THE ROLE OF MENTAL TRAINING IN OPTIMIZING PERFORMANCE IN SHOOTING SPORTS- A SYSTEMATIC REVIEW

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Abstract. *The aim of our study was to conduct a literature review of studies in which mental training was used in shooting sports. To conduct this review, we used the PRISMA2020 schema, for new systematic reviews that included only database and journal searches. The exclusion criteria for the studies were as follows: mental training was studied in relation to other sports (n=121), mental training was not used for sports activities (n=93), mental training was used for other age groups (n=25), and studies that were not open access (n=17). The final articles that met all the inclusion criteria were 23 studies. The participants involved in the initial studies were performance athletes. The results of the included studies showed that the effects between the professional psychological support, performance shooting sports and effective coaching can promote higher performance in precision sports. Within the limits of the study, we note that there is not a very large number of research conducted in the direction of establishing the effects of psychological training in sports shooting. The practical implications of the study draw attention to the importance of the presence of mental training in the preparation of athletes in precision sports, which require a high level of emotional stability and self-control.*

Keywords*: mental training, shooting sports, self-control.*

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Introduction

The effectiveness of psychological interventions in achieving performance in precision sports should certainly not be neglected at all, and their role and place should be central to the integrated approach to shooting sports training.

Mental factors like stress, the impact of physical injuries, access to professional mental health services, psychological readiness, and the dynamics between athletes and coaches can all play a role in shaping players' performance.

One of the most important psychological and cognitive components of athletes is attention, which allows you to select certain external and internal stimuli and focus on them. In addition, due to the specifics of the competition, the professional success of athletes involved in practical shooting is determined by the ability to distribute/switch attention between various stimuli

when necessary. Even minor disturbances in the attention process can lead to dramatic changes in the efficiency and effectiveness of the process. An analysis of domestic and foreign sources showed that for athletes involved in high-precision sports, the main characteristics are: a strong resistance to noise, quick motor response, along with the ability to concentrate for a long time and maintain attention on a specific object or task (Huang & Liao, 2022). Currently, there is a sufficient selection of various approaches and techniques aimed at improving the mental, visual and psychomotor components of the attention of a shooting athlete (Goldschmied et al., 2022*).*

Success in shooting sports is related to the ability to focus and manage distractions, which greatly enhances the performance of athletes during competitive shooting events. Achieving better concentration, proper stress and anxiety management, and optimizing shooting performance can be achieved through neurofeedback training (NFT) (Yan et al., 2023).

Research on the application of mental training in optimizing performance in shooting sports

In order to have a more accurate picture of the role and place of mental training in achieving performance in shooting sports, we conducted a review study, in which we used several electronic databases and journals, including Web of Science, Google Scholar, PubMed and Journal of Sports Science and Medicine (JSSM), in order to identify publications in which psychological training was used in the training of shooting sports players.

The review was carried out in accordance with the PRISMA statement, an updated guideline for reporting systematic reviews (Page et al., 2021).

We initially searched for physical training in shooting sports in search engines and, subsequently, to narrow down the number of articles on the topic of interest to us, namely mental training, we obtained the following results in several databases, as follows:

- in the Web of Science database, the initial search generated 1750 articles, and the specific search, 178;
- in the Google Scholar database, the initial search recorded 2598 results, and when the mental training filter was introduced, 345 articles;
- in the case of the PubMed database, the first search generated 312 articles, and then, when the narrowed search was applied, 55 articles were generated;
- in the Journal of Sports Science & Medicine 35 articles were generated, but for mental training, no article was generated.

All records from mentioned databases included studies published between 1 March, 2019 to 1 March 2025. The words used to search for the articles in databases were: shooting sports and mental training. Boolean operators (“AND” and “OR”) were used to combine these terms. Thus, in total, 578 articles were identified that used mental training in shooting sports.

Before our review, we eliminated 299 duplicate studies, which led to a reduction in their number to 279.

We decided to exclude 256 studies, for the following reasons:

Reason 1 – Mental training was studied in relation to other sports (n=121)

Reason 2 – Mental training was not used for sports activities (n=93)

Reason 3 – Mental training was used for other age groups than seniors (n=25)

Reason 4 – Studies that were not open access (n=17).

