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# The Effect of tDCS-Mindfulness Program on Self-Control and Emotion Regulation in Badminton Players

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A B S T R A C T

**Objective:** Mindfulness and tDCS have been shown to have psychological and physiological effects. However, the effects of using both simultaneously have not yet been fully determined. This study aimed to investigate the effect of a tDCS-mindfulness program on selective attention in skilled badminton players.

**Methods and Materials**: Thirty-six healthy skilled male badminton players were selected based on the study criteria and divided into three groups: A-tDCS-mindfulness, sham-tDCS-mindfulness, and control (N=12). The research variables were measured using pre- and post-tests. The Shapiro-Wilk test indicated that the data were normal; therefore, the t-test and one-way ANOVA were used to test the research hypotheses.

**Results**: The results showed that A significant difference was observed between the pre- and post-test scores for self-control and emotion regulation in both the A-tDCS and sham-tDCS mindfulness groups. In the between-groups comparison effect, it was also found that there was a significant difference in self-control and emotion regulation, and post-hoc analysis showed that the A-tDCS-mindfulness, sham-tDCS-mindfulness, and control groups had the best SC and ER, respectively.

**Conclusions**: This study supports the effectiveness of tDCS-mindfulness on self-control and emotion regulation in badminton players. The results also indicate that the simultaneous use of tDCS and mindfulness was more effective than mindfulness alone.

***Keywords:*** *Motivation, Performance, Physical education, Intervention, Students.*

## 1. Introduction

Self-control (SC) refers to an individual's ability to inhibit prevailing response tendencies and manage behaviors, thoughts, and emotions to achieve favorable long-term goals (1). In sports, controlling impulses or behavioral tendencies is critical to high performance; for example, athletes need to reduce their anxiety levels in high-pressure situations such as athletic competitions to become calmer and more focused. A review of previous research on SC and athletic performance underscores the importance of SC use in sports. Findings indicate that low levels of SC are associated with poor athletic performance in various tasks (2), reduced likelihood of successful training programs (3), and impaired performance under pressure (4). Therefore, it can be concluded that SC serves as a critical factor, and its

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effectiveness varies depending on the type of sport and the level of professional performance.

Self-regulation refers to any effort made by people to modify their internal states or responses, including actions, thoughts, feelings, and task performance. It is argued that such efforts are fundamental to human functioning and foster individual and cultural flourishing by promoting moral, disciplined, and virtuous behavior while inhibiting hostile and aggressive impulses that underlie prosocial behavior (5). Emotion regulation (ER) involves being aware of personal emotional experiences, accurately identifying emotions, and adjusting emotional responses according to situational demands or individual goals (6). Thompson (1994) defined ER as "external and internal processes responsible for monitoring, evaluating, and modifying emotional responses to achieve goals" (7). There is growing support for the notion that ER is critical for individuals (8), teams (2), and other personnel in sports and sports performance outcomes. Research has also suggested that emotions are discrete experiences that serve socially constructive purposes (9). Given the extensive literature emphasizing the functional implications of emotions experienced before and during sports competition, the existence of such effects is unsurprising (10). Given that ER and SC strategies are prerequisites for peak performance in competitive sports, mindfulness training could serve as a valuable mental training technique in competitive sports (11).

The notion that mindfulness can significantly influence athletes' motor and cognitive performance is not a novel concept and has been substantiated by various researchers; for instance, Birrer, Röthlin, and Morgan (2012) showed that mindfulness's impact on psychological skills could develop and improve the effectiveness of mindfulness-based interventions in sports (12). The results of previous studies have provided evidence that mindfulness is effective in improving athletic performance (13), reducing anxiety (14) symptoms of stress and burnout (15), athletes' flow (16) and cognitive function (17). In fact, it can influence both functional and cognitive aspects of athletes.

