Research Paper

THE EFFECTS OF TAI CHI ON SLEEP QUALITY IN ADULT PRACTITIONERS

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Abstract

The purpose of this study was to examine the effect of a mixed intervention program with live and online Tai Chi practice on the sleep quality of the participants. The sample of the research consisted of 19 practitioners (7 men & 12 women), with an average age of 53.9 ± 6.3 years. They participated in an organized Tai Chi Chuan program which lasted 18 weeks, of which 9 weeks in live sessions and the remaining 9 in online distance learning environment due to Covid-19. The exercise frequency was 3 times/week lasting 90 minutes in live sessions. During the online exercise the duration was adjusted to 60 minutes. The Pittsburgh Sleep Quality Index (PSQI) questionnaire (Greek version GR-PSQI) was used as a measuring instrument, which was given and completed by the participants at baseline (initial measurement) and at completion (final measurement) of the program. The results of the present study showed that after the application of t-test for dependent samples with significance index ($p<0.05$), an improvement in sleep quality was observed between the initial and final measurement. In conclusion, participating in a Tai Chi exercise program seems to be an effective method of improving insomnia and sleep quality in healthy adults.

Keywords: Tai Chi, Sleep quality, PSQI, Live and online distance learning exercise

Introduction

Modern society is expecting tremendous adjustments in time management and people are trying to cope with it by cutting back on sleep. 'Better sleep, Better life, Better Planet' is a global slogan outcall by the World Sleep Society highlighting the major impact of sleep quality on the quality of life. The depth, the duration and continuity of sleep are the three contents of good sleep quality. The adequate amount of sleep is nurturing our ability to function effectively in all aspects of everyday life. Adequate sleep each day affects our ability to learn new tasks that require motor coordination and performance (Ellenbogen et al., 2006). Sleep disorders may cause increased fatigue, sleepiness during the day, decreased functional ability, emotional and psychiatric disorders and consequently low quality of life (Crowley, 2011; Irwin et al.,2006; Morin and Benca, 2012; Yang et al., 2012). Sleep deprivation impairs temporal memory despite other conditions promoting optimal performance (Harrison and Horne, 2000). A probability sample survey of noninstitutionalized adults, aged 18 to 79 years, conducted in 1979 by Mellinger et al. 1985, found that insomnia afflicts 35% of all adults during the course of a year. About half of these persons experience the problem as serious. Research reveals that only 15 % of insomniacs look for treatment or consultation (Mellinger et al. 1985). Despite the high significant morbidity, insomnia often remains unrecognized and untreated, partly due to several barriers to assessment (Morin et al., 2011). Pharmacological therapy is most commonly reported although the magnitude of effect is small (Glass et al., 2005), revealing increased risk of adverse events like

