



EFFECTIVENESS OF HIGH-INTENSITY PHYSICAL EXERCISE (HIIT) THROUGH POUNDFIT EXERCISE ON COGNITIVE FUNCTION IN YOUNG ADULTS WITH A SEDENTARY LIFESTYLE

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ABSTRACT

Technological developments and lifestyle changes following the COVID-19 pandemic have increased the prevalence of sedentary behavior in young adults, potentially negatively impacting cognitive function. Physical activity interventions, particularly High-Intensity Interval Training (HIIT), are known to have benefits for brain health. Pound Fit is a form of HIIT that combines high-intensity exercise, rhythmic music, and motor coordination, but empirical evidence regarding its effects on cognitive function in sedentary young adults is still limited. This study aims to analyze the effectiveness of HIIT through Pound Fit on cognitive function in young adults with a sedentary lifestyle. This study used a Randomized Controlled Trial (RCT) design with a quantitative approach. The MoCA-Ina has been reported to have good construct validity and high reliability with a Cronbach's Alpha value >0.70 , making it considered reliable for measuring cognitive function in the Indonesian population. A total of 40 female Nursing students with a sedentary lifestyle were recruited and randomly divided into an intervention group ($n=20$) and a control group ($n=20$). The intervention group participated in a HIIT-based Pound Fit exercise program for four weeks (3 times/week, ± 45 minutes/session), while the control group carried out their usual activities. Cognitive function was measured using the Indonesian version of the Montreal Cognitive Assessment (MoCA-Ina) before and after the intervention. Data analysis was performed using a Paired Samples t-test and an Independent Samples t-test. The results of the paired samples t-test showed a significant increase in cognitive function in the intervention group after Pound Fit exercise ($p < 0.001$). The independent samples t-test also showed a significant difference in cognitive function scores between the intervention group and the control group in the posttest measurement ($p < 0.001$). All data met the assumptions of normality and homogeneity. HIIT training through Pound Fit exercise has been proven effective in improving cognitive function in young adults with a sedentary lifestyle. This intervention has the potential to be an applicable promotive and preventive strategy in nursing and public health practice to support the cognitive health of young adults.

Keywords: cognitive function; HIIT; pound fit; sedentary lifestyle; young adults

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INTRODUCTION

Rapid technological advancements and changes in people's lifestyles following the COVID-19 pandemic have significantly altered the way individuals carry out their daily activities. Many work, learning, and social activities are now conducted online, leading people to spend more time at home (Durante & Lau, 2022). This situation has triggered an increase in physically inactive or sedentary behavior, characterized by a predominance of activities involving prolonged sitting or lying down, such as watching television, using computers, and driving (Yu et al., 2024). The sedentary phenomenon has become a global concern, with a World Health Organization (WHO, 2020) report indicating that approximately 31% of young adults and more than 80% of adolescents do not meet the recommended minimum of 150 minutes of physical activity per week. A 2021 survey in Hong Kong showed that 45.1% of young adults aged 18-25 spend ≥ 8 hours a day sitting, while 77.2% do not achieve the minimum of 2.5 hours of exercise per week (Hung & Choi, 2024). In Indonesia, the 2018 Basic Health Research (Riskesdas) data reported that 24.5% to 33.8% of adolescents and

college students, particularly females, spent ≥ 3 hours per day in sedentary conditions, while post-pandemic longitudinal studies showed a significant decline in physical activity in young adults, particularly in the transportation and recreation domains (Andriyani et al., 2021).

According to the Sedentary Behavior Research Network, sedentary behavior is defined as activity with an energy expenditure of ≤ 1.5 MET while sitting or lying down while awake. The impacts of sedentary behavior are broad and significant, including an increased risk of chronic non-communicable diseases (NCDs) such as obesity, type 2 diabetes, cardiovascular disease, and cancer (WHO, 2013; Apaflo et al., 2025). In addition to physical impacts, a sedentary lifestyle also affects cognitive function, including memory, attention, and thinking speed, through reduced blood flow to the brain and decreased levels of brain-derived neurotrophic factor (BDNF), an important protein that plays a role in neuroplasticity and brain function (Vos et al., 2015). This condition is particularly concerning for young adults, as the age of 18–25 is a critical period in the development of cognitive function and the formation of long-term lifestyles. This group is vulnerable to a sedentary lifestyle due to prolonged sitting, exposure to screen technology, academic pressure, and increased digital activities, including media multitasking and online multitasking (Alves et al., 2021).

