
HOW PHYSICAL EXERCISE IMPROVES THE SLEEP QUALITY OF THE ELDERLY: AN EVIDENCE FROM CHINA

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Abstract

The sleep problems are commonplace in the elderly, which seriously endangers physical and mental health. Physical exercise is a non-drug treatment that may improve the sleep quality of the elderly. Based on the Pittsburgh Sleep Quality Index (PSQI), this paper evaluates the sleep quality of the elderly in local communities in China, and sets up a series of controlled experiments to analyze the influence of Tai Chi on the sleep quality of the elderly. The experimental results were analyzed on the SPSS20 software. The results show that sleep quality index and total sleep score of the elderly with were significantly reduced through the intervention of physical exercise, with a smaller-than-0.05 P-value. Furthermore, the author elaborated the influencing mechanism of physical exercise on the sleep quality of the elderly, and put forward relevant suggestions. The research results provide a good reference for the improvement of sleep quality of the elderly.

Key words: Elderly, Sleep Quality, Tai Chi, Physical Exercise, Pittsburgh Sleep Quality Index (PQSI).

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INTRODUCTION

With the development of economy and society and the evolution of population structure, following the trajectory of developed countries such as Britain and Japan, China began to enter an aging society since the early 21st century (Zisberg, Gur-Yaish, & Shochat, 2010). China's population aging has three main characteristics: large base, fast speed, and high peak (Wu, Su, Fang et al., 2008). Some experts predicted that by 2025, China will have 280 million elderly people, accounting for one-fifth of China's total population. By the middle of the 21st century, China's elderly population will even exceed 500 million, reaching a 32% aging level (Obayashi, Saeki, Miyata et al., 2015). The aging of the population has sharply increased the medical and pension burdens on the families and the whole society. Medical care, health level,

daily life care, and spiritual and cultural needs of the elderly have become important problems for the community construction.

For the elderly themselves, their tissues and organs are aging with age and the body functions and immunity are gradually declining, which seriously endangers the physical health of the elderly (Amer, Hamza, El Akkad et al., 2013). Among these problems, the sleep problem is an important indicator of the health of the elderly, and sleep quality has a significant positive correlation with the physical condition of the elderly. Sleep is a protective mechanism for human health, only in deep sleep, the fatigue of the human body tissue system can be alleviated and the energy can be restored (Ichimori, Tsukasaki, & Koyama, 2015). Sleep disorders can increase the chance of slip-and-fall of the elderly, and meanwhile it would aggravate their depression and anxiety, and deteriorate their long-term memory (Zheng, Chen, Chen et al., 2014). Physical exercise can maintain and improve the physical condition of the elderly and it is an effective non-medication treatment

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method. Tai Chi is a traditional boxing technique in China, which can exercise both the inside and outside of the human body, and can exercise both the rigidity and the flexibility of the exerciser. Legend says that Tai Chi was created and developed by Zhang Sanfeng, and the dialectical concept of yin and yang in Chinese classical Confucianism and Taoism has been incorporated in Tai Chi (Chan, Chan, & Mok, 2010). The function of Tai Chi is obvious in helping the elderly to regulate breathing, rest the mind, strengthen the body, improve the sleep quality, as well as entertain them and relax their mood (Buysse, Reynolds, Monk et al., 1991).

Since physical exercise has played a positive role in people's health and sleep quality, in recent years, many scholars have studied the influence of physical exercise on the sleep quality of the elderly (Garfinkel, Laudon, Nof et al., 1995). Tanaka, Taira, Arakawa, Urasaki et al. (2010) surveyed 420 community elderly people, 46% of whom have sleep disorders, and 61% have difficulty falling asleep after suddenly waking up at night, 56% have the trouble of daytime sleepiness, and 21% are using drugs to help fall asleep. Hosseini, Esfirizi, Marandi et al. (2011) systematically expounded the sleep characteristics of the elderly: their depth of sleep becomes shallower, they are easily awakened by outside disturbance, and during the daytime, they are prone to sleepiness. Sleep disorders would largely reduce the life quality of the elderly and increase their risk of illness. Through experimental data, Karimi, Soroush, Towhidi et al. (2016) expressed that frequent use of drugs can make insomnia even more serious, and physical exercise intervention is one of the scientific methods to improve sleep quality. Du, Dong, Zhang et al. (2015) conducted a controlled trial of the elderly in the communities, and the results showed that Tai Chi has a certain effect on the treatment of insomnia and anxiety in the elderly.

