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Effectiveness of breathing exercise in reducing competitive anxiety among roller skating athletes

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Abstract

Competitive anxiety can impair an athlete's performance, particularly in high-pressure events such as the National Student Sports Week (POMNAS). Research on breathing-based anxiety regulation for roller skaters remains limited, despite the sport's high psychophysiological demands. This study examined changes in Cognitive Anxiety, Somatic Anxiety, and Self-Confidence before and after a breathing exercise intervention among roller skating athletes. A one-group pre-test post-test design was used due to participant limitations and competitive conditions that did not allow group division. Seven athletes (4 males, 3 females), aged 17–21 years, from the East Java contingent were selected using purposive sampling. Competitive anxiety was measured using the CSAI-2R (α = 0.89), covering Cognitive Anxiety, Somatic Anxiety, and Self-Confidence. The intervention consisted of a diaphragmatic 4-4-4 breathing routine performed for 10–15 minutes. Data were analyzed using a paired samples t-test (α = 0.05). The results showed significant reductions in Cognitive Anxiety (t = 2.97; p = 0.025; d = 1.12; mean decrease = 1.43 points / 13.0%) and Somatic Anxiety (t = 3.04; p = 0.023; d = 1.15; mean decrease = 2.72 points / 19.0%), indicating large effect sizes. In contrast, Self-Confidence showed no change (t = 0.00; p = 1.00; d = 0.00), confirming that anxiety and confidence function as independent constructs. These findings show that brief breathing exercises effectively reduce short-term anxiety, although additional psychological methods are needed to improve confidence. The study provides practical guidance for integrating controlled breathing routines into pre-competition preparation.

Keywords: Breathing exercise, competitive anxiety, roller skating athletes, pre-test–post-test design.

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INTRODUCTION

National sporting tournaments are crucial for developing university-level athletes. Within this competitive landscape, the Pekan Olahraga

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Mahasiswa Nasional (POMNAS) XIX 2025 in Central Java stands out as one of Indonesia's most prominent events. The tournament is expected to gather around 3,000 athletes from various provinces across 22 disciplines, creating an intense atmosphere of rising expectations and public scrutiny (Kemenpora, 2023). In such high-stakes environments, student-athletes often face significant psychological and physiological stressors that heighten competitive anxiety, which can impair decision-making, motor coordination, and attentional focus (Mulvey, 2024; Palazzolo, 2020; Weinberg & Gould, 2018). Prolonged exposure to unmanaged competitive pressure may also affect long-term motivation and increase the risk of burnout among collegiate athletes (Dewi et al., 2018). Therefore, identifying brief, evidence-based strategies to regulate anxiety is essential for competition readiness, especially in technique-dominant sports like roller skating.

Competitive anxiety comprises cognitive anxiety, somatic anxiety, and self-confidence (Aliyyah et al., 2020; Nengah et al., 2025). Increased cognitive anxiety disrupts attentional control, while somatic anxiety heightens physiological arousal and muscle tension, which may reduce coordination crucial in roller skating (Parnabas et al., 2014). Recent empirical observations show that roller skaters experience elevated heart rates (85–92% HRmax) during pre-race phases and a 14–17% increase in balance-loss and edge-slip errors under anxiety-inducing conditions (Amaro, 2023). Pre-competition CSAI-2 scores further reveal consistently high cognitive and somatic anxiety among competitive skaters (Horvath et al., 2022). These indicators highlight the need for targeted psychological interventions specifically designed to address the unique psychophysiological demands of roller skating.

Breathing exercises have garnered strong empirical support as a practical strategy for emotion regulation (Elia & Lemaître, 2025). Controlled diaphragmatic breathing activates the parasympathetic nervous system, reduces sympathetic dominance, and stabilizes emotional responses (O.V. & Romanchuk, 2024). Prior studies on swimmers, runners, and team-sport

athletes show that structured breathing enhances attentional control and reduces stress in high-pressure conditions (Laborde et al., 2022; Merlin et al., 2024). In contrast, techniques such as mindfulness and progressive muscle relaxation often require extended practice and calmer environments, making them less suitable for rapid use in the lead-up to competition. Although early Indonesian applications of breathing exercises show promising results (Amaro, 2023; Ismail et al., 2022; Nur'aini et al., 2025), research specifically involving roller skating athletes remains limited. The portability and simplicity of breathing routines make them ideal for competitive schedules with minimal preparation time.

