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Associations between Physical Exercise with Risk of Fall and Low-Back Pain in Older Adults with Alzheimer

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ABSTRACT: Background and Aim: Existing research indicates that physical activity programs can enhance physical function and mitigate the risk of age-related functional decline within the broader aging population. Consequently, age may also influence the dynamics between physical activity and falls. In order to comprehend the influence of consistent physical activity on individuals diagnosed with Alzheimer's disease, this investigation was designed to explore the associations between physical exercise with risk of fall and low-back pain in older adults with Alzheimer.
Methods: A descriptive-correlational methodology was utilized in this investigation. The sample consisted of 256 older adults diagnosed with Alzheimer's disease, including 86 females. The participants' ages varied from 55 to 78 years, with an average age of 65.46±3.74 years. Selection of participants was conducted using an available and convenience sampling technique. Standard questionnaires were used to collect data. Pearson correlation test was used for data analysis.
Results: Results revealed significant indirect relationship between physical activity and risk of fall ($P<0.001$). Moreover, physical activity was indirectly and significantly associated with low back pain ($P<0.001$). Finally, risk of fall was directly and significantly associated with low back pain ($P<0.001$).
Conclusion: Increased levels of physical activity are associated with a reduced incidence of falls and pain, with no significant differences observed between genders in this relationship among the elderly population. It is imperative for policymakers to promote physical activity among older adults, taking into account their age and gender, as a strategy to mitigate the risk of falls.

Keywords: Physical activity, Fall, Pain, Aging, Alzheimer

INTRODUCTION

Due to the detection of one new case of dementia every four seconds, the World Health Organization designated it as a "global public health priority" in 2015. At that time, the global prevalence of Alzheimer's disease and other forms of dementia was estimated to affect approximately 47 million individuals, with projections indicating an increase to 75 million by 2030 and 131 million by 2050 (Bayartai et al. 2014; Hirase et al. 2020). Currently, there is no cure for dementia; therefore, implementing lifestyle modifications targeting known risk factors for cognitive decline is a crucial approach to mitigate the risk of developing dementia or at least postpone its onset. Nevertheless, sustaining long-term lifestyle changes related to diet, physical activity, and social engagement among the elderly population poses significant challenges in the effort to prevent dementia or decline in cognitive function (Khalagi et al. 2024; Micheli et al. 2024).

Impaired physical function and diminished muscle strength are frequently observed in individuals with cognitive deficits. The processes of aging and the onset of dementia contribute to a decline in physical capabilities, overall quality of life, and an elevated incidence of negative outcomes, including a heightened risk of falls, fall-related fractures, and various comorbid conditions (Murata et al. 2019; Puente-Gonzalez et al. 2021,Ilkım et al. 2021). This decline in physical function arises from a combination of a high occurrence of injuries and an increased vulnerability to them, exacerbated by the prevalence of clinical conditions such as osteoporosis and age- or dementia-related physiological alterations, including slowed protective reflexes, which render even minor falls particularly hazardous (Koren et al. 2024; Marshall et al. 2017,Ilkım et al. 2021). Research indicates that the risk of falls is significantly elevated in individuals, even during the initial stages of dementia or mild cognitive impairment. Normal gait is contingent upon several biomechanical factors, including the integrity of leg joints, as well as the precise timing and intensity of muscular contractions, alongside normal visual acuity, vestibular function, sensory perception, and proprioceptive feedback. Alterations in gait and balance may be closely associated with this heightened risk of falls (Doré et al. 2015, Ilkım &Yurtseven 2021).

Falls represent a significant contributor to severe injuries, disabilities, and mortality in the elderly population. The World Health Organization estimates that approximately 684,000 individuals succumb to fall-related incidents each year worldwide, with the highest incidence of fatal falls occurring among those aged 60 and above (Cruz-Almeida et al. 2017; Yurtseven et al., 2024). Data from the National Injury Monitoring System in China (2014) indicates that within the demographic of individuals aged 60 and older, there were 77,779 recorded accidental injuries, with 52.8% attributed to falls. The repercussions of falls and their associated injuries exert considerable strain on national healthcare systems and escalate medical expenses. Therefore, the early identification of fall risk factors in older adults is crucial for effective fall prevention strategies (Innes et al. 2020).

