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The Impact of Aerobic Training Programs on Cognitive Functions in Older Adults Based on Intervention Studies: a Narrative Review

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Abstract

Background: In the face of progressive population aging, the decline in cognitive functioning among older adults represents a critical challenge for healthcare systems. Within the paradigm of successful aging, physical activity plays a pivotal role.

Aim: This review aims to evaluate the impact of structured aerobic training programs on global and domain-specific cognitive functions in older adults, based on recent interventional evidence.

Methods: A narrative literature review was conducted by searching the PubMed, Scopus, Web of Science, and Cochrane Library databases. The search was restricted to randomized controlled trials (RCTs) published in English between 2021 and 2026. Studies evaluating cohorts aged 60 years or older, utilizing an aerobic exercise intervention lasting for at least 4-6 weeks, and employing validated neuropsychological assessment tools were eligible for analysis.

Results: Synthesis of the included trials demonstrated that short- and medium-term aerobic training programs (ranging from 6 to 20 weeks, performed 3-5 times per week) induce statistically significant improvements in global cognitive performance, as evidenced by elevated MMSE and MoCA scores. Conversely, in long-term interventions (spanning 1 to 5 years), endurance exercise effectively decelerated the trajectory of normative physiological cognitive decline. Regarding specific cognitive domains, regular moderate-intensity training yielded the most pronounced benefits in memory, executive functions, and information processing speed. This neuroprotective outcome is mediated by a synergistic combination of vascular, neurobiological, and psychological mechanisms.

Conclusions: Aerobic training represents a safe, well-tolerated, and highly effective non-pharmacological intervention that preserves and enhances cognitive health in the geriatric population, demonstrating substantial utility in both mitigating acute age-related deficits and preventing long-term neurodegeneration.

Keywords: aerobic training, physical activity, cognitive function, older adults, aging, episodic memory, executive functions

1. Introduction

Contemporary societies are facing a progressive population aging process, leading to a systematic increase in the proportion of older adults. These profound demographic shifts have generated growing scientific interest in the cognitive functioning of the elderly, as age represents one of the primary determinants of cognitive proficiency. Cumulative evidence indicates that physiological aging may induce declines in memory, attention, information processing speed, and executive functions, though the natural trajectory of these changes exhibits substantial inter-individual variability [1]. The integrity of cognitive functions directly underpins independence in daily life, governing the capacity for action planning, problem-solving, decision-making, and the maintenance of social engagement. Consequently, cognitive impairment can severely limit the autonomy of older individuals and diminish their quality of life, posing a significant challenge to both healthcare systems and caregivers [2,3].

Against this backdrop, the concept of “successful aging” has gained paramount importance, with regular physical activity playing a pivotal role. In older populations, systematic physical exercise contributes to enhanced cardiorespiratory fitness, preservation of muscle mass and strength, optimized postural balance, and a reduced risk of falls [4]. Furthermore, physical activity exerts a beneficial effect on psychological well-being by reducing depressive and anxiety symptoms, improving sleep quality, and enhancing overall morale [5-7]. In recent years, a growing body of interventional and observational research has demonstrated that these benefits extend to the cognitive domain - older adults who maintain a more active lifestyle may exhibit a decelerated rate of cognitive decline and a lower risk of developing memory impairments [1].

Aerobic training - defined as continuous, rhythmic exercise that engages large muscle groups and primarily utilizes aerobic metabolic pathways - is considered uniquely effective in this context. Common modalities of aerobic exercise prescribed for older adults include brisk walking, Nordic walking, stationary cycling, swimming, dancing, and tailored fitness classes. While the intensity of such exercise can be classified as low, moderate, or high, clinical and research guidelines predominantly recommend a moderate-intensity workload, subjectively perceived as “exertional but allowing for comfortable conversation”. When appropriately tailored to accommodate comorbidities and individual functional limitations, aerobic training represents a highly safe and well-tolerated intervention in this demographic [7].

Given the expanding literature evaluating the relationship between endurance training and mental acuity in late life, a synthesis of the available empirical evidence is highly warranted. Therefore, the primary objective of this narrative review is to evaluate the impact of structured aerobic training programs on the cognitive functions of older adults based on evidence from interventional studies.

