No. 5 Cognitive restructuring		No. 6 Balancing physical activity		No. 7 Stress management		No. 8 Summary and transfer	
	<i>n</i> = 48		<i>n</i> = 46		<i>n</i> = 49		<i>n</i> = 45		<i>n</i> = 42		<i>n</i> = 39		<i>n</i> = 34		<i>n</i> = 25	
	<i>M</i>	(s.d.)	<i>M</i>	(s.d.)	<i>M</i>	(s.d.)	<i>M</i>	(s.d.)	<i>M</i>	(s.d.)	<i>M</i>	(s.d.)	<i>M</i>	(s.d.)	<i>M</i>	(s.d.)
1. I was engaged during today's session.	3.53 ^a	(0.65)	3.43	(0.69)	3.39	(0.76)	3.39 ^c	(1.04)	3.38	(1.01)	3.67	(0.66)	3.59	(0.66)	3.24	(1.09)
2. I actively participated in today's session.	3.38	(1.04)	3.33	(0.82)	3.31	(0.90)	3.24	(1.00)	3.24	(1.12)	3.59	(0.72)	3.29	(0.84)	3.28	(1.24)
3. I could well comprehend the contents of this session.	3.65	(0.57)	3.67	(0.52)	3.55	(0.61)	3.47	(0.79)	3.40	(0.99)	3.62	(0.63)	3.50	(0.71)	3.36	(1.08)
4. Today's session gave me suggestions for coping with my complaints.	2.08	(1.30)	2.78	(1.09)	2.96	(0.98)	2.96	(1.02)	2.98 ^d	(1.11)	3.21	(0.92)	3.26	(0.96)	2.52	(1.26)
5. Today the group was helpful for me.	2.79	(0.99)	2.91	(1.07)	3.12	(0.86)	2.96	(0.95)	3.02 ^d	(1.13)	3.51	(0.79)	3.32	(0.88)	2.80	(1.08)
6. After today's session, I think that this approach is promising for coping with my complaints.	2.77	(0.86)	2.53 ^b	(0.92)	2.78	(0.96)	2.76	(0.96)	2.93 ^d	(1.13)	3.21	(0.89)	3.24 ^e	(0.97)	2.44	(1.29)
7. Today the atmosphere in the group was good.	3.40	(0.96)	3.41	(0.78)	3.47	(0.62)	3.42	(0.72)	3.57	(0.74)	3.56	(0.60)	3.62	(0.65)	3.28	(0.98)
8. Overall, I am satisfied with today's session.	3.35	(0.86)	3.26	(0.98)	3.47	(0.74)	3.24	(0.86)	3.40	(0.94)	3.56	(0.79)	3.55 ^e	(0.71)	3.16	(1.03)
Total (mean of all 8 items)	3.12	(0.65)	3.17	(0.61)	3.26	(0.62)	3.18	(0.68)	3.25	(0.83)	3.49	(0.58)	3.41	(0.67)	3.01	(0.95)

Note. ^a*n* = 47, ^b*n* = 45, ^c*n* = 44, ^d*n* = 41, ^e*n* = 33. GTS-P, group therapy session evaluation by patients. Items were rated on a 5-point scale from (0) „disagree” to (4) „agree”.

Table 4. Pre-post comparisons of self-report measures for the intention-to-treat sample

Outcome	Intention-to-treat sample (<i>n</i> = 63)	
	Mean difference [95% CI]	Within-group comparison
Somatic symptom distress (PHQ-15)	−0.81 [−1.67, 0.05]	$t(62) = -1.89, p = 0.064, d_{av} = 0.24$
Psychobehavioral features (SSD-12)	−0.75 [−2.58, 1.09]	$t(62) = -0.81, p = 0.420, d_{av} = 0.10$
Fatigue (FSS)	−0.38 [−0.67, −0.09]	$t(62) = -2.60, p = 0.012, d_{av} = 0.33$
Depression (PHQ-9)	−0.59 [−1.44, 0.26]	$t(62) = -1.38, p = 0.171, d_{av} = 0.17$
Anxiety (GAD-7)	−0.49 [−1.21, 0.22]	$t(62) = -1.37, p = 0.175, d_{av} = 0.17$
Self-efficacy (HEALTH-49)	0.25 [0.06, 0.44] ^a	$t(61) = 2.61, p = 0.011, d_{av} = 0.33$
Illness cognitions (ICQ)		
Helplessness	−1.08 [−1.81, −0.36] ^b	$t(60) = -2.99, p = 0.004, d_{av} = 0.39$
Acceptance	1.52 [0.60, 2.45] ^b	$t(60) = 3.31, p = 0.002, d_{av} = 0.43$
Perceived benefits	1.34 [0.63, 2.06] ^b	$t(60) = 3.78, p < 0.001, d_{av} = 0.49$