Physical activity plays a crucial role in maintaining physical function and mobility, which can subsequently postpone the emergence of significant disabilities (Abdoshahi & Ghorbani, 2022). As a standalone intervention, physical activity is the most frequently evaluated strategy for fall prevention, with prior research indicating its effectiveness in reducing fall incidents (Baniasadi et al. 2022; Najafzadeh et al. 2024). Some investigations have identified a correlation between both low and high levels of physical activity and the occurrence of falls in older adults, suggesting a U-shaped relationship between physical activity and fall risk (Chaharbaghi et al. 2022; Khosravi et al. 2023). Conversely, other studies have demonstrated that elevated levels of PA may lower the likelihood of falls. A recent longitudinal study conducted over ten years in Australia revealed that older adults who enhanced their moderate-to-vigorous physical activity further diminished their fall risk. While there is consistent evidence linking low activity levels to increased fall risk among older adults, the question of whether high activity levels might ultimately lead to a higher incidence of falls remains a topic of debate (Shafaei et al. 2024; Taghva et al. 2020).

Certain physical activities may play a significant role in mitigating the decline of physical capabilities and decreasing the likelihood of falls, as well as aiding in the recovery from injuries sustained due to falls (Baniasadi, 2024, Baniasadi et al. 2022). The cognitive status of older adults can range from normal functioning to mild impairment or full-blown dementia, and the impact of exercise on this demographic is varied. Incorporating passive finger exercises into physical activity regimens for elderly individuals with dementia can enhance their urinary control, bowel function, and overall performance in activities of daily living (Ghorbani et al. 2020). Furthermore, tailored intensive training for individuals with dementia has been shown to be practical and to yield improvements in clinically relevant gait parameters. This exercise regimen could serve as a model for both the prevention and rehabilitation of gait impairments within this specific population (Omidvar et al. 2018; Seyedi Asl et al. 2020).

A growing body of evidence indicates that both physical exercise and mental engagement serve as effective strategies for enhancing cognitive function in individuals, regardless of whether they experience cognitive complaints or impairments (Baniasadi et al. 2022). Nevertheless, a randomized controlled trial focusing on moderate- to high-intensity exercise among individuals with dementia revealed that such exercise does not mitigate cognitive decline in those with mild to moderate dementia (Seyedi Asl et al. 2016). Nonetheless, the exercise regimen did lead to improvements in physical fitness. Regardless, the American College of Sports Medicine advocates for exercise as it promotes functional independence, enhances quality of life, and lowers the risk of chronic diseases among the elderly population (Shafaei et al. 2024).

A population-based investigation conducted in the United States revealed that older women were more inclined than older men to report incidents of falling and to seek medical attention for such occurrences. Prior research has indicated that older women experience a higher frequency of falls compared to their male counterparts (Najafzadeh et al. 2024). Additionally, diminished mid-calf muscle strength was found to be independently linked to an increased risk of falls in both genders. A subsequent study in the United States highlighted that older adult, regardless of gender, who experienced frequent falls exhibited distinct patterns of physical activity. While numerous studies have explored gender disparities in falls and physical activity independently, the potential differences in how physical activity correlates with falls across genders remain

ambiguous (Buchman et al. 2010). Furthermore, the incidence of fall-related injuries escalates with advancing age, particularly among individuals aged 75 and above, who exhibit a greater decline in physical function associated with aging (Hirase et al. 2020). Nevertheless, existing research indicates that physical activity programs can enhance physical function and mitigate the risk of age-related functional decline within the broader aging population. Consequently, age may also influence the dynamics between physical activity and falls. In order to comprehend the influence of consistent physical activity on individuals diagnosed with Alzheimer's disease, this investigation was designed to explore the associations between physical exercise with risk of fall and low-back pain in older adults with Alzheimer.

METHODS

A descriptive-correlational methodology was utilized in this investigation. The sample consisted of 256 older adults diagnosed with Alzheimer's disease, including 86 females. The participants' ages varied from 55 to 78 years, with an average age of 65.46±3.74 years. Selection of participants was conducted using an available and convenience sampling technique.

The assessment of physical exercise was performed using the Rapid Assessment of Physical Activity (RAPA) scale (Schega et al. 2021), which consists of seven items requiring dichotomous responses of 'Yes' or 'No'. The total score on this scale ranges from 0 to 7. In this study, the internal consistency reliability of the RAPA scale, as measured by Cronbach's alpha, was found to be 0.92. Furthermore, the validity of this tool has been established by a panel of ten experts, resulting in a Content Validity Index (CVI) of 0.90 and a Content Validity Ratio (CVR) of 1.00.