Various studies have shown the negative impact of a sedentary lifestyle on cognitive function. A longitudinal study of over 3,200 individuals aged 18–30 years found that high television consumption (>3 hours/day) combined with physical inactivity (<2.5 hours/week) was associated with decreased working memory performance, slower processing speed, and impaired executive function, although verbal memory was not affected (Belinda Luscombe, 2015). A systematic review in adolescents and young adults also confirmed that sitting duration and screen exposure were significantly associated with attention deficits, stress, anxiety, and negative mood, which can ultimately hinder learning effectiveness and academic and professional productivity. Therefore, young adults deserve special attention in health interventions that emphasize physical activity and manage digital technology consumption, to maintain optimal cognitive function to support learning, decision-making, and quality of life (Arnett et al., 2000).

Physical activity-based interventions are the most recommended strategy to address the negative impacts of a sedentary lifestyle. High-Intensity Interval Training (HIIT) is a form of high-intensity exercise performed for short periods interspersed with active recovery periods. A recent meta-analysis reported that HIIT significantly improved information processing (SMD = 0.33), executive function (SMD = 0.38), and working memory (SMD = 0.21) compared to a control group (Kaihang Liu et al., 2024). Experimental studies also found that a single session of HIIT combining dynamic movements with bodyweight resistance can directly improve working memory in young adults, compared to light activity such as walking (Bahdur et al., 2019).

Physiologically, HIIT stimulates blood flow to the brain and increases the release of various neurotrophic factors such as BDNF, VEGF, and IGF-1, which play a key role in neuroplasticity, synapse formation, and neural network repair (Oliva et al., 2023; Qing Li et al., 2022). Central nervous system activation resulting from intense exercise is also believed to strengthen the integration between the sensorimotor system and executive functions in the brain's prefrontal cortex, making HIIT not only physically efficient but also supports brain health and cognitive function. One attractive implementation of HIIT for young adults is Pound Fit, which combines cardio, muscle strength, motor coordination, energetic music, and the use of Ripstix (light sticks) to mimic drumming. Pound Fit not only emphasizes physical fitness but also provides a pleasurable emotional experience, increases intrinsic motivation, and creates a positive atmosphere during exercise (Karageorghis et al., 2025). Thus, Pound Fit is an efficient, engaging, and youth-appropriate intervention alternative, potentially enhancing cognitive function.

Based on this phenomenon, this study aims to explore the effectiveness of HIIT through Pound Fit exercise on the cognitive function of sedentary young adults. This study is expected to provide theoretical contributions, in the form of strengthening the literature on the relationship between high-intensity physical activity and cognitive function, as well as practical benefits, namely as a basis for developing promotive-preventive programs that are applicable, enjoyable, and adaptive to the demands of the digital era (Bahdur et al., 2019). The results of the study are expected to increase young adults' awareness of the importance of physical activity for brain and mental health, assist health practitioners and fitness trainers in designing interventions, and serve as a reference for educational institutions in supporting students' cognitive capacity through the integration of physical activity into the curriculum or campus activities (Arundell et al., 2019). Thus, this study has high relevance in facing health challenges in the digital era while offering innovations to optimize brain function and the quality of life of the younger generation affected by a sedentary lifestyle.

METHOD

This study used a quantitative approach with a Randomized Controlled Trial (RCT) design, chosen because it has a strong level of evidence in assessing the effectiveness of an intervention on changes in cognitive function. The study respondents were female Nursing Study Program students from three classes: 2022, 2023, and 2024, and who had sedentary lifestyle characteristics. The participant recruitment process was conducted online by distributing a Google Form link to students from the three classes. From this recruitment process, 59 applicants were obtained who expressed their willingness to participate in the study. Of the total 59 applicants, the sample size for this study was determined based on the minimum sample size for experimental research specifically for small populations. The number of respondents was determined using the Federer formula, commonly used in experimental research, to ensure sufficient numbers of subjects in each treatment group for valid statistical analysis. The Federer formula is expressed as $(t-1)(n-1) \geq 15$, where t is the number of treatment groups and n is the number of subjects in each group.

