Sedentary Behavior, Physical Activity, Social Participation, and Loneliness Among Community-Dwelling Older Adults in China

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This study examined the relationship between loneliness, sedentary behavior, physical exercise, and social participation in Chinese older adults, and provided ideas to formulate preventive strategies that can help reduce loneliness. Data on demographics, health behavior, social participation, and loneliness were collected from a cross-sectional study of 629 older adults in Hefei, Anhui province, from June to August 2020. After adjusting for age, income, religion, marital status, and chronic illness demographic variables, sedentary behavior ($\beta = 0.111, SE = 0.671, p = .001$), physical exercise ($\beta = -0.229, SE = 0.358, p < .001$), and social participation ($\beta = -0.329, SE = 0.086, p < .001$) were found to be significantly correlated with loneliness in older adults. These findings suggest that a higher level of loneliness may be linked to greater sedentary behavior, less social engagement, and decreased physical exercise among older men and women.

Keywords: social interaction, physical exercise, health behavior, healthy aging

Population aging has become an important social concern in the 21st century, and the aging situation in developing countries is even more prominent. As the largest developing country, China’s population statistics showed that the number of people over 60 years old had reached 253 million by the end of 2019, accounting for 18.1% of China’s population base (National Bureau of Statistics of the People’s Republic of China, 2020). It is estimated that the number of Chinese older adults will be close to 400 million by 2030, accounting for a quarter of the total domestic population (Chen et al., 2018). Aggravated by increasing urbanization, the empty nest phenomenon has become widespread in China in recent years (Zhang, 2012). Meanwhile, the increasing widowed population, the weakening of social and physical functions, the lack of interpersonal communication, and the narrowing of social support resources make the emotional experience of loneliness widespread (Zhao & Li, 2019; Zhao et al., 2020).

Loneliness is described as subjective distress associated with a lack of peers or social connections (Somes, 2021). Social isolation and loneliness are distinct but interrelated because social isolation is the objective description of scarce social connections (Pakoya et al., 2020). Greater social isolation may be related to higher levels of loneliness. According to a health and retirement study in the United States, the incidence of loneliness in adults over 65 years old is 17.6% (Donovan et al., 2017). A longitudinal study based on population aging in the United Kingdom showed that the incidence of loneliness among older adults reached 21.0% (Valtorta et al., 2018). In addition, data based on a Chinese social tracking survey demonstrated that the loneliness rate of older adults reached 24.7% (Dong, 2017). Meanwhile, loneliness has been proven to be closely related to the occurrence and development of heart disease, cerebrovascular disease (Valtorta et al., 2016), cognitive impairment, and depression (Boss et al., 2015; Erzen & Çikrikçi, 2018). In addition, loneliness increases the risk of suicide in older adults (Holt-Lunstad et al., 2015). Both loneliness and its adverse outcomes seriously interfere with the process of healthy aging. The high incidence of loneliness in older adults and its serious physical and mental health implications make it imperative to explore effective preventive measures, which become a key focus of current healthcare work. Simultaneously, since the outbreak of the COVID-19 pandemic in early 2020, people’s outdoor activities have been restricted, home isolation has become normalized, and it also has a certain impact on the psychology of older adults. The pandemic has brought changes to the loneliness of older adults, which also needs investigation.

Social participation, one of the core concepts of “active aging,” is defined as the process of individuals maintaining social relations with relatives and friends, and participating in social activities, such as religious or club activities (Piskur et al., 2014). These activities are significant in improving psychological and social adaptation of older adults, enhancing their physical and mental health (Vlachantoni et al., 2020), and improving quality of life in their later years (Amiri et al., 2017). Previous studies have shown a correlation between social participation and loneliness (Tao et al., 2019). High-quality social participation can expand the scope of social activities of older adults, increase social communication, and maintain and strengthen close relationships, thus reducing the occurrence of loneliness.

