

Effectiveness of using calligraphic activity to treat people with schizophrenia: a randomized controlled trial in Southern Taiwan

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Abstract

Background: Prior research has shown preliminary evidence that calligraphy activity improves various body functions and decreases severity of psychotic symptoms in individuals with schizophrenia. However, major limitations of earlier studies include small and heterogeneous samples. The current large-scale randomized controlled trial examined effects of calligraphy activity on cognition (including attention), emotions, psychotic symptoms, quality of life, and mood in people with schizophrenia.

Methods: One-hundred-and-fifty patients with schizophrenia were randomly allocated to the treatment group (receiving calligraphy activity) or the control group (receiving general activity), both of which lasted for 24 weeks (70 minutes per session; one session per week). Assessments were conducted at pretest, posttest, and three-month follow-up. The Montreal Cognitive Assessment, Chu's Attention Test, Depression, Anxiety, and Stress Scale, Positive and Negative Syndrome Scale, World Health Questionnaire on the Quality of Life-Brief Form, and Visual Analogue Scale were used.

Results: Improved cognition and attention were found in both groups, although no group effects were shown. The treatment group appeared to show lower severity of positive symptoms at follow-up than posttest, whereas the control group appeared to show the opposite pattern. Improved mood was found in the treatment group.

Conclusion: This study provides evidence regarding effects of calligraphy activity on increasing cognition and potentially decreasing severity of positive symptoms in patients with schizophrenia. Calligraphy activity can be incorporated in clinical occupational therapy and may be provided to supplement medication treatment.

Trial Registration: ClinicalTrials.gov NCT03882619; <https://clinicaltrials.gov/ct2/show/NCT03882619>

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Introduction

Chinese calligraphic handwriting (Shufa (書法) in Mandarin; hereafter termed calligraphy activity) is defined as 'the writing of Chinese characters by hand using a soft-tipped brush' (p. 283).¹ Because

the calligraphy activity needs individuals' bodily functions (e.g. the movements of the wrist), executive functions (e.g. the images of shapes and procedures of the writing), and attention (e.g. the focus on the using materials for calligraphy

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activity), this activity involves integration of mind, body, and character within a process of dynamic graphonomy.²

Because of the aforementioned features of calligraphy activity, research on effects of calligraphy activity has been investigated across multiple populations, including patients with Alzheimer's disease or mild cognitive impairments,^{3,4} patients with nasopharyngeal carcinomas,⁵ and people experiencing stress in the general population.² Changes observed in the aforementioned studies include lessened psychological distress and improved cognition.

A recent systematic review and meta-analysis⁶ synthesized the current evidence on calligraphy activity and concluded that calligraphy effectively improved psychosis, emotions (i.e. depression, anxiety, and stress-related symptoms), and cognition. Although the systematic review reports positive effects of calligraphy activity, Chu *et al.* concluded that evidence for these improvements is insufficient given the following reasons.⁶ First, samples, which have ranged from 15 to 30 participants, of the randomized controlled trials (RCTs) are small. Second, information regarding calligraphy activity effects on quality of life (QoL) and neuropsychiatric symptoms has rarely been reported. Third, the populations studied are heterogeneous (six studies of students, one of children, two of older adults, one of people with mild cognitive impairments, three of people with anxiety or depression, one of cancer patients, and seven of people with schizophrenia). Thus, additional evidence from larger-scale RCTs is needed to examine the effects of calligraphy activity.

Calligraphy activity may be particularly helpful for people with schizophrenia. This population experiences psychosis, including positive and negative symptoms,⁷ and other health concerns, including cognitive impairments,^{8,9} low QoL,^{10,11} and emotional problems including depression, anxiety, and stress.¹² To build upon preliminary evidence of treatment effects of calligraphy activity for people with schizophrenia,⁶ additional evidence using rigorous methods and large samples is needed.

Three theoretical models have been proposed to explain the effects of calligraphy activity on symptom reduction. First, calligraphy activity can provide sensory feedback (i.e. receiving sensory

feedback when writing the graphic characteristics). Via sensory feedback, it is postulated that patients with schizophrenia may feel and focus on what they are writing, which subsequently may suppress their psychotic symptoms. Second, calligraphy activity also provides biomotional feedback (i.e. feeling the movements of one's body, especially in the arms and hands). Via the biomotional feedback, it is postulated that patients with schizophrenia may feel and focus on their movements, which also may subsequently suppress their psychotic symptoms. Third, calligraphy activity may additionally provide cognitive feedback (i.e. paying high levels of attention during the activity). Via cognitive feedback, it is postulated that patients with schizophrenia may attend preferentially to the calligraphy activity, thus suppressing their psychotic symptoms.^{2,13,14}

The present RCT aimed to investigate whether calligraphy activity is effective in improving emotions, cognition, psychotic symptomatology, QoL, and mood in a large sample of people with schizophrenia. Specifically, the present RCT recruited 150 participants, which is more than four-fold higher than in previous studies of calligraphy activity.⁶ Moreover, the recommended sample size for a pilot RCT is 70 participants (i.e. 35 in each arm),¹⁵ and our sample size is twice as large as recommended. We hypothesized that after receiving 24 weeks of calligraphy activity, people with schizophrenia would demonstrate improvements on measures of emotion, cognition, psychotic symptomatology, QoL, and mood.

Methods

Design, participants, and recruitment

A two-arm single-blind parallel-group RCT was launched to investigate effects of calligraphy activity and occupational therapy over a 6-month period. The group receiving calligraphy activity was defined as the calligraphy group; the group receiving occupational therapy or therapeutic groups provided by other professionals (e.g. nurses and psychologists) was defined as the treatment-as-usual (TAU) group. The study design is shown in the flow chart of the study design (Figure 1). Potential participants were invited after they were identified as eligible, and each signed a written informed consent form. Primary and secondary outcomes were assessed onsite at baseline, 6 months after baseline

