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THE IMPACT OF THE MAC AND SMARTACT TRAINING PROGRAM ON THE COGNITIVE, EMOTIONAL PROCESSES AND SOMATIC EFFECTS OF ATHLETES

ABSTRACT OF THE DOCTORAL THESIS

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- Barabási Madár Timea, Costea-Bărluţiu Carmen, Ordean Mircea Nicolae, Mancini Nicola, Grosu Vlad Teodor, Sabău Anca Maria, Popovici Cornelia, Carlos Hervás-Gómez, Grosu Emilia Florina and Monea Dan, 2025 Effects of the SmartACT Intervention on Motor and Psychological Variables in Adolescent Athletes: A Controlled Trial Using BlazePod and Microgate https://www.mdpi.com/3530338

- Barabási Madár Timea, Costea-Bărluţiu Carmen, Toma Vlad, Grosu Vlad Teodor, Monea Dan, 2025. Pilot Study Examining Mindfulness Intervention Effects on Perceived and Objective Stress in Adolescent Basketball Players https://gymnasium.ub.ro/journal/article/view/745

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Introduction

Research on cognitive, emotional and somatic processes in the field of sports psychology is very extensive and has approached the concept of anxiety, stress and performance from different perspectives. Considering that performance anxiety and stress in general are concepts, emotions, that are becoming increasingly common in the 21st century, an increasing number of athletes and coaches turn to sports psychologists to help them successfully comply with the demands and challenges of the environment. These professionals turn to psychologists to be helped to manage competitive stress and performance anxiety, to reduce the intensity and frequency of somatic symptoms, to improve their concentration and motivation, to develop self-confidence, to communicate better within the team, etc. During training and competitions, the body is "asked" to exceed its physical limits of endurance, power, speed and strength. Similarly, on the mental level, it is more than welcome to manage mental barriers, in order to maintain an adequate level of concentration, calm and determination. Without neglecting the importance of physical preparation and technical and tactical skills, the psychological factor plays a predominant role in winning a competition. The ability to concentrate before the competition, to manage stress as effectively as possible and to set realistic goals for implementation are an integral part of the athlete's behavior.

This doctoral thesis presents the benefits of two psychological intervention programs, MAC (Mindfulness-Acceptance-Commitment) and SmartACT (Smart Acceptance and Commitment Therapies) on the cognitive, emotional processes, somatic effects and performance of adolescent athletes. The MAC training program is a protocol developed by Gardner and Moore (2007) in which elements directed towards full awareness, acceptance and commitment are found. The SmartACT program is built on the principles of acceptance and commitment therapy, as well as mental imagery and elements of hypnotherapy.

The main objective of the thesis is to emphasize the importance of training programs on the well-being and the most efficient adaptation of adolescent athletes to competitive conditions. The aim is to manage mental barriers, maintain an adequate level of concentration, manage competitive stress and performance anxiety, reduce the intensity of somatic symptoms, respectively improve their performance.

Considering that adolescence is a period of emotional flows and stress, neuroplasticity is accentuated during this period, respectively the fact that athletes are subjected to tense situations generating anxiety, we propose to intervene by developing psychological flexibility with these psychological trainings during this period of development both for preventive purposes and to optimize performance.

Part I contains the theoretical and scientific foundation of the work, including relevant concepts such as stress among athletes, their emotional states, stress and anxiety management through mindfulness and hypnotherapeutic elements, sports performance, the role of attention, barriers to sports excellence and a detailed description of the MAC and SmartACT training programs.

Part II contains the original contributions of the research, based on empirical results supported by the literature in the field of sports psychology.

In the preliminary research - the pilot study - we examined the effects of the MAC protocol on 31 adolescent athletes, divided into a study group and a control group. Both the pre-test and the post-test consisted of examining salivary cortisol using the ELISA Human Cortisol (Saliva) kit, completing questionnaires on lifestyle and social relationships, a psychological flexibility questionnaire (MPFI - Multidimensional Psychological Flexibility Inventory), the Depression Anxiety and Stress Scale DASS-21, the Ghent Multidimensional Somatic Complaints Scale - GMSCS, the d2 attention test, and a physical agility and performance test. The results showed a reduction in the level of perceived stress, while the level of cortisol did not change significantly, which suggests that adolescents have difficulties in correctly identifying their stress levels, which may have an impact on their well-being and sports performance. At the end of the research, participants provided feedback questionnaires detailing the MAC training program and the exercises it contained. At the same time, based on the results obtained, we developed the SmartACT program, which is the training program tested in chapters 5, 6, and 7.

The first study in the main research tested the effects of the SmartACT intervention on motor and psychological variables in adolescent athletes, being a controlled study using BlazePod devices and Microgate equipment. Taking into account that agility and reaction speed are critical components of sports performance and are influenced by both physical condition and psychological elements, the SmartACT program, which integrates elements of mindfulness, acceptance, commitment, guided imagery and hypnotherapeutic elements, intervened in a sample of 193 athletes aged between 15-18 years. The participants were divided into 3 groups: SmartACT (69 athletes benefited from the hybrid program), MAC (65 athletes benefited from the program developed by Gardner and Moore, 2007) and Control (59 athletes benefited from the usual psychological treatment). Agility was measured using the T Drill agility test with time measurement by the Microgate equipment, reaction speed was measured by the Blazepod equipment, and psychological and somatic symptoms by the DASS-21 and GMSCS. The SmartACT group had improvements in agility, faster reaction times, a greater number of Blazepod hits, and significantly reduced psychological and somatic symptoms.

The second study investigated the impact of the SmartACT intervention on attention and psychological flexibility in adolescent student-athletes, the study being conducted with a similar composition of the groups, namely SmartACT, MAC and Control. Given that executive functions such as attention and processing speed are essential for sports performance, more specifically for quick reaction and decision-making in tense situations. The study was conducted on a sample of 309 adolescent athletes, aged between 15 and 18 years. The d2 attention test was used to examine attention and visual processing, and the AAQ-II (Acceptance and Action Questionnaire-II) questionnaire was used to determine the level of psychological flexibility. The SmartACT group showed improvements in both the number of items processed during the attention test and an increase in psychological flexibility.

The third study focused on investigating the role of variables such as coaching style, relationships with the coach and teammates, parental support, training frequency, duration of sports practice, and type of sport on the relationship between the type of intervention and changes between the two measurement times (pretest and posttest). To test the hypotheses, a general linear model with repeated measures was used, which allowed the examination of main effects and interactions between interventions, time, and contextual variables. The results indicate that, in general, the effectiveness of the SmartACT and MAC interventions is not significantly influenced by most of the variables investigated, suggesting a stability of their effects across different sports contexts. However, certain variables demonstrated a relevant moderating role: a coaching style oriented towards technical improvement is associated with more consistent improvements in reaction time, supporting the idea that a climate of continuous learning and development favors sports performance. Also, perceived parental support influenced the effectiveness of interventions on experiential avoidance, indicating the importance of a supportive family climate in the development of psychological flexibility. Regarding sports experience, the results suggest that the duration of sports practice can influence the effect of psychological interventions, especially regarding somatic symptoms, with more experienced athletes demonstrating a better capacity for emotional adaptation and regulation. In contrast, variables such as the type of sport, the relationship with the team or the frequency of training did not have a significant impact on the effectiveness of the interventions.

The results of this thesis particularly support the importance of integrated psychological training in youth sports and highlight the role of the training environment and the family environment in improving the psychological well-being and performance of adolescent athletes. Interventions based on mindfulness, acceptance and commitment, combined with guided imagery and hypnotherapy techniques can be considered valuable tools for supporting sports performance and psychological health in a competitive context. Therefore, we can further argue that collaboration between coaches, parents and sports psychology specialists can be an essential element for the optimal development of young athletes.

PART I. – THEORETICAL-SCIENTIFIC BASIS OF THE THESIS

SUMMARY OF CHAPTER 1. Introductory concepts

1.1.Stress among athletes

Stress is present in our daily lives and can be seen as a change that we need in order for our body to adapt. At the same time, researchers in the field confirm that if stress reaches high levels, it can have a harmful effect. (Davis, Eshelman & McLay, 2000). The results of Natsir, Dipoatmodjo, Arjang, Hidayat and Mustafa, (2021) confirm that stress affects the performance of athletes (Z. Li & S. Li, 2022; Barabási-Madár, Costea-Bărluţiu, Toma, Grosu & Monea, 2025; Diamond, 2013; Podlog, Dimmock & Miller, 2011; Johles et al., 2020).

″Stress is the nonspecific response of the organism to environmental demands.″ (Selye, 1975, page 25). Stress can be defined as a condition in which an individual perceives a discrepancy between the physical or psychological demands of a situation and his biological, psychological and social resources (Lazarus & Folkman, 1985; Lovallo, see Sarafino & Smith, 2011), or as a reaction to the environment in which there is either the threat of a loss of resources, the actual loss of resources, or a lack of gain from the investment of resources. (Hobfoll, 1989).

Neff and Germer (2018) argue that when the stress response (fight-flight-freeze) is triggered by a threat to our self-concept, we are likely to turn on ourselves with a negative trinity of reactions, namely: we fight with ourselves (self-criticism), we run away from others (isolation), or we freeze, we get stuck (rumination).

The development of a functional psychological attitude, along with the acquisition and consolidation of adaptive behaviors, supports the individual's ability to respond effectively to environmental demands and pressures. (Zelazo & Carlson, 2020; Hayes, 2019; Dehghani, Saf, Vosoughi, Tebbenouri & Zarnagh, 2018; Baer, 2018; Moran, 2004)

Elite athletes, in addition to academic stress (Shearer, Hunt, Chowdhury & Nicol, 2016) or created by the high context of psychological vulnerability (González-García, Álvarez, Pérez, Fernandez-Carriba & López, 2021), may present depressive, anxiety, and eating disorder symptoms at even higher levels than the general population, their mental health being influenced by both acute events (such as competitions) and demands, such as increased training volume. (Poucher, Tamminen, Sabiston, Cairney & Kerr, 2021).

Competitive anxiety can have facilitating or inhibiting effects, depending on how it is interpreted by the athlete. (Tenenbaum and Eklund, 2007)

Parents and coaches are key sources of influence in the learning process about and coping mechanisms. (Tamminen and Holt, 2012).

1.2. The influence of parents, coaches and teammates

Parents play a critical role, being the most important social influence in an athlete's life up to the age of 13 and a continuing influence throughout an athlete's career. (Wylleman & Rosier, 2016). Parental encouragement has been shown to be vital in establishing children's long-term involvement in youth sports activities (Vella et al., 2014; Knight, Berrow & Harwood, 2017), with perceptions of parental encouragement having a strong significant effect on intrinsic motivation. (Teques, Calmeiro, Rosado, Silva & Serpa, 2019).

Even though most successful athletes would typically be considered psychologically healthy, they may still experience a wide range of internal processes, such as competitive anxiety, negative emotions, fear of failure, and dysfunctional thinking that can negatively influence performance. (Birrer, Rothlin & Morgan, 2012). Gustafsson, Sagar and Stenling's (2017) findings show that fear of failure is linked to burnout and psychological distress in athletes. Harwood, Knight, Thrower and Berrow, (2019) support the idea that parental involvement increases the chances of children reaching their athletic potential (Parietti, 2015), having a positive psychosocial experience, and developing a range of positive developmental outcomes.

Coaching style has an effect on performance (Schwebel et al., 2016). The climate created by coaches and excessive orientation towards winning can contribute to the emergence of aggressive behaviors or increase psychological pressure on young athletes. (Hoffmann et al., 2022). Sport competitions, especially those that include elements of social evaluation, such as referees and the public, which can have threatening effects on the social self and performance, are associated with increased anxiety and emotional stress. (Mehrsafar et al., 2019).

Peers influenced motivation through competitive behaviors, collaborative behaviors, evaluative communications, and the nature of the social relationships developed between them. (Keegan, Spray, Harwood & Lavallee, 2010). According to studies by Vella et al. (2014), practicing team sports can facilitate the development of coping mechanisms (Murray, Sabiston, Doré, Bélanger & O'Loughlin, 2021), necessary to manage competitive pressure, and group dynamics can be a protective factor against psychological difficulties. (Hoffmann et al., 2022; Sabiston et al., 2016). These can contribute to reducing symptoms of anxiety and depression and improving psychosocial adaptation.

The model of motivational dynamics developed by Skinner and Pitzer was tested by Nicholls, Morley and Perry (2016) in a sports context and according to the results, we can say that peers influence levels of behavioral involvement, which, in turn, are related to adaptation and resilience.

1.3. General principles of stress and anxiety management

According to Gross et al. (2018), emotion regulation is the process by which, in order to respond appropriately to environmental demands, individuals modify their emotions, their responses to them, or intervene in situations that trigger emotions.

Maladaptive thought patterns may be associated with decreased athletic performance, while adaptive thinking styles are correlated with higher levels of performance (Fox, Kang, Lifshitz & Christoff, 2015; Zinsser et al., see Luiselli & Reed, 2011). Meditation and hypnosis facilitate the reduction of rigid associative chaining of thoughts and can diversify the content of the cognitive stream, favoring a more adaptive reporting of internal experiences. (Fox et al., 2015). Hypnotic interventions influence emotional regulation mechanisms by modifying automatic processing patterns and strengthening more adaptive responses to stressful experiences. The integration of suggestion-based language with neurobiological processes supports sustainable cognitive and affective transformations among individuals. (Menon & Bhagat, 2025).

Mindfulness

In psychology literature, mindfulness is the form of awareness that is open, curious, accepting, friendly, non-judgmental, and carried out with compassion and goodwill (Baer, 2018).

Based on the results of a meta-analysis (Gu et al.; Velden et al., see Baer, 2018), it was found that the MBSR (Mindfulness-Based Stress Reduction) and MBCT (Mindfulness-Based Cognitive Therapy) programs significantly increase mindfulness, and these increases were significantly associated with improvements in mental health.

The use of mindfulness-based interventions can be beneficial in reducing stress-related thoughts, reducing injuries, improving overall well-being (Petterson & Olson, 2017), and significant improvements in sustained and selective attention (Kittler, Arnold & Jekauc, 2022).

Mindfulness-based programs could represent a suitable strategy for optimizing performance and improving the flow experience (Shortway, Wolanin, Block-Lerner & Marks, 2018).

Psychological flexibility among athletes

Based on a recent meta-analysis (Levin et al., see Blackledge, 2018), we can say that defusion methods have a positive effect on both problematic thoughts and distress levels. (Khazraee, Bakhtiari, Kianimoghadam & Hajmanouchehri 2023; Blackledge, 2018; García et al., 2004). Mindfulness-based interventions have had a positive effect on reducing negative thoughts and perceived stress. (García et al., 2004). Petterson and Olson (2017) found a reduction in injuries after integrating a mindfulness-based intervention into a sports population. (Shortway et al., 2018)

In performance sports, the ability to accept physical discomfort and psychological pressure favors the maintenance of goal-oriented behavioral direction (Khazraee et al., 2023; García et al., 2004).

Participants in MAC training programs demonstrated a reduction in generalized anxiety as well as increased psychological flexibility from post-intervention to one-month follow-up. The results of Gross et al. (2018) suggest that MAC is an effective intervention for the mental health and performance needs of female athletes.

Athletes participating in MAC training sessions are taught to manage their challenging internal experiences in a non-judgmental way (Khazraee et al., 2023), choosing to persist in the task at hand despite discomfort and remaining focused and grounded in the present moment (Yau, Ping & Kuan, 2021; Johles et al., 2020).

Key components of acceptance and commitment-based interventions include anchoring in the present moment, accepting the multitude of thoughts and emotions that arise without necessarily acting on them, and clarifying personal values, along with a commitment to act according to these values, all of which are relevant to optimizing performance in sports (Johles et al., 2020; García et al., 2004; Fox et al., 2015), as well as in the recovery process after injury (Shortway et al., 2018).

Impact of mindfulness-based training on cortisol levels among athletes

Regarding neuroendocrine responses to stress, reflection on personal values can maintain low cortisol levels (Creswell et al., 2005; Brown, Weinstein & Creswell, 2012; Gregg, Namekata, Louie & Chancellor, 2014), and mindfulness-based interventions may be associated with reduced physiological and psychological stress responses in competition. (Mehrsafar et al., 2019) At the same time, increased cortisol levels are frequently correlated with higher levels of anxiety. (Lader, 1983).

The role of sports hypnosis

Clinical hypnosis is increasingly recognized as an intervention designed to stimulate neuroplasticity. This phenomenon, described by Kandel (2005), shows that by practicing new behaviors, physical changes occur in the brain due to an increase in the number of synapses.

Whether used to overcome a mental block, build a clearer focus for mental imagery, or increase self-confidence, hypnosis has been used for over a century as a tool to optimize the mental processes involved in sports performance among both athletes and coaches. (Khazraee et al., 2023; Valentine, Milling, Clark & Moriarty, 2019; Straub & Bowman, 2016; Milling & Randazzo, 2016; García et al., 2004).

Hypnosis is a communication technique using hypnotic (Z. Li & S. Li, 2022) and post-hypnotic (García et al., 2004) suggestions and can be seen as an altered state of awareness (Dafinoiu & Vargha, 2003), in which a person's attention is detached from their immediate environment and is absorbed by inner experiences, such as emotions, cognition, reliving, projection and imagery. (Heap, 2012).

From a sports perspective, according to Straub and Bowman (2016) clinical sports hypnosis helps athletes overcome a variety of somatic symptoms and psychological problems and is widely used in sports competitions (Khazraee et al., 2023; Valentine et al., 2019; Milling & Randazzo, 2016; Barker & Jones, 2006).

In the meta-analysis conducted by Wark (2008), the beneficial effects of clinical hypnosis in depression, pain (Khazraee et al., 2023), anxiety alleviation were revealed. (Valentine et al., 2019; Williamson, 2019; Márquez-Gurrola et al., 2023; Hunter, 1994). Hypnosis has been shown to be effective for improving performance in a variety of sports for improving basketball, golf, soccer and badminton skills. (Milling & Randazzo, 2016). Hypnosis appears to restructure cognitive processes that are essential for athletic performance, peak performance (Unestahl, 2018), including self-confidence (Hunter, 1994), attention and memory (Z. Li & S. Li, 2022; Barker & Jones, 2006). In a recent meta-analysis by Valentine et al. (2019), hypnosis was more effective in reducing anxiety when combined with other psychological interventions than when used as a stand-alone treatment (Fox et al., 2015).

The role of attention in sports performance

Perceptual-cognitive expertise in interactive sports involves the ability to quickly analyze the competitive environment, select relevant information, and integrate this data into efficient motor decisions (Brinkbäumer, Kupper, Reichert & Zentgraf, 2024; Shimi, Tsestou, Hadjiaros, Neokleous & Avraamides, 2021; Fleddermann et al., 2019; Moreau & Conway, 2013).