Physical exercise may be a modifiable factor to help reduce social isolation and loneliness. Chen et al. (2010) found that physical exercise can reduce the loneliness of older adults and increase their happiness. Inactive physical exercise may be associated with a higher prevalence of loneliness (Vancampfort et al., 2019). Independent of physical exercise, sedentary behavior is a common lifestyle for older adults. Sedentary behavior refers to an...
individual’s energy consumption of less than or equal to 1.5 metabolic equivalent of task when sitting or lying down in a sober state and includes a series of behaviors, such as watching television, using computers and mobile phones, or passive entertainment (sitting and listening to music) (Tremblay et al., 2017). Research shows that sedentary behavior is also closely related to the occurrence of individual psychological problems, such as depression and anxiety (Hallgren, Nguyen, et al., 2020). Physical exercise and sedentary behavior have been proven to be independent of each other in terms of depression risk (Tremblay et al., 2010), and physical exercise has been shown to effectively reduce emotional problems (Patiño Villada et al., 2015). Lucas et al. (2011) conducted a 10-year prospective cohort study on physical activity, sedentary behavior, and the risk of clinical depression among older women in the United States. The study found that the risk of depression for older women who watched more than 21 hr of television per week increased by 1.13 times compared with those who watched 1 hr per week. Moreover, older women who exercised for more than 90 min per day had a 0.8-fold lower risk of depression compared with those who exercised for 10 min or less per day (Lucas et al., 2011). A large Belgian study of older adults found that more sedentary time spent on watching television was associated with lower social engagement, less contact with neighbors, and higher feelings of loneliness (Van et al., 2014). However, Tully et al. (2019) investigated the association between objectively measured physical activity and sedentary behavior, and social isolation and loneliness in 1,360 community-dwelling older adults. In the study, physical activity and sedentary behavior were not found to be significant predictors of loneliness.

Therefore, the aim of this study was to examine the associations of physical exercise and sedentary behavior with social participation and loneliness in older adults in China. We hypothesized that increased physical exercise, social participation, and reduced sedentary time may be related to lower levels of loneliness.

**Materials and Methods**

**Participants**

This cross-sectional study was a secondary analysis of research on daily lifestyles and physical and mental care needs. We conducted the study in a province ranked 11th in China in terms of gross domestic product, where doctors cooperate with primary health care personnel regularly to provide convenient medical services, and older adults have access to high-quality medical care. Data were collected from four community health service centers from June to August 2020. Inclusion criteria were: age ≥60 years old, residence time ≥1 year in Hefei, and a basic ability to take care of themselves. Older adults with dementia and severe mental and psychological diseases were excluded. Older adults were interviewed face-to-face and provided written informed consent. A total of 650 older adults were invited in the survey, and four participants were rejected. Of the 646 questionnaires collected, 17 invalid responses (where only partial information was given) were removed after verification, and 629 valid questionnaires were retained. The response rate of questionnaires was 97.37%.

**Assessment of Physical Exercise and Sedentary Behavior**

Physical activity was measured by self-report. The Exercise Vital Sign and the two-item questionnaire still proved to have good reliability and validity in measuring physical exercise (Coleman et al., 2012): (a) “On average, how many days per week do you engage in moderate or higher intensity physical activity (jogging, brisk walking, field dancing, etc.)?” and (b) “How many minutes of such physical exercise do you do on average every day?” The product of responses to the two questions was calculated to determine the amount of time an individual spent exercising per week, which was divided by seven to find the average amount of time spent exercising per day in this study.

