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The Impact of High-Intensity Interval Training on Brain Health in Athletes A comprehensive review

Wanyi Wei[a], Liwen Qin[a], Junwen Jiang[a, b*]
[a]Faculty of Chinese Medicine Science Guangxi University of Chinese Medicine, No. 13 Wuhe Avenue, Nanning 530000, China
[b]International College , Krirk University , Bangkok 10220, Thailand

Abstract:
Background and goal:
HIIT It is a form of cardiovascular exercise that involves alternating between short bursts of intense anaerobic exercise and low-intensity recovery periods. HIIT workouts are designed to be short, typically lasting anywhere from 10 to 30 minutes
Method:
Google Scholar, Scopus, Pub Med, Science Direct and Springer databases were used to find articles in English from 2017 to 2024. Articles were extracted using the keywords HIIT, BDNF, brain health and acute exercise. 15 quality articles related to the effect of high-intensity interval training on the brain. The health status of the athletes was obtained and analyzed.
Findings:
Six articles investigated the impact of high-intensity interval training (HIIT) on cognitive performance and brain health, with the majority finding positive effects on various cognitive domains. Another six articles focused on the effects of HIIT on executive function, with most indicating positive effects. However, one study reported no specific effects of HIIT on brain functioning, and another suggested extreme fatigue from HIIT may negatively impact executive performance accuracy. Additionally, one study found no significant beneficial changes in decision-making enhancement from HIIT, while another reported positive effects on brain pressure flow.
Conclusion:
The results suggest that high-intensity interval training (HIIT) may have a positive effect on the brain health of athletes. While more research is needed to fully understand the mechanisms and long-term effects of HIIT on brain health in athletes.

Keywords: HIIT, High Intensity, Brain Function, Athletes

Introduction

The positive impact of physical activity on the body's health and performance is widely recognized. Additionally, exercise induces advantageous adaptive alterations, evident across various scales, including molecular dynamics. Such physiological 'remodeling' enhances overall physical condition, optimizes energy utilization, augments muscular volume, and bolsters neuromuscular synchronization, thereby exerting a beneficial influence on cerebral activities (1). Studies show that high-intensity interval training (HIIT) has numerous benefits for physical fitness and health, partly due to increased levels of brain-derived neurotrophic factor (BDNF) in the blood after HIIT sessions. BDNF is crucial for neuronal growth, brain resilience, mood regulation, and cognitive functions. The boost in BDNF from HIIT may lead to better mental health and cognitive abilities, making IT a potentially more effective exercise method for overall wellness (2). High-Intensity Interval Training (HIIT) is a workout regimen marked by brief periods of intense activity, typically executed at levels of 80% or greater of an individual's maximum heart rate (3). High-intensity interval training (HIIT) increases brain-derived neurotrophic factor (BDNF) levels, improving mitochondrial function. The rise in lactate during HIIT may contribute to these benefits, as lactate is now seen as an important metabolic and signaling molecule. The hippocampus, crucial for memory and learning, is particularly sensitive to BDNF and mitochondrial changes. Studies suggest that HIIT boosts BDNF in the hippocampus, leading to cognitive

