

**ORIGINAL ARTICLE**

Effects of PETTLEP Imagery Training on Competitive Anxiety and Self-Confidence in Badminton Athletes

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**KEYWORDS**

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ABSTRACT

Background. Competitive anxiety and self-confidence influence badminton athlete performance. PETTLEP imagery training is a structured mental training technique designed to create a realistic and immersive visualization experience.

Objectives. This study aims to identify the effect of PETTLEP imagery training on competitive anxiety and self-confidence in badminton athletes. **Methods.** Participants in this study were ninety-five badminton athletes randomly divided into three groups: PETTLEP Imagery, Traditional Imagery, and Control. Each group underwent 16 training sessions for 6 weeks (three times a week). Assessments were conducted using the Competitive State Anxiety Inventory-2 (CSAI-2) and the Sport Imagery Ability Questionnaire (SIAQ). Data were analyzed using the Kruskal-Wallis test. **Results.** The PETTLEP Imagination group showed the most significant reduction in competitive anxiety (mean reduction in cognitive anxiety from 29.09 to 25.27); somatic anxiety from 29.55 to 24.85; statistical difference test = 62.524, $p=0.00$) and the highest increase in self-confidence with statistical difference test = 54.427, $p=0.00$) compared to the Traditional Imagination and Control groups. **Conclusion.** PETTLEP imagery training is more effective than traditional imagery in reducing competitive anxiety and increasing self-confidence in badminton athletes. This training offers a superior psychological preparation strategy for badminton athletes, with potential applications in both training and competition.

INTRODUCTION

As sports develop, it is increasingly recognized that psychological factors play a significant role in determining an athlete's performance. Any athlete can be affected by psychological health issues; therefore, carefully planning a suitable approach is essential to achieving maximum performance (1). Athletes who cannot read the match situation will experience anxiety, resulting in decreased

performance during the match (2). Two psychological aspects that are often the focus of attention are competitive anxiety and self-confidence. These two variables are connected and have a significant impact on athletic performance. Excessive anxiety can degrade performance, whilst excessive self-confidence can improve it (3). A bad performance is often associated with loss of concentration, tension

under pressure, or other mental aspects of competition, such as excessive anxiety, decreased motivation, and lack of self-confidence, which can affect the athlete's game (4).

Competitive anxiety can hinder performance and interfere with concentration, while high self-confidence can support optimal performance and increase the chances of success in competition. Previous research found that competitive anxiety contributed to 38% of the change in sports performance and that increased competitive anxiety reduced athletes' performance (5). Competitive anxiety is a negative emotional response to competitive stress that athletes exhibit before and during a match, characterized by cognitive symptoms (fear, concern) and physical symptoms (limb shaking) (6).

Self-confidence is the belief in one's ability to achieve desired goals. High self-confidence is generally associated with better performance. An athlete's strong sense of self-confidence correlates with aspects of "mental toughness," or the ability to cope with multiple demands better than opponents and remain determined, focused, and self-controlled under pressure. When athletes face stress during sports, their self-confidence decreases (7). Several studies have shown that the relationship between self-confidence and athlete performance is 0.25, and a significant effect appears in individual sports compared to team sports (8).

One method that has been identified as effective in managing anxiety and increasing self-confidence is PETTTLEP imagery. PETTTLEP imagery, which stands for Physical, Environmental, Task, Timing, Learning, Emotion, and Perspective, is an imagery technique developed (9). The PETTTLEP method advises that features associated with the practice should be added to maximize imagery and action observation, such as having the necessary tools or assuming the proper body positions to execute the skill (10). A form of simulation that athletes use to improve their abilities in sports is now part of modern sports training, namely imagery. Imagery promotes mental visualization (mental practice), which aims to develop greater attention to detail and all wisdom and logic in athletes to improve their performance, thereby helping to create a more flexible and real image in the mind (11). Sports often employ imagery to improve their players' performance in various situations (12). PETTTLEP uses a multisensory, evidence-based

framework conditioned on actual performance, unlike traditional imagery training. This approach is considered superior because it is based on functional conditioning and embodied cognition principles (13), which can enhance motor and psychological preparation. Therefore, PETTTLEP was chosen in this study because it better integrates physical, emotional, and cognitive aspects relevant to competition. PETTTLEP imagery has been widely applied in sports contexts, but there have been no specific studies in badminton. Badminton presents unique psychological demands, including rapid decision-making, high-intensity rallies, frequent momentum changes, and the need for rapid emotional regulation under pressure (14). With a relatively short field size, players must move quickly to all corners of the field in a relatively short time (15). These characteristics distinguish it from other sports and highlight the importance of targeted psychological training.