Mindfulness has been defined as 'the awareness that emerges through paying attention on purpose, in the present moment, and non-judgmentally to the unfolding of experience moment by moment' (18). In mindfulness, what is common to different definitions is attention and awareness of the present, purposefulness, and attention to behavior without judgment (19); in fact, it is included in the interventions of the third wave of cognitive behavioral therapy, which emphasizes the present and acceptance. When a person pays attention to the present without judgment, they are no longer preoccupied with the past or worry about the future. Psychologists have found that most cognitive problems are exacerbated when a person is preoccupied with past events or worries about an unknown future (20). Mindfulness addresses this issue by fostering a shift in perception, and subsequently, a change in self-concept. It is crucial for athletes to be fully present without bias or judgment while competing, and mindfulness is a tool that can provide these conditions for athletes. It guides athletes to consciously utilize their physical and cognitive abilities. In mindfulness, athletes' distance themselves from their emotions, thoughts, and perceptions by adopting the perspective of an external observer. In this state, individuals become aware of emotions and thoughts that occur without identifying them. This external observer perspective prevents athletes from being overwhelmed by their emotions and thoughts, providing an opportunity to consciously choose whether to follow certain thoughts or to focus on something else. Through this technique, athletes achieve emotional stability and learn to focus on the present moment (11).

To use mindfulness in sports, there are various programs, the most reliable of which is mindful sports performance enhancement (MSPE), designed by Kaufman et al. (2018). The MSPE program spans six weeks, with each week featuring a session lasting 1.5 to 2 hours. The researcher was concerned that requesting this significant time commitment from the athletes might lead to reluctance to participate due to their busy lives and careers. Given that these athletes were not actively seeking performance improvement or addressing physical or mental issues, the decision was made to incorporate a moderator to streamline the number and duration of sessions, focusing on the simultaneous use of tDCS and mindfulness.

tDCS can modulate neural processing in the human brain, influencing cognition and behavior, making it an effective method for both daily activities and sports (21). The process involves applying a low-intensity direct current (ranging between 1 and 4 mA) to the skin between the two cathode and anode electrodes at a specific location on or outside the skull. Numerous studies have demonstrated that the electric current in tDCS can permeate the skull, impacting neural tissue and blood vessels (22). Recent findings indicate that tDCS leads to an increase in neuroplasticity (23). The extent and duration of physiological changes also affect the current intensity and application duration (24). tDCS has the potential to induce both physiological and behavioral

alterations. One of the significant effects of tDCS is its ability to reduce the duration of treatment or intervention periods. Based on this, and considering the reported positive effects of tDCS in athletes, such as enhanced cognitive functions (25), enhanced selective attention (26), improved balance and performance in basketball players (21), and generally enhanced and improved athletic performance (27); also, its positive effects on psychological factors, including cognitive tools and skills, have been well defined (28), and it has been widely used to improve motor performance (29), It can be utilized concurrently with mindfulness to shorten the duration of mindfulness sessions while increasing their effectiveness (30). Based on these considerations, the current study aimed to investigate whether a five-session tDCS-mindfulness program can impact ER and SC in badminton players.

Based on the literature review and the limitations of previous studies, we aim to address the question of whether a 5-session tDCS-mindfulness program can improve ER and SC in badminton players.

## 2. Materials and Methods

This study employed a semi-experimental pre-test and post-test design with a control group to investigate the effects of tDCS-mindfulness on SC and ER in male badminton players. 36 healthy skilled right-handed male badminton players from Hamedan City were selected based on the inclusion and exit criteria. They were randomly assigned to three groups: A-tDCS-mindfulness (n=12), sham-tDCS-mindfulness (n=12), and control (n=12). Before the start of the experimental period, all participants completed the Edinburgh Handedness Inventory (EHI), DASS-21, SC, and ER inventory. The A-tDCS-mindfulness group listened to a guided mindfulness audio through a high-quality sound system while simultaneously receiving anodal tDCS (ActivaDose, ActivaTeK Inc., Salt Lake City, Utah, USA) with sponge pads of 5 × 5 $cm^2$. The positive electrode (anode) was placed over F8 -according to the 10-20 brain system, and a negative electrode (cathode) was placed over the left supraorbital region, with a current of 1.5 mA for 30 min. In accordance with a previous study by Badran et al. (2017), all tDCS-related instructions were set (31).

In the sham-tDCS-mindfulness group, all conditions mirrored those of the A-tDCS-mindfulness group, but the current was disconnected after 30 seconds without informing the participant. The entire intervention consisted of five sessions of continuous tDCS-mindfulness with a 24 h interval between the sessions. Finally, post-test (SC and ER questionnaires) measurements were taken after the fifth session.

