Proceedings of ICBioMed 2025 Symposium: Computational Modelling and Simulation for Biology and Medicine
DOI: 10.54254/2753-8818/2025.LD27998

The Effect of a Combined Cognitive Behavioral Therapy and Exercise Prescription on the Physical and Mental Health of Highly Academically Stressed Adolescents

Benyuan Huang

Faculty of Education, The National University of Malaysia, Bangi, Malaysia
A207713@siswa.ukm.edu.my

Abstract. Prolonged academic stress increasingly places adolescents at high risk for both stress-related issues and physical inactivity. Although physical activity is known to improve cognitive function and metabolic health, existing interventions largely explore physiological outcomes, with limited integration of psychological strategies. This study investigates the effects of a cognitive-behavioral exercise prescription combined with six weeks of aerobic exercise and twelve weeks of strength and endurance training, integrated with psychological interventions, on the physical fitness and mind-body interactions of high-stress adolescents. Based on the literature and a quantitative intervention design, physiological outcomes, such as maximal oxygen uptake and strength tests, are assessed before and after the intervention, along with psychological measures including perceived stress and self-efficacy. The results indicate that the integrated intervention markedly boosted cardiorespiratory fitness, muscle strength, and muscular endurance, while improving psychological resilience, self-efficacy, and emotional regulation abilities. These findings can support combining physical training with cognitive-behavioral therapy in school programs for stressed adolescents.

Keywords: Cognitive behavioral therapy, Exercise prescription, Muscle strength and muscular endurance, Cardiorespiratory fitness

1. Introduction

Although prolonged academic stress makes adolescents vulnerable to chronic stress and insufficient physical activity, regular physical activity has been shown to enhance cognitive function and foster metabolic health [1]. In particular, aerobic and resistance training interventions improve executive function, emotional regulation, and cardiovascular and metabolic biomarkers [2]. However, existing interventions emphasize physical effects and overlook psychological strategies, leaving a major gap in developing programs that target both mental and physical health. Thus, this study proposes and evaluates a cognitive-behavioral exercise program aimed at improving physical fitness and boosting psychological resilience in adolescents exposed to high academic stress. To this end, mindfulness, self-efficacy training, and group interaction are incorporated into a structured exercise regimen to strengthen cardiorespiratory fitness, muscular strength, and endurance. Concurrently, changes in psychological constructs such as resilience, self-esteem, and anxiety are monitored. To evaluate the

© 2026 The Authors. This is an open access article distributed under the terms of the Creative Commons Attribution License 4.0 (https://creativecommons.org/licenses/by/4.0/).

DOI: 10.54254/2753-8818/2025.LD27998

effectiveness of the intervention, the study employed a protocol combining physiological measures, such as maximal oxygen uptake and strength tests, with psychological scales of perceived stress and self-efficacy. On this basis, a dual-track intervention program addressing both physiological and psychological needs was developed specifically for high-stress adolescents. Through this approach, the study simultaneously enhances physical fitness and psychological resilience, fostering a positive cycle of holistic health. This provides an evidence base for school physical education curricula and adolescent health interventions, and promotes the maintenance of sustainable healthy behaviors in high-pressure environments.

2. Psychological-physiological exercise approach for high-pressure adolescents

Under high academic pressure, adolescents often experience psychological burdens and insufficient physical activity. Therefore, an intervention model integrating exercise prescriptions with cognitive behavioral therapy (CBT) is proposed, which aims to alleviate psychological stress and promote the coordinated development of physical and mental health by boosting physical fitness and integrating psychological modules like stress management, cognitive restructuring, and mindfulness practices. This model, compared with physical training alone, emphasizes mind-body coordination to reduce academic stress and enhance both resilience and academic performance [1,3].

