Does Chinese calligraphy therapy reduce neuropsychiatric symptoms: a systematic review and meta-analysis

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Abstract

Background: There are currently no systematic reviews or meta-analyses of Chinese calligraphy therapy (CCT) to reduce neuropsychiatric symptoms. The aim of this systematic review and meta-analysis was to explore the efficacy of CCT for people with neuropsychiatric symptoms.

Methods: We searched Chinese and English databases, including the Cochrane Central Register of Controlled Trials and Wanfang Data for relevant articles published between the earliest year available and December 2016. The search was limited to randomized controlled trials and controlled clinical studies and the associated keywords were “handwriting,” “Chinese calligraphy,” “Chinese calligraphy therapy,” “Calligraphy exercise,” and “Calligraphy training.” The 21 articles that met these criteria were used in the analysis. The Joanna Briggs Institute critical appraisal checklist was used to assess methodological quality.

Results: CCT significantly reduced psychosis (10 studies, 965 subjects, standardized mean difference [SMD] = −0.17, 95% confidence intervals [CI] [−0.30, −0.40], Z = 2.60, p < 0.01), anxiety symptoms (9 studies, 579 subjects, SMD = −0.78, 95% CI [−0.95, −0.61], Z = 8.98, p < 0.001), and depressive symptoms (7 studies, 456 subjects, SMD = −0.69, 95% CI [−0.88, −0.50], Z = 7.11, p < 0.001). CCT also significantly improved cognitive function (2 studies, 55 subjects, MD = 2.17, 95% CI [−0.03, 4.38], Z = 1.93, p = 0.05) and neurofeedback (3 studies, 148 subjects, SMD = −1.09, 95% CI [−1.44, −0.73], Z = 6.01, p < 0.001). The therapy also significantly reduced the positive psychopathological expression of schizophrenia symptoms (4 studies, 287 subjects, SMD = −0.35, 95% CI [−0.59, −0.12], Z = 2.96, p = 0.003) and reduced the negative symptoms of schizophrenia (4 studies, 276 subjects, SMD = −1.39, 95% CI [−1.65, −1.12], Z = 10.23, p < 0.001).

Conclusions: CCT exerts a curative effect on neuropsychiatric symptoms, but the evidence remains insufficient. A large number of RCTs are needed to facilitate additional systematic reviews of evidence for CCT.

Keywords: Chinese calligraphy, Art therapy, Psychiatric disorders

Background

The term psychosis refers to a serious psychological disorder characterized by obvious and long-lasting abnormalities in understanding, emotion, cognition, behavior, and other psychological activities. Psychoses such as schizophrenia often involve cognitive impairment and comorbid anxiety and depression [1]. Pharmacological therapy often has a limited effect or produces side effects [2, 3]. Non-pharmacological therapies (such as psychotherapy, occupational therapy, and art therapy) for patients with psychiatric disorders are useful, adaptable, and potentially cost-effective approaches to improve outcomes and quality of life [4].

Chinese calligraphy therapy (CCT) is a branch of art therapy that involves visual–spatial patterning of characters. This type of calligraphy is more than an art therapy; in essence, it involves culture, health, behaviour treatment and rehabilitation. The art nature is only one of its varied roles and functions. It necessitates exercising motor control of the brush to follow...
specific character configurations based on a projection of the cognitive images of the characters [5]. CCT requires the use of a soft-tipped brush to reproduce Chinese glyphs. It combines physical, mental, and personal processes and integrates visual performance, spatial abilities, and cognitive planning [6].

Recent empirical studies have shown that the practice of calligraphy may improve behavioral and psychosomatic disorders and may have a therapeutic effect on attention and emotional stability [7]. CCT has been scientifically investigated within the contexts of psychology, cognitive science, and cognitive neuroscience, and the findings suggest that it can reduce neuropsychiatric symptoms [8].