2. Materials and methods

2.1. Databases and Search Timeline

To prepare this narrative review, a comprehensive literature search was conducted across the PubMed database, which served as the primary source for identifying interventional studies evaluating the effects of aerobic training on cognitive functions in older adults. To ensure a thorough identification of available literature and minimize the risk of omitting relevant publications, supplementary searches were performed in the Scopus, Web of Science, and Cochrane Library databases. The search timeline was restricted to articles published between 2021 and 2026.

2.2. Search Strategy and Eligibility Criteria

The search strategy was structured around combinations of keywords and Boolean operators pertaining to the type of intervention, target cognitive domains, and the older population. Advanced search strings tailored to the specific syntax of each electronic database were utilized.

("aerobic exercise" OR "aerobic training" OR "endurance training" OR "cardiorespiratory fitness") **AND** (cognition OR "cognitive function*" OR "cognitive performance" OR "cognitive decline" OR "cognitive impairment") **AND** ("older adults" OR "elderly" OR "seniors") **AND** (randomized controlled trial[pt] OR clinical trial[pt] OR intervention[tiab]) **AND** ("2021/01/01"[Date - Publication] : "2026/12/31"[Date - Publication]) **AND** english[lang]

Studies were eligible for inclusion if they were randomized controlled trials involving human participants. The target population comprised older adults, operationalized as cohorts with a mean participant age of 60 years or older, who exhibited intact or normative baseline cognitive functioning. Regarding the intervention, the training programs were required to feature a predominant aerobic component, such as brisk walking, Nordic walking, stationary cycling, or aerobic dancing, with a minimum duration of 4-6 weeks. Additionally, studies had to perform an objective assessment of cognitive performance both pre- and post-intervention using validated global cognitive scales or neuropsychological tests specific to distinct cognitive domains. Finally, the selection was limited to original, peer-reviewed scientific articles published in the English language between 2021 and 2026.

Conversely, studies involving animal models or those evaluating interventions focused exclusively on resistance, strength, balance, or flexibility training without a clearly defined aerobic component were excluded from this review. Papers that failed to report outcomes regarding cognitive functioning were likewise rejected. Furthermore, secondary literature, including narrative reviews, systematic reviews, meta-analyses, commentaries, letters to the editor, and study protocols, was systematically excluded. Lastly, study populations with a mean age below 60 years were eliminated from the analysis, unless subgroup data for the older cohort could be independently extracted.

3. Theoretical Background

3.1. Cognitive Functioning in Late Life

Cognitive functions encompass the complex processes that enable the acquisition, processing, storage, and utilization of information, including attention, memory, executive functions, language, and information processing speed. Advancing age is accompanied by structural and functional alterations within the central nervous system, which directly impact the efficiency of these processes. In the course of normative physiological aging, the most frequently observed changes include a deceleration in information processing speed and a decline in specific aspects of memory and executive control. However, these manifestations are highly heterogeneous, and numerous cognitive abilities remain relatively well-preserved. This preservation is particularly evident in accumulated lifelong knowledge, vocabulary size, and crystallized intelligence, all of which can maintain stability well into late adulthood. Furthermore, it is increasingly emphasized that the trajectory of cognitive aging exhibits substantial inter-individual variability, shaped by a multifaceted array of biological, medical, and environmental factors [3,8].

The boundary between normative cognitive aging and pathological cognitive decline is often blurred, which necessitated the clinical introduction of the concept of mild cognitive impairment (MCI). MCI is defined as a state characterized by subjective and objective (neuropsychologically verified) deficits in at least one cognitive domain. While these impairments exceed what would be expected based on an individual's age and educational background, they do not cause significant disruption to daily functioning - the individual remains fully capable of independently performing both basic and instrumental activities of daily living. Consequently, status MCI is recognized as a transitional syndromic state between healthy aging and dementia, carrying a significantly elevated risk of progression to Alzheimer’s disease and other forms of neurodegenerative disorders [8,9].

3.2. Methods for Assessing Cognitive Function

The assessment of cognitive function in studies investigating the effects of aerobic exercise on older adults typically includes both screening tools that evaluate overall cognitive performance and detailed neuropsychological tests designed to assess specific cognitive domains. This combined approach is particularly important in intervention studies because the effects of regular physical activity often involve improvements in selected cognitive domains, such as memory, executive function, attention, and processing speed, rather than substantial changes in global cognitive screening scores [9,10].

