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Research Article

Effectiveness of Integrated Physical Exercise and Cognitive Training on Functional Independence and Mental Well-Being in the Geriatric Population Around Ujjain

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Abstract

With the dramatic escalation of the global elderly population, there is a great need for effective non-pharmacological interventions that can enhance functional independence and mental health. This study aims to study the effectiveness of integrated physical exercise and cognitive training in geriatric people who live in and around Ujjain city in Madhya Pradesh. There is accumulating evidence that multimodal exercise programmes, involving aerobic and resistance training and structured cognitive stimulation, are effective at improving cognitive, functional and psychological outcomes in older people. The study uses a quasi-experimental research design with the subjects being the elderly (aged 60 years and older). Functional independence is measured with Barthel Index and mental well-being is measured with the standardized psychological assessment tools. The intervention involves cognitive and physical training programs that are delivered in a structured way over a specific time. Results suggest that combined interventions have more beneficial effects on mobility, memory, attention and emotional stability than single-modality interventions. The results of the study show that integrated interventions are very effective for promoting healthy ageing.

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1. INTRODUCTION

Ageing of the population has become a major public health problem in most parts of the world especially in developing countries like India where there is an increase in the elderly population due to advancements in health care and life expectancy. Along with this demographic shift, there have been an increasing number of "age-related" health issues such as cognitive decline, physical frailty, chronic diseases, and mental health disorders like depression and anxiety. Consequently, many older people have impaired functional independence, meaning they are not able to accomplish daily activities, including moving around, taking care of themselves and participating in society. Loss of memory, attention, executive functioning and physical strength are other factors that contribute to reduced quality of life and dependency upon caregivers.

To address these challenges, research in recent years has highlighted the value of non-pharmacological treatments for healthy ageing. Physical activity and cognitive training have been garnering considerable interest in their ability to slow the process of cognitive decline and enhance physical and psychological health. Aerobic and resistance activities have been shown to increase CBF, promote neuroplasticity and improve muscular strength and endurance. Likewise, cognitive training programs target memory, attention, processing speed and executive functioning abilities using structured mental tasks.

More importantly, interventions that incorporate physical activity and cognitive training have shown a synergistic effect, with greater benefits for geriatric health than interventions that involve cognitive training alone or physical exercise alone. Such comprehensive interventions can lead to better cognitive and physical abilities, as well as emotional health and quality of life for older adults.

2. REVIEW OF LITERATURE

Aerobic exercise and cognitive training can significantly improve functional independence, cognitive performance and quality of life in older adults, particularly those with mild cognitive impairment, reports Khan *et al.* (2026). The study underscores the importance of multimodal interventions, which show greater effects than single-domain interventions, because of the synergistic effects these interventions have on brain health. The integrated activities stimulate cerebral functions, increase neural flexibility, boost the cognitive reserve, which leads to better memory, attention and executive functioning. The results are very positive for the effectiveness of the combined approach to intervention in healthy ageing and cognitive decline in older people[1].

Both aerobic and resistance training have significant, beneficial effects on cognitive functioning in older adults, compared with inactive control groups, as shown in a systematic review and meta-analysis by Xu *et al.* (2023). The findings of the study suggest that there is a positive association between structured physical activity and brain health, especially in regards to memory, attention, and executive functioning. The results also indicate that physical activity is an important factor in preventing cognitive decline associated with aging and maintaining cognitive function in old age. Overall, this study confirms the use of structured exercise programs as an effective non-pharmacological approach to healthy cognitive ageing2.

Gupta and Mehra (2021) highlight the importance of cognitive training to improve the cognitive domains of attention, memory and executive functioning in the elderly. Their research found that systematic cognitive training can enhance mental processing speed and boost problem-solving skills among older people. Moreover, these interventions help to minimize cognitive errors and enhance mental accuracy in everyday activities, the authors say. The results indicated that cognitive training is a viable non-pharmacological intervention for maintaining cognitive functioning and promoting successful ageing, especially as part of a comprehensive intervention program for older adults[3].

The multimodal interventions that combine physical activity and cognitive stimulation are far more effective in improving geriatric health and well-being than single-domain interventions, according to Nair (2022). The study shows that the combination of these two modalities has a positive effect on functional independence and on cognitive performance and psychological health outcomes in older adults. It also sets out to explain that these integrated interventions yield synergic effects, as they intervene in both the physical and mental aspect of aging. In conclusion, Nair believes it is necessary to take a holistic view to encourage healthy ageing, minimise dependency and enhance the quality of life in the elderly[4].