This study makes a distinctive contribution by implementing a single-session breathing exercise directly in real-world competition settings, rather than in controlled laboratory conditions. The 10–15-minute diaphragmatic breathing intervention was delivered immediately prior to the race, without prolonged training or repeated sessions, ensuring that the measured effects reflect short-term responses. Conducting the intervention in an authentic, high-pressure environment characterized by limited preparation time, crowd presence, and elevated performance demands enhances ecological validity and provides directly applicable insights for coaches and sport psychologists.

The primary aim of this experimental study is to examine the effect of breathing exercises (independent variable) on competitive anxiety (dependent variable), specifically changes in Cognitive Anxiety, Somatic Anxiety, and Self-Confidence from pre-test to post-test among East Java roller skating athletes participating in POMNAS XIX. A one-group pre-test post-test design was employed due to limited athlete availability and competition constraints, with each athlete serving as their own comparison. This section outlines the research design, sampling method, assessment tools, and analytical procedures, presenting a coherent IV–DV framework that strengthens internal validity.

The study is expected to provide practical guidance for incorporating brief breathing exercises into pre-competition routines, supporting coaches,

sport psychologists, and athletes in regulating physiological and cognitive arousal. Tailored breathing approaches may benefit athletes differently depending on whether they exhibit stronger somatic or cognitive anxiety symptoms (Perdana et al., 2022). These findings can inform systematic mental preparation programs for Indonesian student-athletes and foster long-term psychological resilience.

Given the academic, social, and competitive pressures faced by collegiate athletes, understanding effective and evidence-based anxiety management strategies is vital. By situating the intervention within a real national sporting event, this study contributes sport-specific insights to the broader field of applied sport psychology in Indonesia. Accordingly, the following section outlines the experimental procedures used to evaluate the short-term effects of the breathing intervention.

METHOD

This study employed an experimental one-group pre-test post-test design to evaluate short-term changes in competitive anxiety among roller skating athletes participating in POMNAS XIX 2025. The design was selected because the limited number of athletes and the competition schedule did not permit random assignment or the formation of comparison groups. The same athletes were measured twice, approximately 15 minutes before the breathing exercise (pre-test) and immediately after the intervention (post-test), with an interval of about 8–10 minutes that corresponds to standard warm-up durations used in competitive settings. This within-subject approach allowed each participant to serve as their own control, effectively reducing individual variability and strengthening internal validity (Smith, 2013; Tweedy et al., 2024). The short time gap between both measurements ensured that the observed changes represented immediate intervention effects rather than external competition factors.

Data collection was conducted at the official POMNAS XIX venues, the Jatidiri Sports Arena and the Icn Room Hotel in Semarang, during September 2025, aligned with athletes' actual warm-up routines. The intervention took place in the late afternoon, approximately 45–60 minutes

prior to the race, inside a designated preparation area that minimised unnecessary distractions while still exposing athletes to authentic competitive elements, such as time pressure and ambient noise. All procedures, including breathing instruction and anxiety scoring, were supervised directly by the research team, with contingent coaches assisting to maintain procedural consistency and athlete compliance. Conducting the study in a genuine competition environment ensured that the anxiety levels captured truly reflected the psychophysiological demands of high-stakes performance.

The research population consisted of 11 East Java roller skating athletes registered for POMNAS XIX, from which seven athletes aged 17–21 were selected using purposive sampling. The inclusion criteria required athletes to be official race participants, willing to follow all study procedures, and free from respiratory issues that could interfere with the breathing routine. Although modest, this sample size represents 63.6% of the competition roster. It aligns with small-N experimental methodologies commonly applied in elite and semi-elite sport contexts where participant access is naturally restricted. This sampling approach ensured that only athletes experiencing genuine competition pressure were evaluated, reinforcing ecological validity and contextual relevance.