One of the most commonly used instruments is the Mini-Mental State Examination (MMSE), which is employed to assess global cognitive functioning. The scale evaluates orientation, memory, attention, calculation, language abilities, and basic visuoconstructive skills. In clinical practice, a score of ≥27 points is generally considered indicative of normal cognitive functioning, whereas scores of approximately 24–26 points may suggest mild cognitive impairment (MCI), depending on factors such as age, educational level, and the population studied. Scores below approximately 24 points are more frequently associated with significant cognitive decline. In studies examining aerobic exercise interventions, the MMSE is primarily used to evaluate overall cognitive changes and to determine participants' eligibility for study inclusion [9,10].

Another frequently used instrument is the Montreal Cognitive Assessment (MoCA), which demonstrates greater sensitivity than the MMSE in detecting subtle cognitive changes. The MoCA assesses executive functions, attention, short-term memory, language, orientation, visuospatial abilities, and abstract thinking. A score of ≥26 points is generally considered normal, whereas scores ranging from 19 to 25 points are often interpreted as indicative of mild cognitive impairment. In intervention studies involving aerobic exercise, an increase in MoCA scores following completion of the training program is typically interpreted as an improvement in global cognitive performance [9,10].

Despite the usefulness of the MMSE and MoCA, global cognitive screening tools may not always detect subtle changes resulting from aerobic exercise interventions. Therefore, studies frequently employ tests targeting specific cognitive domains. One of the most commonly used measures is the Trail Making Test (TMT), particularly Parts A and B. TMT-A primarily assesses psychomotor speed, visual attention, and information-processing speed, whereas TMT-B places greater demands on executive functioning, cognitive flexibility, and attentional switching. In exercise intervention studies, improved TMT performance is reflected by shorter completion times, indicating enhanced executive efficiency and cognitive processing speed [11].

Memory performance is commonly assessed using instruments such as the Wechsler Memory Scale (WMS), word recall tests, spatial memory tasks, and logical memory assessments. The WMS consists of several subtests evaluating story recall, paired-associate learning, digit span performance, and delayed recall tasks. The scale enables assessment of multiple aspects of memory, including immediate memory, delayed memory, working memory, learning ability, and verbal as well as visuospatial memory performance. The resulting scores provide a comprehensive profile of memory functioning and facilitate the detection of subtle cognitive impairments [12].

To assess executive functioning and higher-order cognitive processes, some studies employ comprehensive neuropsychological assessment batteries, such as those used in the Virginia Cognitive Aging Project (VCAP). These assessments allow researchers to generate composite indices encompassing executive function, episodic memory, and processing speed, among other cognitive domains [13].

In summary, MMSE and MoCA are primarily used in studies investigating the effects of aerobic exercise on cognitive function in older adults to assess overall cognitive status and identify individuals with possible mild cognitive impairment. In contrast, tests such as the TMT, WMS, memory tasks, and comprehensive neuropsychological assessments enable a more detailed evaluation of domain-specific cognitive effects associated with aerobic exercise interventions.

3.3. Aerobic Training: Characteristics and Guidelines for Older Adults

Aerobic training constitutes the cornerstone of physical activity recommendations for the geriatric population, aimed at optimizing cardiorespiratory fitness and maintaining overall functional independence. It encompasses rhythmic, repetitive exercises that engage large muscle groups, including brisk walking, Nordic walking, cycling (including stationary cycling), swimming, and dancing. The essential components of prescribing such exercise are encapsulated by the FITT principles: frequency (number of sessions per week), intensity (workload categorized as light, moderate, or vigorous), time (duration of a single session), and type of activity, which must be tailored to the individual capacities and medical restrictions of the older individual [14].

Current guidelines established by the World Health Organization (WHO) recommend that older adults should accumulate at least 150-300 minutes of moderate-intensity aerobic physical activity per week, or at least 75-150 minutes of vigorous-intensity aerobic physical activity, or an equivalent combination of both modalities. This activity should be distributed regularly throughout the week, with the explicit caveat that any amount of physical activity is inherently beneficial to health, even if it falls short of the recommended thresholds [7].