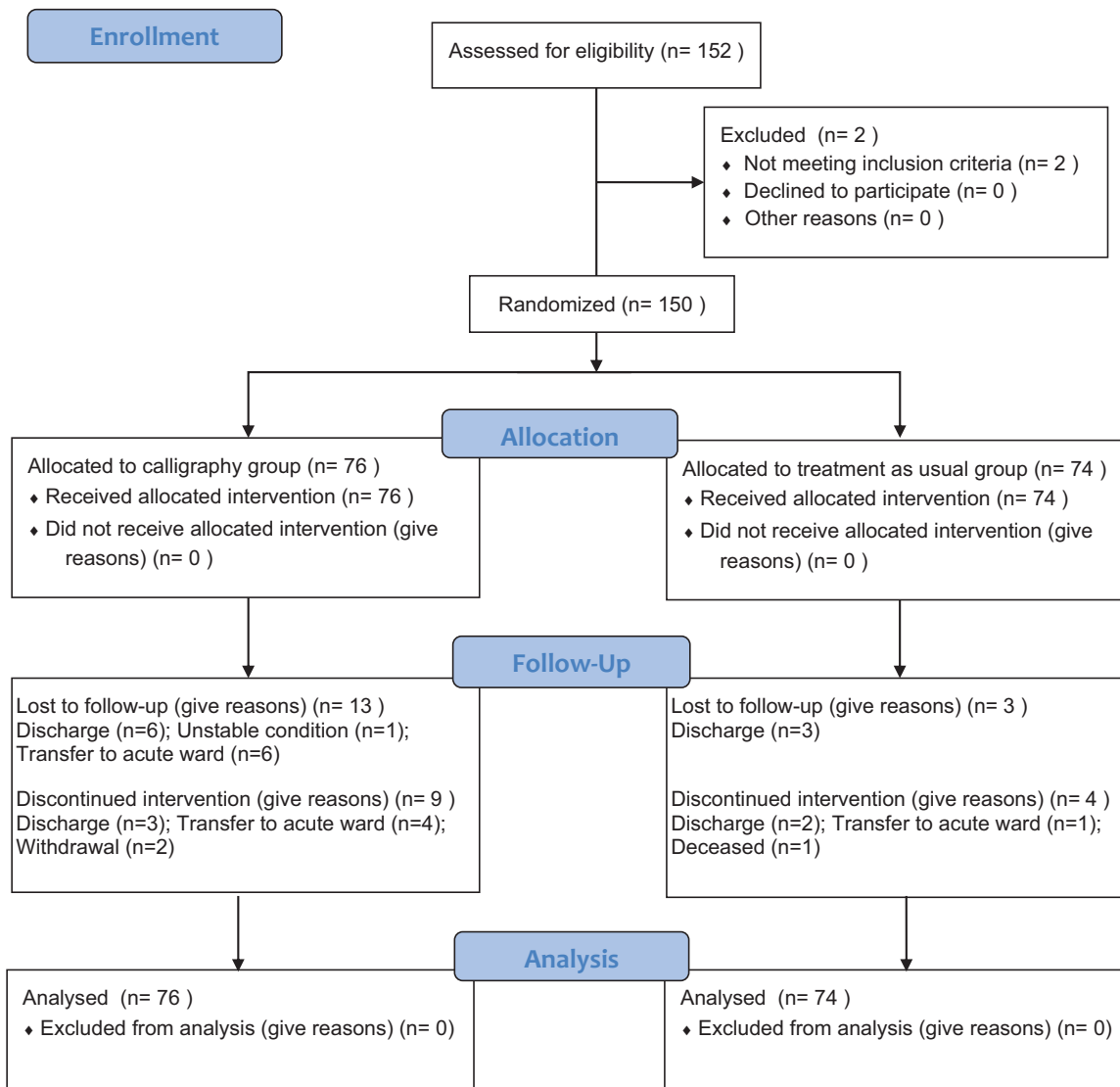


Figure 1. Study CONSORT flowchart.

(i.e. posttest), and 9 months after baseline (i.e. follow-up). The study period was between April 2019 and November 2020.

Figure 1 illustrates the process of the recruitment. The eligibility of the participants was first reviewed by the first author to ensure that they fulfilled the recruitment criteria. The first author thus screened 152 participants and ensured that 150 were eligible to participate. After invitation with clear explanations of the study purpose and participants' rights, all 150 eligible participants agreed to participate. Seventy-six individuals were randomly allocated into the calligraphy group and the other 74 into the TAU group. All

participants were inpatients in the Jianan Psychiatric Center, Ministry of Health and Welfare (MOHW), and all received calligraphy activity or TAU in a therapeutic room. During the intervention period, 13 participants were lost to follow-up (6 individuals were discharged from the Jianan Psychiatric Center, 1 had an unstable condition for assessment, and 6 were transferred to an acute ward) and 9 participants discontinued the intervention (3 were discharged, 4 were transferred to an acute ward, and 2 withdrew) from the calligraphy group. Regarding the TAU group, three were lost to follow up (all discharged) and four discontinued the intervention (two were discharged, one was transferred to an acute ward,

and one died). As a result, 64 participants remained in the calligraphy group and 67 in the TAU group. Data from all 150 participants were used for intention-to-treat (ITT) data analysis.

Ethics and dissemination

After the present study protocol was approved by the Institute of Review Board in the Jianan Psychiatric Center, MOHW with the IRB number of 19-0001, the protocol was registered with ClinicalTrials.gov (Identifier: NCT03882619; last updated January 2021). In accordance with principles of the Helsinki Declaration, this study was performed with expressed objectives, and ensured confidentiality and withdrawal rights to participants. Each participant provided written informed consent under the witness of a legal guardian to ensure willingness to participate in this study.

Inclusion criteria and exclusion criteria

The inclusion criteria of the eligible participants were (1) an inpatient in the Jianan Psychiatric Center, MOHW during the study period; (2) a diagnosis of schizophrenia (ICD-10-CM Codes of F20.0, F20.1, F20.2, F20.3, F20.89, and F20.9) or schizoaffective disorder (ICD-10-CM Codes of F25.0 and F25.9); (3) not being in an acute stage; and (4) voluntary participation after fully understanding the study purpose and participants' rights. The exclusion criteria were (1) having severe cognition problems identified by the medical record, (2) having a diagnosed intellectual disability, (3) having behavioral problems and psychotic symptoms (as identified by the occupational therapists) that prevented participation, and (4) blindness.

