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ORIGINAL ARTICLE

Noise Cancelling Program: evaluating the implementation and effectiveness of a psychoeducational program for mental skills development in young athletes

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BACKGROUND
The Noise Cancelling Program is a six-month mental skills training (MST) intervention designed to enhance psychological functioning in young athletes aged 12-19. The program included modules on mindfulness, resilience, stress management, goal setting, and multi-sensory imagery.

PARTICIPANTS AND PROCEDURE
A total of 92 athletes from Polish schools with successful sports programs completed both the pretest and the posttest assessments six months later. The pre- and post-assessments consisted of three questionnaires: the Mental Toughness in Sport Questionnaire (MTSQ-19), Sport Imagery Questionnaire for Children (SIQ-C), and Mental Skills Questionnaire (MSQ). The program was conducted by six sport psychology students from a graduate program under the supervision of two academic sport psychologists and one practitioner. Each session lasted 45-60 minutes and was held twice monthly. The 12 sessions combined theoretical psychoeducation with practical skill-building exercises, reflective discussions, and interactive activities. Topics were the same across all groups; however, activities and level of discussion were adjusted to the younger groups (12-15 years old) and older groups (16-19 years old).

RESULTS
The results revealed significant improvements in participants' imagery use and mental skills application, with qualitative feedback highlighting mindfulness and imagery exercises as particularly impactful. By bridging gaps in psychological support within youth sports, the program emerges as a scalable, evidence-based model for integrating MST into middle- and high-school educational and athletic settings.

CONCLUSIONS
Future research should focus on the program's long-term impact in different age groups such as middle vs high school, and specific sports and cultural contexts.

KEY WORDS
youth sports; mental toughness; psychological skills; imagery; mental skills training

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BACKGROUND

Mental skills training (MST) is a foundational component of applied sport psychology, addressing the complex psychological demands faced by athletes across all levels (Henriksen et al., 2014; Makarowski et al., 2021; Vealey, 2024). The Mental Training Program (MTP) is based on the mental toughness model developed by Sheard and Golby, which builds upon previous research (e.g., the 4C model: Control, Commitment, Challenge, Confidence). For young athletes, these demands are especially acute, as they navigate the dual challenges of excelling in their chosen sports and academic study while managing the pressures of social and personal development (Gould et al., 2002). These challenges underscore the importance of providing structured psychological support, particularly during formative years when cognitive and emotional skills are still developing (Durlak et al., 2015; Merlin et al., 2024). Sheard and Golby (2006) examined a broad spectrum of mental skills and demonstrated the positive effects of the MTP on swimming performance. Similarly, Fournier et al. (2005) examined the impact of the MTP on gymnastics performance and the results showed that the MTP significantly improved imagery, relaxation, concentration, and re-concentration. Furthermore, ten gymnasts who underwent the MTP exhibited a five percent improvement in their competition performance compared to the control group. Key limitations of Fournier et al.'s (2005) research include the lack of placebo control condition and a small, non-representative sample of only ten young gymnasts. Furthermore, the ten-month duration of the intervention makes it challenging to isolate the specific effects of the training from external variables. The study also relies on self-report instruments, which are susceptible to subjectivity and social desirability bias.

The psychoeducational component, in particular, is pivotal within the MST, especially for student-athletes under the age of 20. This demographic represents a unique intersection of cognitive, emotional, and social development, making it an ideal period for introducing mental skills that can foster resilience, goal setting, and stress management, and promote positive body image (Martindale et al., 2005). Etnier (2009) suggested that the MST has a greater impact on adolescents than on adults, with adolescents being more open to positive mental changes. Despite these evident effects, there remains a critical shortage of sport psychologists who can deliver the MST, leaving many young athletes without the resources they need to thrive both in sports and life (Henriksen et al., 2014).