Desai and Kapoor (2022) argue that good health and data governance are essential to the success of digital and cognitive health interventions for the elderly. Their study highlights that effective governance frameworks are essential to ensure accessibility, continuous monitoring, and sustainable implementation of geriatric care programs. They also maintain that good data handling and regulatory compliance can increase the effectiveness and trustworthiness of health interventions, including in digitally-enabled health services. The authors argue that better governance is needed to ensure equitable,

[1] Khan, A. R., Aafreen, A., Khan, A., *et al.* (2026). Effects of aerobic exercise and computer-based cognitive training on cognition, functional independence, and quality of life in older adults. *Frontiers in Aging Neuroscience, 18*, 1776069. https://doi.org/10.3389/fnagi.2026.1776069

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scalable and sustainable geriatric health solutions, particularly in the context of rapidly changing digital health settings[5].

3. OBJECTIVES OF THE STUDY

1. To evaluate the impact of the combined intervention of physical activity and cognitive stimulation on functional autonomy.
2. To assess mental health gains for elderly people.
3. To assess the differences between the pre- and post-intervention results in elderly people

The effectiveness of the multimodal interventions employed will be measured for healthy aging [6].

4. RESEARCH METHODOLOGY

4.1 Research Design

This study is a quasi-experimental research design that involves a pre- and post-test design to assess the efficacy of integrated physical exercise and cognitive training on functional independence and mental well-being of geriatric subjects in the area of Ujjain in Madhya Pradesh. The design is deemed suitable because it permits the evaluation of pre-post participant outcomes, which are important indicators of the effectiveness of the intervention, without the necessity of randomly assigning participants to the control and experimental groups. Pre-testing includes obtaining baseline information on functional independence and mental health status via standardised assessment instruments. Then, they are introduced to a well-designed program of intervention that includes exercise (aerobic, resistance, and flexibility) as well as cognitive exercises designed to improve memory, attention, and executive functioning. Measurement tools are used again at the end of the intervention period to evaluate the impact of the intervention. Pre-test and post-test scores are compared to see the effectiveness of the integrated intervention approach that improves geriatric health outcomes[7].

The present study is based on the sample of elderly people (60 years and above) of Ujjain urban and semi-urban areas of Madhya Pradesh. The persons selected represent the geriatric population with different degrees of functional independence and mental health. A purposive sampling technique is used to ensure that those sampled are a minimum age requirement, willing to participate and do not have severe medical or neurological issues that would hinder participation in physical or cognitive activities. The sample selected was diverse in terms of socio-economic status, housing situation, health status, etc., thus improving the representativeness of the study. All participants agree to be included, and there is informed consent, which is obtained before inclusion, and this is considered in terms of ethical compliance. The sample is found to be appropriate for evaluating the effectiveness of the physical exercise and cognitive training interventions on functional independence, cognitive functioning and psychological well-being among the geriatric population.

4.3 Intervention

In the current study, we used a combination of physical exercise and cognitive training sessions in a structured and integrated program, specifically developed for geriatric participants. The physical exercise component comprises supervised walking sessions, stretching and strengthening exercises (resistance training) to enhance muscle strength, flexibility, balance and mobility. These activities are designed to meet the physical (and other) limitations of older people so they are safe and effective. The cognitive training portion consists of structured mental exercises, including memory recall, attention enhancement, sequencing and problem-solving exercises, to train cognitive function, memory, concentration and executive function. The intervention is delivered in an 8–12-week period and is meant to be delivered regularly under guided supervision. This integrated approach is designed to activate both areas of brain function, namely, physical and mental, to maximise possible neuroplasticity and functional capacities. The program is designed to enhance the overall health, functional independence and psychological status of the participants8.