Prominent cardiological and geriatric societies emphasize that for older populations, a primary focus must be placed on the principle of gradual progression. This involves initiating the intervention at lower intensities and shorter durations, coupled with the routine monitoring of subjective well-being, heart rate, and blood pressure. Consequently, the implementation of an aerobic exercise protocol must be preceded by a comprehensive health assessment - specifically evaluating cardiovascular stability, postural balance, and musculoskeletal integrity - to identify any individual contraindications [15]. Accumulating empirical evidence confirms that appropriately tailored and supervised endurance training regimens in older adults represent a highly safe and well-tolerated intervention. Furthermore, they provide a sufficient physiological stimulus to induce measurable adaptations, enhancing not only cardiorespiratory parameters but also objective measures of cognitive function [1].

4. Characteristics of the Included Interventional Studies

A detailed overview of the characteristics of each included study - encompassing authors and year of publication, study design, population characteristics, parameters of the implemented aerobic intervention, utilizing tools for cognitive assessment, and the primary findings - is presented in Table 1. This tabular synthesis serves as the foundation for the subsequent, in-depth analysis provided in Chapter 5, which discusses the impact of aerobic training on both global cognitive functioning and specific cognitive domains in older adults.

Table 1. Methodological characteristics and primary findings of the included interventional studies.

Author, Year [Ref]	Study Design	Study Population	Training parameters	Cognitive Assessment Tools	Primary Findings
Xu et al., 2024 [16]	RCT	89 healthy older adults	1. Aerobic training: 50 min/day, 3-5 times a week for 20 weeks	the Schulte Table, reaction	Aerobic exercise interventions significantly

		aged 65-75 years	2. Control: absence of regular physical activity	test, the spatial memory test	enhance cognitive performance in older adults.
Mundada et al., 2022 [17]	RCT	40 healthy older adults aged 60-70 years	1. Aerobic training: 45 min/day, 5 days/week for 6 weeks 2. Comparison: dual task training	TMT-A, TMT-B, MoCA	A statistically significant improvement was observed in post-intervention cognitive function scores.
Xu et al., 2025 [18]	RCT	128 healthy older adults aged >60 years diagnosed with depression	1. Aerobic training: 30-45 min/day, 3-5 days/week for 12 weeks 2. Strength training: 30 min/day, 3-5 days/week for 12 weeks 3. Balance training: 15-30 min, 3-5 days/week for 12 weeks 4. Control: absence of regular physical activity	MMSE	All modalities of exercise (aerobic, strength, and balance training) significantly improved cognitive functions in the elderly.
Bakken et al., 2025 [19]	RCT	1486 healthy older adults aged 70-76 years	1. Aerobic training: 50 min/day, 2 days/week for 5 years 2. HIIT: 40 min/day, 2 days/week for 5 years 3. Active control: 30 min of moderate-to-vigorous physical activity daily for 5 years (adherence to national guidelines)	MoCA	The analysis revealed an overall decline in MoCA score (0.98 points over 7 years); however, post-intervention scores for both active groups were higher compared to the control group, though this difference did not

					reach statistical significance (0.32 points).
Tomoto et al., 2022 [20]	RCT	73 healthy older adults aged 60-80 years	1. Aerobic training: progressed from 25-30 min (3 days/week) to 30-40 min (4-5 days/week) for 12 months 2. Active control: stretching-and-toning program progressed from 25-30 min (3 days/week) to 30-40 min (4-5 days/week) for 12 months	Educational Testing Service Letter Sets test, Raven's Progressive Matrices, Wechsler Memory Scale, Digit Comparison test, WMS Letter Number Sequencing test, Operation Span test	A 1-year aerobic training program induces small but statistically significant improvements in cognitive performance (particularly memory) in older adults.

Abbreviations: HIIT, high-intensity interval training; MMSE, Mini-Mental State Examination; MoCA, Montreal Cognitive Assessment; RCT, randomized controlled trial; TMT, Trail Making Test.