In order to study the effect of physical exercise on the sleep quality of the elderly, this study conducted surveys on the community elderly in Changchun, Wuhan and Guangzhou, and set up a series of controlled experiments to analyze the influence of Tai Chi on the sleep quality of the elderly before and after physical exercise intervention, and then this paper expounds its mechanism and proposes feasible suggestions and countermeasures.

PHYSICAL EXERCISE INTERVENTION PROGRAM

The research target of this paper is the influence of Tai Chi on the sleep quality of the elderly in the communities. Research methods such as literature review, questionnaire survey and controlled experiment were applied to carry out the studies. In the specific experiment, a set of physical exercise intervention programs were formed: 360 elderly people under the age of 60 were selected from several typical communities in Changchun, Wuhan and Guangzhou, China. All subjects met the following criteria: no major physical illness, able to complete the exercises during the test independently, and all were informed of the study and volunteered to participate in the experiment.

The experimental subjects studied and practiced Tai Chi under formal instructions for a period of 3 months. Subjects exercised more than 20 times a month, and each exercise time was about 1 hour. The exercise intensity was kept moderate and the heart rate during exercise was controlled at 88~120/min. The subjects were asked to take no extra physical exercise other than necessary routine labor works.

Then, the Pittsburgh Sleep Quality Index (PSQI) was used to evaluate the sleep quality of the elderly during the experiment. There were 19 self-assessments and 5 others-reviews in the scoring items, and the cumulated score was the PSQI score. The higher the score, the worse the sleep quality. At the same time, based on the statistical principle, the experimental data was expressed by the mathematical expectation \pm standard deviation, and the results were statistically analyzed by SPSS20 software. If P-value is less than 0.05, then it is a significant difference.

SURVEYS OF THE SPORTS OF THE ELDERLY BEFORE PHYSICAL EXERCISE INTERVENTION

Figure 1 shows the preferred sports programs of the elderly in communities. The survey results show that 48% of the elderly people like to jog or walk. According to the questionnaires we can know that, the reason for this is that the physical functions of the elderly are degraded in all aspects, so they prefer this sport type with lighter intensity and less injury. 24% of the elderly people choose aerobics or square dance,

the proportion of elderly people who choose ball games is 17%, and 4% select swimming, in addition, 7% of the elderly have a preference for Tai Chi.

Figure 2 shows the survey results of the exercise amount of the elderly in the communities, and the calculation of the exercise amount is shown as follows:

$$\text{Exercise amount } Q = \text{Exercise intensity } S \times \text{Exercise frequency } P \times \text{Exercise time } T \quad (1)$$

