

Longitudinal Study on the Effects of Physical Exercise on Loneliness and Mental Health of old adults

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DOI: <https://doi.org/10.36347/sjahss.2025.v13i07.006>

| Received: 01.06.2025 | Accepted: 11.07.2025 | Published: 15.07.2025

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Abstract

Original Research Article

Objective: This paper explores the mechanism of loneliness and physical exercise in old adults, and provides a theoretical basis for promoting the mental health level of the old adults and the development of social interaction ability.

Methods: A cluster random sampling method was used to investigate the loneliness, physical exercise and mental health of 476 community old adults in Jinhua City, Zhejiang Province. **Result:** Physical exercise has a significant positive predictive effect on mental health level ($\beta=0.420$, $P<0.001$), while mental health level has a significant negative predictive effect on loneliness ($\beta=-0.200$, $P<0.001$); Psychological health level also has a significant positive predictive effect on physical exercise ($\beta=0.210$, $P<0.001$), while loneliness has a significant negative predictive effect on psychological health level ($\beta=-0.176$, $P<0.001$). **Conclusion:** There is a longitudinal relationship between physical exercise, old adults loneliness and mental health. We should strengthen the support of physical exercise for old adults and improve the mental health of old adults, so as to effectively alleviate the loneliness of old adults.

Key words: physical exercise, loneliness, old adults, mental health level, longitudinal research.

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1. INTRODUCTION

Loneliness can be both a trait and a state, and loneliness expresses the pain of feeling lonely. Millions of people suffer from loneliness every day [1][2], which is a debilitating psychological state characterized by deep feelings of emptiness, worthlessness, lack of control, and personal threat [3,4].

Old age is a period in a person's life when they are prone to social isolation and feelings of loneliness. Loneliness is related to the adverse health consequences and higher mortality rate of the old adults [5,6]. With the increase of age, the risk factors of cognitive function degradation and loneliness of the old adults are also increasing, which also increase the risk factors related to limiting social activities (such as losing a spouse and having difficulty moving) [7].

Previous studies have shown that loneliness may lead to a decline in mental health levels through several pathways [8]. People who participate less in satisfying social activities have fewer opportunities to engage in more complex interpersonal communication and dynamic environments. In addition, numerous psychological studies have shown that the association

between loneliness and social psychological variables such as health status can be attributed to a reduced likelihood of participating in physical exercise [9].

Practice has proved that physical exercise has multiple ways and methods to infiltrate mental health education, and its health value of caring, monitoring and improving the quality of life of the old adults has been widely recognized by people. In addition, physical exercise also has the effect of improving emotional value [10]. Previous studies have shown that positive emotions can predict an increase in long-term physical activity [11]. However, at the same time, negative emotions can reduce the motivation to participate in physical exercise [12], and negative emotions are closely related to loneliness. Therefore, the path of emotional factors affecting sports activities can be explained as follows: lonely people tend to exhibit higher levels of negative emotions for a long time, while their positive emotional levels are lower than their peers who have normal connections with them [13], leading to a decrease in enthusiasm for participating in sports activities, an increase in negative emotional levels, and a decrease in motivation for physical exercise.

2. LITERATURE REVIEW

Regarding the definition of the concept of physical exercise, early domestic definitions believed that physical exercise is a planned, regular, and repetitive physical activity carried out by people under the interaction of their internal conditions and external living environment, with the aim of enhancing physical fitness and improving physical and mental health. Domestic scholars believe that physical exercise refers to various conscious and purposeful physical activities that people engage in to pursue physical and mental health or achieve other goals under the influence of internal factors and external environment; Foreign scholars believe that physical exercise is a continuous and regular physical activity carried out through indoor or outdoor activities. Physical exercise in this study refers to various sports activities that old adults carry out consciously and purposefully according to their own interests and needs. The purpose of physical exercise for the old adults is to enrich their life, dominate their leisure time, develop their physical quality and regulate their mental state. In order to comprehensively understand the physical exercise behavior of the old adults, in this study, physical exercise includes four variables: "frequency of participating in physical exercise", "duration of participating in regular physical activities", "duration of general physical exercise" and "intensity of participating in physical exercise". In addition to the physical exercise scale, the general situation questionnaire includes "the organizational form of participating in physical exercise" and "the items of participating in physical exercise", which also makes a preliminary investigation on the current situation of physical exercise for the old adults.

The term 'loneliness' was first mentioned by Sigmund Freud in 1939, describing an individual's inner experience as changing due to the feeling of loneliness. Although there is controversy among scholars from different stages and schools of thought regarding loneliness, they generally agree that loneliness is an emotional experience that arises from a discrepancy between reality and expectations. It can be indicated that loneliness refers to a negative experience that occurs when an individual feels isolated or isolated from others. It is an unpleasant emotional feeling that arises when an individual desires to interact with others but cannot be satisfied. It is subjective and a self emotional or psychological experience. Loneliness occurs in specific situations where an individual's inner needs for interpersonal relationships cannot be met, resulting in a gap between reality and ideal social status. For the old adults, loneliness is the feeling of loneliness, loneliness, emptiness, loss and other feelings caused by the change of their social roles and the unsatisfactory social status, which is a negative emotional response.