Competitive anxiety was measured using the Indonesian-adapted Competitive State Anxiety Inventory–2 Revised (CSAI-2R), which has demonstrated strong reliability ($\alpha = 0.89$) and has been validated through expert review for linguistic and conceptual accuracy. The scale contains 17 items distributed across three dimensions: Cognitive Anxiety (CA), Somatic Anxiety (SA), and Self-Confidence (SC). Each item is rated on a four-point Likert scale ranging from 1 (Strongly Disagree) to 4 (Strongly Agree), with higher scores indicating stronger state responses. Prior Indonesian research (Fariz et al., 2022) confirms the construct's dimensional structure, making it appropriate for diagnosing specific anxiety components that may respond differently to the breathing intervention. The use of a validated,

concise, and multidimensional instrument ensured accurate assessment of competition-related anxiety under real-event conditions.

Table 1. Dimensions and sample Item of the CSAI-2R instrument

Dimension	Number of Items	Interpretation	Sample Item
Cognitive Anxiety (CA)	5 item	Higher scores indicate more worry and negative thoughts cognitively	”I am worried I will fail”
Somatic Anxiety (SA)	7 item	Higher scores indicate more physical anxiety	”My body feels tense”
Self-Confidence (SC)	5 item	Higher scores indicate greater self-confidence	”I am confident I can win”

Participants engaged in a single-session diaphragmatic breathing exercise with a rhythmic 4-4-4 pattern (inhale for 4 seconds, hold for 4 seconds, exhale for 4 seconds) for a predetermined length of 10 minutes. The activity was performed in an upright seated position with both feet planted and shoulders relaxed, under the direct supervision of the researcher to guarantee consistent breathing and accurate cycling. The intervention occurred in a tranquil preparatory space close to the tournament venue, reducing auditory distractions and visual disruptions. Environmental conditions were stabilized, with restricted spectator access and minimized noise exposure to regulate focus and respiratory pattern. Upon concluding the breathing session, participants administered the CSAI-2R for the post-test assessment. Pre- and post-test scores were compared to assess instantaneous alterations in competitive anxiety levels.

Table 2. Paired samples t-test results (N = 7)

Dimension	***t***	***df***	***p***	***d***
Cognitive Anxiety	2.97	6	.025	1.12
Somatic Anxiety	3.04	6	.023	1.15
Self-Confidence	0.00	6	1.00	0.00

Note. p < .05 indicates statistically significant difference; d = Cohen’s d effect size.

The paired samples analysis revealed significant decreases in both Cognitive Anxiety (t = 2.97, p = .025, d = 1.12) and Somatic Anxiety (t = 3.04, p = .023, d = 1.15), indicating high impact sizes. These findings indicate that diaphragmatic breathing significantly diminished intrusive rumination and physiological activation. Conversely, no notable difference was observed in Self-Confidence (t = 0.00, p = 1.00, d = 0.00), affirming complete stability between pre- and post-test scores. The lack of improvement corresponds with current findings indicating that confidence

necessitates prolonged cognitive-based interventions and is less influenced by acute physiological management methods. The findings indicate that brief breathing exercises are an effective short-term method for regulating anxiety, specifically addressing cognitive and physical responses, without altering confidence levels.

RESULT

Descriptive statistics were initially used to elucidate the athletes' psychological responses before and after the intervention, highlighting overarching tendencies in competitive anxiety dimensions. This stage is crucial for comprehending the baseline circumstances of the roller skating athletes and monitoring the direction and amplitude of score variations following the breathing exercise. The descriptive analysis provides essential insights into the responses of each dimension, Cognitive Anxiety, Somatic Anxiety, and Self-Confidence, to the intervention prior to the presentation of statistical significance tests.

Table 3. Descriptive statistics of pre-test and post-test scores(N=7)

Dimension	Measurement Time	M	SD	SE
Cognitive Anxiety	Pre-test	11.00	1.83	0.69
	Post-test	9.57	1.13	0.43
Somatic Anxiety	Pre-Test	14.29	3.15	1.19
	Post-Test	11.57	2.44	0.92
Self-Confidence	Pre-Test	13.00	2.00	0.76
	Post-Test	13.00	2.16	0.82

Note: M(Mean), SD(Standard Deviation), SE(Standard Error)

Table 3. The analytical results indicate a significant reduction in the Cognitive Anxiety dimension following the breathing exercise intervention. The pre-test mean of 11.00 (SD = 1.83) diminished to 9.57 (SD = 1.13), resulting in a mean difference of –1.43 points, along with a decrease in SD from 1.83 to 1.13, signifying more uniform post-test responses.

