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Effect of Sprint Interval Training on Cognition in Young Adults

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Abstract

Objectives: To evaluate the effect of Sprint Interval Training (SIT) on short-term memory, working memory, cognitive flexibility, selective/sustained attention, and processing speed among young adults. **Materials and Methods**: An experimental study was conducted on 60 young adults aged 18–25 years who were randomly allocated into an experimental group (n = 30) and a control group (n = 30). The experimental group underwent Sprint Interval Training on a cycle ergometer, while the control group received no intervention. Cognitive outcomes were assessed using the Digit Span Test, Trail Making Test, Bells Test, and Stroop Test. **Results**: The experimental group demonstrated significant improvements in short-term memory ($p = 0.003$), working memory ($p < 0.001$), and selective/sustained attention ($p < 0.001$). Processing speed showed significant within-group improvement ($p = 0.046$), whereas cognitive flexibility did not improve significantly. **Conclusions**: Sprint Interval Training significantly improved short-term memory, working memory, and selective/sustained attention in young adults, suggesting that SIT is an effective and time-efficient strategy for enhancing selected domains of cognition.

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Introduction

Cognition encompasses all forms of knowing and awareness, including perceiving, remembering, reasoning, judging, imagining, and problem-solving. It is defined as the collection of processes through which sensory input is transformed, stored, recovered, and utilized (Bayne et al., 2019). Cognitive function refers to the mental processes involved in acquiring knowledge, processing information, and reasoning, including domains such as perception, memory, attention, decision-making, and language (Kiely, 2014). These processes enable individuals to learn, think, remember, plan, make judgments, and interact effectively with their environment (Sternberg and Sternberg, 2017). Young adulthood, particularly during college education, represents a critical developmental period characterized by increasing academic demands, social adjustments, and personal responsibilities. These challenges can influence both emotional well-being and cognitive functioning, thereby affecting academic performance and overall quality of life. Previous studies have reported a high prevalence of mental health problems among university students. It's found that approximately one in three college students experiences significant symptoms of depression (Khan et al., 2024). In developing countries such as India, additional sociocultural influences, including familial expectations, societal pressures, and cultural norms, may further affect psychological health and cognition. Reports show a higher prevalence of depression and anxiety among Indian college students compared with the general population, highlighting the importance of investigating cognitive function within this population (Khan et al., 2024).

Physical activity has been widely recognized as an important contributor to cognitive health. Regular exercise promotes neuroplastic adaptations, including increased grey matter volume, enhanced cerebral blood flow, improved cerebrovascular health, and increased release of neurotrophic factors such as Brain-Derived Neurotrophic Factor (BDNF). These physiological changes have been associated with improvements in memory, attention, executive function, and overall cognitive performance across the lifespan. Furthermore, regular physical activity has been shown to reduce age-related cognitive decline and improve quality of life (Mandolesi et al., 2018).

Among various exercise modalities, interval training has gained considerable attention due to its efficiency and effectiveness. Interval training involves alternating periods of high-intensity exercise with periods of recovery, enabling individuals to achieve substantial physiological adaptations within shorter durations of exercise (Gistet al., 2013). Sprint Interval Training (SIT), a specialized form of interval training, consists of repeated short bouts of maximal or near-maximal effort separated by recovery periods. Research has demonstrated that SIT can improve aerobic capacity and muscular performance while requiring significantly less time than traditional endurance training (Jin et al., 2025; Huang et al., 2025). In addition to its physiological benefits, SIT has shown promising effects on cognitive functioning. Evidence suggests that both acute and chronic high-intensity interval exercise can enhance executive functions, including working memory, inhibitory control, cognitive flexibility, and processing speed (Liu et al., 2024). These cognitive improvements are thought to be mediated by increased levels of neurotrophic factors such as BDNF and Vascular Endothelial Growth Factor (VEGF), which support neuroplasticity, neurogenesis, and angiogenesis (Li et al., 2022). Studies have also reported improvements in working memory following short-term sprint-based interventions, accompanied by increases in BDNF levels (Williams et al., 2022). Furthermore, high-intensity exercise has been shown to enhance cerebral blood flow, facilitating improved delivery of oxygen and nutrients to the brain (Smith et al., 2010).

Cognitive functions such as memory, attention, and decision-making are essential for academic success and daily functioning among young adults. However, modern lifestyles characterized by academic stress, insufficient sleep, sedentary behaviour, and inadequate physical activity have raised concerns regarding declining cognitive performance (Hershner and Chervin, 2014; Guerriero et al., 2025). Although traditional aerobic and resistance exercise programs are known to improve cognition, they often require substantial time commitments and long-term adherence. Sprint Interval Training offers a practical and time-efficient alternative that can be completed within a relatively short duration while producing meaningful physiological and cognitive benefits (Herold et al., 2022; Kujach et al., 2020). Despite growing evidence supporting the effects of SIT on cognition, research examining its impact among general college populations, particularly non-athletes and healthcare students, remains limited. Therefore, this study aims to fill the gap by examining the impact of a structured SIT protocol on key cognitive domains among young adults.