2.1. Key psychological factors in adolescent exercise

The initiation and maintenance of adolescent physical activity are shaped by multiple psychological factors, primarily intrinsic motivation, social recognition, self-efficacy, and psychological resilience [4]. First, intrinsic motivation drives individuals to derive pleasure and satisfaction from the activity itself. This drive mechanism, grounded in interest and enjoyment, differs from external rewards and consequently exhibits greater persistence and stability. Second, social recognition meets adolescents' need for social belonging, increasing their willingness to engage in group activities and effectively mitigating exercise avoidance behaviors arising from self-doubt and concerns about appearance [5]. Moreover, self-efficacy denotes one's belief in their ability to manage skill demands, physical effort, and time constraints. Individuals with high self-efficacy are more inclined to set clear goals and adopt proactive coping strategies, thereby enhancing exercise persistence [6]. Finally, psychological resilience, as a form of mental regulation, buffers the negative effects of academic pressure and exercise setbacks while enabling adolescents to resume training promptly after short-term failures, thus sustaining long-term psychological stability and commitment to physical activity [7]. Notably, the psychological plasticity of adolescence renders these core psychological factors key targets for exercise interventions. However, negative factors like peer pressure, academic load, and appearance anxiety may weaken these positive psychological mechanisms. To enhance exercise compliance and participation persistence among adolescents experiencing high academic stress, relevant strategies should prioritize developing and strengthening intrinsic motivation, peer recognition, self-efficacy, and psychological resilience.

2.2. Major physiological factors in adolescent exercise

Maximal oxygen uptake (VO_2max), which reflects the efficiency of oxygen delivery and utilization during high-intensity exercise, serves as a key physiological indicator of overall cardiorespiratory fitness in adolescents. Meanwhile, heart rate recovery reflects autonomic nervous system regulation and cardiovascular recovery efficiency. Improvements in cardiorespiratory fitness reduce the risk of

DOI: 10.54254/2753-8818/2025.LD27998

obesity and metabolic disorders, enhance endurance, stabilize neuro-metabolism, alleviate exercise fatigue, and thereby improve adolescents' vitality and cognitive performance [2]. Prior studies have shown that improved cardiorespiratory fitness is closely linked to enhanced executive function and concentration, potentially mitigating the adverse effects of academic stress in adolescents. However, the exact neuroendocrine mechanisms underlying this relationship remain unclear [8]. Meanwhile, the development of muscle strength and endurance is crucial for shaping the neuromuscular system during adolescence [9]. By promoting muscle fiber hypertrophy, enhancing neural excitability, and improving motor unit recruitment, targeted training increases motor skill automaticity and lowers the risk of sports injuries [10]. Moreover, greater muscle strength enhances movement efficiency, helping adolescents perform daily activities and sports with less fatigue [3]. In parallel, muscular endurance training enhances fatigue resistance, supporting prolonged physical activity and mental stamina. As shown in Figure 1, improvements in cardiorespiratory fitness and muscular endurance help adolescents manage stress, enhance well-being, and strengthen body image, self-efficacy, and continued exercise [11]. These combined improvements also regulate neuroendocrine responses and relieve stress, creating a positive cycle for physical and mental health [12].