Managing competitive anxiety and building self-confidence in badminton athletes is key to achieving optimal performance. Excessive anxiety can impair focus and performance, while strong self-confidence can enhance performance and endurance. A holistic approach that includes mental techniques such as PETTTLEP imagery, as well as good physical training and strategy, is essential to optimize the potential of badminton athletes.

This study presents a novel contribution to the field of sport psychology by being one of the first empirical investigations to apply PETTTLEP imagery training to badminton athletes and compare it to traditional training and a non-intervention control group. Doing so contributes new evidence to the literature and fills a critical gap in understanding sport-specific.

MATERIALS AND METHODS

Study Design. This study applied a quasi-experimental design with a pre-post measures approach to evaluate the effectiveness of the PETTTLEP imagery on competitive anxiety and self-confidence among badminton athletes in Sumedang, Indonesia (Figure 1).

Participants. A total of 95 badminton athletes (ages 10-17) were included in the study based on the following inclusion criteria: 1) active club participation, 2) a minimum of three competitive match experiences in the past year, 3) being physically and psychologically healthy, 4)

willingness to adhere to the entire research protocol. Participants were selected using total sampling from accessible badminton clubs in Sumedang that agreed to participate. Due to

logistical considerations, group allocation was non-random and based on club assignment. Three groups were formed: PETTTLEP Imagery (n=33), Traditional Imagery (n=32), and Control (n=30).