Materials and Methods

This experimental study was conducted to evaluate the effect of Sprint Interval Training (SIT) on cognitive function among young adults. Approval was obtained from the Institutional Research Committee (IRC), and permission was secured from Columbia College of Physiotherapy, Bangalore, prior to commencement of the study. A total of 60 participants were recruited using convenience sampling and randomly allocated into an experimental group (n = 30) and a control group (n = 30). Participants were healthy young adults aged 18–25 years with higher cognitive function (Mini-Mental State Examination score >24), no neurological or cardiovascular disorders, and had the ability to provide informed consent. Both male and female participants were included in the study. Cognitive performance was assessed before and after the intervention using standardized neuropsychological tests. Short-term memory and working memory were evaluated using the Digit Span Test (Dillon et al., 2024; de Paula et al., 2016), cognitive flexibility using the Trail Making Test (Gaudino et al., 1995; Sanchez-Cubillo et al., 2009), selective and sustained attention using the Bells Test (Paiva et al., 2017; Wong et al., 2017), and processing speed using the Stroop Color and Word Test (Scarpina and Tagini, 2017; Periáñez et al., 2020). The experimental group underwent Sprint Interval Training on a cycle ergometer thrice weekly for four weeks, while the control group continued their routine daily activities without any structured exercise intervention. Each training session lasted approximately 32 minutes and consisted of a warm-up phase, Sprint Interval Training phase, and cool down phase. The SIT protocol included repeated bouts of high-intensity sprint cycling interspersed with recovery periods, with exercise intensity maintained at 90–100% of predicted maximum heart rate. Detailed intervention procedures are presented in Table 1. Post-intervention assessment was performed after completion of the four-week training programme using the same outcome measures. Data were analysed using Statistical Package for the Social Sciences (SPSS). Descriptive statistics were calculated for all variables. Paired t-tests were used for within-group comparisons, unpaired t-tests for between-group comparisons, and the Chi-square test where appropriate. Statistical significance was set at $p < 0.05$.

Table 1. Sprint Interval Training (SIT) Intervention Protocol

Phase	Duration	Description
Warm-up	5 min	Raise Activate Mobilize and Potentiate (RAMP)-based warm-up including jogging on the spot, static jumping, hip and ankle mobility exercises, shuttle running, and light pedalling on the cycle ergometer
MainSIT Protocol	18 min	Four bouts of 30-second all-out sprint cycling, each followed by 4 minutes of active recovery
Repeated Sprint Protocol	4 min	Eight bouts of 15-second sprint cycling interspersed with 15 seconds of passive recovery
Cooldown	5 min	Light jogging, diaphragmatic breathing, static stretching exercises, relaxation, and rehydration
Total duration	32 min	Two sessions per week for four weeks

Results

The mean age of participants in the experimental group was 21.07 ± 1.31 years, while the control group had a mean age of 21.53 ± 1.33 years. The difference between the groups was not statistically significant ($t = 1.367$, $p = 0.177$). Both groups were comparable with respect to gender distribution, with each group comprising 15 males (50%) and 15 females (50%) (Table 2).

Table 2. Demographic Characteristics of the Experimental and Control Groups

Variable	Experimental Group (n = 30)	Control Group (n = 30)	t value	p value
Age (years) Mean ± SD	21.07 ± 1.31	21.53 ± 1.33	1.367	0.177
Male, n (%)	15 (50%)	15 (50%)	–	–
Female, n (%)	15 (50%)	15 (50%)	–	–

Table 3. Comparison of Cognitive Outcome Changes between Experimental & Control Groups

Outcome Measure	Group	Average Difference	Std. Deviation	t value	p value
Short-term Memory	Experimental	0.900	1.539	3.855	<0.001
	Control	0.433	1.104		
Working Memory	Experimental	1.333	1.241	4.660	<0.001
	Control	0.067	1.081		
Cognitive Flexibility	Experimental	5.105	18.901	1.194	0.237
	Control	0.332	16.261		
Selective/Sustained Attention	Experimental	0.063	0.072	3.443	0.001
	Control	0.001	0.069		
Processing Speed	Experimental	2.073	5.435	1.110	0.272
	Control	0.863	2.476		

Table 3 shows the comparison of cognitive outcome changes between the experimental and control groups demonstrated significant differences in short-term memory, working memory, and selective/sustained attention. For short-term memory, the experimental group showed an average difference of 0.900 ± 1.539 compared to 0.433 ± 1.104 in the control group, with a statistically significant difference between groups ($t = 3.855$, $p < 0.001$). Working memory also showed a significant difference, with the experimental group demonstrating an average difference of 1.333 ± 1.241, whereas the control group showed an average difference of 0.067 ± 1.081 ($t = 4.660$, $p < 0.001$).

