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The Effect of the Baduanjin Exercise on the Covid-19-Related Anxiety, Psychological Well-being and Lower Back Pain of College Students During the Pandemic

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Research Article

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Abstract

Background

Baduanjin exercise is recognized as having a beneficial effect on both physical and mental health. However, studies lacked consideration of its potential advantageous outcomes during the coronavirus pandemic. This study aimed to examine the effect of Baduanjin exercise on the COVID-19-related anxiety, psychological well-being, and the lower back pain of college students during the coronavirus pandemic in China.

Methods

Participants consisted of 387 people, ranging in age from 20 to 30 years (M = 23.55; SD = 3.13), and were randomly divided into two groups: 195 participated in the 12-week Baduanjin exercise program, and 192 learned health knowledge during this time. Subsequently, the two groups were analyzed and compared in terms of an intervention effect on the COVID-19-related anxiety, psychological well-being, and lower back pain.

Results

The intervention effect on the Baduanjin exercise group was remarkably better than that of the control group ($p < 0.05$). With the intervention of the Baduanjin exercise, the COVID-19-related anxiety score decreased from 5.22±0.45 to 5.07±0.27. The total psychological well-being score increased from 70.11±8.65 to 84.12±7.38, and the prevalence of low back pain decreased from 22.45±1.67 to 18.35±1.05 among college students.

Conclusion

During the pandemic, the Baduanjin exercise contributes to the reduction of the perceived anxiety related to the COVID-19, decreases the prevalence of the lower back pain, and improves the psychological well-being of college students.

Introduction

Since the beginning of the COVID-19 pandemic until May 2021, numerous changes and restrictions have been introduced by countries that have significantly influenced the lifestyle of the inhabitants. People's traditional daily life and physical activities in China were highly affected by the government’s policy as well as by the trajectory of changes in the pandemic situation (e.g. changes in the spread of the COVID-19 virus, periods of increased mortality and morbidity). Meanwhile, the pandemic has made Chinese universities lockdown, and college students have to study online courses at home. Long-term online courses have increased students' sedentary time, while pandemics have reduced daily exercise and social time [1]. This has led to a high incidence of chronic diseases among people due to insufficient physical activity [2].

Numerous studies have shown that sedentary behavior has become a leading global public health problem, and as we all know this behavior is an important risk factor of several diseases, and even loss of life. In the sedentary behavior, the neck and lumbar spine and other body parts stay dormant for a long time. This leads to an abnormal body position, causing pain in the waist, abdomen and back, in addition to decreased muscle strength. Sedentary behavior is one of the main risk factors for various chronic noncommunicable diseases, such as spondylosis, periarthritis of shoulder, nonspecific low back pain and many others [3-4]. It also increases the severity of perceived stress, and reduces people's quality of life and psychological well-being, and thus should be recognized as an additional risk factor during the pandemic when people generally report greater fear and more worries [5-6]. There is growing evidence pointing that the COVID-19 pandemic contributes to the increased number of cases of mental health problems, anxiety, and depression [7].

Baduanjin, in terms of its effect as an exercise intervention, has been recognized in many international studies [8-9]. It consists of eight independent, simple, subtle, and smooth movements [10]. Although the potential effectiveness of each movement may be different, the overall Baduanjin exercise has been demonstrated to have a good effect on body and mind [10]. For instance, the Baduanjin exercise has been recognized as an effective way of alleviating the lower back pain (even its chronic condition) caused by lumbar disc herniation [11-12].It improves the strength and flexibility of the neck, shoulder, and back. Thus, it helps reducing the occurrence and

development of diseases related to the above-mentioned parts of the body [9, 13-14]. The positive effect of the Baduanjin exercise on mental health was previously observed in cohorts of college students, as well as middle-aged and older people [15-17].

However, little is known about the effect of the Baduanjin exercise on the prevalence of lower back pain, COVID-19-related anxiety and psychological well-being in collge students during the pandemic. Thus, this article aims to explore the effects of Baduanjin intervention on physical and mental health of people during the pandemic, together with providing theoretical and practical references for healthy lifestyles for sedentary groups.

Methods

2.1. Design

The purpose of the study was to examine whether Baduanjin exercises can decrease COVID-19-related anxiety, improve the prevalence of lower back pain, and increase psychological well-being in College Students during the pandemic. The protocol of this study was approved by the Ethics Board for Research Projects at the Institute of Psychology, University of Gdansk, Poland (decision no. 33/2020). Figure 1 presents the stages of the study regarding also the flow of the respondents.

2.2. Participants

From May 2020 to March 2021, four universities students were randomly selected from Wenzhou City in Zhejiang Province, China. According to the inclusion criteria, the participants were between 20 – 30 years old. Furthermore, they must have worked, studied, or lived in a selected school for more than two months in the past year and needed to be able to participate in online and offline activities as well as answer questions from the surveys. Eventually, a total of 387 participants were qualified for the study.