The inclusion criteria for the study were skilled male badminton players with at least five years of experience, average age of 18-30, right-handed (based on EHI), and participants with a psychiatric or neurological disease, head trauma, history of alcohol or drug abuse, and/or previous tDCS therapy or mindfulness. Exit criteria included the subject's unwillingness to cooperate; scoring on the moderate, high, or very high scale of the DASS-21 Questionnaire; missing more than one session of training programs; and failure to record data or occurrence of errors in programs and tools.

### *2.1 Tools*

**Self-Control Questionnaire**: The abbreviated form of Tangney et al. (2004) Self-Control Questionnaire, which includes 13 statements on a 5-point Likert scale, was used to measure people's control over themselves. It is scored by assigning 1 point for never, 2 points for rarely, 3 points for sometimes, 4 points for often, and 5 points for very often (32).

**Emotion Regulation Questionnaire**: Garnefski and Kraaij's (2006) Emotion Regulation Questionnaire was used. It is an 18-item form scored on a 5-point Likert scale ranging from never (1 point) to always (5 points) (33).

**Edinburgh Handedness Inventory (EHI)**: The EHI is a measurement scale used to assess a person's right- or left-hand dominance in everyday activities, such as writing, drawing, throwing, using scissors, brushing, using a knife, using a spoon, sweeping, matching, and opening a can lid. In this scale, individuals indicate their hand preference for each action by selecting one of the following options: always use the right hand, usually use the right hand, always use the left hand, usually use the left hand, and no difference in the use of the right or left hand (34).

**DASS-21 Questionnaire**: This scale is a shortened version of the original 42-item questionnaire that was reduced to 21 items by removing some items. The questionnaire included 8 items related to depression (D), 7 items related to anxiety (A), and 6 items related to stress (S), measuring these factors in both normal and clinical populations (35).

### *2.2 Statistical Analysis*

Descriptive and inferential statistical methods were used to analyze the data. The Shapiro-Wilk test was used to assess the normality of the data distribution. A paired t-test was used for within-group effects, and one-way way ANOVA was used for between-group effects. Statistical analysis was performed using SPSS software version 26, with a significance level of α=0.05.

## 3. Results

The descriptive statistics of the demographic and measured variables are shown in Table 1.

**Table 1.** Mean and Standard deviation of all variables

| Groups | A-tDCS mindfulness | | Sham-tDCS mindfulness | | Control | |
|---|---|---|---|---|---|---|
| Variables | X | SD | X | X | SD | X |
| Age (year) | 22.67 | 2.535 | 24.25 | 3.519 | 24.42 | 3.118 |
| High (cm) | 178.58 | 1.832 | 177.00 | 6.150 | 177.58 | 5.054 |
| Wight (kg) | 77.25 | 1.712 | 74.58 | 4.400 | 73.00 | 2.892 |
| BMI | 24.227 | .658 | 23.83 | 1.336 | 23.183 | 1.324 |
| History (year) | 4.83 | 1.030 | 5.17 | 2.406 | 3.92 | .669 |
| DASS-21 | 2.17 | 2.329 | .67 | 1.303 | .83 | 1.586 |
| SC (Pre) | 28.42 | 2.968 | 29.00 | 2.828 | 28.83 | 4.933 |
| SC (Post) | 49.58 | 1.311 | 42.58 | 1.832 | 28.83 | 4.549 |
| ER (Pre) | 35.92 | 2.234 | 36.50 | 3.317 | 36.00 | 2.663 |
| ER (Post) | 55.42 | 1.676 | 43.25 | 3.494 | 36.00 | 2.954 |

The Shapiro-Wilk test was used to assess the normality of the data distribution, and the results indicated normality for all variables ($P > 0.05$). Subsequently, the paired samples t-test for within-group effects revealed a significant difference ($P < 0.05$) between the pre- and post-test SC and ER scores in both the A-tDCS and sham-tDCS groups. However, no significant differences were observed in the control group. One-way ANOVA was performed to examine between-group differences (Table 2).