1.5. Description of the MAC intervention for athletes - Program structure MAC

- **Module 1:** Psychoeducation
- **Module 2:** Mindfulness training and cognitive defusion
- **Module 3:** Value identification and value-driven behavior
- **Module 4:** Cognitive and emotional acceptance
- **Module 5:** Enhancing commitment
- **Module 6:** Skill consolidation and poise
- **Module 7:** Maintaining and enhancing mindfulness, acceptance, and commitment (Gardner & Moore, 2007).

1.6. Description of the SmartACT intervention for athletes - Program structure SmartACT

- **Module 1:** Psychoeducation
- **Module 2:** Cognitive defusion and acceptance - the "passengers on the bus" metaphor (adapted from O'Donoghue, Morris, Oliver & Johns, 2018) (Annex 6) (Hayes, 2025; Harris, 2022)
- **Module 3:** Personal values - the "Eye of the Hurricane" meditation (adapted from Harris, 2022) (Annex 7); awareness of strengths and vulnerabilities. The "Time Bank" exercise is used (Annex 8)
- **Module 4:** Dealing with difficult thoughts and emotions - the "Leaves on the Pond" meditation (adapted from Hunter, 1994) (Annex 9), the "Three Boxes" exercise (adapted from Vargha, Szabó, Batiz & Kiss, 2020; Dafinoiu & Vargha, 2003; Hunter, 1994)
- **Module 5:** Training attention and reconnecting with the present moment - the "5 - 4 - 3 - 2 - 1" meditation (adapted from Gardner & Moore, 2007) (Annex 11) and the "5 - 4 - 3 - 2 - 1 Start! Control the moment" meditation (Annex 12)
- **Module 6:** Awareness of obstacles, identification of internal and external resources - the "Treasure Chest" exercise (adapted from Vargha et al., 2020) (Annex 13)

- **Module 7:** Consolidation of developed skills - guided meditation performed against the background of the hymn "You'll Never Walk Alone" (adapted from Vargha et al., 2020) (Annex 14).

1.7. Components of the participant warm-up

Participants in the SmartACT, MAC and control groups completed a standardized 10-minute warm-up period before taking the tests (Paşcan, 2008; Szabó & Vasile, 2007), both at the time of the initial testing and at the posttest stage. In the preliminary study, this stage preceded the T-Test agility tests and the Smart Basketball shooting test. Later, in the main study, the warm-up was performed before the TDrill Test agility test and the interactive exercises performed using the Blazepod device.

SUMMARY OF CHAPTER 2. Research design

2.1. General objectives

The general objective of the research is, according to theoretical models and empirical data from contemporary psychology, to facilitate the development of psychological flexibility in athletes, defined as the ability to experience difficult thoughts and emotions, while maintaining orientation towards personal values and commitment to the proposed sporting activity. The fundamental processes of a conscious presence, openness to internal experiences and orientation towards value-guided actions are integrated into the intervention program, along with complementary techniques, such as guided imagery and elements of clinical and sports hypnosis.

2.3. The instruments used in the MAC and SMARTACT study

- ***Questionnaire on demographic characteristics, training and lifestyle:*** (Annex 15, 16, 17)
- ***Questionnaire on expectations and feedback in the case of the study group, participating in the preliminary research*** (Annex 5)
- ***Multidimensional flexibility questionnaire - Multidimensional Psychological Flexibility Inventory (MPFI)*** (Annex 15) (Rolffs, Rogge & Wilson, 2016)
- ***AAQII Acceptance and Commitment Questionnaire*** (Annex 16, 17) (Bond et al., 2011; Szabo, Vargha, Balazsi, Bartalus & Bogdan, 2011).
- ***DASS21 - Depression, Anxiety and Stress Scale-21*** (Annex 16, 17) (Henry & Crawford, 2005)
- ***Ghent Multidimensional Somatic Complaints Scale (GMSCS).*** (Annex 16, 17) (Beirens & Fontaine, 2010)
- ***Attention Test d2*** (Annex 18) (Dobrean, 2010)
- ***Blazepod Devices***
- ***T-Drill Test***
- ***MicroGate System***
- ***Smart Siq Basketball***
- ***Cortisol Measurement Blisters: Human Cortisol (Saliva) ELISA Kit, detection range: 1 - 100 ng/mL96 well plate***

PART II – ORIGINAL RESEARCH CONTRIBUTION

SUMMARY OF CHAPTER 3. Preliminary research on the impact of the Mindfulness-Acceptance-Commitment program on the cognitive, emotional processes and somatic effects of athletes – MAC study[1]

3.1. Introduction

. Considering the results presented in the literature, we can say that improving psychological flexibility and the ability to defuse problematic thoughts is associated with reducing emotional distress (Khazraee et al., 2023; Blackledge, 2018; Gross et al., 2018; French et al., 2017; García et al., 2004), reducing cognitive rigidity (Johles et al., 2020; Fox et al., 2015), reducing injuries (Shortway et al., 2018), maintaining attention in the present, even in conditions of discomfort (Khazraee et al., 2023; Yau et al., 2021; Johles et al., 2020), including reducing cortisol levels and psychological reactivity in competitions (Mehrsafar et al., 2019; Gregg et al., 2014; Brown et al., 2012; Creswell et al., 2005).

At the physiological level, interventions based on mindfulness and reflection on personal values are associated with regulating the stress response, given that chronic stress is correlated with anxiety and depression (Z. Li & S. Li, 2022; Lader, 1983). In this sense, excessive self-criticism represents a factor of psychological vulnerability (Khazraee et al., 2023; Neff & Germer, 2018).

In sports performance, the rapid processing of relevant information and its integration to make relevant decisions in the game is of particular importance. (Brinkbäumer et al., 2024; Shimi et al., 2021). Performance in dynamic contexts depends on the efficiency of selective, sustained and divided attention (Tenenbaum & Eklund, 2007; Moran, 2004;), being influenced by factors such as fatigue, anxiety and motivation (Reigal et al., 2019; Heppe et al., 2016).

[1] This subchapter includes content partially published in the Gymnasium magazine. Barabási Madár, T. , Costea-Bărlutiu, C., Vlad, T., Grosu, V. T. & Monea, D.(2025) Pilot Study Examining Mindfulness Intervention Effects on Perceived and Objective Stress in Adolescent Basketball Players https://gymnasium.ub.ro/journal/article/view/745

3.2. Participants

The preliminary study involved 31 basketball players, distributed as follows: the study group included 17 athletes (N=17), and the control group was composed of 14 athletes (N=14). The age of the participants ranged from 14 to 15 years, with a mean age of 14.76 years (SD = .437).

3.3. Objectives

The theoretical objective is to explore the relationship between mindfulness, ACT-based intervention on the one hand and sports performance, reduction of somatic symptoms, anxiety and stress management on the other.

The methodological objective is to confirm the internal consistency of the versions for the Romanian sports population of the questionnaires and scales used, as well as the applicability and effectiveness of the adapted version of the MAC program.

The practical objective aims to reduce the vulnerability to anxiety and stress of athletes, improve divided attention, reduce cortisol levels and improve sports performance. At the same time, by providing feedback to the participants in the preliminary study, a clearer vision is gained on the exercises that are relevant, on those that are not to their liking and that are not helpful to them, respectively which dimensions require improvement or modification.

3.4. Hypotheses

1. The MAC (Mindfulness - Acceptance - Commitment) training program, based on full awareness, acceptance and commitment, positively influences the cognitive, emotional processes and somatic effects of adolescent athletes.
2. The decrease in stress and anxiety levels, as well as the improvement of focused attention, are related to the increase in the participants' level of mindfulness and psychological flexibility.

3.5. MAC study design and steps

The Mindfulness Acceptance Commitment program, developed by Gardner and Moore (2007), was implemented and applied to the study group during 7 weekly modules.

The participants in the program and the members of the control group completed the tests and questionnaires both at the pretest and at the posttest. (Annex 15) They were subjected to the physical test called T Drill test and 3-2-1 shooting with a Smart Basketball Siq, approved by FIBA (International Basketball Federation). During the pretest and posttest, saliva was collected from the athletes to determine the level of salivary cortisol, which was subsequently processed with the Human Cortisol (Saliva) ELISA kit.

3.7. Presentation, analysis and interpretation of the initial results obtained in the pilot study

After entering the results of the study and control group questionnaires, they were evaluated and processed. The results were presented, the relevant items were illustrated and the results were explained.

The data of the study and control group were processed with the SPSS 22 program.

Correlations between variables

The ability to concentrate is closely related to global performance (NT-E) and cortisol levels, which means that higher levels of the stress hormone are associated with increased levels of attention. The scores obtained on the Acceptance and Action Questionnaire AAQ-II are related to the execution times of the agility test Ttest and with the anxiety and stress subscale of the DASS-21 and with the GMSCS total frequency subscale, which means that psychological inflexibility is correlated with high levels of anxiety and stress, respectively with a higher frequency of somatic symptoms. The anxiety and stress subscales are closely related to the frequency of somatic symptoms measured by the GMSCS scale. The flexibility subscale is closely related to the agility and change of direction Ttest. (table 14)

Comparison of pre- and posttest measurements of the study group

- in terms of the percentage of relative errors, in the case of the study group, they decreased significantly ($p = .005$).
- a significant increase in the average global performance (NT-E) of the athletes was found between the pre-test and post-test assessments ($p = .000$).
- the concentration capacity of the participants, which is necessary for athletes because it allows them to direct their attention to specific tasks during training and competitions, increased significantly ($p = .000$).

Comparison of pre- and posttest measurements of the control group

- on the Anxiety subscale of the DASS-21, the increase in vulnerability to anxiety increased significantly ($p = .015$)
- the difference is significant in the case of the analysis of the cold-hot/frequency subscale in the case of the control group, which increased significantly ($p = .032$)
- in the case of the heart-chest subscale, which gathers somatic symptoms in this area, in the case of the control group there is a significant increase (frequency: $p = .036$; intensity: $p = .047$)
- in the case of the control group, comparing the pre- and posttest means, the somatic symptoms in the head and shoulders area increased significantly ($p = .037$).

Comparison of differences between the measurement data of the study and control groups

The comparative analysis between the experimental group and the control group was performed using the independent samples test, evaluating the difference between the means of the two groups at the posttest.

- in the study group, the execution time was reduced, while in the control group an increase in execution time was recorded ($p = .000$)
- significant differences in the Acceptance subscale within the MPFI, in the case of the control group it decreased significantly ($p = .007$), the Present moment subscale decreased ($p = .014$), the flexibility subscale decreased in the case of the control group ($p = .034$)

3.8. Discussion

Following the analysis of the correlations between the measured and relevant variables, we can say the following: the ability to concentrate is closely correlated with the average global performance (NT-E) and with the cortisol level. Psychological inflexibility shows a significant relationship with the performance on the T-test, as well as with the anxiety and stress subscales of the DASS-21 and with the general frequency subscale of the GMSCS. The anxiety and stress subscales are strongly correlated with the frequency of somatic symptoms measured by the GMSCS scale. The psychological flexibility subscale has a close relationship with the results on the T-test, which assesses agility and the ability to change direction.

The percentage of relative errors (E%) in the study group decreased significantly, and the average global performance (NT-E) of the athletes increased significantly between the pre-test and post-test assessments. Also, the ability to concentrate, essential for making quick and effective decisions during the game, was considerably improved.

The pretest was conducted at a time when the subjects of both groups were in a period of low anxiety and stress, not stressed by school or sports competitions. On the occasion of the posttest, which took place during the competition and busy time at school, in the case of the study group, the stress and anxiety scores decreased insignificantly, while the posttest scores obtained by the participants in the study group increased significantly in terms of anxiety. In addition, the number of physical symptoms and their intensity decreased significantly more in the intervention group than in the control group. (Hazlett-Stevens, 2018; Kahrizi et al., 2017)

Salivary cortisol concentration increased in both the control and study groups, an increase that is consistent with the results of D. Cabarkapa, Eserhaut, D. V. Cabarkapa, Philipp and Fry (2023) and Madrigal and Wilson (2017), according to which total competitive anxiety was positively correlated with pre-competition cortisol levels (D. Cabarkapa et al., 2023; de Arruda, Aoki, Paludo, Drago & Moreira 2018). According to the results obtained by Robazza et al. (2012), pre-competition cortisol levels in basketball players may have a perceived functional effect on future performance.

Regarding somatic symptoms, they increased in both groups, with a significant increase only in the control group in the subscales related to somatic symptoms in the cold-warm area, heart-chest in terms of their frequency, heart-chest and head-shoulders in terms of intensity.

The results of the comparative analysis between the experimental group and the control group, which assesses whether the differences between the two samples are likely to have arisen as a result of the MAC intervention, show that the performance improved in terms of the speed of direction change and agility of the participants in the study group, respectively the level of full awareness increased (Würtzen et al., 2015), especially in the acceptance, conscious presence and flexibility subscales.

Regarding one of the measurements, namely the free throw test, there was an increase in misses during the post-test, and we can say that these are consistent with the results of Wolch, Arthur-Cameselle, Keeler and Suprak (2021), who highlighted that the mindfulness-based intervention did not have a statistically significant effect on the athletes performance, but a significant reduction in the level of anxiety was observed among the study group (Shaabani, Naderi, Borella & Calmeiro, 2020), suggesting that mindfulness training has a positive influence on the mental state of athletes under pressure.

3.9. Conclusions and future directions

- the MAC training program had a positive influence on most of the measured cognitive processes and had a moderate influence on the level of stress, anxiety and somatic symptoms of basketball players.
- the data provided through feedback (Annex 5) from the participants in the preliminary study allowed us to outline the areas that require adjustments, thus contributing to the review and refinement of the intervention in the form of the SmartACT program, with the aim of more effectively supporting both sports performance and psychological well-being.

The SmartACT program integrates specific Acceptance and Commitment Therapy (ACT) exercises, such as present-moment anchoring, cognitive defusion exercises, personal values clarification, contextual self, and commitment to directed action. These components are empirically supported for their effectiveness in improving psychological flexibility and reducing symptoms of anxiety, stress, and mental exhaustion among athletes (Noetel et al., 2019; Myall et al., 2023). In addition, the integration of guided imagery and hypnosis exercises has been associated with better emotional self-regulation and increased focus in competitive contexts (Morris et al., 2005; Wolch et al., 2021; Henriksen, Hansen & Larsen, 2019).

SUMMARY OF CHAPTER 4. Effects of the SmartACT Intervention on Motor and Psychological Variables in Adolescent Athletes: A Controlled Trial Using BlazePod and Microgate[2]

4.1. Introduction

Agility is a complex skill that integrates coordination, speed, and rapid decision-making, along with perceptual-cognitive processes such as visual scanning and anticipation; it is an essential determinant of performance in open-skill team sports, where athletes must respond to unpredictable stimuli (Sheppard & Young, 2006; Mancini et al., 2024; Zemkovà, Vilman, Kovácíková & Hamar, 2013; Trajković et al., 2020; Young & Farrow, 2013; Chow et al., 2022; Young & Farrow, 2006; Sporiš et al., 2011; Wang et al., 2024; Delextrat et al., 2015; Yilmaz, 2014).

Reaction time (RT) is not only an indicator of performance potential, but is closely correlated with reactive agility outcomes and decision speed in ecologically valid tasks (Mancini et al., 2024; Zemkovà et al., 2013; Trajković et al., 2020; Young & Farrow, 2013; Paul et al., 2016). Given this connection, the present study treats reaction time as an essential motor outcome alongside agility, as both reflect the integration of perceptual, cognitive and motor processes that our intervention aims to influence.

Beyond motor performance, adolescent participation in sports is associated with psychological benefits, including increased self-esteem and reduced depressive and anxiety symptoms, while stress and anxiety can contribute to the emergence of somatic symptoms (fatigue, pain, gastrointestinal discomfort), which can interfere with training and competition (Sabiston et al., 2016; Eime et al., 2013; Panza et al., 2020; He et al., 2018; Murray et al., 2021; Ashdown-Franks et al., 2017; Merikangas et al., 2009; Serido et al., 2004; Kovács & Borcsa, 2017; Demuthova, 2019; Vulić-Prtorić, 2016; Gallant, 1998; Barroso & Thiele, 2011; Roșioară et al., 2025; Diduch, 2017; de Oliveira et al., 2014; Waterman & Kapur, 2012; Wright et al., 2009; Wilson, 2020; Poucher et al., 2021).

Mindfulness- and acceptance-based approaches, guided imagery, and hypnosis have been associated with reducing psychosomatic symptoms and improving performance under pressure

[2] The content of this subchapter represents the entire manuscript published in the journal Children. Barabási Madár, T. , Costea-Bărlutiu, C. 2, Ordean, M.N., Mancini, N., Grosu, V. T. , Sabău, A. M., Popovici, C., Hervás-Gómez, C., Grosu, E. F. & Monea, D.(2025) Effects of the SmartACT Intervention on Motor and Psychological Variables in Adolescent Athletes: A Controlled Trial Using BlazePod and Microgate. *Children (Basel, Switzerland)*, *12*(10), 1338. https://doi.org/10.3390/children12101338

(Budgett, 1998; Hasyim, 2023; Rosendahl, Alldredge & Haddenhorst, 2024; Z. Li & S. Li, 2022; Di Corrado, Guarnera, Vitali, Quartiroli & Coco, 2019; Khoury, Sharma, Rush & Fournier, 2015; Shearer et al., 2016; Pates & Palmi, 2002; Milling & Randazzo, 2016; Straub & Bowman, 2016; Lindsay, Maynard & Thomas, 2005; Pates & Maynard, 2000; Mattle, Birrer & Elfering; 2020; Hamid, Abdoli & Shahroie, 2018; Sahabuddin, Sofyan & Fadillah, 2025; Barker, Jones & Greenlees, 2013; Noetel et al., 2019; Gonzáles-García et al., 2021; Johles et al., 2020; Petterson & Olson, 2017; Tang, Hölzel & Posner, 2015). However, the SmartACT protocol, which integrates mindfulness, acceptance, commitment, guided imagery, and hypnosis, has not been systematically tested among adolescent athletes for simultaneous motor and psychological outcomes, leaving a relevant gap in the literature.

4.2. Objectives and hypotheses

This study aims to evaluate the effects of a 7-week SmartACT intervention on motor performance (agility, reaction time) and psychological well-being (anxiety, depression, somatic symptoms) in adolescent athletes. Based on the existing literature, we hypothesize that SmartACT will produce more consistent improvements than the MAC and control conditions for all measured variables.

4.3. Materials and methods

This study followed a quasi-experimental, controlled, repeated-measures design, including pretest and posttest assessments over a seven-week period. A total of 193 student athletes (age 15–18 years, M = 16.34; SD = 0.64) were recruited from sports-oriented high schools in Transylvania (Romania) and from educational centers in Hungary (Table 30). Participants were assigned to three groups (SmartACT, MAC, Control) using cluster allocation at the school or training group level, not by individual randomization, which justifies the quasi-experimental design.

