TRADITIONAL AND INTEGRATIVE MEDICINE

Trad Integr Med, Volume 9, Issue 2, Spring 2024

Original Research

Enhancing Flexibility through Chinese Auriculotherapy: Investigating the Impact on Sit and Reach Test – A Randomized Controlled Trial

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Received: 25 Jun 2023 **Revised:** 31 Oct 2023 **Accepted:** 16 Jan 2024

Abstract

Chinese auriculotherapy (CA) is a technique that is part of acupuncture and traditional Chinese medicine (TCM). Acupuncture techniques have been utilized in physical practices to enhance performance and manage pain. Nevertheless, it remains uncertain whether CA can enhance performance in stretching exercises. Thus, this study aims to determine if CA can have an ergogenic effect on the sit and reach test and to evaluate the impact of CA on pain perception and effort during the test. Our hypotheses is that CA will positively influence performance in the sit and reach test by reducing pain perception through the implemented protocol. The study employed a randomized, double-blind, crossover design. The sample consisted of 15 individuals (12 women and 3 men, mean age 22.33 ± 6.4 years, BMI 23.43 ± 4.24). The participants underwent a flexibility assessment protocol using the sit and reach test under three different conditions: I) CA protocol; II) CA placebo protocol (CAP); III) control group without any therapeutic intervention (CG). Subjective pain and effort perception were evaluated using the CR-10 Borg scale. A statistical difference was observed between CA vs. CAP and CA vs. CG in the sit and reach test. No statistical changes were found for the other variables and conditions studied. A significance level of 5% was adopted. Therefore, CA can enhance performance in the sit and reach test; however, the mechanisms responsible for this improvement are still unclear.

Keywords: Chinese medicine; Acupuncture; Stretching; Auriculotherapy

http://doi.org/10.18502/tim.v9i2.15865

Citation: Garramona FT, Oliveira Moreira RS, Korch H, Cruz JE, Milano Teixeira LF. **Enhancing Flexibility through Chinese Auriculotherapy: Investigating the Impact on Sit and Reach Test – A Randomized Controlled Trial.** Trad Integr Med 2024;9(2):121-127. http://doi.org/10.18502/tim.v9i2.15865

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Introduction

The Chinese auriculotherapy (CA) is a technique that is part of acupuncture and aims to restore the flow of human body energies, contributing to the maintenance of health, through the stimulation of specific points on the surface of the ear [1-3]. CA can be used as a primary therapeutic method or as an adjunctive resource combined with other Traditional Chinese Medicine (TCM) techniques [1,2,4,5].

CA involves stimulating reflex areas on the ear, where specific points correspond to specific body parts, as well as other points with specific energetic functions. Auriculotherapy can be applied in a variety of ways, including manual techniques such as acupuncture needles, ear seeds or acupressure, as well as non-invasive methods such as the use of lasers or electrical stimulation. [1,2,4-7]. Ear points can be utilized for the treatment of systemic pathologies and musculoskeletal pain. This non-invasive and holistic approach has gained significant recognition for its effectiveness in managing a wide range of health conditions, offering an alternative or complementary solution to conventional medical treatments [1,2,4-6,8]. Additionally, ear points can serve as a diagnostic method through the observation and palpation of the ear areas [1,2,7].

In the realm of sports, acupuncture techniques are often employed to treat injuries and manage pain [6,9-11]. Furthermore, several studies have investigated the use of acupuncture as a means to enhance physical performance in recreational and professional athletes [10-17]. However, the literature is inconclusive regarding whether acupuncture can be employed as an adjunctive method to improve performance in stretching exercises.

Therefore, the aim of this study is to examine whether CA can induce an ergogenic effect in the sit and reach test, as well as to evaluate the impact of CA on pain perception and effort during the test.

Our hypotheses are that CA will positively influence performance on the sit and reach test by reducing pain perception, as a result of the implemented protocol.

Methods

The study was conducted in accordance with the Declaration of Helsinki proposed by the World Medical Association. Subjects were provided with information regarding the risks and benefits of participating in the study and provided written informed consent for the approved protocol, which had been reviewed and approved by the Ethics Committee on Human Research of the University of Sorocaba (document 3.181.734).

