

Analysis of the Advantages of Sand Table Tennis on the Physical and Mental Health of the Elderly

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Abstract: In order to further understand the impact of sandpaper table tennis on the physical and mental health of the elderly, and to provide more scientific and reasonable sports activity choices for the elderly, this study designed a detailed questionnaire based on comparative experiments, and optimized the reliability and effectiveness of the questionnaire through predictive testing. In order to understand the specific impact of sandpaper table tennis on the physical and mental health of elderly people, the study also adopted field observation method. Elderly people who participated in sandpaper table tennis were observed for several weeks in communities and elderly activity centers, and their activity participation, physical coordination, and social interaction were recorded. Research has found that elderly people who participate in sandpaper table tennis maintain a testing distance of over 509m, while those who do not participate in the sport have a maximum distance of only 445m. The loneliness rating scale also showed that elderly people who participated in sandpaper table tennis scored lower than those who did not participate in the sport.

1. Introduction

The global trend of aging population is intensifying, making the physical and mental health issues of the elderly gradually a focus of public health attention. Among the many activities that benefit the physical and mental health of the elderly, sandpaper table tennis, as an emerging sport, has received widespread attention due to its unique sports characteristics and social functions. However, research on the impact of sandpaper table tennis on the physical and mental health of the elderly is still insufficient, especially in quantifying its specific effects on physical coordination, physical fitness, social interaction, and mental health of the elderly.

Through comparative experimental methods, this article aims to explore the impact of sandpaper table tennis on the physical and mental health of the elderly, in order to provide more scientific and reasonable sports activity choices for the elderly and provide scientific basis for the formulation of relevant health promotion policies. This study not only fills the gap in existing research, but also

comprehensively evaluates the potential benefits of sandpaper table tennis on the physical and mental health of the elderly through quantitative and qualitative data collection and analysis.

In the article, the research background and importance are first introduced; secondly, relevant work has been reviewed, including the current research status on the relationship between physical activity and health of the elderly both domestically and internationally; subsequently, the research method is described, including research design, sample selection, data collection, and processing; then, the data analysis results are presented and discussed; finally, the research findings are summarized, and corresponding suggestions and future research directions are proposed.

2. Related Work

With the intensification of global population aging, the health issues of the elderly are increasingly receiving social attention. Li Yihao [1] further explored the factors of reduced physical activity and its impact on the health of the elderly population, and based on the necessity of physical activity in the context of the epidemic, put forward targeted suggestions to increase the amount of physical activity of the elderly in the context of the COVID-19 epidemic, with a view to promoting the health of the elderly. Zhu Hailu [2] selected 568 elderly family members from 9 nursing homes in Shaanxi Province and conducted a survey using the Simplified Stress Perception Scale, the Intolerable Uncertainty Scale, and the World Health Organization's five health scales to explore the relationship between chronic disease comorbidities among elderly people in closed management institutions and the physical and mental health of their families, and analyzed the mediating effects of perceived stress and unbearable uncertainty. Liu Caimei [3] conducted a questionnaire survey on 400 elderly people to explore the relationship between social networks and mental health, using loneliness and depression as indicators of mental health. The study examined the mediating role of aging attitudes in the relationship between the two and the moderating effect of education level. The results showed that social networks of elderly people were significantly negatively correlated with their levels of loneliness and depression. Liang Xiaolin [4] used data from the 2018 "China Elderly Health Longevity Tracking Survey" to comprehensively analyze the impact of social participation on the health of the elderly and its urban-rural differences using logistic regression models and propensity score matching methods. Shang Zijuan [5] found that Internet accessibility has a negative impact on the health of the elderly, but it has improved the health of the elderly. Internet participation and the development of digital economy have significantly improved the health of the elderly, especially the impact of digital society on the health of female elderly.