Mental toughness is one of the key results of consistent mental skills training and forms a foundation for high-level performance (Predoiu et al., 2024). Etnier (2009) also viewed mental toughness as a general concept that develops through mental skills training. Components of mental toughness, such as self-confidence and control, grow through mental training (Sheard & Golby, 2006). Mental toughness training included techniques such as visualization, mindfulness training, goal setting, deep breathing, and positive self-talk. Etnier (2009) defined mental toughness as an umbrella term describing personal characteristics that enable effective coping with stress, distractions, and adversity (Przybylski, 2011). Unlike adult athletes, young athletes are still developing their identity both within and outside of sports, which makes them more susceptible to the adverse effects of stress and pressure from competition and academic demands (Crust & Glough, 2011). Literature suggests that mental toughness and resilience are critical predictors of success in both sports and life (Gucciardi et al., 2012; Rawat et al., 2023). Mental toughness has been shown to be trainable through structured psychological interventions (Gucciardi, 2010). Similarly, resilience-building techniques that emphasize reflection, mindfulness, and adaptive thinking are particularly impactful for young athletes, helping them to develop coping strategies that extend beyond the playing field (Gucciardi et al., 2012).

Previous studies have highlighted the importance of teaching student-athletes to manage stress, communicate effectively, and build a growth-oriented mindset during their formative years (Henriksen et al., 2014). The psychoeducational framework of this program aimed to mitigate these stressors by teaching athletes how to recognize and manage their emotional and cognitive responses to challenging situations. This included mindfulness exercises and mental-toughness building techniques (Joyce et al., 2018). These strategies were designed to help young athletes develop a robust mental toolkit that they can rely on throughout their athletic and personal journeys.

With one psychologist often serving thousands of students in schools and a general scarcity of sport psychologists (Sohn, 2024), it is imperative to equip young athletes with self-regulatory tools that they can practice independently (Merlin et al., 2024). This program focused predominantly on fostering these skills through evidence-based methods, including mindfulness exercises (Carsley et al., 2015), goal-setting workshops (Epton et al., 2017), and multi-sensory imagery techniques (Rhodes & May, 2022).

The Noise Cancelling Program was designed to incorporate these elements into a systematic, age-appropriate framework that aligns with the developmental needs of young athletes. The term "Noise Cancelling" reflects the program's aim to help young athletes filter out the overwhelming internal and external distractions, so they can focus on what truly matters in the present moment: their mindset, effort, and execution. The idea for the name was derived from the book entitled *Noise* by Kahneman et al. (2021).

The study is unique in presenting the first long-term (6 month) and holistic MST program in Poland implemented in sports schools, integrating mental training with psychoeducation and social emotional competencies. The project is the first to demonstrate a scalable model of MST implementation delivered by trained students under supervision, addressing the shortage of sport psychologists. It also fills a key research gap by offering a long-term MST intervention in a school environment and providing a new, validated tool (MSQ) for measuring knowledge, use, and effectiveness of mental skills.

HYPOTHESES

Upon completion of the program, participants are expected to demonstrate higher levels of knowledge, more frequent use of mental skills, and increased perceived effectiveness of these skills, as measured by the Knowledge and Use subscales of the MSQ, and increased mental resilience and imagery ability, as measured by the MTSQ, and the SIQ-C subscales, compared to their pre-intervention scores.

PARTICIPANTS AND PROCEDURE

PARTICIPANTS

The study recruited a total of 253 student-athletes aged 12-19 years (M = 13.84, SD = 2.33; 81 females, 165 males, and 4 self-identified as other) from primary and secondary sports schools in Gdansk (Poland). The participants were selected based on their enrollment in sports schools or sports championship schools; no further requirements were applied. The participants were a relatively experienced sample of student-athletes with an average of 7.34 years of experience in both individual and/or team sports (SD = 2.5).