improvements, and enhances mitochondrial quality control, essential for maintaining cellular health and function (4). Rodriguez et al. (2024) conducted research that demonstrated the efficacy of high-intensity interval training (HIIT) in elevating levels of peripheral brain-derived neurotrophic factor (BDNF) among adults. The conclusion was reached after a meticulous systematic review and network meta-analysis of the current studies concerning this subject matter (5). A preliminary study investigated the effects of a 6-week high-intensity interval training (HIIT) program on individuals with posttraumatic stress disorder (PTSD). Participants were divided into a HIIT group and a control group without intervention. Results showed that the HIIT group experienced significant improvements in PTSD symptoms, physical fitness, and quality of life compared to the control group, suggesting that HIIT may be an effective treatment for PTSD (6). In research conducted by Hwang and colleagues (2023), it was demonstrated that high-intensity interval training (HIIT) exhibits neuroprotective properties by facilitating neuroplastic alterations in an animal model of depression induced by restraint stress. This model is frequently employed to elicit depressive-like symptoms in laboratory animals, and it has been observed that HIIT can mitigate the detrimental impact of such stress on cerebral function (7). alsoThe study of Tsai et al(2021) compared the effects of high-intensity interval training (HIIT) and moderate-intensity continuous exercise (MICE) on brain health in middle-aged adults. Both exercise types increased BDNF and irisin levels, but HIIT had a greater impact on irisin. Additionally, both HIIT and MICE improved neurocognitive function, particularly in executive tasks, with HIIT showing more significant enhancements. The results suggest that both HIIT and MICE are beneficial for cognitive abilities and brain health in this age group (8). also Research indicates that High-Intensity Interval Exercise (HIIE) could potentially enhance cerebrovascular health, which may result in better cognitive abilities and a decreased likelihood of cerebrovascular disorders. Additional investigations are essential to comprehensively decipher the underlying processes of this association and to ascertain the most effective HIIE regimens for augmenting cerebral health advantages (9) . According to the above , and the importance of research in this study, we're looking at the impact of high-intensity interval training on brain health in athletes.

Materials And Methods

The present study was a review type. Google Scholar, Scopus, Pub Med, Science Direct and Springer databases were used to search for articles in English from 2017 to 2024. Articles were extracted using the keywords of HIIT, BDNF, brain health and acute-exercise. The inclusion and exclusion criteria for the study encompassed factors such as the impact of high-intensity interval training on brain health, availability of full-text studies, exclusion of articles older than 2017, inclusion of high-quality articles, and inclusion of participants without any specific illnesses. Ultimately, 69 article titles were searched based on the keywords used, and after reviewing the articles according to the inclusion and exclusion criteria, as well as removing duplicate articles, 15 high-quality articles related to the impact of high-intensity interval training on brain health in athletes were obtained and analyzed. Additionally, Figure 1 illustrates the selection process of articles for the present study.

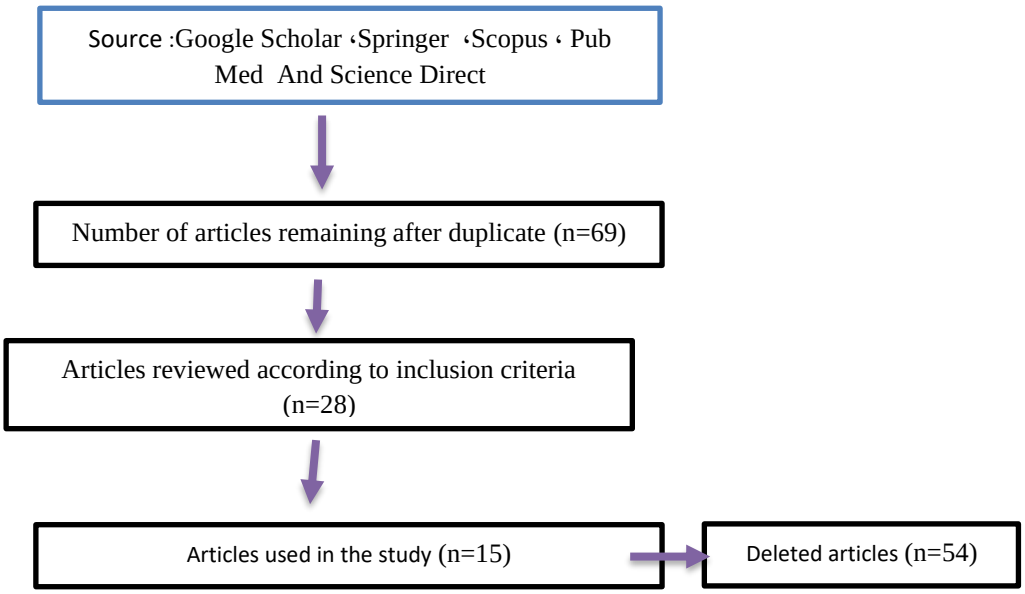

Figure 1- The process of selecting articles.

