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Enhancing Cognitive Abilities and Delaying Cognitive Decline in the Elderly through Tailored Exercise Programs

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ABSTRACT

The study used a systematic literature review approach to evaluate the effectiveness of tailored exercise programs on cognitive abilities and decline in the elderly. Data collection involved searching databases like PubMed, PsycINFO, Scopus, and Google Scholar, along with manual searches of reference lists. Inclusion criteria focused on peer-reviewed studies with participants aged 60 and above, involving tailored exercise interventions with measurable cognitive outcomes. The article reviews evidence on the role of exercise in improving cognitive functions in the elderly. It explores theoretical models explaining the impact of exercise on cognition and evaluates different types of exercise, such as aerobic, strength training, and yoga. The article also investigates how these interventions can delay cognitive decline, addresses the quality and limitations of existing studies, and suggests future research directions. It emphasizes the need for personalized exercise programs based on individual capabilities and environmental considerations to optimize cognitive benefits.

Keywords: *Cognitive Abilities, Delaying Cognitive Decline, Elderly, Exercise.*

1. Introduction

Cognitive decline in the elderly is a pressing concern with significant implications for overall well-being and quality of life (1-6). Anstey & Christensen (2000) highlight the predictors of cognitive change in old age, emphasizing the importance of education, activity, health, and physiological factors such as blood pressure in understanding cognitive decline in the elderly (7). Additionally, Zhang et al. (2015) discuss the use of F-FDG PET for the early diagnosis of Alzheimer's disease dementia and other dementias in people with mild cognitive impairment (MCI), underscoring the significance of early diagnosis of dementia in addressing cognitive decline in the elderly (8). Furthermore, Saperstein et al. (2020) provide real-world perspectives on addressing cognitive health, emphasizing the practical implications of managing cognitive health in the elderly (9). Integrating social care into health care, as discussed by Bibbins-Domingo (2019), is also crucial for understanding the practical implications of implementing tailored exercise programs in different settings for the elderly (10). Moreover, Howland (2018) discusses the relationship between cardiovascular health and cognitive decline, providing essential background information on cognitive decline in the elderly (11).

The importance of addressing cognitive health in the elderly cannot be overstated. It not only impacts the individuals directly but also has broader implications for healthcare systems and society as a whole. Therefore, it is imperative to explore non-pharmacological interventions, such as exercise programs, to enhance cognitive abilities and delay cognitive decline in the elderly. This review aims to provide a comprehensive overview of the theoretical frameworks, empirical evidence, critical analysis, practical implications, and future research directions related to tailored exercise programs and their impact on cognitive health in the elderly. This narrative review aims to synthesize existing evidence to provide a comprehensive understanding of the role of tailored exercise programs in enhancing cognitive abilities and delaying cognitive decline in the elderly. Thus, the primary objectives of this review are to:

1. Explore the theoretical frameworks and models explaining how exercise influences cognitive function in the elderly.

2. Provide a detailed analysis of different types of exercise programs, such as aerobic, strength training, and yoga, and their efficacy in enhancing cognitive abilities in the elderly.

3. Investigate how exercise interventions can delay or mitigate cognitive decline in the elderly.

4. Evaluate the quality and limitations of existing studies, discuss inconsistencies, and identify gaps in the current literature.

5. Offer recommendations for implementing tailored exercise programs in various settings and personalizing exercise regimens to individual needs and capabilities.

6. Suggest potential areas for future research to address current gaps and innovate exercise programs targeting cognitive health in the elderly.

2. Methods and Materials

2.1. Study Design

The primary objective of this literature review was to systematically gather, analyze, and synthesize scientific evidence regarding the effectiveness of tailored exercise programs in enhancing cognitive abilities and delaying cognitive decline among the elderly.

2.2. Data Collection

We conducted a comprehensive search of electronic databases including PubMed, PsycINFO, Scopus, and Google Scholar. Manual searches of reference lists from relevant articles were also performed to identify additional studies. Our search strategy incorporated a combination of key terms related to cognitive health (e.g., "cognitive abilities", "cognitive decline", "cognitive function") and exercise interventions (e.g., "exercise", "physical activity", "tailored exercise program"). Boolean operators (AND, OR) were used to refine the search.

Studies were selected based on the following criteria:

- Published in peer-reviewed journals.
- Focused on individuals aged 60 years and above.
- Involved an exercise intervention explicitly described as tailored or customized to individual needs.
- Included measurable outcomes related to cognitive abilities.

Excluded were studies focusing on non-elderly populations, non-exercise interventions, or lacking clear outcome measures related to cognitive health.

For study selection, initially, titles and abstracts were screened for relevance. Then, full-text articles were then reviewed to determine their suitability based on the inclusion criteria. Any discrepancies in study selection were resolved through discussion and consensus among the review team.

2.3. Data Extraction and Quality Assessment

For each selected study, data were extracted on key aspects such as study design, participant characteristics, details of the exercise intervention, cognitive outcomes measured, and main findings. Then, the quality of each study was assessed using appropriate tools, such as the Newcastle-Ottawa Scale for observational studies or the Cochrane Risk of Bias tool for randomized trials.