5. Results of the Review -Effects of Aerobic Exercise on Cognitive Function

5.1. Effects on Global Cognitive Function

Global cognitive performance was assessed in all included studies, most commonly using the Mini-Mental State Examination (MMSE) or the Montreal Cognitive Assessment (MoCA). In the studies by Xu et al. (2024, 2025) and Mundada et al. (2022), short- to medium-term aerobic exercise programs (6-20 weeks), performed three to five times per week, resulted in statistically significant improvements in MMSE/MoCA scores compared with baseline values. In the study by Xu et al. (2025), similar improvements were also observed following other forms of exercise, including resistance and balance training, suggesting that regular physical activity itself - not necessarily aerobic exercise alone - may positively influence global cognitive function in older adults with depression.

In the longer, 12-month study by Tomoto et al. (2022), the effects of aerobic exercise on global cognitive function were more modest. The authors reported small but statistically significant improvements in selected cognitive measures, whereas more pronounced benefits were observed in specific memory tests. Similarly, in the long-term study by Bakken et al. (2025), which evaluated a 5-year aerobic exercise intervention in healthy older adults, an overall decline in MoCA scores was observed across the entire cohort. However, participants assigned to the exercise intervention maintained slightly higher levels of global cognitive performance than those in the comparison group, although these differences did not reach clear statistical significance.

Overall, the findings suggest that shorter aerobic exercise interventions are more likely to produce measurable improvements in global cognitive assessment scores, whereas over longer follow-up periods, aerobic exercise appears primarily to slow age-related cognitive decline rather than completely prevent it.

5.2. Effects on Specific Cognitive Domains

Specific cognitive domains were also assessed in all reviewed studies. The studies by Xu et al. (2024) and Tomoto et al. (2022) demonstrated that aerobic exercise primarily improves memory, including both short-term and episodic memory, as measured by verbal memory tests, spatial memory assessments, and instruments such as the Wechsler Memory Scale. In the study by Tomoto et al. (2022), a one-year aerobic exercise intervention was associated with significant improvements in memory test performance, which the authors attributed to enhanced vascular function and cerebral blood flow.

Mundada et al. (2022) focused particularly on executive functions and processing speed, using the Trail Making Test (TMT) Parts A and B. Following six weeks of intensive aerobic exercise (45 minutes per session, five times per week), participants demonstrated significantly reduced completion times on both TMT-A and TMT-B, indicating improvements in cognitive flexibility, attention, and information-processing speed. Similar trends, although generally of smaller magnitude, were observed in other studies employing symbol comparison tests, reaction time assessments, and tasks requiring attentional shifting.

In summary, aerobic exercise appears to be particularly beneficial for memory- especially episodic memory - as well as executive functioning and processing speed. These effects are most evident in studies employing comprehensive neuropsychological test batteries that allow for a detailed assessment of individual cognitive domains.

6. Discussion

6.1. Overall assessment of aerobic training effectiveness

Based on the analyzed intervention studies, it can be concluded that aerobic training in older adults is an effective strategy for supporting cognitive function, particularly over a period of several weeks or months of regular exercise. In short- to medium-term interventions (6-20 weeks, 3-5 sessions per week), the majority of studies observed significant improvements in global cognitive performance, as assessed by the MMSE or MoCA scales. In longer programs (12 months or longer), the effect of aerobic training tends to be an attenuation of the physiological cognitive decline rather than its complete halt. This is reflected in smaller between-group differences, albeit with a slightly better preservation of scores in the intervention groups.

An analysis of detailed neuropsychological assessments indicates that three groups of cognitive domains appear most responsive to the effects of aerobic training. First, memory, particularly episodic and working memory, which exhibits improvement following longer endurance-based programs. Second, executive functions (including planning, cognitive flexibility, and attention switching), evaluated via tools such as the Trail Making Test and tasks requiring information manipulation, which respond even to shorter, high-intensity interventions. Third, attention and information processing speed, measured by symbol matching tests, reaction time tasks, or simple visuomotor tasks, where systematic, albeit typically modest, improvements in execution speed have been noted. Collectively, the findings suggest that regular, moderate-intensity aerobic training can both enhance specific aspects of cognition and help preserve overall cognitive performance in older adults.

The available evidence allows for the identification of an approximate aerobic exercise prescription that may be associated with the most favorable outcomes. Regular moderate-intensity aerobic training appears to represent the most practical recommendation for older adults, with sessions lasting 30-45 minutes and performed at least three times per week. Training volume may be progressively increased according to individual exercise tolerance and the intended goals of the intervention.