daytime sleepiness, risk of falls, psychomotor or cognitive impairment. Increased sleep duration due to the use of benzodiazepines in the treatment of insomnia which may encounter adverse effects is also reported (Holbrook, 2000). Non pharmacological treatment therapies for sleep disorders address the application of Complementary and alternative medicines (CAM). A growing body of clinical trials using CAM have revealed their effectiveness and benefits for sleep quality through the use of modalities like melatonin, valerian, acupuncture, acupressure or mind-body practices like Tai Chi, yoga and meditation (Gooneratne, 2008). Tai Chi is often referred to as 'medication in motion' and, as a mind-body exercise, it strengthens, stretches and balances the practitioner while improving health, personal development and self-defense (Wayne and Fuerst, 2013). Numerous systematic reviews have examined the effectiveness of Tai Chi in general health. Tai Chi seems to enhance psychological wellbeing improving anxiety, stress, depression and mood disorders while increasing self-esteem (Wang et al., 2010). Tai Chi exercise appears to improve both cell-mediated immunity and antibody response in immune system (Ho et al., 2013), aerobic capacity (Lee et al., 2009) and chronic musculoskeletal pain (Hall et al., 2017). Tai Chi may be an effective, safe, and practical intervention for maintaining BMD in postmenopausal women (Wayne et al., 2007) while a systematic review (Wang et al., 2004) suggest that Tai Chi appears to have physiological and psychosocial benefits and also appears to be safe and effective in promoting balance control, flexibility, and cardiovascular fitness in older patients with chronic conditions. Evaluating the participation motives in Tai Chi programs, results show that practitioners exercise more for the enhancement of vitality, the reduction of stress, tension and the improvement of their fitness (Chatzipanagioti et al.,-2013). Y T Wang, et al (2004) evaluated the effect of Tai Chi training on the physical and mental health of college students on the southeast coast of the United States revealing significant improvements in physical pain, general health, mental and emotional function, vitality, and mental health perception. Tai Chi Chuan training can be considered a non-pharmacological approach to improving adult sleep (Irwin et al., 2008; Yuhao et al., 2020) and as an effective alternative and complementary approach to existing therapies for self-reported sleep problems (Shizheng et al., 2015). Tai Chi Chuan reduced cellular inflammatory responses and expression of genes in proinflammatory mediators (Irwin et al., 2015) in older adults with insomnia while practicing Tai Chi for 24 weeks positively affected fatigue, depression, vigour and sleep quality among older adult women (Cheng et al., 2021). The results of a 10-week Tai Chi Chuan (TCC) intervention on anxiety and sleep quality in young adults randomized into three groups reported that sleep quality scores improved across time for all three groups, but adherent TCC participants reported greater improvement than control participants (Caldwell et al., 2016). Research suggest that Tai Chi may have a positive effect on sleep quality, balance and cognitive training (Nguyen et.al,2012) while clinical evidence proof that Tai Chi may improve sleep quality among heart failure patients and among patients of fibromyalgia, arthritis and cancer (Lan et al., 2013).

The nature of Tai Chi is considered as a complex, multicomponent mind-body intervention. It scales from easier to learn basics to very high demanding movement patterns, forms and partner work. The presence and supervision of a qualified teacher is with no doubt essential in order to master and understand all applications for all levels on all stages of the education.

Some of the key points in the structure and design of online Tai Chi lessons are: 'Shaping' the environment - 'Marking' the room - Technical issues and materials - Costs of production – Preps - Methodology – follow-ups – feedback - Group dynamics - Motivation and communication - Self-control - Intros and closures. Tai Chi online programs had already answered to the needs of people with busy life style conditions as a good solution to work out at home. Many factors must be taken into account in order to have a successful implementation of online education through a corresponding platform. The preparation phase includes the correct configuration of the teaching area - especially when it is done from the familiar environment of the instructor's home - the familiarization with the use and application of new technologies and the correct guidance in the application of all monitoring factors by the group of the sample (Daskalaki K. et al, 2021).

This study was conducted in order to support current literature and to measure the extent that Tai Chi Chuan practice can affect sleep quality. The purpose was to examine the effects of an 18 weeks Tai Chi Chuan Yang style mixed intervention program with live and online distance learning methodology on the sleep quality of the participants. The adaptation of the program into online sessions after 9 weeks of live training was due to the Covid-19 pandemic that influenced at that time the intervention. The adaptation of the research conditions, the training contents and methodology during the online practice was a necessary procedure in order to maintain the quality of the intervention program.

Methods

Study Participants

Participants were 19 healthy adults (7 men and 12 women) with an average age of 53.9 ± 6.3 years, who were recruited for this research through a presentation of the aims of the research intervention program and its structure. All participants signed the informed consent and they filled up a brief medical history. In order to enroll the volunteer's population of this study a few criteria were used. With a few exceptions, the main three inclusion criteria were: a.) being inactive, as defined by the absence of involvement in any structured or regular exercise activities during the previous 3 months, b.) the absence of chronic disease, the systematically use of medication and being healthy to the extent that the participation in exercise testing and an exercise program would not affect any existing disease or health conditions c.) willingness to be assigned to the pre and post research measurements and testing conditions, the answering of questionnaires and the participation in a three time on a weekly basis Tai Chi exercise sessions for the 18-week intervention program. A letter of consent for the use of the indoor facilities of the Progressive Association of Xanthi, a community-based non-profit organization, was handed for the realization of the practical sessions in the Tai Chi intervention program. The protocol of this study was approved by the ethical committee of the Democritus University. Adherence to the intervention was set a priori as attendance at 80% of the Tai Chi Chuan classes.