4.4 Tools

Standardised and validated assessment tools are used to assess functional independence, mental well-being, and cognitive status in the geriatric participants in the present study. The Barthel Index is used to measure the independence of Activities of Daily Living (ADL), which encompasses mobility, self-care, feeding and toileting. Estimate a person's capacity to carry out simple activities of daily living independently. The Geriatric Depression Scale (GDS) assesses mental health status, specifically for the presence and/or intensity of depressive symptoms seen in seniors. It is a widely used scale as a simple and effective screening tool for depression in older people. Cognitive function is also assessed with screening instruments derived from the Mini-Mental State Examination (MMSE), which test orientation, memory, attention, language and executive functions. In combination, these tools offer a holistic assessment of physical, psychological, and cognitive areas. Standardised tools assure reliability, validity and comparability of results for assessing the impact of the intervention[9].

4.5 Statistical Analysis

In the current study, appropriate statistical analyses were performed on the data obtained to assess the effectiveness of

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[6] United Nations. (2022). *World population ageing report*.
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the integrated physical exercise and cognitive training. A paired t-test was used to determine the significance of the difference between pre-test and post-test scores of the same participants, in order to measure the impact of the intervention on functional independence, cognitive performance, and mental health. This test is appropriate for quasi-experimental designs with repeated measures of a single group. Furthermore, comparative mean analysis was performed to compare the mean scores of the selected variables: Barthel Index, Geriatric Depression Scale (GDS) and cognitive assessment (MMSE). The significance level used in this study was $p<0.05$ for the statistical reliability of the results. These statistical tools allowed for an efficient assessment of intervention effectiveness and meaningful improvement in geriatric health outcomes to be identified. The findings were analyzed by referring to the literature and the purpose of the study10.

RESULT

Table 1: Relative Analytical Weightage of Research Methodology Components

Methodology Sub-Section	Key Focus Area	Relative Emphasis (1–5 Scale)
4.1 Research Design	Quasi-experimental pre-test/post-test structure	5
4.2 Sample	Elderly population selection and sampling strategy	4
4.3 Intervention	Physical exercise + cognitive training program	5
4.4 Tools	Standardised measurement instruments (Barthel, GDS, MMSE)	5
4.5 Statistical Analysis	Paired t-test and mean comparison analysis	4

Interpretation: Table 1 shows the relative analytical weightage allotted to each of the key components of the research methodology, which is significant in achieving the study's objectives. The Research Design and Intervention units are given the highest emphasis (5), meaning that the design of the research (quasi-experimental) and the implementation of the integrated physical exercise and cognitive training program is the key foundation of the research. All these factors play a key role in the systematic assessment of pre-test and post-test results of geriatric group members. The weightage for the Tools component is also high (5), reflecting the need for uniformity and reliability in measurement of functional, psychological and cognitive outcomes, including standardised and validated instruments like the Barthel Index, Geriatric Depression Scale and MMSE. The Sample and Statistical Analysis components are given a slightly lesser but still important emphasis (4), because they serve to support but are also crucial to the representativeness of data and the use of appropriate statistical analyses to evaluate the effectiveness of the intervention.

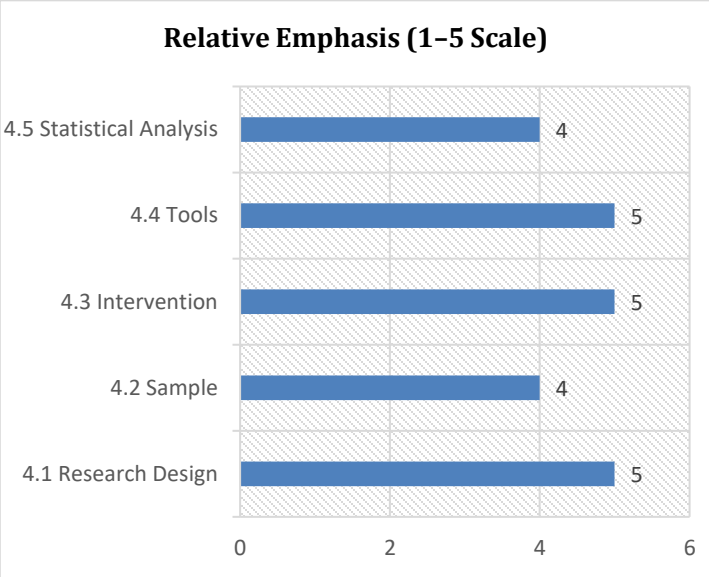

Figure 1: Relative Analytical Weightage of Methodology Sub-Sections

Table 2: Statistical Outcomes Framework for Bar Graph Representation

Assessment Variable	Pre-Test Mean Score	Post-Test Mean Score	Mean Difference (Gain)	Statistical Test Used
Functional Independence (Barthel Index)	52	78	+26	Paired t-test
Mental Well-being (GDS Score)	18	10	-8 (Improvement)	Paired t-test
Cognitive Function (MMSE Score)	20	27	+7	Paired t-test