Subjects and study design

The study utilized a randomized, double-blind, crossover design to investigate the phenomenon of stretching exercise and the effect of CA in this process. The sample consisted of 15 individuals (12 women and 3 men, mean age 22.33 ± 6.4 years, mean BMI 23.43 ± 4.24). Inclusion criteria for participation in the study were as follows: I) age between 18 and 60 years; II) regular engagement in physical exercise (minimum of 150 minutes per week for at least 6 months); III) absence of injuries or musculoskeletal pain; IV) non-use of ergogenic substances. Subjects were excluded if they met any of the following criteria: I) specific medical restrictions; II) inability to perform the established protocol for specific reasons; III) presence of auricular diseases or absence of the auricle; IV) needle phobia; V) prior knowledge of the CA map and its application.

The sample underwent a flexibility assessment protocol using the sit and reach test under three different conditions: I) CA protocol; II) CA placebo protocol; III) control group without the use of any therapeutic intervention. A washout period of 1 week was implemented between each condition. Subjective perception of pain and effort was assessed using the CR-10 Borg scale, five minutes after completing the test.

All subjects were individually assessed under similar environmental conditions. The room temperature was not controlled but was monitored for analysis of variations using a digital room thermometer (Max & Min model, produced by Supermedy). Subjects were instructed to refrain from engaging in physical exercise for 48 hours before the tests. All tests were conducted in two distinct time periods: in the morning between 09:30 AM and 11:30 PM and in the late afternoon between 5:00 PM and 7:00 PM. All individuals were analyzed and re-analyzed at the same period of the day to mitigate the potential influence of time-of-day variations.

Randomization and familiarization

Initially, all individuals underwent two familiarization sessions of the sit and reach test, with three needles inserted into randomly selected ear points. Five minutes after the test, the individuals assessed their subjective perception of pain and effort using the CR-10 Borg scale. Subsequently, the sample was stratified into terciles based on the results of the sit and reach from the second familiarization session. Randomization was performed using a Latin square design, ensuring equal representation of all treatment sequences. The randomization process was conducted by an independent researcher, who had no contact with the sample and used computer-generated randomization sequences. The individuals were divided into three groups, which performed tests in different orders as follows: group A – CA, CAP, and CG; group B – CAP, CG, and CA; group C – CG, CA, and CAP.

Double-blind Procedure

Health professionals with experience in the applied

tests and therapeutic techniques conducted all the tests. However, the professional responsible for assessing the sit and reach test had no knowledge of acupuncture. Thus, both the sample individuals and this professional were blinded to the treatment. They were informed that the study aimed to investigate the effects of two different CA protocols on the stretching test.

Sit and reach test

The primary outcome measure was the sit and reach test results. Participants arrived at the laboratory and remained at rest for at least 10 minutes. Subsequently, needles insertions were carried out in accordance with the established protocol for each session.

Regarding the sit and reach test, the original guidelines proposed by Wells and Dillon (1952) [18] were followed. For the test, the individuals were instructed to sit with their knees fully extended and place the soles of their feet on the vertical bench support. They were instructed to interlace their hands, position their arms above their heads with their elbows fully extended, take a deep breath, and flex their trunk at the exhalation time. They were instructed to support their hands on the ruler positioned on the bench and try to reach the greatest possible distance. This procedure was repeated for three attempts, and the best attempt was used for the analysis.

Assessment of subjective perception of pain and effort

As secondary outcomes measures, we assessed the subjective perception of pain and effort. For this, participants were instructed to rate the maximum pain and effort experienced during the test on a CR-10 Borg scale. This scale ranges from zero (no pain or difficulty) to 10 (maximum pain or effort during the test). The scale was administered 5 minutes after the completion of the test.

Chinese auriculotherapy protocols

A standard protocol for CA intervention was developed based on the fundamentals of Traditional Chinese Medicine (TCM) [2,8,19]. The protocol aimed to prioritize the energy flow to the most relevant body areas during the test. Points corresponding to the hip, lumbar, and hamstring areas were used, along with other points whose energetic actions could favor the improvement of flexibility. The following points were included: Shen men, kidney, liver, and corresponding area points. These points were specifically chosen for their therapeutic effects and their ability to influence energy flow in the body.