Results

Of the 15 reviewed studies, 6 articles focused on investigating the effects of high-intensity interval training (HIIT) on cognitive performance in the context of brain health. All of these studies reported positive impacts of these exercises on various cognitive domains, except for one study in which no effects of HIIT on cognitive performance were reported. However, this particular study did mention that the physical improvements resulting from HIIT may not directly influence cognitive aspects. Additionally, 6 other articles examined the effects of HIIT on executive function in brain health, with four of them indicating the positive efficacy of these exercises on executive performance. In a study that explored the effects of different intensities of HIIT and their impact on various cognitive functions, the results demonstrated that moderate-intensity HIIT yielded the best outcomes. One study did not report any specific effects of HIIT on brain functioning, while another study suggested that performing HIIT to extreme fatigue levels may have a negative impact on the accuracy factor of executive performance. One article focused on investigating the influence of these exercises on decision-making, with no beneficial changes observed in decision-making enhancement. Another study examined the effects of high-intensity interval training on brain pressure flow and reported its effectiveness. Additionally, one article explored the association of HIIT with blood biomarkers related to brain injury, showing an increase in these markers in response to the exercises. However, it was reported that after a 2-week training protocol, these responses decreased for certain biomarkers.

Table 1. Investigating the effect of high-intensity interval training on brain health in athletes

name	year of publication and journal	Structure of the study	The variable under consideration	Conclusion
(Buzdagli et al., 2024) (10)	2024 BMC sports science, medicine & rehabilitation	A total of twenty-eight elite male boxing athletes aged > 18 years, with at least eight years of training experience, who successfully achieved national and international levels were included in this study. The elite athletes participating in the study were aged 24.43 ± 4.72 years, 14.45 ± 5.89 years of training experience, had a body weight of 74.64 ± 7.82 kg, and had a height of 177 ± 7.15 cm. Athletes who consumed any stimulants during the testing or supplementation phase, nutritional supplements, or steroids that may have affected hormone levels or sports performance in the last three months were excluded from this study. Venous blood samples were obtained, and cognitive performance tests (Stroop tests) were applied immediately after high-intensity intermittent	high-intensity intermittent and moderate-intensity continuous exercises and neurobiological markers and cognitive performance	HIIE and MICE have favorable effects on improving cognitive performance and neuroprotection in an athlete population. HIIE is considered to be superior to MICE in improving neuroprotection and cognitive performance. Our study has remarkable results demonstrating the benefits of HIIT on neuroprotection and cognitive performance. HIIE is recommended instead of MICE, especially in sports where cognitive performance is more important.

		exercise (HIIE), one hour after HIIE, immediately after moderate-intensity continuous exercise (MICE), and one hour after MICE. Serum BDNF, S100B, and NSE levels were measured after each session.		
(Jiménez-Roldán et al.,2023) (11)	2023 International Journal of Environmental Research and Public Health	At least 77 women will be recruited and randomly assigned to either a HIIT group (12-week exercise HIIT intervention, 3 sessions/week), the HIIT + PA group (12-week exercise HIIT intervention, 3 sessions/week, plus 10,000 steps/day), or a control group (usual care).	HIIT And IGF-1 And Brain Executive Function	To best of our knowledge, no HIIT interventions have been developed where a HIIT program is developed in conjunction with an increase in daily physical activity, with the aim of observing changes mainly in IGF-1 and executive functions in the population studied.
(Wang et al.,2023) (12)	2023 Brain Sciences	All the participants were randomly divided into three groups. One group was not assigned any HIIT, which was called the control group. One group was assigned one session of HIIT/week, which was called the low-dose group. The last group was assigned wo sessions of HIIT/week, which was called the moderate-dose group. All groups were subjected to EF measurements.	Different Dose sofHIIT And Executive Functions	Low-dose HIIT and moderate-dose HIIT improved the EF in college students, but moderate-dose HIIT was better. This study suggests that moderate-dose HIIT should be adopted to improve the EF in college students.
(Abbariki et al., 2022) (13)	2022 Physiological reports	In 18 endurance-trained men (age: 27 ± 6 years, VO_2max: 55.5 ± 4.7 ml·kg^{-1}·min^{-1}), we evaluated the impact of 6 weeks of HIIT to exhaustion on dCA directionality using induced MAP oscillations	high-intensity interval training to exhaustion and the directional sensitivity of the cerebral pressure-flow	The main findings of the current study are two-fold. First, there was a presence of asymmetry in the cerebral pressure-flow relationship of our endurance-trained young men before the