The final articles, which met all the inclusion criteria, were 23 in number and are presented, in much more detail, in Table 1. Studies were included if they met the following criteria: the study was conducted on a shooting sport that studied mental training or other psychological factors involved in training and achieving performance.

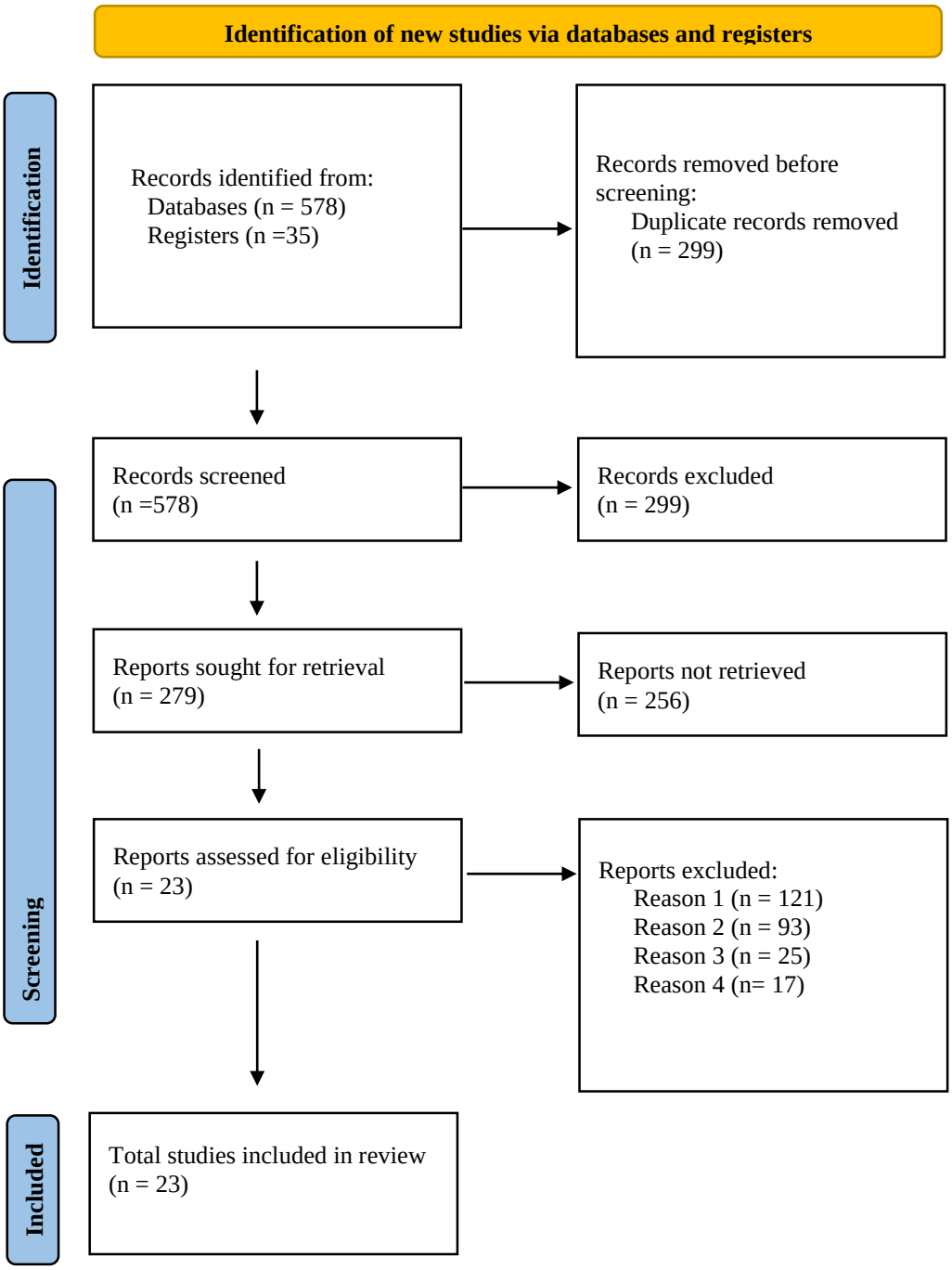

Figure 1. PRISMA flow diagram for updated systematic reviews (https://www.prisma-statement.org/prisma-2020-flow-diagram)

Results

We selected the articles that met the selection criteria and then these were subjected to a more detailed analysis, presented in Table 1.