Research Design

The study took place from January and May 2020. The aim of the study was to examine the effect of a Tai Chi program on the sleep quality of adult practitioners. Initially the study was designed for 12

weeks. Due to the outburst of the Covid-19 pandemic during the 9th week of the intervention, it became necessary to reschedule and adapt the program into online sessions. The duration of the study expanded to 18 weeks because it became necessary - due to those restrictions - to delay the follow up measurements and proceed only later in May 2020 in the facilities of the University. Data of the research were collected at baseline and after a period of 18 weeks in the laboratory of Rehabilitation of the Department of Physical Education & Sport Science of the Democritus University of Thrace in Komotini and the indoor facilities of a community-based organization in the town of Xanthi. Participants were given instructions and were asked to fill out the Pittsburgh Sleep Quality Index (Greek index-PSQI) questionnaire prior of their first practical session. A new reality appeared in the world of internet - based exercise in Tai Chi that would - in this case of emergency - support with effective solutions and protocols. During the pandemic of Covid-19 the need for livestreaming exercise became a must-have, gaining more popularity. During the first 9 weeks of live sessions each participant would attend classes of Yang style Tai Chi and the duration of each session was 90 min three times a week during live training. Each session consisted of 10-15 minutes warming up routines, the Tai Chi fundamentals practice and form and a 5-10 minutes cooling down or closure session and was enriched through relaxation musical accompaniment. The main part of the training session included basic legwork routines and stances, tai chi principles, walking routines and standing, rooting, weight shifting and core-alignment fundamentals, breathing and relaxation techniques, meditation and imagery techniques, multidirectional coordination practice of leg, arms and core movements and the learning of a short version 13 movements of the traditional Yang style Tai Chi form.

During the online distance learning period the duration of each training session was adapted to 60min/3 times a week while the training contents remain the same. In this case a decrease in total training time or number of repetitions of movements is often imposed in online training sessions, because experts need to secure a more effective communication with the participants. —The intervention program was coordinated by an experienced certified Tai Chi Chuan & Qi gong instructor and coach who applied the scientific and traditional principles of training and coaching in this internal martial art. The online program was designed by the same instructor who applied all necessary adaptations in the methods of instruction, feedback, verbal and visual guidance at all times in order to control the correct execution of the movements, support the contents of the intervention program and enhance the participation motives of the participants.

Measurements

The Pittsburgh Sleep Quality Index (PSQI) (Greek version-PSQI)

The Pittsburgh Sleep Quality Index questionnaire (PSQI-Greek version) validated for its Greek version by (Perantoni et al., 2012) was used to assess sleep quality and sleep disturbances of the participants. The Pittsburgh sleep Quality Index (Buysse et al.,1989) is a self-rated questionnaire widely used both for clinical purpose as for research evaluation. It is easy to be used and has shown high internal consistency and good validity for patients with primary insomnia and sleep disorder. It consists of 19 self-rated questions that correspond to 7 component scores (subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication,

and daytime dysfunction). The answers are given on a higher scale with a score from 0 to 3 (not during the past month, less than once a week, etc.). The questions are related to sleeping habits during the last thirty days only. The measures of the 7 component scores are summed and give the PSQI World Index (from 0 to 21). Based on the PSQI world rating, sleep quality is ranging from poor (PSQI world score > 5) to good (PSQI world score ≤ 5). A total score of 5 or higher indicates poor sleepers. The higher the score, the worse the quality of sleep. When the PSQI world score is > 5, more than at least two severe areas or three moderate areas indicate difficulties of the subjects to sleep. Therefore, it is accurately analyzing the severity of sleep disorders and the number of existing problems through one simple measure (Feinstein, 1987). The purpose of this study was to evaluate sleep quality distinguishing poor sleepers from good sleepers. Data of this study was collected at baseline and after a period of 18 weeks at the completion of the intervention program.