		during 5-min 0.05 and 0.10 Hz repeated squat-stands. We calculated time-adjusted changes in middle cerebral artery mean blood velocity (MCAv) per change in MAP ($\Delta MCAv_T/\Delta MAP_T$) for each squat transition. Then, we comparedaveraged $\Delta MCAv_T/\Delta MAP_T$ during MAP increases and decreases.		training program at 0.10 Hz repeated squat-stands, where MCAv changes were attenuated when MAP increased. Second, 6 weeks of HIIT to exhaustion led to a disappearance of the asymmetrical response of MCAv with MAP changes at 0.10 Hz, while an inversed pattern appeared at 0.05 Hz repeated squat-stands. These results suggest the potential for HIIT to influence the directional sensitivity of the cerebral pressure-flow relationship in young endurance-trained men.
(Clemente-Suárez et al.,2022) (14)	2022 Healthcare (Basel, Switzerland)	A total of 32 players of tennis at recreational level (25 men and 7 women) were enrolled in this cross-sectional the study. Participants had to perform, randomly, two HIIT sessions. In one of them, cognitive load was induced by conducting an incongruent Stroop during rests. After training accuracy of tennis serve, CFFT, and RPE were measured.	HIIT and Cognitive Load on Cortical Arousal	HIIT with and without cognitive load increased the RPE in recreational tennis players. Furthermore, HIIT sessions with cognitive load significant altered tennis serve accuracy. Results showed that accuracy after baseline and HIIT without cognitive load were significantly higher than after HIIT with cognitive load.
(Costello et al.,2022) (15)	2022 Journal of Sports Sciences	Twenty-four trained rugby players completed multiple bouts of repeated sprints across two consecutive days. Prior to and following each set of maximal effort sprints or equivalent control duration, a battery of cognitive tasks assessing simple and choice reaction time, visuo-spatial working memory and inhibition were completed as well as visual analogue scales that assessed mood, energy, and fatigue.	repeated high-intensity sprint interval exercise and executive function and mood	Findings suggest that intensified periods of high-intensity sprint interval exercise have detrimental effects on executive function, mood and perceptions of physical and mental energy, and fatigue. These deleterious effects have the potential to impact performance and may increase the propensity for injury/accidents in certain sporting and

				non-sporting
(Alves et al.,2021) (16)	2021 International Journal of Environmental Research and Public Health.	A database search (Web of Science, PubMed, Scopus, and PsycINFO) for original research articles was performed. A total of eight articles met the inclusion criteria, and the Cochrane risk of bias tool was used. The studies' results were recalculated to determine effect sizes using Cohen's d. Different HIIT interventions reported improvements on cognitive performance at executive function (d = 0.75, +78.56%), linguistic reasoning (d = 0.25, +7.66%), concentration (d = 0.71, +61.10%), selective attention (d = 0.81, +60.73%), non-verbal and verbal abilities (d = 0.88, +47.50%; d = 1.58, +22.61%, respectively), abstract reasoning (d = 0.75, +44.50%), spatial and numerical abilities (d = 37.19, +22.85%; d = 1.20, +8.28%, respectively), and verbal reasoning (d = 1.00, +15.71%) in youth	High-Intensity Interval Training and Cognitive and Psychological Outcomes	To sum up, HIIT interventions between 4–16 weeks, for 8–30 min/session, at ≥85% maximal heart rate, would provide positive effects on cognitive performance and psychological outcomes in youth.
(Park et al.,2021) (17)	2021 International Journal of Environmental Research and Public Health	Forty-two healthy young adults (M = 23.3, SD = 2.94, age-range 19–30, 13 women) participants volunteered to participate in the experiment. They were recruited from the University Sports Center of the University of Stuttgart, Germany. A questionnaire for sports biography was used to determine what type of sport the participants did and how often they exercised per week to participate in the intervention study. Since sport type determines differences in executive functions in elite athletes,	3D-Multiple Object TrackingTask And Perceptual-Cognitive Performance	Our findings suggest that training resulted in substantial, task-specific gains (physical fitness, perceptual–cognitive performance), but there was no effect of HIIT on perceptual–cognitive performance. Due to the specific 3D-MOT task characteristics, improved physical abilities may not directly affect perceptual–cognitive performance related to sport-specific tasks. The absence of an additional training