There have been many systematic reviews of other art therapies, such as painting therapy, music therapy, and gardening therapy. However, there are no systematic reviews or meta-analyses of CCT’s effect in reducing neuropsychiatric symptoms. Thus, the aim of this systematic review and meta-analysis was to explore the efficacy of CCT for people with neuropsychiatric symptoms.

**Methods**

**Search strategy**

A systematic search for articles was made in December 2016 using the databases MEDLINE, EMBASE, PsycINFO, Cochrane Central Register of Controlled Trials, and Wanfang Data. We searched for keywords and/or controlled vocabulary, such as medical subject headings and Emtree terms. Keywords were “handwriting,” “Chinese calligraphy,” “Chinese calligraphy therapy,” “Calligraphy exercise,” and “Calligraphy training.”

**Study selection**

We included in the analysis studies that met the following criteria: (1) randomized controlled trial (RCT), cohort study, or case-control study, (2) published in Chinese or English, (3) subjects were either healthy or psychiatric patients, (4) experimental group intervention measures for Chinese calligraphy; the control group intervention could be general care, health education, or no care, and (5) measurement of physiological or mental indicators. The exclusion criteria were as follows: (1) not relevant to Chinese calligraphy/calligraphy therapy, (2) commentary, case report, or a review article, (3) experimental interventions other than calligraphy treatment, (4) and lack of a control group and/or overlapping populations.

**Quality assessment**

We used the guideline suggested by Queen’s Joanna Briggs Collaboration critical appraisal checklist, Version 4.0 [9]. This scale contains 10 appraisal criteria that assess whether the assignment to treatment groups was truly random, participants were blinded to treatment allocation, allocation to treatment groups was concealed from the allocator, the outcomes of people who withdrew were described and included in the analysis, those assessing the outcomes were blind to the treatment allocation, the control and treatment groups were comparable at entry, the groups were treated identically other than for the named interventions, the outcomes were