Participants received the same topics with slightly adjusted levels of description and practice according to their age; the age groups were adjusted to 15 and under (N = 192), and 16 and over (N = 58) as a cognitive maturity threshold and school organization and logistics. A total of 253 participants initially enrolled in the intervention. Of these, 92 participants completed the full intervention and provided post-intervention data, due to the timing of the school year and sporting seasons. Baseline analyses were conducted using the full sample in accordance with an intent-to-treat approach, while pre-post analyses were conducted on participants who completed the intervention.

The data revealed that handball was the most represented sport among participants (27.39%), followed closely by swimming (11.74%). Football (10%) and athletics (11.30%), which included specific events such as track and field, running, and throwing, were also highly common, with significant representation. Team sports, particularly handball and football, dominated the data, reflecting strong engagement in group-based activities. In contrast, individual sports such as athletics, swimming, and gymnastics were also well represented, showcasing the diversity of sporting preferences and participation among the groups. This distribution highlights a balance between team-oriented and individual pursuits within the sample.

PSYCHOEDUCATIONAL MODULES

Participants engaged in a 12-session mental skills training intervention, tailored for athletes aged 12-19. The program was designed to systematically build core mental skills through structured, age-appropriate modules. Each session targeted a specific psychological competency, progressing from foundational themes such as goal setting and communication to advanced topics such as stress management, resilience, and mental imagery.

Sessions were interactive, combining psychoeducation, group discussions, role-play, and reflective exercises. For example, athletes explored effective communication through scenario-based tasks and role-play, while stress management was addressed via mindfulness, guided imagery, and coping simulations. The final session focused on developing a personal action plan to sustain mental skills practice beyond the program. Each module lasted 45-60 minutes and was delivered twice a month in group settings by trained sport psychology graduate students. Participants received materials and guidance to reinforce techniques between sessions.

The 12 modules included in the program were:

Goal Setting and Values – an introduction to structured goal-setting, including the WOOP (Wish, Outcome, Obstacle, Plan) framework, and the identification of personal and team values that underpin motivation and sustained engagement.

Communication – development of effective verbal and non-verbal communication skills, with emphasis on role clarity, cooperation, and interpersonal effectiveness in sport-specific contexts.

Mental Health Awareness – foundational education on psychological well-being, incorporating mindfulness-based practices and reflective journaling to enhance emotional awareness and stress regulation.

Growth Mindset – cultivation of a growth-oriented cognitive framework through the examination and modification of maladaptive beliefs, fostering adaptive interpretations of effort, mistakes, and progress.

Reducing Overthinking – application of techniques aimed at reducing rumination and intrusive thoughts, with a focus on sustaining task-relevant attention during training and competition.

Performing Under Stress – instruction in strategies for managing physiological and cognitive aspects of performance-related stress, including arousal regulation and structured pre-performance preparation.

Resilience – enhancement of mental resilience through guided reflection on setbacks, appraisal of coping resources, and the development of adaptive responses to adversity.

Self-Talk – identification and systematic modification of internal dialogue to strengthen self-regulation, confidence, and task execution.

Multi-Sensory Imagery – training in multi-modal imagery to support technical, emotional, and strategic preparation, with emphasis on vividness, controllability, and sport-specific application.

Pre-Start Routine – development of individualized pre-competitive routines to promote readiness, consistency, and optimal performance conditions.

Concentration – training focused on attentional control, including maintaining, shifting, and refocusing attention in dynamic and demanding sport environments.

Tools Beyond the Program – consolidation of acquired mental skills and formulation of individualized plans for continued mental skills practice beyond the intervention period.

A detailed description of each session and associated exercises is available in Supplementary materials.

The intervention was delivered by six graduate sport psychology students who received structured preparatory training, including theoretical instruction in youth sport psychology, familiarization with standardized session protocols, and practice-based workshops. Throughout the program, they operated under continuous supervision provided by two academic sport psychologists and one applied practitioner, who ensured methodological accuracy and professional quality. Treatment fidelity was monitored using standardized session scripts, post-session checklists completed by facilitators, periodic supervision meetings, observational audits of selected sessions, and brief written reports documenting adherence to session objectives and any deviations from protocol.