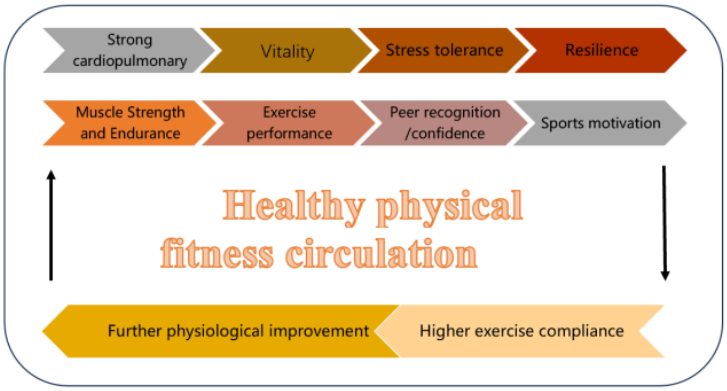

Figure 1. Healthy physical fitness circulation

2.3. Underlying interventional factors in adolescent exercise

For adolescents experiencing high academic pressure, exercise interventions should be tailored to fulfill both physiological and psychological requirements, with strategies explicitly targeting social withdrawal, low self-efficacy, and heightened anxiety [1]. Firstly, enjoyment should be the primary principle in designing exercise programs. By gamifying the exercise process, adolescents' intrinsic motivation can be effectively stimulated, increasing the pleasure and initiative of participation and thereby promoting the formation and maintenance of exercise habits. Secondly, the enhancement of social aspects is crucial for meeting adolescents' psychological needs. Specifically, the integration of peer collaboration and team-based tasks contributes to increased social recognition and a sense of belonging, while alleviating feelings of isolation and providing emotional support, thus improving exercise adherence. In addition, exercise intensity and goal setting should be scientifically tailored to adolescents' developmental stages and increase gradually. This ensures physiological adaptation and physical fitness improvement, progressively builds psychological resilience, and lowers the risk of exercise-related injuries. Finally, adolescents' autonomy matters. The adoption of varied exercise options and modifiable intensity for program tailoring boosts autonomy and sustains participation. Consequently, effective exercise interventions should address psychological needs, such as stress relief, social recognition, self-efficacy, and autonomy, alongside physiological training to achieve a

DOI: 10.54254/2753-8818/2025.LD27998

positive interaction between mental and physical development. Existing studies demonstrate that interventions focusing solely on physiological aspects have limited effectiveness, whereas dual-path comprehensive strategies targeting adolescents under high academic pressure offer greater practical value and potential for wider implementation.

3. Integration of cognitive exercise prescriptions for adolescent cardiorespiratory fitness

3.1. Mechanisms of cognitive enhancement through aerobic exercise

Existing studies reveal that aerobic exercise significantly enhances cognitive function in adolescents via multiple neurobiological pathways [13]. In particular, aerobic exercise promotes hippocampal neurogenesis and increases cerebral angiogenesis, a process closely associated with the upregulation of vascular endothelial growth factor (VEGF) [12]. Concurrently, increased levels of brain-derived neurotrophic factor (BDNF) enhance synaptic plasticity, thereby optimizing brain structure and function [8]. And enhancements in cardiorespiratory fitness particularly strengthen neural activity in the prefrontal cortex (PFC) and superior parietal lobule (SPL), both of which play key roles in executive function and cognitive control [12]. Moreover, aerobic exercise improves cerebral blood flow and glucose metabolism efficiency, enhancing overall neural efficiency; related studies have also observed increased EEG amplitudes, reflecting optimized neural function [14]. For adolescents in puberty, moderate aerobic exercise not only promotes cortical maturation but markedly improves executive function [12]. Empirical evidence further indicates that cardiorespiratory fitness levels, as assessed by tests like PACER, are positively correlated with adolescents' mathematics and reading performance [15]. Therefore, aerobic exercise that enhances cardiorespiratory fitness can promote neuroplasticity and improve adolescents' cognitive function.

3.2. Features and suitability of three cardiorespiratory training methods

The main methods of aerobic cardiorespiratory training include lactate threshold training, interval training, and continuous training. For adolescents facing high academic stress, understanding the characteristics and applicability of these methods aids in designing effective exercise programs. In particular, lactate threshold training emphasizes exercising at intensities near the lactate threshold to enhance the body's tolerance and clearance of lactate, thereby improving aerobic endurance and exercise performance. This approach is highly effective but involves high intensity and substantial recovery demands, making it suitable mainly for trained or competitive individuals. For adolescents facing high academic stress and limited time, the intensity and recovery demands may conflict with daily study and life, and thus it is not recommended as a primary choice. Moreover, interval training alternates high-intensity bursts with short rest periods, repeatedly challenging the cardiorespiratory system and rapidly improving power, speed, and aerobic capacity. It is suitable for a wide age range and popular among exercise enthusiasts, but its high intensity may impose significant physical and psychological strain on adolescents. Under high academic stress, the intensity and pace can lead to cumulative fatigue, influencing both study and recovery, thus presenting certain limitations. At the same time, continuous training involves low-intensity, prolonged, steady aerobic exercise, usually lasting over 30 minutes per session, delivering sustained stimulus to the cardiorespiratory system and improving aerobic metabolism and foundational endurance. Physiologically, it promotes fat metabolism; psychologically, it reduces stress and anxiety via endorphin, serotonin, and dopamine release, improving mood, attention, executive function, and self-efficacy. Thus, continuous exercise

DOI: 10.54254/2753-8818/2025.LD27998

builds psychological resilience, boosts academic coping and well-being, and serves as an effective cardiorespiratory training for adolescents under high academic stress [16].