Table 30 presents the characteristics of the participants at baseline, in terms of the type of sport practiced, sports experience expressed in years, frequency of weekly training, their involvement in other sports, and type of diet.

Table 30.

Participant characteristics at baseline (N = 193)

Characteristic	**Category**	***N* (%)**
Age (years), mean ± SD	-	16.34 ± 0.64
Primary sport	Volleyball 46 (23.9%); Basketball 45 (23.4%); Football 42 (21.8%); Handball 20 (10.2%); Athletics 13 (6.6%); Wrestling 12 (6.1%); Others ≤ 2% each	
Sports experience	>4 years 107 (55.3%); 3-4 years 26 (13.7%); 1-2 years 44 (22.8%); 1 year 16 (8.1%)	
Training frequency	≥5x/week 105 (54.3%); 4x/week 43 (22.3%); 2-3x/week 43 (22.3%); 1x/week 2 (1.0%)	
Additional sports	Yes 66 (34.0%); No 127 (66.0%)	
Diet patters	Balanced 89 (46.0%); High-protein 58 (29.9%); Carbohydrate-dominant 28 (14.7%); Sugar-rich 6 (3.3%); Not reported 12 (6.2%)	

Note. *N* = number of participants, % = percentage, SD = standard deviation

Participants took part in an assessment that addressed both motor and psychological components. From a motor perspective, agility was tested using the T-Drill agility test with the Microgate electronic timing system, and reaction speed was assessed using BlazePod devices, which involve rapid responses to visual stimuli.

From a psychological perspective, participants completed two validated instruments: the Depression, Anxiety, and Stress Scale (DASS-21) (Henry & Crawford, 2005) and the Ghent Multidimensional Somatic Symptom Scale (GMSCS) (Beirens & Fontaine, 2010).

Prior to testing, all participants performed a standardized 10-minute warm-up under supervision, including dynamic stretching, joint rotations, and functional exercises designed to activate major muscle groups (Aguilar et al., 2012).

Of the 193 athletes initially enrolled in the study, completion rates varied across outcome measures due to occasional absenteeism or missing data. A total of 168 participants completed the T-Drill agility test, 185 completed the BlazePod tests, and all 193 completed the DASS-21 and GMSCS questionnaires (Table 31). No adverse events or withdrawals related to the intervention were reported.

Participants were divided into three experimental groups: SmartACT (N = 69; 35.8%) – the SmartACT program, MAC (N = 65; 33.7%) – the MAC program (Gardner and Moore, 2007), and control group (N = 59; 30.6%) – usual training.

4.4. Results

Correlation analysis between motor variables, perception of somatic symptoms and indicators of psychological distress

Table 32 presents significant correlations between motor performance (T-Drill agility, number of BlazePod touches and reaction time) and scores obtained on the DASS-21 and GMSCS, which assess psychological distress and psychosomatic symptoms.

T-Drill agility times were negatively correlated with number of BlazePod touches ($r = -0.400$, $p < 0.01$), indicating a moderate to strong association, according to which better agility (shorter time) was associated with more efficient visual-motor responses. Number of BlazePod touches and Reaction Time were strongly and inversely correlated ($r = -0.894$, $p < 0.01$), confirming that increased reactivity corresponds to shorter response times. T-Drill agility times were also positively correlated with several GMSCS subscales, particularly fatigue ($r = 0.283$, $p < 0.01$), hot-cold sensations ($r = 0.223$, $p < 0.01$), and abdominal symptoms ($r = 0.313$, $p < 0.01$), suggesting that lower agility is associated with greater perceived somatic discomfort. Significant positive correlations were also observed between DASS-21 scores and T-Drill agility times (range $r = 0.307$-0.391, $p < 0.01$), indicating that higher levels of emotional distress are associated with poorer agility. BlazePod touch count showed weak but significant negative correlations with DASS-21 subscales (Depression $r = -0.172$, $p < 0.05$), suggesting that better reaction performance is associated with lower emotional distress.

In contrast, Reaction Time was positively correlated with DASS-21 total score ($r = 0.203$, $p < 0.01$) and GMSCS total score ($r = 0.118$, $p < 0.01$), indicating that slower responses are associated with more pronounced psychological and somatic symptoms.

Analysis of pre-posttest differences in the SmartACT group for motor variables (T-Drill agility, BlazePod touches, and reaction time)

Paired-samples t-tests were used to assess within-group changes for agility (T-Drill), number of BlazePod touches, and reaction time in the SmartACT group. The results are presented in Table 33 and highlight significant pre-post improvements for all motor outcomes.

- T-Drill agility improved significantly from pretest (M = 11.80 s) to posttest (M = 10.78 s), MD = -1.07 s, t (68) = 10.29, p < 0.001, with a large effect size (d = 2.50, 95% CI (1.79-3.35).
- BlazePod touch count increased from 16.34 to 19.01, MD = +2.53, t(68) = -5.90, p < 0.001, also with a large effect size (d = 1.43, 95% CI (0.87-2.07).
- BlazePod reaction time decreased from 3770.84 ms to 3108.10 ms, MD = -643.75 ms, t (68) = 3.52, p < 0.001, with a large effect size (d = 0.85, 95% CI (0.35-1.41).

These results confirm that SmartACT produced strong and practically relevant improvements in both agility and visual-motor reactivity.

Table 33.

Significant pretest–posttest differences in the SmartACT group for the analyzed motor variables (T-Drill agility, BlazePod Hits, BlazePod Reaction Time).

Variable	Time	M	MD	T (df)	p	Cohen's d [95% CI]
T-Drill agilitate (s)	Pretest	11.80	-1.07	10.29(68)	<0.001	2.50 [1.79, 3.35]
	Posttest	10.78				
BlazePod Hits	Pretest	16.34	+2.53	-5.90(68)	<0.001	1.43 [0.87, 2.07]
	Posttest	19.01				
BlazePod Reaction Time (ms)	Pretest	3770.84	-643.75	3.52(68)	<0.001	0.85 [0.35, 1.41]
	Posttest	3108.10				

Note. MD = mean difference; t = t statistic; p = probability value; d = Cohen's d; CI = confidence interval

Motor agility - T-Drill

T-Drill agility times in the SmartACT group improved significantly from pretest (M = 11.80 s) to posttest (M = 10.78 s), with a mean difference of -1.07 s, t(68) = 10.29, p < 0.001. This change corresponds to a large effect size (d = 2.50, 95% CI (1.79-3.35), confirming the strong impact of the intervention on agility. The MAC and Control groups showed minimal or no changes.

Visual response – BlazePod Hits

The number of BlazePod hits increased significantly in the SmartACT group from 16.34 to 19.01 (MD = +2.53, t(68) = -5.90, p < 0.001). This improvement reflects a large effect size (d = 1.43, 95% CI (0.87-2.07), indicating substantial gains in visual reactivity. No comparable improvements were observed in the MAC or Control groups.

Reaction Time - BlazePod Reaction Time (RT)

Reaction time decreased significantly in the SmartACT group from 3770.84 ms to 3108.10 ms (MD = -643.75 ms, $t(68) = 3.52$, $p < 0.001$). This corresponds to a large effect size ($d = 0.85$, 95% CI (0.35-1.41), demonstrating faster psychomotor responses after the intervention. No relevant changes occurred in the MAC or Control groups.

Repeated measures ANOVA: pretest-posttest evolution in the three groups for motor variables and psychological indicators

To investigate the differential effects of the interventions in more detail, repeated measures ANOVA analyses were performed for each outcome, followed by Tukey post hoc tests where appropriate. The results are presented below for motor variables (T-Drill agility, BlazePod touches, reaction time) and psychological indicators (DASS-21, GMSCS).

Group Comparison on the T-Drill Agility Test

A repeated-measures ANOVA was performed on the T-Drill agility scores (n = 168) to assess changes in agility over time and between groups, followed by post hoc Tukey comparisons.

The results revealed a significant main effect of time, $F(1,165) = 13.14$, $p < 0.001$, and a significant time x group interaction, $F(2,165) = 20.29$, $p < 0.001$, indicating that agility improvements varied between groups.

Tukey's post hoc test (Table 34) showed that the SmartACT group performed significantly better than the MAC group (MD = -1.11, $p < 0.001$, $\eta 2p = 0.19$, 95% CI (0.09-0.29) and than the Control group (MD = -1.07, $p < 0.001$, $\eta 2p = 0.18$, 95% CI (0.08-0.28). No significant difference was observed between the MAC and Control groups (MD = 0.04, $p = 0.987$, $\eta 2p = 0.00$).

Table 34.

Results of the Tukey post hoc test for comparing T-Drill Agility scores (sec) between groups

Compare groups	MD	SE	p	$\eta^2 p$ (95% CI)
SmartACT vs MAC	-1.11	0.226	0.000	0.19 [0.09-0.29]
SmartACT vs Control	-1.07	0.232	0.000	0.18 [0.08-0.28]
MAC vs Control	0.04	0.246	0.987	0.00 [0.00-0.04]

Note. MD = mean difference; SE = standard error; p = probability value; $\eta^2 p$ = partial eta squared; CI = confidence interval.

Group comparison of DASS-21 total score

DASS-21 and GMSCS data were collected from all 193 participants at both pretest and posttest. Tukey post hoc analysis (Table 35) showed that DASS-21 scores at posttest were significantly lower in the SmartACT group compared to both the MAC group (MD = -6.43, p =

0.002, η2p = 0.11, 95% CI (0.03-0.21) and the Control group (MD = -4.87, p = 0.029, η2p = 0.07, 95% CI (0.01-0.16).

No significant difference was observed between the MAC and Control groups (p = 0.697, η2p = 0.01).

Table 35.

Results of the Tukey post hoc test for comparing DASS-21 Total between groups

Compare groups	MD	SE	p	η^2p (95% CI)
SmartACT vs MAC	-6.43	1.844	0.002	0.11 [0.03-0.21]
SmartACT vs Control	-4.87	1.891	0.029	0.07 [0.01-0.16]
MAC vs Control	1.56	1.918	0.697	0.01 [0.00-0.06]

Note. MD = mean difference; SE = standard error; p = probability value; η^2p = partial eta squared; CI = confidence interval.

Group Comparison Regarding GMSCS Total

Somatic symptoms (GMSCS Total) decreased significantly in the SmartACT group (from 38.91 to 30.54), with smaller reductions in the MAC group (49.69 to 45.00) and negligible changes in the Control group (42.85 to 40.98).

Tukey's post hoc test (Table 36) revealed significant differences between groups. Specifically, SmartACT demonstrated greater effectiveness than MAC (MD = -12.62, p < 0.001, η2p = 0.15, 95% CI (0.07-0.25) in reducing somatic symptoms. The difference between SmartACT and Control was also significant (MD = -7.19, p = 0.050, η2p = 0.08, 95% CI (0.01-0.17), suggesting a relevant benefit compared to no intervention.

Table 36.

Results of the Tukey post hoc test for comparing GMSCS Total scores between groups

Compare groups	MD	SE	p	η^2p (95% CI)
SmartACT vs MAC	-12.62	2.968	0.000	0.15 [0.07-0.25]
SmartACT vs Control	-7.19	3.045	0.050	0.08 [0.01-0.17]
MAC vs Control	5.43	3.088	0.186	0.03 [0.00-0.09]

Note. MD = mean difference; SE = standard error; p = probability value; η^2p = partial eta squared; CI = confidence interval.

In contrast, no significant differences were identified between the MAC and Control groups (p = 0.186, η2p= 0.03), indicating that the MAC intervention did not have a substantial impact on somatic symptoms in this context.

GMSCS scores decreased significantly over time, suggesting an overall improvement in somatic symptomatology among participants. Group 1 (SmartACT) presented significantly fewer symptoms compared to Group 2 (MAC) and marginally fewer than Group 3 (Control), as also highlighted in Figure 42.

Group Comparison on the GMSCS Subscale—Fatigue

Fatigue subscale scores decreased significantly over time in all groups ($p < 0.001$), but post hoc analysis revealed that SmartACT produced significantly greater reductions than the other conditions. The mean difference between SmartACT and MAC was -4.88 ($p < 0.001$), and between SmartACT and Control was -2.91 ($p = 0.014$), confirming the superior effectiveness of SmartACT (Table 37).

No significant differences were observed between MAC and Control ($p = 0.143$).

Table 37.

Results of the Tukey post hoc test for comparing GMSCS fatigue scores between groups

Compare groups	MD	SE	p	η^2p (95% CI)
SmartACT vs MAC	-4.88	.998	0.000	0.17 [0.08-0.27]
SmartACT vs Control	-2.91	1.024	0.014	0.09 [0.01-0.18]
MAC vs Control	1.97	1.038	0.143	0.04 [0.00-0.11]

Note. MD = mean difference; SE = standard error; p = probability value; η^2p = partial eta squared; CI = confidence interval.

Group comparison regarding GMSCS Stomach/Abdominal symptoms

Tukey's post hoc test revealed a significant difference between SmartACT and MAC (MD = -1.84, $p = 0.014$), indicating fewer gastric/abdominal symptoms in the SmartACT group. The comparison between SmartACT and Control did not reach statistical significance ($p = 0.272$), and no difference was identified between MAC and Control ($p = 0.449$) (Table 38).

Table 38.

Results of the Tukey post hoc test for comparing GMSCS Stomach/Abdominal scores between groups

Compare groups	MD	SE	p	η^2p (95% CI)
SmartACT vs MAC	-1.84	0.647	0.014	0.08 [0.01-0.17]
SmartACT vs Control	-1.03	0.664	0.272	0.03 [0.00-0.09]
MAC vs Control	0.81	0.673	0.449	0.02 [0.00-0.07]

Note. MD = mean difference; SE = standard error; p = probability value; η^2p = partial eta squared; CI = confidence interval.

Group comparison regarding GMSCS Head/Shoulder symptoms

Tukey's post hoc test (Table 39) revealed a statistically significant difference between SmartACT and MAC (MD = -2.36, $p < 0.001$, η2p = 0.13, 95% CI (0.05-0.23), indicating that participants in the SmartACT group reported fewer symptoms experienced in the head and shoulders. The differences between SmartACT and Control were not significant (MD = -1.02, p = 0.194, η2p = 0.04), as were the differences between MAC and Control (MD = 1.34, p = 0.067, η2p = 0.05).

These results confirm that SmartACT was significantly more effective than MAC in reducing head and shoulder pain.

Table 39.

Results of the Tukey post hoc test for comparing GMSCS Head/Shoulders scores between groups

Compare groups	MD	SE	p	η^2p (95% CI)
SmartACT vs MAC	-2.36	0.574	0.000	0.13 [0.05-0.23]
SmartACT vs Control	-1.02	0.588	0.194	0.04 [0.00-0.11]
MAC vs Control	1.34	0.597	0.067	0.05 [0.00-0.12]

Note. MD = mean difference; SE = standard error; p = probability value; η^2p = partial eta squared; CI = confidence interval.

Group comparison regarding GMSCS Warm-Cold Symptoms

All three groups experienced decreases in scores between pretest and posttest, suggesting an overall reduction in hot-cold somatic symptoms, but the differences between groups were not statistically significant.

The most pronounced reduction was observed in the SmartACT group, where the score decreased from approximately 7.7 to 6.0. This indicates a clear effect of the intervention in this group, contributing to the reduction of perceived thermal discomfort at the body level. The MAC and Control groups experienced smaller decreases of approximately one point.

Group comparison regarding GMSCS Heart/Chest symptoms

Although the SmartACT group showed the greatest reductions in cardiac/thoracic subscale scores, the differences between groups were not statistically significant. This suggests a general trend of improvement across groups, with no evidence of a specific intervention effect.

4.5. Discussion

The present results indicate that psychological well-being and somatic symptomatology are closely related to motor performance among adolescent athletes. SmartACT produced significant improvements in agility and visual-motor reactivity, evidenced by shorter T-Drill times and better BlazePod performance along with greater reductions in DASS-21 and GMSCS scores compared to both the MAC and Control conditions.

These results are consistent with contemporary models that conceptualize agility as primarily reactive, with changes in direction being triggered by sport-specific stimuli and limited by perceptual-cognitive demands (Sheppard & Young, 2006; Mancini et al., 2024; Zemoková et al., 2013; Trajković et al., 2020; Young & Farrow, 2013; 2006; Sporiš et al., 2011; Wang et al., 2024; Delextrat et al., 2015; Yilmaz, 2014; Paul et al., 2016). Faster responses to external cues are a characteristic of higher competitive levels in open-skill sports, and measures that capture stimulus-response speed are considered useful for talent identification and training monitoring (Mancini et al., 2024; Zemoková et al., 2013; Trajković et al., 2020; Young & Farrow, 2013; Paul et al., 2016; Hoffman, 2020). The improvements observed in the BlazePod indices fit within this theoretical framework, providing experimental evidence that targeted psychological interventions can translate into more effective reactive behaviors on the field.

A plausible mechanism for SmartACT's superiority over MAC is its hybrid structure, which combines ACT processes with guided imagery and hypnosis. Previous research shows that these techniques can enhance attentional focus, emotional regulation, and self-efficacy, and facilitate access to optimal performance states, such as relaxation and flow (Hasyim, 2023; Rosendahl et al., 2024; Z. Li & S. Li, 2022; Di Corrado et al., 2019; Pates & Palmi, 2002; Milling & Randazzo, 2016; Straub & Bowman, 2016; Noetel et al., 2019; González-García et al., 2021; Johles et al., 2020; Petterson & Olson, 2017; Tang et al., 2015; Gardner & Moore, 2007). Imagery and hypnosis have also been associated with improvements in technical execution and competitive accuracy in several sports, including cycling, shooting, golf, soccer, basketball, and volleyball (Milling & Randazzo, 2016; Pates & Maynard, 2000; Mattle et al., 2020; Hamid et al., 2018; Sahabuddin et al., 2025; Barker et al., 2013; Miró et al., 2025).

The reductions in GMSCS scores observed in this study are consistent with evidence that mindfulness/ACT and imagery-based methods can diminish psychophysiological stress responses and improve interoceptive awareness, thereby reducing the perceived importance of somatic symptoms (Rosendahl et al., 2024; Noetel et al., 2019; González-García et al., 2021; Johles et al., 2020; Petterson & Olson, 2017; Tang et al., 2015; Volgemute, Vazne & Malinauskas, 2025; Gutman & Gottlieb, 2024).

In contrast, the smaller changes observed in the MAC group may reflect issues related to the intervention interval and age-appropriateness. A seven-week period may not be sufficient for adolescents to consolidate their mindfulness and acceptance skills, which often require longer-term daily practice to produce robust transfer to performance contexts (Noetel et al., 2019; Gardner & Moore, 2007). In addition, adolescents may be more engaged in techniques perceived as directly integrated into sport (imagery, hypnosis, performance routines) than in introspective exercises, which may lead to higher motivation and adherence to SmartACT (Noetel et al., 2019; Johles et al., 2020; Petterson & Olson, 2017).