Many foreign scholars have also explored the physical and mental health of the elderly. Bhandari P [6] analyzed the relationship between the lifestyle behaviors of the elderly (such as diet, exercise, social activities) and health through literature review, and considered the moderating role of socio-economic factors. Turana Y [7] explored the association between elderly health issues and hypertension by systematically reviewing and analyzing data from the HOPE Asia Network. Hofman A [8] used a cross-sectional study design to investigate the relationship between alternative patterns of physical activity, sedentary behavior, and sleep and health in middle-aged and elderly individuals. Aliyas Z [9] explored the benefits of elderly people's exposure to green and blue outdoor spaces for their physical, mental, and physiological health. Bailey L [10] used a questionnaire survey to collect data on physical activity, mental health, and quality of life of elderly people during home quarantine. Although the above research provides valuable insights into the multidimensional factors influencing the physical and mental health of the elderly, there is still a relative lack of research on the impact of specific activities, such as sandpaper and table tennis, on the health of the elderly, especially when considering it as a low-cost, low-risk, and easy-to-use exercise. Therefore, this article will analyze the impact of sandpaper table tennis on the physical

function and psychological state of the elderly through comparative experiments, in order to provide scientific basis for the promotion of sports activities and the formulation of health promotion policies for the elderly.

3. Method

3.1 Research Design

3.1.1 Selection of comparative experimental methods

The research objective is to evaluate the specific effects of sandpaper table tennis on the physical and mental health of elderly people, which requires the use of methods that can reveal the causal relationship between activity and health outcomes [11-12]. To achieve this goal, a mixed method research approach was chosen, combining the advantages of quantitative and qualitative research to understand the experience and effects of elderly people participating in sandpaper table tennis from different perspectives.

Quantitative research involves designing questionnaires that include basic information, health status, frequency and duration of participation in sandpaper table tennis among elderly people. The questionnaire design has undergone pre testing to ensure its reliability and effectiveness. In addition, field observation was conducted for several weeks in elderly activity centers and communities to record the participation, physical coordination, and social interaction of elderly people in sandpaper table tennis activities.

Qualitative research collects personal feelings and experiences of elderly people participating in sandpaper table tennis through interviews. The interview covers their views, feelings, and the impact of the activity on their daily lives. These qualitative data help to understand the inner world of elderly people and how they perceive and evaluate the impact of sandpaper table tennis on their physical and mental health.

3.1.2 Research sample

To ensure the representativeness and wide applicability of the research results, the sample was randomly selected from community centers, elderly activity centers, and sports clubs, ensuring the diversity and breadth of the sample. Clearly defining the age range of the elderly, set at 60 years old and above, with a male to female ratio of 1:1 [13-14].

To evaluate the impact of sandpaper table tennis on the physical and mental health of elderly people, the self-reported health status of the sample, the presence of chronic diseases, and physical activity ability were considered. The sample includes elderly people with different health conditions, in order to study the effects of sandpaper table tennis on their physical and mental health under different health conditions. The diversity of gender and education level is also reflected in the sample.

When determining the sample size, power analysis is performed based on the expected effect size, significance level, and required statistical power to determine the minimum sample size required to detect the impact of sandpaper table tennis on physical and mental health.

In the process of sample determination, dynamic management of samples is carried out, including tracking of participants, regular review of data, and handling of missing data. At the same time, we will ensure that all participants have signed informed consent forms and that their personal information is properly protected to comply with research ethics requirements.

3.2 Data Collection

3.2.1 Questionnaire design

At the beginning of the questionnaire, participants are first introduced to the purpose of the study, emphasizing its importance, and ensuring that all information provided will be strictly confidential and used only for research purposes. Next, the questionnaire requires participants to provide basic information including gender, age, education level, and residential area. The health status section asks participants about their self-rated health status, using a 5-point scale ranging from 1 (very poor) to 5 (very good), and whether they have any chronic diseases.

In the section on participation in sandpaper table tennis, the questionnaire detailed the frequency of participants' participation in sandpaper table tennis (once a week, twice a week, or once a month). At the same time, they will also be asked about the total duration of their participation in this activity, as well as the reasons and level of interest they started participating in this sport.

The mental health section uses standardized scales to assess participants' emotional states, such as depression and anxiety levels, as well as their satisfaction with their current lives. Before officially distributing the questionnaire, conduct a pre-test to check its comprehensibility and fluency, ensuring that all questions are clear and unambiguous. The format design of the questionnaire is neat and logically clear. The design of questions should avoid guiding language and ensure that each question is neutral (as shown in Attachment 1).

