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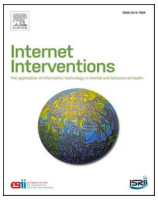

Efficacy of online psychoeducation and relaxation training program (OnPR) on mental health problems in COVID-19 patients: A randomized controlled trial

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ABSTRACT

Purpose: Prior studies found that the prevalence of anxiety, depression, stress and insomnia were relatively high in COVID-19 patients. This study aimed to explore the efficacy of OnPR on mental health outcomes in patients with asymptomatic or mildly symptomatic COVID-19.

Patients and methods: We employed a randomized controlled trial following the CONSORT guidelines. The Thai Clinical Trials Registry identification number of this study is TCTR20220729003. We used a block of 4 randomizations generated by a computer program. The intervention group (n = 38) received the OnPR program, and the control group (n = 36) received care as usual. OnPR was an online psychological intervention comprising psychoeducation, sleep hygiene education and relaxation techniques. OnPR was provided by qualified therapists trained with a standard protocol. The primary outcomes were depression, anxiety, and stress, which were determined by the Depression Anxiety and Stress Scale-21 (DASS-21). Sleep quality was measured by the Pittsburgh Sleep Quality Index (PSQI). Outcomes were compared between groups at pre-intervention and post-intervention at 1, 4, and 12 weeks using paired *t*-test or Wilcoxon signed-rank test. In addition, a linear mixed model was employed to demonstrate the effect changes of OnPR over time. All analyses were two-tailed, with a significance level of 0.05.

Results: Of 74 Thai participants, 89.2 % were female, and 11.8 % were male. The average age was 31 years. Participants' baseline characteristics were not statistically significant between the intervention and control groups except for depression and stress scores from DASS-21. OnPR resulted in significantly better improvement in depression, anxiety, stress, and sleep quality. The mean differences between groups of DASS-21 scores in depression, anxiety and stress at 7-day follow-up were −4.69, −3.29, and −5.50 respectively. The differences continue to be significant at 4-week and 12-week follow-ups. The mean difference between groups of PSQI at 7-day follow-up is −0.91.

Conclusion: OnPR improved mental health outcomes, and the effect on depression, anxiety and stress lasted for at least a 12-week follow-up period. In addition, it could enhance sleep quality after the intervention.

1. Introduction

The World Health Organization (WHO) issued an emergency declaration in response to the COVID-19 pandemic in 2019 (https://www.who.int/news/item/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-(2019-ncov), n.d.). Like many other nations, Thailand had to encounter this public health crisis. During the initial and subsequent waves of the pandemic, Thailand's Ministry of Public Health implemented a policy requiring asymptomatic or mildly symptomatic COVID-19 patients to be isolated in designated facilities, such as hospitels or hospitals, for a minimum of seven days. This measure was implemented to control the virus's spread and prevent further infections (Tangcharoensathien et al., 2022). The 'hospitel' is a 'hospital in a hotel'. It is a newly formed healthcare setting led by the Ministry of Public Health of Thailand, which allows admission to

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Table 1
The OnPR program for the treatment group.

Session 1	Psychoeducate about COVID-19 symptoms and the treatment process. Provide an overview of the relaxation program.
Session 2	Educate on sleep hygiene and practice breathing exercises (box breathing).
Session 3	Educate and practice visualization techniques.
Session 4	Educate and practice Jacobson's progressive muscle relaxation.
Session 5	Participants select one of their favourite techniques and practice.
Session 6	Review of each technique, Question and Answer.

Table 2
DASS-21 classification.

Interpretation	Depression	Anxiety	Stress
Normal	0–9	0–7	0–14
Mild	10–13	8–9	15–18
Moderate	14–20	10–14	19–25
Severe	21–27	15–19	26–33
Extremely severe	≥28	≥20	≥34

DASS-21; Depression Anxiety Stress Scale.

patients with COVID-19 with asymptomatic or mild symptoms. The hospitel serves as a quarantine and primary medical unit. Professionals working in the hospitel include general practitioners or family medicine doctors, and nurses. They monitor the physical and mental health of admitted patients and can liaise with a specialist in an affiliated hospital and refer cases whose symptoms have deteriorated (Tangcharoensathien et al., 2022). In addition, worsening medical and psychological conditions were referred to internal medicine consultants, psychologists and psychiatrists by telemedicine (Tangcharoensathien et al., 2022). The hospital dormitory at Vajira Hospital employs a concept similar to that of a "hospitel." It serves as a facility for quarantining healthcare workers from Vajira Hospital and their family members who have been infected with COVID-19.

Recent studies (Liu et al., 2021; Lerthattasilp et al., 2020; AlRasheed et al., 2022) found that the prevalence of anxiety symptoms, depression, stress and insomnia were relatively high (26.9 %, 32.3 %,25.8 %, and 52.7 %, respectively) in COVID-19 patients admitted to hospitels in Thailand, especially on the first day of admission (Kerdcharoen et al., 2022). These mental health issues could affect the quality of life and recovery process (Triantafillou et al., 2022; Azizi et al., 2022). Prior studies revealed that relaxation training such as breathing exercises, progressive muscle relaxation and guided imagery, as well as cognitive behavioral intervention and minded-fullness intervention online based, could reduce anxiety scores and improve sleep quality in a wide range of patients, from acute illness of COVID-19 infection to rehabilitation period (Lerthattasilp et al., 2021; Shaygan et al., 2021; Li et al., 2020; Kong et al., 2020; Wei et al., 2020; Liu et al., 2020). Mental health problems may interfere with the recovery process from COVID-19 and lead to persistent psychiatric disorders (Bourmistrova et al., 2022).

While there is currently no established psychological treatment protocol for COVID-19 patients experiencing mental health issues, and the WHO recommend only basic psychological support for patients to prevent mental health problems, and there may not be enough for patients who have moderate to severe symptoms of depression, stress and anxiety (https://www.who.int/campaigns/connecting-the-world-to-combat-coronavirus/healthyathome/healthyathome, n.d.), we propose that providing psychoeducation and relaxation training to isolated patients can potentially reduce stress, anxiety, and depression as well as enhance their sleep quality. Thus, this study aims to investigate the effect of an online psychoeducation and relaxation training program (OnPR) in comparison to care as usual (CAU) on the mental health outcomes of COVID-19 patients residing in hospitels or Vajira dormitories supervised by the Faculty of Medicine at Vajira Hospital. This hospital is responsible for the care of patients from the Thonburi district in Bangkok. The findings from this study will be used to develop psychological interventions aimed at mitigating mental health issues and promoting overall mental well-being.