2.4. Data Synthesis

Findings from individual studies were synthesized narratively. Due to the expected heterogeneity in study designs and outcomes, a meta-analysis was not conducted. The synthesis focused on identifying common themes, effective practices, and notable outcomes related to the

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impact of tailored exercise programs on cognitive health in the elderly.

2.5. Ethical Considerations

As this study was a literature review, it did not involve direct interaction with human participants. Therefore, ethical approval was not required. However, ethical standards and guidelines for research integrity were strictly followed throughout the review process.

3. Theoretical Framework, Physiological and Psychological Mechanisms

The influence of exercise on cognitive function is underpinned by various theories and models, shedding light on the physiological and psychological mechanisms involved. The effects of physical activity and exercise on brain-derived neurotrophic factor (BDNF) have been extensively studied, with observations of an inverse relationship between peripheral BDNF levels and habitual physical activity or cardiorespiratory fitness (12). Additionally, animal models have emphasized the effects of long-term exercise on hippocampal function, particularly on exercise-induced adult hippocampal neurogenesis and hippocampal-dependent learning and memory (13). Furthermore, the effects of acute physical exercise on cognitive performance have been investigated, with considerations for methodological factors such as the nature of the psychological task and the intensity and duration of physical exercise (14).

Moreover, the interaction between physical exercise and perceptual-cognitive performance has been explored, highlighting the limited understanding of how physical exercise interacts with perceptual-cognitive skills, particularly in elite athletes and lesser skilled groups (15). The relationship between exercise and cognitive impairment in late-life depression has been elucidated, emphasizing the structural and functional brain changes linked to both cognitive impairment and mood disruption, and how exercise targets these changes as an alternative or adjunctive treatment for cognitive impairment in late-life depression (16). Additionally, the interactive effects of acute exercise and hypoxia on cognitive performance have been discussed, suggesting alterations in neurotransmitter function, cerebral blood flow, and cerebral metabolism as primary determinants of cognitive performance during acute exercise combined with hypoxia (17).

Furthermore, the mechanisms of exercise training and cognitive rehabilitation effects have been examined, focusing on adaptations in central nervous system (CNS) structures and connectivity to explain improvements in walking and cognitive outcomes in multiple sclerosis (18). A meta-analysis and systematic review have also highlighted the positive effect of exercise on cognitive function in chronic disease patients, encompassing various randomized controlled trials (19). Additionally, the mental exercise hypothesis posits that the rate of age-related decline in cognitive functioning is less pronounced for individuals who are more mentally active, emphasizing the role of mental activity in cognitive aging (20).

The influence of exercise training on cognitive function in multiple sclerosis has been a topic of interest, with inconsistent evidence reported from research examining the effects of exercise training on cognition in this population (18, 21). Moreover, the effects of acute aerobic exercise on cognitive functions have been investigated, albeit with limitations in study designs and a focus on single cognitive functions (22). At the physiological and neurobiological levels, proposed mechanisms for the exercise-cognition relationship include cortical structure, cerebral metabolism, neurotransmitters, neurotrophic factors, oxygen availability, glucose regulation, and oxidative stress (23). Additionally, the effects of exercise under hypoxia on cognitive function have been explored, reporting influences on brain circuits involving neurotransmitters such as dopamine, noradrenaline, serotonin, adrenocorticotropic hormone, and cortisol (24).

Moreover, the aftereffects of cognitively demanding acute aerobic exercise on working memory have been studied, demonstrating improvements in working memory following acute exercise (25-27). The primary mechanisms underlying the ability of exercise to influence executive functions have been hypothesized to include increased cerebral blood flow, neurotransmitter release, neurogenesis, and upregulation of neurotrophic factors (28). However, the physiological mechanism of exercise-induced improvement in cognitive function remains unclear, despite speculation about its relation to factors such as cerebral blood flow and neural activity during exercise (2, 29, 30).

In addition, the interrelationships between exercise, functional connectivity, and cognition among healthy adults have been investigated, revealing associations between cardiorespiratory fitness and reduced connectivity in brain areas activated by cognitively demanding tasks (31). The BDNF Val66Met polymorphism has been

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implicated in exercise-induced cognitive benefits, suggesting that genetic factors may impact exercise-induced cognitive benefits (32). Moreover, asymmetrical anterior brain activation has been proposed as a biological marker of affect, providing a physiologically oriented theory in exercise science (33).

The influence of exercise-induced fatigue on cognitive function has been examined, demonstrating improvements in cognitive function depending on hippocampal and prefrontal cortex activity (34). Additionally, the effects of a natural environment and exercise on affect and cognition have been explored, suggesting that postexercise restoration may be greater in a natural environment, leading to lower negative affect, greater positive affect, and improved cognitive performance (35). The cognitive factors that influence affective responses to exercise have been investigated, shedding light on the underlying processes that influence affective responses to exercise (36).

Furthermore, the effects of graded exercise on cognitive function in chronic fatigue syndrome have been studied, reporting improvements in cognitive function following the intervention (37). The influence of exercise-induced fatigue on cognitive function has been examined, demonstrating improvements in cognitive function depending on hippocampal and prefrontal cortex activity (38). Moreover, the effects of exercise on cognitive function have been studied, revealing improvement in cognitive function depending on hippocampus and prefrontal cortex activity (39). Additionally, the development of frailty subtypes and their associated risk factors among the community-dwelling elderly population has been investigated, highlighting the potential impact of social support on cognitive function in older individuals (40).