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**Fig. 1 Flow diagram of study selection**
| Study        | Inclusion criteria                | No. of patients | Treatment duration | Ages (yrs) (mean ± SD) | Main measurement scale | Intervention          |
|-------------|-----------------------------------|-----------------|-------------------|------------------------|------------------------|-----------------------|
| Luo 2000 [14] | Military college students          | P: 31 C: 24     | 30 days           | 23.9                   | SCL-90                 | Calligraphy           |
| Cui 2003 [11] | Senior college students            | P: 60 C: 40     | 1 year            | P: 65.4 ± 5.25 C: 64.8 ± 8.46 | SCL-90                 | Calligraphy and painting |
| Zhou B 2005 [15] | Grade 3 elementary school students | P: 87 C: 37 | 2 years           | –                      | CPQ                    | Calligraphy           |
| Zhou GQ 2005 [16] | Patients with schizophrenia       | P: 15 C: 21     | 20 weeks          | P: 49.67 ± 6.9 C: 53.33 ± 6.64 | PANSS TESS              | Calligraphy           |
| Dong 2006 [17]  | Patients with anxiety              | P: 28 C: 27     | 8 weeks           | P: 32.4 ± 7.8 C: 30.5 ± 8.6 | HAMA SAS CGI           | Calligraphy           |
| Zhao 2006 [18] | Patients with chronic schizophrenia | P: 48 C: 50    | 8 weeks           | P: 25 ± 8.6 C: 24 ± 7.8 | SCL-90                 | Calligraphy           |
| Guo 2007 [19] | Schizophrenic inpatients           | P: 30 C: 30     | 2 months          | P: 31.3 ± 11.6 C: 32.3 ± 11.7 | SAS SDS                 | Music, calligraphy, painting, and dancing |
| Zeng 2007 [20] | Patients with generalized anxiety  | P: 34 C: 34     | 8 weeks           | P: 32.49 ± 8.2 C: 33.2 ± 8.3 | HAMA SAS                | Calligraphy           |
| Zheng 2008 [21] | Patients with depression           | P: 31 C: 30     | 6 weeks           | P: 375 ± 125 C: 36.6 ± 12.8 | HAMA HAMD              | Calligraphy           |
| Li 2010 [22]  | Schizophrenic inpatients           | P: 30 C: 30     | 8 weeks           | P: 32.6 ± 11.3 C: 32.1 ± 11.2 | BPRS SANS              | Calligraphy and painting |
| Yang 2010 [12] | NPC patients                       | P: 24 C: 29     | 4 weeks           | 4963 ± 10.81           | SDS POMS SF           | Three groups: relaxation, calligraphy, and control |
| Zhou 2010 [23] | Schizophrenic inpatients           | P: 30 C: 30     | 3 months          | 4038 ± 11.20           | BPRS SANS              | Calligraphy and painting |
| Kwok 2011 [13] | Older people with MCI             | P: 14 C: 17     | 8 weeks           | P: 85.79 ± 4.93 C: 85.76 ± 6.93 | CMMSE                  | Calligraphy           |
| Tian 2012 [24] | Patients with chronic schizophrenia | P: 60 C: 60   | 6 months          | 3621 ± 2.54           | BPRS                   | Occupational therapy, fine art, and calligraphy |
| Zhang 2012 [25] | Schizophrenic inpatients           | P: 30 C: 30     | 12 months         | –                      | PANSS                  | Calligraphy and painting |
| Dong 2013 [26] | Patients with chronic schizophrenia | P: 35 C: 34    | 12 weeks          | P: 32 ± 7 C: 31 ± 9   | SCL-90 PANSS           | Calligraphy and painting |
| Xu 2013 [27]  | Undergraduate students             | P: 8 C: 8       | 10 days           | –                      | EEG-theta waves       | Calligraphy           |
| Zhou 2013 [28] | Grade 3 to 4 elementary school students | P: 101 C: 69  | 2 school years    | P: 8.60 ± 0.55 C: 8.59 ± 0.41 | PANAC-c CERO-k | Calligraphy |
| Zhu 2014 [29] | Children with hyperarousal symptoms | P: 64 C: 38 C: 129 | 30 days           | P: 105.2 ± 1.16 C: 105.4 ± 1.15 | Salivary cortisol level | Calligraphy |
| Chu et al. BMC Psychiatry (2018) 18:62 |                          |                |                   |                        |                       |                      |
| Study       | Inclusion criteria          | No. of patients | Treatment duration | Ages (yrs) (mean ± SD) | Main measurement scale          | Intervention                          |
|------------|----------------------------|----------------|--------------------|------------------------|----------------------------------|---------------------------------------|
| Tai 2016 [8] | Patients with AD         | P: 14          | 6 weeks           | P: 70.21 ± 7.9         | CDR-SB                           | Tai-chi, calligraphy, and drawing     |
|            |                            | C: 10          |                   | C: 76.3 ± 7.03         | TC MMSE, GDS-S                    |                                       |
| Chan 2016 [30] | Individuals with MCI  | P: 14          | 8 weeks           | P: 65.9 ± 5.0          | Reaction time on the Chinese and  | Calligraphy                           |
|            |                            | C: 16          |                   | C: 66.4 ± 3.65         | digit 2-back and detection tasks |                                       |