The training students included:

Theoretical instruction covering sport psychology, the principles of the Noise Cancelling Program, and best practices for working with youth athletes.

Practical workshops, during which students practiced session delivery, group facilitation, responding to group-based challenges, and applying specific techniques (mindfulness, imagery, self-talk work).

Familiarization with standardized materials, including detailed scripts for all 12 modules, worksheets, and implementation guidelines.

Initial supervision, during which experienced sport psychologists assessed the students' readiness to deliver the program independently.

STUDY DESIGN

The program was developed by academic sport psychologists with extensive experience working with youth athletes. This study employed a six-month long pretest-posttest design to evaluate the effectiveness of the Noise Cancelling Program. Data were collected at two main time points: before the intervention (pretest) and after the final session (posttest). A control group was not included in this study due to growing ethical concerns around withholding potentially beneficial interventions from participants. Recent discussions in applied practice emphasize that when an intervention has demonstrated effectiveness – particularly in enhancing well-being, mental skills, or performance – it may be unethical to deny access to it for the sake of experimental control (Moore et al., 2015). In this context, ensuring that all participants receive support aligns with both best ethical practices and the duty of care owed to young athletes. The intervention spanned six months and was implemented in group settings during regular school schedules. Session length and frequency were selected to meet methodological requirements while also fitting within school constraints, such as the standard 45-minute lesson structure.

PROCEDURE

The pilot version of the Noise Cancelling Program was originally developed and tested in England (the format was adapted as a result of an unpublished PhD research). For this study, the program content was expanded, modernized, translated, and adapted for the educational context of Polish sports schools. The program was conducted by six sport psychology students from a graduate program under the supervision of two academic sport psychologists and one practitioner. Each session lasted 45-60 minutes and was held twice a month. The 12 sessions combined theoretical psychoeducation with practical skill-building exercises, reflective discussions, and interactive activities. Topics were the same across all groups; however, language, activities, and level of discussion were adjusted to the younger groups (12-15 years old) and older groups (16-19 years old). The student facilitators verified addressing session's objectives by marking completed components after each session.

MEASURES

Mental Toughness in Sport Questionnaire (MTSQ-19). The MTSQ-19 (Przybylski & Karasiewicz, 2026) was employed to assess mental toughness among participants. This validated tool is a shortened version of the

original 42-item Mental Toughness in Sport Questionnaire (Przybylski, 2018). The MTSQ-19 consists of 19 items measuring a unidimensional construct of mental toughness, defined as the ability to remain resilient and focused under stress. The instruction is as follows: Decide which of the following factors occur in your life and to what extent they stress, annoy, irritate, or burden you. Determine the degree of annoyance of each of these factors on a scale of 1-7. Participants rated each statement on a 7-point Likert scale ranging from 1 (*not at all like me*) to 7 (*very much like me*). Higher scores indicate lower mental toughness. The tool has demonstrated robust psychometric properties, including high internal consistency (Cronbach's $\alpha = .87$) and test-retest reliability over a two-week period ($r = .84$).

Sport Imagery Questionnaire for Children (SIQ-C). The SIQ-C (Hall et al., 2009) in the Polish adaptation (Budnik-Przybylska & Karasiewicz, 2020) is a widely used measure of imagery use in youth sports, specifically designed for individuals aged 7-18. This 21-item self-report questionnaire assesses five distinct dimensions of imagery: (a) Cognitive Specific (CS; imagery related to the mental rehearsal of specific skills or techniques); (b) Cognitive General (CG; imagery involving overall strategies, routines, or game plans); (c) Motivational Specific (MS; imagery focusing on goal-directed behaviors and achieving specific outcomes); (d) Motivational General-Arousal (MGA; imagery linked to managing emotions such as excitement or anxiety); and (e) Motivational General-Mastery (MGM; imagery that fosters confidence, control, and resilience). This measure allowed for a nuanced understanding of how imagery practices were integrated into participants' mental skills repertoire. Participants responded to items using a 5-point Likert scale ranging from 1 (*never*) to 5 (*always*). The SIQ-C has demonstrated strong reliability across its subscales, with internal consistency coefficients ranging from .78 to .92.