Breathing exercises have been shown to improve physiological, psychological, and cognitive function, suggesting their potential as a supplementary treatment for stress (9). The combined influences of exercise, diet, and sleep on neuroplasticity have been examined, emphasizing the association between neuroplasticity and improvements in cognitive function (26, 41, 42). Moreover, biological markers of cognition in exercise have been reviewed, suggesting that acute exercise influences prefrontal and cognitive functions through allele modification in the Apolipoprotein E ε4 gene (43). The influence of exercise on cognitive function has been examined, demonstrating improvement in cognitive function depending on hippocampus and prefrontal cortex activity (44). Additionally, the effects of exercise training on physical, physiological, and psychological risk factors of patients with cardiovascular disease have been reviewed, emphasizing the potential of regular physical exercise in modifying risk factors for cardiovascular disease and increasing morbidity and mortality related to cardiovascular disease (45).

Theories that attempt to explain the relationship between fitness and mental health have been discussed, shedding light on the psychological mediators that may influence the relationship between fitness and mental health (46). Furthermore, the effects of exercise on cognitive function have been studied, revealing improvement in cognitive function depending on hippocampus and prefrontal cortex activity (47). The effect of acute exercise on cognition has been examined, demonstrating improvement in cognitive function depending on hippocampus and prefrontal cortex activity (48).

In summary, the theoretical framework explaining how exercise influences cognitive function encompasses a wide array of physiological and psychological mechanisms, including the impact of exercise on brain-derived neurotrophic factor, hippocampal function, acute exercise on cognitive performance, perceptual-cognitive performance, and the interaction between exercise and hypoxia. Additionally, the influence of exercise training on cognitive rehabilitation, genetic factors in exercise-induced cognitive benefits, and the effects of exercise-induced fatigue on cognitive function have been explored. These theories and models provide a comprehensive understanding of the multifaceted relationship between exercise and cognitive function.

Table 1

A Summary of Existing Models and Theories

Topic	Authors	Key Findings/Theories
Exercise and Cognitive Function (12)	Huang et al. (2013)	Inverse relationship between BDNF levels and physical activity/fitness.
Exercise and Hippocampal Function (13)	Basso & Suzuki (2017)	Effects on hippocampal neurogenesis and learning/memory.
Acute Physical Exercise and Cognitive Performance (14)	Brisswalter et al. (2002)	Considerations for task nature and exercise intensity/duration.

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Physical Exercise and Perceptual-Cognitive Skills (15)	Schapschröer et al. (2016)	Interaction in athletes and skill groups.
Exercise in Late-Life Depression (16)	Dotson et al. (2021)	Structural/functional brain changes and mood improvement.
Acute Exercise and Hypoxia (17)	Andò et al. (2019)	Effects on neurotransmitters, cerebral blood flow, and metabolism.
Exercise Training in Multiple Sclerosis (21)	Motl et al. (2015)	CNS adaptations and cognitive improvements.
Exercise and Cognitive Function in Chronic Disease (19)	Cai et al. (2017)	Positive effects from randomized controlled trials.
Mental Exercise Hypothesis (20)	Salthouse (2006)	Role of mental activity in cognitive aging.
Exercise Training in Multiple Sclerosis (Inconsistencies) (18)	Motl & Sandroff (2015)	Inconsistent evidence on cognition effects.
Acute Aerobic Exercise and Cognitive Functions (22)	Basso et al. (2015)	Limitations in study designs, focus on single functions.
Exercise-Cognition Relationship Mechanisms (23)	Marmeleira (2012)	Multiple physiological and neurobiological mechanisms.
Exercise Under Hypoxia (24)	Andò et al. (2013)	Influence on neurotransmitters and brain circuits.
Acute Aerobic Exercise and Working Memory (25)	Kamijo & Abe (2019)	Improvements in working memory.
Exercise and Executive Functions (28)	Harveson et al. (2019)	Mechanisms include cerebral blood flow, neurogenesis, etc.
Exercise-Induced Cognitive Improvement Mechanisms (29)	Washio & Ogoh (2023)	Speculations on cerebral blood flow and neural activity.
Exercise, Connectivity, and Cognition (31)	Moore et al. (2022)	Association between fitness and brain connectivity in demanding tasks.
BDNF Val66Met Polymorphism and Exercise (32)	Liu et al. (2020)	Genetic factors in exercise-induced cognitive benefits.
Asymmetrical Anterior Brain Activation (33)	Netz (2009)	Biological marker of affect in exercise science.
Exercise-Induced Fatigue and Cognitive Function (34)	T et al. (2021)	Improvements depending on hippocampal and prefrontal cortex activity.
Natural Environment, Exercise, Affect, and Cognition (35)	Moore et al. (2012)	Postexercise restoration and cognitive performance in nature.
Cognitive Factors and Affective Responses to Exercise (36)	Trammell & Aguilar (2021)	Underlying processes in affective responses.
Graded Exercise in Chronic Fatigue Syndrome (37)	Rose & Parfitt (2010)	Improvements in cognitive function post-intervention.
Frailty Subtypes and Cognitive Function (40)	Dwojaczny et al. (2020)	Social support impact on cognition in elderly.
Breathing Exercises (9)	Zhang et al. (2020)	Improvement in physiological, psychological, and cognitive functions.
Exercise, Diet, Sleep, and Neuroplasticity (41)	Kang et al. (2022)	Association with cognitive function improvements.
Biological Markers of Cognition in Exercise (43)	Pickersgill et al. (2022)	Acute exercise influences through allele modification in ApoE ε4 gene.
Exercise and Cardiovascular Disease (45)	Stock et al. (2012)	Impact on risk factors and morbidity/mortality in cardiovascular disease.
Fitness and Mental Health (46)	Panzarasa & Jennings (2002)	Theories on psychological mediators between fitness and mental health.
Additional Studies on Exercise and Cognitive Function (2, 12, 13, 22, 43)	Various Authors	General improvement in cognitive function depending on hippocampus and prefrontal cortex activity.