A comparable reduction was noted in Somatic Anxiety, with the mean decreasing from 14.29 (SD = 3.15) to 11.57 (SD = 2.44), resulting in a mean difference of –2.72 points. The reduction in standard deviation from 3.15 to 2.44 indicates a more tranquil physiological response and diminished variability in somatic symptoms among athletes post-intervention.

Conversely, Self-Confidence exhibited total stability, with equivalent pre-test and post-test mean values (13.00) and a negligible variation in

standard deviation (from 2.00 to 2.16), underscoring the absence of any directional movement in this dimension. This stability reinforces the theoretical assertion that self-confidence is less susceptible to one-time regulatory methods and necessitates prolonged cognitive-based intervention.

The descriptive findings indicate that breathing exercises directly and measurably affected both cognitive and physiological anxiety indicators. However, self-confidence remained stable, aligning with its established resistance to short-term alteration.

Table 4. Paired Samples T-Test Result Between Pre-test and Post-test (N=7)

Dimensi	t	df	p	Cohen's d
Cognitive Anxiety	2.97	6	0.025	1.12
Somatic Anxiety	3.04	6	0.023	1.15
Self-Confidence	0.00	6	1.000	0.00

Note: p< 0,05 indicates statistically significant difference; df= degrees of freedom.

Table 4 summarizes the paired samples t-test results comparing pre-test and post-test scores. For Cognitive Anxiety, the analysis yielded t(6) = 2.97, p = .025, d = 1.12, with a 95% CI [0.48, 2.38], indicating a statistically significant reduction that aligns with the descriptive decrease reported in Table 3. The large effect size (d > 1.00) reinforces the substantial impact of the intervention.

Somatic Anxiety demonstrated a similar pattern, with t(6) = 3.04, p = .023, d = 1.15, and a 95% CI [1.21, 4.23], confirming a significant reduction in physiological anxiety symptoms. The large effect size confirms that the breathing exercise generated a strong parasympathetic calming response.

Conversely, Self-Confidence showed no measurable change, t(6) = 0.00, p = 1.00, d = 0.00, with a 95% CI [–1.05, 1.05], indicating complete score stability. The absence of change underscores that self-confidence, as a relatively stable cognitive construct, is unlikely to shift through a single short-term breathing exercise session.

Overall, the inferential results demonstrate that the breathing intervention effectively reduced both Cognitive and Somatic Anxiety—each supported by statistically significant values and large effect sizes—while

exerting no influence on Self-Confidence. These findings affirm the suitability of breathing techniques for rapid anxiety regulation but also highlight the necessity of additional psychological training approaches (e.g., imagery, mastery feedback) to strengthen confidence.

DISCUSSION

The statistical analysis demonstrated significant reductions in both Cognitive Anxiety ($t = 2.97$, $p = .025$, $d = 1.12$) and Somatic Anxiety ($t = 3.04$, $p = .023$, $d = 1.15$), indicating that the breathing exercise produced a strong immediate regulatory effect. The large effect sizes ($d > 1.10$) align with the theoretical mechanisms explaining how rhythmic breathing influences emotional regulation. From a cognitive perspective, directing attention toward structured breathing patterns reduces the mental capacity available for processing intrusive thoughts, consistent with the attention-diversion mechanism described by Kumar (2025) and Reardon et al. (2024). This corresponds with the reduction in Cognitive Anxiety (mean decrease = –1.43), showing that breathing temporarily limits worry and self-doubt. Physiologically, slow exhalation activates vagal pathways (Pires et al., 2024) and increases HRV (Russo et al., 2017; Steffen et al., 2017), supporting the stronger decline observed in Somatic Anxiety (mean decrease = –2.72). Together, the statistical results and psychophysiological mechanisms consistently reinforce the effectiveness of the intervention on acute anxiety.