**Assessment of Sedentary Behavior**

The sedentary time was estimated by the Sedentary Behavior Questionnaire (Rosenberg et al., 2010). Participants reported the sedentary time spent on transportation, working, watching television, using computer/mobile phone, and other rest time activities (such as reading newspapers and books, playing cards, and playing chess) on weekdays and the sedentary time spent on the above activities on weekends. The following formula was used to calculate daily sedentary behavior time:

\[
\text{Daily sedentary behavior time} = (\text{Weekday sitting time} \times 5 + \text{Weekend sitting time} \times 2)/7.
\]

**Assessment of Social Participation**

Social participation was measured using a nine-item social participation index questionnaire developed by the World Health Organization’s study on global ageing and adult health (Feng et al., 2020). The social participation of the respondents was calculated by inquiring about the frequency of their participation in social activities (public meetings, meetings with leaders or subordinates, clubs or organized gatherings, inviting friends home, cooperating with neighbors to solve problems, interacting with distant neighbors, interacting with coworkers, religious activities, going out to events, or visiting relatives and friends) in the past year. Each question had five answer options (1 = never, 2 = once or twice a year, 3 = once or twice a month, 4 = once or twice a week, and 5 = once or twice a day). The participants responded based on their situations, and the results were converted to a score of 1–5. The total score was calculated by summing up the scores of the nine items, ranging from 9 to 45 points. The Cronbach’s α coefficient of the scale in this study was .721.

**Assessment of Loneliness**

Loneliness was measured by the UCLA-3 Loneliness Scale (version 3; Russell, 1996). The scale contains 20 items, and each item has four answers, which are scored as 1–4 points (never, rarely, sometimes, or all the time, respectively). Among them, nine items are scored in reverse. The scores of 20 items are added together to obtain the total score of loneliness. The total scores range from 20 to 80 (for low levels of loneliness: scores range from 20 to 34, medium: scores range from 35 to 49, and high: scores range from 50 to 80). The Cronbach’s α coefficient of the scale in this study was .741.

**Assessment of Covariates**

This study employed face-to-face interviews to obtain the demographics of older adults. Research has found that demographics
are closely linked to loneliness (Huang et al., 2021; Tully et al., 2019), thus, age (60–70, 70–80, and ≥80 years), sex (male/female), education (middle school and below, high school, college and above), religion (yes/no), marital status (spouse/single), income (low: <1,000 Yuan/month, middle: 1,000–2,000 Yuan/month, and high: ≥3,000 Yuan/month), smoking (current: current smokers, none: never smokers, and quit: quit smoking for more than 6 months), and alcohol consumption (current: current drinkers, none: never drank, and quit: quit drinking for more than 6 months) were considered. In order to assess the presence of chronic illness, participants were asked if they had any long-standing illness. Participants reported their weight in kilograms and height in centimeters. Body mass index (BMI) was calculated as weight in kilograms divided by the square of height in meters. Participants were categorized as underweight (BMI < 18.5 kg/m²), normal weight (18.5–24.0 kg/m²), overweight (24.0–28.0 kg/m²), and obese (BMI ≥ 28.0 kg/m²), according to Chinese population reference standards.

### Data Collection

The study was approved by the ethics committee of the First Affiliated Hospital of University of Science and Technology of China, and all participants provided written informed consent. Prior to the implementation of the program, all interviewers underwent training on how to deliver the interview protocol. They visited four community health service centers to administer the questionnaire survey after successfully completing the training. Questions regarding the process were explained by data collectors. Questions about the process were explained and the questionnaires were promptly recovered and checked to ensure their completeness and validity.

### Statistical Analysis

EpiData (version 3.1, EpiData Association) and SPSS (version 21.0) were used for data entry and analysis. Before statistical analysis, the normality of the data on social participation, physical exercise, sedentary behavior, and loneliness was tested. Mean and SD were used to describe the normal distribution of the quantitative data, including social participation and loneliness. Sedentary behavior and physical exercise were converted to categorical variables because of abnormal distribution. Frequency and percentages were used to describe the counting data. Two independent sample t tests and a one-way analysis of variance were used to explore the differences in loneliness scores among different demographic variables and health behaviors. A correlation analysis was used to assess the correlation between social participation, physical exercise, sedentary behavior, and loneliness. Since data on loneliness are normally distributed, the relationship between physical activity, sedentary behavior, and social participation and loneliness was further explored using multiple linear regression. We constructed two models with loneliness as a dependent variable, and social participation, sedentary behavior, and physical exercise as independent variables. Two models were evaluated in each analysis, and each model was analyzed twice. Model 1 represents unadjusted relationships between loneliness and independent variables, respectively. Model 2 was additionally adjusted for age, religion, marital status, income, chronic disease, and two more independent variables. Results are presented as standardized regression coefficients (β) and SE.