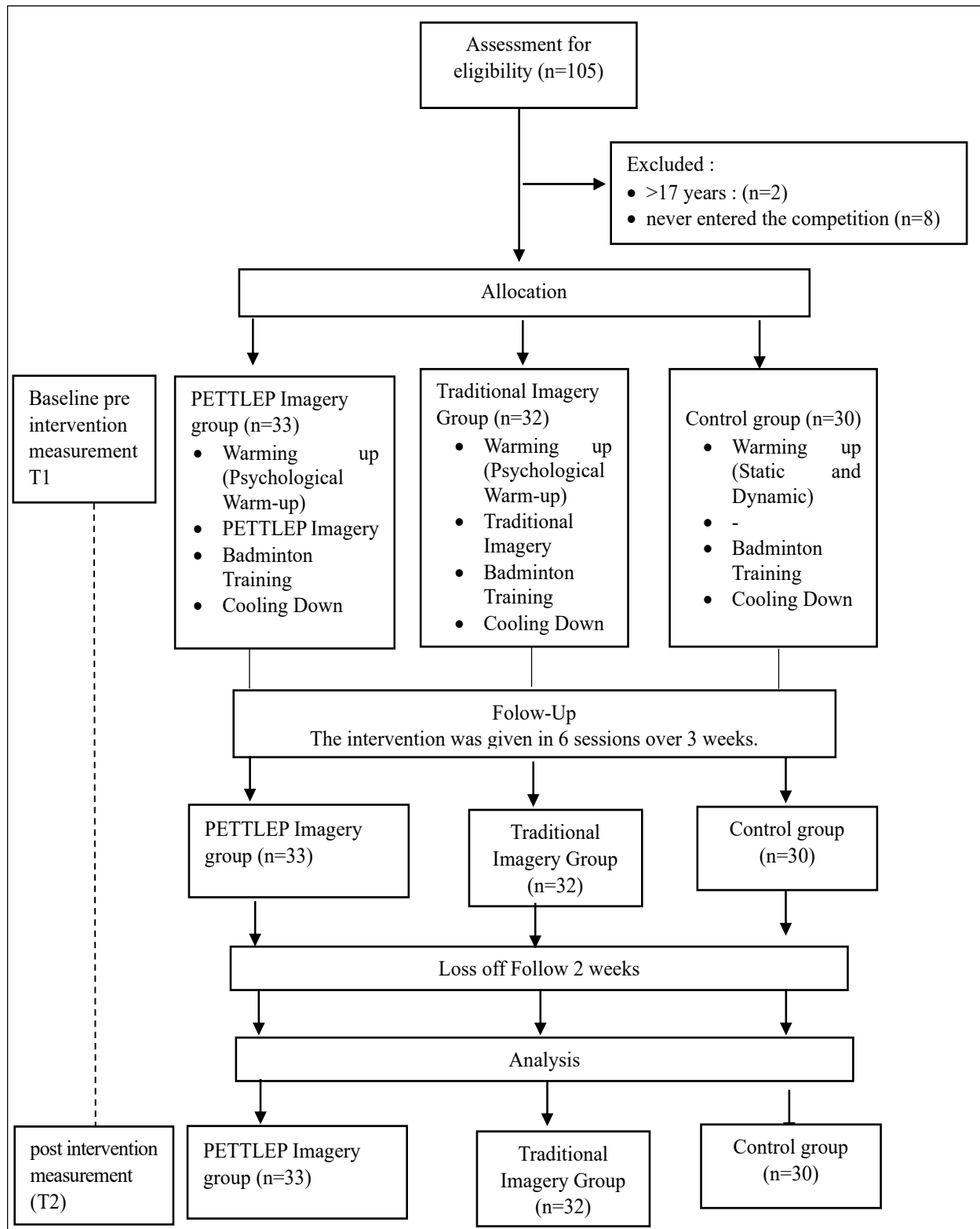


Figure 1. Flow diagram of the study.

Intervention Protocol. The intervention was conducted from April 22 to June 25, 2024, and included 16 training sessions over 6 weeks (three times a week), each lasting approximately 30 minutes.

Stage 1: Psychological Warm-Up. All participants began with mindfulness-based breathing exercises to calm the body and focus attention.

Stage 2: Imagery Training. The PETTLEP Group received guided imagery training integrating all seven PETTLEP components—Physical (e.g., performing strokes), Environment (competition setting), Task (specific game strategies), Timing (real-time movement), Learning (skill correction), Emotion (regulation under pressure), and Perspective (first-person view). Besides, the Traditional Imagery Group received standard imagery focused on motivation, tactics, and match visualization without structured multisensory elements. However, the Control Group continued with routine physical training only, with no imagery interventions provided.

Stage 3: Regular Badminton Training. All groups resumed their usual training schedule outside of the assigned intervention. Certified coaches supervised sessions.

Stage 4: Cool Down. All participants performed guided stretching and relaxation activities post-session.

All sessions were supervised by trained sports psychologists and research assistants. Attendance logs were maintained throughout the intervention, with adherence rates averaging 94% across all sessions.

Data Collection. Participants and guardians signed informed consent forms before the study initiation.

Pre-tests were conducted one week before the intervention, and post-tests were administered one week following the final session. All assessments were completed on-site in quiet training facilities and under the supervision of the research team to ensure accuracy and minimize bias. After two weeks, a post-test was administered to reassess competitive anxiety and self-confidence.

Assessment Tool. Three questionnaires were used in this study. The Sport Imagery Ability Questionnaire (SIAQ) (16) has 12 items with a reliability range of 0.70 to 0.88 for Strategy Image, Goal Image, Influence Image, and Skill

Image. Cognitive and physical anxiety are measured using the 27-item Competitive State Anxiety Inventory (CSAI-2) (17), which has a reliability of 0.902. The 32-item Self-Confidence and Self-Esteem Questionnaire (18) measures optimism, independence, sportsmanship, self-regulation, and adaptability with 0.872 reliability. All instruments were administered in paper format in individual sessions lasting 20-25 minutes before and after the intervention.