Sample size calculation

The sample size was estimated based on a previous systematic review on the effects of Chinese calligraphy therapy on neuropsychiatric symptoms.⁶ Chu *et al.* found the effects of Chinese calligraphy therapy ranged between small and large;⁶ therefore, we used a medium effect size (i.e. Cohen's $d=0.5$) to estimate the sample size. Using a two-tailed test with significance level at $p=0.05$ and 1:1 ratio between the two groups, a sample size of 128 (i.e. 64 per group) was estimated to have 80% power. We further estimated that 15% of invited participants might drop out or

decline; thus, the recommended sample size was 152 participants (i.e. 76 per group).

Randomization and allocation procedures

Using the Microsoft EXCEL program, a blinded statistician randomly assigned the recruited participants to a calligraphy or a TAU group at a 1:1 ratio. Specifically, the 'randbetween' function in the EXCEL program was used to define the participant to be in calligraphy or TAU groups. However, the calligraphy activity was obvious to participants and it was impossible to blind them from this condition. Some assessments were self-administered (e.g. emotions assessed using the Depression, Anxiety, and Stress Scale; please see *Measures* section for details) and raters (i.e. the participants) were unable to be blinded. However, for the rater-administered assessments (e.g. the Positive and Negative Syndrome Scale; please see *Measures* section for details), the raters were blinded. The blindness of the raters was sustained using the following precautions: (1) all participants were reminded by the first author, who was the intervention provider for calligraphy activity, not to reveal their treatments when they were assessed by a rater, (2) the first author was the only researcher in the study who knew the group allocation, and she did not disclose the information to any other research personnel involved in the present study until all the assessments were completed, and (3) the information regarding group allocation was stored electronically in an encrypted fashion.

Intervention of calligraphy and treatment as usual

Calligraphy group. The intervention in the calligraphy group (once per week for 24 weeks) was provided by the first author, an experienced occupational therapist with a master's degree who worked in the Jianan Psychiatric Center for more than 20 years. She designed the schedule of the calligraphy activity using the following components: (1) emotion detection (i.e. the participants observed his or her emotion; 3 min), (2) meditation (i.e. the participants used breathing techniques and listened to meditation music to mediate; 10 min), (3) calligraphy writing (i.e. the participants wrote positive terms such as peace and life using calligraphy; 45 min), (4) emotion detection (2 min), and (5) experience sharing (i.e. the participants shared their feelings and opinions with their group members regarding the first

three components; 10 min). Therefore, each session of calligraphy activity lasted 70 min. The calligraphy activity did not provide the skills of calligraphic handwriting; instead, the calligraphy activity taught the participants using ‘*stop, look, and write*’ to enjoy calligraphy. Specifically, *stop* is the *meditation* component mentioned above and indicates putting down all the current tasks (e.g. talking and walking) to meditate with breathing; *look* indicates looking at the special location on the paper sheet for the calligraphy writing; *write* indicates using the aligned position to write the characters, with reference to the copybook. When necessary, the first author provided positive feedback to the participants during the activity period. Moreover, participants were asked to do their calligraphy homework (nine Chinese characters on two pieces of paper) after each session of calligraphy activity.

TAU group. The intervention in the TAU group (once per week for 24 weeks; the same frequency and duration to the calligraphy group) was provided by different healthcare professionals (e.g. occupational therapists, nurses, and psychologists) working in the Jianan Psychiatric Center with work experiences ranging between 1 and 9 years. The TAU group participants engaged in different types of occupational therapy or therapeutic groups (e.g. leisure activities, physical exercise, and work training).

Measures

Aside from the primary and secondary outcomes mentioned below, all participants completed a background information questionnaire, including age, gender, years of education, age at illness onset, duration of illness, diagnosis, marital status, and work training. The background information questionnaire was completed at baseline only, and the primary and secondary outcomes were completed at baseline, posttest (6 months after baseline), and follow-up (9 months after baseline). All measures were completed in a therapeutic room under the supervision of an experienced occupational therapist. The rater-administered measures were assessed by qualified professionals (i.e. registered nurses and occupational therapists with proper training). Through the three assessment points, the Positive and Negative Syndrome Scale (PANSS) was evaluated by seven health professionals, including psychiatrists, occupational therapists, and nurse practitioners. All individuals making PANSS

assessments had received standardized training from a qualified psychiatrist and had over three years of working experience in a psychiatric setting. Moreover, the inter-rater reliability was satisfactory (intraclass correlation coefficient = 0.905 to 0.924). The Taiwanese version of the Montreal Cognitive Assessment (MoCA-T) was administered by six occupational therapists, each of whom had received standardized training in using the instrument. Both PANSS and MoCA-T measures were assessed individually; all of the other measures were administered in a group fashion with a ratio of 1:10 (i.e. one assessor with 10 participants). All raters were blinded from the group allocation; therefore, the same rater(s) assessed both the calligraphy activity and TAU groups. The defined daily dose (DDD) of antipsychotic drugs was calculated using the medical records for baseline, posttest, and follow-up. Specifically, using the ATC codes, we calculated the assumed average maintenance dose for each participant per day per his or her main indication (<https://www.who.int/tools/atc-ddd-toolkit/about-ddd>). Moreover, antipsychotic equivalence doses based on chlorpromazine equivalents were calculated.

Primary outcomes

Emotions. The self-administered Depression, Anxiety, and Stress Scale (DASS-21) contains 21 items, with each item rated as 0 (never), 1 (sometimes), 2 (often), and 3 (almost always). The 21 items were distributed into three different types of emotions: depression (7 items), anxiety (7 items), and stress (7 items). A higher score in each domain reflects worse levels of emotions; that is, more severe depression, anxiety, or stress.¹⁶ The Chinese DASS-21 had satisfactory psychometric properties, including internal consistency ($\alpha = 0.80$ to 0.92)¹⁷ and test-retest reliability over 3- to 6-month intervals ($r = 0.39$ to 0.46).¹⁷

Attention. The self-administered Chu’s Attention Test contains 100 items, with the symbol ‘*’ randomly distributed in some items. Participants were requested to cross out the ‘*’ symbols in ten minutes. Attention scores can be calculated in two ways: severity rate (SR) and error rate (ER). A higher score in attention SR and a lower score in attention ER indicate better attention.¹⁸ The Chu’s Attention Test has demonstrated satisfactory psychometric properties, including test-retest reliability (intraclass correlation coefficient (ICC)=0.95).¹⁹