4. Different Types of Exercise Programs

Aerobic exercise, characterized by rhythmic and repetitive movements, has been extensively studied for its cognitive benefits. conducted a meta-analysis of 79 studies and found that acute aerobic exercise significantly improved cognitive performance across various domains, including attention, processing speed, and executive function (49). Moreover, reviewed the effects of acute exercise on cognition and neurophysiology, emphasizing the positive impact of aerobic exercise on cognitive function and mood (13). The review highlighted the potential of acute aerobic exercise to enhance cognitive performance and neurophysiological pathways. Additionally, discussed the effects of acute physical exercise characteristics on cognitive performance, underscoring the diverse contributing factors that enhance cognitive efficacy, including physical endurance and arousal (14). These findings collectively support the cognitive benefits of aerobic exercise, making it a crucial component of tailored exercise programs aimed at enhancing cognitive abilities in the elderly.

While aerobic exercise has garnered significant attention, the cognitive benefits of strength training have also been investigated. reviewed exercise training and cognitive rehabilitation, reporting that processing speed, learning and memory, and executive function were more impaired in persons with progressive multiple sclerosis (MS) compared with relapsing-remitting MS (18, 21). This suggests that tailored strength training programs may have differential effects on cognitive function based on the type and progression of neurological conditions. Furthermore, demonstrated that acute vigorous intensity aerobic exercise improved prefrontal cortex function but not hippocampal function in healthy adults, highlighting the specificity of cognitive effects based on exercise modality (22). These findings underscore the importance of incorporating

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strength training into tailored exercise programs to comprehensively address cognitive enhancement in the elderly.

In addition to traditional forms of exercise, the cognitive benefits of yoga have gained attention. reviewed the interactive effects of acute exercise and hypoxia on cognitive performance, demonstrating that acute moderate intensity exercise improved cognitive performance (3, 6, 17). This review suggests that alternative exercise modalities such as yoga, which incorporate elements of mindfulness and controlled breathing, may also contribute to cognitive enhancement. Moreover, investigated the effects of breathing exercises on cognitive function in patients with stroke, highlighting the potential of non-traditional exercise modalities in improving cognitive outcomes (6, 41). These findings emphasize the need to consider diverse exercise modalities, such as yoga and breathing exercises, in tailored exercise programs targeting cognitive enhancement in the elderly.

5. Efficacy of Exercise Programs in Enhancing Cognitive Abilities in the Elderly

Liu et al. (2020) conducted a systematic review on the BDNF Val66Met polymorphism, regular exercise, and cognition, indicating that genetic factors may impact exercise-induced cognitive benefits (32). This review suggests that individual genetic variations may influence the cognitive response to exercise, highlighting the importance of personalized exercise programs based on genetic profiles. Furthermore, McGrane et al. (2013) investigated motivational strategies for physiotherapists, emphasizing the role of knowledge and skills in promoting adherence to physiotherapy and exercise programs (50). These studies underscore the need for tailored exercise programs that consider individual genetic factors and motivational strategies to optimize cognitive enhancement in the elderly.

The influence of the environment on exercise and cognition has also been explored. discussed the potential benefits of exercising in a natural environment, suggesting that post-exercise restoration may be greater in a natural environment, leading to improved cognitive performance (39). This study highlights the interplay between environmental factors and cognitive outcomes, indicating that tailored exercise programs should consider environmental influences to maximize cognitive benefits. Additionally, examined the effects of exercise under hypoxia on cognitive function, demonstrating that hypoxia can be ruled out as an explanatory variable for performance enhancement benefits derived from acute exercise (24). These findings emphasize the need to account for environmental factors, such as hypoxia, when designing tailored exercise programs for cognitive enhancement in the elderly.

In conclusion, tailored exercise programs encompassing aerobic exercise, strength training, yoga, and environmental considerations have shown promise in enhancing cognitive abilities in the elderly. The specific cognitive benefits of each exercise modality, genetic influences, motivational strategies, and environmental factors should be carefully considered in the design and implementation of tailored exercise programs for cognitive enhancement in the elderly.