In this study, there are two treatment groups, namely the intervention group and the control group, so the t value is 2. By entering this value into the Federer formula, the calculation $(2-1).(n-1) \geq 15$ is obtained, which is further simplified to $(n-1) \geq 15$. From the results of this calculation, the value of $n \geq 16$ is obtained, which indicates that the minimum number of subjects needed in each research group is 16 people. Thus, the minimum number of samples needed for the two groups is 32 people. However, to anticipate the possibility of *drop outs*, participant absence, or subject loss during the intervention process, the number of samples was increased to 20 people in each group. Therefore, the total number of samples used in this study was 40 people, which was considered adequate and appropriate to achieve the research objectives.

Next, all applicants underwent an initial screening process using the *Sedentary Behavior Questionnaire* (SBQ) to assess their level of sedentary behavior and compliance with the research criteria. Based on the SBQ screening results and the application of inclusion and exclusion criteria, 40 individuals were selected as eligible participants and were designated as study respondents. Inclusion criteria included being 18–25 years old, having an SBQ score indicating a sedentary lifestyle, having no history of neurological disease or cognitive impairment, and being willing to participate in the entire study series by signing an *informed consent*. Meanwhile, exclusion criteria included participants who had physical impairments or medical conditions that limited physical activity, did not participate in the full intervention session, or experienced significant changes in physical activity habits outside of the research intervention. Participants who met the criteria were then randomly divided into two research groups using a random assignment method, so that each participant had an equal opportunity to enter the intervention group or the control group. A total of 40 participants were divided equally, each consisting of 20 people in the intervention group and 20 people in the control group.

The sedentary behavior screening procedure was conducted according to the guidelines of Rosenberg et al. (2010). The SBQ consists of nine types of sedentary activities commonly performed in daily life, including watching television, using a computer or laptop for entertainment, reading, writing or typing, talking on the phone, playing video games, sitting in a vehicle, eating while seated, and other activities performed while seated. Each activity was assessed based on its duration on weekdays and weekends, with respondents asked to report the duration in hours and minutes. All activity durations were then converted into hours using standard provisions, namely 0 hours for never, 0.25 hours for ≤ 15 minutes, 0.5 hours for 30 minutes, 1–6 hours as chosen, and ≥ 6 hours as 6 hours. The total weekly duration of sedentary activities was calculated using the formula $\text{total weekly} = (\text{total weekday time} \times 5) + (\text{total weekend time} \times 2)$. Respondents were categorized as having a sedentary lifestyle if the duration of sedentary activity reached ≥ 6 hours per day or ≥ 42 hours per week, in accordance with the recommendations of Tremblay et al. (2017).

Data collection was conducted in two stages, before and after the intervention. The instrument used to measure cognitive function was the Indonesian version of the Montreal Cognitive Assessment (MoCA-Ina), which is designed to detect mild cognitive impairment and has been widely used in neuropsychological research. The MoCA-Ina evaluates various domains of cognitive function, including short-term memory, visuospatial and executive function abilities, attention and concentration, language, abstraction, and orientation to time and place. This instrument consists of 30 items with a time duration of approximately 10–15 minutes, where a score ≥ 26 is categorized as normal cognitive function. The MoCA-Ina has been reported to have good construct validity and high reliability with a Cronbach's Alpha value > 0.70 , thus being considered reliable for measuring cognitive function in the Indonesian population.