Shen men, also known as "Spirit Gate" in TCM, is located in the ear and is believed to have a calming and harmonizing effect on the spirit and emotions. It is commonly used to promote relaxation and reduce

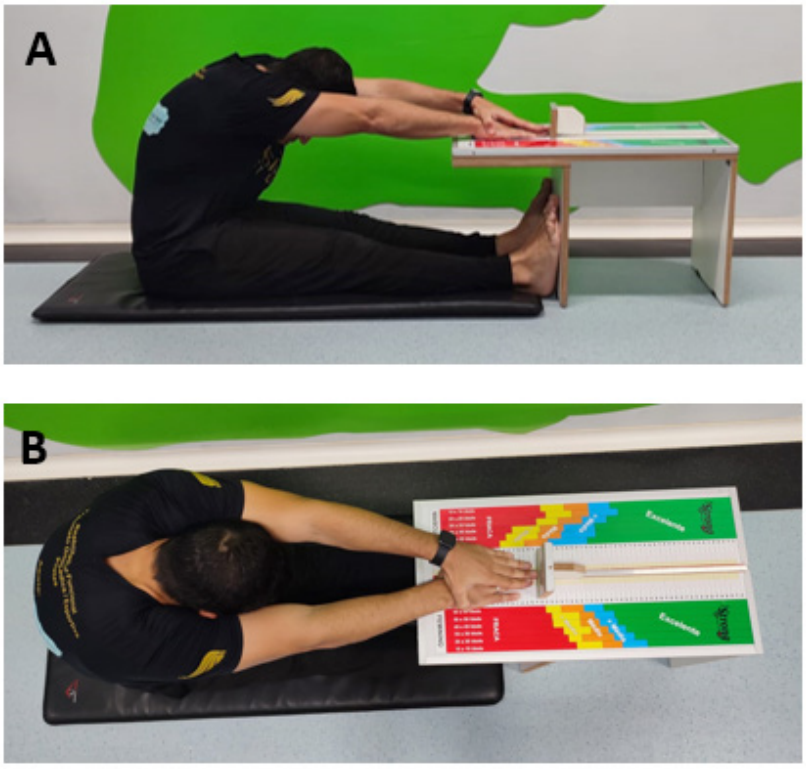

Figure 1. Sit and reach test

stress, which can indirectly contribute to improved flexibility.

The kidney is considered the foundation of vitality in TCM, governing the water element and the yin aspect of the body. It plays a crucial role in maintaining the balance of bodily fluids and nourishing the muscles and bones. Stimulating the kidney points can help strengthen the lower back and promote overall vitality, which is essential for flexibility.

The liver, according to TCM, is responsible for the smooth flow of Qi (energy) and blood in the body. When the liver Qi is stagnant, it can lead to tension and stiffness in the muscles and tendons. By targeting the liver points, we aim to promote the free flow of Qi and blood, thereby enhancing flexibility and reducing restrictions in the body.

The hip, lumbar, and hamstring areas correspond to specific meridians associated with flexibility and musculoskeletal health. Stimulation of these points aims to promote harmonious energy flow, support optimal function, and enhance flexibility in the respective areas.

For the placebo protocol, points such as the elbow, forearm, wrist, eye, throat, and a point in the central region of the triangular fossa were used. These points were chosen to create a placebo effect and mimic the experience of acupuncture without directly targeting areas associated with flexibility or musculoskeletal health. The number of needles used in the placebo protocol was kept consistent with the active intervention protocol to maintain blinding and ensure comparability between the two groups.

Regarding point stimulation, DONGBANG needles (size 0.25x15mm) were used for the acupuncture intervention. The needle insertion procedure was conducted in a separate room by an experienced acupuncturist, ensuring no contact between the therapist and the evaluator of the sit and reach test. Prior to insertion, the auricular pavilion was palpated to determine the precise location of the points. To ensure hygiene and minimize the risk of infection, proper asepsis of the auricular pavilion was performed. The insertion technique involved oblique insertion at a 30-degree angle in the corresponding areas and perpendicular insertion in other areas. The needles were inserted until they achieved fixation in the auricular pavilion. No additional procedures, such as rotation or electrical stimulation, were performed on the needles. After a 10-minute needle retention period, the patients proceeded to undergo the flexibility evaluation while retaining the needles in their ears. Following the completion of the test, the needles were safely removed and disposed of in accordance with appropriate protocols.

Statistical Analysis

The Shapiro-Wilk test was used to verify data normality. To compare means of the studied variables, One-Way Analysis of Variance with repeated measures (ANOVA) and the Tukey post-hoc test for multiple comparisons were employed. When data did not follow a normal distribution among the groups, the Friedman and Dunn's multiple comparisons were performed. Effect size was calculated using Hedges' g. A significance level of 5% was adopted, and the software used was GraphPad Prism®, version 7.

Results

Figure 3 presents the CONSORT diagram of the clinical trial. Table 1 and figure 4 present the mean values and standard deviations for the three conditions studied; while Table 2 displays the p values and effect sizes for the multiple comparisons. There was no significant change in room temperature on the evaluation days ($p = 0.789$).