Figure 1. Sports programs preferred by the elderly in communities

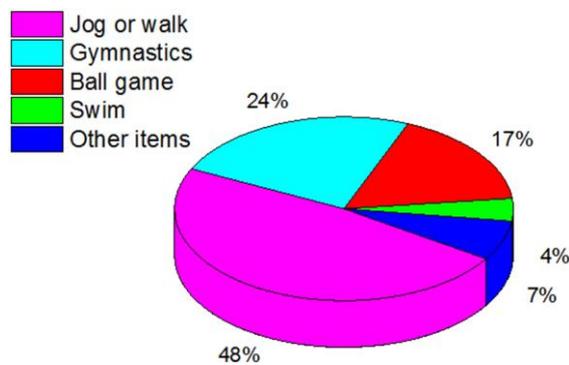
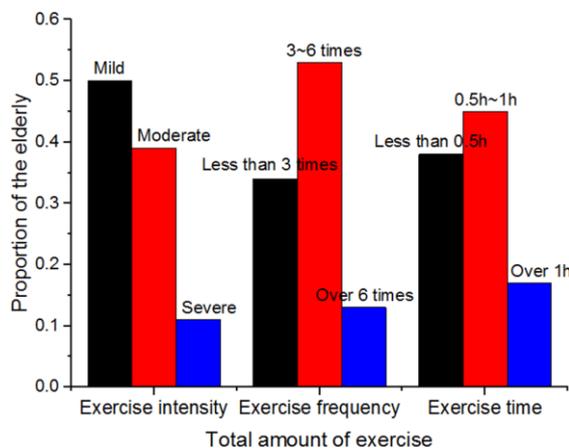


Figure 2. The amount of physical exercise of the elderly in the communities

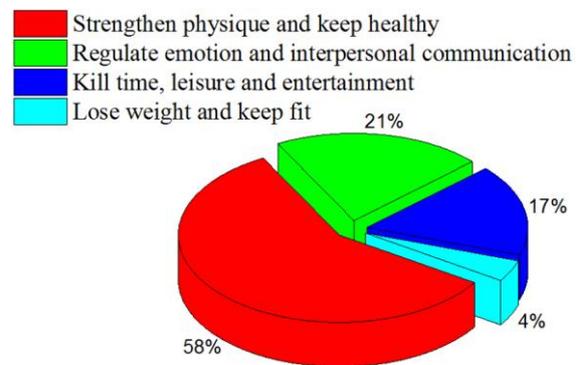


The results show that, for half of the elderly, their exercise intensity only reaches a mild level, that is, a little sweating; the elderly who exercise to sweat heavily only accounts for 11%. For more than half of the elderly, their exercise frequency is 3 to 6 times a week, only 13% exercise more than 6 times a week. 42% of the elderly have an average exercise time of between half an hour and one hour, which is suitable for physical

health, but there are still nearly 40% of the elderly who have an average exercise time of no more than half an hour.

With the development of social economy and the improvement of people's living standards, the exercise frequency and total exercise amount of the elderly have increased to some extent, and people's awareness of physical exercise has been strengthened significantly. As shown in Figure 3, the survey results show that the main purpose of the elderly to do physical exercise is to enhance physical fitness and maintain health, accounting for up to 58%. In addition, the number of elderly people who exercise for the purpose of mood regulation and interpersonal communication ranks second, accounting for 21%. Since the children of the elderly in modern communities are working in other places, there are many empty-nest elderly people, so 17% of the elderly do physical exercise to kill time, and for leisure and entertainment. Besides, a few elderly people want to lose weight and keep fit through the means of physical exercise.

Figure 3. Main motivations of community elderly to do physical exercise



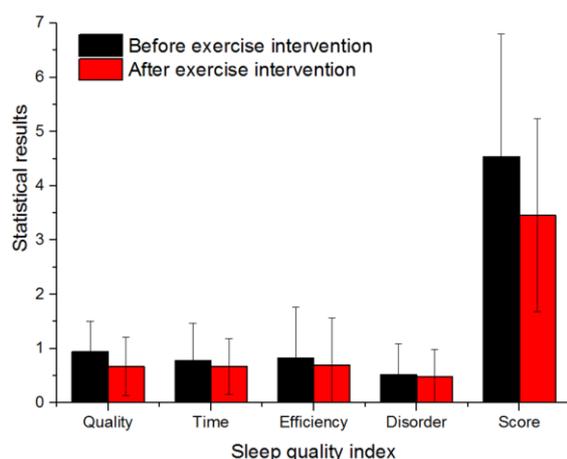
EFFECT OF PHYSICAL EXERCISE ON THE SLEEP QUALITY OF THE ELDERLY

Data analysis of experimental results

As shown in Figure 4, based on the experimental data analysis of 360 community elderly in Changchun, Wuhan and Guangzhou, after a three-month non-medication physical exercise intervention, the sleep quality of the community elderly had been improved to some extent. Compared with the sleep situation before physical exercise intervention, the sleep quality index and total sleep score of the elderly

had been significantly reduced, after statistical calculation, the obtained P-value was less than 0.05. In addition, the sleep time, efficiency and sleep disorders had not changed much, and the calculated P-values exceeded 0.05, which is in line with the basic principle of mathematical statistics.