These issues, together with the current data, support the utility of hybrid, performance-oriented mental training for young athletes.

Practical implications

From an applied perspective, these results support the integration of brief, structured mental training alongside routine physical training in youth sport. Micro-sessions delivered by psychologist-trainers, combining ACT-compatible skills with sport-specific imagery, concise hypnosis scripts, and competitive routines, may help athletes translate psychological regulation into faster and more effective responses in open-ended skill contexts, i.e., improvements in T-Drill agility and stimulus-response speed, consistent with agility and perceptual-cognitive models (Forster et al., 2023; Paul et al., 2016) and device-based reactive training (Mancini et al., 2024; Hoffman, 2020).

Evidence that ACT/mindfulness improves stress regulation (Noetel et al., 2019; González-García et al., 2021; Johles et al., 2020; Petterson & Olson, 2017; Tang et al., 2015), and that imagery and hypnosis can increase focus, flow, self-efficacy, and performance in various sports provides an explanation for this hybrid approach among adolescents (Pates & Palmi, 2002; Milling & Randazzo, 2016; Straub & Bowman, 2016; Mattle et al., 2020; Barker et al., 2013; Miró et al., 2025).

For implementation, sessions can be integrated twice a week, for approximately 10–15 minutes, during warm-up or recovery after exercise, over a period of 7 weeks, using simple scripts aligned with technical objectives (e.g., cue-based focusing, brief imagery of sport-specific decision points, and brief relaxation/hypnosis inductions appropriate for minors and delivered or supervised by trained personnel) (Pates & Palmi, 2002; Milling & Randazzo, 2016; Straub & Bowman, 2016; Mattle et al., 2020; Barker et al., 2013¸ Noetel et al., 2019; González-García et al., 2021; Johles et al., 2020; Petterson & Olson, 2017; Tang et al., 2015; Miró et al., 2025).

Programs should be integrated with existing monitoring of loading and recovery to address perceived fatigue and somatic symptoms, domains associated with performance and injury risk, using easy-to-administer instruments (DASS-21, GMSCS) alongside standard fatigue monitoring methods (Robson-Ansley et al., 2009; Halson, 2014; Thorpe et al., 2017; Almonroeder et al., 2020; Radin, 1986; Sikora et al., 2024; Migliaccio, Russo, Maric & Padulo, 2023).

Field-applicable tests, already used in this study (T-Drill, BlazePod "Color Catch"), can be used in motor monitoring to ensure that psychological skills training remains performance-integrated and ecologically valid (Mancini et al., 2024; Paul et al., 2016; Pauole et al., 2000; Hoffman, 2020).

Limitations and Future Directions

Several limitations must be acknowledged. The lack of randomization limits internal validity, and although baseline equivalence between groups was partially ensured, unmeasured confounders may have influenced the results. In addition, the absence of long-term follow-up prevents conclusions about the durability of effects, and the use of self-report for psychological variables introduces potential response bias.

Future research should prioritize randomized controlled designs, include objective physiological markers (HRV, cortisol), and integrate follow-up assessments to examine the maintenance of changes over time. It would also be useful to group participants by sport type (team vs. individual sports; endurance vs. power-based sports) to reflect differences in cognitive-motor and emotional demands, as well as test dose-response relationships to identify the minimum amount of intervention needed to achieve a measurable benefit in adolescent athletes.

4.6. Conclusions

Agility and visual reaction time are critical components of athletic performance in disciplines with variable playing environments that require rapid responses to unpredictable stimuli. In this controlled study, the SmartACT program produced greater improvements in T-Drill agility and BlazePod performance compared to both the MAC and Control groups, along with significant reductions in DASS-21 and GMSCS scores. Regarding somatic symptoms, all groups showed improvements over time, but the reductions were consistently greatest in the SmartACT group, indicating added value over usual practice and over an approach based exclusively on mindfulness, acceptance, and commitment.

Although the quasi-experimental design and lack of follow-up limit conclusions regarding causal relationships and durability of effects, the magnitude and consistency of the results support the utility of SmartACT used as a complementary intervention to usual training. Future studies should test SmartACT in randomized designs, include longer follow-up periods, and analyze differential responses by sport type and competitive level.

SUMMARY OF CHAPTER 5. The Impact of an Integrated ACT-Based Psychological Intervention (SmartACT) on Attention and Psychological Flexibility in Adolescent Student-Athletes[3]

5.1. Introduction

Cognitive functions such as attention, working memory, and processing speed play a central role in athletic performance, particularly in disciplines that require rapid adaptation and decision-making under pressure (Kiely, 2014; Best, 2010; Furley & Wood, 2016). Sports research has highlighted the contribution of executive functions, including inhibition, cognitive flexibility, and information updating, to athletes' ability to perform effectively in unpredictable and high-pressure environments (Vestberg, Reinebo, Maurex, Ingvar & Petrovic, 2017; Vaughan & Laborde, 2021).

Different components of attention support athletic performance (Johnson & Zatorre, 2006; Funayama, 2024; Ginstfeldt & Emanuelson, 2010). In sports characterized by intense dynamics, such as basketball and football, executive control is essential for filtering information and inhibiting inappropriate responses under competitive pressure (Barabási-Madár et al., 2025; Mancini et al., 2024; Moroşanu et al., 2024; Diamond, 2013). In sports contexts with high visual demands, the d2 focused attention test is frequently used to assess concentration performance, processing speed, and response stability (Vater, Kredel & Hossner, 2017; Taylor, Wright, Dischiavi, Townsend & Marmon, 2017; Millard, Breukelman, Mathe, I. Shaw & B.S. Shaw, 2022; Brickenkamp & Zillmer, 1998).

In addition to conventional cognitive training techniques, such as computer programs (Walton et al., 2018) and perceptual-cognitive training (Walton et al., 2018; Renshaw et al., 2019), clinical psychology interventions based on acceptance and mindfulness have also been integrated into sports practice (Noetel et al., 2019). Although a review by Noetel et al. (2019) indicates promising benefits on performance, the results remain inconsistent and are often limited by methodological issues. With the aim of improving self-regulation and attentional control, mindfulness has become increasingly popular. It may improve performance through mechanisms

[3] The content of this subchapter represents the entire manuscript published in Applied Sciences Journal: Barabási, T.M.; Costea-Bărlutiu, C.; Ordean, M.-N.; Mancini, N.; Popovici, C.; Grosu, V.T.; Zadic, A.; Pop, R.-M.; Cristea, D.I.; Grosu, E.F.; et al. The Impact of an Integrated ACT-Based Psychological Intervention (SmartACT) on Attention and Psychological Flexibility in Adolescent Student-Athletes. *Appl. Sci.* **2026**, *16*, 825, https://doi.org/10.3390/app16020825.

such as more effective emotional regulation, cognitive flexibility, and mindfulness (Birrer et al., 2012; Barabási-Madár et al., 2025). However, it remains debated whether these methods primarily help athletes use existing cognitive skills more effectively or whether they directly improve executive functions. In sports, hypnosis and guided imagery have also been used to improve attentional and motor performance, reduce anxiety, and increase self-confidence (Barabási-Madár et al., 2025; Milling & Randazzo, 2016; Barker & Jones, 2006). These benefits have also been documented in basketball and soccer (Valentine et al., 2019; García et al., 2004). According to a comparative study, no significant differences were observed between hypnosis and acceptance and commitment therapy in terms of improving physical strength in elite canoeists (Shimi et al., 2021).

Mindfulness, ACT, and hypnosis are frequently used in sports to regulate attention, emotions, and cognitive processes (Barabási-Madár et al., 2025; Shimi et al., 2021; Ibanez et al., 2009; Gutiérrez-Hernández et al., 2021). However, it is unclear whether these techniques directly modify executive functions or simply help athletes use existing capacities more effectively (Shimi et al., 2021). This discrepancy between mechanisms and interventions is rarely addressed. The MAC protocol (Figure 43) is well-established and promotes mindfulness, emotional regulation, and psychological flexibility (Noetel et al., 2019; Birrer et al., 2012), while hypnosis and imagery offer complementary methods for influencing cognitive-motor performance (Milling & Randazzo, 2016; Valentine et al., 2019; Straub & Bowman, 2016; Gutman & Gottlieb, 2024). However, these strategies are frequently used without adequate consideration of moderating characteristics such as sport type, skill level, or age, factors that may influence their effectiveness (Straub & Bowan, 2016; Kabat-Zinn, 2003; Baer, 2018; Bishop et al., 2004; Kittler et al., 2022; Shortway et al., 2018).

Objective and Hypotheses

The objective of this study was to compare the effects of the SmartACT intervention with those of a standardized MAC protocol and a control condition on attentional performance and psychological flexibility in adolescent student-athletes.

Based on previous evidence indicating that multimodal psychological interventions can improve self-regulation and attention processes, and considering the quasi-experimental design, conducted in a school setting, as an applied investigation and not as a definitive causal test, we formulated the following hypotheses:

1. Participants in the SmartACT group will show more significant improvements in processing speed on the d2 test compared to the MAC and control groups;

2. Participants in the SmartACT group will show more pronounced decreases in experiential avoidance (AAQ-II scores) compared to both comparison groups.

5.2. Materials and methods

Participant characteristics

A total of 309 adolescent student-athletes (age range 15–18 years; M = 16.34, SD = 0.64) were recruited from educational institutions in Hungary, as well as from high schools in the Transylvania region of Romania, which had intensive sports programs and a sports profile. The sample included 118 female participants (38.2%) and 191 male participants (61.8%), reflecting the gender distribution of the investigated group. As shown in Table 40, the entire sample of N = 309 athletes was divided into three groups: SmartACT (N = 93), MAC (N = 109), and control group (N = 107). Due to missing data, the analyzed samples were smaller in number, although initially the 309 student-athletes were assigned to the three study conditions. Only participants who completed both the pretest and posttest were included in the analysis of the d2 test, resulting in a sample of 197 individuals. (Annex 16, 17, 18). Similarly, 194 participants who provided complete data at both measurement times formed the basis of the AAQ-II analysis.

Table 41.

Demographic and sport characteristics

Characteristics	Category	%
Sport discipline	Volleyball	19.3%
	Basketball	22.9%
	Football	20.7%
	Handball	10.4%
	Wrestling	8.2%
	Swimming, gymnastics, triathlon, rowing, skiing, tennis	<2% each
Hours of sleep	>8 h	14.2%
	6-8 h	69.9%
	<6 h	16.0%
Daily meal frequency	3 meals/day	62.4%
	4-5 meals/day	26.2%
	>5 meals/day	5.0%
	1 meal/day	6.4%
Daily time spent on smartphones	>4 h/day	45.0%
	3-4 h/day	31.2%
	2-3 h/day	17.7%
	1-2 h/day	5.0%
	<1 h/day	1.1%

Mixed-design ANOVA was considered appropriate for the study objectives because it allowed direct assessment of Time x Group interaction effects across all conditions.

Study Design

Convenience sampling was used in a quasi-experimental pretest-posttest design with a control group. Three groups of participants were assigned: a control group, a Mindfulness-Acceptance-Commitment (MAC) group, and a Smart Acceptance and Commitment Therapy (SmartACT) group. Assessments were conducted before and after the intervention, which lasted a total of seven weeks. The seven-week duration of the intervention was determined by the constraints of the school schedule and the structure of the academic calendar, and is also consistent with previous studies on psychological interventions implemented in the school environment, which highlighted measurable cognitive and psychological changes in the short term, in similar time intervals.

Intervention groups

Smart Acceptance and Commitment Therapy (SmartACT) group: structured psychological intervention lasting 7 weeks, which included acceptance and commitment techniques, hypnosis, and guided imagery.

Mindfulness, Acceptance, and Commitment (MAC) group: a standardized protocol developed by Gardner and Moore (2007)

Control group: usual academic and sports program and received standard support from the school psychologist ("usual intervention").

Applied tests and statistical analysis

G*Power 3.1 software (Heinrich Heine University Düsseldorf, Düsseldorf, Germany) was used for an a priori power analysis (Faul et al., 2007), based on the planned sample size, indicating that the study had sufficient statistical power (power = 0.95) to detect Group x Time interaction effects in the mixed ANOVA design. Equivalence of baseline values was checked before analysis, and pre-post changes within groups were analyzed descriptively to complement the interpretation based on interaction effects.

The d2 Attention Test and the Acceptance and Action Questionnaire-II (AAQ-II) were applied at pre- and posttest.

Statistical Analysis

IBM SPSS Statistics version 25 (Armonk, NY, USA) was used in all analyses.

A mixed-design, repeated-measures ANOVA was applied for each outcome variable, with time (pretest, posttest) as a within-subjects factor and group (SmartACT, MAC, Control) as a between-subjects factor, using type III sums of squares. The main inferential evidence for intervention effects was assessed by the Time x Group interaction. When interactions were significant, simple effects were examined using pairwise comparisons with Bonferroni adjustment. In addition, baseline-adjusted ANCOVAs were performed as sensitivity analyses to statistically control for possible pretest differences, using posttest scores as dependent variables, group as a fixed factor, and corresponding pretest scores as covariates, with Bonferroni-adjusted pairwise comparisons of estimated marginal means.

Effect sizes are reported as partial eta squared (ηp^2); For pre-post changes within groups, Cohen's d coefficient and 95% confidence intervals were calculated using IBM SPSS Statistics version 25 (Armonk, NY, USA). The threshold for statistical significance was set at $p < 0.05$.

5.3.Results

Attention Test d2

Differences between groups at baseline were analyzed before the main analysis, using a one-way ANOVA at pretest. For the main variable d2 (total number of items processed, NT), significant differences between groups were observed at baseline, $F(2. 194) = 21.63$, $p < 0.001$, ɲp2 = 0.182. Specifically, the MAC group had higher baseline NT values (M = 553.16) compared to both the SmartACT group (M = 457.83) and the control group (M = 513.40). Given the quasi-experimental design and the existence of baseline differences, baseline-adjusted analyses were performed as a robustness check (see ANCOVA results below). To statistically control for baseline differences, an ANCOVA was performed, using NT at posttest as the dependent variable, Group as the fixed factor, and NT at pretest as the covariate. The adjusted effect of Group was statistically significant, $F(2.193) = 17.16$, $p < 0.001$, ɲp2 = 0.151. Bonferroni-adjusted pairwise comparisons of estimated marginal means showed significantly higher NT values at posttest in the SmartACT group compared to the MAC group (adjusted mean difference = 59.70, $p < 0.001$) and the control group (adjusted mean difference = 50.37, $p < 0.001$), while no significant differences emerged between the MAC group and the control group (adjusted mean difference = -9.33, $p = 1.000$).

The mean values of the total number of items processed (NT) in the d2 test, measured at pretest and posttest, highlight notable differences between the three groups: SmartACT, MAC and Control.

The SmartACT group recorded a substantial increase, from 457.83 to 600.24, indicating a significant improvement in processing speed and selective attention over time. The MAC group recorded a more modest increase, from 553.16 to 586.70, indicating moderate progress. In the control group, the increase from 513.40 to 576.78 can be partially attributed to the effect of familiarization with the task, given the absence of a specific psychological intervention.

Table 42 provides a detailed presentation of the pre-posttest differences for the SmartACT group, highlighting in particular the changes in the NT score on the d2 test during the intervention period. At the pretest, participants presented a mean score of 457.83 (SD = 82.01), which increased substantially to 600.24 (SD = 57.22) at the posttest. The mean difference of -142.41 (SD = 68.76) reflects a strong improvement in attentional performance (higher scores indicating better performance).

Table 42.

Pre-post differences for the SmartACT (d2 Test)

Variable	Time	M	SD	MD	MD SD	t (df)	p	Cohen's d
d2-NT	Pretest	457.83	82.01	-	-	-	-	-
d2-NT	Posttest	600.24	57.22	-142.41	68.76	−16.83 (65)	<0.001	2.014

The paired-samples t-test indicated a highly significant difference, $t(65) = -16.83$, $p < 0.001$, indicating that this improvement is statistically robust and unlikely to be due to chance. Cohen's d =2.014 indicates a very large effect size, suggesting that the intervention had a strong impact on the increase in attentional capacity, as measured by the d2 attention test. This paired-samples t-test represents an exploratory within-group analysis and should be interpreted in the context of the overall Time x Group interaction observed in the mixed ANOVA.

Bonferroni-corrected post hoc pairwise comparisons were performed on d2-NT change scores (posttest - pretest) to further analyze the significant Time x Group interaction (Table 43). The SmartACT group showed significantly greater improvement than both the MAC group (MD = 108.87 items, $p < 0.001$) and the control group (MD = 79.03 items, $p < 0.001$). The MAC and Control groups did not differ significantly after Bonferroni correction (MD = -29.85 items, $p = 0.061$).

These results indicate that the magnitude of improvement over time differed between groups, with the most pronounced change observed in the SmartACT group.

Table 43.

Bonferroni-corrected post hoc pairwise comparisons between groups regarding the rate of processed items (d2 test)

Compare groups	MD	SE	p
1 vs. 2	108.87 [73.86; 143.89]	14.57	<0.001
1 vs. 3	79.03 [42.21; 115.86]	15.31	<0.001
2 vs. 3	−29.85 [−66.05; 6.35]	15.07	0.061

Psychological Flexibility (AAQ-II Results)

The SmartACT group showed an increase in psychological flexibility, reflected by a decrease in experiential avoidance scores from pretest to posttest, from a mean of 18.48 to 12.80. The MAC group showed a slight decrease between the two measurement times (from 20.65 to 20.12), while the control group showed a small reduction, with scores from 20.08 to 18.37.

Baseline comparisons revealed no statistically significant differences between groups in AAQ-II scores.

In the mixed-design, repeated-measures ANOVA for the AAQ-II, the Time × Group interaction was statistically significant, $F(2, 191) = 7.71$, $p = 0.00054$, $\eta p^2 = 0.076$, indicating that changes over time differed between groups. A significant main effect of Time also emerged, $F(1, 191) = 12.28$, $p = 0.00059$, $\eta p^2 = 0.157$, while the main effect of Group was not statistically significant, $F(2, 191) = 2.34$, $p = 0.099$, $\eta p^2 = 0.024$. Therefore, post hoc comparisons between groups are interpreted in the context of the significant Time × Group interaction and the analyses adjusted for baseline.