6.2. Comparison with previous reviews and meta-analyses

The findings of the present review remain largely consistent with previous reviews and meta-analyses regarding the association between physical activity and cognitive function in older adults. Earlier literature emphasized that regular physical activity can exert an overall beneficial effect on the cognitive performance of older adults, although the effect size is typically small to moderate, and its magnitude depends on the intervention type, its duration, and the baseline characteristics of the study population [21,22]. A particularly significant conclusion is that interventions exceeding 12 weeks in duration and programs including an aerobic component are more likely to result in cognitive improvements compared to shorter or less rigorous forms of physical activity [2].

Newer meta-analyses suggest that the impact of physical activity on cognition can be domain-specific. In analyses evaluating different exercise types, it has been proposed that aerobic training exerts a particularly positive effect on memory, while other modalities, like resistance training or mind-body exercises, may more strongly influence global cognitive functioning or specific aspects of executive functions, respectively [23-26]. At the same time, some authors point out that while aerobic training improves executive functions and attention, its superiority over other exercise modalities does not always reach statistical significance [18]. This pattern is consistent with the findings of the present review, which most frequently observed improvements in memory, executive functions, and processing speed, whereas the effects on global cognition were more variable and dependent on program duration and the participants' baseline status.

Studies and reviews concerning populations with cognitive decline also serve as a crucial point of reference. It can be observed that aerobic interventions in older adults with cognitive impairment may lead to improvements in global cognitive function as well as selected domains, such as memory and executive functions [27].

A meta-analysis focusing on multicomponent exercises demonstrated that the beneficial effect on global cognitive function emerges primarily when the program includes an aerobic component; upon its removal, the effect becomes inconclusive [28]. This finding reinforces the interpretation of the results obtained in the present review, suggesting that the aerobic element itself may be one of the key factors responsible for cognitive improvements in exercise interventions.

However, not all studies corroborate the beneficial impact of aerobic training on cognitive function in older adults. Some meta-analyses indicate that despite improvements in physical fitness, changes in cognitive performance are marginal or not statistically significant [29,30]. For instance, systematic reviews have demonstrated that the effects of aerobic training in healthy older adults are frequently small and limited to specific cognitive domains, such as memory or executive functions, with no significant changes in global cognitive performance across many of the analyzed trials [31].

6.3. Potential mechanisms underlying the observed effects

The possible mechanisms underlying the positive impact of aerobic exercise on cognitive function in older adults are multifactorial in nature, encompassing both biological and psychological processes. From a physiological perspective, regular aerobic exercise may improve cognitive function by enhancing cerebral blood flow, improving cardiorespiratory fitness, and exerting a beneficial effect on oxygen and glucose metabolism in neural tissue. These mechanisms are particularly crucial for older adults, who face an age-related increase in vascular and metabolic burden that contributes to the decline in memory, attention, and executive functions [22].

A second crucial mechanism is the impact of aerobic exercise on neuroplasticity, including BDNF expression as well as the processes of neurogenesis and synaptic plasticity. Evidence from reviews and meta-analyses indicates that aerobic training can increase BDNF levels in older adults, and these changes are considered one of the biological mediators of improved memory and learning. This explains why, in several studies, the greatest improvements were observed specifically in episodic memory and executive functions, which are highly dependent on hippocampal integrity and fronto-subcortical networks [22,32-34].

The results of the interventional studies included in the current review are highly consistent with this explanatory model. For example, Tomoto et al. (2022) discussed improvements in specific memory metrics after a 1-year aerobic intervention in light of beneficial vascular adaptations and better cerebral perfusion [20]. Additionally, research on brain plasticity in older adults indicates that physical activity may promote the preservation of brain structural integrity and slow down brain aging processes, which strengthens the biological rationale for the observed cognitive effects [35].

Psychological and behavioral mechanisms also play a significant role. Aerobic exercise can elevate mood, lower stress, decrease the severity of depressive symptoms, and improve sleep quality, with all these factors indirectly supporting cognitive functioning [5-7]. In the older adult population, enhancing self-efficacy, structuring daily routines, and the social engagement associated with participating in an exercise program may also be particularly important. Research on interventions combining physical and cognitive components highlights that the program's structure itself-its regularity, attentional engagement, and social interaction-can amplify the cognitive gains [24,26].