Mental Skills Questionnaire (MSQ). A custom-designed questionnaire was developed specifically for this study to evaluate participants' understanding, application, and perceived effectiveness of the mental skills taught in the intervention. The questionnaire included: (a) knowledge with items assessing participants' comprehension of key mental skills concepts (e.g., "I understand how mindfulness can help me reduce overthinking"); (b) application with items evaluating how frequently participants applied the skills (e.g., "I use goal-setting techniques during practice"); and (c) perceived impact with items measuring participants' perceptions of the effectiveness of these skills (e.g., "Using imagery helps me feel more prepared for competition"). Participants rated their responses on a 7-point Likert scale from 1 (*strongly disagree*) to 7 (*strongly agree*). A 7-point Likert scale was used as it offers an optimal balance between sensitivity and participant usability, allowing for greater variability in responses without overwhelming the respondent.

An exploratory factor analysis was conducted to evaluate the construct validity of the MSQ. The results supported a three-factor structure (knowledge, application, impact). Model fit was acceptable (RMSR = 0.05; RMSEA = 0.075). Reliability was strong, with omega total = .95 and subscale ω ranging from .76 to .90. These results support both the structural validity and reliability of the MSQ and justify its use as a tool for assessing mental skill knowledge, use, and perceived effectiveness.

RESULTS

DESCRIPTIVE STATISTICS

A total of 92 participants completed both pretest and posttest measures. Participants ranged in age from 12 to 19 years ($M = 14.04$, $SD = 1.66$) and gender (16 females, 74 males and 2 self-identified as other). The majority participated in team sports, while the remainder were involved in individual sports.

T-TEST (PRE AND POST MEASURES)

The paired *t*-test results revealed significant improvements across most measures, indicating the effectiveness of the Noise Cancelling Program. For the Mental Skills Questionnaire (MSQ), all subscales demonstrated significant positive changes; all results can be found in Table 1.

The baseline comparisons between the age groups indicated significant differences. The younger group (12-15 years) included a higher proportion of females compared to the older group, $\chi^2(1) = 8.00$, $p = .018$. They also reported greater use of mental skills, $t(248) = 3.45$, $p = .001$, and higher cognitive general imagery, $t(248) = 2.16$, $p = .030$. As expected, the older group reported more years of sport experience, $t(248) = -2.16$, $p = .035$.

The knowledge subscale showed a robust improvement, $t(91) = -5.76$, $p < .001$, with a mean difference of −0.63 (95% CI [−0.85, −0.42]), reflecting a significant increase in participants' understanding of mental skills. Similarly, the use subscale exhibited the largest effect, $t(91) = -7.14$, $p < .001$, with a mean difference of −0.72 (95% CI [−0.93, −0.52]), indicating that participants applied mental skills more frequently after the intervention. The impact subscale also showed a significant improvement, $t(91) = -2.70$, $p = .008$, with a mean difference of −0.25 (95% CI [−0.43, −0.06]).