2.3 The Intervention

Qualified subjects were randomly assigned into the Baduanjin exercise group (BEG, n = 195) and Control group (CG, n = 192).

2.3.1. Baduanjin exercise group.

In this group, the participants were performing the Baduanjin exercises for 12 weeks. They were guided by a professional Qigong Baduanjin coach in the first week and then began a formal 11-week intervention period of Baduanjin exercises after mastering moving and breathing methods. During this intervention period, the participants were exercising independently, and each week they have been doing the Baduanjin exercises no fewer than five times for a total duration of 45 minutes per session [18]. They were required to wear sportswear and sports shoes during these exercises. Participants performed a warm-up exercise for approx. 5-10 minutes before the practice, with formal exercises beginning after 3-5 minutes of Qi practicing. Stretching exercises for 5 minutes after the exercise were also performed by the participants. The coach guided subjects through a group exercise once a week (during the formal 11-week intervention period). Participants need to provide instant feedback which they had encountered in their daily exercises to the doctor and coach at any time.

2.3.1. Control group.

Participants were instructed to learn health knowledge on the Internet independently. They were required to learn for 12 consecutive weeks. For each week, they had to learn no fewer than 5 times and have to learn at least 30 minutes every time. Management staff undertook a return visit to the control group every other week.

2.4. Measurements

2.4.1. Nordic Musculoskeletal Questionnaire (NMQ)

The Nordic Musculoskeletal Questionnaire (NMQ) is a reliable instrument that measures musculoskeletal symptoms' prevalence, severity, and impact [9]. Previous studies have demonstrated that NMQ is well-validated[8-9]. The internal consistency of the Nordic Musculoskeletal Questionnaire in our study was $\alpha = 0.93$.

2.4.2. The Coronavirus Anxiety Scale (CAS)

For the research purposes, we used the Coronavirus Anxiety Scale (CAS) developed by Lee et al[19], which consists of 20 items developed based on the psychological descriptions of fear and anxiety symptoms [10,20,21, 22]. Each item is scored on a 5-point Likert scale that represents the frequency of the symptom over the previous two weeks, ranging from 0 (never) to 4 (nearly every day). The total score is calculated by adding the scores for each of the responses [19]. The internal consistency of the Coronavirus Anxiety Scale CAS scale in our study was α = 0.793.

2.4.3. Psychological Well-being Scale (PWBS)

This questionnaire was originally designed and proposed by Ryff [23], yet we used the version developed by Ryff and Almeida [24] for this study, which is more in line with the current pandemic situation. After being quoted by many experts and scholars, it's reliability was scored as being high. PWBS is a measurement tool with a multi-dimensional structure, with six scales:

(1) Autonomy (independence and self-steering);

(2) Environmental Mastery (the ability to transform the environment according to one's needs and values);

(3) Personal growth (the ability to improve one's skills);

(4) Positive relationships with others (experiencing deep and meaningful connections with others);

(5) Life purpose (perceiving life as meaningful);

(6) Self-acceptance (acceptance of one's advantages and disadvantages).

The internal consistency of the PWBS total scale in our study was α = 0.78.

2.5 Statistical Analyses

IBM SPSS Statistics, Version 26.0 (IBM, Armonk, New York, USA) was used for statistical analysis. A one-way analysis of variance and chi-square tests were used to analyze baseline demographic characteristics between two groups. After analyzing normal distribution with the Kolmogorov-Smirnoff (K-S) test, the descriptive characteristics of variables were expressed using means and standard deviations (SD). The paired t-test (t-test for dependent variables) was used to verify the group's changes before and after the intervention. An independent sample t-test (t-test for independent variables with a 95% confidence interval) was used to compare the two groups' mean values after the intervention. The tests were conducted to examine the effect of Baduanjin exercise on the COVID-19-related anxiety, psychological well-being, and the prevalence of lower back pain of college students. P-value of 0.05 has been adopted for the standard evaluation of significant differences, and p = 0.01 - for noticeable significant differences. The correlation analysis was used to analyze the correlation between the prevalence of lower back pain, changes in psychological well-being, and improvement of COVID-19-related anxiety.

Results

3.1 Descriptive statistics of sociodemographic information of Baduanjin exercise group and controls

A total of 387 participants were in this study, and most of them were College/Undergraduate students (57.62%). Men covered 50.9%. There were no significant differences between the Baduanjin exercise group and the control group regarding gender, age, education level, marital status, smoking history, drinking history, Sedentary time, Frequency of participation in exercise ($p > 0.05$). More detailed statistics of the participants' characteristics are presented in table 1.