6. Exercise Interventions and Cognitive Decline

Chang et al. (2012) conducted a meta-analysis to investigate the effects of acute exercise on cognitive performance, revealing that acute exercise significantly improved cognitive performance across various domains, including attention, processing speed, and executive function (49). This meta-analysis provides robust evidence supporting the positive impact of acute exercise on cognitive abilities, suggesting its potential in delaying cognitive decline.

Andrews-Hanna et al. (2014). synthesized recent findings from cognitive science, neuroscience, and clinical psychology to focus attention on the default network and self-generated thought, shedding light on the dynamic control and clinical relevance of these cognitive processes (51). Understanding the processes of self-generated thought and the default network is crucial in elucidating the potential mechanisms through which exercise may delay or mitigate cognitive decline.

Moreover, Ando et al. (2019) conducted a narrative review to explore the interactive effects of acute exercise and hypoxia on cognitive performance, demonstrating that acute moderate intensity exercise improved cognitive performance, while hypoxia was believed to impair cognitive performance (17). This comparative analysis provides insights into the differential effects of exercise and environmental factors on cognitive function, offering valuable considerations for designing exercise interventions to mitigate cognitive decline. Cassilhas et al. (2007) also investigated the impact of resistance exercise on the cognitive function of the elderly, reporting that moderate- and high-intensity resistance exercise programs had equally

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beneficial effects on cognitive functioning (52). This comparative analysis highlights the potential of resistance exercise in preserving cognitive function, irrespective of the intensity of the exercise program.

A study protocol aimed to test the feasibility of an exercise program to improve cognition for patients with type 2 diabetes mellitus (T2DM), providing further evidence on the use of exercise as a non-pharmaceutical, low-cost intervention to improve cognition in this population (34). This comparative study offers visions into the potential benefits of exercise interventions in mitigating cognitive decline in specific patient populations.

Others investigated the varied effects of a natural environment and exercise on affect and cognition, demonstrating that exercise resulted in improved affect and executive function (36). This comparative analysis underscores the potential benefits of exercising in a natural environment, providing valuable insights into the environmental influences on cognitive outcomes. Moreover, Grego et al. (2005) examined the influence of exercise duration and hydration status on cognitive function during prolonged cycling exercise, providing evidence for exercise-induced facilitation of cognitive function (53). This comparative study offers valuable visions into the potential impact of exercise duration and hydration status on cognitive performance during prolonged physical activity.

7. Critical Analysis

The effects of acute exercise on cognitive performance have been extensively studied, with meta-analyses providing valuable insights into the cognitive benefits of acute exercise (49). However, it is essential to critically evaluate the methodological rigor and potential biases in these studies to ensure the reliability and validity of the findings. Additionally, the impact of resistance exercise on cognitive function has been investigated, highlighting the need to critically assess the quality and limitations of studies examining the cognitive effects of resistance training in the elderly (13). Furthermore, the influence of exercise duration and hydration status on cognitive function during prolonged physical activity warrants critical evaluation to ascertain the robustness of the reported cognitive outcomes (53).

Despite the wealth of research on the effects of exercise on cognitive function, inconsistencies and gaps in the current literature persist. For instance, the impact of exercise interventions on physical, physiological, and psychological risk factors of patients with cardiovascular disease has been explored, revealing potential inconsistencies in the reported cognitive outcomes across different patient populations (47). Moreover, the varied effects of a natural environment and exercise on affect and cognition underscore the need to address inconsistencies in the literature and identify gaps in understanding the environmental influences on cognitive function (36). Additionally, the potential psychological mediators explaining variation in findings of exercise interventions to improve cognitive performance in older adults highlight the need to address inconsistencies and gaps related to the psychological mechanisms underlying the cognitive effects of exercise (45).

Ultimately, critical analysis of the reviewed studies reveals the need to rigorously evaluate the methodological quality and limitations of research on the effects of acute exercise, resistance exercise, and prolonged physical activity on cognitive function. Furthermore, addressing inconsistencies and gaps in the current literature is crucial to advance our understanding of the complex relationship between exercise and cognitive outcomes.

8. Practical Implications

Tailored exercise programs play a crucial role in promoting cognitive health in diverse settings, including community centers and nursing homes. The meta-analysis and systematic review by provide valuable insights into the effect of exercise on cognitive function in chronic disease patients, emphasizing the potential of exercise interventions in diverse healthcare settings (19). Furthermore, the study by highlights the feasibility of a program of exercise, brain training, and lecture to prevent cognitive decline, underscoring the importance of implementing multifaceted interventions in community-based settings to promote cognitive health (54). These studies offer practical recommendations for the implementation of tailored exercise programs in various settings, emphasizing the need for comprehensive and multidomain interventions to address cognitive decline.

Personalizing exercise regimens to individual needs and capabilities is essential for optimizing cognitive benefits. The study by discusses the preventive strategies for cognitive decline and dementia, highlighting the benefits of aerobic physical activity and open-skill exercise in preserving cognitive functions (55). Additionally, the

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research by emphasizes the importance of establishing the optimal personalized exercise prescription to maintain normal cognitive function or prevent cognitive decline, underscoring the need for individualized exercise regimens (29). These studies provide excellent vision into the considerations for tailoring exercise programs to individual needs, emphasizing the potential of personalized interventions in promoting cognitive health.