For the imagery subscales, significant improvements were observed across cognitive and motiva-

Table 1

Pre- and post-intervention means, standard deviations, and paired t-test results for mental skills and imagery measures (N = 92)

Measure	Pre *M*	Pre *SD*	Post *M*	Post *SD*	*t*(91)	*p*
Total Mental Skills	4.36	0.92	4.90	0.82	−6.11	< .001
Knowledge	4.37	1.04	5.01	0.88	−5.76	< .001
Use	3.80	1.04	4.52	0.92	−7.13	< .001
Impact	4.92	1.05	5.17	0.90	−2.70	.008
CS (Cognitive Specific)	3.23	0.97	3.57	1.45	−2.23	.028
CG (Cognitive General)	3.14	0.81	3.53	1.16	−2.89	.005
MS (Motivational Specific)	3.10	0.89	3.54	1.38	−2.86	.005
MGA (Motivational General-Arousal)	3.26	1.02	3.93	1.47	−3.90	< .001
MGM (Motivational General-Mastery)	3.46	0.73	3.75	1.18	−1.94	.056
MTSQ-19	4.45	1.21	4.35	1.30	0.94	.349

Note. Higher scores indicate greater endorsement of the measured construct. CS – Cognitive Specific imagery; CG – Cognitive General imagery; MS – Motivational Specific imagery; MGA – Motivational General-Arousal imagery; MGM – Motivational General-Mastery imagery; MTSQ-19 – Mental Toughness in Sport Questionnaire-19.

tional dimensions. Cognitive specific imagery (CS) improved significantly, $t(91) = -2.23$, $p = .028$, with a mean difference of −0.35 (95% CI [−0.65, −0.04]). Cognitive general imagery (CG) also increased, $t(91) = -2.89$, $p = .005$, with a mean difference of −0.38 (95% CI [−0.66, −0.12]). Motivational specific imagery (MS) improved significantly, $t(91) = -2.86$, $p = .005$, with a mean difference of −0.44 (95% CI [−0.74, −0.13]). Notably, motivational general arousal imagery (MGA) showed the largest change, $t(91) = -3.90$, $p < .001$, with a mean difference of −0.67 (95% CI [−1.01, −0.33]). Motivational general mastery imagery (MGM) approached significance, $t(91) = -1.94$, $p = .056$, with a mean difference of −0.29 (95% CI [−0.58, 0.01]).

In contrast to these findings, mental toughness (MTSQ-19) did not show a significant change, $t(91) = 0.94$, $p = .349$, with a mean difference of 0.11 (95% CI [−0.12, 0.34]). This suggests that the intervention did not directly affect mental toughness, indicating that this construct may require a longer or more targeted approach.

DISCUSSION

The aim of this study was to evaluate the long-term effectiveness of the Noise Cancelling Program, a comprehensive mental skills training (MST) intervention designed for young athletes aged 12-19. The intervention integrated core components known to facilitate psychological development in youth sport – mindfulness, resilience training, stress-management strategies, goal-setting, and multisensory imagery – and was expected to enhance athletes' knowledge, application, and perceived effectiveness of mental skills, as well as their sport-imagery abilities. The findings largely supported this hypothesis, with consistent improvements across nearly all measured mental skills and imagery dimensions. The only variable that did not demonstrate a significant change was mental toughness. This pattern offers valuable insights into the developmental nature of psychological adaptation in youth athletes and aligns with theoretical frameworks suggesting differential malleability of psychological constructs across adolescence.

A central finding of the present study was the strong improvement in sport-imagery abilities – particularly Cognitive Specific, Cognitive General, Motivational Specific, and Motivational General-Arousal imagery. Cognitive General imagery demonstrated the strongest associations with overall psychological skill functioning, highlighting its importance for routines, attentional regulation, and strategic preparation during adolescence. These results are consistent with evidence suggesting that imagery-based MST components are highly trainable in early and mid-adolescence, a developmental period marked by substantial neurocognitive plasticity in attentional systems and emotion regulation.

Beyond imagery, the program produced significant gains in mental skills knowledge, frequency of skill use, and the perceived effectiveness of these skills. These improvements align with previous literature showing that MST is particularly impactful for adolescents, who demonstrate heightened cognitive openness and receptivity to psychological instruction compared with adults. As youth athletes mature,

these foundational psychological skills often serve as precursors to higher-order competencies such as adaptive coping, performance consistency, and long-term resilience. Thus, the observed improvements in the MSQ subscales likely represent meaningful developmental changes that support athletes' long-term progression in sport and beyond.