Abbreviations: SCL-90 Symptom Checklist 90, CPQ Children’s Personality Questionnaire, PANSS Positive and Negative Symptom Scale, TESS Treatment Emergent Symptom Scale, HAMA Hamilton Anxiety Scale, SAS Self-Rating Anxiety Scale, CGI Clinical Global Impression Scale, SDS Symptom Distress Scale, HAMD Hamilton Depression Rating Scale, POMS SF Profile of Mood State - Short Form, BPRS The Brief Psychiatric Rating Scale, SANS Scale for the Assessment of Negative Symptoms, CMMSE Chinese version of the Mini-Mental State Examination, EEG electroencephalogram, PANAC-c Positive and Negative Affect Scale for Children, CERO-k Child version of the Cognitive Emotion Regulation Questionnaire, CRIES Children’s Revised Impact of Event Scale, CDR-SB Clinical Dementia Rating Sum of Boxes, TC MMSE Traditional Chinese version of the Mini-Mental State Examination, GDS-S Geriatric Depression Scale, SD standard deviation, NPC nasopharyngeal carcinoma, AD Alzheimer’s disease, MCI mild cognitive impairment, P patient or experiment, C control, *p < 0.05, **p < 0.01
measured in the same way for all groups, the outcomes were measured in a reliable way, and the statistical analysis was appropriate. Two researchers extracted information and screened the quality of the articles independently. A third researcher was used to determine the quality of the studies in cases where it was difficult to reach a consensus.

Data analysis

Meta-analysis was performed using RevMan 5.3 software (Review Manager (RevMan) [Computer program]. Version 5.3. Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014.). The mean and standard deviation of each group was calculated to determine the overall effect of the intervention. Chi-square was used to determine heterogeneity. In addition, I² values were calculated to test the heterogeneity among the studies. When I² was < 50%, a fixed-effects model was used to determine the homogeneity among studies [10]. However, if there were differences between the studies (such as study location, population, and intervention program), a random-effects model analysis was used to avoid underestimation of treatment variability. Odds ratios and mean differences were used to compare different measurement indexes, to obtain standardized mean differences (SMD), and to estimate the combined effect level. Based on the different psychiatric symptoms and diseases included in the studies, we divided the meta-analysis into six groups: group 1: psychosis, group 2: anxiety, group 3: depression, group 4: cognition, group 5: neurofeedback, and group 6: schizophrenia.

Results

Characteristics of the studies

Figure 1 shows the process of study selection. Our initial search strategy yielded 299 citations, 233 of which were ineligible based on our screening of titles and abstracts. Thus, we retrieved the full text of 66 studies. Of these, 24 were excluded because they were commentaries; 4 were case reports; 8 lacked a control group; 6 had study populations that overlapped with other included studies; and 3 did not meet the eligibility criteria because they were not intervention studies. Consequently, 21 eligible studies were analyzed.

Table 1 shows study characteristics and patient demographic data from each of the 21 studies included in the review. These studies were published between 2000 and 2016, and had sample sizes ranging from 16 to 224. Ten studies measured psychosis or general psychosis (the meta-analysis results and forest...
Nine studies on anxiety were analyzed; one study was removed [11] because the sensitivity analysis indicated large heterogeneity (Fig. 3). Seven studies on depression were analyzed (Fig. 4). Two studies on cognitive impairment were analyzed (Fig. 5) and three studies on neurofeedback were analyzed (Fig. 6).

Eight studies evaluated patients with schizophrenia, of which four measured positive psychopathology of schizophrenia and four measured negative syndromes of schizophrenia (see Figs. 7 and 8).

Table 2 shows the methodological quality of the 21 included studies. Two studies clearly documented the use of random allocation [12, 13]. The remaining quality criteria were scored based on the narrative of the studies. The scores for risk of bias ranged from 6 to 9 points. Agreement between the two reviewers was assessed using Cohen’s kappa coefficient and was 0.891 ($p < 0.001$), indicating a high degree of consistency.

Figure 2 shows the meta-analysis results for group 1. Using a fixed-effects model, the heterogeneity test ($I^2$) result for the seven studies was 0%, indicating homogeneity among the studies. The SMD indicated that calligraphy treatment significantly reduced psychosis (10 studies, 965 subjects, SMD = $-0.17$, 95% CI [−0.30, −0.04], $Z = 2.60$, $p = 0.009$).

Figure 3 shows the meta-analysis results for group 2. Using a fixed-effects model, the heterogeneity test ($I^2$) was 0%, indicating that the nine studies were homogeneous. The SMD indicated that calligraphy treatment significantly reduced anxiety symptoms (9 studies, 579 subjects, SMD = $-0.78$, 95% CI [−0.95, −0.61], $Z = 8.98$, $p < 0.001$).