The collected questionnaire results are shown in Table 1:

Table 1: Partial questionnaire results

ID	Gender	Age	Education Level	Health Status Score	Chronic Disease Count	Physical Activity Score	Participation Frequency	Mental Health Score
1	Male	65	High School	4	0	5	Twice a week	3
2	Female	68	University	3	1	3	Once a week	3
3	Male	72	Primary School	2	1	2	Twice a month	2
4	Female	70	Junior High	5	0	4	Thrice a week	4
5	Male	67	University	3	2	3	Once a month	2
6	Female	64	High School	4	0	4	Twice a week	3
7	Male	75	Junior High	2	1	3	Once a week	2

3.2.2 On site observation

Field observation is a key method for obtaining the behavioral performance of elderly people participating in sandpaper table tennis activities, which can understand their level of participation, physical coordination, and social interaction during the activity.

In the field observation, the frequency, duration and participation degree of sandpaper table tennis were recorded. The assessment of physical coordination is based on the balance, flexibility, and coordination demonstrated by older adults during activities. Observation of social interaction

focuses on the communication, cooperation, and social participation of elderly people with other participants. Using standardized tables for data recording to document observed behaviors and events. Time sampling and event sampling are two main recording methods to ensure data consistency and accuracy. Table 2 shows the field observation data.

Table 2: Field observation data

Participant ID	Duration per Session (minutes)	Engagement Score	Balance Score	Flexibility Score	Coordination Score	Social Interaction Score
1	45	4	3	4	4	5
2	60	3	4	3	3	4
3	38	2	2	2	3	3
4	50	5	5	5	5	5
5	52	3	3	4	3	4
6	60	4	4	4	4	3
7	45	3	3	3	2	4

Table 2 records the physical coordination and social interaction of elderly people participating in sandpaper table tennis activities [15]. Each row of data represents a participant, including the duration of each activity, level of engagement, physical balance, flexibility, coordination, and social interaction ratings. These ratings are based on a 5-point scale, where 5 represents the highest level.

3.3 Data Analysis

3.3.1 Data processing

Field observation data includes the frequency, duration, level of engagement, physical coordination (including balance, flexibility, and coordination), and social interaction of elderly people participating in sandpaper table tennis activities. These data need to be recorded in detail and converted into an analyzable format. The questionnaire data includes basic information, self-assessment of health status, chronic disease status, and self-assessment of physical activity ability of the elderly. These data need to be cleaned after collection to ensure accuracy and consistency. Therefore, it is necessary to organize, code, and digitize the data collected from field observations and questionnaire surveys for subsequent statistical analysis.

3.3.2 Statistical analysis

The purpose of descriptive statistical analysis is to provide basic information about the dataset, calculate and report statistical measures such as mean, median, standard deviation, and range, and describe the central trend and dispersion of the frequency, duration, physical coordination, and social interaction of elderly people participating in sandpaper table tennis activities. Regression analysis is used to evaluate the relationship between sandpaper table tennis activity and the physical and mental health of elderly people. This article constructs multiple regression models to predict how physical and mental health indicators (psychological health score and physical coordination score) change with frequency and duration of participation.

4. Results and Discussion

4.1 Physical Health

Sand board table tennis has a significant effect on improving the physical coordination and fitness of the elderly. Due to the special nature of its racket, sandpaper table tennis has weaker rotation and slower speed compared to traditional table tennis, which makes it easier for the elderly to pick up and increases their opportunities to participate in sports activities. For the improvement of body coordination and physical fitness, sandpaper table tennis requires athletes to have better control over strength and direction when hitting the ball, which can exercise the hand eye coordination, reaction speed, and physical flexibility of the elderly.