3.3. Design and implementation of continuous aerobic exercise programs

The continuous aerobic exercise program for adolescents facing high academic pressure needs to balance physiological adaptation with psychological regulation. Thus, the cycle is set at six weeks, divided into an adaptation and formation phase and a consolidation and improvement phase, as detailed in Table 1 [6]. To ensure safety, participating students must pass the PAR-Q screening. The core objectives of the program include improving cardiorespiratory endurance (with an expected increase in maximal oxygen uptake of 5%-8%), alleviating anxiety and depression, and enhancing concentration, while boosting social connectedness and group identification through team activities. And exercise intensity is maintained at 60%-80% of maximum heart rate and consists of 70% continuous aerobic exercise (jogging, cycling, jump rope) combined with 30% fun interval training, with the duration gradually increasing from 25 minutes to 45 minutes. For frequency, the program schedules after-school workouts 5 days a week, with weekend group activities to enhance teamwork and psychological support. It emphasizes gradual progression, steadily increasing exercise duration and intensity while incorporating psychological interventions to improve intrinsic motivation and adherence. The implementation is divided into three phases. In the initial stage, exercise rhythms are set up to reduce physical and psychological resistance. In the middle stage, cardiopulmonary endurance is improved, exercise habits are formed, and short sprint runs are introduced. In the final stage, psychological resilience and neural efficiency are enhanced, with a focus on team activities and attention training. Throughout the entire process, psychological interventions, such as mindful breathing, emotional expression and release, and self-efficacy cultivation, are employed to regulate emotions, reduce stress, and promote exercise motivation.

Table 1. Six-week continuous aerobic exercise implementation plan

Week	Objective	Training overview	Key Areas of Psychology Intervention
Weeks 1-2	Adaptation Period: Establish routines and reduce resistance.	Joint mobility + dynamic stretching warm-up; 25-minute jog (heart rate 60%-65%); Jump rope during class breaks	Deep breaths to relax; Mindful breathing clears brain fog.
Weeks 3-4	Intensive Phase: Boost Cardio, Build Habits	Warm-up; 30-minute jog (heart rate 65%-75%); 30-second sprint training; Class jumps rope competition	Emotional recording and release; Teamwork and interest enhancement
Weeks 5-6	Consolidation Phase: Psychological Resilience, Social Reinforcement	Warm-up; 35-minute jog (heart rate 65%-80%); sprint runs; 30-kilometer team ride and writing assignment on weekends.	Light-tracking exercises enhance concentration; Memory training with resistance to distractions during exercise

4. Integration of cognition into strength and muscular endurance training

4.1. Design of cognition-integrated movement guidance

To ensure safety and effectiveness, strength training for adolescents under high academic pressure requires a thorough integration of cognitive strategies. Specifically, maximal strength testing (1RM) should be avoided, with a focus instead on mastering movement technique and developing overall body coordination to prevent injury and promote long-term progress. In training, mindfulness and

DOI: 10.54254/2753-8818/2025.LD27998

attentional exercises are deliberately incorporated to direct participants' awareness toward muscle activation, joint positioning, and breathing patterns. For instance, they may feel chest tension during the press and back stretch during the lowering phase, which enhances both movement quality and body awareness. Besides, participants are encouraged to silently or aloud repeat key points while performing movements. For example, during squats, cues like "chest up, hips back, knees aligned with toes" are emphasized to ensure proper form. In high-intensity sets, short, positive phrases like "keep going" or "I can do it" are used to enhance intrinsic motivation and support self-regulation. In addition, the subjective rating of perceived exertion (RPE 1-10) is used to help participants adjust training intensity according to bodily feedback, preventing the blind pursuit of heavier weights or higher repetitions and fostering sensitivity to physical cues [3]. Moreover, mental imagery training guides participants to imagine themselves performing movements smoothly and powerfully, while experiencing muscle contractions and a sense of accomplishment. This process is further reinforced via movement reflection using video review and coach feedback, promoting skill internalization and continuous improvement [17].