Psychotic symptoms. The rater-administered Positive and Negative Syndrome Scale (PANSS) contains 30 items for a rater to evaluate the psychotic symptoms of a person with mental illness using a seven-point Likert-type scale. The 30 items were distributed into three different types of symptoms: positive symptoms (7 items), negative symptoms (7 items), and general symptoms (16 items). A higher score in each type of psychotic symptoms rated using the PANSS reflects a worse condition. The Chinese PANSS has demonstrated satisfactory psychometric properties, including interrater reliability (over 90% of items had ICC above 0.4).²⁰

Cognition. The rater-administered Montreal Cognitive Assessment (MoCA) uses 10 to 15 min to assess the following cognitive domains: visual spatial functions; executive functions; attention, concentration, and working memory; short-term memory recall; delayed memory recall in a 5-minute interval; language; and orientation to time and place.²¹ A higher score on the MoCA indicates better cognition.²² The Taiwan version of MoCA (MoCA-T) with proper cultural adaptation has demonstrated satisfactory psychometric properties, including internal consistency ($\alpha = 0.86$) and concurrent validity ($r = 0.91$ with the Mini-Mental State Examination).²³

Quality of life. The self-administered World Health Questionnaire on the Quality of Life, Brief Form (WHOQOL-BREF) contains 26 items with each item rated using a one- to five-point Likert-type scale. Two WHOQOL-BREF items assess general QoL (i.e. *How would you rate your quality of life* and *How satisfied are you with your health*), and the remaining 24 items are distributed into four different types of QoL: physical (7 items), psychological (6 items), social (3 items), and environment (8 items).²⁴ The Taiwan version of the WHOQOL-BREF additionally adds one local item to the social QoL (*Do you feel respected by others*) and another local item to the environment QoL (*Are you usually able to get the things you like to eat*).²⁵ After reverse coding three items in the WHOQOL-BREF, a higher converted score ranging between 4 and 20 in each type of QoL indicates better QoL.^{11,26} The Taiwan version of WHOQOL-BREF has demonstrated satisfactory psychometric properties, including internal consistency ($\alpha = 0.70$ to 0.91)²⁵ and test-retest reliability over a one-month interval (ICC = 0.81 to 0.88).¹¹

Secondary outcome

Mood status. A 10-point Visual Analogue Scale (VAS) was used to assess the mood of the participants in the calligraphy group. Mood status was not assessed in the TAU group. Forty-eight assessments of mood status in the calligraphy group were collected. That is, participants rated their mood twice per week during the 6-month intervention period (one assessment before they participated in each calligraphy activity and another assessment after they completed each activity). Given that the intervention was provided 24 times (i.e. once per week throughout six months), 24 assessments of mood were collected before participating in the calligraphy activity and another 24 assessments of mood were collected after completing the activity.

Data analysis

Following the Consolidated Standards of Reporting Trials (CONSORT) guidelines, we used the principle of ITT to address attrition. The first step in the data analysis used descriptive statistics to summarize participants' characteristics and their primary outcomes across three time-points (i.e. baseline, posttest, and follow-up). Moreover, McNemar-Bowker tests were used to compare the differences between pretest, posttest, and follow-up test for categorical variables; paired t-tests were used for continuous variables. The second step in the data analysis used several generalized estimation equations (GEEs) to evaluate the magnitudes of changes in primary outcomes over time across the two groups. Age, gender, years of education, age at illness onset, and DDD were controlled in each GEE model. The GEE model, a semiparametric statistical approach, is a powerful statistical tool that can evaluate group differences over time when there are unequal numbers of participants at baseline and follow-up. The GEE model used the inverse probability-weighted method to estimate missing data and thus satisfied ITT requirements.²⁷ The third step in the data analysis assessed simple effects of the two groups (i.e. calligraphy and TAU) whenever a significant interaction was identified in the GEE models. The last step of the data analysis used GEE to examine effects of calligraphy activity on mood status for the calligraphy group across the treatment period (i.e. the 24 weeks when the participants received the calligraphy activity). All inferential statistics adopted a two-sided test with p -values evaluated as statistically significant at the 0.05 level. All statistical analyses were

Table 1. Demographics of the groups receiving treatment as usual and calligraphy activity.

	M ± SD or n (%)		t or χ^2 (p-value)
	TAU group (n = 74)	Calligraphy group (n = 76)	
Age	46.59 ± 10.45	46.68 ± 9.35	0.06 (0.96)
Years of education	11.84 ± 3.47	10.93 ± 4.10	1.46 (0.15)
Age at illness onset	24.68 ± 7.72	24.87 ± 7.73	0.15 (0.88)
Duration of illness	22.39 ± 9.76	22.25 ± 8.8	0.09 (0.93)
Defined daily dose ^a (pretest)	1.57 ± 0.94	1.62 ± 0.96	0.38 (0.70)
Defined daily dose ^a (posttest)	1.54 ± 0.98	1.68 ± 0.94	0.91 (0.37)
Defined daily dose ^a (follow-up)	1.62 ± 1.02	1.64 ± 0.84	0.11 (0.92)
Antipsychotic equivalent doses ^b (pretest)	534.85 ± 359.85	604.24 ± 395.34	1.12 (0.26)
Antipsychotic equivalent doses ^b (posttest)	501.75 ± 355.55	627.00 ± 415.46	1.92 (0.06)
Antipsychotic equivalent doses ^b (follow-up)	506.33 ± 385.60	629.55 ± 438.78	1.67 (0.10)
Dosage and drug change (from pretest to posttest)			2.06 (0.36)
No change	51 (68.9)	46 (60.5)	
Dosage change	6 (8.1)	11 (14.5)	
Drug change	13 (17.6)	10 (13.2)	
Dosage and drug change (from posttest to follow-up)			0.87 (0.65)
No change	58 (78.4)	45 (59.2)	
Dosage change	5 (6.8)	6 (7.9)	
Drug change	4 (5.4)	5 (6.6)	
Gender (male)	53 (71.6)	48 (63.2)	1.22 (0.27)
Diagnosis (schizophrenia) ^c	72 (97.3)	72 (94.7)	0.15 (0.70)
Marital status (single) ^c	67 (90.5)	65 (85.5)	0.89 (0.35)
Work training (yes)	56 (75.7)	56 (73.7)	0.08 (0.78)

SD, standard deviation; TAU, treatment as usual.
^aThe antipsychotic drugs were considered using the defined daily dose.
^bUsing chlorpromazine equivalents with the unit of mg.
^cYate's correction.

performed using IBM SPSS version 20.0 (Armonk, NY: IBM Corp.).