2. Method

2.1. Study design, setting and participants

We employed a randomized controlled trial (RCT) study based on CONSORT guidelines. Within our power analysis, the sample size was

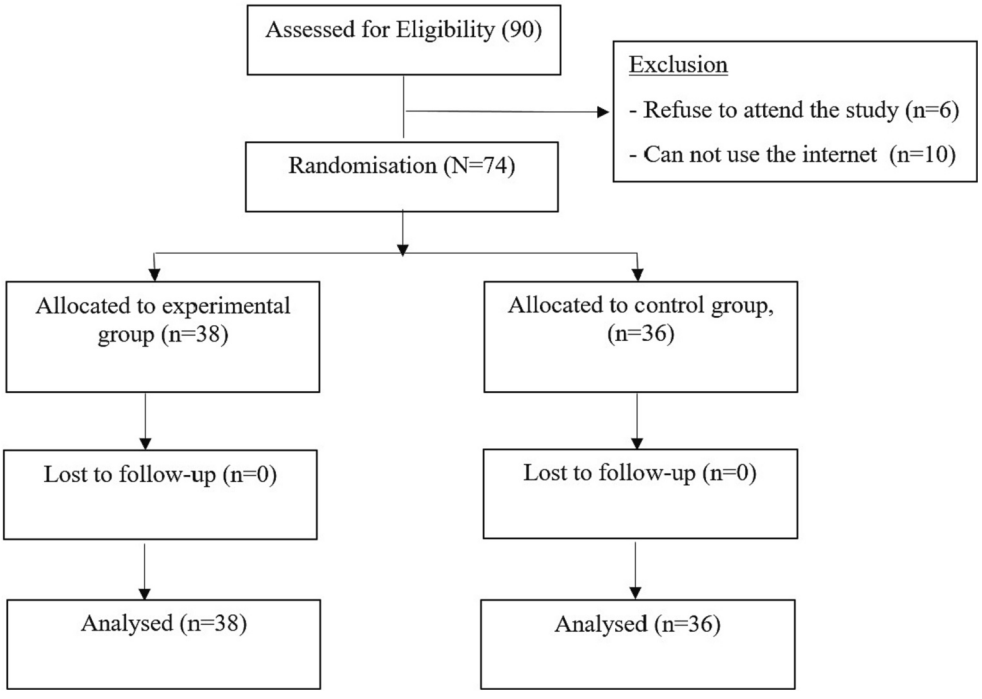

Fig. 1. The consort diagram of the study.

Table 3
Baseline characteristics of participants.

Characteristics	Intervention (n = 38)		Control (n = 36)		P-value	
Age (years)	31.74 ± 8.85		31.56 ± 9.32		0.932	t
Sex						
- Male	9	(23.7)	9	(25.0)	0.895	c
- Female	29	(76.3)	27	(75.0)		
Marital status						
- Single	26	(68.4)	24	(66.7)	0.899	f
- Married	11	(28.9)	12	(33.3)		
- Divorced/separated	1	(2.6)	0	(0.0)		
Education						
- Secondary school	3	(7.9)	5	(13.9)	0.531	f
- Diploma	6	(15.8)	4	(11.1)		
- Bachelor's degree	26	(68.4)	21	(58.3)		
- Higher than a bachelor's degree	3	(7.9)	6	(16.7)		
Occupation						
- Unemployed	0	(0.0)	2	(5.6)	0.681	f
- Student	9	(23.7)	6	(16.7)		
- Government officer	17	(44.7)	13	(36.1)		
- Employee	11	(28.9)	12	(33.3)		
- Self-employed	1	(2.6)	3	(8.3)		
Income (Baht per month)						
- 0–5000	8	(21.1)	5	(13.9)	0.806	f
- 5001-10,000	2	(5.3)	4	(11.1)		
- 10,001–15,000	4	(10.5)	6	(16.7)		
- 15,001-20,000	6	(15.8)	7	(19.4)		
- 20,001–25,000	9	(23.7)	6	(16.7)		
- >25,000	9	(23.7)	8	(22.2)		
Hometown						
- Bangkok	15	(39.5)	18	(50.0)	0.363	c
- Up-country	23	(60.5)	18	(50.0)		
Living with						
- Live alone	11	(28.9)	7	(19.4)	0.569	f
- Live with friends	4	(10.5)	2	(5.6)		
- Live with partner	3	(7.9)	5	(13.9)		
-Live with family	20	(52.6)	22	(61.1)		
Underlying medical illness	5	(13.2)	11	(30.6)	0.069	c
A family history of psychiatric disorder	6	(15.8)	2	(5.6)	0.263	f
DASS-21 classification						
- Depression						
Normal	13	(34.2)	22	(61.1)	0.046	f
Mild	5	(13.2)	3	(8.3)		
Moderate	7	(18.4)	8	(22.2)		
Severe	5	(13.2)	2	(5.6)		
Extremely severe	8	(21.1)	1	(2.8)		
- Anxiety						
Normal	5	(13.2)	7	(19.4)	0.686	f
Mild	8	(21.1)	10	(27.8)		
Moderate	8	(21.1)	9	(25.0)		
Severe	6	(15.8)	4	(11.1)		
Extremely severe	11	(28.9)	6	(16.7)		
- Stress						
Normal	13	(34.2)	22	(61.1)	0.020	f
Mild	2	(5.3)	6	(16.7)		
Moderate	10	(26.3)	4	(11.1)		
Severe	8	(21.1)	3	(8.3)		
Extremely severe	5	(13.2)	1	(2.8)		
Severity of COVID-19						
- Asymptomatic	2	(5.3)	1	(2.8)	1.000	f
- Mildly symptomatic	36	(94.7)	35	(97.2)		
Treatment						
- Symptomatic treatment	38	(100)	33	(91.7)	0.110	f
- Referred to hospital	0	(0.0)	1	(2.8)		
- Home isolation	0	(0.0)	2	(5.6)		
Number of family members with COVID-19 infection	1	[0–2]	1	[0–2]	0.840	m
Number of family members with high-risk of COVID-19 infection.	0	[0–2]	1	[0–1.5]	0.195	
Duration of COVID-19 symptoms (days)	4	()	4	()	0.995	m
Perceived empathic listening	29	(76.3)	29	(80.6)	0.658	c

Data are presented as number (%), mean ± standard deviation or median [interquartile range]. P-value corresponds to [t]independent samples t-test, [m]Mann-Whitney U test, [c]Chi-square test or [f]Fisher's exact test.
DASS-21; Depression Anxiety Stress Scale.

calculated by RCT for continuous data formulation. We employed the means difference and standard deviation from both the treatment and control group from the study of Lerthattasilp et al. (2021). The mean difference (standard deviation) in the treatment and control group were 5.1 (5.8) and 1.8 (3.9), consecutively (Lerthattasilp et al., 2021). We set the type 1 error (α) as 0.05 and the type 2 (β) error as 0.8. The required sample was 30 per arm. In addition, we adjusted the sample size in case of dropout and withdrawal rates, so the sample was 45 participants per arm.