4.2. Psychological benefits of muscular endurance training

Training for strength and muscular endurance enhances adolescents' physical capabilities while also mitigating the negative impact of high academic stress through various psychological mechanisms [11]. Specifically, the completion of a set of challenging training exercises, such as lifting a certain weight or performing a specified number of squats, delivers an immediate sense of accomplishment and mastery. This enhances adolescents' self-efficacy and alleviates feelings of helplessness and anxiety from academic stress [3]. Additionally, regular strength training promotes the secretion of neurotransmitters like serotonin and dopamine, improving mood and reducing depression, anxiety, and irritability [12]. Simultaneously, high-intensity resistance exercise provides adolescents with an effective outlet for emotional release, relieving stress [3]. Progress in strength and endurance can be measured by lifting heavier dumbbells, completing more push-ups, or holding a plank for longer periods. These accomplishments bolster self-confidence and body awareness, providing positive reinforcement beyond academic performance [11]. Training is typically conducted in small groups or classroom settings, promoting peer interaction and support. Even simple actions such as eye contact, encouragement, or collaboration can strengthen a sense of belonging, reduce feelings of loneliness, and help build a social support network [11]. As training intensity gradually increases, adolescents continually push their limits, enduring muscle fatigue and discomfort while cultivating perseverance and delayed gratification. When confronting training challenges and slow progress, they learn to persist and adapt, which significantly enhances psychological resilience and stress tolerance and empowers them to confidently navigate academic and life pressures [7]. This shows that muscle strength and muscular endurance training fortify the body while tempering adolescents' psychology. Each weight lifted and each moment of perseverance becomes a crucial opportunity to rebuild courage and self-confidence.

4.3. Scientific program design for strength training

The strength training program aims to simultaneously improve adolescents' muscular strength and endurance while alleviating symptoms of anxiety and depression, fostering integrated development of physical and psychological capacities. For adolescents aged 15 to 18 experiencing high academic stress, the program spans 12 weeks, with two 45-minute physical education sessions per week. Each session includes warm-up, training, rest between sets, and cool-down stretching. Training intensity

DOI: 10.54254/2753-8818/2025.LD27998

is maintained at a moderate level (60%-75% 1RM), with progressive overload applied gradually while ensuring safety. Instructors provide both movement guidance and psychological support, and participants monitor their perceived exertion in real time using the Borg scale (levels 6-12). Based on this training arrangement, the course employs a combined resistance-aerobic circuit model to balance training effects and recovery. Specifically, resistance-focused sessions are held on Mondays to allow central nervous system (CNS) recovery (48-72 hours), while Thursday sessions integrate aerobic training to stimulate metabolism without causing excessive fatigue, as illustrated in Table 2.

Table 2. Dual-course weekly schedule framework

Session	Training Type	Exercise (30-35 min)	Psychology Intervention (10-15 min)	Physiological Goals	Psychological Goals
1 (Mon)	Resistance-Dominated	Multi-Joint Strength	Cognitive Tagging	Muscle Strength Increase (+15-20% max)	Boost Self-Efficacy
2 (Thu)	Aerobic-Integrated	Resistance-Aerobic Circuit	Emotional Dissociation	Muscular Endurance Enhancement (+10% lactate threshold)	Reframe Discomfort

To achieve phased objectives, the training cycle employs a three-stage model: the neuromuscular adaptation phase (weeks 1-3), the muscle hypertrophy phase (weeks 4-8), and the neural drive phase (weeks 9-12). This structure facilitates stepwise progression of physiological and psychological capacities. The detailed schedule is shown in Table 3. During the Neuromuscular Adaptation Phase, training focuses on establishing proper movement patterns and enhancing foundational endurance. Meanwhile, psychological interventions are adopted to boost safety awareness, stress management, and body awareness, providing a foundation for the subsequent training. The Muscle Hypertrophy Phase emphasizes accumulating muscle strength and endurance via compound equipment training and metabolic circuitry to intensify physical adaptation. And psychology interventions expand from tracking progress to peer witnessing, fostering resilience resources. The Neuro drive Phase centers on explosive power and group activities to enhance strength, mental toughness, and collaboration, supported by stress-control drills and celebratory gestures.