Results

The two groups did not differ on demographics (Table 1) and baseline primary outcomes, except

for the measure of attention SR (Table 2). Specifically, the calligraphy group had significantly poorer attention SR at baseline (1.79 ± 0.96 vs 2.15 ± 1.02 ; $p = 0.03$). All primary outcomes were not significantly different between the two groups at posttest ($p = 0.13$ to 0.96) or follow-up ($p = 0.13$ to 0.89). Moreover, changes in

Table 2. Primary outcome measures in the two treatment groups at baseline, posttest, and follow-up.

Outcomes	Mean (SD)		t (p-value) ^a
	Calligraphy group (N=76)	TAU group (N=74)	
Baseline			
Depression	4.34 (4.20)	3.73 (4.45)	0.87 (0.39)
Anxiety	4.39 (3.80)	3.95 (4.11)	0.70 (0.49)
Stress	4.76 (4.11)	5.08 (5.03)	0.43 (0.67)
Cognition	22.47 (4.65)	23.38 (4.69)	1.19 (0.24)
Positive symptoms	13.63 (4.16)	13.85 (3.61)	0.35 (0.73)
Negative symptoms	17.05 (4.52)	16.69 (5.35)	0.45 (0.65)
General symptoms	30.70 (7.35)	30.55 (6.82)	0.12 (0.90)
Physical QoL	13.11 (2.41)	13.63 (2.48)	1.29 (0.20)
Psychological QoL	12.22 (2.72)	13.01 (3.10)	1.66 (0.10)
Social QoL	12.41 (3.01)	12.57 (2.92)	0.33 (0.74)
Environmental QoL	12.63 (3.03)	12.62 (2.84)	0.02 (0.99)
Attention ER	0.044 (0.117)	0.038 (0.107)	0.35 (0.73)
Attention SR	1.79 (0.96)	2.15 (1.02)	2.23 (0.03)
Posttest	N = 67	N = 70	
Depression	4.82 (4.36)	4.06 (4.57)	1.00 (0.32)
Anxiety	4.87 (4.34)	4.43 (4.44)	0.58 (0.56)
Stress	5.16 (4.13)	5.41 (5.17)	0.31 (0.76)
Cognition	22.97 (4.85)	24.04 (5.18)	1.25 (0.21)
Positive symptoms	15.02 (5.19)	14.14 (3.35)	1.16 (0.25)
Negative symptoms	17.50 (4.77)	17.26 (6.24)	0.26 (0.80)
General symptoms	32.68 (6.95)	31.34 (7.36)	1.09 (0.28)
Physical QoL	13.52 (2.78)	13.54 (2.37)	0.06 (0.96)
Psychological QoL	13.10 (3.15)	13.00 (2.96)	0.20 (0.84)
Social QoL	13.15 (3.68)	12.81 (2.95)	0.59 (0.56)
Environmental QoL	13.21 (3.47)	12.79 (2.82)	0.79 (0.43)
Attention ER	0.045 (0.081)	0.029 (0.041)	1.51 (0.13)
Attention SR	2.07 (1.15)	2.30 (1.16)	1.14 (0.26)
Follow-up	N = 54	N = 67	
Depression	3.65 (3.53)	2.81 (3.44)	1.32 (0.19)
Anxiety	3.63 (3.32)	3.28 (3.41)	0.56 (0.57)

(Continued)

Table 2. (Continued)

Outcomes	Mean (SD)		t (p-value) ^a
	Calligraphy group (N=76)	TAU group (N=74)	
Stress	4.17 (3.65)	4.03 (4.07)	0.19 (0.85)
Cognition	23.74 (5.06)	25.09 (4.60)	1.53 (0.13)
Positive symptoms	14.28 (4.41)	15.06 (3.97)	1.03 (0.31)
Negative symptoms	16.31 (4.63)	16.93 (5.10)	0.68 (0.50)
General symptoms	32.61 (6.23)	33.15 (6.73)	0.45 (0.65)
Physical QoL	13.79 (2.71)	13.49 (2.56)	0.62 (0.54)
Psychological QoL	13.19 (3.22)	13.06 (2.80)	0.24 (0.81)
Social QoL	12.65 (3.60)	12.57 (2.83)	0.14 (0.89)
Environmental QoL	13.09 (3.37)	12.92 (2.88)	0.30 (0.76)
Attention ER	0.049 (0.102)	0.034 (0.049)	1.09 (0.28)
Attention SR	2.28 (1.22)	2.48 (1.05)	0.97 (0.34)

ER, error rate; QoL, quality of life; SD, standard deviation; SR, severity rate; TAU, treatment as usual.
^aIndependent t-tests comparing the difference between the two groups.

pharmacological treatments are reported in Table 1. Specifically, most participants did not change their drugs or dosage during the study period (68.9% of the participants in the TAU and 60.5% of those in the calligraphy group did not change pharmacological treatments from pretest to posttest; 78.4% of the participants in the TAU and 59.2% of those in the calligraphy group did not change pharmacological treatments from posttest to follow-up; $p=0.36$ and 0.65).

The GEE models demonstrated that participants, regardless of calligraphy or TAU group assignment, showed: improved cognition (coefficient = 1.44; SE = 0.36; $p < 0.001$; 95% CI = 0.73, 2.15); worsening of positive symptoms (coefficient = 1.19; SE = 0.51; $p = 0.02$; 95% CI = 0.19, 2.19); worsening of general symptoms (coefficient = 2.52; SE = 0.77; $p = 0.001$; 95% CI = 1.01, 4.03); and improved attention SR (coefficient = 0.31; SE = 0.09; $p = 0.01$; 95% CI = 0.13, 0.49). A significant interaction in positive symptoms was observed in the GEE models ($p = 0.04$) (Table 3). This interaction appeared related to the calligraphy group having a trend-level improvement in positive symptomatology at follow-up when

compared to the positive symptomatology at posttest (coefficient = -1.02; SE = 0.54; $p = 0.06$). The TAU group demonstrated a trend-level worsening of positive symptomatology at follow-up when compared to the positive symptomatology at posttest (coefficient = 0.82; SE = 0.46; $p = 0.07$) (Figure 2).