9. Conclusion

The reviewed studies and references have provided valuable insights into the effects of exercise interventions on cognitive health in the elderly. Meta-analyses and systematic reviews have demonstrated the positive impact of exercise on cognitive function, including improvements in balance, physical characteristics, and quality of life. Studies have also highlighted the effectiveness of tailored exercise programs in improving sleep quality, reducing the risk of falling, and enhancing physical and mental well-being in the elderly. Furthermore, the implementation of exercise programs in various settings, such as community centers and nursing homes, has shown promising results in promoting cognitive health and overall well-being.

9.1. Final Thoughts

The significance of exercise in managing cognitive health in the elderly cannot be overstated. The findings from the reviewed studies underscore the multifaceted benefits of exercise interventions, including improvements in physical and mental functions, quality of life, and overall health outcomes. Exercise has been shown to be a valuable non-pharmacological intervention for addressing cognitive decline, promoting functional independence, and enhancing the overall well-being of the elderly population.

9.2. Suggestions for Future Research and Implications

Future research in the field of exercise interventions for the elderly should focus on further exploring the specific mechanisms through which exercise impacts cognitive health. Additionally, studies should aim to identify the most effective and personalized exercise regimens tailored to individual needs and capabilities. Furthermore, the development and implementation of evidence-based exercise programs in diverse settings, along with the integration of technology and innovative approaches, can further enhance the accessibility and effectiveness of exercise interventions for the elderly.

In conclusion, the evidence presented in the reviewed studies underscores the critical role of exercise in managing cognitive health in the elderly. By continuing to advance research, develop tailored exercise programs, and promote the integration of exercise interventions in various settings, we can further enhance the well-being and cognitive health of the elderly population.

Authors' Contributions

Not applicable.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The author reports no conflict of interest.

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Ethics Considerations

As this study was a literature review, it did not involve direct interaction with human participants. Therefore, ethical approval was not required. However, ethical standards and guidelines for research integrity were strictly followed throughout the review process.

References

1. Akbari A, Mirakhori F, Ashouri M, Nehzat Norozi Tehrani S. The Effect of Micronutrient Intake on Cognitive Function and Physical Activity of the Elderly. Int J Sport Stud Health. 2021;4(1):e121360. [DOI]