In contrast, mental toughness (as measured by the MTSQ-19) did not exhibit significant pre–post change. While this could be interpreted as a limitation of the intervention, theoretical and empirical work suggests that global mental toughness is a slower developing, higher order construct shaped by cumulative exposure to competitive stress, psychological maturity, and long-term integration of mental skills. Adolescents face unique external pressures – growing training loads, academic demands, social comparison, and developmental volatility – that may inhibit short-term gains in global toughness. Alternatively, mental toughness might require a practical and experiential environment, suggesting a longer development period. Therefore, the absence of change in mental toughness might be theoretically consistent with its developmental trajectory and suggests that longer or more targeted interventions may be needed to shift this construct.

Taken together, the results indicate that the Noise Cancelling Program effectively enhanced mental skills that are considered foundational for youth athlete development. These findings mirror earlier work demonstrating that structured MST programs yield the greatest benefits in adolescence, a period characterized by heightened cognitive malleability and rapid emotional development. As athletes grow older, the mental skills fostered by MST – particularly imagery, goal setting, and emotion regulation – play an increasingly central role in performance preparedness and adaptive coping. As such, categorizing mental skills according to their developmental malleability is essential for designing MST programs that align with the psychological needs of youth athletes and maximize long-term transfer.

Finally, the integration of a newly validated Mental Skills Questionnaire (MSQ) provides an important methodological contribution. The exploratory factor analysis confirmed a three-factor structure – knowledge, application, and impact – with strong psychometric properties. These findings not only strengthen confidence in the present results but also offer a practical and developmentally sensitive measurement tool for future MST research involving youth athletes.

LIMITATIONS

Several limitations should be considered when interpreting these results. First, the study used a pre–post design without a control or placebo group, which limits its causal inference and parallels limitations in previous sport psychology interventions such as Fournier et al. (2005). Second, substantial attrition occurred: although 253 participants enrolled, only 92 completed the intervention, potentially impacting representativeness. Third, the sample was heterogeneous in age, sport type, and competitive level, which may have moderated intervention effectiveness. Fourth, although the MSQ demonstrated strong internal consistency and a stable factor structure, further validation – including test–retest reliability, convergent validity, and measurement invariance – is still required. Finally, the program was delivered by supervised graduate students; variation in facilitation quality may have introduced implementation variation.

FUTURE DIRECTIONS

Future studies should incorporate controlled or randomized designs to strengthen causal interpretation. Longer follow-up periods (12-18 months) may capture delayed gains in mental toughness and provide insight into the long-term durability of MST effects. Moderation analyses (e.g., by age, sport type, experience) could clarify for whom and under what conditions MST is most effective. Mechanisms of change – such as whether imagery mediates broader psychological improvement – should be examined in more detail. From a logistical and feasibility perspective, variation between facilitators, e.g. therapist's effect, should be captured and analyzed to understand the feasibility of the MST program and additional factors that may affect its implementation. Additional validation of the MSQ is recommended across independent samples. Finally, implementation research should compare delivery by students versus expert practitioners and evaluate how MST can be embedded within regular sport practice and supported by coaches and parents.

CONCLUSIONS

The Noise Cancelling Program produced meaningful improvements in youth athletes' knowledge, application, and perceived effectiveness of psychological skills, along with increases in multiple imagery dimensions. These results highlight the possibility of delivering MST programs within school settings using supervised graduate facilitators, with additional measures. Although mental toughness did not change, this pattern aligns with theoretical models describing it as a slow maturing construct requiring longer term exposure or specific training elements. The MSQ appears to be a promising tool for assessing MST outcomes among youth and warrants further validation.

Supplementary materials are available on the journal's website.

Disclosures

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The authors declare no conflict of interest.

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