Falls were assessed through face-to-face interviews. Participants were instructed that a fall was defined as an incident where they ended up on the floor or ground due to an inability to prevent the fall. During the interview, participants were queried with the question, "Have you ever fallen on the floor or ground in the past 12 months?" (Response options: yes or no) and, if applicable, "If yes, how many falls have you experienced in the past 12 months?". The classification of fall status was divided into two categories: those who had not experienced any falls and those who had experienced falls.

A validated questionnaire was employed to gather data regarding low back pain, encompassing lifetime prevalence, prevalence over the past week (yes/no), point prevalence (yes/no), intensity of low back pain experienced in the last three months (measured using a visual analogue scale—VAS—ranging from 0 to 10), the extent to which low back pain interfered with usual activities (never/only when in pain/always), occurrences of low back pain while in bed or upon waking (yes/no), as well as demographic information such as sex and age. The assessment of lifetime prevalence of low back pain was conducted through the inquiry, "Have you ever had low back pain?" with response options including (1) never; (2) only once; (3) several times; (4) frequently; and (5) almost constantly. Given the self-reported nature of the questionnaire and the participants' age, it was determined that reporting low back pain "only once" did not adequately reflect a history of low back pain, as it represents a singular event. Consequently, this variable was reclassified into a dichotomous format, where 0 indicated either never having experienced low back pain or having experienced it only once, and 1 indicated having experienced low back pain several times, frequently, or almost constantly.

Data analysis was conducted using SPSS-26 and Lisrel software. Descriptive statistics, including means and standard deviations, were utilized to define the characteristics of the variables. To evaluate the relationships among the variables, a Pearson correlation test was performed. Additionally, independent t test was used for measuring gender differences. A significance level of $P < 0.05$ was established.

RESULTS

The study involved a sample of 256 elderly individuals diagnosed with Alzheimer's disease, comprising 86 females. The ages of the participants ranged from 55 to 78 years, with a mean age of 65.46±3.74 years. Specifically, the average age for male participants was 65.55±3.63 years, while female participants had a mean age of 65.32±3.89 years ($P=0.893$). However, male participants were significantly taller and heavier than females ($P<0.001$). Importantly, no statistically significant differences were found between genders in terms of BMI (see Table 1).

Table 1. Demographic data of the participants

	Male	Female	Gender differences
Age (years)	65.55±3.63	65.32±3.89	t=0.089 P=0.893
Height (m)	1.76 ± 0.05	1.66 ± 0.05	t=5.967 P<0.001
Weight (kg)	78.85 ± 3.22	69.47 ± 2.85	t=5.846 P<0.001
BMI	22.63 ± 0.85	22.57 ± 0.69	t=0.128 P=0.765

Descriptive statistics are summarized in Table 2. The findings indicate that, overall, the level of physical activity is below the average threshold. Furthermore, the average risk of falling was recorded at 2.78 times over the past year. Additionally, the average score for low back pain was 6.85, suggesting that participants experienced levels of low back pain that exceed the average. The Kolmogorov-Smirnov tests confirmed that all variables followed a normal distribution (all P>0.05). Independent t-tests demonstrated that there were no significant differences between male and female participants across all study variables.

Table 2. Descriptive data

	Physical activity	Risk of fall	Low back pain
Mean	1.25	2.78	6.85
SD	0.12	0.85	1.05

Bivariate relationships between physical activity with risk of fall and low back pain are demonstrated in Table 3. Results revealed significant indirect relationship between physical activity and risk of fall (P<0.001). Moreover, physical activity was indirectly and significantly associated with low back pain (P<0.001). Finally, risk of fall was directly and significantly associated with low back pain (P<0.001).

Table 3. Results of bivariate relationships between variables

	1	2	3
1. Physical activity	-		
2. Risk of fall	r= - 0.596 P<0.001	-	
3. Low back pain	r= - 0.759 P<0.001	r=0.637 P<0.001	-

DISCUSSION

Existing research indicates that physical activity programs can enhance physical function and mitigate the risk of age-related functional decline within the broader aging population. Consequently, age may also influence the dynamics between physical activity and falls. In order to comprehend the influence of consistent physical activity on individuals diagnosed with Alzheimer's disease, this investigation was designed to explore the associations between physical exercise with risk of fall and low-back pain in older adults with Alzheimer.