As a sensitivity analysis, a baseline-adjusted ANCOVA was conducted for the AAQ-II, using posttest scores as the dependent variable, Group as the fixed factor, and pretest AAQ-II scores as the covariate. These baseline-adjusted results indicate that the differences observed between groups at posttest are consistent with different trajectories of change over time, and do not reflect static differences between groups, independent of the intervention. The adjusted effect of the Group factor was statistically significant, $F(2, 190) = 14.28$, $p < 0.001$, $\eta p^2 = 0.131$. Pairwise comparisons of estimated marginal means, adjusted by Bonferroni correction, revealed significantly lower AAQ-II scores at posttest (indicating a higher level of psychological flexibility) in the SmartACT group compared to both the MAC group (adjusted mean difference = -6.07, $p < 0.001$) and the control group (adjusted mean difference = -4.65, $p = 0.00056$). In contrast, there was no statistically significant difference between the MAC and control groups (adjusted mean difference = 1.42, $p = 0.748$).

Table 44 details the pre-posttest differences for the SmartACT group, highlighting the changes in AAQ-II scores over the intervention period. At baseline (pretest), the mean score was 18.48 (SD = 9.17), decreasing to 12.80 (SD = 6.41) at posttest. The mean difference of 5.68 points (SD = 8.25) indicates a significant reduction in experiential avoidance (i.e., psychological inflexibility) over time.

The results of the dependent samples t-test were statistically significant, $t(68) = 5.72$, $p < 0.001$, suggesting that the change observed between pretest and posttest is unlikely to be attributable to chance. Cohen's $d = 0.72$ indicates a large effect size, suggesting that the intervention generated a substantial and clinically relevant improvement in AAQ-II scores.

Table 44.

Pre-post differences for the SmartACT group (AAQ-II)

Variable	Time	M	SD	MD	MD SD	t (df)	p	Cohen's d
AAQ-II	Pretest	18.48	9.17	-	-	-	-	-
AAQ-II	Posttest	12.80	6.41	5.68	8.25	5.72 (68)	<0.001	0.72

Post hoc comparisons, adjusted by Bonferroni correction, applied to AAQ-II change scores (posttest - pretest) indicated that the SmartACT group experienced a significantly greater reduction in AAQ-II scores (i.e., a greater increase in psychological flexibility) compared to both the MAC group (p = 0.004) and the control group (p = 0.016).

There were no statistically significant differences between the MAC and control groups (p = 1.000) (Table 45). These results are consistent with the ANCOVA analysis adjusted for baseline values, which also confirmed significantly lower adjusted AAQ-II scores at posttest in the SmartACT group compared to both comparison groups.

Table 45.

Bonferroni-corrected post hoc pairwise comparisons between groups for AAQ-II change scores (posttest − pretest)

Compare groups	MD [CI]	SE	p
1 vs. 2	-5.15 [-8.67; -1.62]	1.46	0.004
1 vs. 3	-3.97 [-7.57; -0.37]	1.49	0.016
2 vs. 3	1.17 [-2.60; 4.94]	1.57	1.0

5.4. Discussion

The results obtained indicate that improvements in attentional performance and psychological flexibility over time were more pronounced in the SmartACT group, however, given the quasi-experimental design of the research, these associations should be interpreted with caution. The SmartACT group recorded the most consistent progress on the d2 test, although all groups showed improvements, possibly explained by a practice effect. Regarding psychological flexibility, assessed by the AAQ-II, only participants in the SmartACT group showed an improvement, while the MAC and control groups did not record significant changes. These findings suggest that the SmartACT intervention may contribute to optimizing psychological adaptability and cognitive functioning at a developmental stage characterized by a high level of plasticity.

The improvements observed on the d2 test are consistent with the hypothesis that suggestion- and imagery-based components contribute to strengthening attentional control and optimizing processing speed (Barabási-Madár et al., 2025; Barabási-Madár et al., 2023; Gutman & Gottlieb, 2024; Johles et al., 2020). In line with previous research indicating that hypnosis and imagery can facilitate increased flexibility, ACT-specific processes such as acceptance, value clarification, and cognitive defusion may have contributed to enhancing psychological flexibility and reducing ruminative tendencies (Khazraee et al., 2023; Khazraee et al., 2023; Fox et al., 2015; Menon & Bhagat, 2025). Also, the components oriented towards strengthening the ego and activating internal resources probably favored the development of coping strategies and increased self-efficacy, generating a broader and more integrative regulatory effect than interventions based exclusively on ACT.

5.5. Conclusions

According to the study results, SmartACT, a program that integrates ACT-based strategies with hypnosis and guided imagery techniques, was associated with greater short-term improvements in attentional performance and psychological flexibility, although not all post hoc comparisons between groups reached statistical significance. These findings suggest that SmartACT may activate a broader set of psychological mechanisms relevant to adolescent student-athletes, such as improved emotional regulation, enhanced attentional control, and increased self-efficacy and self-awareness, which may contribute to its superior effects compared to the MAC intervention.

The added value of the SmartACT program appears to reside in the complementary interaction between ACT-specific processes (acceptance, value clarification, cognitive defusion) and imagery- and suggestion-based components, previously shown to be effective in supporting attentional regulation and psychological flexibility (Barabási-Madár et al., 2025; Barabási-Madár et al., 2025; Gutman & Gottlieb, 2024; Johles et al., 2020; Khazraee et al., 2023; Fox et al., 2015; Menon & Bhagat, 2025), and not just in the simple association of distinct techniques. Compared to exclusively mindfulness-based interventions, this multimodal framework could provide a more complex and integrative path to cognitive and psychological development.

5.6. Limitations and future research

Although the results provide relevant preliminary indications of the potential benefits of the SmartACT program, they should be interpreted with caution, given the limitations of the study.

- The quasi-experimental design, with classroom-level allocation, appropriate to the school context, limits the possibility of drawing firm causal conclusions, as initial differences between groups could have influenced the results obtained.
- Dropout rate and missing data, which led to a reduction in the size of the analyzable samples for the different outcome variables - future studies should implement strategies

aimed at reducing the dropout rate and, where possible, apply intention-to-treat analyses to ensure a more robust estimate of the effects of the intervention.

- Possible clustering effects associated with implementing the intervention at the classroom level, as well as the use of analyses based exclusively on complete cases. In addition, the exclusion of participants with incomplete data may introduce potential bias, in the situation where missing data were associated with outcome trajectories. Future studies should use multilevel or mixed-effects models and implement more robust strategies for handling missing data to strengthen internal validity. Further research is needed that includes different age groups and different types of sports.
- The seven-week intervention duration may have been insufficient to capture long-term changes, and the improvement in the control group on the d2 test suggests possible practice or familiarization effects
- Although the d2 test has solid validation in the field of sport psychology (Reigal et al., 2019; Heppe et al., 2016; Brinkbäumer et al., 2024; Bektaş, 2019), it is a non-ecological, pencil-and-paper test that does not adequately reflect the complexity and dynamics of attentional demands specific to real-life sports performance. Future research could integrate biophysiological indicators, such as heart rate variability (HRV), heart rate parameters, or electroencephalographic (EEG) indices, to provide a more objective and multidimensional assessment of the autonomic and neurocognitive responses associated with the SmartACT intervention. Correlating self-report psychological measures with physiological data could contribute to increased validity and a more rigorous interpretation of the effects of the intervention.

A relevant direction for future research is to extend the duration of the SmartACT program and include follow-up assessments to examine the stability of effects over time. Performance indicators with higher ecological validity or specific to different sports disciplines are also needed to determine the extent to which improvements in attention and psychological flexibility translate into tangible competitive advantages. Investigating the effectiveness of SmartACT across a variety of sports disciplines and at different levels of expertise, ideally in larger samples and within randomized controlled designs, will be essential to assess the generalizability and practical applicability of the intervention.

SUMMARY OF CHAPTER 6. Moderators of the effects of MAC and SmartACT interventions on the performance and well-being of adolescent athletes: the role of coaching style, parental support and sports experience

6.1. Introduction

During adolescence, sport is considered a complex training framework, which has a positive impact on physical health (Oja et al., 2015; Berg, Warner & Das, 2015; Malm, Jakobsson & Isaksson, 2019), cognitive development (Fong Yan et al., 2024; Martín-Rodríguez et al., 2024; McKee, Daneshvar, Alvarez & Stein 2014) and social adaptation (Li & Guo, 2023; Eather, Wade, Pankowiak & Eime 2023). The constant involvement of adolescents in sports activities contributes to the development of motor skills and reaction time, and favors both the consolidation of social relationships and emotional adaptation. (Mancini et al., 2024; Iorga, Jianu, Gheorghiu, Crețu & Eremia, 2023; Horvath, Kovacs, D. Toth & L. Toth, 2022; Trajković et al., 2020).

Among the protective factors that contribute to the development of flexibility in the social and emotional segment are positive and stable relationships between adolescents and adults. It is essential for the adolescent to feel a sense of belonging, to feel valued and to know that his or her performance is appreciated. (Chadwick, 2014). In this sense, mistakes are not viewed as a failure and are not punished, but rather approached as opportunities for learning and development. (Schwebel et al., 2016) The coach's style is a relevant factor in determining sports performance (Schwebel et al., 2016). According to the studies of Hoffmann et al. (2022), the motivational climate generated by coaches and excessive orientation towards winning can contribute to the manifestation of aggressive behaviors and to the amplification of psychological pressure on athletes. Adequate parental support perceived by athletes is associated with positive self-esteem and an optimal level of well-being in athletes, and the study by Rouquette et al. (2021) highlights this fact. The influence of coaches and parents is associated with their specific roles: coaches mainly perform training and evaluation functions, while parents contribute through the support they provide and by facilitating children's participation in sports activities. (Keegan et al., 2010).

According to the study by Mageau and Vallerand (2003), coaches who support autonomy consider themselves more involved with their team and can stimulate both intrinsic motivation and their performance. The relationship with the coach plays a determining role in athletes' motivation and intention to continue practicing (Jowett, 2017; Wekesser, Harris, Langdon & Wilson 2021). A relationship with the coach, which is perceived as supportive, based on autonomy (Lafrenière, Jowett, Vallerand & Carbonneau, 2011) and respect, is associated with persistence in sport and better performance (Liu, Wang & Li, 2025). At the same time, Kim, Panza & Evans (2021) concluded that positive relationships between team members stimulate individual commitment and performance.

Harwood et al. (2019) show that parental involvement increases children's chances of reaching their sporting potential (Parietti, 2015), of having a positive psychosocial experience and of achieving favourable performance outcomes. They believe that a successful sporting environment is one that supports the child's consistent participation in physical activity, promotes psychological well-being and provides opportunities for the development of transferable life skills across all areas of their lives (Harwood et al., 2019). Lundy et al. (2019) highlight that siblings and parents have distinct but interconnected roles in the development of an athlete throughout childhood and adolescence. Wylleman and Rosier (2016) highlight that parents are the most important social influence in an athlete's life up to the age of 13 and continue to exert significant influences throughout their sporting career. Self-assessment of performance and social support from parents contribute to the development of perceived self-efficacy and intrinsic motivation. Realistic assessments of competence and supportive contexts are considered by Hofseth, Toering, Jordet and Ivarsson (2017) to be key factors in achieving optimal performance.

Family is considered a protective factor in both stress management and the development of psychological flexibility. In this context, parental encouragement has been shown to be essential for maintaining children's long-term involvement in sports activities, and perceptions of parental support and encouragement are associated with higher levels of intrinsic motivation among young athletes. (Vella et al., 2014; Knight et al., 2017; Teques et al., 2019). Through verbal encouragement, modeling an active lifestyle, and logistical support (transportation to training or purchasing equipment), parents significantly influence children's participation in sports activities (Vella et al., 2014; Rouquette et al., 2021). However, according to Padaki et al. (2017), parental pressure and perfectionistic expectations can reduce enjoyment of sports and increase anxiety in young athletes.

6.2. Materials and methods

The interventions investigated include the SmartACT program (an acceptance and commitment training program, combined with elements of hypnotherapy and guided imagery) and the MAC (Mindfulness-Acceptance-Commitment) intervention, compared to a control condition. Their efficiency was evaluated through a multidimensional set of indicators: motor performance and reaction (through the T-Drill and Blazepod agility tests), cognitive performance (d2 test -

number of items processed), experiential avoidance (through the AAQ-II questionnaire), psychological symptomatology (DASS21) and somatic symptoms (GMSCS), presented in the published studies and reproduced in chapters 4 and 5.

Objectives

- integration of psychological variables (psychological flexibility, anxiety, depression, stress, attention performance), relational variables (coaching style, relationship with coach and teammates, parental support) and those related to sports life (sports experience, frequency of weekly training, type of sport) into a unitary explanatory model of the effectiveness of the interventions.
- testing the effectiveness of the two psychological interventions (SmartACT and MAC) in relation to a control group, using an experimental design, by applying the general linear model with repeated measurements, which aims to analyze the moderating role of sports and relational variables on the observed changes
- formulating some applicative recommendations for optimizing psychological interventions in the field of sports, depending on the individual and contextual characteristics of the athletes. The results can contribute to personalizing psychological intervention programs depending on the level of sports experience, adapting interventions according to the relational climate (coaching style, parental support, team cohesion), respectively developing differentiated intervention strategies depending on the type of sport.

Hypotheses

1. The effectiveness of psychological interventions on performance indicators and psychological variables will be moderated by sport and contextual factors, such as training frequency and duration of sport practice.
2. Relational variables (coaching style, perceived relationship with the coach, relationship with the team and perceived parental support) will influence the effectiveness of psychological interventions, such that athletes who report supportive relationships and an adaptive leadership style will have improvements following the interventions.

The equivalence of the experimental groups at the pretest time was verified in the preliminary analyses presented in previous studies conducted on the same sample. The results did not reveal significant differences between the SmartACT, MAC and Control groups for the analyzed variables, which indicates that the groups were comparable before the interventions were applied.

6.3. Results

The moderating role of coaching style on reaction time measured with Blazepod equipment

To interpret the moderation factor, pretest-posttest means were analyzed for each coaching style. Given that performance is better when reaction time measured by Blazepod devices decreases, a negative difference between posttest and pretest means an improvement in performance.

Table 46.

Pretest-posttest means for coaching styles

Coaching style	Pretest (M)	Posttest (M)	Difference
very demanding, authoritarian	3374.75	3187.33	-187.42
demanding	3531.53	3763.03	+231.50
win-oriented	3329.02	3320.84	-8.18
technical improvement-oriented	3479.09	3266.52	-212.57
permissive	4523.94	3704.18	-819.76

According to Table 46, we can say that the analysis of pretest-posttest means shows that the greatest improvement in reaction time was observed in the case of athletes who perceived the coach's style as being oriented towards technical improvement. A moderate improvement was observed in the case of the very demanding/authoritarian style, respectively the demanding style was associated with a deterioration in performance, which suggests a possible negative influence on the evolution of performance over time. Although the permissive style recorded the greatest numerical reduction in reaction time, we interpreted this result with caution due to the relatively small number of participants in this category, which may affect the stability of the analysis.

The results presented in Table 47 did not reveal a significant main effect of time on reaction time, $F(1,155) = 0.88$, $p = 0.350$, indicating that, overall, performance did not change significantly between pretest and posttest. At the same time, a significant interaction was identified between time and intervention type, $F(2,155) = 16.75$, $p < 0.001$, suggesting that performance evolution differs depending on the intervention applied. Regarding the role of coaching style, the interaction between time and coach style was not statistically significant, $F(4,155) = 1.89$, $p = 0.116$, indicating that coach style does not directly influence the change in performance between pretest and posttest.

The analysis revealed a significant interaction between time, intervention type and coaching style, $F(7,155) = 2.69$, $p = 0.012$, indicating that the effectiveness of psychological interventions on reaction time depends on the coach's style perceived by the athletes. Also, coaching style had a significant main effect on overall performance, $F(4,155) = 3.29$, $p = 0.013$, suggesting differences between coaching styles in terms of overall reaction time.

Table 47.

Effects of intervention and coaching style on reaction time measured by the Blazepod device

Effect	F	df	p	η^2p
Time	0.88	1,155	0.350	0.006
Time x Group	16.75	2,155	< 0.001	0.178
Time x Coaching style	1.89	4,155	0.116	0.046
Time x Group x Coaching style	2.69	7,155	0.012	0.108
Coaching style	3.29	4,155	0.013	0.078

Note: Time = pretest vs. posttest; Group = SmartACT, MAC, Control; Coaching style = perceived style of the coach (1 = very demanding/authoritarian; 2 = demanding; 3 = win-oriented; 4 = technical improvement-oriented; 5 = permissive).

The moderating role of parental support and sports practice time

Parental support as a moderator of experiential avoidance (AAQ-II)

The GLM analysis with repeated measures revealed a significant main effect of time on AAQ-II scores, indicating an overall reduction in experiential avoidance between pretest and posttest, $F(1,180) = 19.99$, $p < 0.001$, $\eta2p = 0.10$, a result that suggests that, overall, the psychological interventions contributed to increasing the athletes' psychological flexibility. Also, the interaction between time and type of intervention was significant, $F(2,180) = 13.49$, $p < 0.001$, $\eta2p = 0.13$, indicating that the change in the level of experiential avoidance (which means increasing psychological flexibility) differs depending on the type of intervention applied.

Regarding the role of parental support, the interaction between time and parental support was close to the threshold of statistical significance, $F(3,180) = 2.65$, $p = 0.051$, $\eta2p = 0.04$, a result that suggests a possible influence of the family context on the evolution of experiential avoidance. The interaction between time, type of intervention and parental support was significant, $F(5,180) = 3.87$, $p < 0.01$, $\eta2p = 0.10$, indicating that the effectiveness of psychological interventions in reducing experiential avoidance and implicitly increasing psychological flexibility depends on the level of support perceived from parents.

The results presented above suggest that athletes who perceive a high level of support from their parents, in a more stable emotional climate, which facilitates the process of developing psychological flexibility and the ability to manage difficult internal experiences (thoughts, emotions) associated with sports competition, benefit to a greater extent from the SmartACT psychological intervention.

Time of sports practice as a moderator of somatic symptoms (GMSCS)

The GLM analysis with repeated measures revealed a significant effect of time on somatic symptoms, indicating a change in GMSCS scores between pretest and posttest, $F(1,179) = 12.19$, $p < 0.001$, $\eta 2p = 0.06$. Regarding the role of sports experience, the interaction between time and duration of sports practice was significant, $F(3,179) = 5.60$, $p < 0.01$, $\eta 2p = .09$, indicating that the evolution of somatic symptoms differs depending on the experience measured by the number of years of sports practice (data presented in Table 48).

Table 48.

Effects of moderators on the effectiveness of psychological interventions

Moderator	Dependent variable	F	df	p	η^2p
Parental support	AAQ-II	3.87	(5,180)	< 0.01	0.10
Time of sports practice	GMSCS	5.60	(3,179)	< 0.01	0.09

6.4.Discussion

The results of the study highlight the moderating role of specific factors in the effectiveness of psychological interventions applied to adolescent athletes, but at the same time we can say that the effects of the SmartACT and MAC programs do not depend significantly on most of the variables investigated. This stability of the intervention effects may indicate that strategies based on mindfulness, acceptance and commitment, as well as hypnotherapy and guided imagery can be effectively applied in a variety of sports contexts and do not depend on the number of weekly training sessions, the relationship with the coach, the team and the type of sport practiced.