### Results

Table 1 displays the demographic characteristics and participants’ health behavior. Their mean age was 70.6 years (SD = 7.2 years), ranging from 60 to 95 years, and 57.9% of the participants were women. Approximately 60% of the participants completed junior high school or below. Most participants had no religious beliefs (94.1%) and 89.2% of them were married. The proportion of participants whose income was less than 1,000 Yuan/month did not exceed one-tenth (8.9%). More than half of the participants were overweight or obese, and more than 80% had a chronic illness. The health behavior assessment results of the participants are shown in Table 2. The proportion of smokers and drinkers was 16.2% and 14.9%, respectively of the total participants; 7.3% had stopped smoking; 6.2% had given up drinking; and 35.8% of the participants performed physical exercise for less than 30 min per day. The self-reported sedentary behavior survey found that 20.7% of the participants were sedentary for more than 8 hr a day, 74.2% of the participants were sedentary for more than 4 hr but less than 8 hr a day, and only 5.1% of the total participants were sedentary for less than 4 hr a day. The average score for social participation was 15.5 (SD = 3.7) and, for loneliness, was 37.1 (SD = 8.6).

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Categories</th>
<th>N (%)</th>
<th>t/F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>60–70</td>
<td>304 (48.3)</td>
<td>2.973</td>
<td>.052</td>
</tr>
<tr>
<td></td>
<td>70–80</td>
<td>232 (36.9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥80</td>
<td>93 (14.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td>Male</td>
<td>265 (42.1)</td>
<td>-0.124</td>
<td>.901</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>364 (57.9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Religion</td>
<td>Yes</td>
<td>37 (5.9)</td>
<td>-2.884</td>
<td>.004</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>592 (94.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>Middle school and below</td>
<td>375 (59.7)</td>
<td>0.715</td>
<td>.489</td>
</tr>
<tr>
<td></td>
<td>High school</td>
<td>144 (22.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>College and above</td>
<td>110 (17.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marital status</td>
<td>Married</td>
<td>561 (89.2)</td>
<td>1.768</td>
<td>.078</td>
</tr>
<tr>
<td></td>
<td>Single</td>
<td>68 (10.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income</td>
<td>Low</td>
<td>56 (8.9)</td>
<td>8.999</td>
<td>&lt;.001</td>
</tr>
<tr>
<td></td>
<td>Middle</td>
<td>309 (49.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>264 (42.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body mass index</td>
<td>Underweight</td>
<td>24 (3.8)</td>
<td>0.440</td>
<td>.724</td>
</tr>
<tr>
<td></td>
<td>Normal</td>
<td>282 (44.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overweight</td>
<td>256 (40.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Obese</td>
<td>67 (10.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chronic illness</td>
<td>Yes</td>
<td>513 (81.6%)</td>
<td>-3.251</td>
<td>.001</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>116 (18.4%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health behaviors</td>
<td>Smoke</td>
<td>102 (16.2%)</td>
<td>1.485</td>
<td>.227</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>481 (76.5%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Quitting</td>
<td>46 (7.3%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drink</td>
<td>Yes</td>
<td>94 (14.9%)</td>
<td>1.444</td>
<td>.237</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>496 (78.9%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Quitting</td>
<td>39 (6.2%)</td>
<td></td>
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</tr>
</tbody>
</table>
Among the total participants, 247 (39.3%) felt a low level of loneliness, 329 (52.3%) felt moderate loneliness, and 53 (8.4%) felt a high level of loneliness.