		the sports biography was categorized into static sports (self-paced activities in highly consistent circumstances, e.g., taekwondo, athletics, and dancing, etc.), strategic sports (requiring the adaption to highly varying situations considering teammates, opponents, positions or objects, e.g., soccer, basketball, handball, and volleyball, etc.) or interceptive sports (requiring dynamic coordination between athlete′s body and an implement or environment, e.g., table tennis and tennis, etc.) as well as sport-unspecific training such as strength and endurance. The different categories′ participants were randomly assigned to the three experimental conditions and the control group.		effect of the HIIT or HIIT + NT compared to the NT group is only somewhat surprising and maybe (a) due to the nature of the HIIT protocol, (b) the short intervention period, and/or (c) the difference between this specific 3D-MOT task and the usually tested cognitive abilities.
(Ai et al.2021) (18)	2021 International Journal of Environmental Research and Public Health	Standard databases (i.e., the PubMed, Medline, Scopus, and CENTRAL databases) were searched for studies that examined the effect of acute HIIT on EF and were published up until January 2021. The overall EF and factors grouped by three categories, namely, EF assessment characteristics, exercise intervention characteristics, and sample and study characteristics, were analyzed by percentage of comparison for positive or null/negative effects. Overall, 35 of 57 outcomes (61%) across 24 studies revealed that acute HIIT has a positive effect on overall EF.	Acute High-Intensity IntervalTrainingAnd Executive Function	Acute HIIT is generally considered a viable alternative for eliciting EF gains, with factors related to EF components, timing of the assessment, exercise total time, and age potentially moderating the effect of HIIT on EF.
(Martínez-Díaz et al.,2020) (19)	2020 International Journal of Environmental	Twenty-five male college students of Physical Education performed a single bout of HIIT	Brain-Derived Neurotrophic Factor And Cortisol	In conclusion, the stress induced by a single bout of HIIT induces a remarkable

	Research and Public Health	consisting of 10 × 1 min of cycling at their VO_2 peak power output. Plasma Brain-Derived Neurotrophic Factor (BDNF) and cortisol (CORT) levels, and WM (Digit Span Test (DST)), were assessed pre-, post- and 30 min post-intervention.	and Working Memory and HIIT	response of BDNF and CORT boosting WM capacity in healthy young males. Future research should clarify the association between cognitive and neurobiological markers during intense exercise stimulation.
(Leahy et al.,2020) (20)	2020 Medicine and science in sports and exercise	A systematic search was conducted, and studies were eligible if they 1) included a HIIT protocol, 2) examined cognitive function or mental health outcomes, and 3) examined children or adolescents (5-18 yr). Separate meta-analyses were conducted for acute and chronic studies, with potential moderators (i.e., study duration, risk of bias, participant age, cognitive demand, and study population) also explored.	Cognitive and Mental Health And HIIT	Our review provides preliminary review evidence suggesting that participation in HIIT can improve cognitive function and mental health in children and adolescents. Because of the small number of studies and large heterogeneity, more high-quality research is needed to confirm these findings.
(Fuentes-García et al.,2021) (21)	2021 Sustainability	32 recreational players (25 men and 7 women; aged 21.40 ± 1.52 years) performed a HIIT and a HIIT with a Stroop in recovery phases before performing a series of tennis services. Speed and accuracy of the services, spirometry, and strength manifestations were registered	physical and cognitive fatigue HIIT & speed and accuracy of the serve	The results of the present study showed that both conditions significantly decrease tennis serve speed, whereas the accuracy of the service, spirometry, and strength manifestations was not significantly affected by either of these protocols. To our knowledge, this is the first study that analyzed the effects of HIIT on serve speed and accuracy. We hypothesized that HIIT would decrease the speed and accuracy of the tennis service. The results of this study suggest that physical fatigue induced by a HIIT decreases the serve speed, without