Discussion

To the best of our knowledge, this study is the first to examine the effect of CA on stretching performance. The key finding of this study was the effectiveness of CA in improving performance in the sit and reach test, despite no significant changes in subjective perception of pain and effort. As a result, the initial hypothesis that CA could reduce subjective perception of pain was rejected. Similarly, there was no reduction in subjective perception of effort.

The possible explanation for the results in subjective perception of pain and effort in the CA condition is

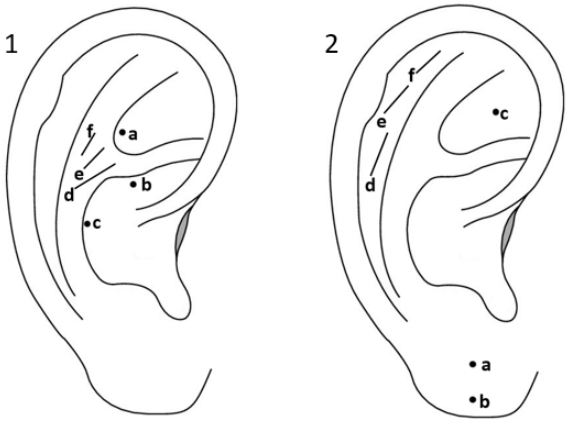

Figure 2. Location of auricular acupoints used in Chinese auriculotherapy (1) and Chinese auriculotherapy placebo (2). *Chinese auriculotherapy 1:* a = Shen men; b = kidney; c = Liver; d, e, f = corresponding area with oblique insertion at a 30-degree angle. *Chinese auriculotherapy placebo (2):* a = eye; b = throat; c = central region of the triangular fossa; d, e, f = elbow, forearm, and wrist with oblique insertion at a 30-degree angle.

Table 1. Means and standard deviation in the three conditions

	CA (n=15)	CAP (n=15)	CG (n=15)
Sit and reach test (cm)	41.27 ± 5.341$^{\alpha\beta}$	40.07 ± 5.467	39.43 ± 6.181
subjective perception of pain	3.267 ± 1.387	3.33 ± 0.8997	3.6 ± 1.724
subjective perception of effort	3.67 ± 1.633	3.6 ± 1.183	4.13 ± 1.506

CA – Chinese Auriculotherapy; CAP – Chinese Auriculotherapy Placebo; CG – Control Group; α - Statistically significant difference compared with CAP ($p \leq 0.05$); β - Statistically significant difference compared with CG ($p \leq 0.05$)

Table 2. P value and Effect Size.

	Sit and Reach test		Subjective perception of pain		Subjective perception of effort	
	p value	ES	p value	ES	p value	ES
CA x CAP	0.0095	0.22	>0.999	-0.05	>0.999	0.05
CA x CG	0.0192	0.31	>0.999	-0.21	0.248	-0.29
CAP x CG	0.2813	0.11	>0.999	-0.19	0.6037	-0.38

CA – Chinese Auriculotherapy; CAP – Chinese Auric
ulotherapy Placebo; CG – Control Group; ES – Effect Size