A systematic literature review on mental health levels, using a combination of systematic review and best evidence, included 247 studies. The results indicate that

physical activity is beneficial for mental health, but its impact and intensity are influenced by multiple factors. Many psychological and social factors can explain the benefits of physical activity for mental health, while the roles of environmental, behavioral, and neurobiological factors are less clear. It is believed that further exploration of relevant mechanisms and the impact of different types, intensities, and environments of sports activities on mental health should be conducted in the future.

3. RESEARCH OBJECTS AND METHODS

3.1 Research Object

Using a cluster random sampling method, elderly people aged 65 and above with basic physical health were selected as participants in 10 communities in Jinhua City, Zhejiang Province. After the training for the old adults, the graduate students of sports psychology who have received systematic professional training will explain the questionnaire in detail and fill in the instructions, and issue the paper and pencil questionnaires to the old adults, requiring the participants to answer carefully and independently according to the guidance and their own actual situation. To ensure the quality of the answer sheet, the research assistant first read out the questionnaire filling instructions and explained the purpose and requirements of the questionnaire. It takes an average of 15 minutes to complete the survey. The survey is conducted voluntarily and anonymously, with the questionnaire collected by the respondents themselves and coded for each participant to avoid data loss in the second post test. A total of 500 questionnaires were distributed for the first time. After deleting invalid questionnaires, 490 valid questionnaires were distributed, with an effective response rate of 98.00%. After a period of 2 months, a second survey was conducted and 490 questionnaires were distributed. After removing invalid questionnaires, 476 valid questionnaires were collected, with an effective response rate of 97.14%. The final valid sample consists of 476 participants who have completed two surveys and whose questionnaire codes are consistent. According to G-power test (expected significance $P < 0.05$); The estimated inspection force is $1 - \beta = 0.8$, and finally it is confirmed that the collected sample size meets the conditions for longitudinal cross-lagged analysis.

3.2 RESEARCH METHODS

3.2.1 Physical Activity Rating Scale (PARS-3)

This scale examines the amount of physical exercise from three aspects: intensity, duration, and frequency, and measures the level of participation in physical exercise based on the amount of physical exercise. The score for physical exercise is equal to intensity multiplied by (time-1) multiplied by frequency. Each aspect is divided into 5 levels, with scores ranging from 1 to 5. The highest score for physical exercise is

100 points, with small exercise ≤ 19 points, moderate exercise 20-42 points, and large exercise ≥ 43 points. In this study, the Cronbach's alpha values of the two scales were 0.720 (T1) and 0.701 (T2), respectively.

3.2.2 UCLA Loneliness Scale-8 (ULS-8)

The scale was adapted by Hays and DiMatteo based on the UCLA-20 scale (University of California Los Angeles Loneliness Scale)^[14]. The ULS-8 loneliness Scale has a total of 8 items, including 6 positive items and 2 negative items. This scale does not mention the word 'loneliness' in any of its items, which helps to reduce biased responses. Each item adopts a four level frequency rating, with scoring methods of 1) never, 2) rarely, 3) sometimes, 4) often. The higher the total score, the higher the degree of loneliness. This scale was translated and discussed by bilingual researchers to form a translated Chinese version. In this study, the Cronbach's alpha values of the two scales were 0.786 (T1) and 0.773 (T2), respectively.

3.2.3 SYMPTOM CHECKLIST 90(SCL-90)

This table is divided into 10 factors, namely somatization, obsessive-compulsive symptoms, interpersonal sensitivity, depression, anxiety, hostility, terror, paranoia, psychoticism, and others, with 90 evaluation items. Each item is scored on a 5-point scale, and the distribution characteristics of the research subjects' symptoms are understood by calculating the total score and factor scores. In 1986, led by Wu Wenyuan and others, this scale was tested in 1338 normal adults and 245 individuals with neurological disorders in multiple regions across the country. The results of normal individuals were used as a standard model, and it had good reliability and validity in the normal population. The Cronbach's alpha values of the two tested scales were 0.7110 (T1) and 0.745 (T2), respectively.

3.3 STATISTICAL ANALYSIS

All statistical analyses were conducted using SPSS 22.0 (IBM, Amonk, New York, USA) and Mplus 8.3. A p -value <0.05 is considered statistically significant. We conducted descriptive analysis, reliability analysis, and correlation analysis on the

questionnaire data, and Pearson chi square test was used to evaluate the differences between categorical variables. For continuous variables, the cross-lagged panel model (CLPM) modeled by structural equation is used to examine the longitudinal relationship between physical exercise and the relationship between old adults mental health and loneliness. It is worth noting that there are two specific paths in all models: the autoregressive path, the measurement of the variables controlling the previous wave, and the cross-lagged path between mental health, physical exercise and loneliness. In addition, we have also specified the concurrent correlation between variables of the same wave.