For selective/sustained attention, the experimental group demonstrated an average difference of 0.063 ± 0.072 compared to 0.001 ± 0.069 in the control group, and the difference between groups was statistically significant ($t = 3.443$, $p = 0.001$). In contrast, cognitive flexibility showed an average difference of 5.105 ± 18.901 in the experimental group and 0.332 ± 16.261 in the control group, with no statistically significant difference between groups ($t = 1.194$, $p = 0.237$). Similarly, processing speed demonstrated an average difference of 2.073 ± 5.435 in the experimental group and 0.863 ± 2.476 in the control group, with no statistically significant difference observed between groups ($t = 1.110$, $p = 0.272$) (Table 3).

The results of the present shows that Sprint Interval Training was associated with significant changes in short-term memory, working memory, and selective/sustained attention, whereas no statistically significant differences were observed for cognitive flexibility and processing speed over the intervention period.

Discussion

The present study evaluated the effect of Sprint Interval Training (SIT) on short-term memory, working memory, cognitive flexibility, selective/sustained attention, and processing speed among young adults. The findings of the present study demonstrated significant improvements in short-term memory, working memory, and selective/sustained attention in the experimental group compared with the control group, whereas cognitive flexibility and processing speed did not show significant between-group differences.

The demographic characteristics of the participants of the present study were comparable between groups, with no significant differences in age or gender distribution. This suggests that the observed cognitive changes were more likely attributable to the intervention rather than baseline demographic variations. Short-term memory improved significantly following the SIT intervention. This finding is consistent with previous evidence indicating that high-intensity exercise may facilitate memory processes through enhanced cerebral blood flow and exercise-induced neurophysiological adaptations (Liu et al., 2024; Gilson et al., 2023). Similarly, working memory showed the greatest improvement among the assessed cognitive domains. These findings support previous reports that high-intensity interval exercise can positively influence executive functions and working memory performance (Liu et al., 2024; Alves et al., 2014).

In the present study, Selective/sustained attention also improved significantly in the experimental group, while the control group showed no meaningful change. Improved attentional performance following exercise has been attributed to enhanced cortical activation and improved neural efficiency associated with physical activity (Hillman et al., 2008).

In contrast, cognitive flexibility did not demonstrate significant improvement following the intervention. Although numerical changes were observed, they did not reach statistical significance. Similar findings have been reported in previous studies, suggesting that cognitive flexibility may be less responsive to short-term exercise interventions than other executive functions and may require longer intervention periods to produce measurable effects (Alves et al., 2014; Xiong et al., 2020).

Processing speed showed significant within-group improvement in the experimental group; however, the between-group comparison was not statistically significant. This finding suggests that although SIT may influence processing speed, the effect may not be sufficiently large to demonstrate clear superiority over routine activities during a short-term intervention period (Liu et al., 2024).

Overall, the findings of the present study indicate that Sprint Interval Training has a positive effect on selected cognitive domains, particularly short-term memory, working memory, and selective/sustained attention, among young adults. These results support the growing evidence that high-intensity interval-based exercise can enhance cognitive performance, while highlighting that certain cognitive functions may require longer or more targeted interventions to achieve significant improvement.

Limitations of the study include a relatively small sample size. The duration of the intervention may have been insufficient to elicit changes in more complex domains of cognition. External lifestyle factors such as diet, sleep, stress, and emotions were not controlled. The timing of pre- and post-tests varied (e.g., evening sessions), which may have introduced fatigue or exhaustion effects affecting post-test performance. In addition, daily physical and mental fatigue levels were not monitored, which could have influenced cognitive performance and introduced bias into the findings.

Conclusion

The results of the present study suggest that Sprint Interval Training is an effective, time-efficient intervention to enhance specific domains of cognition in young adults, particularly short-term memory, working memory, and selective attention. These results support the role of high-intensity interval-based protocols in improving neurocognitive outcomes, likely through mechanisms such as increased cerebral blood flow, neurochemical modulation, and enhanced cortical activation. However, the lack of significant improvement in cognitive flexibility and processing speed indicates that not all cognitive functions are equally responsive to short-duration SIT protocols

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