Statistical Analysis

After the use of IBM SPSS statistical package with the application of paired t-test for dependent samples, mean values were compared with a p-value < 0.05 considered as statistically significant.

Results

Participants of the study showed improvements in 6 PSQI subscale scores (subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, daytime dysfunction) and the PSQI Global score. Subscale score 6 (Use of sleep meds) remained unchanged. There was not any statistically significant difference in 6 out of 7 components, that are sleep latency (COM2), sleep duration (COM3), habitual sleep efficiency (COM4), sleep disturbance (COM5), use of sleep meds (COM6), daytime dysfunction (COM7) as presented in Table 1.

Table 1: Results of paired t-test for dependent samples

Paired Samples Test							
Paired Differences							
Pairs	**Variables**	**Differences**	**Mean**	**Std. Deviation**	**t**	**df**	**Sig.(2-tailed)**
Pair1	Subjective sleep quality	BCOM1-ACOM1	0.421	0.607	3.024	18	0.007
Pair2	Sleep latency	BCOM2-ACOM2	0.000	0.577	0	18	1.000
Pair3	Sleep duration	BCOM3-ACOM3	0.158	0.602	1.143	18	0.268
Pair4	Habitual sleep efficiency	BCOM4-ACOM4	-0.211	1.316	-0.697	18	0.494
Pair5	Sleep disturbance	BCOM5-ACOM5	0.737	3.194	1.005	18	0.328
Pair7	Daytime dysfunction	BCOM7-ACOM7	0.053	0.705	0.325	18	0.749

BCOM1=Component 1 Before, ABCOM1= Component 1 After *statistically significant difference at baseline and at follow up (p<0.05)

Tai Chi had a statistically significant effect (t=3.024, respectively p<0.05) on improving the subjective sleep quality at baseline (0.79± 0.787) and at follow up (0.37±0.767) as presented in Table 1. There was an improvement on sleep onset latency (COM2) 3.15 min less per night while the score of (COM6) Use of sleep meds remained unchanged. 6 out of 7 subscale scores show improvements as shown in Figure 1.

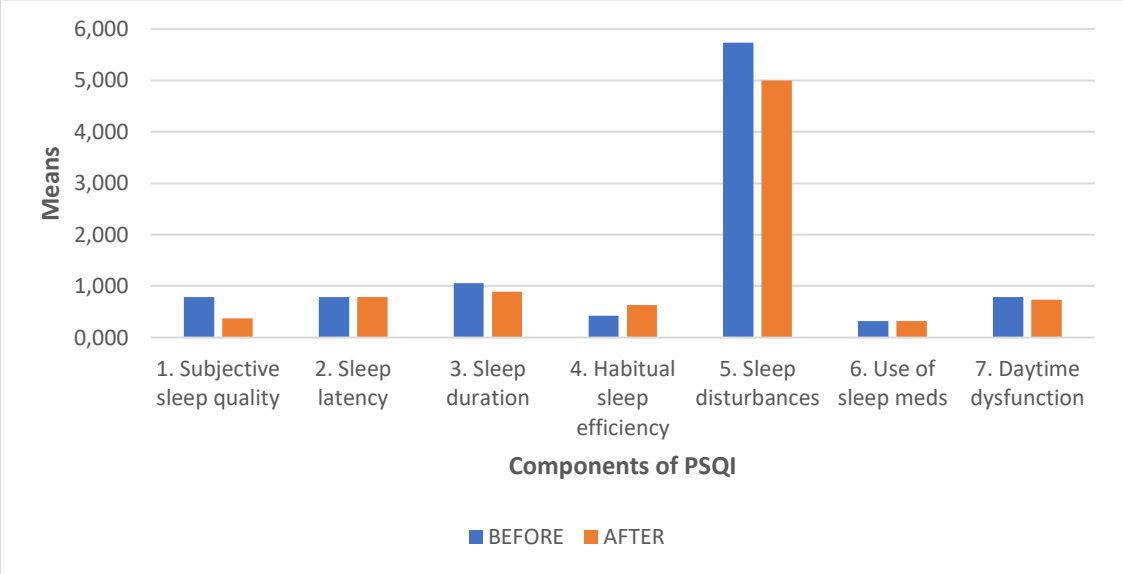

Figure 1.: Differences in means of all components of PSQI both at baseline and follow up

PSQI Global Score revealed no significant statistical difference (t=1,073, respectively p>0.05) as shown in Table 2.