Table 1. *Relevant studies on mental training in shooting sports*

Article	Purpose	Research Design	Results
Dina (2024)	The aim of the present study was to highlight the importance of attention in achieving performance in target shooting athletes.	The research was qualitative and reviewed the main types of exercises that could improve target shooting performance, many of which come from psychology, namely mental relaxation, sculpting and immobilization.	The researchers concluded that for athletes involved in precision sports such as target shooting, key characteristics incorporate a strong ability to resist distractions, quick reaction times, and the capacity to sustain attention on a particular object or task for an extended period.
Corrado et al. (2024)	The study is a review and explores how neurofeedback training can be utilized to enhance mental and cognitive abilities in athletes.	The authors included the studies conducted from 1990 to 2023 were selected based on inclusion criteria that emphasized the use of neurofeedback in enhancing sports performance. Studies unrelated to neurofeedback or precision sports were excluded from consideration.	The results of the included studies highlighted the importance of neurofeedback.
Mikicin et al. (2018)	The purpose of this study was to investigate the effects of neurofeedback-EEG training on the levels of attention and activation in sports shooting.	The research involved 27 students from a technical university. Assessments took place before and after 20 neurofeedback-EEG training sessions that focused on enhancing the beta frequency range of 12-22 Hz.	Thus, as a result of completing the neurofeedback training sessions, the level of attention, speed and accuracy of the athletes improved.
Ahmadzadeh et al. (2019)	This study aimed to investigate the effectiveness of NLP techniques on the mental skills of athletes and their shooting performance (in sports shooting).	This quantitative study is a semi-empirical research with a pretest-posttest design (N=24, with a mean age of 24 years, randomly divided into two groups). The first group took part in 8 training sessions with NLP techniques. To carry out the measurements, a mental skills assessment scale was used, and performance was measured both in common playing conditions and in competition conditions.	The results of this study showed that NLP techniques improve the mental skills of shooters and their performance both in ordinary conditions and under pressure conditions of competition.

Badarin et al. (2023).	The study explored the neural and behavioral processes related to precise visual-motor coordination involved in learning target shooting.	Multimodal analysis (integration and measurement of response from all senses)	An increase in right temporal alpha and delta EEG power was observed before shooting. There is also an inverse relationship between theta band energies in frontal and central brain regions and the success in target shooting.
Lee et al. (2023)	The aim of the study was to investigate the impact of mental training from a psychophysiological point of view, utilizing heart rate variability.	Five pistol shooting athletes took part in an eight-week mental training program. A psychological skills questionnaire, an inventory for investigating intrinsic motivation, and a sports anxiety scale were also used.	The results showed that the analysis of heart rate underwent changes, namely, it decreased when confronted with moments of crisis and success, thus reflecting the nervous system's response capacity to stress. Demonstrating the association between psychological techniques and the physiological reaction of athletes during competition may determine their introduction by more coaches.
Moreira da Silva et al. (2021)	This study attempted to determine critical aspects from the perspective of shooting athletes. Eight shooting athletes who achieved Olympic performances were interviewed.	The qualitative results obtained from the interviews drew attention to the importance that athletes give to psychological interventions and their effects on the relationship between anxiety and competition, stress during training, the psychological effects of training and the role of coaches.	The study concluded that the interplay between professional psychological support, competitive shooting experience, and effective coaching can enhance performance in Olympic shooting.
Mon-López et al. (2019)	This study belongs to the same authors as the previous study and also involved Olympic shooting athletes.	The importance of physical preparation on performance, professional support in this regard, the intensity of training in the pre-competitive period, the development of core motor skills, and the influence of training on psychological state were the aspects investigated.	The authors determined that there needs to be more stringent oversight of training and recovery protocols in Olympic shooting.
Lu et al. (2021)	The current research focused on identifying the essential types of attention for elite athletes in archery and shooting, as well as investigating the potential benefits of mindfulness training in enhancing their attention skills.	The research included 62 elite athletes from the Chinese national archery and shooting team and 49 athletes from a provincial team in China. Elite athletes demonstrated significantly better attention compared to non-shooters. The 62 athletes from the national team underwent mindfulness training that lasted between 5 to 8 weeks.	The study found that incorporating mindfulness practice into the daily training regimen of archery and shooting athletes could be beneficial.