Table 1. Descriptive statistics of sociodemographic information of Baduanjin exercise group and controls ;n=387

Variable		BEG (n=195)	CG (n=192)	χ^2	*p*
Age (years)		24 ± 4	23 ± 3	-0.32	0.964
Gender (M/F)	Men	106（54.3%）	91 (47.3%）		0.716
	Female	89（45.7%）	101 (52.7%）		
Education	College/Undergraduate	114 (58.4%）	109 (56.7%）	1.493	0.439
	Postgraduate Student	49 (25.25%)	61(31.9%)		
	Doctoral Candidate	20(10.4%)	22(11.4%)		
Marital status	Married	19(9.7%）	13（6.7%）	0.719	0.35
	Other	176（90.3%）	179 (93.3%）		
Smoking status	Never	104（53.3%）	99 (51.56%）	0.819	0.631
	Yes	65（33.3%）	70（36.4%）		
	Ever Smoking	26（13.4%）	23(12.04%）		
Drinking status	Never	106 (54.35%）	109 (56.7%）	0.496	0.774
	Yes	77（39.4%）	69（35.9%）		
	Ever Drinking	12（6.25%）	14（7.4%）		
Sedentary time（hour）	≤5	40（20.5%）	37（19.2%）	1.33	0.628
	5-9	58（29.8%）	63（32.9%）		
	10≥	97（49.7%）	92（47.9%）		
Frequency of participation in exercise（times / week）	≤3	83（42.5 %）	78（ 40.6%）	-0.25	0.356
	3-5	70（ 35.8%）	67（ 34.8%）		
	5≥	42（ 21.7%）	47（ 24.6%）		

Note. In the case of variables with a quantitative measurement scale, the data was presented using mean ± standard deviation.

3.2 The musculoskeletal pain among the participants of the study

Before we started analyzing between-group and within-group differences, we decided to find out which part of the body college students most commonly experience pain. The analysis of scores obtained in the Nordic Musculoskeletal Questionnaire (NMQ)[*9*] before the intervention (at baseline) revealed that among 387 of participants, the highest prevalence of pain was in the waist (22.39%), and the lowest prevalence – in the thigh (6.25%). The details are presented in Figure 2.

3.3 Nordic Musculoskeletal Questionnaire (NMQ): before and after the intervention

Before the intervention, there were no significant differences in scores obtained in the Nordic Musculoskeletal Questionnaire (NMQ) between BEG and CG ($p > 0.05$), and after the intervention, BEG group scored significantly lower than CG group in NMQ ($p > 0.05$). There was significant decrease in scores obtained in NMQ between the two assessments in the BEG group, yet the difference between the two measurements in the CG group was insignificant (see table 2 for the details).

Table 2. Nordic Musculoskeletal Questionnaire (NMQ): scores before and after intervention in the two groups (BEG vs. CG); n=387

Group	Before intervention	After intervention	p^2
CG(n=192)	22.51±1.81	22.47±1.46	>0.05
BEG (n=195)	22.45±1.67	18.35±1.05**	<0.05
p^1	>0.05	<0.05	

Note. CG: Control group; BEG: Baduanjin exercise group;

[1] Between-group difference

[2]Within-group difference

* : p <0.05

** : p <0.01

3.5 Coronavirus Anxiety Scale (CAS): before and after the intervention

Before the intervention, there was no significant difference between BEG and CG in scores obtained in the CAS (p > 0.05), however, such a between-group difference was found after the intervention (p < 0.05). Moreover, in both – the BEG and CG, the scores obtained in CAS decreased in exercise time (BEG: p < 0.01; CG: p < 0.05). The Baduanjin exercise group was significantly lower than the control group (p <0.05). Table 3 provides more details.

Table 3. Coronavirus Anxiety Scale (CAS) before and after intervention between the two groups (BEG vs. CG); n=387

Group	Before intervention	After intervention	p^2
CG(n=192)	5.21±0.67	5.18±0.78	<0.05
BEG (n=195)	5.22±0.45	5.07±0.27**	<0.01
p^1	>0.05	<0.05	

Note. Control group; BEG: Baduanjin exercise group;

p^1 : Between-group difference

p^2 : Within-group difference

* : p <0.05

** : p <0.01

3.6 Psychological Well-Being (PWBS): before and after intervention

Before the intervention, there were no significant differences in the PWBS scores between BEG and CG (p > 0.05). However, groups differed significantly after the intervention (p < 0.05) with BEG group scoring significantly better in environmental mastery, personal growth, self-acceptance, and PWBS total score. Significant improvement between the two assessments was observed only in the BEG group: participants received better scores in such PWBS's subscales as environmental mastery, personal growth, positive relations with others, self-acceptance, and in the PWBS total score (see Fig. 3 for the details).

