

High-Intensity Functional Training in Elderly with Cognitive Impairment

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High Intensity Functional Training (HIFT) is a new exercise modality that emphasizes multi-joint functional movements adaptable to any fitness level and promotes greater muscle recruitment.

Keywords: high-intensity functional exercise ; older adults ; general cognition

1. Introduction

Some of the most significant changes facing the world population are the increase in the number and proportion of older people ^[1] and the progression of life expectancy to older ages ^[1]. Cognitive impairment is a possible consequence of the aging process, since from the third decade of life the brain begins to atrophy, reducing its blood flow and weight ^[2]. This greatly affects the functioning of the central nervous system ^[1], producing loss of memory, attention, reduced learning capacity and deterioration of cognitive functions ^{[3][4]}. This decline is associated with an increased risk of dementia, as well as adverse health outcomes such as functional limitations and disability ^[5].

The burden on health systems caused by dementia and other adverse cognitive outcomes has become a major social challenge with great added financial costs ^[6]. New methods are required in order to prevent losses and even improve cognitive performance, functionality, autonomy, and quality of life in general ^[5]. For this reason, over the last decades interest has grown concerning the influence of lifestyle factors such as physical exercise on the prevention of cognitive impairment among older people ^[5].

Today, physical activity is deemed to be a highly protective factor of cognitive functions in normal brain aging, as well as in several stages of pathology-related cognitive deterioration ^{[7][8]}. Regular physical exercise has been associated with an increased brain volume of regions related to cognitive functions, which normally decline with age ^[9].

Lately, high-intensity interval training (HIIT) has gained attention as a good exercise option for both the young and adult population. This type of exercise is characterized by short, intermittent sessions of high intensity activity alternated with periods of rest or low intensity. The number of studies investigating this type of training in the elderly population has increased in recent years ^{[10][11][12]}.

An alternative to HIIT is high-intensity functional training (HIFT), a relatively new training modality that emphasizes multi-joint functional movements that can be adapted to any fitness level and lead to greater muscle recruitment than more traditional forms of exercise. HIFT sessions can last anywhere from two minutes to over an hour ^[13]. It differs from HIIT in the use of constantly varied functional exercises and activities of adaptable duration that may or may not incorporate breaks. ^[14]. HIFT employs multiple energy pathways through the use of multimodal exercise ^[15]. Due to the multiple prescription schemes related to repetitions and exercise durations in HIFT, programs can range from bodyweight exercises performed in circuits or timed intervals to more complicated schemes involving Olympic lifts, with a set number of repetitions ^[13].

Although HIIT AND HIFT share many similarities, they differ in that HIIT uses only aerobic exercises performed at very high intensity without variation ^[16], whereas HIFT uses constantly varied high-intensity functional and muscle-strengthening exercises of varying durations that may or may not incorporate breaks ^[14]. Similarly, studies suggest that HIFT is more effective than HIIT in increasing strength ^[17] and adherence to exercise ^{[15][18]}, and strength training increases brain-derived neurotrophic factor ^[19] and IGF-1, ^[20] myokines important in cognition to a greater extent.

2. High-Intensity Functional Training in Elderly with Cognitive Impairment

Evidence exists of the benefits of HIFT on general cognition in older adults with cognitive impairment, assessed using the MMSE, the ADAS-cog, or both. Two works that showed improvement in cognitive function used progressive HIFT with 80% RM at 6, 12, and 18 weeks; on the other hand, studies with HIFT interventions at intensities of 12 RM find no significant differences at 3, 4, 6, 7 or at 12 months. However, due to the heterogeneity of intervention protocols, measurement time points, and control group activities, divergent results were evidenced. It is still necessary to determine the modality (load and duration) that guarantees the effectiveness of the intervention.

Khandker et al. [24], evaluated the comparability of ADAS-cog and MMSE, finding a significant association between MMSE and ADAS-cog ($p < 0.001$, $R^2 = 0.561$, in 813 patients and 1520 MMSE/ADAS-cog paired measurements) where increases by 2.01 points (95% CI [1.90, 2.11]) of ADAS-cog were associated with decreases by one point for MMSE.

Furthermore, variability in the HIFT protocols were identified, which was expected because this training modality uses constantly varied, multi-joint exercises of varying duration, with or without rest periods [14]. Two works [22][23] used intensity-based prescription (%1 RM), while the remaining five works [24][25][26][27] used a volume measure (the number of repetitions). Despite these two measures usually being correlated, recent research has raised doubts about the accuracy of this correlation [28]. It has been reported that the amount of muscle mass used during exercise influences the number of repetitions performed at a given percentage of 1 RM [29]. Likewise, intensity (expressed as %1 RM) and volume (expressed as the number of repetitions), when used as the only measures of training load control, are insufficient to correctly prescribe this type of training, as it is necessary to control variables such as inter-set recovery duration [30], the predominance of the eccentric or concentric phase [31], and speed of execution [32]. These variations influence force production and other hormonal [32] and neuromuscular responses [33]. In addition, there is evidence for a positive association between movement speed and cognition in older adults [34], and it has been reported that a greater cognitive load is required in eccentric-predominant exercises compared to concentric-predominant ones [35]. On the other hand, some differences found in the load progression strategies should be pointed out, which could induce different adaptations with respect to load volume [36]. In the strategy used by Gbiri et al. [22] the rate of execution of the exercises was monitored, increasing by 10% every 2 weeks. Additionally, the same authors reported an initial measure of the load equal to 80% RM, with no progressions in this regard.

On the other hand, although the benefits of exercise on cognitive function are well documented [37][38][39], a recent work revealed no beneficial effect of HIIT-only interventions on cognitive functioning in people with dementia [40]. In contrast, functional exercise-based programs have been reported to have some positive effects on cognitive function in older adults with mild cognitive impairment (MCI) [41]. In addition, HIFT has been administered to older adults with moderate to severe dementia in nursing homes, generating in this population joy and rediscovery of bodily skills, as well as a safe adherence to activities and understanding of the objectives of the exercises [42]. Likewise, the applicability of this type of intervention has been successfully evaluated in relation to the intensity of exercise achieved [43]. However, the results on the effect of HIFT on general cognition are varied and in some cases contradictory.

It is important to emphasize that more studies are still needed to better monitor the activities in the control group, as well as the standardization of an instrument used to assess general cognition and a more rigorous design of the intervention. This design must consider, for example, the speed of execution of the exercise, the type of contraction (concentric or eccentric) and the recovery period between series. Only in this way would it be possible to know precisely the possible effects induced by the intervention and their duration over time. Unification of concepts in both intervention and measurement variables in RCTs is required to elucidate the effects of HIFT on general cognition in older adults with mild to moderate cognitive impairment.

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