Park et al (2020).	This study sought to investigate the impact of the level and intensity of self-talk among shooting athletes during competitions on their intrinsic motivation and career outcomes.	170 participants who were performance shooting athletes. Two tests were administered, a self-talk questionnaire and an intrinsic motivation scale.	Athletes who used self-talk had a more appropriate relationship to competition and performance.
Hamilton et al. (2021)	The inclusion of trans women in elite women's sport has recently been called into question.	Thus, according to the existing scientific research, it is reasonable to permit trans women to participate in elite archery to ensure fair competition and prioritize equity.	The effects of integrating trans women into elite sports like archery and shooting could also be observed in other sports, especially those where safety issues related to contact with opponents are not a concern.
Kim et al. (2021)	This meta-analytic study aimed to evaluate the efficacy of psychological skill training interventions for shooting players in Korea.	17 research papers were included for data analysis.	In particular, adult players and longer training periods had larger effects.
Gu & Xue (2022)	This study developed a mediation model to examine how cohesion influences psychological collectivism, mental toughness, and sports commitment among Chinese team sports athletes. It also aimed to investigate the mediating roles of psychological collectivism and mental toughness in the relationship between athletes' cohesion and their commitment.	A total of 326 active Chinese athletes aged 14–26 years from eight sports were investigated through questionnaire.	Increasing psychological cohesion and collectivism may improve Chinese athletes' ability to cope with stressful situations in sports, which may enable them to achieve better performance.
Lang & Zhou (2024)	The objective of this study was to determine the factors that influence shooting performance among elite 10m air rifle athletes.	Twelve air rifle shooters from the Chinese national team each completed 60 shots following their standard shooting procedures.	Grip ability was the most important component.
Wang et al. (2023)	This research intended to evaluate the current evidence regarding the impact of mindfulness on enhancing athletic performance in athletes.	In accordance with the PRISMA guidelines, a literature search was conducted across five electronic databases, along with pertinent review articles. The selection of articles, assessment of bias risk, and extraction of data were carried out independently by two separate investigators.	The findings indicated that mindfulness practices enhanced athletes' performance, but there were no notable effects on their mental health from the interventions.
Spancken et al. (2021)	The study aimed to perform a systematic review of existing literature to identify and summarize the factors that affect performance in air rifle and small-bore shooting. Additionally, it sought to establish whether the same factors apply to both shooting disciplines.	After evaluating each article, essential information was gathered and summarized.	The lack of data prevented evidence-based conclusions from elite air rifle and small-bore shooting athletes.

Mon-López & Tejero-González (2019)	The aim of the study was to assess the validity and reliability of the *TargetScan ISSF Pistol* & *Rifle application*.	A total of 1440 shots were fired by 24 shooters, and the target sheets were examined using an app installed on an iPhone X.	The researchers determined that the TargetScan ISSF Pistol & Rifle is an affordable, valid, and dependable tool for assessing the shooting performance of amateur and semi-professional shooters.
Englert et al. (2021)	In the present study, it was hypothesized that shooting performance would be related to fluctuations in self-control levels.	21 shooters (14 elite and 7 non-elite) participated in this study and were asked to perform a series of 10 shots at a standardized target.	The results suggest that the perception of self-control strength is very important for optimal shooting performance.
Mon-López et al. (2019)	A total of 292 shooters who participated in the 2016 and/or 2018 European Championships and attained top-50 results were included in the study.	Both men and women performed equally well when using rifles, but men had a better performance with pistols compared to women.	The study draws attention to the importance of a greater gender equality in sport.
Hung et al. (2021)	The objective of this research was to investigate the effects of complex functional strength training, integrating whole body vibration and unstable surface training, on overall shooting performance. This includes assessing the stability of shooters while targeting, the duration they spend on target, and their body balance.	The study participants were eight rifle shooters.	A 6-week complex training method can effectively improve shooting stability, flow and balance.
Josefsson et al. (2021)	The aim of the study was to examine the temporal relationship mindfulness and shooting performance in a population of 25 elite biathlon athletes.	Mindfulness facets were positively associated with shooting performance, with higher levels of awareness, reorientation, and awareness being related to better shooting performance in competitions.	Mindfulness can increase an athlete's chances of winning a biathlon competition.
Köykkä et al. (2022)	This research examined the key factors that influence performance in prone shooting within the context of biathlon.	A total of ten female and sixteen male biathletes, with an average age of 19 years, from the Finnish national teams and the Vuokatti-Ruka Sports Academy participated in a study where they performed six sets of five biathlon shots. This exercise was conducted without any physical stress and under controlled laboratory conditions.	The findings emphasize the significance of achieving precision and accuracy in aiming, as well as the timing of the trigger pull, alongside a substantial level of trigger force prior to shooting.
Gallicchio et al. (2019)	This research examined the impact of exercise on the relationship between shooting accuracy and the particular phase of the cardiac cycle at the time of shooting.	13 biathletes participated in the study.	The study concluded that the accuracy of shooting is affected by the stage of the cardiac cycle.