We used purposive sampling from asymptomatic or mild symptomatic COVID-19 patients who had properties following the eligibility criteria.

All participants were asymptomatic or mild symptomatic COVID-19 patients confirmed by polymerase chain reaction (PCR) or rapid antigen kit test (ATK) and admitted to hospitel or the hospital's dormitory in Thailand, under the supervision of the Faculty of Medicine Vajira Hospital.

Other eligibility criteria included age 18 or over, having substantial depression, anxiety or stress determined by the Depression Anxiety and Stress Scale-21 (DASS-21) score of moderate to severe severity in at least one dimension. In addition, participants must be fluent in Thai and be able to use the Internet.

We excluded participants who had a psychiatric history or were on psychotropic medications. The withdrawal criteria consisted of 1) participants who could not attain the program at least 50 % (3 of 6 sessions) and 2) they had unstable or worsened medical conditions that changed their status to moderate to severe COVID-19 symptoms.

2.2. Ethics

We obtained approval from the Ethical Committee of the Institutional Review Board of the Faculty of Medicine Vajira Hospital on July 16, 2021 (COA no. 212/64E). Before starting the study, all participants were informed of the study's objectives and method. Then, they provided written informed consent via Google Sheets. The Thai Clinical Trials Registry identification number of this study is TCTR20220729003. We started collecting the data from August 1, 2022, to December 31, 2022, and we began to analyze the data on January 15, 2023.

2.3. Randomization and masking

We used a block of 4 randomizations generated by a computer program. A database programmer undertook treatment allocation independently of the trial team. Participants were included and allocated to either treatment or control groups parallelly throughout the whole duration of the research. Due to the therapy trial, participants, nurses, and clinical psychologists could not be masked to treatment allocation. The primary outcomes were rated by the participants themselves. Finally, the statistician analyzing primary outcomes was masked to treatment allocation.

2.4. Procedure

The treatment group received 6 consecutive individual sessions of OnPR consisting of 1) psychoeducation about COVID-19 symptoms and orientation to the program 2) sleep hygiene education 3) breathing exercises (box breathing or square breathing) 4) visualization technique or guided imagery designed to help patients relive peaceful experiences, and 5) Jacobson's progressive muscle relaxation focused on alleviating tension related to anxiety symptoms. This exercise entails deliberately

Table 4
Comparison of mental health outcomes within the group.

Outcome	Mean ± SD	Mean difference (95 % CI)		t	P-value[a]
Intervention group (n = 38)					
DASS-21:					
Depression					
Baseline	8.08 ± 5.71	Ref.			
7 days	2.92 ± 3.15	−5.16	(−6.74, −3.58)	−6.606	<0.001*
4 weeks	2.66 ± 3.57	−5.42	(−7.26, −3.58)	−5.981	<0.001*
12 weeks	2.13 ± 3.74	−5.95	(−7.90, −4.00)	−6.185	<0.001*
DASS-21: Anxiety					
Baseline	7.42 ± 4.16	Ref.			
7 days	2.63 ± 2.75	−4.79	(−6.06, −3.52)	−7.642	<0.001*
4 weeks	1.92 ± 2.38	−5.50	(−7.00, −4.00)	−7.454	<0.001*
12 weeks	1.97 ± 2.70	−5.45	(−6.97, −3.93)	−7.252	<0.001*
DASS-21: Stress					
Baseline	10.5 ± 5.24	Ref.			
7 days	3.92 ± 3.18	−6.58	(−8.20, −4.95)	−8.208	<0.001*
4 weeks	3.95 ± 3.85	−6.55	(−8.47, −4.63)	−6.918	<0.001*
12 weeks	3.84 ± 4.00	−6.66	(−8.59, −4.72)	−6.976	<0.001*
PHQ-9					
Baseline	10.79 ± 6.04	Ref.			
7 days	5.03 ± 5.04	−5.76	(−7.45, −4.08)	−6.921	<0.001*
PSQI					
Total PSQI scores					
Baseline	8.00 ± 2.39	Ref.			
7 days	6.87 ± 2.17	−1.13	(−1.79, −0.47)	−3.461	0.001*
Sleep latency (min)					
Baseline	32.59 ± 23.32	Ref.			
7 days	28.12 ± 23.34	−4.47	(−7.73, −1.21)	−2.781	0.009*
Sleep duration (h)					
Baseline	6.18 ± 1.18	Ref.			
7 days	6.50 ± 1.23	0.32	(−0.02, 0.65)	1.917	0.063
Sleep efficiency (%)					
Baseline	86.76 ± 14.01	Ref.			
7 days	87.67 ± 14.04	0.91	(−2.92, 4.74)	0.480	0.634
Control group (n = 36)					
DASS-21:					
Depression					
Baseline	4.42 ± 4.09	Ref.			
7 days	3.94 ± 4.78	−0.47	(−1.83, 0.89)	−0.704	0.486
4 weeks	3.94 ± 4.60	−0.47	(−2.07, 1.13)	−0.598	0.554
12 weeks	3.82 ± 4.84	−0.53	(−2.12, 1.06)	−0.676	0.504
DASS-21: Anxiety					
Baseline	6.17 ± 3.85	Ref.			
7 days	4.67 ± 3.89	−1.50	(−2.65, −0.35)	−2.639	0.012
4 weeks	4.19 ± 3.82	−1.97	(−3.46, −0.48)	−2.682	0.011
12 weeks	3.12 ± 3.18	−3.21	(−4.67, −1.74)	−4.445	<0.001*
DASS-21: Stress					
Baseline	6.39 ± 4.62	Ref.			
7 days	5.31 ± 4.43	−1.08	(−2.63, 0.46)	−1.423	0.164
4 weeks	5.42 ± 4.08	−0.97	(−2.91, 0.96)	−1.021	0.314
12 weeks	4.71 ± 4.22	−1.88	(−3.67, −0.09)	−2.138	0.040*
PHQ-9					
Baseline	8.50 ± 4.61	Ref.			
7 days	7.08 ± 6.13	−1.42	(−3.25, 0.42)	−1.565	0.127
PSQI					
Total PSQI scores					
Baseline	7.08 ± 1.92	Ref.			
7 days	6.86 ± 2.07	−0.22	(−0.77, 0.32)	−0.831	0.412
Sleep latency (min)					
Baseline	34.38 ± 34.22	Ref.			
7 days	32.71 ± 28.85	−1.67	(−10.58, 7.25)	−0.380	0.707
Sleep duration (h)					
Baseline	6.53 ± 1.06	Ref.			
7 days	6.74 ± 1.19	0.26	(0.00, 0.52)	1.999	0.054
Sleep efficiency (%)					
Baseline	88.41 ± 9.68	Ref.			
7 days	89.84 ± 9.91	1.40	(−2.13, 4.92)	0.806	0.426