Table 1 shows the distribution of differences in loneliness scores between demographic variables. The results showed that religious belief had an impact on loneliness, and the loneliness level of participants with religious beliefs was lower than that of participants without religious beliefs (t = −2.884, p = .004). The loneliness level of participants with an income of less than 1,000 Yuan and above 3,000 Yuan was higher than that of participants with an income of 1,000–2,000 Yuan (F = 8.999, p < .001). Participants without a chronic health history experienced a higher level of loneliness than those with a chronic history (t = −3.251, p = .001). The influence of age (p = .052) and marital status (p = .078) on loneliness were marginally significant. There was no significant difference in loneliness between different genders or BMI (p > .05). However, there was no effect of smoking and drinking on loneliness (p > .05).

The correlation analysis was used to examine the associations between physical exercise, sedentary behavior, and loneliness. Loneliness showed negative correlations with social participation (r = −.356, p < .001) and physical exercise (r = −.240, p < .001), and a positive correlation with sedentary behavior (r = .207, p < .001; Table 3). Social participation showed negative correlations with sedentary behavior (r = −.291, p < .001). There was no correlation between physical activity and sedentary behavior or social engagement (p > .05; Table 3).

Table 4 explains connections between social participation, sedentary behavior, physical exercise, and loneliness. After adjusting for other variables, a 1-unit increase in the social participation score was associated with a 0.329-unit decrease in the loneliness score (β = −0.329, SE = 0.086, p < .001). A higher level of sedentary behavior was associated with a 0.111-unit increase in the loneliness score (β = 0.111, SE = 0.671, p > .05), showing that the predictive effect of sedentary behavior on loneliness was significant but had a decreased strength. A higher level of physical exercise was related to a 0.229-unit decrease in the loneliness score (β = −0.229, SE = 0.358, p < .001), suggesting that physical exercise still had a significant predictive effect on loneliness.

**Discussion**

This study investigated the association between sedentary behavior, physical exercise, social participation, and loneliness in community-dwelling older adults. Loneliness was associated with poor social participation, greater sedentary behavior, and decreased physical exercise.

We found that the loneliness score of older adults was 37.1 ± 8.6, and 60.7% of them felt more than moderate loneliness, which was inconsistent with the research report of Ku et al.’s (2020) findings. Ku et al. (2020) used the UCLA Loneliness Scale with 1,375 older adults in nine communities in Chongqing and found that loneliness was 36.36 ± 7.67, and 43.78% of them felt more than moderate loneliness. The overall level of loneliness was lower than the results of this study. This is because the duration of the prior study was 2018–2019, while COVID-19 was not yet prevalent, while this study was conducted after COVID-19. COVID-19 prevention policy requires the suspension of group activities, reduction of gatherings of people, implementation of isolation, and so forth. Such measures disturb the daily life of adults and result in loneliness and other psychological problems. This result has also been confirmed in the research reports of Xie et al. (2021) in China, van Tilburg et al. (2021) in the Netherlands, and Kotwal et al. (2021) in the United States.

Greater social participation was related to a lower level of loneliness among participants, which is consistent with previous research (Tao et al., 2019). Active participation in social activities increased closeness with friends, and consequently, individuals showed better physical health and happier emotions, which can positively affect every member of social networks (Douglas et al., 2017). The study was carried out in the context of COVID-19, and the implementation of a home self-quarantine policy restricted individual’s social activities, such as outdoor physical activities, playing games, and chatting with friends. The lockdown policy made people distance socially and spend more time watching television, which may have increased social isolation and loneliness (Wu, 2020).