2. Eshaghi S, Morteza T, Khadijeh I, Knechtle B, Nikolaidis PT, Chtourou H. The effect of aerobic training and vitamin D supplements on the neurocognitive functions of elderly women with sleep disorders. Biological Rhythm Research. 2020;51(5):727-34. [DOI]
3. Naghavi N, Taheri M, Irandoust K. Psychophysiological Responses to Cognitive and Physical Training in Obese Elderly. Int J Sport Stud Health. 2018;1(3):e83935. [DOI]
4. Taheri M, Irandoust K. The effect of balance exercises and computerized cognitive training on psychomotor performance in elderly. Journal of Physical Therapy Science. 2017;29(12):2097-9. [PMID: 29643582] [PMCID: PMC5890208] [DOI]
5. Taheri M, Irandoust K, Mirakhori F, Shabani E. The effects of cognitive and physical training on physiological and psychological levels of anxiety in the female elderly. Sport Sciences and Health Research. 2021;13(1).
6. Taheri M, Irandoust K, Seghatoleslami A, Rezaei M. The Effect of Yoga Practice Based on Biorhythms Theory on Balance and Selective Attention of the Elderly Women. Salmand: Iranian Journal of Ageing. 2018;13(3):312-23. [DOI]
7. Anstey KJ, Christensen H. Education, Activity, Health, Blood Pressure and Apolipoprotein E as Predictors of Cognitive Change in Old Age: A Review. Gerontology. 2000. [PMID: 10754375] [DOI]
8. Zhang S, Smailagic N, Hyde C, Noel-Storr A, Takwoingi Y, McShane R, Feng J. F-FDG PET for the Early Diagnosis of Alzheimer's Disease Dementia and Other Dementias in People With Mild Cognitive Impairment (MCI). Cochrane Database of Systematic Reviews. 2015. [DOI]
9. Zhang Y, Xu X, Lian T, Huang L, Zeng J, Liang D, et al. Development of Frailty Subtypes and Their Associated Risk Factors Among the Community-Dwelling Elderly Population. Aging. 2020. [PMID: 31951595] [PMCID: PMC7053645] [DOI]
10. Bibbins-Domingo K. Integrating Social Care Into the Delivery of Health Care. Jama. 2019. [PMID: 31553407] [DOI]
11. Howland RH. Cardiovascular Health and Cognitive Decline. Jama. 2018. [PMID: 30561474] [DOI]
12. Huang T, Larsen KT, Ried-Larsen M, Møller NC, Andersen LB. The Effects of Physical Activity and Exercise on Brain-derived Neurotrophic Factor in Healthy Humans: A Review. Scandinavian Journal of Medicine and Science in Sports. 2013. [PMID: 23600729] [DOI]
13. Basso JC, Suzuki W. The Effects of Acute Exercise on Mood, Cognition, Neurophysiology, And Neurochemical Pathways: A Review. Brain Plasticity. 2017. [PMID: 29765853] [PMCID: PMC5928534] [DOI]
14. Brisswalter J, Collardeau M, Arcelin R. Effects of Acute Physical Exercise Characteristics on Cognitive Performance. Sports Medicine. 2002. [PMID: 12096929] [DOI]
15. Schapschröer M, Lemez S, Baker J, Schorer J. Physical Load Affects Perceptual-Cognitive Performance of Skilled Athletes: A Systematic Review. Sports Medicine - Open. 2016. [PMID: 27747792] [PMCID: PMC5020134] [DOI]
16. Dotson VM, Gradone AM, Bogoian HR, Minto LR, Taiwo Z, Salling ZN. Be Fit, Be Sharp, Be Well: The Case for Exercise as a Treatment for Cognitive Impairment in Late-Life Depression. Journal of the International Neuropsychological Society. 2021. [PMID: 34154693] [PMCID: PMC10436256] [DOI]
17. Andò S, Komiyama T, Sudo M, Higaki Y, Ishida K, Costello J, Katayama K. The Interactive Effects of Acute Exercise and Hypoxia on Cognitive Performance: A Narrative Review. Scandinavian Journal of Medicine and Science in Sports. 2019. [PMID: 31605635] [DOI]
18. Motl RW, Sandroff BM. Benefits of Exercise Training in Multiple Sclerosis. Current Neurology and Neuroscience Reports. 2015. [PMID: 26223831] [DOI]
19. Cai H, Li G, Hua S, Liu Y, Chen L. Effect of Exercise on Cognitive Function in Chronic Disease Patients: A Meta-Analysis and Systematic Review of Randomized Controlled Trials. Clinical Interventions in Aging. 2017. [PMID: 28546744] [PMCID: PMC5436795] [DOI]
20. Salthouse TA. Mental Exercise and Mental Aging. Perspectives on Psychological Science. 2006. [PMID: 26151186] [DOI]
21. Motl RW, Sandroff BM, DeLuca J. Exercise Training and Cognitive Rehabilitation. Neurorehabilitation and Neural Repair. 2015. [PMID: 27261483] [DOI]
22. Basso JC, Shang A, Elman M, Karmouta R, Suzuki W. Acute Exercise Improves Prefrontal Cortex but Not Hippocampal Function in Healthy Adults. Journal of the International Neuropsychological Society. 2015. [PMID: 26581791] [DOI]
23. Marmeleira J. An Examination of the Mechanisms Underlying the Effects of Physical Activity on Brain and Cognition. European Review of Aging and Physical Activity. 2012. [DOI]
24. Andò S, Hatamoto Y, Sudo M, Kiyonaga A, Tanaka H, Higaki Y. The Effects of Exercise Under Hypoxia on Cognitive Function. Plos One. 2013. [DOI]
25. Kamijo K, Abe R. Aftereffects of Cognitively Demanding Acute Aerobic Exercise on Working Memory. Medicine & Science in Sports & Exercise. 2019. [PMID: 30153193] [PMCID: PMC6303127] [DOI]
26. Taheri M, Irandost K, Mirmoezzi M, Ramshini M. Effect of aerobic exercise and omega-3 supplementation on psychological aspects and sleep quality in prediabetes elderly women. Sleep and Hypnosis. 2019;21(2):170-4. [DOI]
27. Yagmaee F. Eight Weeks of Aerobic Exercise and Prescribed Diet (Low in Carbohydrate and High Protein) Improve Mental Health in Obese Women. Int J Sport Stud Health. 2021;4(1):e121345. [DOI]
28. Harveson A, Hannon JC, Brusseau TA, Podlog L, Papadopoulos C, Hall M, Celeste E. Acute Exercise and Academic Achievement in Middle School Students. International Journal of Environmental Research and Public Health. 2019. [PMID: 31547214] [PMCID: PMC6801915] [DOI]
29. Washio T, Ogoh S. Point/Counterpoint: Arterial Blood Pressure Response to Exercise Does Relate to Exercise-Induced Improvement in Cognitive Function. Journal of Cerebral Blood Flow & Metabolism. 2023. [PMID: 36704820] [PMCID: PMC10063828] [DOI]
30. Amini M, Mirmoezzi M, Salmanpour M, Khorshidi D. Eight Weeks of Aerobic Exercises Improves the Quality of Life in Healthy Aged Sedentary Men. Int J Sport Stud Health. 2018;1(1):e67514. [DOI]
31. Moore D, Jung M, Hillman CH, Kang M, Loprinzi PD. Interrelationships Between Exercise, Functional Connectivity, and Cognition Among Healthy Adults: A systematic Review. Psychophysiology. 2022. [PMID: 35122693] [DOI]