				significantly changing service accuracy, strength manifestations, or spirometry. Therefore, we can only partially confirm this hypothesis.
(Kittel et al2019) (22)	2019 Journal of Sports Sciences	20 amateur Australian football umpires volunteered to participate in a randomised control trial. Participants completed an 8-week training intervention in a conditioning only (CON; n=7), combined video-based training and conditioning (COM; n=7), or separated conditioning and video-based training (SEP; n=6) group. Preliminary and post-testing involved a Yo-Yo Intermittent Recovery Test (Yo-YoIR1), and 10x300m run test with an Australian football specific video-based decision-making task.	perceptual decision-making training and HIIT	There was no additional benefit to completing video-based training, whether combined with, or separate to physical training(HIIT), suggesting that this was not an optimal training method. For video-based training to be an effective decision-making tool, detailed feedback should be incorporated into training. It is recommended that longer conditioning and video-based training interventions be implemented to determine training effectiveness.
(Di Battista et al., 2018) (23)	2018 Frontiers in Physiology	Eleven healthy, recreationally active males (median age = 29.0, interquartile range = 26.0–31.5) performed HIIT on a bicycle ergometer (8-12 × 60-s intervals at 100% of peak power output, interspersed by 75-s recovery at 50 W) three times/week for 2 weeks. Peripheral blood samples were collected before and immediately after HIIT during the first and last training sessions. Differences in biomarker concentrations in response to HIIT were evaluated by partial least squares discriminant analysis (PLSDA) within a repeated-measures bootstrapped framework.	HIIT And panel of blood biomarkers associated with brain injury	Blood biomarkers commonly associated with brain injury are significantly elevated in response to a single bout of HIIT. After a 2-week, six-session training protocol, this response was attenuated for some, but not all markers.

Authors	Buzdagli et	Jiménez-Rold	Wang et al.	Abbariki et al.	Clement e-	Costello et al.	Alves et al.	Park et al. (17)	Ai et al. (18)	Martínez-Díaz	Leahy et al.	Fuentes-Garc	Kittel et al.	Di Battista	Zimmer et al.

(Zimmer et al.,2017) **(**24**)**	2017Multiple Sclerosis Journal	A total of 60 persons with MS (Expanded Disability Status Scale (EDSS): 1.0–6.5) were randomized to a HIT group (3×/week for 20 minutes, including five 3-minute exercise intervals at 80% of peak oxygen uptake ($VO_{2\text{-peak}}$)) or a CT group (continuously 5×/week for 30 minutes/session at 65% of $VO_{2\text{-peak}}$). Cognitive performance was assessed using the Brief International Cognitive Assessment for MS at entry (t_0) and discharge (t_1). Furthermore, $VO_{2\text{-peak}}$, brain-derived neurotrophic factor, serotonin and matrix metalloproteinases (MMP)-2 and -9 were measured.	High-intensity interval exercise and cognitive performance	Significant improvements over time in executive functions were found in both groups. Secondary outcomes indicated significant improvements in $VO_{2\text{-peak}}$ and a significant reduction in MMP-2 in the HIT group only. HIT represents a promising strategy to improve verbal memory and physical fitness in persons with MS.