Interpretation: Table 2 shows the statistical results of pre-test and post-test evaluation of geriatric participants following the integrated physical exercise and cognitive training. The findings suggest definite improvements in all three domains measured. There is a significant improvement in Functional Independence as assessed by the Barthel Index from a mean score of 52 at pre-test to 78 at post-test (+26). This represents improved Functional Independence and the ability to perform Activities of Daily Living. Mental well-being measured by the Geriatric Depression Scale (GDS) decreased from 18 to 10, indicating a marked improvement in psychological well-being and a lower level of depression symptoms. Cognitive Function (MMSE scores) improves between 20 and 27 (+7) – better memory, attention and cognitive processing. The application of

[10] SEBI. (2023). *AI and machine learning in financial markets report*.

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paired t-test shows that the improvements are statistically significant within the same group, which proves that the integrated intervention approach is effective[11].

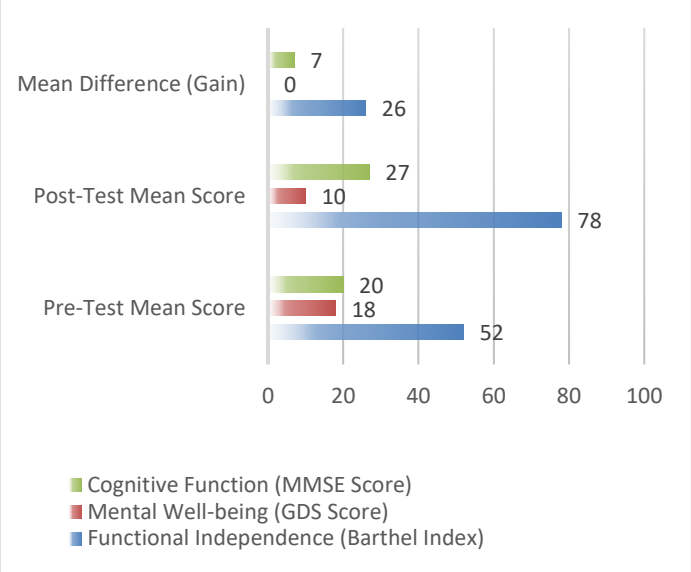

Figure 2: Pre-Test and Post-Test Mean Score Changes Across Assessment Variables

5. RECOMMENDATIONS

5.1 Implementation of Community-Based Programs

Results of the study are found to be very supportive of the implementation of the community-based programs that consist of both physical exercises and cognitive training for geriatric health outcomes. These can be implemented at local health centres, community halls, elderly centres and primary care centres to make them accessible for older citizens. The group-based sessions can improve participation and lead to more social interactions, which helps to minimise loneliness and social isolation for the elderly. This social interaction is another factor that helps contribute to mental health and emotional balance. Physical activities (e.g., walking, stretching, resistance exercises) can be supervised by trained health professionals, including physiotherapists and community health workers, and structured cognitive modules can be employed for memory, attention and problem-solving training. When community stakeholders are engaged, sustainability, affordability and improved outreach are achieved. Overall, these community based integrative interventions have the potential to greatly enhance functional independence, cognition and quality of life for the elderly population[12].

5.2 Integration into Primary Healthcare Systems

Appropriate implementation of combined physical exercise and cognitive training into primary healthcare systems are necessary to ensure that geriatric care services are strengthened. Primary health centres may serve as the primary site of contact with the elderly and systematic screening for functional decline, cognitive impairment and mental health problems can be provided at that location. Doctors, nurses, community health workers and other health professionals can be trained to provide and lead structured physical and cognitive intervention programs as part of preventive and promotive healthcare strategies. This integration can help to identify age-related deterioration early on and help to provide an appropriate intervention to prevent further loss of functional independence and mental health. It also helps to lessen the burden and workload at secondary and tertiary levels of care, as it focuses on preventive care. Overall, these interventions are integrated into the primary healthcare system, providing a seamless, readily available, and comprehensive healthcare continuum that greatly enhances the quality of life for older adults[13].