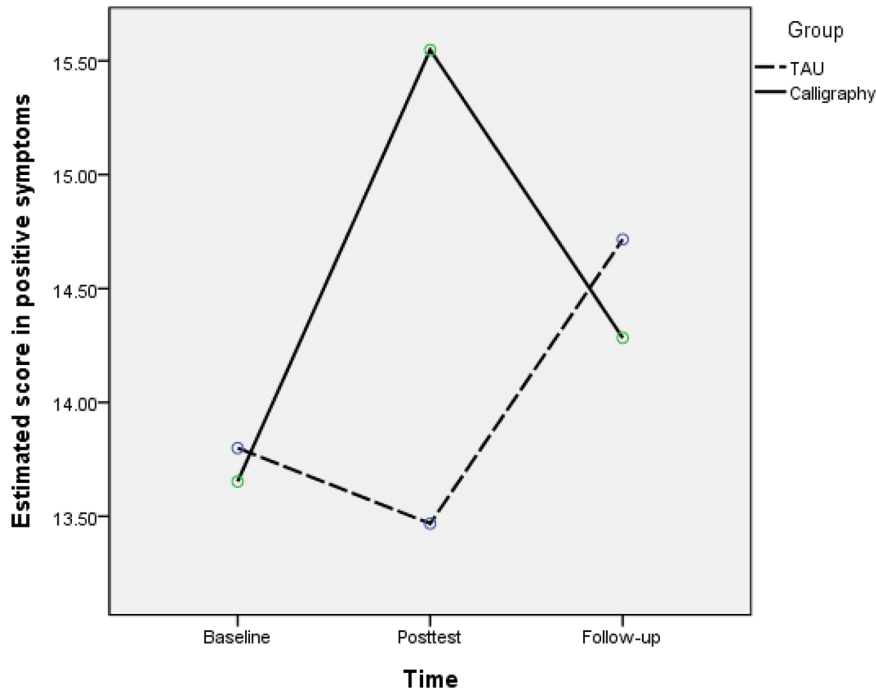
Participants had gradually improved mood after the 24-week period of calligraphy activity. Specifically, the improvement in mood before participating calligraphy activity for each session was 0.008 (SE = 0.004; $p = 0.0497$; 95% CI = 0.0002, 0.016); improvement in mood after completing calligraphy activity for each session was 0.015 (SE = 0.004; $p < 0.001$; 95% CI = 0.01, 0.02) during the 24 weeks of calligraphy activity (Figure 3).

Because the current study period overlapped with the COVID-19 pandemic, we have performed subsequent analyses; that is, we separated the participants' data and reanalyzed data from those who completed the calligraphy activity or TAU before the COVID-19 outbreak ($n = 79$). The results showed that the GEE model suggested a trend improvement in emotional concerns at

Table 3. Comparing primary outcomes between the two treatment groups at baseline, posttest, and follow-up using generalized estimating equations.

Outcomes	B (SEI)/ p-value (95% CI)			Wald χ^2 (p-value)
	Calligraphy (Ref: TAU)	Posttest (Ref: baseline)	Follow-up (Ref: baseline)	
Depression	0.66 (0.70)/ 0.34 (-0.71, 2.03)	0.36 (0.66)/ 0.59 (-0.93, 1.65)	-0.90 (0.57)/ 0.12 (-2.02, 0.22)	0.36 (0.84)
Anxiety	0.41 (0.61)/ 0.50 (-0.79, 1.61)	0.60 (0.55)/ 0.28 (-0.48, 1.68)	-0.60 (0.50)/ 0.28 (-1.58, 0.38)	0.04 (0.98)
Stress	-0.31 (0.73)/ 0.67 (-1.74, 1.12)	0.48 (0.72)/ 0.51 (-0.93, 1.89)	-0.98 (0.59)/ 0.10 (-2.14, 0.18)	0.79 (0.68)
Cognition	-0.49 (0.70)/ 0.49 (-1.86, 0.88)	0.62 (0.38)/ 0.10 (-0.12, 1.36)	1.44 (0.36)/ < 0.001 (0.73, 2.15)	0.09 (0.95)
Positive symptoms	-0.27 (0.63)/ 0.67 (-1.50, 0.96)	0.34 (0.46)/ 0.46 (-0.56, 1.24)	1.19 (0.51)/ 0.02 (0.19, 2.19)	6.68 (0.04)
Negative symptoms	0.22 (0.79)/ 0.78 (-1.33, 1.77)	0.47 (0.56)/ 0.40 (-0.63, 1.57)	0.23 (0.44)/ 0.60 (-0.63, 1.09)	2.86 (0.24)
General symptoms	-0.40 (1.10)/ 0.97 (-2.56, 1.76)	0.88 (0.82)/ 0.28 (-0.73, 2.49)	2.52 (0.77)/ 0.001 (1.01, 4.03)	2.63 (0.27)
Physical QoL	-0.48 (0.39)/ 0.22 (-1.24, 0.28)	-0.10 (0.26)/ 0.71 (-0.61, 0.41)	-0.15 (0.29)/ 0.60 (-0.72, 0.42)	2.57 (0.28)
Psychological QoL	-0.74 (0.47)/ 0.12 (-1.66, 0.18)	-0.03 (0.32)/ 0.93 (-0.60, 0.66)	-0.03 (0.33)/ 0.92 (-0.68, 0.62)	3.53 (0.17)
Social QoL	-0.25 (0.48)/ 0.60 (-1.19, 0.69)	0.26 (0.37)/ 0.48 (-0.47, 0.99)	0.07 (0.30)/ 0.81 (-0.52, 0.66)	0.97 (0.62)
Environmental QoL	0.04 (0.47)/ 0.94 (-0.88, 0.96)	0.22 (0.31)/ 0.47 (-0.39, 0.83)	0.33 (0.30)/ 0.27 (-0.26, 0.92)	0.86 (0.65)
Attention ER	0.003 (0.017)/ 0.88 (-0.0003, 0.0063)	-0.010 (0.013)/ 0.45 (-0.04, 0.02)	-0.004 (0.011)/ 0.71 (-0.03, 0.02)	0.39 (0.82)
Attention SR	-0.29 (0.15)/ 0.054 (-0.58, 0.004)	0.16 (0.09)/ 0.08 (-0.02, 0.34)	0.31 (0.09)/ 0.001 (0.13, 0.49)	0.89 (0.64)

CI, confidence interval; ER, error rate; QoL, quality of life; SE, standard error; SR, severity rate; TAU, treatment as usual.
 Note: Age, gender, years in education, onset age, and defined daily dose were controlled in the models.
 Significant findings are presented in **bold**.