After completing the SBQ screening process, all participants underwent a baseline cognitive function measurement (pre-test) using the MoCA-Ina. The intervention group was then given a High-Intensity Interval Training (HIIT) program, packaged in the form of Pound Fit exercises, for four weeks, with a frequency of three times per week and a duration of approximately 45 minutes per session (Bahdur et al., 2019). At each meeting, prior to the Pound Fit exercise intervention, vital signs were checked, including blood pressure, pulse rate, respiratory rate, and body temperature. Additionally, body mass index (BMI) measurements were taken to monitor the respondents' nutritional status throughout the study period. These tests aimed to ensure the respondents were in a stable and safe physiological condition for high-intensity physical exercise, as well as to control for confounding factors that could influence the study results. Vital signs and BMI examination in this study were used as safety parameters and monitoring of respondents' physical condition, not as the main research variables, so they were not analyzed inferentially. The intervention was carried out at the Fitness Lab of the Indonesian University of Education and was guided by certified instructors. Each training session consisted of a 5–7 minute warm-up stage, namely dynamic stretching and joint mobilization movements. Warm-up exercises followed by slow to moderate rhythmic music. Then, HIIT core training based on Pound Fit movements for 30–35 minutes. The movement involves a combination of: *Drumming squat* (hitting the sticks on the floor while squatting), *Lunge with drum hits* and *Overhead pound* that is Cardio exercises such as *jumping jacks* or *side steps* with stick kicks, along with a 5–10-minute cool-down and stretching session, are included. Exercise intensity is controlled at 80–95% of maximum heart rate, in accordance with World Health Organization (WHO) and American College of Sports Medicine (ACSM) guidelines. Exercises are performed using Ripstix and set to high-energy music to improve cardiorespiratory performance and motor coordination.

Figure 1. PoundFit Exercise



The control group received no specific intervention and continued their daily activities as usual. After the intervention period ended, all participants in both groups underwent a post-test for cognitive function using the MoCA-Ina instrument. Physical activity outside the intervention could have influenced the study results. Data analysis was performed using SPSS with the Shapiro–Wilk normality test and the homogeneity of variance test using Levene's Test. If the data were normally distributed, comparisons of pretest and posttest scores within groups were analyzed using *the Paired Samples t-test* , while comparisons between the intervention and control groups were analyzed using *the Independent Samples t-test* . All research procedures adhered to ethical principles, including data confidentiality, voluntary participant consent, protection against the risk of injury, and the right to withdraw at any time. This research has received ethical approval from the Ethics Committee of the Faculty of Nursing and Health Sciences, Jenderal Achmad Yani University. with number 017/KEPK/FITKes–Unjani/VIII/2025, and implemented according to *Good Clinical Practice (GCP)* standards.

RESULT

Table 1.
Characteristics of Respondents

Characteristics	Category	f	%
Team	2022	29	72.5
	2023	6	15.0
	2024	5	12.5
Sedentary Group	High Sedentary	40	100
	Low Sedentary	0	0

Table 1 shows the characteristics of the study respondents based on their year and level of sedentary behavior. Most of the respondents were from the class of 2022, amounting to 29 people (72.5%), followed by the class of 2023 with 6 people (15.0%), and the class of 2024 with 5 people (12.5%). Based on the screening results using the Sedentary Behavior Questionnaire (SBQ), all respondents were included in the high sedentary category, with a total of 40 people (100%), while there were no respondents in the low sedentary category. These findings indicate that all recruited participants met the study criteria, namely having a sedentary lifestyle. Data normality testing was performed using the Shapiro–Wilk test to assess the distribution of cognitive function scores in the control and intervention groups, both in the pre-test and post-test measurements. Based on the results of the normality test in the control group, a significance value of 0.186 was obtained in the pre-test and 0.229 in the post-test. Meanwhile, in the intervention group, a significance value of 0.218 was obtained in the pre-test and 0.700 in the post-test. All significance values were greater than 0.05, so

it can be concluded that the cognitive function score data in both groups, both before and after the intervention, were normally distributed. Furthermore, the homogeneity of variance test was conducted using Levene's Test to assess the similarity of post-test score variances between the control and intervention groups. Based on the results of the homogeneity test, the significance value based on the mean was 0.448, based on the median was 0.433, based on the median with adjusted degrees of freedom was 0.433, and based on the trimmed mean was 0.476. All significance values were greater than 0.05, so it can be concluded that the data variance between the control and intervention groups was homogeneous. Thus, the data of this study met the assumptions of normality and homogeneity, so it is suitable for analysis using parametric statistical tests.

Table 2.