- Regarding coaching style, the results indicate that the orientation towards technical improvement is associated with more consistent improvements in reaction time. The literature highlights that the coach's style influences the performance and lived experiences of athletes (Schwebel et al., 2016) and a development- and learning-oriented climate in which errors are not treated as failures, but rather viewed as opportunities for progress, can favor the increase in sports performance, on the other hand, excessive orientation towards winning can increase psychological pressure on athletes and contribute to the emergence of negative experiences (Hoffmann et al., 2022).

- The results also indicate that perceived parental support moderated the effect of interventions on experiential avoidance, suggesting that the effectiveness of interventions in developing psychological flexibility is influenced by family support. The literature shows that the family is an important protective factor in stress management and in the development of psychological resources of young athletes (Vella et al., 2014; Knight et al., 2017). Perceived parental support is associated with positive self-perceptions, well-being, and increased intrinsic motivation among young athletes (Rouquette et al., 2021; Teques et al., 2019).
- Regarding the duration of sports practice, the results suggest that sports experience can influence how athletes respond to psychological interventions through indicators of somatic symptoms. Athletes with longer experience have more effective mechanisms for emotional regulation and adaptation to competitive stress. Research shows that sustained participation in sports activities in an appropriate environment contributes to the development of transferable psychological and life skills, which support adaptation to the demands of sports performance (Harwood et al., 2019).

At the same time, the fact that most of the variables analyzed did not significantly moderate the effectiveness of the intervention may suggest that the SmartACT and MAC program has a relatively broad applicability in diverse sports contexts. The effectiveness of the investigated psychological interventions does not seem to depend on the type of sport practiced, the perceived relationship with the team, or the frequency of training, which indicates a certain stability of the program's effects in the youth sports environment.

6.5.Conclusions

The results of the study highlight that the effectiveness of psychological interventions implemented through the SmartACT program is influenced by a limited number of contextual factors, in particular by the coach's style, perceived parental support and sports experience. At the same time, most of the variables analyzed did not significantly moderate the effects of the intervention, suggesting that the program maintains its effectiveness in a variety of sports and relational contexts.

The results support the importance of integrated psychological approaches in youth sports and highlight the role of the training environment and the family environment in the psychological well-being and performance of adolescent athletes. Interventions based on mindfulness, acceptance and commitment, as well as guided imagery and hypnotherapy techniques can be considered valuable tools for supporting sports performance and psychological health in a competitive context.

6.6. Practical implications

The results of the study highlight the importance of integrating psychological interventions into the training programs of adolescent athletes. Interventions based on mindfulness, acceptance and commitment, as well as hypnotherapy and guided imagery can contribute to optimizing sports performance and improving psychological adaptation in a competitive context. At the same time, the results suggest that the training environment and family environment can influence the effectiveness of these interventions. In this regard, coaches can contribute to maximizing the effects of psychological interventions by creating a training climate oriented towards technical development and learning, in which errors are addressed as development opportunities. The specialized literature shows that coaching style influences both sports performance and psychological symptomatology of athletes (Schwebel et al., 2016), and parental involvement and support can facilitate the development of psychological flexibility and support athletes' adaptation to the demands of sports activity (Vella et al., 2014; Knight et al., 2017). Therefore, we can further argue that collaboration between coaches, parents, and sports psychology specialists can represent an essential element for the optimal development of young athletes.

6.7. Limitations and future directions

The present study presents some limitations that must be taken into account when interpreting the results. First, the use of self-report questionnaires to assess certain psychological variables may be influenced by subjective factors. Another limitation is that the analysis focused on a limited number of moderating variables and it is possible that other contextual or individual factors that were not taken into account in the present study, such as the athletes' personality traits or their coping styles, may influence the effectiveness of psychological interventions.

Future research directions could include investigating more concrete samples, by age categories, by defined types of sports, as well as analyzing the long-term effects of psychological interventions on sports performance and psychological well-being. It would also be useful to focus on interventions dedicated to coaches and parents in order to integrate them into the process of appropriate and adaptive evolution of young athletes. We believe that training aimed at prevention on multiple levels would contribute more effectively to the well-being and performance of adolescent athletes.

SUMMARY OF CHAPTER 7. PERSONAL CONTRIBUTION

The results obtained indicate that the SmartACT program was associated with more consistent improvements in psychological flexibility and attentional performance compared to MAC-type interventions and the control group. These findings suggest that integrating ACT processes with hypnosis and guided imagery techniques may activate a broader set of self-regulatory mechanisms relevant to the cognitive and emotional functioning of adolescent student-athletes.

From a theoretical perspective, the data support the hypothesis of complementarity between the specific experiential processes of ACT and the hypnosis and imagery techniques. Acceptance, value clarification, and cognitive defusion may contribute to reducing experiential avoidance and rumination, while the imagery and suggestion components may facilitate the consolidation of attentional control and the activation of internal resources. Together, these mechanisms may explain the observed effects on psychological flexibility and performance on attention tests, in particular the d2 test.

At the same time, the interpretation of the results should be made with caution. The quasi-experimental design, the relatively short duration of the intervention, and the possible practice effects on the d2 test limit the possibility of formulating firm causal conclusions. Also, the non-ecological nature of the d2 test imposes reservations regarding the direct transfer of attentional improvements to competitive sports performance.

Despite these limitations, the data obtained provide preliminary indications that multimodal interventions, adapted to the developmental peculiarities of adolescence, may have a relevant role in optimizing psychological self-regulation in the school sports context.

The originality of this thesis lies in the development and empirical evaluation of an integrative intervention program - SmartACT - that correlates specific Acceptance and Commitment Therapy (ACT) processes with hypnosis and guided imagery techniques, applied to a population of adolescent student-athletes. This integration is carried out in a structured manner, with the explicit objective of simultaneously influencing psychological flexibility and attentional performance.

A first relevant contribution is the formulation of an intervention model that combines ACT processes (acceptance, value clarification, cognitive defusion) with suggestive and imagery mechanisms associated with hypnosis and resource activation. Through this approach, the thesis proposes an integrative perspective on psychological self-regulation, suggesting that optimizing psychological flexibility may have functional implications on attentional control in a sports context.

A second contribution consists in applying and testing this framework among adolescent student-athletes, a category insufficiently investigated in the literature of ACT-based interventions in sports. The period of adolescence, characterized by high cognitive and emotional plasticity, provides a relevant context for examining the effects of interventions aimed at emotional regulation and cognitive performance.

We also highlight the interdisciplinary nature of the work, given that the studies presented investigate two psychological interventions, MAC and SmartACT, applied among adolescent athletes and present instruments specific to psychology alongside evidence characteristic of sports science. From a methodological point of view, the thesis contributes through the combined use of validated psychological measures (AAQ-II, DASS-21, GMSCS), a standardized indicator of attentional performance (d2 test), as well as through the objective measurement of agility (T-test agility test measured using the Microgate apparatus) and reaction time (Blazepod apparatus) to a more rigorous evaluation of the changes associated with the intervention, within the limits imposed by the quasi-experimental design.

At a theoretical level, the research supports the hypothesis that psychological flexibility, attentional regulation, psychological variables (depression, anxiety, stress), psychosomatic and performance variables can be addressed through a common intervention framework, integrating experiential processes such as mindfulness, imagery and hypnotherapy. The results obtained provide preliminary empirical data that support this perspective and substantiate future research directions that may include randomized designs, measures with high ecological validity and bio-physiological indicators.

GENERAL CONCLUSIONS OF THE DOCTORAL THESIS

Analyzing the results of the four studies, we can say that the SmartACT program, developed based on the MAC protocol with the integration of techniques from acceptance and commitment therapy (ACT), guided imagery and hypnosis, constitutes an effective hybrid intervention for optimizing sports performance and well-being in adolescent student-athletes. This integrative approach simultaneously supports cognitive processes, especially attention and reaction speed, psychological flexibility and emotional regulation, while contributing to the reduction of stress, anxiety and somatic symptoms. According to data from the specialized literature, the effectiveness of the program results from the interaction of its components: mindfulness, elements of hypnosis, guided imagery (Noetel et al., 2019; Myall et al., 2023; Morris et al., 2005; Wolch et al., 2021; Henriksen, Hansen & Larsen, 2019; Barabási-Madár et al., 2025; Gutman and Gottlieb, 2024; Johles et al., 2020; Khazraee et al., 2023; Fox et al., 2015; Menon & Bhagat, 2025). At the same time, the results suggest an applicability in various contexts with some methodological limitations, which require caution in their interpretation.

The MAC program, tested in the preliminary study, demonstrated positive effects on most cognitive processes and moderate effects on stress, anxiety, and somatic symptoms. Participant feedback facilitated the identification of the limitations of the intervention and formed the basis for the development of the SmartACT program, which integrates ACT techniques and imagery and hypnosis methods, which contribute to increasing psychological flexibility and emotional regulation (Noetel et al., 2019; Myall et al., 2023; Morris et al., 2005; Wolch et al., 2021; Henriksen, Hansen & Larsen, 2019).

The studies presented in chapters 4, 5 and 6 aim to contribute to the development of the theoretical framework in sport psychology by deepening the understanding of the role of psychological flexibility, mindfulness and mental self-regulation in supporting performance and well-being in adolescent athletes involved in various sports disciplines - both individual and team. By integrating the principles of ACT therapy (Acceptance and Commitment Therapy), as well as the complementary techniques of hypnosis and guided imagery, the research explores the influence of these interventions on the cognitive and emotional processes involved in effective adaptation to the specific demands of the sport context. In addition, the study aims to theoretically substantiate how these approaches contribute to the optimization of reaction time, directed attention and rapid decision-making capacity, using objective measurements such as those provided by the BlazePod system.

The studies aim to develop and validate a structured psychological intervention, designed to support athletes in managing competitive pressure, optimizing concentration and maintaining emotional balance in high-performance contexts. The program is designed based on a flexible framework, which can be adapted according to the age of the participants and the particularities of each sport, by integrating exercises specific to the competitive context (team vs. individual, intensity vs. precision sports, etc.). The research results can constitute a useful benchmark for coaches, sports psychologists and specialists in applied interventions, providing clear directions for the implementation of personalized and empirically validated SmartACT protocols, within the psychological preparation process of performance and pre-performance athletes, regardless of the discipline practiced.

The developed SmartACT program generated superior improvements compared to the MAC protocol and the control group in terms of agility and reaction speed, as well as significant reductions in stress and somatic symptoms. Furthermore, SmartACT was associated with greater improvements in attention and psychological flexibility, suggesting the activation of multiple psychological mechanisms (emotional regulation, attentional control, self-efficacy). (Barabási-Madár et al., 2025; Gutman and Gottlieb, 2024; Johles et al., 2020; Khazraee et al., 2023; Fox et al., 2015; Menon and Bhagat, 2025).

The effectiveness of the SmartACT program is limited by contextual factors (coaching style, parental support, sports experience), but most of the variables analyzed did not significantly moderate the effects of the intervention, suggesting that the program proves to be effective in a variety of sports and relational contexts.

GENERAL LIMITATIONS OF THE RESEARCH

Interpretation of the results is limited by the quasi-experimental design and lack of randomization. The dropout rate and the use of analyses only on complete pre- and posttest data may represent bias and reduce statistical power, and possible clustering effects (class-level implementation) may affect the independence of observations. Also, the predominant use of self-report measures carries the risk of subjective distortions.

The relatively short duration of the intervention and the absence of follow-up assessments limit conclusions regarding the maintenance of effects over time, and possible practice effects (e.g. in the case of the d2 test) may influence the results.

Future research should use randomized controlled designs, reduce the dropout rate, and include objective measures (HRV, EEG, cortisol) correlated with self-reports. Follow-up assessments are necessary, as well as the use of performance indicators with high ecological validity. Also, investigating differences depending on the type of sport, competitive level, age and individual characteristics and developing interventions addressed to coaches and parents can contribute to strengthening the validity and applicability of the program.

PRACTICAL IMPLICATIONS

The results of this thesis support the integration of SmartACT-type interventions, which combine ACT techniques (mindfulness, acceptance, values-guided action) with guided imagery and hypnosis, which can facilitate on the one hand psychological well-being and on the other hand more efficient motor performance, especially in dynamic contexts involving rapid reactions and decisions under pressure (Forster et al., 2023; Paul et al., 2016; Mancini et al., 2024; Hoffman, 2020).

From an application point of view, the interventions can be implemented in 10–15 minute micro-sessions, twice a week, integrated into warm-up or cool-down, using short scripts adapted to the technical objectives.

At the same time, the effectiveness of the interventions, according to the results of our study, is supported by the relational context, being important to promote a development-oriented training climate and the active involvement of parents. Collaboration between coaches, family, and sport psychology specialists helps maximize the effects on performance and psychological health (Schwebel et al., 2016; Vella et al., 2014; Knight et al., 2017).

SELECTIVE BIBLIOGRAPHY

Aguilar, A. J., DiStefano, L. J., Brown, C. N., Herman, D. C., Guskiewicz, K. M., & Padua, D. A. (2012). A dynamic warm-up model increases quadriceps strength and hamstring flexibility. *The Journal of Strength & Conditioning Research*, *26*(4), 1130-1141.

Almonroeder, T. G., Tighe, S. M., Miller, T. M., & Lanning, C. R. (2020). The influence of fatigue on decision-making in athletes: a systematic review. *Sports biomechanics*, *19*(1), 76-89.

de Arruda, A. F. S., Aoki, M. S., Paludo, A. C., Drago, G., & Moreira, A. (2018). Competition stage influences perceived performance but does not affect rating of perceived exertion and salivary neuro-endocrine-immune markers in elite young basketball players. *Physiology & behavior*, *188*, 151-156.

Ashdown-Franks, G., Sabiston, C. M., Solomon-Krakus, S., & O'Loughlin, J. L. (2017). Sport participation in high school and anxiety symptoms in young adulthood. *Mental Health and Physical Activity*, *12*, 19-24.

Baer, R. (2018) Mindfulness Practice. In Hayes, S.C. & Hofmann, S.G. *Process-based CBT. The science and core clinical competencies of cognitive behavioral therapy.* Oakland: New Harbinger Publications

Barabási- Madár, T.; Costea-Bărluţiu, C.; Toma, V.; Grosu, V.T.; Monea, D. (2025) Pilot Study Examining Mindfulness Intervention Effects on Perceived and Objective Stress in Adolescent Basketball Players. *Gymnasium,* 26, 125-136.

Barabási-Madár, T., Monea, D., & Costea-Bărluţiu, C. (2023) Effects of a Mindfulness-Based Intervention on the Physical and Psychological Well-Being in Teenagers. Education for Health and Performance, 25.

Barker, P. (2013) *Psychotherapeutic Metaphors: A Guide to Theory and Practice*; Routledge: London, UK; ISBN 9780203765838.

Barker, J.B. & Jones, M.V. (2006) Using hypnosis, technique refinement, and self-modeling to enhance self-efficacy: A case study in cricket. *Sport Psychol.*, 20, 94-110.

Barker, J. B., Jones, M. V., & Greenlees, I. (2013). Using hypnosis to enhance self-efficacy in sport performers. *Journal of Clinical Sport Psychology*, *7*(3), 228-247.

Barroso, G. C., & Thiele, E. S. (2011). Muscle injuries in athletes. *Revista brasileira de ortopedia*, *46*, 354-358.

Berg, B. K., Warner, S., & Das, B. M. (2015). What about sport? A public health perspective on leisure-time physical activity. *Sport Management Review*, *18*(1), 20-31.

Beirens, K., & Fontaine, J. R. (2010). Development of the Ghent Multidimensional Somatic Complaints Scale. *Assessment*, *17*(1), 70-80.

Bektaş, F. (2019) Evaluation of D2 attention levels of orienteering national team athletes who are in education age. *J. Educ. Train. Stud.,* 7, 49-55.

Best, J.R. (2010) Effects of Physical Activity on Children's Executive Function: Contributions of Experimental Research on Aerobic Exercise. *Dev. Rev*., 30, 331-551.

Birrer, D., Röthlin, P., & Morgan, G. (2012). Mindfulness to enhance athletic performance: Theoretical considerations and possible impact mechanisms. *Mindfulness, 3*, 325-246.

Bishop, S. R., Lau, M., Shapiro, S., Carlson, L., Anderson, N. D., Carmody, J., ... & Devins, G. (2004). Mindfulness: A proposed operational definition. *Clinical psychology: Science and practice*, *11*(3), 230.

Blackledge, J.T. (2018) Cognitive defusion. In Hayes, S.C. & Hofmann, S.G. *Process-based CBT. The science and core clinical competencies of cognitive behavioral therapy.* Oakland: New Harbinger Publications

Bond, F. W., Hayes, S. C., Baer, R. A., Carpenter, K. M., Guenole, N., Orcutt, H. K., ... & Zettle, R. D. (2011). Preliminary psychometric properties of the Acceptance and Action Questionnaire-II: A revised measure of psychological inflexibility and experiential avoidance. *Behavior Therapy, 42*(4), 676-688. https://doi.org/10.1016/j.beth.2011.03.007

Brickenkamp, R. & Zillmer, E. (1998) *The d2 Test of Attention*; Hogrefe and Huber Publishers: Seattle, WA, USA

Brinkbäumer, M.; Kupper, C.; Reichert, L.; Zentgraf, K. (2024) Dual-task costs in speed tasks: A comparison between elite ice hockey, open-skill and closed-skill sports athletes. *Front. Psychol.,* 15, 1357312.

Brown, K.W., Weinstein, N. & Creswell, J.D. (2012) Trait mindfulness modulates neuroendocrine and affective responses to social evaluative threat, *Psychoneuroendocrinology,* Volume 37, Issue 12, 2012, Pages 2037-2041, https://doi.org/10.1016/j.psyneuen.2012.04.003.

Budgett, R. (1998). Fatigue and underperformance in athletes: the overtraining syndrome. *British journal of sports medicine*, *32*(2), 107-110.

Cabarkapa, D., Eserhaut, D. A., Cabarkapa, D. V., Philipp, N. M., & Fry, A. C. (2023). Salivary testosterone and cortisol changes during a game in professional male basketball players. *The Journal of Strength & Conditioning Research*, *37*(8), 1687-1691.

Chadwick, S. (2014) *Impacts of Cyberbullying, building social and emotional resilience in schools.* North Ryde: Springer

Chow, C. C. G., Kong, Y. H., & Wong, C. L. (2022). Reactive-agility in touch plays an important role in elite playing level: Reliability and validity of a newly developed repeated up-and-down agility test. *Journal of Sports Science & Medicine*, *21*(3), 413.