As shown in Figure 1, this study conducted 30 comparative experiments to compare elderly people with similar physical conditions. Elderly people who did not engage in sandpaper table tennis were compared with those who engaged in sandpaper table tennis for a long time. Elderly people who participated in sandpaper table tennis for a long time showed improvements in physical shape, physical fitness, and physical function. The results of the six minute walk test are shown in Figure 1:

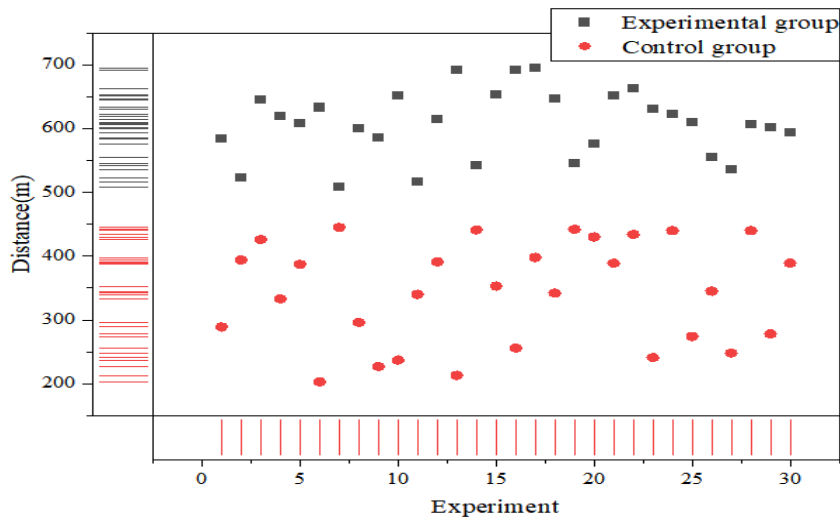


Figure 1: Six minute walking test distance

The results of the six minute walk test in the figure indicate that elderly people who engage in sandpaper table tennis for a long time perform better in the test compared to those who do not engage in sandpaper table tennis. Those who engage in sandpaper table tennis maintain a test distance of over 509m, but those who do not engage in this sport have a maximum distance of only 445m. This suggests that sandpaper table tennis has a strong training effect on participants' cardiovascular function, muscle strength, and endurance.

Meanwhile, sandpaper table tennis, as a low-intensity aerobic exercise, is an effective means of chronic disease management and prevention for the elderly. It can help the elderly control their weight, enhance their cardiovascular function, and improve their metabolism, so as to prevent and assist in the treatment of chronic diseases such as diabetes to a certain extent. The comparison of incidence rates is shown in Figure 2:

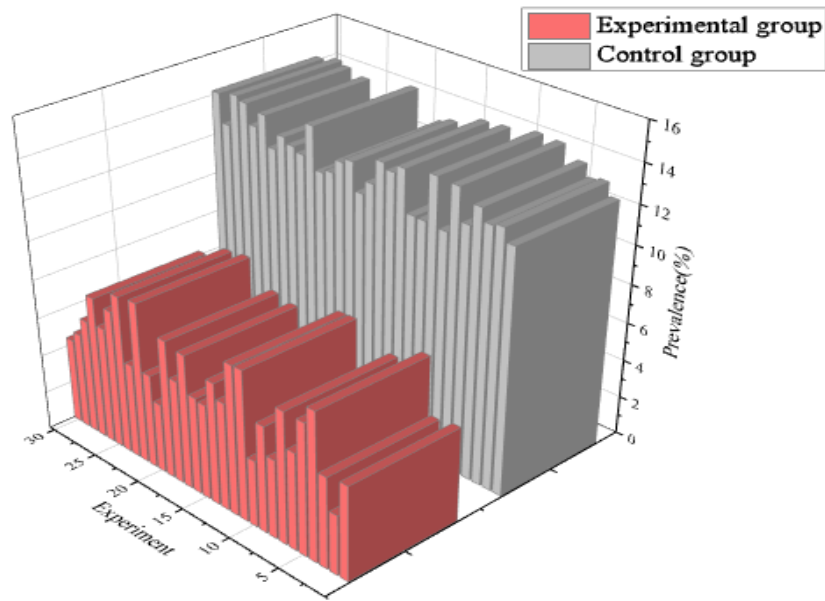


Figure 2: Comparison of disease rates

Figure 2 reveals the effect of sandpaper table tennis on the incidence of disease in elderly athletes. According to the data in the figure, sandpaper table tennis has a positive effect on the incidence of disease in the elderly. The incidence rate of elderly people who maintain long-term sandpaper table tennis exercise is only between 3.15% and 8.41%, which is in sharp contrast to the elderly population who do not participate in sandpaper table tennis exercise, whose incidence rate is relatively higher. This result indicates that sandpaper table tennis, as a moderate intensity exercise, has a positive impact on the cardiovascular function and overall health status of elderly people. By regularly participating in sandpaper table tennis, elderly people can improve their exercise tolerance, enhance muscle strength and coordination, thereby preventing and reducing the occurrence of chronic diseases to a certain extent.

4.2 Psychological Health

Sandpaper table tennis is a highly social sport that provides opportunities for the elderly to communicate and interact with others. By regularly participating in sandpaper table tennis activities, elderly people establish new social connections, enhance their social support network, thereby improving their mental health and alleviating feelings of loneliness.

In addition, sandpaper table tennis also has a positive impact on the emotional state and quality of life of the elderly. Participating in sports activities can promote the release of chemicals such as endorphins in the brain, which can enhance emotions and reduce symptoms of depression and anxiety. Meanwhile, as a moderate intensity physical activity, sandpaper table tennis helps elderly people maintain vitality, improve life satisfaction, and enhance their overall quality of life. The quantitative comparison results of the loneliness scale are shown in Figure 3.

The total score of the scale in Figure 3 ranges from 6 to 24, with higher scores indicating stronger feelings of loneliness. In each experimental group, the loneliness score of elderly people who engage in sandpaper table tennis for a long time is always lower than that of elderly people who do not engage in sandpaper table tennis. In the sixth comparative experiment, the experimental group scored 7 on the loneliness scale, while the control group scored 18. This indicates that elderly people who participate in sandpaper table tennis have a significant effect in alleviating loneliness

and indirectly proves the social impact of sandpaper table tennis.

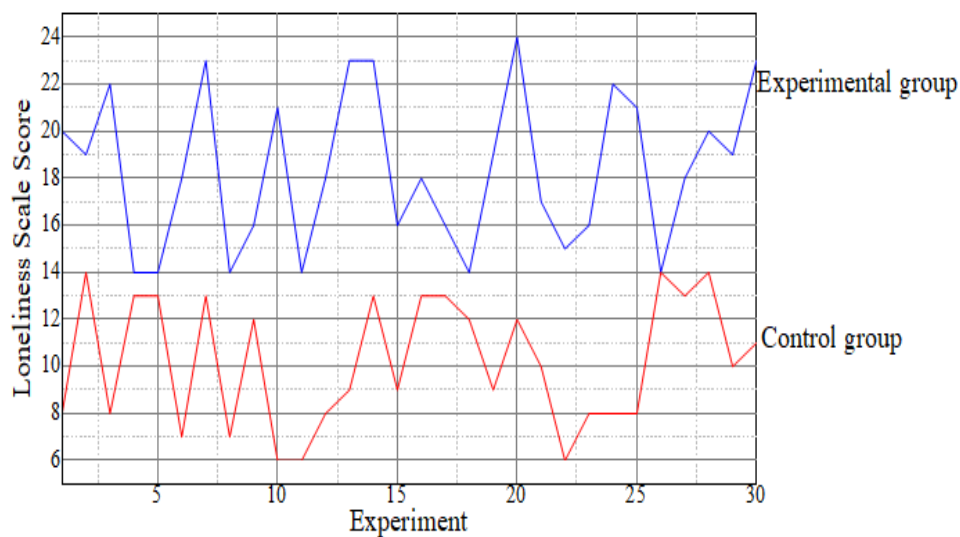


Figure 3: Loneliness scale score

4.3 Discussion

Based on the results of comparative experiments, this study explores the positive effects of sandpaper table tennis on the physical coordination, physical fitness improvement, social interaction, loneliness relief, emotional state, and quality of life of elderly people. Especially, through comparative experiments, it was found that elderly people who participated in sandpaper table tennis performed significantly better than those who did not participate in the six minute walking test, indicating that sandpaper table tennis can effectively improve the cardiovascular function and exercise tolerance of elderly people.