DASS-21; Depression Anxiety Stress Scale, PHQ-9; Patient Health Questionnaire 9, PSQI; the Pittsburgh Sleep Quality Index.
[a] P-value corresponds to paired samples t-test.
* Significant at P-value < 0.05.

tensing and subsequently relaxing muscles throughout the body, with the primary emphasis placed on the relaxation phase following muscle tension (Norelli et al., 2021). Participants would receive one session per day. Each session was approximately 20 to 25 min, and it was provided by trained clinical psychologists or mental health nurses. We encouraged participants to practice relaxation techniques by themselves after each session; however, we did not assign the homework between the sessions. Psychoeducational and relaxation programs were designed to alleviate anxiety and enhance self-regulation in order to mitigate psychological stress associated with COVID-19 infection. We developed a standard written protocol for therapists under the supervision of qualified psychiatrists, clinical psychologists and mental health nurses from an external institution (Table 1). We organized three one-hour sessions of training to prepare clinical psychologists and mental health nurses to utilize the program protocol.

Following the quarantine protocol, all sessions were provided online via Zoom program or Line application.

The control group received care as usual (CAU), such as basic

Table 5
Comparison of outcome between the intervention group and control group.

Outcome	Intervention (n = 38)	Control (n = 36)	Mean difference (95 % CI)		t	P-value[a]
	Mean ± SD	Mean ± SD				
DASS-21: Depression						
Baseline	8.08 ± 5.71	4.42 ± 4.09	3.66	(1.37, 5.96)	3.183	0.002*
7 days	2.92 ± 3.15	3.94 ± 4.78	−1.02	(−2.89, 0.84)	−1.093	0.278
4 weeks	2.66 ± 3.57	3.94 ± 4.60	−1.29	(−3.09, 0.62)	−1.349	0.182
12 weeks	2.13 ± 3.74	3.82 ± 4.84	−1.69	(−3.71, 0.33)	−1.669	0.100
DASS-21: Anxiety						
Baseline	7.42 ± 4.16	6.17 ± 3.85	1.25	(−0.61, 3.11)	1.345	0.183
7 days	2.63 ± 2.75	4.67 ± 3.89	−2.04	(−3.60, −0.48)	−2.616	0.011
4 weeks	1.92 ± 2.38	4.19 ± 3.82	−3.27	(−3.74, −0.81)	−3.090	0.003
12 weeks	1.97 ± 2.70	3.12 ± 3.18	−1.14	(−2.53, 0.24)	−1.652	0.103
DASS-21: Stress						
Baseline	10.5 ± 5.24	6.39 ± 4.62	4.11	(1.82, 6.41)	3.571	<0.001
7 days	3.92 ± 3.18	5.31 ± 4.43	−1.38	(−3.17, 0.40)	−1.550	0.126
4 weeks	3.95 ± 3.85	5.42 ± 4.08	−1.47	(−3.31, 0.37)	−1.594	0.115
12 weeks	3.84 ± 4.00	4.71 ± 4.22	−0.86	(−2.80, 1.07)	−0.891	0.376
PHQ-9						
Baseline	10.79 ± 6.04	8.50 ± 4.61	2.29	(−0.21, 4.79)	1.826	0.072
7 days	5.03 ± 5.04	7.08 ± 6.13	−2.06	(−4.65, 0.54)	−1.581	0.118
PSQI						
Total PSQI scores						
Baseline	8.00 ± 2.39	7.08 ± 1.92	0.92	(−0.09, 1.93)	1.812	0.074
7 days	6.87 ± 2.17	6.86 ± 2.07	0.01	(−0.98, 0.99)	0.015	0.988
Sleep latency (min)						
Baseline	32.59 ± 23.32	34.38 ± 34.22	−1.78	(−15.29, 11.72)	−0.263	0.793
7 days	28.12 ± 23.34	32.71 ± 28.85	−4.59	(−16.72, 7.54)	−0.754	0.453
Sleep duration (h)						
Baseline	6.18 ± 1.18	6.53 ± 1.06	−0.34	(−0.87, 0.18)	−1.304	0.196
7 days	6.50 ± 1.23	6.74 ± 1.19	−0.24	(−0.80, 0.32)	−0.840	0.404
Sleep efficiency (%)						
Baseline	86.76 ± 14.01	88.41 ± 9.68	−1.65	(−7.32, 4.01)	−0.582	0.562
7 days	87.67 ± 14.04	89.84 ± 9.91	−2.18	(−7.83, 3.48)	−0.766	0.446

DASS-21; Depression Anxiety Stress Scale, PHQ-9; Patient Health Questionnaire 9, PSQI; the Pittsburgh Sleep Quality Index.
[a] P-value corresponds to Independent samples t-test.
* Significant at P-value < 0.05.

Table 6
Effect of the OnPR program on mental health outcomes in asymptomatic or mild symptomatic COVID-19 patients.