In contrast, the statistical findings for Self-Confidence ($M = 13.00 \rightarrow 13.00$; $t = 0.00$; $p = 1.00$; $d = 0.00$) confirm that confidence remained unchanged. This stability is consistent with the view that self-confidence is not easily altered through short-term interventions (Nengah et al., 2025). While breathing exercises may induce temporary calmness, feeling calm does not automatically translate into greater belief in one's ability to perform. Previous studies (Domínguez-González et al., 2024; Salim et al., 2025; Widhi Harita et al., 2022) emphasize that confidence development requires repeated mastery experiences, positive feedback, and structured psychological conditioning. Thus, the present results reinforce that

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breathing exercises should be understood as an acute anxiety-regulation tool rather than a strategy for immediate confidence enhancement.

These empirical patterns provide a clear basis for practical application. The substantial effect sizes in both anxiety dimensions validate breathing exercises as a rapid and accessible pre-competition strategy, particularly within 10–15-minute warm-up periods. Coaches and sport psychologists can incorporate these techniques to reduce pre-race tension quickly. However, because confidence did not change, athletes with low self-confidence require complementary interventions such as imagery, success rehearsal, and positive self-affirmation (Lauren et al., 2024). These findings align with meta-analytic evidence (Perdana et al., 2022) suggesting that combining several psychological methods yields stronger outcomes than relying on a single technique. Breathing exercises, therefore, should be viewed as a specialized tool for managing short-term anxiety, not a comprehensive psychological skills program.

Several limitations should be considered when interpreting these results. The small sample size (n = 7) and the single-group design may inflate both t-values and effect sizes, limiting the generalizability of the conclusions. The absence of a comparison group prevents definitive attribution of the observed changes solely to the intervention, as natural adaptation or psychological warm-up effects may have contributed. Additionally, the sample was limited to East Java roller skaters, making it unclear whether athletes from other regions or sports would show similar responses. Unmeasured variables, including prior competition experience, baseline anxiety, and support systems, may also have influenced the outcomes. Reliance on self-report measures increases the risk of response bias, especially in competitive situations where athletes may attempt to present themselves positively.

Future research should involve larger samples, employ comparison or randomized controlled trial designs, and extend to different sporting contexts. Longitudinal studies are needed to determine whether breathing exercises produce sustained benefits beyond immediate competition. It

would also be valuable to compare breathing techniques with other psychological strategies such as visualization or meditation to identify which method is most effective for specific anxiety profiles. Furthermore, integrating physiological indicators such as HRV or continuous heart rate monitoring would strengthen the explanatory validity. Statistical analysis of additional variables, such as correlations between HRV improvements and reductions in anxiety scores, would deepen understanding of the psychophysiological mechanisms underlying the intervention.

CONCLUSION

The quantitative findings of this study reveal that breathing exercises significantly reduced both Cognitive Anxiety ($t = 2.97$, $p = .025$, $d = 1.12$) and Somatic Anxiety ($t = 3.04$, $p = .023$, $d = 1.15$), demonstrating strong short-term psychophysiological benefits in competitive environments. These large effect sizes support the conclusion that regulated diaphragmatic breathing activates parasympathetic pathways, enhances emotional control, and reduces intrusive thoughts as well as physiological tension before competition. In contrast, Self-Confidence showed no measurable change ($t = 0.00$, $p = 1.000$, $d = 0.00$), highlighting that confidence is a more stable psychological construct that does not shift through brief physiological interventions and instead requires longer-term cognitive reinforcement.

Based on these results, breathing exercises can be recommended as an immediate and accessible strategy for managing pre-competition anxiety. Confidence enhancement, however, should be approached through supplementary methods, such as imagery, positive self-talk, or mastery-based psychological training. The limited sample size restricts statistical power, and the absence of a comparison group reduces the strength of causal conclusions. However, the present findings still offer preliminary empirical support for integrating breathing routines into structured mental preparation programs.

Future research should involve larger samples, employ controlled experimental designs such as randomised trials, and explore multimodal

psychological approaches. Combining breathing exercises with confidence-building strategies may provide broader psychological benefits, enabling both effective anxiety reduction and stronger long-term confidence development.

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