This explanation appears especially likely in the study by Xu et al. (2025), focusing on older adults with depression. In this cohort, post-intervention improvements in global cognitive function could have resulted not only from the direct effects of exercise on the cardiovascular system and the brain, but also from enhanced mental well-being and a decrease in depressive burden, a factor known to independently worsen cognitive abilities [18].

Overall, it can therefore be assumed that the observed effects of aerobic exercise stem from the interaction of vascular, metabolic, neurobiological, and psychological mechanisms, whereas the strength of these effects relies on proper intervention design and population traits [22].

6.4. Practical implications for promoting physical activity among older adults

The findings from the reviewed studies show that aerobic training can be a practical and easily accessible method to support cognitive function in older adults. From a clinical practice and community perspective, this means that physical activity should not be viewed solely as a way to improve physical fitness or prevent cardiovascular diseases, but also as a potential method for supporting brain health and maintaining cognitive function in later life.

This is particularly important in the context of an aging population and the growing need to implement simple, non-pharmacological strategies that help maintain independence for longer.
For physical therapists, trainers, and recreational activity instructors, these results suggest that exercise programs targeted at older adults need to regularly include an aerobic component. It appears most appropriate to use activities such as brisk walking, treadmill walking, stationary cycling, basic endurance exercises, or other rhythmic activities that engage large muscle groups. It is essential that the training is tailored to the health status, fitness level, and functional capabilities of the participants, and that its intensity remains at least moderate.
For doctors working with older adults, these results support the more frequent recommendation of regular aerobic activity as a preventive measure against cognitive decline. General practitioners, geriatricians, or neurologists can view regular exercise as a complement to standard care, especially for patients with low physical activity, low mood, decreased fitness, or early subjective cognitive difficulties. At the same time, implementing such an intervention should be preceded by an assessment of overall health, cardiovascular risk, and contraindications to exercise, to ensure the program is not only effective but also safe.
The practical implications of these findings also extend to those designing activity programs for older adults, including adult day care centers, senior clubs, Universities of the Third Age, and local sports and recreation centers. Based on the analyzed research, it seems reasonable to develop programs centered around consistent, repetitive aerobic effort, conducted in an organized, long-term format. These types of programs can have additional value thanks to the social component. Participation in group classes boosts motivation, enhances mood, and increases the chances of staying consistent, which is essential for sustaining the results.
From a health promotion perspective, it is particularly important that these recommendations are realistic and feasible to implement. For many older adults, regular participation in walking, group classes, or stationary cycling will be far more achievable than engaging in high-intensity exercise programs. This implies that effective physical activity promotion in this age group should be grounded not only in the knowledge of health benefits but also in the accessibility, simplicity, and safety of the proposed activities. Such an approach seems to best align with the research findings on the impact of aerobic training on cognitive function in older adults.

7. Conclusions

Based on the reviewed studies, it can be inferred that aerobic training exerts a beneficial effect on cognitive function in older adults, although the magnitude of this effect is not consistent across all studies. The most commonly reported findings were improvements or superior maintenance of memory, executive functioning, and processing speed. Additionally, several studies demonstrated increased scores on measures of global cognitive performance. Regular moderate-intensity aerobic training, performed for 30-45 minutes at least three times per week, appears to yield the optimal benefits for older adults, with the possibility of gradually increasing the volume based on exercise tolerance and program goals.
The findings indicate that regular aerobic physical activity may represent a safe, accessible, and practical intervention for promoting healthy aging. Special importance is the fact that activities such as walking, treadmill exercise, stationary cycling, and simple endurance-based training can be implemented in the majority of older adults, provided that exercise intensity is appropriately adjusted to individual functional capacity and health status.
However, it should be pointed out that the available studies do not always show clear-cut results. The limitations mainly come from small sample sizes, vastly different training routines, various methods used to test cognitive

functions, and observation times that are simply too short in some papers. This makes it hard to directly compare the findings and figure out the exact, best amount of training.

Therefore, further well-designed randomized studies are needed, involving larger groups of participants, longer intervention and observation times, and more standardized cognitive measures. It also seems particularly important to determine which parameters of aerobic training-frequency, intensity, and duration-bring the greatest cognitive benefits to diverse groups of older adults.

Disclosure

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