Outcome	Intervention (n = 38)			Control (n = 36)			Difference between groups (95 % CI)		P-value
	Change from baseline (95 % CI)		P-value	Change from baseline (95 % CI)		P-value			
DASS-21: Depression									
7 days	−5.16	(−6.13, −4.18)	<0.001[a]	−0.47	(−1.48, 0.53)	0.356	−4.69	(−6.09, −3.29)	<0.001[a]
4 weeks	−5.42	(−6.61, −4.23)	<0.001[a]	−0.47	(−1.70, 0.75)	0.450	−4.95	(−6.66, −3.24)	<0.001[a]
12 weeks	−5.95	(−7.43, −4.46)	<0.001[a]	−0.51	(−2.05, 1.03)	0.519	−5.44	(−7.58, −3.30)	<0.001[a]
DASS-21: Anxiety									
7 days	−4.79	(−5.68, −3.9)	<0.001[a]	−1.50	(−2.41, −0.59)	0.001[a]	−3.29	(−4.56, −2.02)	<0.001[a]
4 weeks	−5.50	(−6.55, −4.45)	<0.001[a]	−1.97	(−3.05, −0.89)	<0.001[a]	−3.53	(−5.03, −2.02)	<0.001[a]
12 weeks	−5.45	(−6.72, −4.17)	<0.001[a]	−2.99	(−4.32, −1.67)	<0.001[a]	−2.46	(−4.29, −0.62)	<0.001[a]
DASS-21: Stress									
7 days	−6.58	(−7.67, −5.48)	<0.001[a]	−1.08	(−2.21, 0.04)	0.059	−5.50	(−7.06, −3.93)	<0.001[a]
4 weeks	−6.55	(−7.84, −5.26)	<0.001[a]	−0.97	(−2.30, 0.35)	0.150	−5.58	(−7.43, −3.73)	<0.001[a]
12 weeks	−6.66	(−8.22, −5.10)	<0.001[a]	−1.67	(−3.29, −0.05)	0.043[a]	−4.99	(−7.23, −2.74)	<0.001[a]
PHQ-9									
7 days	−5.76	(−6.98, −4.55)	<0.001	−1.42	(−2.67, −0.17)	0.026	−4.35	(−6.09, −2.60)	<0.001
PSQI									
Total PSQI scores									
7 days	−1.13	(−1.55, −0.71)	<0.001[a]	−0.22	(−0.65, 0.21)	0.314	−0.91	(−1.51, −0.31)	0.003[a]
Sleep latency (min)									
7 days	−4.47	(−10.32, 1.37)	0.134	−1.67	(−7.68, 4.34)	0.587	−2.81	(−11.19, 5.58)	0.512
Sleep duration (h)									
7 days	0.32	(0.11, 0.52)	0.003[a]	0.26	(0.04, 0.47)	0.019[a]	0.06	(−0.24, 0.36)	0.699
Sleep efficiency (%)									
7 days	0.91	(−1.62, 3.44)	0.482	1.4	(−1.24, 4.03)	0.299	−0.49	(−4.14, 3.17)	0.793

DASS-21; Depression Anxiety Stress Scale, PHQ-9; Patient Health Questionnaire 9, PSQI; the Pittsburgh sleep quality index.
[a] Analyses were conducted with the use of a mixed-effects model adjusted for baseline value.

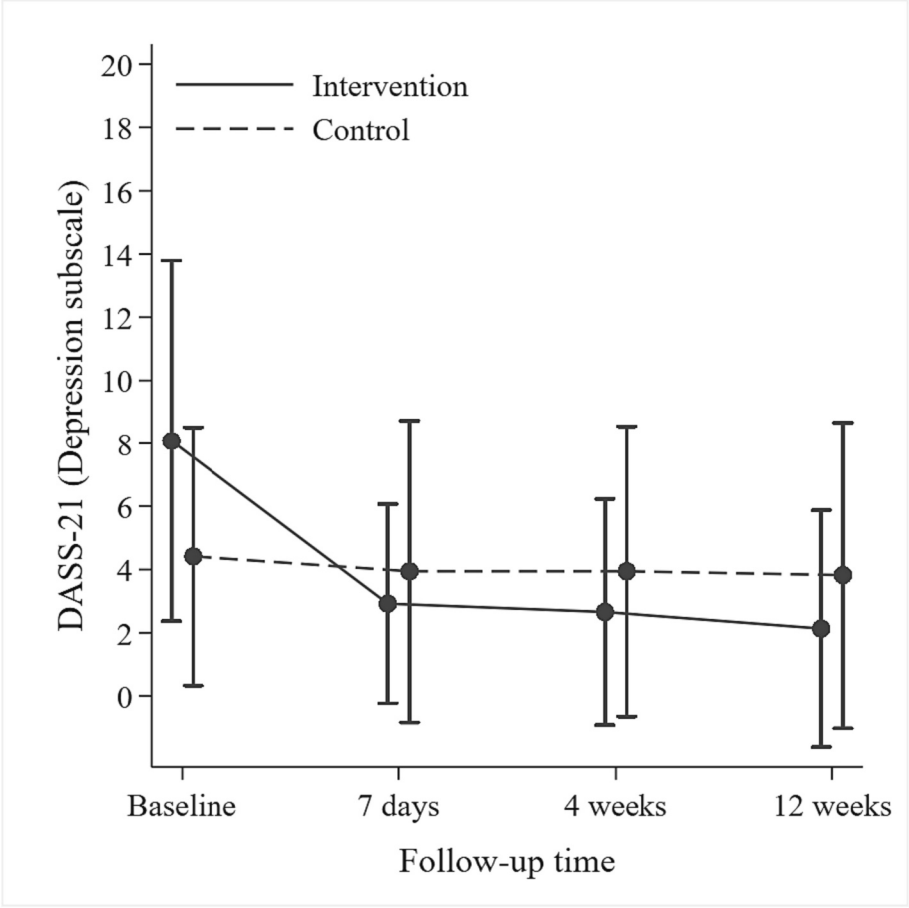

Fig. 2. Baseline and follow-up periods of depression subscale of DASS-21 for participants in the intervention and control group. Note. Error bars represent standard errors.

counselling and online self-help resources regarding physical symptoms of COVID-19 and mental health support, such as video clips or leaflets.

2.5. Measure

2.5.1. Baseline characteristic

Baseline characteristic items included age, sex, marital status, education, occupation, income, hometown, household members, underlying medical illness, family history of psychiatric disorders, severity of COVID-19 infection, treatment for COVID-19 infection, number of family members infected with COVID-19, number of family members with high-risk of COVID-19 infection, duration of COVID-19 symptoms, and perceived empathic listening.