DOI: 10.54254/2753-8818/2025.LD27998

Table 3. 12-week progression schedule

Phase (Weeks)	Session	Training Content and Intensity	Psychological Intervention
Phase 1: Neuromuscular Adaptation (Weeks 1-3)	1	Bodyweight Basics: Squats / Push-ups / Plank Intensity: 50% 1RM or 12-15 reps to failure	Group Awareness + 4-7-8 Breathing Technique
	2	Low-Impact Aerobics Fusion: Resistance Band Rows + High-Knee March Intensity: 60%-70% of Heart Rate Reserve	Body Sensation Mapping of Heat & Energy
Phase 2: Muscle Hypertrophy (Weeks 4-8)	1	Machine Compound Training: Barbell Deadlift / Seated Chest Press Intensity: 65-70% of 1RM, 10 reps × 3 sets	Strength Log (Record Breakthrough Moments)
	2	Metabolic Circuit: Kettlebell Swings + Battle Ropes + Agility Ladder Intensity: Borg Scale 14-15 (Strenuous)	Companion Witness Circle
Phase 3: Neural Drive (Weeks 9-12)	1	Explosive Power Training: Box Jumps + Medicine Ball Rotational Throws Intensity: 75% 1RM, 5-8 reps × 4 sets	Stress Transformation Ritual (Healthy Stress Release)
	2	Competitive Challenge: Team Weight Carry / Resistance Parachute Sprint Intensity: 85% of Heart Rate Reserve	Victory emotions are released, gaining a sense of self-efficacy.

This intervention program precisely matches adolescents' developmental needs by establishing a triple-loop mechanism incorporating physiological stimulation, cognitive restructuring, and social reinforcement, transforming traditional physical education classes into effective interventions for promoting physical and psychological well-being. After 12 weeks, participants are projected to achieve significant physiological improvements, such as a 25% increase in bench press 1RM and a 40% rise in maximum push-up repetitions. Psychologically, anxiety and depression symptoms are anticipated to decrease markedly. Meanwhile, the program focuses on behavioral change, raising participants' willingness to engage in exercise to 3.2 times their initial baseline. In order to increase enjoyment and engagement, gamified elements are introduced, turning deadlifts into a "tire-flipping challenge" and squats into a "treasure chest digging" activity. Besides, immediate visual feedback, such as awarding "Strength Badge Stickers" and displaying them on the Milestone Wall, leverages dopamine-driven positive reinforcement to strengthen social motivation, creating a continuous and positive cycle of physical and mental development.

5. Conclusion

This study examined the multidimensional effects of exercise prescriptions integrating CBT on the physical and mental health of adolescents experiencing high academic stress. The comprehensive program combined aerobic endurance training with strength-endurance exercises, while embedding cognitive and behavioral modules such as mindful breathing, self-affirmation, emotional release, and social interaction. This approach enhances both physiological and psychological capacities. The results demonstrate that on the physiological level, continuous aerobic training effectively enhances VO_2max and heart rate recovery capacity, boosting cardiorespiratory fitness. Structured resistance training greatly improves muscle strength and muscular endurance while enhancing neuromuscular control and metabolic efficiency. Psychologically, cognitive fusion training reduces anxiety and depression by enhancing focus, challenging negative exercise thoughts, and providing immediate

DOI: 10.54254/2753-8818/2025.LD27998

feedback. It also enhances team spirit and social belonging while increasing intrinsic motivation and exercise adherence. In summary, the proposed "physiological-psychology" bidirectional interaction model offers a feasible and efficient pathway for promoting physical and mental health among adolescents experiencing high academic stress. It addresses the limitations of traditional purely physiological training while providing theoretical and practical foundations for school physical education curricula and extracurricular health interventions. Future research should use multicenter randomized controlled trials to confirm the model's generalizability and long-term benefits across cultures and types of adolescent stress.