Table 2.: Results for paired sample t-test for dependent samples, PSQI Global Score

Paired Samples Test Paired Differences							
Pairs	**Variable**	**Differences**	**Mean**	**Std. Deviation**	**t**	**df**	**Sig.(2-tailed)**
Pair1	Global Score	BSCORE-ASCORE	1.158	4.705	1.073	18	0.298

However, the score improved in mean values from 9.895 at baseline to 8.737 at follow up (good to poor 4/19 participants) (Figure 2).

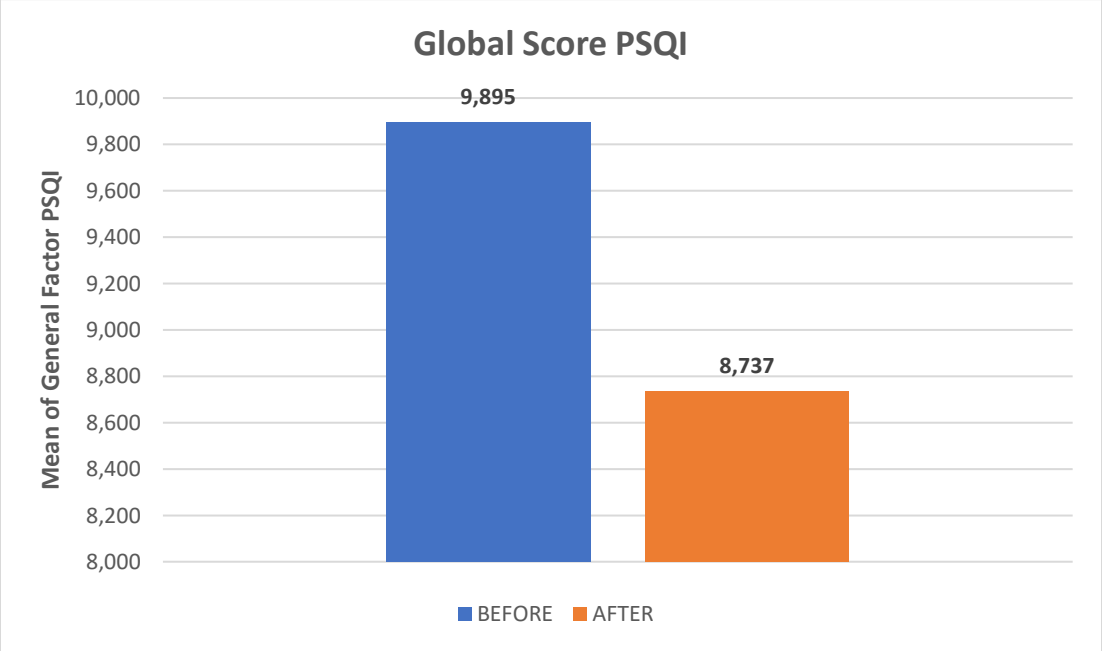

Figure 2: Results of means Global Score (PSQI)