Note. ^a*n* = 62, ^b*n* = 61. PHQ-15, Patient Health Questionnaire – somatic symptom scale; SSD-12, Somatic Symptom Disorder – B criteria scale; FSS, Fatigue Severity Scale; PHQ-9, Patient Health Questionnaire – depression scale; GAD-7, General Anxiety Disorder Scale; HEALTH-49, Hamburg Modules for the Assessment of Psychosocial Health; ICQ, Illness Cognition Questionnaire.

overall treatment dose the sample received as sufficient. Interestingly, for behavioral treatments of chronic pain, shorter treatments actually performed better than longer treatments, suggesting that individuals recover more quickly when offered fewer sessions from the outset (Glombiewski et al., 2018). Another explanation may be the small time difference between pre- and post-intervention assessment. Despite evidence for a substantial improvement of disease coping in our sample, less is known about how long it takes for these changes to translate into a reduction of somatic or psychopathological symptom burden. Because the time difference between assessments was small and post-intervention assessment was administered before discharge from inpatient rehabilitation (i.e. after a maximum of four weeks and before return to daily life), the study design may not have been optimal to detect changes in these measures. Therefore, future studies should include longer follow-up periods to address this issue.

Participants in our sample experienced predominantly fatigue, but overall, reported symptoms were polysymptomatic and reported alongside elevated psychological distress. The average time since SARS-CoV-2 infection was approximately 62 weeks and the proportion of people reporting psychobehavioral features of somatic symptom distress was comparable to other cohorts with PCC after mild COVID-19 in a neurological setting (Fleischer et al., 2022; Kachaner et al., 2022). In addition, a substantial proportion of our sample was diagnosed with a current mental disorder. The elevated psychopathological symptom burden among PCC patients, including the high rate of psychiatric comorbidities, corroborates the need for integrative approaches to the understanding and treatment of PCC (Lemogne et al., 2023). Although we cannot elaborate on the temporal relationship between PCC and psychiatric comorbidities, their co-occurrence clearly demonstrates the relevance of psychotherapeutic treatment strategies for PCC. Besides CBT-PCC primarily targeting somatic symptom distress, many of the proposed interventions have a transdiagnostic character (e.g. stress management, cognitive restructuring), thus CBT-PCC might be particularly suited for dealing with psychiatric comorbidities. Consistent with this, our results demonstrated the acceptability of CBT-PCC for a chronically and complex burdened sample. Generalizability of our results

to other phenotypes of PCC (e.g. post-intensive care syndrome; Yong & Liu, 2022) may be restricted due to the exclusion of people with severe courses of acute COVID-19, but CBT has been shown to be indicated for PSS with varying extent of biological underpinnings (McNaughton et al., 2019). Nonetheless, research concerning the application of specific treatment options for different phenotypes of PCC is needed to allow for evidence-based, personalized treatment decisions.

Several limitations have to be considered when interpreting our results. The lack of a control group, the small sample size, and the relatively high drop-out rate restrict the interpretation of the data. More precisely, the study design does not allow treatment effects to be attributed to the intervention since we pursued a one-group design and participants additionally received routine inpatient treatment. In addition, health insurance coverage for inpatient rehabilitation did not cover the entire intervention duration in some cases, resulting in participants being discharged before study completion. Moreover, results may have been biased due to the self-selection of participants, and because discontinuation of the study was associated with baseline clinical characteristics. Lastly, information on the long-term effects of the intervention is missing.

Conclusion

The post-COVID-19 condition affects a significant proportion of people after COVID-19, leading to a substantial burden on both an individual and societal level (Davis et al., 2021), but research on effective treatments for PCC is still at an early stage. Our results provide evidence for the feasibility, acceptability, and safety of a specialized CBT protocol in inpatients with PCC. With regard to treatment effects for PSS (Kleinstäuber et al., 2011), we assume CBT-based interventions to be an adequate option for PCC as well, but so far, only few promising treatment protocols exist (Frisk et al., 2023; Kuut et al., 2023; Skilbeck, 2022). Therefore, future studies should examine the efficacy of CBT-PCC in randomized controlled trials. In addition, effective treatment options for other associated symptoms (e.g. cognitive deficits) are needed and should be combined within multidisciplinary rehabilitation approaches to address the complexity and diverse phenotypes of PCC.

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