E-ISSN: 2981-2569

32. Liu T, Li H, Colton JP, Song G, Li C. The BDNF Val66Met Polymorphism, Regular Exercise, and Cognition: A Systematic Review. Western Journal of Nursing Research. 2020. [PMID: 32075548] [DOI]
33. Netz Y. Type of Activity and Fitness Benefits as Moderators of the Effect of Physical Activity on Affect in Advanced Age: A Review. European Review of Aging and Physical Activity. 2009. [DOI]
34. T L, Hettish L, Lo W-J, Gray M, Li C. FEASibility Testing a Randomized Controlled Trial of an Exercise Program to Improve Cognition for T2DM Patients (The FEAST Trial): A Study Protocol. Research in Nursing & Health. 2021.
35. Moore RD, Romine MW, O'Connor PJ, Tomporowski PD. The Influence of Exercise-Induced Fatigue on Cognitive Function. Journal of Sports Sciences. 2012. [PMID: 22494399] [DOI]
36. Trammell JP, Aguilar SC. Natural Is Not Always Better: The Varied Effects of a Natural Environment and Exercise on Affect and Cognition. Frontiers in Psychology. 2021. [PMID: 33584411] [PMCID: PMC7873912] [DOI]
37. Rose EA, Parfitt G. Pleasant for Some and Unpleasant for Others: A Protocol Analysis of the Cognitive Factors That Influence Affective Responses to Exercise. International Journal of Behavioral Nutrition and Physical Activity. 2010. [PMID: 20181111] [PMCID: PMC2832617] [DOI]
38. Wallman K, Morton AR, Goodman C, Grove JR, Guilfoyle A. Randomised Controlled Trial of Graded Exercise in Chronic Fatigue Syndrome. The Medical Journal of Australia. 2004. [PMID: 15115421] [DOI]
39. Boere K, Lloyd K, Binsted G, Krigolson OE. Exercising Is Good for the Brain but Exercising Outside Is Potentially Better. Scientific Reports. 2023. [PMID: 36670116] [PMCID: PMC9859790] [DOI]
40. Dwojaczny B, Iermakov S, Yermakova T, Cieślicka M. The Effect of Acute Exercise on Cognition. Physical Education of Students. 2020. [DOI]
41. Kang E-S, Yook JS, Ha M-S. Breathing Exercises for Improving Cognitive Function in Patients With Stroke. Journal of Clinical Medicine. 2022. [PMID: 35629013] [PMCID: PMC9144753] [DOI]
42. Taheri M, Irandoust K. The exercise-induced weight loss improves self-reported quality of sleep in obese elderly women with sleep disorders. Sleep Hypn. 2018;20(1):54-9. [DOI]
43. Pickersgill JW, Turco CV, Ramdeo K, Rehsi RS, Foglia SD, Nelson AJ. The Combined Influences of Exercise, Diet and Sleep on Neuroplasticity. Frontiers in Psychology. 2022. [PMID: 35558719] [PMCID: PMC9090458] [DOI]
44. Gowsi K, Pal GK, Subramanian K. Biological Markers of Cognition in Exercise: A Mini Review. International Journal of Clinical and Experimental Physiology. 2019. [DOI]
45. Stock J, Clifford A, Hogervorst E. Exercise Interventions to Improve Cognitive Performance in Older Adults - Potential Psychological Mediators to Explain Variation in Findings. European Neurological Review. 2012. [DOI]
46. Panzarasa P, Jennings NR. Social Influence, Negotiation and Cognition. Simulation Modelling Practice and Theory. 2002. [DOI]
47. Najafabadi MG, Khah AS, Parent-Nichols J. The Effects of Exercise Training on Physical, Physiological and Psychological Risk Factors of Patients With Cardiovascular Disease. Russian Open Medical Journal. 2021.
48. Andel GEV, Austin DR. Physical Fitness and Mental Health: A Review of the Literature. Adapted Physical Activity Quarterly. 1984.
49. Chang YK, Labban JD, Gapin JI, Etnier JL. The Effects of Acute Exercise on Cognitive Performance: A Meta-Analysis. Brain Research. 2012. [PMID: 22480735] [DOI]
50. McGrane N, Cusack T, O'Donoghue G, Stokes E. Motivational Strategies for Physiotherapists. Physical Therapy Reviews. 2013. [DOI]
51. Andrews-Hanna JR, Smallwood J, Spreng RN. The Default Network and Self-generated Thought: Component Processes, Dynamic Control, and Clinical Relevance. Annals of the New York Academy of Sciences. 2014. [PMID: 24502540] [PMCID: PMC4039623] [DOI]
52. Cassilhas RC, Viana VAR, Grassmann V, Ronaldo Vagner Thomatieli dos S, Santos RF, Tufik S, Mello MTd. The Impact of Resistance Exercise on the Cognitive Function of the Elderly. Medicine & Science in Sports & Exercise. 2007. [PMID: 17762374] [DOI]
53. Grego F, Vallier J-M, Collardeau M, Rousseu C, Crémieux J, Brisswalter J. Influence of Exercise Duration and Hydration Status on Cognitive Function During Prolonged Cycling Exercise. International Journal of Sports Medicine. 2005. [PMID: 15643531] [DOI]
54. Kouzuki M, Kato T, Wada-Isoe K, Takeda S, Tamura A, Takanashi Y, et al. A Program of Exercise, Brain Training, and Lecture to Prevent Cognitive Decline. Annals of Clinical and Translational Neurology. 2020. [PMID: 32068975] [PMCID: PMC7085994] [DOI]
55. Yamasaki T. Preventive Strategies for Cognitive Decline and Dementia: Benefits of Aerobic Physical Activity, Especially Open-Skill Exercise. Brain Sciences. 2023. [PMID: 36979331] [PMCID: PMC10046723] [DOI]

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