**Table 2.** Examining between-group effect in SC and ER of three groups using one-way ANOVA

| Variables | Sum of Squares | Df | Mean Squares | F | Sig | Eta |
|---|---|---|---|---|---|---|
| SC | 2674.500 | 2 | 1337.250 | 155.659 | .001 | .904 |
| ER | 2310.389 | 2 | 1155.194 | 145.966 | .001 | .898 |

The result showed that There was a significant difference between the three groups ($P < 0.05$) in both SC and ER. The Bonferroni test was used for post-hoc determination, which showed a significant difference in the SC and ER results between the A-tDCS-mindfulness group and the other two groups, as well as between the sham-tDCS-mindfulness group and the control group. Additionally, a check of the means showed that the A-tDCS-mindfulness, sham-tDCS-mindfulness, and control groups had the best SC and ER, respectively.

## 4. Discussion

This study was conducted to investigate the effects of a tDCS-mindfulness program on the SC and ER of skilled badminton players. The results showed significant improvements in SC and ER in both the anodal and sham mindfulness groups, but no significant difference was observed in the control group. In the between-groups effect, it was also found that there was a significant difference in SC and ER between the three groups: the A-tDCS-mindfulness, sham-tDCS-mindfulness, and the control group had the best performance.

By reviewing the results of the present study, we can identify the effects of tDCS as a therapeutic and adjunctive therapy method. tDCS is considered a "neuromodulator" in which a weak electric current is passed through electrodes placed on the scalp and leads to specific changes in the polarity of the desired cortex (36), and increases nerve depolarization and cortical-spinal excitability. tDCS not only exerts a neuromodulatory effect on the stimulated region but also modulates distal regions connected to the stimulated region (37). Neuroplasticity is the ability of the central nervous system (CNS) to change in response to experience, use, or environmental demands and is known to be a neural substrate for skill acquisition and recovery from

brain injury (38). These changes, along with mindfulness, are helpful factors that can increase the synergistic effects of the training protocol. Another effect of using tDCS along with other interventions is the reduction in the duration of the treatment or intervention period (39). This case is very important because, in sports, and especially in championship sports, most athletes do not seek to improve their performance or their physical or mental problems, and the existence of training programs and interventions with long sessions raises this concern among researchers. It is possible for athletes to demand this long time because of their busy lives and careers, and sometimes during pre-season training or before competition, there is a need for interventions that are highly effective in a short period of time. Therefore, designing shortened mindfulness programs using tDCS may be a solution. Therefore, in the present study, a shortened version of mindful sport performance enhancement (MSPE) designed by Kaufman et al. (2018) was used along with tDCS.

Previous studies have also used brief examples of mindfulness and reported its usefulness. For example, Mackenzie et al. (2006) reported that four 30-minute mindfulness sessions led to significant improvements in symptoms of occupational depression, relaxation, and life satisfaction in nurses (40). Therefore, based on recent findings, it can be stated that the mindfulness program and the simultaneous use of tDCS may have promising results in improving the SC and ER ability of badminton players; in terms of intervention duration, it is more optimal than standard mindfulness interventions.

## 5. Conclusion

In conclusion, this study supports the effectiveness of tDCS-mindfulness on self-control and emotion regulation in badminton players. The results also indicate that the simultaneous use of tDCS and mindfulness was more effective than mindfulness alone.

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## Conflict of Interest

The authors declare no conflict of interest.

## Author Contributions

All authors contributed to the original idea, study design, writing and editing the manuscript, which was approved as a final draft.

## Data Availability Statement

The dataset presented in the study is available on request from the corresponding author during submission or after its publication. The data are not publicly available due to ethical considerations.

## Ethical Considerations

The study was conducted in accordance with the Declaration of Helsinki. This study was approved by the Ethics Committee (no. IR.UT.SPORT.REC.1401.049). Written consent was obtained from all participants prior to the commencement of the study.