The studies we included in the review are studies published between 2019 and 2025, applying inclusion criteria that focused on the role and place of mental training in achieving performance in sports shooting. The exclusion criteria were studies in which mental training

was studied in relation to other sports or was not used for sports activities or was used for other age categories or studies that were not open access. The findings of the studies examined indicated that mental training can be integrated with various other approaches, including mindfulness techniques, NLP (Neuro-Linguistic Programming), and neurofeedback, to maximize efficiency in precision sports training.

Discussion and Conclusions

The conclusions of the studies point in the same direction, namely, that shooting performance deteriorates over time, the perceived state of self-control decreases during shooting competition, a situation that precedes reduced shooting performance, while shooters who practice performance sports present higher and more robust self-control than those who do not practice performance shooting, so that their training should focus on developing these skills, emphasizing the place and role of mental training.

Imagery is considered the "cornerstone" of sports psychology interventions (Cornelius, 2002), combining various senses and types of visualization (internal and external, kinesthetic, tactile and olfactory). It is proven to be more effective than forms of imagery that use fewer information resources (Morris et al., 2005) in order to project or recreate sports skills (White & Hardy, 1998).

Knight (2002) defines mental training through Neuro-Linguistic Programming as a set of methods and strategies that use the principles of NLP to improve the performance of athletes.

The results of the studies included in this review confirm that mental training

is an essential component of modern sports training, significantly contributing to the stability of performance under competitive pressure. Techniques of visualization, mindfulness, goal stabilization, self-instructions and breathing control have proven effective in increasing concentration, reducing stress and increasing self-confidence in shooting athletes (Lange-Smith et al., 2024; Josefsson et al., 2017). These interventions allowed athletes to more effectively manage critical situations in competition, where the differences between success and failure are often minimal.

An important aspect highlighted by the literature is that the effectiveness of mental training depends largely on the context in which it is implemented. Not only the methodological structure of psychological programs is relevant, but also the attitude of coaches, organizational culture and openness to interdisciplinary collaboration with sport psychologists (Stolarski et al., 2019; Park & Kim, 2024).

The studies reviewed show that coaches who perceive mental training as effective are more willing to systematically integrate it into athlete training and to collaborate with sports psychologists, which leads to superior results.

The review also highlights the essential role of social support and the training environment in maintaining performance and preventing psychological burnout. According to research by Madigan et al. (2021), athletes who benefit from adequate psychological support and functional relationships with coaches and technical staff demonstrate higher levels of motivation and resilience in the long term. In shooting sports, where careers can be long, this aspect is particularly important for maintaining high-level performance.

At the same time, the literature highlights the need to develop professional training programs for coaches, which include applied sports psychology components. The integration of mental training into current training requires specific skills, and the lack of these can limit the effectiveness of interventions (Epuran et al., 2001). Thus, the systemic approach, which combines technical, physical and mental training in a coherent framework, appears to be the most effective strategy for optimizing performance.

In conclusion, this systematic review confirms the importance of mental training as a determining factor of performance in shooting sports. Scientific evidence supports the systematic integration of psychological interventions into the sports training process, both at the junior and high-performance athletes level. The success of these interventions is conditioned by interdisciplinary collaboration, the attitude of coaches towards innovation and the existence of a favorable organizational framework.

By strengthening emotional self-regulation, concentration, and mental resilience, mental training contributes not only to increased athletic performance, but also to the psychological health and career sustainability of shooting athletes.

Further steps that need to be taken in the area of the paper's research could focus on investigating possible determinants of performance, especially with elite athletes, in order to confirm or refute existing findings.

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