Figure 4 shows the meta-analysis results for group 3. Using a fixed-effects model, the heterogeneity test ($I^2$) was 0%, indicating that the seven studies were homogeneous. The SMD indicated that calligraphy treatment significantly reduced depressive symptoms (7 studies, 456 subjects, SMD = $-0.69$, 95% CI [−0.88, −0.50], $Z = 7.11$, $p < 0.001$). Figure 5 shows the meta-analysis results for group 4. Using a fixed-effects model, the heterogeneity test ($I^2$) was 0%, indicating that the two studies were homogeneous. The estimated combined effect showed that CCT significantly improved cognitive function (2 studies, 55 subjects, MD = 2.17, 95% CI [−0.03, 4.38], $Z = 1.93$, $p = 0.05$). Figure 6 shows the meta-analysis results for group 5. Using a fixed-effects model, the heterogeneity test ($I^2$) was 0%, indicating that the three studies were homogeneous. The estimated combined effect showed that CCT significantly improved neurofeedback (3 studies, 148 subjects, SMD = $-1.09$, 95% CI [−1.44, −0.73], $Z = 6.01$, $p < 0.001$). Figure 7 shows the meta-analysis results for group 6–1 (schizophrenia-psychopathy). Using a fixed-effects model, the heterogeneity test ($I^2$) was 0%, indicating that the four studies were homogeneous. The estimated combined effect showed that CCT significantly reduced positive psychopathological expression of schizophrenia symptoms (4 studies, 287 subjects, SMD = $-0.35$, 95% CI [−0.59, −0.12], $Z = 2.96$, $p = 0.003$). Figure 8 shows the meta-analysis results for group 6–2 (schizophrenia-negative...
Using a fixed-effects model, the heterogeneity test (I^2) was 15%, indicating that the four studies were homogeneous. The estimated combined effect showed that CCT significantly reduced negative symptoms of schizophrenia (4 studies, 276 subjects, SMD = −1.39, 95% CI [−1.65, −1.12], Z = 10.23, \(p < 0.001\)).

Discussion

The purpose of this study was to explore the effectiveness of calligraphy therapy in improving symptoms of psychiatric disorders by reviewing and analyzing relevant literature. Twenty-one studies met the inclusion criteria and were reviewed. Most of the evidence suggests that CCT can change targeted behaviors in individuals with neuropsychiatric symptoms and that CCT is associated with improvements in objective measurements of psychiatric performance.

Evidence from these kinds of studies is needed before CCT can be considered effective for neuropsychiatric symptoms. The study findings reviewed here suggest that, used as psychiatric therapy, CCT can significantly improve selected neuropsychiatric symptoms. The use of CCT in compensation-focused interventions and selected psychotherapeutic interventions may lead to neuropsychiatric changes and thus improve daily life.

RCTs provide the best evidence of the efficacy of CCT. In RCTs with large samples, there is more balance between the characteristics of participants in the treatment and control groups. In small-sample RCTs, some characteristics may not be balanced between groups. Table 1 shows that most of the sample sizes in each group were between 15 and 30. Only about half of the included studies had quality scores greater than 8 (Table 2). Therefore, more high-quality RCTs are needed to strengthen the evidence for CCT’s effect in reducing neuropsychiatric symptoms. If more systematic reviews are produced to establish clinical guidelines, this could increase the clinical use of CCT.

A funnel plot of the CCT literature was symmetrical (i.e., showed no positive or negative relations between effect size and standard error). This indicates that there was no publication error. The best way to avoid publication bias is to begin with a rigorous examination of the literature.

As this is the first review of the efficacy of CCT for neuropsychiatric symptoms, we are unable to compare the findings with other similar studies. Compared with other non-pharmacological therapies like music therapy, painting therapy, or gardening therapy, CCT is perhaps a more culture-specific therapy, as it requires participants to learn Chinese writing and use a special soft calligraphy brush.