Figure 4. Sleep quality before and after physical exercise intervention



As the age of the elderly increases, the functions of their tissues and organs are degenerating, which is also reflected in the sleep problem that their sleep quality is greatly reduced. Older people go to bed early, and get up early; their sleep at night is shallow and susceptible to disturbances, resulting in reduced sleep efficiency, in fact, their effective sleep time is far from enough; and they are prone to daytime sleepiness. The long-term accumulated sleep quality problem will weaken the body immunity of the elderly and their risk of illness would increase dramatically; the depression and anxiety of the elderly will continue to spread, which would do serious harm to their health. The

three-month Tai Chi intervention experiment has scientifically proved that Tai Chi has a significant effect on the sleep quality index and the total sleep score of the community elderly. Its mechanism is that Tai Chi makes the daytime exercise time of the elderly longer, thus reducing their chance of daytime sleepiness; the fatigue feeling of moderate exercise help them fall asleep better and improve the sleep efficiency. In short, as a typical sport program, Tai Chi can greatly improve the sleep quality of the elderly.

Suggestions for improving sleep quality of the elderly in communities

Based on the Pittsburgh Sleep Quality Index (PSQI), this study conducted investigation on the subjective sleep sensations of the elderly before and after physical exercise intervention, and the obtained scores of the sleep quality indicators are shown in Table 1. The total PSQI score of the community elderly is 11.08 ± 2.83 . Among the decomposed sleep quality factors, the score of the sleep efficiency is the highest, while the score of the hypnotic drug is the lowest.

Since sports such as Tai Chi have a significant effect on improving the sleep quality of the elderly, the following suggestions are proposed for the sleep quality management of the community elderly: (1) Formulate a suitable Tai Chi program with moderate exercise intensity, frequency and time for the community elderly, and form fixed moves and standard practice methods; (2) Carry out promotion of Tai Chi-related traditional culture among residents and create a good atmosphere for physical exercise and mutual learning; (3) Regularly organize collective exercise activities or performances for public welfare, and bring good news to overcoming or alleviating the sleep quality problem of the elderly.

Table 1. Scores of sleep quality factors

Sleep quality factor	Score distribution				PSQI score
	0-point	1-point	2-point	3-point	
Subjective sleep quality	12	64	25	14	1.21 ± 0.82
Sleep time	8	39	31	37	1.72 ± 0.73
Sleep efficiency	1	38	47	29	1.89 ± 0.64
Sleep disorder	1	60	46	8	1.59 ± 0.61
Hypnotic drug	76	15	9	15	0.72 ± 0.96
Daytime dysfunction	29	51	24	11	1.09 ± 0.89

CONCLUSION

Based on the PSQI, this paper conducted experiments on community elderly in Changchun, Wuhan and Guangzhou, China, and studied the positive effects of physical exercise intervention on improving the sleep quality of the elderly. The specific conclusions are as follows:

(1) Most elderly people in the communities choose low-intensity exercises such as jogging or walking. For some elderly people, their total exercise amount is too low due to not-enough exercise time. Besides strengthening the physique, there are various exercise motivations among the elderly population.

(2) After the three-month Tai Chi training and practicing, the sleep quality of community elderly has been improved to some extent compared with that before the physical exercise intervention. The sleep quality index and total sleep score of the elderly have been significantly reduced, and the calculated P-value is less than 0.05. In terms of sleep time, efficiency and sleep disorders, the changes were not significant, and the corresponding P-values were also greater than 0.05.

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