Table 4. Psychological Well-Being (PWBS) before and after intervention between the two groups (BEG vs. CG); n=387

Group		AU	EM	PG	PRWO	PL	SA	TS
CG (n=192)	Before intervention	12.19±2.12	11.40±1.68	8.15±2.21	13.73±2.15	13.33±2.38	10.12±1.67	68.92±6.72
	After intervention	12.22±1.81	11.43±2.01	8.23±1.89	13.88±2.46	13.39±2.63	10.07±1.35	69.22±5.34
BEG (n=195)	Before intervention	13.21±2.06	11.48±2.19	8.45±2.33	13.54±2.47	13.46±2.24	9.97±1.38	70.11±8.65
	After intervention	13.28±2.37	14.23±2.04*	14.31±2.43*	14.32±1.78	13.51±2.27	13.47±2.65*	84.12±7.38**

Note. AU: Autonomy; EM: Environmental Mastery;

PG: Personal Growth; PRWO: Positive Relations with Others;

PL: Purpose in Life; SA: Self-Acceptance; TS: PWBS total score;

CG: Control group; BEG: Baduanjin exercise group.

3.7Correlation between the prevalence of low back pain, changes of psychological well-being, and improvement of COVID-19 related anxiety.

After 12 weeks of intervention, COVID-19-related anxiety, the prevalence of low back pain and psychological well-being in participants in the two groups have improved in comparison to the assessment before the intervention. Partial correlation analysis was used to analyze the correlation between the prevalence of low back pain, changes in psychological well-being, and improvement of COVID-19 related anxiety. The results (Table 5) show that when controlling for age and sex, there is a significant positive correlation between the changes in the prevalence of low back pain (NMQ) and the COVID-19-related anxiety (CAS) score ($r=0.445$, $p < 0.05$). In addition, the change of psychological well-being (PWBS) was negatively correlated with the change in the COVID-19-related anxiety (CAS) ($r = -0.631$, $P<0.01$).

Table 5**.** Correlations between changes in the prevalence of low back pain, psychological well-being and Coronavirus-related anxiety

Variable	NMQ	PWBS
CAS	0.445*	-0.631*

Note: The data in the table is the correlation coefficient (r). *p* *<0.05; *p*** <0.01;

CAS: Coronavirus Anxiety Scale NMQ:Nordic Musculoskeletal Questionnaire

PWBS: Psychological Well-Being

Discussion

This study aimed to evaluate the effectiveness of the Baduanjin intervention on the physical and mental health of college students during the COVID-19 pandemic. The research purpose was underlying the practical need to explore and find a harmless, non-drug intervention with minimal side effects in musculoskeletal and mental health problems caused by the COVID-19 pandemic and sedentary behavior. And further support the feasibility and acceptability of clinical trials of Baduanjin exercise. The main finding was that the reduction of COVID-19-related anxiety of college students is due to the 12-week training of Baduanjin. While no improvement was observed in the health education control group. In addition, participants in the Baduanjin group also showed a simultaneous improvement in the prevalence of lower back pain and psychological well-being. And the change of the prevalence of lower back pain and psychological well-being is significantly correlated with the improvement of COVID-19-related anxiety. Participants had no adverse reactions during the exercise intervention, and all participants were satisfied with the exercise program.

In our research, one of the most remarkable findings was that the effect of the Baduanjin intervention on the COVID-19-related anxiety was significant and higher than that of the health education control group. After the intervention of the Baduanjin exercise, the COVID-19-related anxiety has decreased significantly from 5.22±0.45 to5.07±0.27. The results are consistent with other studies [25,26,27,28]

showing the Baduanjin exercise has a significant effect on alleviating anxiety symptoms. For example, Yu L et al. proposed that the Baduanjin exercise has a certain positive influence on the COVID-19 patients in the Square cabin hospital, which is conducive to alleviating the anxiety and depression symptoms of the patients[27]. A systematic review concluded that the efficacy of Baduanjin exercise in reducing depression and anxiety symptoms in people with physical or mental illnesses[28]. In addition, some studies have shown that excessive exercise or exercise addiction harms anxiety and psychological well-being [29]. Simultaneously, during the pandemic, people who exercise more are less anxious than people who exercise less [30]. Therefore, exercise helps to relieve COVID-19 anxiety, fear, and stress.

Although the detailed mechanism by which Baduanjin improves the COVID-19-related anxiety is not fully understood. As a comprehensive, multi-component intervention, Baduanjin may act through many intermediate variables along the pathway to improved anxiety outcomes. Several studies have suggested that COVID-19 is a new infectious disease with the characteristics of human-to-human transmission, long latency and high mortality[31,32,33,34]. There is still a lot of uncertainty about the origin, nature and process of the disease. Therefore, people are extremely lack of understanding of it. For the time being, there is no specific cure for the disease, which also aggravates people's panic and fear of COVID-19. Therefore, it is necessary to find suitable ways to alleviate people's anxiety and depression. These findings suggest that exercise-induced changes in the HPA axis modulate stress reactivity and anxiety in humans[35,36]. Another possible mechanism for the anxiolytic effects of exercise is via mediation by the endogenous opioid system. Endogenous opioids have a role in the regulation of mood and emotional responses[37]. As a traditional qigong exercise, Baduanjin exercise has the advantage of accessible learning and no need for physical strength, relaxing the mind, and promoting sleep[38]. Some studies have also shown that Baduanjin exercise significantly reduces anxiety and depression[39-41]. These findings might reveal the likely neurobiological mechanisms of Baduanjin exercise in improving COVID-19-related anxiety of people.