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## References

1. Liang W, Wang DD, Shang BR, Zhang C-Q, Duan YP, Si GY. Further examination of the psychometric properties of the Brief Self-Control Scale: evidence from Chinese athletes and students. International Journal of Sport and Exercise Psychology. 2022;20(1):16-35. [DOI]
2. Wagstaff CR, Weston NJ. Examining emotion regulation in an isolated performance team in Antarctica. Sport, Exercise, and Performance Psychology. 2014;3(4):273. [DOI]
3. Allom V, Panetta G, Mullan B, Hagger MS. Self-report and behavioural approaches to the measurement of self-control: Are we assessing the same construct? Personality and Individual Differences. 2016;90:137-42. [DOI]
4. Landman A, Nieuwenhuys A, Oudejans RR. Decision-related action orientation predicts police officers' shooting performance under pressure. Anxiety, stress, & coping. 2016;29(5):570-9. [PMID: 26215425] [DOI]
5. Bauer IM, Baumeister RF. Self-regulatory strength. Handbook of self-regulation: Research, theory, and applications. 2011;2:64-82.
6. Gratz KL, Roemer L. Multidimensional assessment of emotion regulation and dysregulation: Development, factor structure, and initial validation of the difficulties in emotion regulation scale. Journal of psychopathology and behavioral assessment. 2004;26:41-54. [DOI]
7. Thompson RA. Emotion regulation: A theme in search of definition. Monographs of the society for research in child development. 1994:25-52. [PMID: 7984164] [DOI]
8. Lane AM, Beedie CJ, Jones MV, Uphill M, Devonport TJ. The BASES expert statement on emotion regulation in sport. Journal of sports sciences. 2012;30(11):1189-95. [PMID: 22709410] [DOI]