Creswell, J. D., Welch, W. T., Taylor, S. E., Sherman, D. K., Gruenewald, T. L., & Mann, T. (2005). Affirmation of Personal Values Buffers Neuroendocrine and Psychological Stress Responses. *Psychological Science,* 16(11), 846-851. https://doi.org/10.1111/j.1467-9280.2005.01624.x

Dafinoiu, I., & Vargha, J. L. (2007). *Hipnoza clinica; tehnici de inducţie, strategii terapeutice.* Iasi: Polirom.

Davis, M., Eshelman, E.R. & McLay, M. (2000) *The Relaxation & Stress Reduction Workbook*. Oakland: New Harbinger Publications.

Dehghani, M.; Saf, A.D.; Vosoughi, A.; Tebbenouri, G.; Zarnagh, H.G. (2018) Effectiveness of the mindfulness-acceptance-commitmentbased approach on athletic performance and sports competition anxiety: A randomized clinical trial. *Electron. Physician,* 10, 6749-6755.

Delextrat, A., Grosgeorge, B., & Bieuzen, F. (2015). Determinants of performance in a new test of planned agility for young elite basketball players. *International journal of sports physiology and performance*, *10*(2), 160-165.

Demuthova, S. (2019). The school environment as a source of somatic problems in adolescents. *Revista Românească pentru Educaţie Multidimensională*, *11*(2), 59-71.

de Oliveira, E. P., Burini, R. C., & Jeukendrup, A. (2014). Gastrointestinal complaints during exercise: prevalence, etiology, and nutritional recommendations. Sports medicine, 44(Suppl 1), 79-85.

Di Corrado, D., Guarnera, M., Vitali, F., Quartiroli, A., & Coco, M. (2019). Imagery ability of elite level athletes from individual vs. team and contact vs. no-contact sports. *PeerJ*, *7*, e6940.

Diamond, A. (2013) Executive functions. *Annu. Rev. Psychol.,* 64, 135-168.

Diduch, B. K. (2017). Gastrointestinal conditions in the female athlete. *Clinics in sports medicine*, *36*(4), 655-669.

Dobrean, A. (2010). *Test d2-Test de atenție [d2 test of attention].* Cluj-Napoca, Romania: Romanian Testing Services.

Eather, N., Wade, L., Pankowiak, A., & Eime, R. (2023). The impact of sports participation on mental health and social outcomes in adults: a systematic review and the 'Mental Health through Sport'conceptual model. *Systematic reviews,* 12(1), 102.

Eime, R. M., Young, J. A., Harvey, J. T., Charity, M. J., & Payne, W. R. (2013). A systematic review of the psychological and social benefits of participation in sport for children and adolescents: informing development of a conceptual model of health through sport. *International journal of behavioral nutrition and physical activity*, *10*(1), 98.

Faul, F.; Erdfelder, E.; Lang, A.G.; Buchner, A. (2007) G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav. Res. Methods*, 39, 175-191.

Fleddermann, M.T.; Heppe, H. & Zentgraf, K. (2019) Off-Court Generic Perceptual-Cognitive Training in Elite Volleyball Athletes: Task-Specific Effects and Levels of Transfer. *Front. Psychol*., 10, 1599.

Fong Yan, A., Nicholson, L. L., Ward, R. E., Hiller, C. E., Dovey, K., Parker, H. M., ... & Chan, C. (2024). The effectiveness of dance interventions on psychological and cognitive health outcomes compared with other forms of physical activity: a systematic review with meta-analysis. *Sports Medicine*, *54*(5), 1179-1205.

Forster, J. W., Uthoff, A. M., Rumpf, M. C., & Cronin, J. B. (2023). Training to improve pro-agility performance: a systematic review. *Journal of Human Kinetics*, *85*, 35.

Fox, K.C.; Kang, Y.; Lifshitz, M.; Christoff, K. (2015) Increasing cognitive-emotional flexibility with meditation and hypnosis. In *Hypnosis and Meditation: Towards an Integrative Science of Conscious Planes;* Oxford University Press: Oxford, UK; Volume 11, pp. 191-219.

French, K., Golijani-Moghaddam, N. & Schröder, T. (2017) What is the evidence for the efficacy of self-help acceptance and commitment therapy? A systematic review and meta-analysis. *Journal of Contextual Behavioral Science 6 (2017) 360-374*

Funayama, M. (2024) Subcategories of Attention Function and Its Assessment Methods. *Brain Nerve,* 76, 721-725. (In Japanese)

Furley, P. & Wood, G.W. (2016) Working memory, attentional control, and expertise in sports: A review of current literature and directions for future research. *J. Appl. Res. Mem. Cogn.,* 5, 415-425.

Gallant, S. (1998). Assessing adverse neural tension in athletes. *Journal of Sport Rehabilitation*, *7*(2), 128-139.

Garcia, R.F.; Villa, R.S.; Cepeda, N.T.; Cueto, E.G.; Montes, J.M.G. (2004) Efecto de la hipnosis y la terapia de aceptacion y compromiso (ACT) en la mejora de la fuerza fisica en piraguistas. *Int. J. Clin. Health Psychol.,* 4, 481-493.

Gardner, F. L., & Moore, Z. E. (2007). *The psychology of enhancing human performance: The mindfulness-acceptance-commitment (MAC) approach*. Springer Publishing Company, Berlin/Heidelberg, Germany

Ginstfeldt, T. & Emanuelson, I. (2010) An overview of attention deficits after paediatric traumatic brain injury. *Brain Inj*., 24, 1123-1134.

González-García, M., Álvarez, J. C., Pérez, E. Z., Fernandez-Carriba, S., & López, J. G. (2021). Feasibility of a brief online mindfulness and compassion-based intervention to promote mental health among university students during the COVID-19 pandemic. *Mindfulness*, *12*(7), 1685-1695.

Gregg, J.A., Namekata, M.S., Louie, W.A. & Chancellor, C. (2014). Impact of values clarification on cortizol reactivity to an acute stressor. *Freeland Journal of Contextual Behavioral Science,* Volume 3, Issue 4, 2014, Pages 299-304, https://doi.org/10.1016/j.jcbs.2014.08.002.

Gross, M., Moore, Z.E., Gardner, F.L., Wolanin, A.T., Pess, R., Marks, D.R. (2018) An empirical examination comparing the Mindfulness-AcceptanceCommitment approach and Psychological Skills Training for the mental health and sport performance of female student athletes, *International Journal of Sport and Exercise Psychology*, 16:4, 431-451, DOI: 10.1080/1612197X.2016.1250802

Gustafsson, H., Sagar, S. S., & Stenling, A. (2017). Fear of failure, psychological stress, and burnout among adolescent athletes competing in high level sport. *Scandinavian journal of medicine & science in sports*, *27*(12), 2091-2102. https://doi.org/10.1111/sms.12797

Gutierrez-Hernandez, D.A.; Gomez Diaz, M.S.; Garcia-Quezada, M.I.; Olivares-Vera, D.A. & Diaz-Rodriguez, M. (2021) *Comparison of test d2 with electroencephalographic signals to measure attention and concentration in university students.* In International Conference on Advanced Research in Technologies, Information, Innovation and Sustainability; Springer International Publishing: Cham, Switzerland; pp. 547-558.

Gutman, T., & Gottlieb, A. (2024). Performance mindfulness: Integrating ACT matrix, imagery and mindfulness for performance enhancement. *Journal of Sport Psychology in Action*, 1-17.

Halson, S. L. (2014). Monitoring training load to understand fatigue in athletes. *Sports medicine*, *44*(Suppl 2), 139-147.

Hamid, N., Abdoli, R., & Shahroie, A. (2018). Efficacy of cognitive behavior therapy with positive imagination of success during hypnotism on athletic performance.

Harris, R. (2022). *The happiness trap: How to stop struggling and start living*. Shambhala Publications.

Harwood, C. G., Knight, C. J., Thrower, S. N., & Berrow, S. R. (2019). Advancing the study of parental involvement to optimise the psychosocial development and experiences of young athletes. *Psychology of Sport and Exercise*, *42*, 66-73.

Hasyim, A. H. (2023). The impact of sport hypnosis on volleyball athlete performance: An empirical study. *Journal Sport Area*, *8*(3), 360-370.

Hayes, S.C. (2025) *Get Out of Your Mind and into Your Life: The New Acceptance and Commitment Therapy;* New Harbinger Publications: Oakland, CA, USA; ISBN 9781572247574.

Hayes, S.C. (2019) Acceptance and commitment therapy: Towards a unified model of behavior change. *World Psychiatry*, 18, 226-227.

Hazlett-Stevens, H. (2018). Specific somatic symptoms alleviated by mindfulness meditation training. *OBM Integrative and Complementary Medicine*, *3*(4), 1-12.

He, J. P., Paksarian, D., & Merikangas, K. R. (2018). Physical activity and mental disorder among adolescents in the United States. *Journal of Adolescent Health*, *63*(5), 628-635.

Heap, M. (2012) *Hypnotherapy: A Handbook.* Open University Press

Henriksen, K., Hansen, J., & Larsen, C. H. (2019). *Mindfulness and acceptance in sport: How to help athletes perform and thrive under pressure*. Routledge.

Henry, J. D., & Crawford, J. R. (2005). The short-form version of the Depression Anxiety Stress Scales (DASS-21): Construct validity and normative data in a large non-clinical sample. *British journal of clinical psychology*, *44*(2), 227-239.

Heppe, H.; Kohler, A.; Fleddermann, M.T.; Zentgraf, K. (2016) The Relationship between Expertise in Sports, Visuospatial, and Basic Cognitive Skills. *Front. Psychol.,* 7, 904.

Hobfoll, S. E. (1989). Conservation of resources: A new attempt at conceptualizing stress. *American Psychologist, 44*(3), 513-524. https://doi.org/10.1037/0003-066X.44.3.513

Hoffman, J. R. (2020). Evaluation of a reactive agility assessment device in youth football players. *The Journal of Strength & Conditioning Research*, *34*(12), 3311-3315.

Hoffmann, M.D.; Barnes, J.D.; Tremblay, M.S.; Guerrero, M.D. (2022) Associations between organized sport participation and mental health difficulties: Data from over 11,000 US children and adolescents. *PLoS ONE*, 17, e0268583.

Hofseth, E., Toering, T., Jordet, G., & Ivarsson, A. (2017). Self-evaluation of skills and performance level in youth elite soccer: Are positive self-evaluations always positive?. *Sport, Exercise, and Performance Psychology*, *6*(4), 370.

Horvath, E., Kovacs, M. T., Toth, D., & Toth, L. (2022). A study of the relationship between anxiety, cognitive emotion regulation and heart rate variability in athletes. *Journal of physical education and sport*, *22*(2), 528-534.

Hunter, M.E. (1994) *Creative Scripts for Hypnotherapy*; Routledge: London, UK; ISBN 9780876307427.

Ibanez, S.J., Feu, S., Garcia, J., Parejo, I. & Canadas, M. (2009) Shot differences between professional (ACB) and amateur (EBA) basketball teams, multifactorial study. Revista de Psicologica del Deporte. Vol.18 p 313-317

Iorga, A., Jianu, A., Gheorghiu, M., Crețu, B. D., & Eremia, I. A. (2023). Motor coordination and its importance in practicing performance movement. *Sustainability*, *15*(7), 5812.

Johles, L., Gustafsson, H., Jansson-Fröjmark, M., Classon, C., Hasselqvist, J., & Lundgren, T. (2020). Psychological flexibility among competitive athletes: a psychometric investigation of a new scale. *Frontiers in sports and active living*, *2*, 110.

Johnson, J.A. & Zatorre, R.J. (2006) Neural substrates for dividing and focusing attention between simultaneous auditory and visual events. *Neuroimage*, 31, 1673-1681.

Jowett, S. (2017). Coaching effectiveness: The coach-athlete relationship at its heart. *Current opinion in psychology*, *16*, 154-158.

Kabat-Zinn, J. (2003) Mindfulness-based interventions in context: Past, present, and future. American psychological association d12. *Clin. Psychol. Sci. Pract.,* 10, 144-156.

Kahrizi, S., Taghavi, M., Ghasemi, R., & Goodarzi, M. (2017). The effectiveness of mindfulness-based cognitive therapy (MBCT) on depression, anxiety and somatic symptoms in asthma patients. *Razi Journal of Medical Sciences*, *24*(154), 27-36.

Kandel, E.R. (2005) *Psychiatry, Psychoanalysis and the New Biology of Mind*. Washington: American Psychiatric Publishing

Keegan, R., Spray, C.M., Harwood, C., & Lavallee, D. (2010). The motivational atmosphere in youth sport: Coach, parent and peer influences on motivation in specializing sport participants. Journal of Applied Sport Psychology, 22, 87-105

Khazraee, H.; Bakhtiari, M.; Kianimoghadam, A.S.; Hajmanouchehri, R. (2023) The Effectiveness of Mindful Hypnotherapy on Psychological Inflexibility, Pain Acceptance, Headache Disability and Intensity in Females with Chronic Migraine Headache: A Randomized Clinical Trial. *Life,* 13, 131.

Khoury, B., Sharma, M., Rush, S. E., & Fournier, C. (2015). Mindfulness-based stress reduction for healthy individuals: A meta-analysis. *Journal of psychosomatic research*, *78*(6), 519-528.

Kiely, K.M. (2014) Cognitive Function. In Encyclopedia of Quality of Life and Well-Being Research; Michalos, A.C., Ed.; Springer: Dordrecht, The Netherlands; pp. 974-978.

Kim, J., Panza, M., & Evans, M. B. (2021). Group dynamics in sport. *Essentials of exercise and sport psychology: An open access textbook*, 613-642.

Kittler, C.; Arnold, M.; Jekauc, D. (2022) Effects of a Mindfulness-Based Intervention on Sustained and Selective Attention in Young Top-Level Athletes in a School Training Setting: A Randomized Control Trial Study. *Sport Psychol.,* 36, 77-88.

Knight, C. J., Berrow, S. R., & Harwood, C. G. (2017). Parenting in sport. *Current Opinion in Psychology*, *16*, 93-97.

Kovács, I. K., & Borcsa, M. (2017). The relationship between anxiety, somatic symptoms and hardiness in adolescence. *Romanian Journal of Applied Psychology*, *19*(2).

Lader, M. (1983). Anxiety and depression. In *Individual Differences and Psychopathology* (pp. 155-167). Academic Press.

Lafrenière, M. A. K., Jowett, S., Vallerand, R. J., & Carbonneau, N. (2011). Passion for coaching and the quality of the coach-athlete relationship: The mediating role of coaching behaviors. *Psychology of sport and exercise*, *12*(2), 144-152.

Lazarus, R., & Folkman, S. (1985). Stress and coping. *New York*, *18*(31), 34-42.

Li, Z., & Li, S. X. (2022). The application of hypnosis in sports. *Frontiers in Psychology*, *12*, 771162.

Li, Y., & Guo, K. (2023). Research on the relationship between physical activity, sleep quality, psychological resilience, and social adaptation among Chinese college students: A cross-sectional study. *Frontiers in psychology*, *14*, 1104897.

Lindsay, P., Maynard, I., & Thomas, O. (2005). Effects of hypnosis on flow states and cycling performance. *The sport psychologist*, *19*(2), 164-177.

Liu, R., Wang, S., & Li, J. (2025). How coach leadership behavior influences athletes' performance: the chain-mediated role of the coach-athlete relationship and psychological fatigue. *Frontiers in Psychology*, *15*, 1500867.

Luiselli, J. K., & Reed, D. D. (Eds.). (2011). *Behavioral sport psychology: Evidence-based approaches to performance enhancement.* New York: Springer

Lundy, G. I., Allan, V., Cowburn, I., & Cote, J. (2019). Parental support, sibling influences and family dynamics across the development of Canadian interuniversity student-athletes. *Journal of athlete development and experience*, *1*(2).

Madrigal, L. A., & Wilson, P. B. (2017). Salivary hormone and anxiety responses to free-throw shooting competition in collegiate female basketball players. *Journal of Clinical Sport Psychology*, *11*(3), 240-253.

Mageau, G. A., & Vallerand, R. J. (2003). The coach-athlete relationship: A motivational model. *Journal of sports science*, *21*(11), 883-904.

Malm, C., Jakobsson, J., & Isaksson, A. (2019). Physical activity and sports—real health benefits: a review with insight into the public health of Sweden. *Sports*, *7*(5), 127.

Mancini, N.; Di Padova, M.; Polito, R.; Mancini, S.; Dipace, A.; Basta, A.; Colella, D.; Limone, P.; Messina, G.; Monda, M.; et al. (2024) The Impact of Perception-Action Training Devices on Quickness and Reaction Time in Female Volleyball Players. *J. Funct. Morphol. Kinesiol.*, 9, 147.

Márquez-Gurrola, V. A., Gallegos-Sánchez, J. J., Bayona, E. F. L., Lechuga, C. H. C., Lerma, J. T., Martínez, A. T., ... & Herrera, S. I. T. (2023). Autohipnosis Ericksoniana en la atención de la lesión deportiva sobre los factores de estrés, ansiedad, depresión y dolor (Ericksonian self-hypnosis in sports injury care on stress, anxiety, depression and pain factors). *Retos*, *47*, 326-333.

Martín-Rodríguez, A., Gostian-Ropotin, L. A., Beltrán-Velasco, A. I., Belando-Pedreño, N., Simón, J. A., López-Mora, C., ... & Clemente-Suárez, V. J. (2024). Sporting mind: the interplay of physical activity and psychological health. *Sports*, *12*(1), 37.

Mattle, S., Birrer, D., & Elfering, A. (2020). Feasibility of hypnosis on performance in air rifle shooting competition. *International journal of clinical and experimental hypnosis*, *68*(4), 521-529.

McKee, A. C., Daneshvar, D. H., Alvarez, V. E., & Stein, T. D. (2014). The neuropathology of sport. Acta neuropathologica, 127(1), 29-51.

Mehrsafar, A. H., Strahler, J., Gazerani, P., Khabiri, M., Sánchez, J., Moosakhani, A., & Zadeh, A. M. (2019). The effects of mindfulness training on competition-induced anxiety and salivary stress markers in elite Wushu athletes: A pilot study. *Physiology & behavior,* 210, 112655. https://doi.org/10.1016/j.physbeh.2019.112655

Menon, S. & Bhagat, V. (2025) Neuroplasticity and Clinical Hypnosis: Advancing Therapeutic Prospects in Neuropsychological Health and Well-being. *Res. J. Pharm. Technol.,* 18, 2371-2377

Merikangas, K. R., Nakamura, E. F., & Kessler, R. C. (2009). Epidemiology of mental disorders in children and adolescents. *Dialogues in clinical neuroscience*, *11*(1), 7-20.

Migliaccio, G. M., Russo, L., Maric, M., & Padulo, J. (2023). Sports performance and breathing rate: What is the connection? A narrative review on breathing strategies. *Sports*, *11*(5), 103.