Another result of our study found that with the improvement of COVID-19-related anxiety, the participants in the Baduanjin Group also showed significant improvement in the prevalence of lower back pain and psychological well-being. Statistically significant changes were observed in these measures after the 12-week intervention. This improvement may be due to the benefits of regular Baduanjin exercise are expressed through adjusting breathing to make the process smoother, unifying mind and breathing, strengthening muscles and tendons to make the body more flexible, and the union of mind and body [42,43]. At the same time, Baduanjin stresses ‘take the waist as the axis’ in practice [44]. Therefore, regular Baduanjin exercise enhances participants’ physical and mental health and decreases the prevalence of low back pain.

Several factors may explain the positive effects of Baduanjin training on the prevalence of lower back pain and psychological well-being in college students. First, the Baduanjin exercise can effectively reduce the prevalence of lower back pain. The present study is in keeping with these findings, since, as reported elsewhere, Baduanjin exercise can reduce lower back pain[45,46]. And a significant positive correlation between the prevalence of lower back pain(NMQ)and the COVID-19-related anxiety(CAS)(r=0.445) was observed in the present study. Second, it found significant improvements in psychological well-being from Baduanjin training in the present study, related to the decrease of COVID-19-related anxiety of college students. This result is consistent with the research of other scholars[47-51]. There was also a significant negative relationship between changes in the COVID-19-related anxiety(CAS)and psychological well-being (PWBS)(r =-0.631).

During the coronavirus pandemic, Baduanjin exercise can relieve stress and promote sleep quality, enhance mental health and well-being.

Limited of the study

First, This study has only speculated the possible mechanism of the Baduanjin exercise's influence on COVID-19-related anxiety, the prevalence of lower back pain, and psychological well-being through indirect indicators. Nevertheless, it did not explain in more detail the mechanism of the central nervous system and biological indicators.

Second, this study is limited by the impact of the pandemic, the lack of representativeness of research data and participants. For example, outcomes of COVID-19-related anxiety and psychological well-being in this study were measured by subjective questionnaires (CAS and PWBS). Therefore, the subjective measures might have introduced a bias, leading to the potential overestimated intervention effects.

Finally, the results show that the absence of follow-up beyond the 12-week Baduanjin exercise intervention period has had a beneficial effect on lower back pain, COVID-19-related anxiety, and psychological well-being. However, it is not sure whether the intervention effect

still exists after 12 weeks.

Conclusion

In short, this research shows that during the epidemic period, the 12-week Baduanjin exercise can alleviate the anxiety of college students about COVID-19, reduce the prevalence of low back pain, further promote the health of college students and enhance their psychological well-being. Our finding indicates that regular Baduanjin exercise may be an effective, safe, and helpful exercise. To promote college students' physical health and mental health.

Declarations

Availability of data and materials

The datasets analyzed during the current study are available from the corresponding author on reasonable request. And the data used for this study were part of a large international research project registered in the Protocol Registration and Results System

(ClinicalTrials.gov; **https://clinicaltrials.gov/ct2/show/NCT04432038**).

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Contributions

Conceived and designed the study: KL, TMK,ML.

Collected the data: JY,HF,DK.

Analyzed the data: KL, TMK,ML.

Contributed reagents/materials/analysis tools: KL, TMK, ML.

Wrote the paper: KL, TMK.

All authors read and approved the final manuscript.

Ethics approval and consent to participate

The protocol of this study was approved by the Ethics Board for Research Projects at the Institute of Psychology, University of Gdańsk, Poland (decision no. 33/2020). Participation in this study was voluntary. All participants provided oral informed consent before inclusion.A statement to confirm that all methods were carried out in accordance with relevant guidelines and regulations.

Consent for publication

All participants gave their consent.

Competing interests

The authors have no competing interests or potential conflicts to disclose.