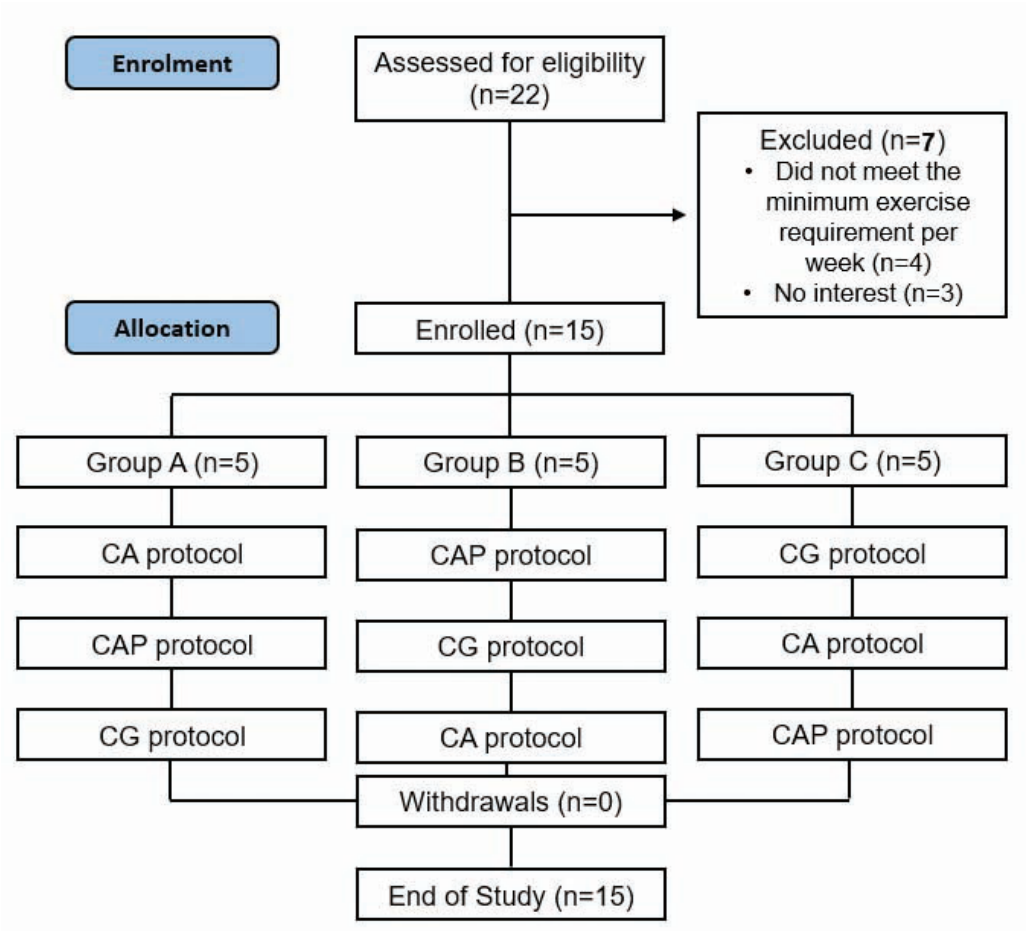

Figure 3. CONSORT diagram of the clinical trial. CA = Chinese Auriculotherapy; CAP = Chinese Auriculotherapy Placebo; CG = Control Group

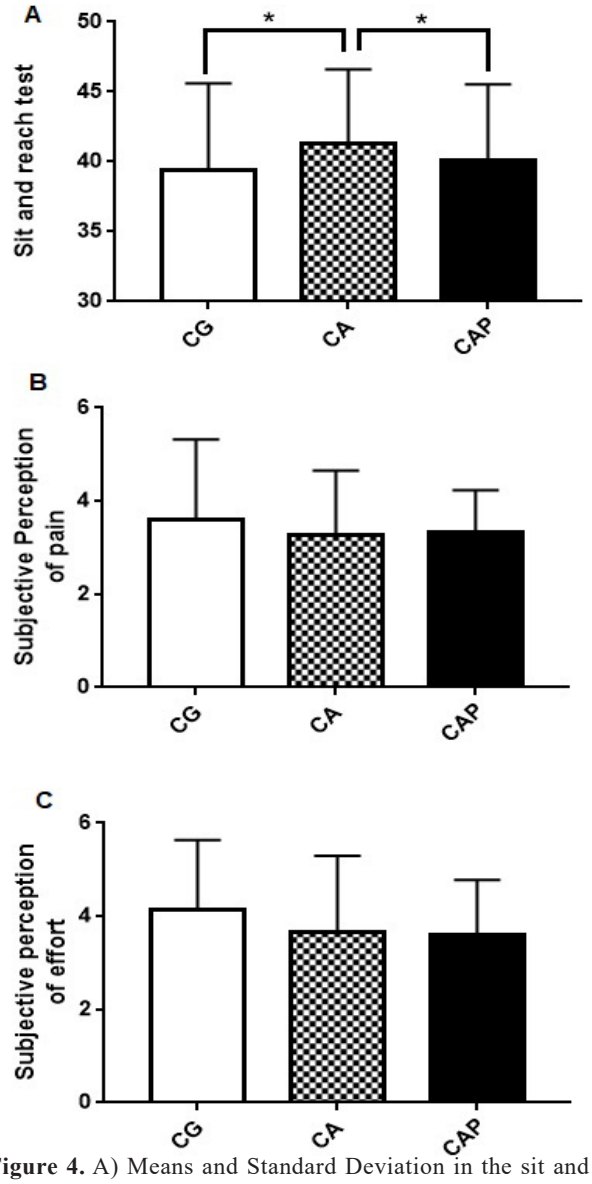

Figure 4. A) Means and Standard Deviation in the sit and reach test; B) Means and Standard Deviation in the Subjective perception of pain; C) Means and Standard Deviation in the Subjective perception of effort; CG – Control group; CA – Chinese Auriculotherapy; CAP – Chinese Auriculotherapy Placebo