2.5.2. Primary outcome measure

The primary outcome measure in this trial was the Depression Anxiety and Stress Scale-21 (DASS-21).

2.5.2.1. DASS-21. DASS-21 include three domains, namely depression, anxiety, and stress domains. Each domain comprises seven items. The items on each domain can be scored separately. The severity of depression, anxiety, and stress are classified into normal, mild, moderate, severe and extremely severe (Table 2). The Cronbach's alpha coefficient of the DASS-21 Thai version is 0.75, reflecting good internal consistency (Lovibond and Lovibond, 1995; Oei et al., 2013). The test-retest reliability is 0.71–0.81 (Brown et al., 1997).

2.5.3. Secondary outcome measure

Secondary outcome measures included the Thai version of Patient Health Questionnaire-9 (PHQ-9) and the Pittsburgh Sleep Quality Index (PSQI) Thai version.

2.5.3.1. The Thai version of PHQ-9. The Thai version of PHQ-9 has a total of 9 questions. The total score of PHQ-9 is categorized into normal (0–6), mild (7–12), moderate (13–18), and severe (≥19). The sensitivity and specificity of PHQ-9 are 84 % and 77 %, respectively, to detect depression (Kroenke et al., 2001; Lotrakul et al., 2008). The test-retest reliability is 0.84 (Spitzer et al., 2014).

2.5.3.2. PSQI Thai version. PSQI Thai version consists of 19 individual items that generate 7 component scores, including 1) subjective sleep quality, 2) sleep latency, 3) sleep duration, 4) sleep efficiency, 5) sleep disturbance, 6) use of sleep medication, and 7) daytime dysfunction. Each item is rated from 0 to 3, giving a total PSQI score between 0 and 21. The cut-off value of a global score >5 indicates poor sleep quality. At this cut-off, PSQI yields a diagnostic sensitivity of 89.6 % and specificity of 86.5 % in distinguishing between good and poor sleepers (Buysse et al., 1989). The test-retest reliability is 0.87 (Backhaus et al., 2002).

The DASS-21 was given to participants before, immediately after the intervention (on day 7), and again at 4 and 12 weeks following the intervention. On the other hand, the PHQ-9 and PSQI assessments were carried out before and after the intervention (on day 7).

2.6. Statistical analysis

Categorical data were reported by distributing frequency and percentage and comparing differences between the experimental and control groups using the Chi-squared test or Fisher's exact test as

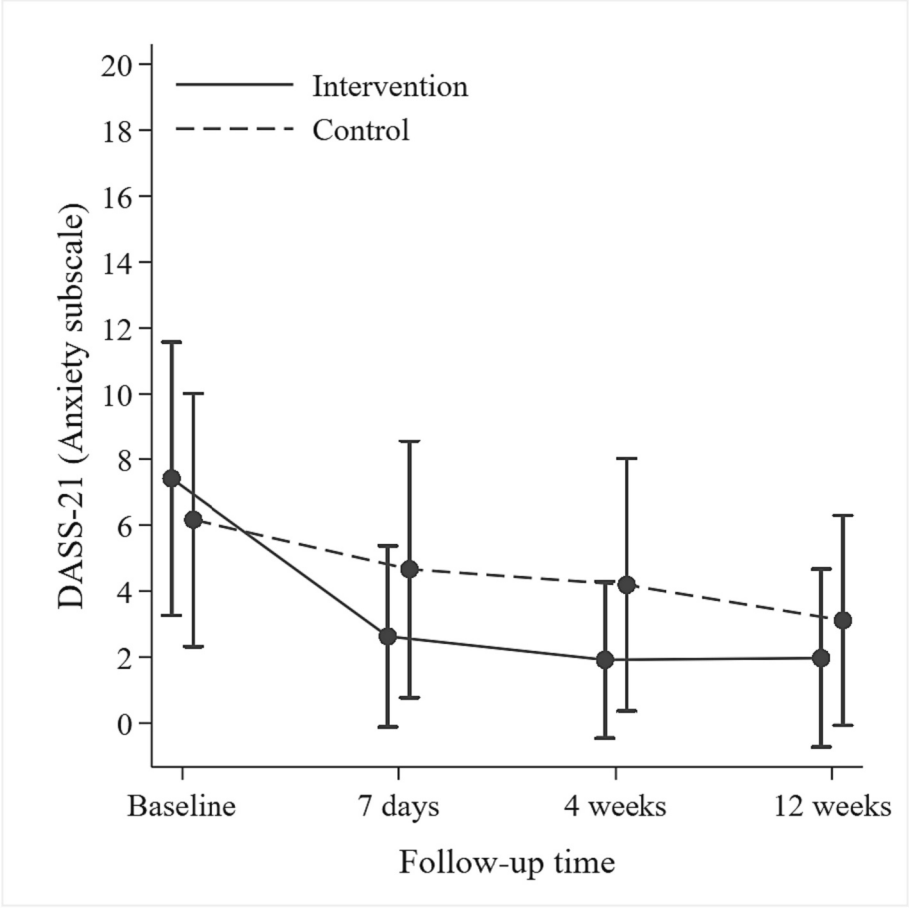

Fig. 3. Baseline and follow-up periods of anxiety subscale of DASS-21 for participants in the intervention and control group. Note. Error bars represent standard errors.

appropriate for the data.

Continuous data were reported with mean, standard deviation (SD), median and interquartile range [IQR], as appropriate, and compared differences between the experimental and control groups were compared using the student's *t*-test or Mann-Whitney *U* test, as appropriate.

DASS-21 scores were compared between pre-intervention and post-intervention within the group at 1, 4, and 12 weeks in both the experimental and control groups, whereas PHQ-9 and PSQI scores were compared between pre-intervention and post-intervention using paired *t*-test.

DASS-21 scores were compared between the experimental and control groups at 1, 4 and 12 weeks, while PHQ-9 and PSQI scores were compared between pre-intervention and post-intervention using the student's t-test. A linear mixed model (LMM) adjusted for baseline was employed to demonstrate effect changes over time. Intent-to-treat (ITT) was applied to analyze data based on randomized groups and address missing data using the last observation carried forward method (LOCF).

All data were analyzed by the Stata version 14.0 computer program (StataCorp, College Station, TX, USA), with statistical significance set at the P-value of 0.05.