Millard, L.; Breukelman, G.J.; Mathe, N.; Shaw, I.; Shaw, B.S. (2022) A review of the essential visual skills required for soccer: Beyond 20-20 optometry. *Front. Sports Act. Living,* 4, 965195.

Milling, L. S., & Randazzo, E. S. (2016). Enhancing sports performance with hypnosis: An ode for Tiger Woods. *Psychology of Consciousness: Theory, Research, and Practice, 3*(1), 45-60. https://doi.org/10.1037/cns0000055

Miró, A., Mesperuza, M., Jensen, M. P., Day, M. A., García, F., & Miró, J. (2025). Therapeutic hypnosis and sports performance: a systematic review. *International Review of Sport and Exercise Psychology*, 1-21

Moran, A.P. (2004) *Sport and exercise psychology*. London: Routledge

Moreau, D. & Conway, A.R. (2013) Cognitive enhancement: A comparative review of computerized and athletic training programs. *Int. Rev. Sport Exerc. Psychol.,* 6, 6155-6183.

Moroșanu, Ș., Grosu, V. T., Răbîncă, S. M., Grosu, E. F., Hervás-Gómez, C., Mancini, N., ... & Moreno-Alcaraz, V. J. (2024). Enhancing psychomotor skills in high school students using virtual reality. *Journal of Physical Education and Sport*, *24*(6), 1434-1440.

Morris, T., Spittle, M., & Watt, A. P. (2005). *Imagery in sport*. Human kinetics.

Murray, R. M., Sabiston, C. M., Doré, I., Bélanger, M., & O'Loughlin, J. L. (2021). Association between pattern of team sport participation from adolescence to young adulthood and mental health. *Scandinavian journal of medicine & science in sports*, *31*(7), 1481-1488.

Myall, K., Montero-Marin, J., Gorczynski, P., Kajee, N., Sheriff, R. S., Bernard, R., ... & Kuyken, W. (2023). Effect of mindfulness-based programmes on elite athlete mental health: a systematic review and meta-analysis. *British journal of sports medicine*, *57*(2), 99-108

Natsir, U. D., Dipoatmodjo, T. S., Arjang, A., Hidayat, M., & Mustafa, M. Y. (2021). Eight Days a Week: Eustress and Distress among the Athletes. *International Journal of Human Movement and Sports Sciences*, *9*(5), 912-920.

Neff, K. & Germer, C. (2018) *The mindful self-compassion workbook.* New York: The Guilford Press

Nicholls, A. R., Morley, D., & Perry, J. L. (2016). The model of motivational dynamics in sport: Resistance to peer influence, behavioral engagement and disaffection, dispositional coping, and resilience. *Frontiers in psychology*, *6*, 2010.

Noetel, M., Ciarrochi, J., Van Zanden, B. & Lonsdale, C. (2019) Mindfulness and acceptance approaches to sporting performance enhancement: a systematic review, *International Review of Sport and Exercise Psychology,* 12:1, 139-175, DOI: 10.1080/1750984X.2017.1387803

O'Donoghue, E. K., Morris, E. M., Oliver, J., & Johns, L. C. (2018). *ACT for psychosis recovery: A practical manual for group-based interventions using acceptance and commitment therapy*. New Harbinger Publications.

Oja, P., Titze, S., Kokko, S., Kujala, U. M., Heinonen, A., Kelly, P., ... & Foster, C. (2015). Health benefits of different sport disciplines for adults: systematic review of observational and intervention studies with meta-analysis. *British journal of sports medicine*, *49*(7), 434-440.

Padaki, A. S., Ahmad, C. S., Hodgins, J. L., Kovacevic, D., Lynch, T. S., & Popkin, C. A. (2017). Quantifying parental influence on youth athlete specialization: a survey of athletes' parents. *Orthopaedic journal of sports medicine*, *5*(9), 2325967117729147.

Panza, M. J., Graupensperger, S., Agans, J. P., Doré, I., Vella, S. A., & Evans, M. B. (2020). Adolescent sport participation and symptoms of anxiety and depression: A systematic review and meta-analysis. *Journal of sport and exercise psychology*, *42*(3), 201-218.

Parietti, M. L. (2015). *Parental influence on the academic and athletic behaviors of collegiate student-athletes* (Doctoral dissertation, The Ohio State University).

Paşcan I. (2008) *Gimnasztika az iskolában*

Pates, J., & Maynard, I. (2000). Effects of hypnosis on flow states and golf performance. *Perceptual and Motor Skills*, *91*(3_suppl), 1057-1075.

Pates, J., & Palmi, J. (2002). The effects of hypnosis on flow states and performance. *Journal of Excellence*, *6*(9), 1-15.

Paul, D. J., Gabbett, T. J., & Nassis, G. P. (2016). Agility in team sports: Testing, training and factors affecting performance. *Sports medicine*, *46*(3), 421-442.

Pauole, K., Madole, K., Garhammer, J., Lacourse, M., & Rozenek, R. (2000). Reliability and validity of the T-test as a measure of agility, leg power, and leg speed in college-aged men and women. *The Journal of Strength & Conditioning Research*, *14*(4), 443-450.

Petterson, H., & Olson, B. L. (2017). Effects of mindfulness-based interventions in high school and college athletes for reducing stress and injury, and improving quality of life, *Journal of Sport Rehabilitation*, *26*(6), 578-587. Retrieved Dec 15, 2022, from https://journals.humankinetics.com/view/journals/jsr/26/6/article-p578.xml

Podlog, L.; Dimmock, J.; Miller, J. (2011) A review of return to sport concerns following injury rehabilitation: Practitioner strategies for enhancing recovery outcomes. *Phys. Ther. Sport*, 12, 36-42.

Poucher, Z. A., Tamminen, K. A., Sabiston, C. M., Cairney, J., & Kerr, G. (2021). Prevalence of symptoms of common mental disorders among elite Canadian athletes. *Psychology of Sport and Exercise*, *57*, 102018.

Radin, E. L. (1986). Role of muscles in protecting athletes from injury. *Acta Medica Scandinavica*, *220*(S711), 143-147.

Reigal, R.E.; Barrero, S.; Martin, I.; Morales-Sanchez, V.; de Mier, R.J.-R.; Hernandez-Mendo, A. (2019) Relationships Between Reaction Time, Selective Attention, Physical Activity, and Physical Fitness in Children. *Front. Psychol.*, 15, 2278.

Renshaw, I.; Davids, K.; Araujo, D.; Lucas, A.; Roberts, W.M.; Newcombe, D.J.; Franks, B. (2019) Evaluating Weaknesses of “Perceptual-Cognitive Training” and “Brain Training” Methods in Sport: An Ecological Dynamics Critique. *Front. Psychol.,* 9, 2468.

Robazza, C., Gallina, S., D'Amico, M. A., Izzicupo, P., Bascelli, A., Di Fonso, A., ... & Di Baldassarre, A. (2012). Relationship between biological markers and psychological states in elite basketball players across a competitive season. *Psychology of Sport and Exercise*, *13*(4), 509-517.

Robson-Ansley, P. J., Gleeson, M., & Ansley, L. (2009). Fatigue management in the preparation of Olympic athletes. *Journal of sports sciences*, *27*(13), 1409-1420.

Rolffs, J. L., Rogge, R. D., & Wilson, K. G. (2016). Disentangling Components of Flexibility via the Hexaflex Model Development and Validation of the Multidimensional Psychological Flexibility Inventory (MPFI). *Assessment*, 1073191116645905.

Rosendahl, J., Alldredge, C. T., & Haddenhorst, A. (2024). Meta-analytic evidence on the efficacy of hypnosis for mental and somatic health issues: a 20-year perspective. *Frontiers in psychology*, *14*, 1330238.

Roșioară, A. I., Năsui, B. A., Ciuciuc, N., Sîrbu, D. M., Curșeu, D., Vesa, Ș. C., ... & Popa, M. (2025). Beyond BMI: Exploring Adolescent Lifestyle and Health Behaviours in Transylvania, Romania. *Nutrients*, *17*(2), 268.

Rouquette, O. Y., Knight, C. J., Lovett, V. E., & Heuzé, J. P. (2021). Effect of parent responsiveness on young athletes' self-perceptions and thriving: An exploratory study in a Belgian French-Community. *Psychology of Sport and Exercise*, *52*, 101801.

Sabiston, C. M., Jewett, R., Ashdown-Franks, G., Belanger, M., Brunet, J., O'Loughlin, E., & O'Loughlin, J. (2016). Number of years of team and individual sport participation during adolescence and depressive symptoms in early adulthood. *Journal of sport and exercise psychology*, *38*(1), 105-110.

Sahabuddin, S., Sofyan, D., & Fadillah, A. (2025). Integrating Self-Hypnotherapy Techniques into Physical Conditioning Programs for Volleyball Performance Enhancement. *COMPETITOR: Jurnal Pendidikan Kepelatihan Olahraga*, *17*(1), 503-518.

Sarafino, E.P. & Smith, T.W (2011). *Health Psychology. Biopsychosocial interactions.* Seventh edition. USA: John Wiley & Sons, INC

Schwebel, F. J., Smith, R. E., & Smoll, F. L. (2016). Measurement of perceived parental success standards in sport and relations with athletes' self-esteem, performance anxiety, and achievement goal orientation: Comparing parental and coach influences. *Child Development Research*, *2016*.

Selye, J. (1975) *Stressz distressz nélkül*. Budapest: Akadémiai kiadó

Serido, J., Almeida, D. M., & Wethington, E. (2004). Chronic stressors and daily hassles: Unique and interactive relationships with psychological distress. *Journal of health and social behavior*, *45*(1), 17-33.

Shaabani, F., Naderi, A., Borella, E., & Calmeiro, L. (2020). Does a brief mindfulness intervention counteract the detrimental effects of ego depletion in basketball free throw under pressure?. *Sport, Exercise, and Performance Psychology*, *9*(2), 197.

Shearer, A., Hunt, M., Chowdhury, M., & Nicol, L. (2016). Effects of a brief mindfulness meditation intervention on student stress and heart rate variability. *International Journal of Stress Management*, *23*(2), 232.

Sheppard, J.M. & Young, W.B. (2006) Agility literature review: Classifications, training and testing. *J. Sports Sci.,* 24, 919-932.

Shimi, A.; Tsestou, V.; Hadjiaros, M.; Neokleous, K. & Avraamides, M. (2021) Attentional Skills in Soccer: Evaluating the Involvement of Attention in Executing a Goalkeeping Task in Virtual Reality. *Appl. Sci.,* 11, 9341.

Shortway, K. M., Wolanin, A., Block-Lerner, J., & Marks, D. (2018). Acceptance and commitment therapy for injured athletes: development and preliminary feasibility of the return to ACTion protocol. *Journal of Clinical Sport Psychology,* 12, 4-26.

Sikora, M., Mikołajczyk, R., Łakomy, O., Karpiński, J., Żebrowska, A., Kostorz-Nosal, S., & Jastrzębski, D. (2024). Influence of the breathing pattern on the pulmonary function of endurance-trained athletes. *Scientific reports*, *14*(1), 1113.

Sporiš, G., Milanović, Z., Trajković, N., & Joksimović, A. (2011). Correlation between speed, agility and quickness (SAQ) in elite young soccer players. *Acta kinesiologica*, *5*(2), 36-41.

Straub, W.F. & Bowman, J.J. (2016) A review of the development of sport hypnosis as a performance enhancement method for athletes. *J Psychol Clin Psychiatry* 6(6): 00378. DOI: 10.15406/jpcpy.2016.06.00378

Szabó, P. Zs. & Vasile, B. (2007). *Bevezetés az atlétikába*

Szabo, K.G.; Vargha, J.L.; Balazsi, R.; Bartalus, J. & Bogdan, V. (2011) Measuring psychological flexibility: Preliminary data on the psychometric properties of the Romanian version of the Acceptance and Action Questionnaire (AAQ-II). *J. Evid.-Based Psychother.,* 11, 67-82.

Tamminen, K. A., & Holt, N. L. (2012). Adolescent athletes' learning about coping and the roles of parents and coaches. *Psychology of sport and exercise*, *13*(1), 69-79.

Tang, Y. Y., Hölzel, B. K., & Posner, M. I. (2015). The neuroscience of mindfulness meditation. *Nature reviews neuroscience*, *16*(4), 213-225.

Taylor, J.B.; Wright, A.A.; Dischiavi, S.L.; Townsend, M.A.; Marmon, A.R. (2017) Activity Demands During Multi-Directional Team Sports: A Systematic Review. *Sports Med.,* 47, 2533-2551.

Tenenbaum, G. & Eklund, R.C. (2007)Handbook of sport psychology. New Jersey: John Wiley & Sons, Inc.

Teques, P., Calmeiro, L., Rosado, A., Silva, C., & Serpa, S. (2019). Perceptions of parenting practices and psychological variables of elite and sub-elite youth athletes. *Frontiers in Psychology*, *10*, 1495.

Thorpe, R. T., Atkinson, G., Drust, B., & Gregson, W. (2017). Monitoring fatigue status in elite team-sport athletes: implications for practice. *International journal of sports physiology and performance*, *12*(s2), S2-27.

Trajković, N., Sporiš, G., Krističević, T., Madić, D. M., & Bogataj, Š. (2020). The importance of reactive agility tests in differentiating adolescent soccer players. *International journal of environmental research and public health*, *17*(11), 3839.

Unestahl, L. E. (2018). Alert, eyes-open sport hypnosis. *American Journal of Clinical Hypnosis*, *61*(2), 159-172.

Valentine, K. E., Milling, L. S., Clark, L. J., & Moriarty, C. L. (2019). The efficacy of hypnosis as a treatment for anxiety: a meta-analysis. *International Journal of Clinical and Experimental Hypnosis*, *67*(3), 336-363.

Vargha, J. L., Szabó, K. G., Batiz, E. & Kiss, Sz. (2020) *Înfruntă coronavirusul : ghid de utilizare.* Brașov : Editura A.P.A.R., 2020

Vater, C.; Kredel, R.; Hossner, E.J. (2017) Examining the functionality of peripheral vision: From fundamental understandings to applied sport science. *Curr. Issues Sport Sci.*, 2, 1-11.

Vaughan, R.S. & Laborde, S. (2021) Attention, working-memory control, working-memory capacity, and sport performance: The moderating role of athletic expertise. *Eur. J. Sport Sci.,* 21, 240-249.

Vella, S.A.; Cliff, D.P.; Magee, C.A.; Okely, A.D. (2014) Sports participation and parent-reported health-related quality of life in children: Longitudinal associations. *J. Pediatr.*, 164, 1469-1474.

Vestberg, T.; Reinebo, G.; Maurex, L.; Ingvar, M.; Petrovic, P. (2017) Core executive functions are associated with success in young elite soccer players. *PLoS ONE*, 12, e0170845.

Volgemute, K., Vazne, Z., & Malinauskas, R. (2025). The benefits of guided imagery on athletic performance: a mixed-methods approach. *Frontiers in psychology*, *16*, 1500194.

Vulić-Prtorić, A. (2016). Somatic complaints in adolescence: Prevalence patterns across gender and age. *Psihologijske teme*, *25*(1), 75-105.

Walton, C.C.; Keegan, R.J.; Martin, M.; Hallock, H. (2018) The Potential Role for Cognitive Training in Sport: More Research Needed. *Front. Psychol.,* 9, 1121.

Wang, P., Shi, C., Chen, J., Gao, X., Wang, Z., Fan, Y., & Mao, Y. (2024). Training methods and evaluation of basketball players' agility quality: A systematic review. *Heliyon*, *10*(1).

Wark, D. M. (2008). What we can do with hypnosis: A brief note. *American Journal of Clinical Hypnosis*, *51*(1), 29-36.

Waterman, J. J., & Kapur, R. (2012). Upper gastrointestinal issues in athletes. *Current sports medicine reports*, *11*(2), 99-104.

Wekesser, M. M., Harris, B. S., Langdon, J., & Wilson Jr, C. H. (2021). Coaches' impact on youth athletes' intentions to continue sport participation: The mediational influence of the coach-athlete relationship. *International Journal of Sports Science & Coaching*, *16*(3), 490-499.

Williamson, A. (2019). What is hypnosis and how might it work?. *Palliative Care: Research and Treatment*, *12*, 1178224219826581.

Wilson, P. B. (2020). The psychobiological etiology of gastrointestinal distress in sport: a review. *Journal of Clinical Gastroenterology*, *54*(4), 297-304.

Wolch, N. J., Arthur-Cameselle, J. N., Keeler, L. A., & Suprak, D. N. (2021). The effects of a brief mindfulness intervention on basketball free-throw shooting performance under pressure. *Journal of Applied Sport Psychology*, *33*(5), 510-526.

Wright, H., Collins, M., & Schwellnus, M. P. (2009). Gastrointestinal (GIT) symptoms in athletes: A review of risk factors associated with the development of GIT symptoms during exercise. *International SportMed Journal*, *10*(3), 116-123.

Würtzen, H., Dalton, S. O., Christensen, J., Andersen, K. K., Elsass, P., Flyger, H. L., ... & Johansen, C. (2015). Effect of mindfulness-based stress reduction on somatic symptoms, distress, mindfulness and spiritual wellbeing in women with breast cancer: Results of a randomized controlled trial. *Acta Oncologica*, *54*(5), 712-719.

Wylleman, P., & Rosier, N. (2016). Holistic perspective on the development of elite athletes. In M. Raab, P. Wylleman, R. Seiler, A.-M. Elbe, & A. Hatzigeorgiadis (Eds.), *Sport and exercise psychology research: From theory to practice* (pp. 269-288). Elsevier Academic Press. https://doi.org/10.1016/B978-0-12-803634-1.00013-3

Zelazo, P.D. & Carlson, S.M. (2020) The neurodevelopment of executive function skills: Implications for academic achievement gaps. *Psychol. Neurosci.,* 13, 273-298.

Zemková, E., Vilman, T., Kovácikova, Z., & Hamar, D. (2013). Reaction time in the agility test under simulated competitive and noncompetitive conditions. *The Journal of Strength & Conditioning Research*, *27*(12), 3445-3449.

Yau, E.K.B., Ping, N.P.T. & Kuan, G. (2021) The Use of Mindfulness Acceptance Commitment (MAC) *Approach For Malaysian Elite Triathletes. Journal of Sport Psychology in Action,* 12(4), 271-279. https://doi.org/10.1080/21520704.2021.1920522

Yilmaz, G. (2014). The effects of power, speed, skill and anaerobic capacity of different training models in young male basketball players. *The Anthropologist*, *18*(3), 877-883.

Young, W., & Farrow, D. (2013). The importance of a sport-specific stimulus for training agility. *Strength & Conditioning Journal*, *35*(2), 39-43.

Young, W., & Farrow, D. (2006). A review of agility: Practical applications for strength and conditioning. *Strength & Conditioning Journal*, *28*(5), 24-29.