that the subjects exhibited better performance in the sit and reach test. Consequently, the improved performance may have contributed to maintaining the pain and effort levels and masking any potential changes in these variables. If the individuals had been instructed to perform the sit and reach test with the same level of performance as in the control condition, possibly lower values could have been observed in the subjective perception of pain and effort. Therefore, further studies are recommended to investigate this hypothesis. Studies examining the effects of CA on muscle performance, including flexibility and strength, are limited. Noll et al. [9] conducted a systematic review on the influence of CA on athletic performance and identified only two studies [15,16] that met the eligibility criteria for inclusion. In one of this, Lin et al. [15] evaluated heart rate, oxygen consumption, and blood lactate levels during recovery in elite basketball athletes subjected to a stationary bike protocol until exhaustion. The authors suggested that CA could improve recovery time after strenuous exercise. Another study by the same authors [16] demonstrated faster recovery after a treadmill protocol in boxing athletes who underwent CA.

In terms of systemic acupuncture treatment, Hüscher et al. [13] concluded that a single session of systemic acupuncture effectively increased quadriceps isometric strength in active individuals. Regarding delayed onset muscle soreness (DOMS), Lin and Yang [14] found a decrease in DOMS in individuals who received acupuncture treatment, although no statistical changes in creatine kinase levels were observed.

The exact mechanism of action of acupuncture is not yet fully understood and requires further investigation. The study by Biella et al. [20] demonstrated that a systemic acupuncture protocol for pain relief activates brain regions involved in pain processing, suggesting pain modulation. Wu et al. [21] obtained similar findings by stimulating the ST36 point, observing increased activity in specific brain regions compared to the placebo situation. Furthermore, other studies have shown that acupuncture stimulates the release of endogenous opioids such as beta-endorphins, which can bind to opioid receptors in the central nervous system and exert analgesic effects [21,22]. Additionally, acupuncture has been found to activate descending pain inhibitory pathways, involving the release of serotonin and norepinephrine, which can suppress pain transmission at the spinal cord level [8,23,24]. Furthermore, acupuncture may modulate pain perception by regulating neurochemicals and neurotransmitters associated with pain, such as substance P, glutamate, and gamma-aminobutyric acid (GABA) [1,8,23]. These mechanisms collectively contribute to the analgesic effects of acupuncture and may explain the potential reduction in pain perception during stretching exercises observed in Chinese auriculotherapy.

In terms of TCM fundamentals, CA can influence all body regions through the 12 main meridians that are directly or indirectly connected to the auricula. As a result, CA stimuli can reach and act on the Zang Fu (organs and viscera). The auricula is connected to all body areas through energy channels. Hou et al. [1] suggest that cranial nerves connect the auricula to the nervous system, enabling ear stimulation to affect the neuroendocrine system.

Regarding the adverse events experienced during the trial, only 2 volunteers reported mild discomfort in the auricular pavilion immediately after needle removal,

with one experiencing it after the placebo protocol and the other following the intervention protocol. It is worth noting that the discomfort subsided within a few minutes.

The present study has several limitations that should be acknowledged. Firstly, the small sample size, consisting of only 15 individuals, may limit the generalizability of the findings to a larger population. Additionally, the heterogeneity in the participants' physical exercise experiences and lifestyles introduces confounding factors that could have influenced the results. Moreover, the study focused solely on the sit and reach test as a measure of stretching performance, neglecting other important aspects of flexibility. These limitations highlight the need for future research with larger and more diverse samples, and extended intervention periods to provide a more comprehensive understanding of the effects of Chinese Auriculotherapy on stretching performance and subjective experiences.

Conclusion

In conclusion, this study demonstrates that Chinese Auriculotherapy (CA) has the potential to enhance performance in the sit and reach test. However, further investigation is needed to fully understand the underlying mechanisms responsible for this improvement. Future research should aim to elucidate the specific physiological and neuroendocrine mechanisms through which CA influences stretching performance. Additionally, exploring the long-term effects and conducting larger-scale studies with diverse populations would contribute to a more comprehensive understanding of the benefits and applications of CA in enhancing flexibility.

Conflict of Interests

The Authors declares that there is no conflict of interest. The article was produced without any funding.

Acknowledgements

None.

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