3. Results

Fig. 1 illustrates the trial profile. 74 (82.2 %) of 90 participants passed the eligibility criteria of this study. In addition, 16 participants were excluded due to their refusal to attend the study and their inability to use the Internet. There was no dropout and withdrawal case.

Table 3 shows the participants' baseline characteristics. Of 74 participants, 89.2 % were female, and 11.8 % were male. The average age was 31 years. The majority of participants were single and had bachelor's degrees. Approximately half of the participants were government officers. Around 96 % of the participants had mild COVID-19 symptoms. There were no statistically significant differences between anxiety, sleep quality, severity of COVID-19 infection, and treatment between both groups. However, participants in the intervention group had higher depression and stress scores.

Table 4 shows the comparison of mental health outcomes within the group. It is noticeable that the mean scales of depression, anxiety and stress outcomes decreased in each follow-up visit in the intervention group ($P < 0.01$), while anxiety and stress domains in the control group decreased significantly only in the 4 and 12-week follow-up visit ($P < 0.05$). In addition, the PHQ-9 and total PSQI and sleep latency in the intervention group significantly reduced at 7 days post-intervention when using paired samples *t*-test to compare ($P < 0.01$).

Tables 5–6 and Figs. 2–5 compare mental health outcomes between the intervention and control groups. Table 5 depicts the mean depression and stress scores from DASS-21 in the intervention group were significantly higher than the intervention group at baseline (8.08 ± 5.71 vs. 4.42 ± 4.09 and 10.50 ± 5.24 vs. 6.39 ± 4.62) ($P < 0.05$). However, Table 5 demonstrates the significantly higher reduction of depression and stress scores in the intervention group at every follow-up. Mean differences between groups in depression scores were −4.69, −4.95, and −5.44 on day 7, week 4 and week 12, consecutively. Mean differences between groups of stress scores were −5.50, −5.58, and −4.99 on day 7, week 4 and week 12, consecutively.

The results also show significantly better mean differences in anxiety. Mean differences between groups in anxiety scores were −3.29,

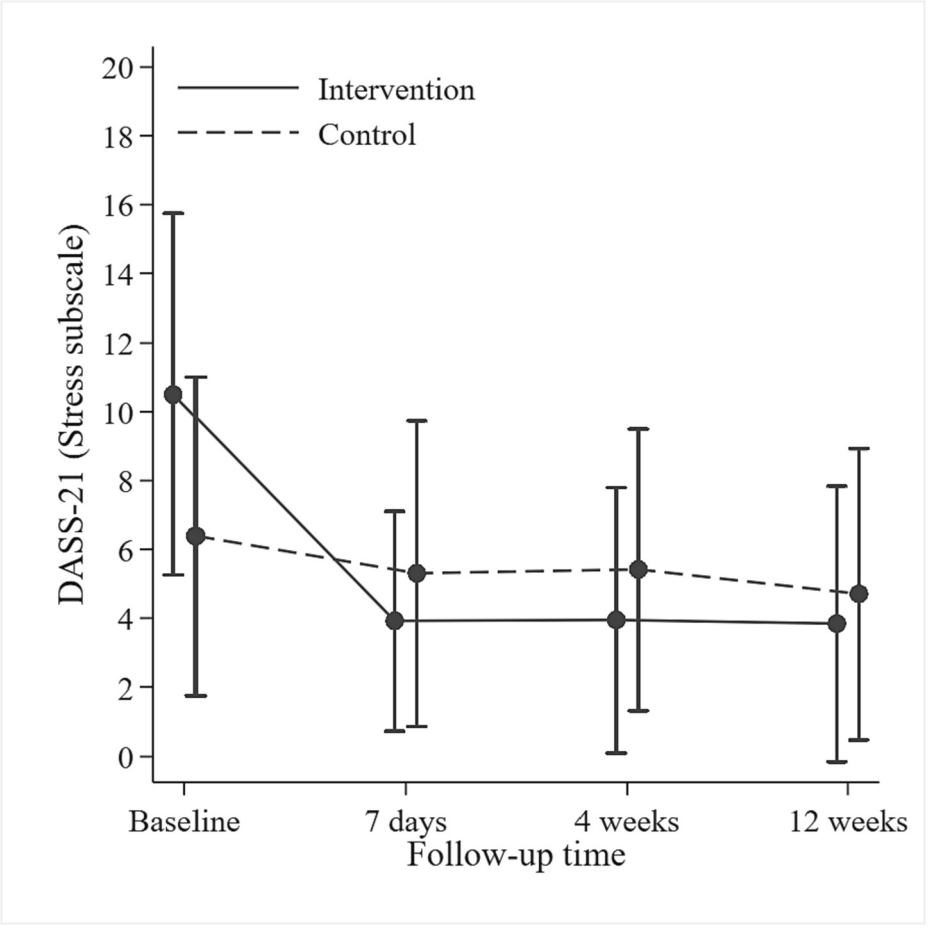

Fig. 4. Baseline and follow-up periods of stress subscale of DASS-21 for participants in the intervention and control group. Note. Error bars represent standard errors.

−3.53, and −2.46 on day 7, week 4 and week 12, consecutively. Furthermore, the total PSQI score was significantly decreased in the intervention group, with a mean difference of −0.91.

4. Discussion

To the best of our knowledge, this study is the first randomized control trial to explore the efficacy of psychological intervention techniques containing psychoeducation and comprehensive relaxation training on mental health outcomes in participants with asymptomatic or mildly symptomatic COVID-19 infection in Thailand.

Even though participants in the intervention group had higher average scores for stress and depression compared to the control group, a linear mixed-effect model found that OnPR could reduce depression, anxiety, stress, and enhance sleep quality as measured by DASS-21, PHQ-9 and PSQI. These findings align with earlier studies suggesting that intensive psychological interventions can effectively ameliorate mental health issues in COVID-19 patients compared with care as causal (Lerthattasilp et al., 2021; Shaygan et al., 2021; Li et al., 2020; Kong et al., 2020; Wei et al., 2020; Liu et al., 2020).

Our OnPR also contains psychoeducation in the first session of the program. Psychoeducation provided participants with facts and information about COVID-19 infection, which reduced the sense of uncertainty often linked with anxiety and stress. In addition, participants were introduced to self-monitoring, which helped increase their sense of control and competency. Psychoeducation could also create trust and hope, which are fundamental to the therapist-client therapeutic relationship.