References

[1] Mandolesi, L., Polverino, A., Montuori, S., et al. (2018). Effects of physical exercise on cognitive functioning and wellbeing: Biological and psychological benefits. Frontiers in Psychology, 9(9).
[2] Franklin, B. A., Rusia, A., Haskin-Popp, C., & Tawney, A. (2021). Chronic stress, exercise and cardiovascular disease: Placing the benefits and risks of physical activity into perspective. International Journal of Environmental Research and Public Health, 18(18), 9922. https: //doi.org/10.3390/ijerph18189922
[3] Marinelli, R., Parker, A. G., Levinger, I., et al. (2024). Resistance training and combined resistance and aerobic training as a treatment of depression and anxiety symptoms in young people: A systematic review and meta-analysis. Early Intervention in Psychiatry, 18(8). https: //doi.org/10.1111/eip.13528
[4] Nogg, K. A., Vaughn, A. A., Levy, S. S., et al. (2020). Motivation for physical activity among U.S. adolescents: A self-determination theory perspective. Annals of Behavioral Medicine, 55(2).
[5] Zhang, K., Liu, M., Yin, Z., et al. (2025). The effect of exercise motivation on adolescents' subjective well-being: Chain mediation of physical activity and social-emotional competency. BMC Public Health, 25(1).
[6] Morrison, J., Coulter, T.J., & Polman, R. (2024). The relationships between role strain, mental toughness and mental health amongst adolescent athletes. Advanced Exercise and Health Science, 1(1).
[7] Dziuba, A., Ennigkeit, F., Gerber, M., et al. (2025). The effect of stress, mental toughness, and their interaction on athletic and cognitive performance. Psychology of Sport and Exercise, 80, 102938.
[8] Griffin, É. W., Mullally, S., Foley, C., et al. (2011). Aerobic exercise improves hippocampal function and increases BDNF in the serum of young adult males. Physiology & Behavior, 104(5), 934-941.
[9] Shigeta, T. T., Leahy, A. A., Smith, J. J., et al. (2021). Cardiorespiratory and muscular fitness associations with older adolescent cognitive control. Journal of Sport and Health Science, 10(1), 82-90.
[10] Tomkinson, G. R., Kaster, T., Dooley, F. L., et al. (2020). Temporal trends in the standing broad jump performance of 10, 940, 801 children and adolescents between 1960 and 2017. Sports Medicine, 51(3), 531-548.
[11] Bermejo-Cantarero, A., Álvarez-Bueno, C., Martínez-Vizcaino, V., et al. (2021). Relationship between both cardiorespiratory and muscular fitness and health-related quality of life in children and adolescents: A systematic review and meta-analysis of observational studies. Health and Quality of Life Outcomes, 19(1).
[12] Hillman, C. H., Erickson, K. I., & Kramer, A. F. (2008). Be smart, exercise your heart: Exercise effects on brain and cognition. Nature Reviews Neuroscience, 9(1), 58-65. https: //doi.org/10.1038/nrn2298
[13] Lee, T.M.C., Wong, M.L., Lau, B. W.M., et al. (2014). Aerobic exercise interacts with neurotrophic factors to predict cognitive functioning in adolescents. Psychoneuroendocrinology, 39, 214-224.
[14] Sanaeifar, F., Pourranjbar, S., Pourranjbar, M., et al. (2024). Beneficial effects of physical exercise on cognitive-behavioral impairments and brain-derived neurotrophic factor alteration in the limbic system induced by neurodegeneration. Experimental Gerontology, 195(112539), 112539.
[15] Atakan, M. M., & Atakan, B. (2023). Acute Pilates and plyometric exercise in school-based settings improve attention and mathematics performance in high school students. Sports Medicine and Health Science.
[16] Guo, Z., Li, M., Cai, J., et al. (2023). Effect of high-intensity interval training vs. moderate-intensity continuous training on fat loss and cardiorespiratory fitness in the young and middle-aged: A systematic review and meta-analysis. International Journal of Environmental Research and Public Health, 20(6), 4741.
[17] Behrendt, F., Zumbrunnen, V., Brem, L., et al. (2021). Effect of motor imagery training on motor learning in children and adolescents: A systematic review and meta-analysis. International Journal of Environmental Research and Public Health, 18(18), 9467. https: //doi.org/10.3390/ijerph18189467