The model fitting is evaluated through three indices: approximate root mean square error (RMSEA), comparative fit index (CFI), and Tucker Lewis index (TLI). The criteria for a good fit are $RMSEA \leq 0.05$, CFI and TLI ≥ 0.95 , and when $RMSEA \leq 0.08$, CFI ≥ 0.90 , and TLI >0.80 , the model fit is considered acceptable [15][16][17].

4. RESULTS

4.1 Common method deviation test

Using program control method and Harman single factor method to investigate the possible common method bias in the measurement. Perform single factor unrotated exploratory factor analysis on all items in the two survey data. The results indicate that, T1、T2、Eight factors with eigenvalues greater than 1 were extracted, and the mutation rates of the first factor were 29.475% and 28.649% ($<40\%$), both below the critical threshold of 40%. The common method bias of the three measurements was acceptable [18].

4.2 Correlation analysis

Table 1 lists the average value (M) and standard deviation (SD) of old adults's loneliness, old adults's mental health level and participation in physical exercise. Pearson analysis was used to obtain the correlation coefficient between old adults loneliness, old adults mental health and physical exercise. The results indicate that there is a significant correlation between all variables.

Table 1: Correlation analysis between physical exercise, mental health level and loneliness

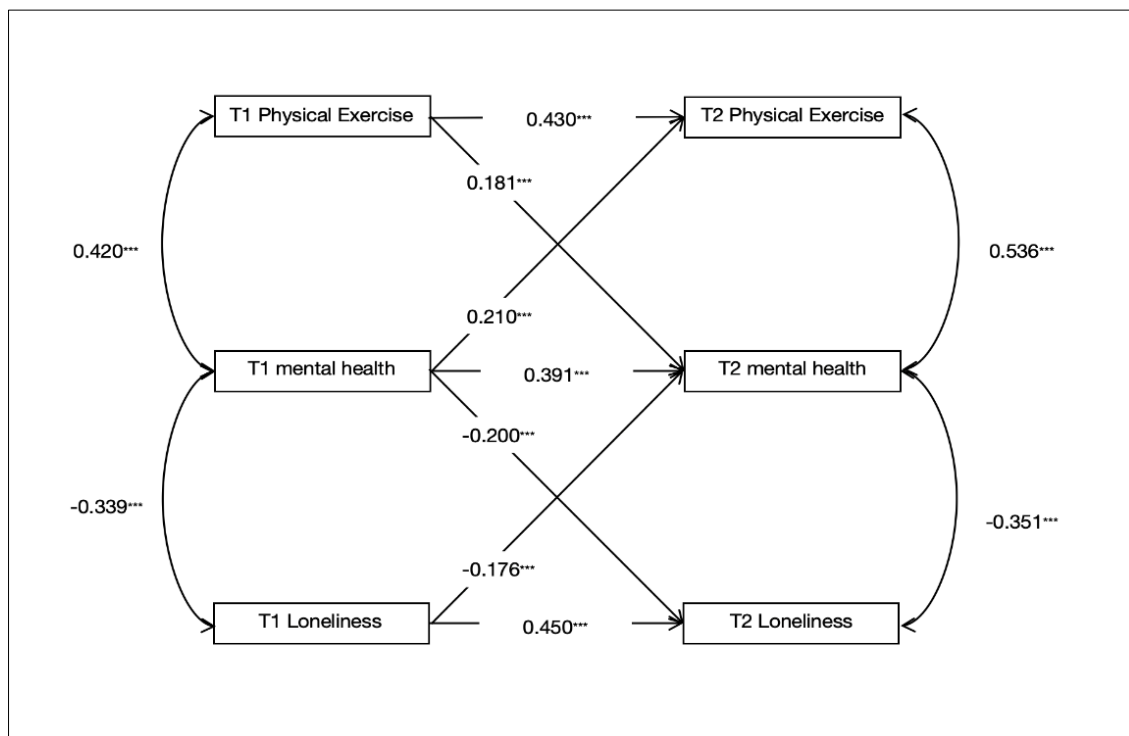
variable	T1PE	T2PE	T1MHL	T2MHL	T1LON	T2LON
T1PE	1					
T2PE	0.521***	1				
T1MHL	0.508***	0.525***	1			
T2MHL	0.578***	0.565***	0.623***	1		
T1LON	-0.633***	-0.528***	-0.489***	-0.501***	1	
T2LON	-0.562***	-0.519***	-0.513***	-0.459***	0.685***	1
<i>Mean</i>	5.55	5.89	4.10	4.95	2.41	3.02
<i>Std</i>	1.01	1.31	0.79	0.96	0.58	0.66