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Figures

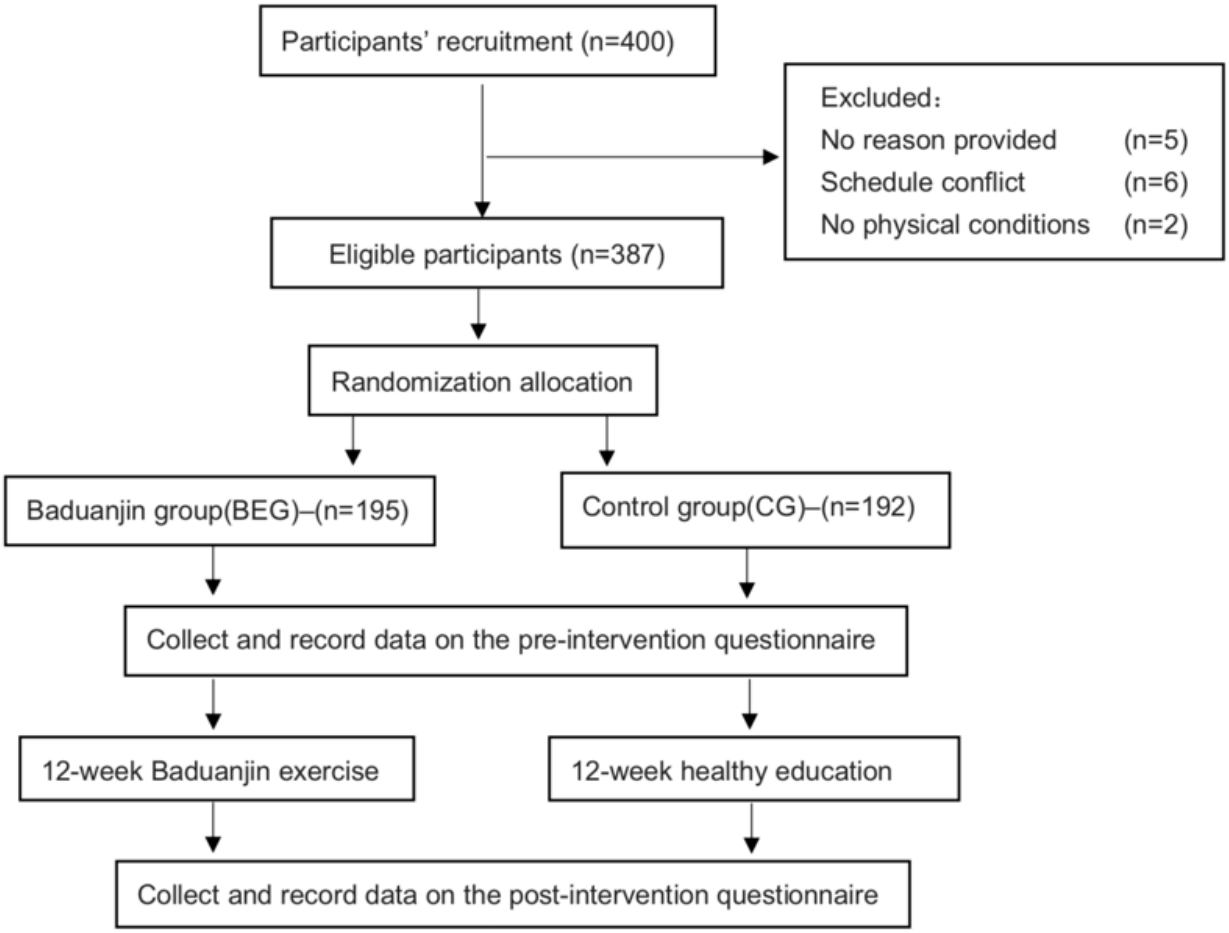

Figure 1

Study flow diagram of the progress through the phases of the experiment

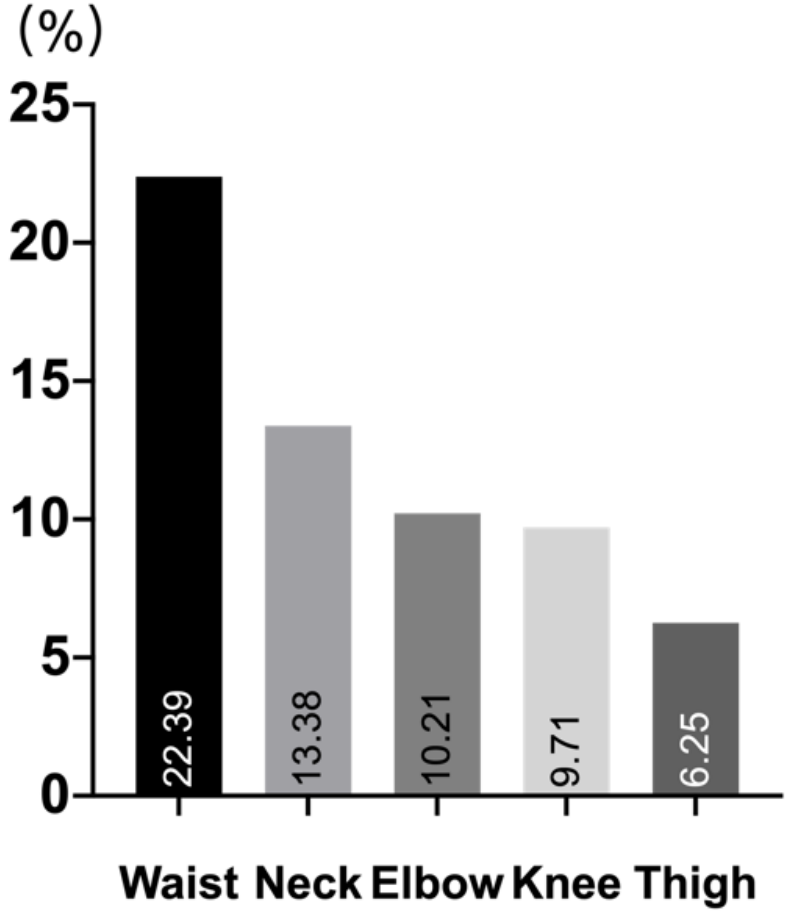

Figure 2