	B (SE)/ p-value		
	Baseline vs. Posttest	Baseline vs. Follow-up	Posttest vs. Follow-up
Calligraphy group	1.46 (0.52)/ 0.005	0.45 (0.49)/ 0.36	-1.02 (0.54)/ 0.06
TAU group	0.34 (0.46)/ 0.46	1.16 (0.51)/ 0.02	0.82 (0.46)/ 0.07

Age, gender, years in education, onset age, and defined daily dose were controlled in the simple models.

Figure 2. Simple effects of calligraphy on positive symptoms. TAU, treatment as usual.

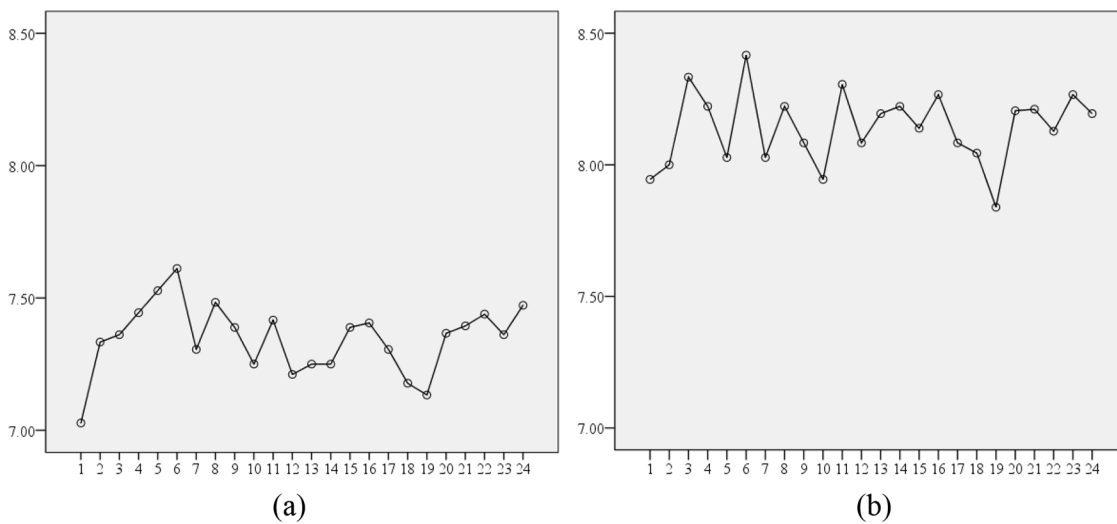


Figure 3. Improvement in mood in the calligraphy group during the 24 weeks of calligraphy activity. (a) Before participating in the calligraphy activity. (b) After completing the calligraphy activity. X-axis is the intervention period by week; Y-axis is the mood Visual Analogue Scale (scaling from 1 to 10).

follow-up compared with baseline measures: coefficient = -1.583 ($p=0.078$) for depression, coefficient = -1.219 ($p=0.097$) for anxiety, and coefficient = -1.944 ($p=0.030$). However, improvement effects were similar between calligraphy activity and TAU.

Discussion

The present findings indicate that calligraphy activity had some positive effects as a treatment for people with schizophrenia. Specifically, our findings indicate that people with schizophrenia demonstrated improved cognition and attention after receiving the calligraphy activity, although these improvements did not outperform occupational therapy. Moreover, a significant interaction effect suggested that remissions in positive symptoms from posttest to follow-up were observed among people with schizophrenia who received calligraphy activity but not among those who received occupational therapy. However, as the significant interaction appeared driven by two within-group findings that approached statistical significance, the magnitude of the effect may not be particularly robust. Improvements in mood were also observed among those who received calligraphy activity. Therefore, our hypotheses that calligraphy activity would improve cognition, psychiatric symptoms, and mood were at least partially supported by the RCT findings. However, our hypotheses that calligraphy activity would improve emotions and QoL were not supported by the findings.

The effects of calligraphy activity on cognition and attention found in the present study echo the findings from prior RCT investigations of older adults with Alzheimer's disease or mild cognitive impairments.^{3,4} Chan *et al.*³ found that calligraphy activity significantly improved participants' attention and working memory; Kwok *et al.*⁴ found that calligraphy activity significantly improved participants' general cognition. Moreover, the effects of calligraphy activity on cognition and attention are consistent with prior research on people with schizophrenia as systematically reviewed and meta-analyzed by Chu *et al.*⁶ The positive effects of calligraphy activity on cognition and attention may further explain the study findings that indicated the effects of calligraphy activity on self-efficacy and social functioning among people with schizophrenia.²⁸ However, the effects of calligraphy activity did not outperform occupational

therapy, the intervention received by the TAU group in the present study.

Both groups were found to have worse psychotic symptoms in the follow-up assessments. A possible reason is the nature of degenerative processes in brain structures of people with schizophrenia.²⁹ Speculatively, due to degenerative processes, their psychotic symptoms may have worsened at follow-up. However, worsening symptoms may be slowed with proper interventions. Indeed, the present findings suggest that calligraphy activity may have effects on positive psychotic symptomatology at follow-up. Thus, our findings resonate with findings from Chu *et al.*⁶ that calligraphy activity may relieve neuropsychiatric symptoms. However, observed effects were solely for positive and not negative or general symptomatology. The possible reasons for relieving neuropsychiatric symptoms may involve sensory, biomotional, and/or cognitive feedback provided by the calligraphy activity for people with schizophrenia. Practicing calligraphy activity may shift attention in people with schizophrenia from their symptoms to sensory, biomotional, and cognitive experiences.^{2,13,14} In turn, they may experience symptom suppression and relief. However, future studies are needed to further explore why effects may be most pronounced for positive symptomatology.

Moreover, one should note that the calligraphy activity provided in the present RCT was delivered by an occupational therapist. The occupational therapist designed the calligraphy activity through the lens of occupational therapy and the cultural significance of integration of activity analysis for calligraphy activity. For example, the eye-hand coordination and cognitive improvement components have been analyzed with respect to calligraphy activity when occupational therapists have used calligraphy activities as a treatment. In other words, the calligraphy activity used in the present study was influenced by the tenets of occupational therapy (i.e. using occupations to increase the engagement of daily activities and achieve the outcomes of health improvement),³⁰ which is different from using calligraphy activity for mere recreation. Therefore, researchers who want to use calligraphy activity as a treatment should understand differences between using calligraphy activity therapeutically, as in the present study, versus recreationally.