However, studying small sample sizes limits the ability to generalize results and findings to higher confidence levels. In addition, the study did not adequately control for confounding variables such as baseline health status, lifestyle habits, and other forms of physical activity among older adults.

Future research can use larger sample sizes and conduct randomized controlled trials to improve the internal validity of current studies. Similarly, advanced statistical analysis is used to explain other confounding variables and long-term follow-up studies are conducted to evaluate the long-term effects of sandpaper table tennis on the physical and mental health of elderly individuals. Finally, the study can be extended to other regions and elderly populations with different cultural backgrounds to evaluate the generalizability of the conclusions drawn in this study regarding the impact of sandpaper table tennis on the physical and mental health of the elderly.

5. Conclusion

This study adopts a comparative experimental method to explore the effects of sandpaper table tennis on the physical and mental health of elderly people, aiming to provide more scientific and reasonable exercise choices for the elderly. Through questionnaire surveys and field observations, data reflecting the frequency, duration, physical coordination, and social participation of elderly people participating in sandpaper table tennis activities during the activity period were collected, and descriptive statistics and regression analysis methods were used in the data analysis.

However, the limited sample size of the study has affected the research results. Secondly, this

study did not fully control for all potential confounding variables. In addition, the use of short-term studies makes it difficult to evaluate the long-term effects of sandpaper table tennis on the physical and mental health of elderly people.

In the future, researchers need to consider using larger samples and random allocation to conduct research, providing stronger internal validity for the study. At the same time, more complex statistical techniques are used to control for more confounding variables, and long-term follow-up studies are conducted to evaluate the long-term effects of sandpaper table tennis on the physical and mental health of elderly people.

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Attachment 1

Questionnaire Investigation

Dear participants:

Hello! We are conducting a study on the impact of sandpaper table tennis on the physical and mental health of elderly people. This study aims to explore how sandpaper table tennis activities promote the physical health and psychological well-being of elderly people, as well as its potential role in improving their quality of life. We highly value your participation, and your opinions and experience are crucial to our research. Please rest assured that all information you provide will be strictly confidential and will only be used for the purpose of this study, and will not be used for any commercial or personal purposes.

Before starting to fill out the questionnaire, we would like you to provide some basic information so that we can better understand the data background. The following is the content of the questionnaire:

Essential information:

1. Gender: ☐ Male; ☐ Female

2. Age: _____

3. Education level: ☐ Primary school and below; ☐ Junior high school; ☐ High school/vocational school; ☐ Junior college; ☐ Bachelor's degree or above

4. Residential area: ☐ City; ☐ Suburban; ☐ Rural

Physical health:

How do you evaluate your own health condition? (1=very poor, 5=very good)

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Do you have any chronic diseases? (such as hypertension, diabetes, etc.)

☐ Yes; ☐ No

Participation in Sandpaper Table Tennis:

7. How often do you participate in sandpaper table tennis?

☐ Once a week; ☐ Twice a week; ☐ Once a month

8. How long did you participate in sandpaper table tennis?

☐ Less than 6 months; ☐ 6-12 months; ☐ 1-2 years; ☐ Over 2 years

What is the reason why you started participating in sandpaper table tennis?

☐ Interests and hobbies; ☐ Recommended by friends; ☐ Improve health;

☐ Other: _____

10. How interested are you in sandpaper table tennis?

☐ Very low; ☐ lower; ☐ Medium; ☐ High; ☐ Very high

Mental health:

11. Please evaluate your emotional state based on the following scale (1=almost none, 5=almost always):

-Feeling frustrated: ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

-Feeling anxious: ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

How satisfied are you with your current life?

☐ Very dissatisfied; ☐ Not satisfied; ☐ Neutrality; ☐ Satisfied;

☐ Very satisfied

We greatly appreciate your valuable time in participating in this research. If you have any questions or need further information about the questionnaire, please feel free to contact us at any time.

Wishing you health and happiness!