Note: *** indicates $P<0.001$; PE=physical exercise, MHL=mental health level, LON=loneliness

4.3 Longitudinal relationship between physical exercise, loneliness, and mental health level

Use the path coefficient of the cross-lagged model to investigate the asynchronous correlation between physical exercise, old adults mental health and loneliness (Figure 1). 1) The regression effect of T1 physical exercise on T1 mental health level is significant ($\beta=0.420$, $P<0.001$); The regression effect of T1 psychological health level on T1 loneliness is significant ($\beta=-0.339$, $P<0.001$); 2) The regression effect of T2 physical exercise on T2 psychological health level is significant ($\beta=0.536$, $P<0.001$); The regression effect of T2 psychological health level on T2 loneliness is significant ($\beta=-0.351$, $P<0.001$); 3) The lagged effect of T1 physical exercise on T2 mental health level was

significant ($\beta=0.181$, $P<0.001$); The lagged effect of T1 psychological health level on T2 physical exercise was significant ($\beta=0.210$, $P<0.001$); 4) The lagged effect of T1 mental health level on T2 loneliness was significant ($\beta=-0.200$, $P<0.001$); The lagged effect of T1 loneliness on T2 mental health level was significant ($\beta=0.176$, $P<0.001$); At the same time, a model report was conducted on the path coefficients of T1 physical exercise $\rightarrow$ T2 mental health level and T1 mental health level $\rightarrow$ T2 physical exercise, T1 mental health level $\rightarrow$ T2 loneliness, and T1 loneliness $\rightarrow$ T2 mental health level, CMIN = 65.487, $df=17$, $p<0.05$; CFI = 0.982, TLI = 0.961, RMSEA = 0.048, SRMR = 0.040.



5. DISCUSSION

This study examines the longitudinal association between loneliness, mental health, and physical exercise in a sample based on the elderly population, and determines whether physical exercise helps predict the association between loneliness and mental health. This analysis provides a clearer answer to the relationship between old adults physical exercise and loneliness and mental health.

Throughout the current research process, our study has found that lack of exercise is largely a risk factor for feelings of loneliness, and the level of physical exercise is also closely related to mental health. And it is not affected by the relationship between a series of related social and psychological variables. Loneliness is associated with a lower probability of engaging in sports activities. The level of physical exercise has a unique role

in improving the mental health level of the old adults^[19]. This study observed these associations through longitudinal analysis, and we believe that self-regulation can be used to explain the impact of loneliness on the probability of physical exercise. Loneliness is closely related to poor emotional self-regulation ability, especially related to weakened hedonic emotion regulation ability. Lonely middle-aged people express, enjoy, and enhance positive emotions less than non lonely people, or use happy thoughts and memories to alleviate negative emotions. These characteristics of weakened ability to regulate hedonic emotions are not only related to loneliness, but also to a lower likelihood of physical activity^[20].

It is worth noting that according to the results of the cross-lagged analysis, the correlation between the mental health level of the old adults and physical

exercise is greater than the correlation with loneliness. The reason is that the participation of the presenters and mediators in existing research shows that physical exercise itself may not lead to low loneliness. The previous disregard for measuring such potential regulatory factors or regulators may explain why some cross-sectional and longitudinal studies investigating the impact of physical exercise on loneliness have failed to find a direct negative relationship between mental health levels and loneliness. However, in summary, the findings regarding the level of mental health as a moderator support the hypothesis that the quality of personal relationships in the field of physical exercise contributes to the degree to which people feel lonely. This is supported by the fact that in intervention studies, physical activity projects were conducted in group environments, and although the content of physical activity varied, each activity could reduce feelings of loneliness.

6. LIMITATIONS

There are still some limitations to this study. Firstly, although we adopted a population-based design, which has the advantage of generalizing the observed interrelationships between physical exercise, loneliness, and mental health levels to the elderly population, we did not specifically recruit clinical patients for research, nor did we measure clinical loneliness and mental health levels. It is unclear whether the relationship between physical exercise and old adults' loneliness, physical exercise and old adults' mental health is similar to the interaction between participants observed in this study. Secondly, we rely on self-reported feelings of loneliness rather than those assessed by examiners. Due to the fact that the measurement of loneliness is also conducted through self-report, common methods may confuse loneliness with mental health levels.

7. CONCLUSION

The sense of loneliness of the old adults is negatively correlated with the degree of physical exercise, and the degree of physical exercise of the old adults is positively correlated with the level of mental health. There is a predictive relationship between old adults' loneliness, physical exercise and old adults' mental health. We should strengthen the support of physical exercise for old adults and improve the mental health of old adults, so as to effectively alleviate the loneliness of old adults.

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