The musculoskeletal pain among the participants of the study ; n=387

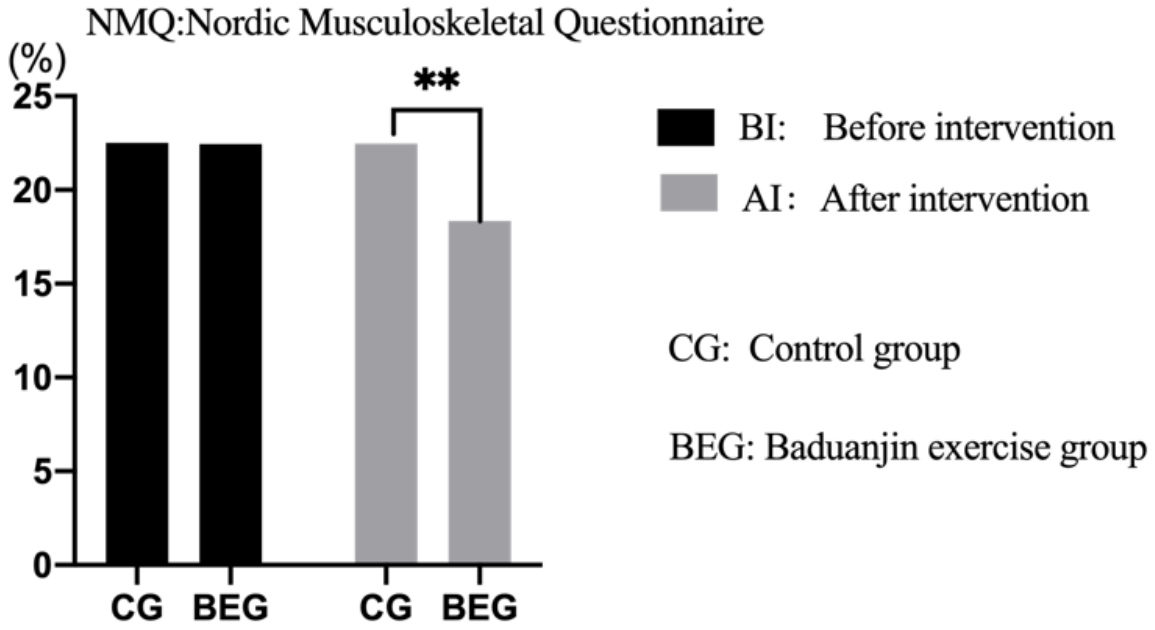

Figure 3

NMQ: before and after intervention between the two groups : Control group vs Baduanjin exercise group p* < 0.05; p** < 0.01.