We found that calligraphy activity did not improve emotions and QoL among people with

schizophrenia, which is not in line with prior findings suggesting an effectiveness of calligraphy activity in targeting emotional concerns in other groups. Specifically, calligraphy activity has been reported to reduce stress in individuals from the general population² and reduce anxiety among patients with nasopharyngeal carcinomas.⁵ There exist several possible explanations for the seemingly inconsistent findings. First, part of the current study period overlapped with the COVID-19 pandemic. Given that COVID-19 pandemic increased psychological distress across different populations, including people with schizophrenia,³¹⁻⁴¹ the nonsignificant findings on emotions in the present study may relate in part to the COVID-19 pandemic. Indeed, our GEE model suggested a trend improvement in emotional concerns at follow-up compared with baseline measures, although improvement effects were similar between groups receiving the calligraphy activity and TAU. Nevertheless, the COVID-19 pandemic served as an important confounder in this RCT study. Second, floor effects on emotional concerns and QoL may have been operating at the beginning of the study. Specifically, the average scores of the DASS-21 and WHOQOL-BREF at baseline indicate emotional concerns and QoL were comparable to those in general populations.^{11,16,42}

The results of this study have noteworthy clinical implications. First, clinical occupational therapists may use calligraphy activity to help address cognitive and attentional impairments in patients with schizophrenia, and benefits achieved may help improving patients' occupational performance, although this speculative possibility warrants direct testing. Second, the use of calligraphy activity may be considered in clinical practice when the therapeutic goal is to improve the mood of patients with schizophrenia. Third, considering potential effects of calligraphy activity on decreasing severity of positive symptoms in patients with schizophrenia, therapy involving calligraphy activity may serve to augment medication treatment.

Study limitations warrant mention. First, the study period overlapped with the COVID-19 pandemic; therefore, the potential impacts of the pandemic cannot be controlled in the present study. More specifically, the effects of the pandemic on psychological health have been widely documented.³¹⁻⁴¹ Therefore, it is possible that the nonsignificant findings in improvement in emotional concerns are

confounded by the impacts of the pandemic. Indeed, our RCT showed a trend of improvement in emotional concerns among participants who received calligraphy activity and completed assessments before the COVID-19 outbreak. Second, both calligraphy activity and TAU were provided by occupational therapists. Therefore, the similar effects found between calligraphy activity and TAU may reflect both interventions (either calligraphy group or TAU) having been provided by healthcare professionals having received similar training. Subsequently, effects of calligraphy activity may not be as robust when the facilitator was more familiar with occupational therapy rather than calligraphy. Third, some assessments (e.g. PANSS) were not uniformly performed by psychiatrists, potentially introducing bias. Fourth, all participants were inpatients of the Jianan Psychiatric Center in Taiwan. Therefore, the generalizability of the present findings may be limited. Following this limitation, the present sample had relatively mild mental health problems reflected in baseline DASS-21 and WHOQOL-BREF scores. Therefore, our findings might not generalize to people with schizophrenia who have more severe mental health concerns. Future studies involving participants from other regions and across different severity levels of mental health problems are thus needed to enhance our understanding of the potential therapeutic effects of calligraphy activity. Finally, although our results indicate the improvement of mood status after completing each calligraphy activity session, the improvements were not compared with the TAU group because the TAU group did not receive assessments of mood status. Therefore, mood status improvement resulting from calligraphy activity should be examined further in future studies.

Conclusion

The present RCT recruited a large sample of people with schizophrenia to examine the effects of calligraphy activity. Specifically, we examined whether calligraphy activity could effectively improve emotions (including depression, anxiety, and stress), cognition (including attention), psychotic symptomatology, QoL, and mood in people with schizophrenia. In sum, calligraphy activity was associated with improved attention and cognition in people with schizophrenia. However, such effects were similar to those of occupational therapy (TAU). Although participants in the calligraphy group demonstrated increased psychotic

symptoms at the posttest and follow-up assessments, their positive symptoms increased less at the follow-up assessment than in those who received TAU. Therefore, we tentatively conclude that calligraphy activity as compared with traditional occupational therapy mitigated against worsening of psychotic symptoms in people with schizophrenia. Given that part of the present study was conducted during the COVID-19 outbreak, the outcome measures, especially those assessing mental health (e.g. emotional concerns), were likely influenced by the COVID-19 pandemic. Future studies are thus needed to further evaluate the effects of calligraphy activity when the impacts of COVID-19 on mental health are less.

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Author contributions

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Chih-Heng Cheng: Data curation; Investigation; Writing – review & editing.

Chih-Yin Chen: Data curation; Investigation; Writing – review & editing.

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Conflict of interest statement

All the authors declare that there is no conflict of interest. Dr. Potenza has consulted for Opiant Therapeutics, Game Day Data, the Addiction Policy Forum, Opiant, AXA and Idorsia Pharmaceuticals; has received research support from Mohegan Sun Casino, the Connecticut Council on Problem Gambling and the National Center for Responsible Gaming; has participated in surveys, mailings or telephone consultations related to drug addiction, impulse-control disorders or other health topics; has consulted for and/or advised gambling and legal entities on issues related to impulse-control/addictive disorders; has provided clinical care in a problem gambling services program; has performed grant reviews for research-funding agencies; has edited journals and journal sections; has given academic lectures in grand rounds, CME events and other clinical or scientific venues; and has generated books or book chapters for publishers of mental health texts. The other authors report no disclosures.

Ethics statement

The research proposal was approved by the Institute of Review Board in the Jianan Psychiatric Center, Ministry of Health and Welfare (IRB ref: 19-0001). Before data collection, all ethical considerations including description of the study, privacy and confidentiality of data, anonymity, and freedom of participation (or withdrawal) were fully explained. In addition, all participants signed written informed consent. The protocol has been registered with ClinicalTrials.gov (Identifier: NCT03882619; last updated January 2021).

Informed consent

Written informed consent was obtained from all individual participants included in the study.

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Supplemental material

Supplemental material for this article is available online.

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