Our findings show that calligraphy therapy can significantly enhance cognitive function and relieve neuropsychiatric and depressive symptoms. However, there were some study limitations. First, studies varied markedly in their intervention approaches and selected outcome measures, and were frequently hampered by design limitations. Second, the pattern of effects on specific neuropsychiatric domains was inconsistent across studies. Additionally, some important outcomes, such as daily functioning, quality of life, and neuropsychiatric symptom severity, were assessed infrequently in the reviewed studies. Moreover, handwritten communication has largely been replaced by typed communications.
and, in more recent years, by mobile phone calls and texts). This may have affected the results.

Overall, the results from trials are promising but inconclusive. Additional well-designed and adequately powered trials are warranted. However, this evidence must be treated with caution because of methodological limitations. To better assess the value of non-pharmacological interventions for this population, we recommend the following: (1) RCTs should have a large size of over 30 subjects; (2) standards for cognitive/neuropsychiatric rehabilitation must be established for treatment of diseases, such as stroke, Alzheimer’s disease and MCI; (3) general character templates for adaptation and modification in diverse fields of clinical trials must be standardized; (4) character form design must be set; (5) authority for standards of template designs, protocols for CCT and a large database for cases and trial follow ups must be established.

**Table 2** Methodological quality assessment of the included studies (JBI)

| Study   | Study design | Score criteria | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Total |
|---------|--------------|----------------|---|---|---|---|---|---|---|---|---|---|-------|
| Luo 2000| CCS          |                | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7     |
| Cui 2003| CCS          |                | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7     |
| Zhou B 2005 | CS       |                | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 6     |
| Zhou GQ 2005 | CCS     |                | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7     |
| Dong 2006 | RCT        |                | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 9     |
| Zhao 2006 | RCT        |                | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 9     |
| Guo 2007 | RCT        |                | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 8     |
| Zeng 2007 | RCT        |                | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 8     |
| Zheng 2008 | RCT       |                | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 8     |
| Li 2010  | RCT        |                | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 8     |
| Yang 2010 | RCT        |                | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 9     |
| Zhou 2010 | RCT        |                | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 8     |
| Kwok 2011 | RCT        |                | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 6     |
| Tian 2012 | RCT        |                | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 9     |
| Zhang 2012 | CCS       |                | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 7     |
| Dong 2013 | RCT        |                | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 9     |
| Xu 2013  | CCS        |                | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 6     |
| Zhou 2013 | CS         |                | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 6     |
| Zhu 2014 | RCT        |                | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 8     |
| Tai 2016  | CCS        |                | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 6     |
| Chan 2016 | RCT        |                | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 8     |

Abbreviations: JBI Joanna Briggs Institute, RCT randomized controlled trial, CCS controlled clinical study, CS cohort study

Score criteria: 1. Was the assignment to treatment groups truly random? 2. Were participants blinded to treatment allocation? 3. Was allocation to treatment groups concealed from the allocator? 4. Were the outcomes of people who withdrew described and included in the analysis? 5. Were outcomes measured in the same way for all groups? 6. Were outcomes measured in a reliable way? 7. Were groups treated identically other than for the named interventions? 8. Were outcomes measured in the same way for all groups? 9. Were outcomes measured in the same way for all groups? 10. Was appropriate statistical analysis used?

The forest plot shows the comparison of Experimental (Chinese calligraphy therapy, etc.) versus Control. Outcome: index of schizophrenia-negative syndrome.
Authors’ contributions
KYC and CYH designed the study and contributed substantially to the design of the search strategy. KYC and CYH searched the literature and extracted data. WCO performed the analysis and interpreted the data. KYC wrote the first draft of the manuscript and CYH and WCO critically reviewed the manuscript. All authors read and approved the final manuscript.

Ethics approval and consent to participate
Ethical approval was not required because of the nature of the study.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

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