.Modified Downs and Black checklist for randomized and non-randomized studies

	al. (10)	án et al. (11)	(12)	(13)	Suárez et al. (14)	(15)	(16)			et al. (19)	(20)	ía et al. (21)	(22)	et al. (23)	(24)
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5	1	1	1	1	1	1	1	0	0	1	1	0	1	1	1
6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7	1	0	1	0	1	1	1	0	0	1	1	1	1	0	1
8	1	1	0	1	1	0	0	1	1	0	1	1	0	1	0
9	1	1	1	1	0	1	1	1	1	1	1	0	0	1	1
10	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1
11	1	UTD	1	1	1	1	1	1	0	1	0	1	1	1	UTD
12	1	1	UTD	1	UTD	0	1	0	1	UTD	1	0	1	1	1
13	1	1	1	1	1	1	1	0	1	0	0	1	1	1	1
14	1	0	0	0	1	1	0	1	0	1	0	0	1	0	1
15	0	1	1	1	1	1	1	1`	1	0	1	1	0	1	0
16	1	1	0	1	0	1	1	0	0	1	0	0	1	1	1
17	1	1	0	1	1	1	1	UTD	1	1	0	1	UTD	1	1
18	1	1	1	1	UTD	1	1	1	1	UTD	UTD	0	1	0	0
19	1	0	0	1	1	0	0	1	1	0	0	1	0	1	1
20	1	1	1	1	1	1	1	0	1	1	1	1	1	0	0
21	1	1	0	1	1	1	1	1	0	1	0	1	1	1	1
22	UTD	1	1	UTD	0	1	0	0	1	1	1	1	UTD	UTD	1
23	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
24	1	1	1	1	0	0	1	1	1	1	1	1	0	1	1
25	0	1	1	0	1	0	0	1	0	1	0	1	0	0	0
26	1	1	1	UTD	0	1	1	1	1	1	1	UTD	1	0	UTD
27	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1
Total	23	23	22	22	21	20	21	19	22	20	19	20	18	19	20

Risk of Bias Assessment (No: score-0; Yes: score-1, UTD-Unable to determine)

Discussion

The purpose of this study was to investigate the effect of high-intensity interval training on the brain health of athletes. Studies have reported the positive effects of these exercises on various cognitive domains, as well as the effect of HIIT on executive function in brain health, the positive effect of these exercises on executive function. This finding aligns with the results of Buchheit, M. et acurrent research (25). Also, in a study conducted by Huang et al., cognitive function and brain flexibility improved in young athletes, which is consistent with the present study (26). However, not all researchers agree on the positive effects of HIIT on brain health in athletes. A review published by Basso et al found that the evidence for the cognitive benefits of HIIT is mixed and that more research is needed to fully understand the relationship between HIIT and brain health in athletes (27). Research has indicated that high-intensity interval training (HIIT) can play a role in enhancing cognitive performance, such as memory, attention, and problem-solving skills, in both healthy individuals and those with neurological conditions. This is especially beneficial for athletes who rely on quick decision-making and mental agility during their training and competitions. Additionally, HIIT has been shown to elevate levels of brain-derived neurotrophic factor (BDNF), a protein that supports the growth and survival of neurons, which is essential for learning and memory (28). Furthermore, HIIT has been shown to decrease markers of inflammation and oxidative stress in the brain, both of which are associated with the onset of neurodegenerative diseases and cognitive decline. This indicates that HIIT may have protective effects on the brain, potentially lowering the risk of brain-related conditions as athletes grow older. Moreover, the cardiovascular advantages of HIIT, including enhanced blood flow and oxygen supply to the brain, may also

play a part in its beneficial influence on brain health.(29). In recent years, experts have been focusing on the impact of high-intensity interval training (HIIT) on the health of athletes. It has been proven to enhance cardiovascular fitness, muscle strength and endurance, and overall athletic performance. Nonetheless, the long-term effects of HIIT on athletes' health, as well as potential risks and benefits, are still under investigation by researchers and exercise professionals (30, 31). Although HIIT can be an effective training method for enhancing athletic performance, it is essential to acknowledge the potential drawbacks. Overtraining and the risk of injury are significant concerns when incorporating HIIT into an athlete's regimen. It is crucial to ensure that athletes are properly conditioned and ready for the rigors of HIIT in order to minimize the potential for injury (32, 33). Overall, while our research suggests a potential link between interval training and brain health in athletes, more studies are needed to confirm and expand on these findings. It's an exciting area of research with the potential to improve athletes' overall well-being and performance.

Conclusion

The results suggest that high-intensity interval training (HIIT) may have a positive effect on the brain health of athletes. This type of exercise has been shown to improve cognitive function, support the growth and survival of neurons, and reduce inflammation and oxidative stress in the brain. Consequently, HIIT may help athletes maintain and even enhance their cognitive abilities throughout their careers and as they age. While more research is needed to fully understand the mechanisms and long-term effects of HIIT on brain health in athletes, the current findings are promising and should be further investigated.

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