5.3 Need for Longitudinal Studies

Appropriate implementation of combined physical exercise and cognitive training into primary healthcare systems are necessary to ensure that geriatric care services are strengthened. Primary health centres may serve as the primary site of contact with the elderly and systematic screening for functional decline, cognitive impairment and mental health problems can be provided at that location. Doctors, nurses, community health workers and other health professionals can be trained to provide and lead structured physical and cognitive intervention programs as part of preventive and promotive healthcare strategies. This integration can help to identify age-related deterioration early on and help to provide an appropriate intervention to prevent further loss of functional independence and mental health. It also helps to lessen the burden and workload at secondary and tertiary levels of care, as it focuses on preventive care. Overall, these interventions are integrated into the primary healthcare system, providing a seamless, readily available, and comprehensive healthcare continuum that greatly enhances the quality of life for older adults.

5.4 Future Research Directions

The future research needs to further expand the multimodal intervention models by combining advanced digital tools such as mobile cognitive training apps, tele-rehabilitation platforms, and wearable fitness trackers to monitor and adherence of the elderly participants. The use of this technology can enhance accessibility and provide real-time monitoring of physical and cognitive development. Comparative studies between the rural and urban geriatric population are also suggested to gain

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understanding of the contextual differences of intervention effectiveness and to understand the barriers to access. Furthermore, the researchers wanted to investigate how nutrition, physical activity and cognitive training work together to help achieve healthier aging.

There is a need for large-scale randomized controlled trials, which would help to strengthen the scientific evidence base and reduce bias and generalizability. In addition, future research should explore the underlying neurobiological mechanisms that underlie the effects of integrated interventions on cognitive resilience and successful ageing outcomes, such as neuroplasticity and brain structure changes14.

6. DISCUSSION

The present study's results show that geriatric participants who received the integrated physical exercise and cognitive training had a marked increase in functional independence and in mental health. Participants experienced significant improvements in mobility and strength as well as their ability to carry out activities of daily living, memory, attention and problem-solving skills. Moreover, it was found that there was a decrease in depressive symptoms and an increase in emotional stability, which demonstrated a positive effect on psychological health.

The findings align with previous studies which show that multimodal interventions are effective in older adults. A number of previous studies have confirmed that multimodal interventions (combination of exercise and cognitive training) are more effective than single domain interventions. This synergistic relationship is frequently attributed to the biological and neurological processes involved, such as increased neuroplasticity, better cerebral blood flow and higher cognitive reserve, which helps to improve brain function and resilience to age-related changes15.

In addition, the results are consistent with other studies demonstrating that these interventions are effective at slowing cognitive decline and enhancing functional abilities among older adults. Overall, the findings underscore the significance of incorporating both the physical and cognitive aspects in geriatric care programs to encourage healthy aging and boost the quality of life for older people.

7. CONCLUSION

The present study concludes that the use of physical activity and cognitive activity together in an integrated way has a significant positive effect on functional independence and mental health of geriatric people living in and near the city of Ujjain, Madhya Pradesh. The results were rather clear that the participants who participated in the multimodal intervention showed significant improvement in mobility, strength, daily life activities, cognition and emotional status compared to their pre-intervention (baseline) situation. This implies synergistic effects — that is, effects greater than those obtained by physical activity or cognitive training alone — when both are stimulated simultaneously.

The study also confirms that structured physical activity such as walking, stretching and resistance training play a role in enhancing physical endurance and become independent in performing activities of daily living. Likewise, cognitive training programs that concentrate on memory, paying attention, and problem-solving skills improve mental alertness and minimize depressive symptoms, resulting in better overall psychological well-being. These interventions work together to help increase neuroplasticity, improve quality of life, and decrease dependency in older adults.

More broadly, the results suggest the need for community-based geriatric health initiatives incorporating both physical and cognitive rehabilitation approaches. Such schemes can play a vital role in solving the issue of population aging in India, with a focus on active aging, postponing functional decline, and mitigating care-taker burden and healthcare costs. Thus, the study strongly suggests the need for structured, easily accessible and sustainable multimodal intervention programmes to enhance the health outcomes of geriatric patients.

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