The OnPR encompassed various relaxation methods, such as breathing exercises, guided imagery, and progressive muscle relaxation. The mechanism underlying the positive effects of deep breathing exercises and progressive muscle relaxation on mental health involves reducing bodily and cognitive arousal (Norelli et al., 2022). Moreover, guided imagery is a technique to replace distressing memories with positive mental images (Norelli et al., 2022). Consequently, incorporating these techniques fosters positive emotions and mitigates stress, anxiety, and depression (Toussaint et al., 2021; Liu et al., 2020; Edinger et al., 2021). Additionally, it has the potential to enhance sleep quality by addressing difficulties in falling asleep and promoting deep sleep (Liu et al., 2020). Notably, relaxation training, a component of cognitive behavioural therapy for insomnia (CBT-I), is endorsed by the American Academy of Sleep Medicine for the treatment of insomnia patients (Edinger et al., 2021). In addition, the results also demonstrated that the effect of OnPR on positive mental health outcomes persisted for at least a 12-week follow-up period. This finding may result from participants' continuing practice after 6 days of consecutive training sessions.

Our study has several advantages. Firstly, it is an experimental study that incorporates a control group. Randomization was executed using a computer program, and the statistician responsible for data analysis was unaware of group assignments, ensuring objectivity. Secondly, we utilized established self-assessment questionnaires, eliminating any potential bias from the primary outcome assessors. Thirdly, our therapists were highly skilled professionals, either psychologists or mental health nurses, and they followed a standardized OnPR protocol. Fourthly, to safeguard therapists from the risk of COVID-19 transmission, we conducted all sessions online. Lastly, it is worth noting that there were no dropouts among participants during the intervention period. It might be that all participants were quarantined in the hospitel or the hospital's

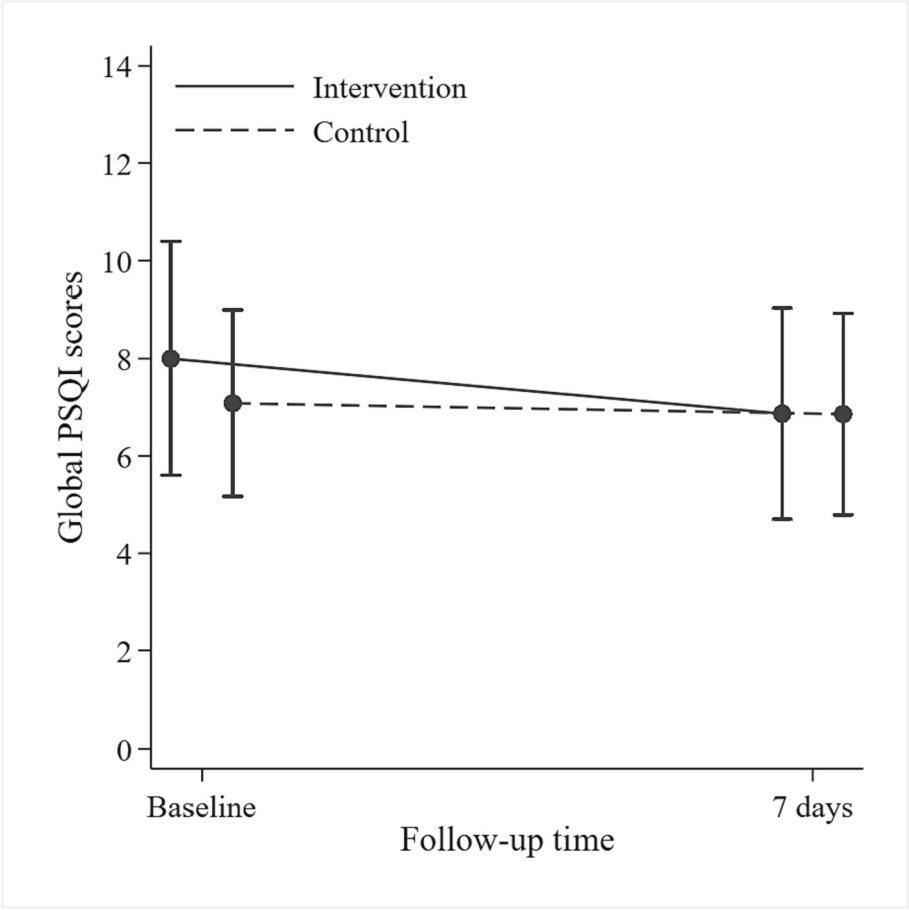

Fig. 5. Baseline and follow-up periods of Global PSQI for participants in the intervention and control group. Note. Error bars represent standard errors.

dormitory throughout the study intervention period. Lastly, as they were all quarantined, potential contamination bias was expected to be very low.

4.1. Limitations

There are limitations that need to be considered: 1) A significant proportion of the participants were women experiencing mild COVID-19 symptoms, potentially limiting the generalizability of our findings to all COVID-19 patients in different contexts. 2) Given the nature of our psychological intervention study, it was impossible to implement blinding for both therapists and participants, which may introduce some bias. 3) We did not conduct follow-up assessments using the PHQ-9 and PSQI questionnaires at the 4 and 12-week marks, which means that we were unable to investigate the long-term effects of OnPR on sleep during this extended period. 4) Participants in the intervention group had higher depression and stress scores; hence, this may give space for improvement for the intervention group.

4.2. Implication and future research

This research provides evidence for the efficacy of an online method of psychoeducation and relaxation methods in enhancing the psychological well-being of individuals with an acute infection. OnPR could potentially be applied to patients with anxiety, depression, stress, and sleep problems related to other acute medical conditions particularly those in isolation. Moreover, it can be remotely provided in the context of a shortage of mental health staff, such as in rural areas of Thailand.

Subsequent studies should delve into how well participants adhere to these techniques and their integration into patients' daily lives, particularly during the recovery phase of individuals who have had COVID-19. Furthermore, exploring the effects of group interventions, specifically focusing on the OnPR group, on mental health outcomes is crucial. This investigation should determine whether group interventions yield favourable results comparable to individual sessions, potentially benefiting more patients simultaneously while reducing the demand for human resources.

5. Conclusion

OnPR could improve mental health outcomes in depression, anxiety, stress and sleep quality. Additionally, the effect on depression, anxiety and stress lasted for at least a 12-week follow-up period. Furthermore, OnPR could enhance sleep quality after the intervention.

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Declaration of competing interest

The author reports no conflicts of interest in this work.

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