Discussion

This present study showed that Yang style Tai Chi had significantly affected the subjective sleep quality of subjects and improved the mean values of global score. This proves that that the application of this style, due to its characteristics, has a strong impact on the results of the PSQI (H Li et.al, 2020). Tai Chi is a low impact safe alternative exercise combining body movement and breathing techniques. The exercise intensity through the intervention program of this present study included all essential components of exercise that supported moderate intensity, like breathing and relaxation routines, walking and posture alignment, imagery techniques supporting mind-body exercise characteristics. Moderate physical activity may have better effects on the improvement of sleep quality than vigorous activity (Wang and Boros, 2021). Yang style Tai Chi is an aerobic exercise with low to moderate intensity improving functional ability (Lan et al., 2008) proving that this might have affected the improvement of the mean values of all 7 component scores in this study. Tai Chi exercise intensity is varying depending on its training styles, the duration of forms and postures. Its characteristics include exercise in semi squat posture of continuous flowing spiral body movements. Further research reported improvement in health outcomes including physical performance, pain reduction, and psychological well-being. With other forms of exercise, the mind-body connection or control is not always incorporated (Yang et al.,2012). For example, compared to a meta-analysis of the effect of exercise training (SMD=0.47, 95% CI 0.08–0.86) on improving sleep quality in middle-aged and older adults with sleep problem, Tai Chi intervention seems to have a better effect (SMD=0.89, 95% CI 0.28–1.50) (Raman et al., 2013). The advantages of Tai Chi exercise as a multifunctional non pharmacological treatment method may be due to its mind body components that heal and restore

health in many ways. Due to pathways that act in the relief of pain, that boost immune function and act in the neuroendocrine system Tai Chi may improve the practitioners mental, emotional, physical and social health (Davidson et al., 2003; Irwin et al., 2007). Mind body exercise like Tai Chi may affect the homeostatic balance of sympathetic/parasympathetic function. Results of the study showed improvement on sleep onset latency less than 3.15 min per night proving that as a mind-body exercise it might release stress and improves mood. The combination of conscious rhythmic breathing, the calming of the mind and the controlled coordinated movement of the body are dimensions of the Tai Chi practice that result to the stimulation of the parasympathetic nervous system and the decrease of the sympathetic. It may additionally result to the stimulation of endogenous neurohormones and other mechanisms that enhance our health, treat insomnia and consequently improve sleep quality (Jahnke et al.,2010).

In conclusion the purpose of this study was to examine if a mixed program with face - to - face exercise and online training effected the sleep quality of participants. Yang style Tai Chi exercise programs due to its multi-component integration of various elements seem to have effectively improved the components of the PSQI (Li H et. al, 2020). Limitations of the study maybe due to the pandemic of Covid19 which might have affected the results.

Tai Chi is a low budget exercise where no other instruments are necessary other than the body weight. As a Chinese type of calisthenics, it can be easily applied in various space conditions and facilities (Lan C. et al, 2013). The mixed intervention program in Tai Chi due to the pandemic was a necessary solution as in many exercise programs worldwide. The success of online courses is the result of good interaction between the trainer and the participants, while the improvement of such a program is based on the ability to evaluate and estimate the factors before and after the implementation of the online session by the trainer himself (Daskalaki K. et al, 2021). Online programs in Tai Chi may attract people that have time limitations in everyday life offering the option of exercising at home. The no commuting nature of online exercise are attractive solutions nowadays.

Some of the difficulties of online courses in Tai Chi that are identified: network connectivity problems, the non - familiarity with new technologies, technical problems, limited practice space, reduced ability to correct practitioners and follow up, the lack of social interaction and the minimization of in-depth practice and detailed observation of movements at all levels (Worobetz, A. et al 2022). However, it is an important tool that additionally enhances the possibilities of exercise and enriches the practice in Tai Chi. Online Tai Chi can subsequently support the exercise but should not be considered as the only effective way to learn.

The need for additional research on the effect of a mixed program with live and online exercise programs in Tai Chi could significantly enhance the understanding of the mechanisms that affect the quality of sleep and the overall functional ability of adult practitioners out of the traditional and controlled environment of learning by the presence of a qualified instructor.

Limitation of Study

Due the restrictions of the pandemic Covid19 the methodology of the intervention does not include a control group. Moreover, the initial team consisted of 26 people. For reasons that relate to the Covid

19 pandemic, the technical difficulties of participation in the online sessions and personal restrictions, 7 people dropped out of the program after the 9th week when the intervention program was adapted to online training. In future research a larger number of participants would be suggested and a control group.

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