Our research showed that compared with sedentary time of less than 4 hr per day, more time spent on sedentary behavior was associated with increased loneliness. 94.9% of older adults were sedentary for more than 4 hr in our research, whereas the more time sedentary behavior increased the risk of mental health (Hallgren, Dunstan, & Owen, 2020). Tully et al. (2019) concluded that objectively measured physical activity and sedentary behavior were associated with social isolation instead of loneliness in older adults.
Table 4  Multiple Linear Regression Analysis of the Association of Social Participation, Sedentary Behavior, and Physical Exercise With Loneliness in 629 Older Chinese Adults

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th></th>
<th>Model 1</th>
<th></th>
<th>Model 2*</th>
<th></th>
<th>Model 2*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unstandardized coefficients</td>
<td>Standardized coefficients</td>
<td>Unstandardized coefficients</td>
<td>Standardized coefficients</td>
<td>Unstandardized coefficients</td>
<td>Standardized coefficients</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(\beta)</td>
<td>(SE)</td>
<td>(\beta)</td>
<td>(t)</td>
<td>(p)</td>
<td>(\beta)</td>
<td>(SE)</td>
</tr>
<tr>
<td>Social participation</td>
<td>-0.817</td>
<td>0.086</td>
<td>-0.356</td>
<td>-9.539</td>
<td>&lt;.001</td>
<td>-0.755</td>
<td>0.086</td>
</tr>
<tr>
<td>Sedentary behavior</td>
<td>3.427</td>
<td>0.704</td>
<td>0.191</td>
<td>4.867</td>
<td>&lt;.001</td>
<td>1.990</td>
<td>0.671</td>
</tr>
<tr>
<td>Physical Exercise</td>
<td>-2.382</td>
<td>0.393</td>
<td>-0.235</td>
<td>-6.053</td>
<td>&lt;.001</td>
<td>-2.321</td>
<td>0.358</td>
</tr>
</tbody>
</table>

Note. Reference category: physical exercise: <30 min per day; sedentary behavior: <4 hr per day; age: 60-70 years; religion: yes; marital status: married; income: low; chronic illness: yes. \(\beta\) = standardized regression coefficients.

*Adjusting variables including age (years), religion, marital status, income (Yuan/month), chronic illness, and other independent variables (e.g., we added sedentary behavior and physical exercise when exploring the associations between social participation and loneliness).
adults. The negative correlation between sedentary behavior and loneliness found in our study may be due to the patterns of sedentary behavior. Smartphones and screen-based devices have become new sedentary type for older adults in the context of COVID-19. Screen-based behavior was usually defined as passive sedentary behavior, which was related to depression, whereas depression was associated with loneliness (Creese et al., 2021; Hallgren, Dunstan, & Owen, 2020). Fingerman et al. (2022) also found that older adults reported higher loneliness when spend more time on television viewing instead of physical activity, which was consistent with our research. Future research will need to take different types of sedentary behavior into account and explore the associations of those with loneliness. Moreover, few face-to-face interactions and an absence of regular activities were related to high loneliness (Frenkel-Yosef et al., 2020). Compared with less than 30 min of physical exercise per day, the longer the exercise time, the lower the degree of loneliness. Musich et al. (2022) concluded that moderate and high physical activity were associated with less loneliness and social isolation. Therefore, physical exercise could be a intervention to alleviate loneliness.

This study has some limitations. Since this is a cross-sectional study, we cannot imply a causal relationship between sedentary behavior, physical exercise, social participation, and loneliness of older adults, which requires further longitudinal research. Furthermore, sedentary behavior and physical exercise were measured using a self-report questionnaire. Although the feasibility of self-report questionnaires has been confirmed by many articles (Araujo et al., 2021; Rosenberg et al., 2010), there may be underestimated or overestimated because of memory bias, affecting the credibility of the study; therefore, the relationship of physical and sedentary activities with loneliness needs to be verified using objective tools in the future. In addition, the data on older adults in urban communities collected with the convenience sampling method limit the representativeness of the samples. More studies should be conducted to verify the relationship between age and loneliness as well.

Our findings warrant more investigation to determine whether having older adults increasing their physical exercise and social participation or decrease sedentary time could be related to reducing loneliness. Future studies should measure these variables using different ways to further validate the effects related to reducing loneliness. Future studies should measure between age and loneliness as well. Musich et al. (2022) concluded that moderate and high physical activity were associated with less loneliness and social isolation. Therefore, physical exercise could be a intervention to alleviate loneliness.

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