9. Fletcher D, Hanton S, Wagstaff CR. Performers' responses to stressors encountered in sport organisations. Journal of sports sciences. 2012;30(4):349-58. [PMID: 22236205] [DOI]
10. Hanin YL. Coping with anxiety in sport. Coping in sport: Theory, methods, and related constructs. 2010;159:175.
11. Jekauc D, Kittler C, Schlagheck M. Effectiveness of a mindfulness-based intervention for athletes. Psychology. 2016;8(1):1-13. [DOI]
12. Birrer D, Röthlin P, Morgan G. Mindfulness to enhance athletic performance: Theoretical considerations and possible impact mechanisms. Mindfulness. 2012;3(3):235-46. [DOI]
13. Bulğay C, Tingaz EO, Bayraktar I, Çetin E. Athletic performance and mindfulness in track and field athletes. Current Psychology. 2022;41(7):4482-9. [DOI]
14. Scott-Hamilton J, Schutte NS. The role of adherence in the effects of a mindfulness intervention for competitive athletes: Changes in mindfulness, flow, pessimism, and anxiety. Journal of Clinical Sport Psychology. 2016;10(2):99-117. [DOI]
15. Moen F, Federici RA, Abrahamsen F. Examining possible Relationships between mindfulness, stress, school-and sport performances and athlete burnout. International Journal of Coaching Science. 2015;9(1).
16. Aherne C, Moran AP, Lonsdale C. The effect of mindfulness training on athletes' flow: An initial investigation. The Sport Psychologist. 2011;25(2):177-89. [DOI]
17. Zhu Y, Sun F, Li C, Chow DH, Wang K. Acute effect of brief mindfulness-based intervention coupled with fluid intake on athletes' cognitive function. Journal of Sports Science & Medicine. 2020;19(4):753.
18. Kabat-Zinn J. Mindfulness meditation for everyday life. New York: Hyperion; 1994.
19. Kabat-Zinn J. Mindfulness. Mindfulness. 2015; 6 (6): 1481–3. [DOI]
20. Zeidan F, Grant J, Brown C, McHaffie J, Coghill R. Mindfulness meditation-related pain relief: evidence for unique brain mechanisms in the regulation of pain. Neuroscience letters. 2012;520(2):165-73. [PMID: 22487846] [PMCID: PMC3580050] [DOI]
21. Veldema J, Engelhardt A, Jansen P. Does anodal tDCS improve basketball performance? A randomized controlled trial. European Journal of Sport Science. 2022;22(2):126-35. [PMID: 33297843] [DOI]
22. Hamner J, Villamar MF, Fregni F, Taylor JA. Transcranial direct current stimulation (tDCS) and the cardiovascular responses to acute pain in humans. Clinical Neurophysiology. 2015;126(5):1039-46. [PMID: 25288502] [DOI]
23. Cavaleiro C, Martins J, Goncalves J, Castelo-Branco M. Memory and cognition-related neuroplasticity enhancement by transcranial direct current stimulation in rodents: a systematic review. Neural plasticity. 2020;2020. [PMID: 32211039] [PMCID: PMC7061127] [DOI]
24. Paulus W. Transcranial electrical stimulation (tES – tDCS; tRNS, tACS) methods. Neuropsychological rehabilitation. 2011;21(5):602-17. [PMID: 21819181] [DOI]
25. Flöel A. tDCS-enhanced motor and cognitive function in neurological diseases. Neuroimage. 2014;85:934-47. [PMID: 23727025] [DOI]
26. Jacoby N, Lavidor M. Null tDCS effects in a sustained attention task: the modulating role of learning. Frontiers in psychology. 2018;9:476. [PMID: 29681876] [PMCID: PMC5897507] [DOI]
27. Machado S, Jansen P, Almeida V, Veldema J. Is tDCS an adjunct ergogenic resource for improving muscular strength and endurance performance? A systematic review. Frontiers in psychology. 2019;10:1127. [PMID: 31156520] [PMCID: PMC6532530] [DOI]
28. Li Y, Wang J, Ye H, Luo J. Modulating the activity of vmPFC regulates informational social conformity: A tDCS study. Frontiers in psychology. 2020;11:566977. [PMID: 33041931] [PMCID: PMC7527649] [DOI]
29. Yavari Kateb M, Moghadas Tabrizi Y, Shahrbanian S, Gharayagh Zandi H, Behjame F. Effects of Transcranial direct current stimulation on Imagery ability in students. Journal of Applied Psychological Research. 2018;9(1):149-65.
30. Kateb MY, Arabameri E, Rostami R, zandi HG, tabrizi YM. The Effects of a tDCS-Mindfulness Program on Some Cognitive and Psychological Factors in skilled Badminton Players. Tehran, Iran: University of Tehran; 2023.
31. Badran BW, Austelle CW, Smith NR, Glusman CE, Froeliger B, Garland EL, et al. A double-blind study exploring the use of transcranial direct current stimulation (tDCS) to potentially enhance mindfulness meditation (E-Meditation). Brain Stimulation: Basic, Translational, and Clinical Research in Neuromodulation. 2017;10(1):152-4. [PMID: 27839723] [DOI]
32. Besharat MA. Cognitive emotion regulation questionnaire: instruction and scoring. 2016.
33. Garnefski N, Kraaij V. Cognitive emotion regulation questionnaire–development of a short 18-item version (CERQ-short). Personality and individual differences. 2006;41(6):1045-53. [DOI]
34. Oldfield RC. The assessment and analysis of handedness: the Edinburgh inventory. Neuropsychologia. 1971;9(1):97-113. [PMID: 5146491] [DOI]
35. Fotohi Ardakani R, Mostofi H. The effectiveness of short-term behavioral activation therapy on reducing depression in students with clinical symptoms of depression. Journal of Psychology New Ideas. 2021;10(14):1-9.
36. Nitsche MA, Paulus W. Sustained excitability elevations induced by transcranial DC motor cortex stimulation in humans. Neurology. 2001;57(10):1899-901. [PMID: 11723286] [DOI]
37. Lang N, Nitsche M, Paulus W, Rothwell JC, Lemon RN. Effects of transcranial direct current stimulation over the human motor cortex on corticospinal and transcallosal excitability. Experimental brain research. 2004;156:439-43. [PMID: 14745467] [DOI]
38. Classen J, Liepert J, Wise SP, Hallett M, Cohen LG. Rapid plasticity of human cortical movement representation induced by practice. Journal of neurophysiology. 1998;79(2):1117-23. [PMID: 9463469] [DOI]
39. Meron D, Hedger N, Garner M, Baldwin DS. Transcranial direct current stimulation (tDCS) in the treatment of depression: systematic review and meta-analysis of efficacy and tolerability. Neuroscience & Biobehavioral Reviews. 2015;57:46-62. [PMID: 26232699] [DOI]
40. Mackenzie CS, Poulin PA, Seidman-Carlson R. A brief mindfulness-based stress reduction intervention for nurses and nurse aides. Applied nursing research. 2006;19(2):105-9. [PMID: 16728295] [DOI]