Paired Sample t-test

Variables	Mean Difference	Standard Deviation	Std. Error Mean	95%CI (Lower)	95%CI (Upper)	t	df	Sig. (2-tailed)
Pretest- Posttest	-1.200	1.005	0.225	-0.730	-5.339	-5.339	19	0.000

Table 2, the results of the *Paired Samples t-test* indicate a significant difference between cognitive function scores before (pretest) and after (posttest) the intervention. The *mean difference value* of -1.200 indicates an increase in cognitive function scores after the intervention compared to before the intervention. The standard deviation value of 1.005 with a *standard error* of 0.225 indicates relatively small data variation and stable measurement results. The *95% confidence interval* ranges from -0.730 to -5.339 and does not cross the zero value, indicating that the differences are statistically significant. A *t-value* of -5.339 with 19 degrees of freedom (*df*) and a *significance value of p = 0.000 (<0.05)* confirms that there is a significant difference between the pretest and posttest scores. Thus, it can be concluded that high-intensity physical exercise through Pound Fit gymnastics has a significant effect on improving cognitive function in the intervention group.

Table 3.

Independent Samples T-test

Variable	Group Comparison	t	df	Sig.(2-tailed)	Mean Difference	95%CI
Cognitive Function Score	Intervention vs Control	-4,319	38	P< 0.001	-2,250	(-3.305 to -1.195)

Table 3, the results of the *Independent Samples t-test* indicate a significant difference in cognitive function scores between the intervention and control groups after treatment. The *t-value* obtained was -4.319 with 38 degrees of freedom (*df*) and a *significance value of p <0.001*, which means less than 0.05. These results indicate a statistically significant difference between the two groups. The *mean difference* of -2.250 indicates that cognitive function scores in the intervention group were higher than those in the control group. This is supported by the *95% confidence interval*, which ranges from -3.305 to -1.195 and does not cross zero, further confirming the intervention's effect on improving cognitive function. Therefore, it can be concluded that high-intensity physical exercise through Pound Fit significantly improves cognitive function in young adults with a sedentary lifestyle.

DISCUSSION

The results of this study indicate a significant increase in cognitive function in the intervention group after being given high-intensity physical exercise based on Pound Fit. This finding is supported by the results of statistical tests that show that the pretest and posttest data in both groups are normally distributed, as indicated by the significance values of the Shapiro–Wilk test which are all greater than 0.05 in the control group (pretest $p = 0.186$; posttest $p = 0.229$) and the intervention group (pretest $p = 0.218$; posttest $p = 0.700$). In addition, the results of the homogeneity test using Levene's test indicate that the variance of posttest scores between the control and intervention groups is homogeneous, with a significance value based on the mean of 0.448 ($p > 0.05$). With the fulfillment of the assumptions of normality and homogeneity, the analysis using the parametric t-

test is considered appropriate.

Based on the results of the independent samples t-test, there was a significant difference between the cognitive function scores of the intervention group and the control group after the intervention was given ($t = -4.319$; $df = 38$; $p < 0.001$). The mean difference value of -2.250 with a 95% confidence interval (-3.305 to -1.195) indicates that the increase in cognitive function in the group that participated in the HIIT-based Pound Fit exercise was significantly higher than the control group. This finding confirms that the intervention given had a real effect on improving the cognitive function of respondents.

In addition to the differences between groups, the results of the paired samples t-test in the intervention group also showed a significant increase in cognitive function before and after the intervention ($t = -5.339$; $df = 19$; $p < 0.001$). The mean difference value of -1.200 indicates an increase in cognitive function scores after the exercise, which strengthens the evidence that the changes were not caused by random variation, but rather a direct result of the high-intensity physical exercise intervention.

The improvements in cognitive function observed in this study indicate that high-intensity interval training (HIIT)-based physical exercise can trigger optimal neurocognitive adaptations. These adaptations occur in response to high-intensity exercise stimuli delivered in a structured and repeated manner. Physiologically, HIIT is known to increase cerebral blood flow, thus optimizing the supply of oxygen and glucose to brain tissue. This is crucial because the brain is an organ with high energy requirements, particularly in areas involved in cognitive function, such as the prefrontal cortex and hippocampus.

In addition to increasing cerebral blood flow, HIIT also plays a role in stimulating the release of Brain-Derived Neurotrophic Factor (BDNF), a neurotrophic protein that plays a key role in maintaining neuron health and function. BDNF functions in the process of neuroplasticity, namely the brain's ability to form, repair, and strengthen connections between nerve cells. Through the mechanisms of synaptogenesis and strengthening neuronal connections, increased BDNF contributes directly to improvements in executive function, working memory, and attention and concentration abilities. This biological mechanism is consistent with the increase in cognitive function scores, which is quantitatively demonstrated through the results of statistical tests in this study, both in the analysis of differences before and after the intervention and comparison between the intervention and control groups.