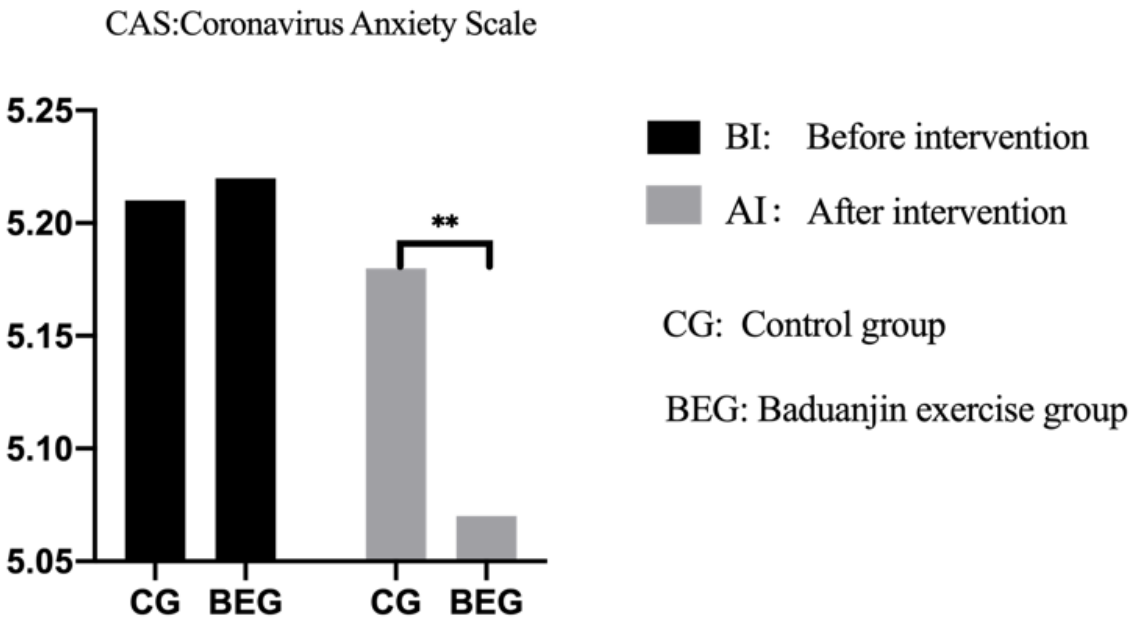

Figure 4

CAS: before and after intervention between the two groups : Control group vs Baduanjin exercise group ; p * < 0.05; p ** < 0.01.

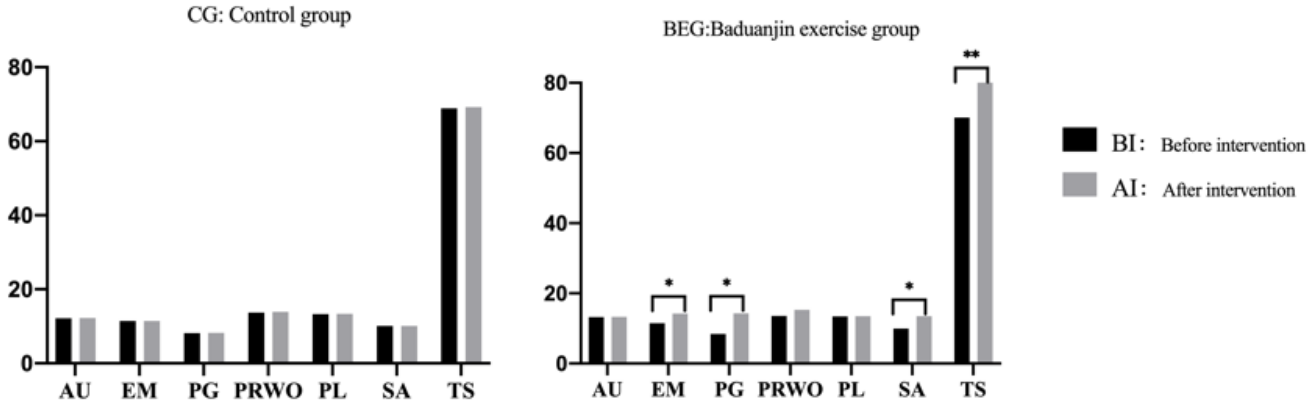

Figure 5

PWBS results by intervention group. Comparison Between before intervention vs. After intervention: p * < 0.05; p ** < 0.01.

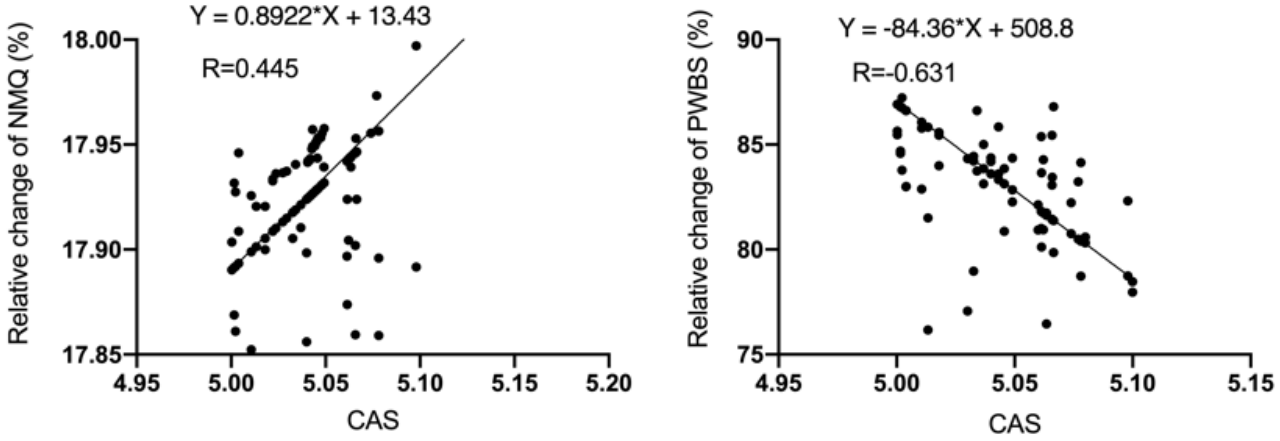

Figure 6