The findings indicate that, overall, the level of physical activity is below the average threshold. These findings are in consistent with those of previous studies (Srivastava & Muhammad, 2022; Todri, 2019), indicating that older adults do not participants in enough health-related physical activity. One potential explanation for this phenomenon is that swift urbanization tends to introduce novel ideas, cultures, and technologies, which collectively promote a more sedentary way of life and diminish physical activity levels in rural regions. Additionally, the lack of available venues and facilities for physical activities in certain rural areas may contribute to this issue (Tavares et al. 2014). Our findings also indicate that the rates of physical activity participation among older women are markedly lower than those of older men. In rural China, it is typical for older women to assume the responsibility of caring for young grandchildren left at home, which may impede their ability to engage in physical activities.

An inverse relationship was identified between physical activity and falls among older adults residing in rural areas. In alignment with our results, numerous studies have indicated that elevated levels of physical activity correlate with a reduced incidence of falls in this demographic. Conversely, other research has proposed a U-shaped correlation between physical activity and falls, suggesting that both excessive and insufficient levels of physical activity may elevate the risk of falling (Wong et al. 2017). The impact of physical activity on fall

risk may vary based on the functional capabilities of older adults. Those with diminished functional status are more susceptible to fatigue or falls, which can result in decreased physical activity levels. Conversely, older adults engaging in high levels of physical activity may be undertaking activities that exceed their physical capabilities, thereby increasing their fall risk. In instances where physical function deteriorates while physical activity levels remain high, the likelihood of falls among older adults may rise (Yalfani et al. 2022).

Exercise training enhances various aspects of physical health in older adults, such as aerobic capacity and functional mobility, while also diminishing the likelihood of chronic illnesses. In this investigation, a consistent exercise regimen was linked to improved upper body strength, aerobic endurance, and balance among all dementia patients. Nevertheless, no enhancements in fitness functionality were observed in individuals with moderate dementia despite regular exercise participation. Subgroup analyses revealed that exercise positively influenced senior fitness test outcomes in patients with mild dementia, whereas no similar improvements were noted in those with moderate dementia (Wright et al. 2016). Several factors may explain the lack of association between exercise and enhanced physical fitness in this group. Firstly, the limited sample size may have resulted in inconclusive findings. Secondly, pharmacological treatments for moderate to severe dementia could potentially obscure the benefits of physical fitness in these patients. Lastly, the inherent challenges posed by moderate to severe dementia may further inhibit the observable effects of exercise (Yalfani et al. 2023).

The current findings indicate that physical activity correlates with a reduced incidence of low back pain and diminished of low back pain severity. Certain studies have suggested that diminished endurance in trunk extensor and flexor muscles is associated with low back pain. Additionally, it has been demonstrated that strengthening exercises can effectively alleviate pain and enhance back function in adults. Regarding lower-limb endurance and power, while some research has indicated a relationship between increased endurance and power with reduced low back pain, the present study did not find such associations (Uysal et al. 2024). Furthermore, literature indicates that core-conditioning programs may mitigate lower-back injuries by enhancing core muscle strength and overall trunk stability; however, no correlation was observed in this study between abdominal strength and low back pain. Some researchers highlight that the mechanisms by which muscle strength compensates for external loads, potentially leading to back pain, remain unclear, likely due to a scarcity of prospective studies that would facilitate the establishment of causality (Weiner et al. 2020).

This research carries significant implications for both practice and policy. The results suggest that public health service managers in rural areas should enhance participation in physical activity among older adults as a strategy to mitigate fall risks and pain. Furthermore, it is essential for rural community leaders to develop appropriate venues and facilities that promote active engagement in physical activity, taking into account the gender-specific needs of older adults. It is advisable to particularly motivate older women and younger seniors to engage more frequently and sustain higher levels of physical activity. Additionally, efforts should be directed towards encouraging older men to achieve elevated levels of physical activity. Concurrently, it is crucial to implement strategies aimed at fall prevention and pain (Whitlock et al. 2017).

CONCLUSION

Increased levels of physical activity are associated with a reduced incidence of falls and pain, with no significant differences observed between genders in this relationship among the elderly population. Older men engaging in high levels of physical activity demonstrate a lower likelihood of experiencing falls. Similarly, older women and older individuals who partake in substantial physical activity also exhibit a decreased risk of falling. It is imperative for policymakers to promote physical activity among older adults, taking into account their age and gender, as a strategy to mitigate the risk of falls.

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