The findings of this study are consistent with those of Rodríguez-Gutiérrez et al. (2024), who reported that HIIT training resulted in a greater increase in BDNF levels compared to moderate-intensity physical exercise. This suggests that exercise intensity plays a key role in triggering a stronger neurobiological response. Furthermore, a systematic review conducted by Mielniczek and Aune (2024) found that the cognitive benefits of HIIT were most pronounced in young adults. This age group is considered to have a higher neural adaptive capacity, making it more responsive to high-intensity exercise stimuli. This condition is relevant to the characteristics of the respondents in this study, who were all in the young adult age range, allowing for optimal intervention effects.

Pound Fit training is unique compared to other forms of HIIT because it combines high-intensity movements with rhythmic music and bilateral motor coordination. This combination provides not only physical stimulation but also simultaneous sensory and cognitive stimulation. The activity of hitting Ripstix to the beat of the music involves alternating right and left hand coordination, which is known to increase activation of the prefrontal cortex, an area of the brain that plays a key role in decision-making, executive control, and attention. Furthermore, auditory stimulation through fast-paced music also contributes to improving participants' focus, emotional regulation, and mood

during the workout.

The musical and rhythmic elements of Pound Fit also play a role in increasing participant motivation, engagement, and adherence to the exercise program. In the context of nursing interventions, this aspect is crucial because the success of an intervention is determined not only by physiological effectiveness but also by the level of adherence and active participation of the individual. High participant engagement during exercise can help maintain the target intensity, thus achieving the desired neurocognitive effects. This is reflected in the significant difference in cognitive function scores between the intervention and control groups in the posttest.

The greater improvement in cognitive function in participants with a sedentary lifestyle can also be explained by physiological compensation mechanisms. Individuals with low baseline levels of physical activity tend to experience less than optimal physiological conditions, including low central nervous system stimulation. When sedentary individuals are given structured physical exercise, especially at high intensity, the body and brain exhibit greater adaptive responses as a form of compensation. Farrukh et al. (2023) reported that individuals with a sedentary lifestyle experienced more significant improvements in cognitive biomarkers after a physical activity intervention compared to individuals who were already physically active. This finding aligns with the results of this study, where all respondents were categorized as having a high level of sedentary activity based on the results of the Sedentary Behavior Questionnaire (SBQ) screening.

Overall, the results of this study indicate that HIIT training through Pound Fit is an effective, practical, and engaging intervention for improving cognitive function in young adults with a sedentary lifestyle. From a nursing and public health perspective, this intervention has great potential to be recommended as a promotive and preventive strategy for improving cognitive health. Nurses, particularly in the areas of community nursing and health promotion, can play a role in educating and facilitating the implementation of HIIT-based physical activity as an early prevention effort against cognitive decline and the negative impacts of a sedentary lifestyle in the young adult population.

CONCLUSION

Based on the research results and discussion, it can be concluded that high-intensity HIIT-based physical exercise through Pound Fit has a significant effect on improving cognitive function in young adults with a sedentary lifestyle. This improvement is evidenced by a significant difference in cognitive function scores both in the pre- and post-intervention comparison within the intervention group and in the comparison between the intervention and control groups after treatment. Pound Fit, as a form of HIIT, provides not only physical stimulation but also sensorimotor and cognitive stimulation through a combination of high-intensity movements, bilateral coordination, and rhythmic music. This combination contributes to improvements in attention, executive function, and memory, as reflected in the increase in MoCA-Ina scores. The stronger adaptive response in participants with a sedentary lifestyle indicates that structured physical exercise plays a significant role in offsetting the negative impact of physical inactivity on brain function. From a nursing perspective, the results of this study confirm that HIIT-based Pound Fit can be recommended as an effective, enjoyable, and easy-to-implement promotive and preventive intervention in the young adult population. This intervention has the potential to be used by community nurses and health educators as part of an active lifestyle promotion program to improve cognitive health and prevent the long-term impacts of sedentary behavior.

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