Statistical Analysis. Data normality was tested using the Shapiro-Wilk test, confirming non-normal distribution. Therefore, the Kruskal–Wallis H test was used for between-group comparisons. Post-hoc analysis was performed using Dunn's test with Bonferroni correction to adjust for multiple comparisons. To assess the practical significance of findings, effect sizes were calculated using eta-squared (η^2), with interpretations based on Cohen's thresholds: small ($\eta^2=0.01$), medium ($\eta^2=0.06$), and large ($\eta^2=0.14$).

RESULTS

The study involved 95 adolescents aged 12-17 years (mean age = 14.53), consisting of 80 boys and 15 girls, with all male-dominated groups. Baseline Sport Imagery Ability (SIA) scores showed the traditional imagination group (T) had the highest overall score (48.44 ± 3.61), followed by the control group (C) at 47.40 ± 3.29 , and the PETTLEP group (P) with the lowest score (34.73 ± 3.09). The T group consistently outperformed the other groups in all components of SIA: Strategy Imagery (SI), Goal Imagery (GI), Affect Imagery (AI), and Skill Imagery (SKI). The significantly lower baseline imagination ability of the PETTLEP group may have influenced the intervention results. This difference suggests that the improvement in the PETTLEP group may reflect training effects and differences in baseline capacity (Table 1).

The most significant change in CSA was in group P, where in pre-treatment it was 90.06 ± 3.288 and post-treatment it was 72.45 ± 6.088 ($p=0.00$), there was a decrease of 18.15 points, and in group T there was a decrease of 13.69 points ($p=0.00$), conversely in group C there was an increase of 0.16 points ($p=0.637$) (Table 2).

The Kruskal-Wallis test showed a significant difference in CSAI scores among the three groups ($\chi^2=62.524$, $p<0.01$, $\eta^2=0.57$). Post hoc analysis

indicated significantly lower CSAI scores in both the PETTLEP and traditional groups compared to the control ($p<0.01$), with no significant

difference between PETTLEP and traditional ($p=0.425$). Power analysis showed high test power (>0.95) (Table 3).

Table 1. Baseline characteristic of participant.

Variable	P	T	C
Gender			
Boys, f(%)	24 (72.7%)	30 (90.9%)	26 (78.8%)
Grils, f(%)	9 (27.3%)	2 (6.1%)	4 (12.1%)
Competition level			
Regional Event, f(%)	27 (28.4%)	26 (27.3%)	24 (25.2%)
Nasional Event, f(%)	7 (7.3%)	6 (6.3%)	5 (5.2%)
Training Frequency			
Three times, f(%)	15 (15.7%)	13 (13.6%)	12 (12.6%)
Four times, f(%)	10 (10.5%)	9 (9.4%)	8 (8.4%)
Five times, f(%)	7 (7.3%)	6 (6.3%)	6 (6.3%)
Six times, f(%)	4 (4.2%)	3 (3.1%)	2 (2.1%)
Age (years)	14.73 \pm 1.567	14.41 \pm 1.521	14.47 \pm 1.592
SIA	34.73 \pm 3.085	48.44 \pm 3.609	47.40 \pm 3.297
SI	9.21 \pm 1.269	12.06 \pm 1.343	11.9 \pm 1.583
GI	8.15 \pm 1.787	12.58 \pm 1.628	12.37 \pm 1.629
AI	8.61 \pm 1.499	12.22 \pm 1.362	12.17 \pm 1.367
SKI	8.76 \pm 1.696	11.56 \pm 1.480	11.27 \pm 1.337

P: PETTLEP Imagery; T: Traditional; C: Control; Values are expressed as mean \pm SD; SIA: Sport Imagery Ability; SI: Strategy imagery; GI: Goal Imagery; AI: Affect Imagery; SKI: Skill imagery.

Table 2. Changes competitive state anxiety after intervention.

Variable	P		T		C	
	Pre	Post	Pre	Post	Pre	Post
CSA	90.06 \pm 3.288	72.45 \pm 6.088*	89.00 \pm 4.143	75.31 \pm 4.7*	87.77 \pm 4.523	87.93 \pm 3.759@
Csa	29.09 \pm 2.141	25.2 \pm 2.349*	30.22 \pm 2.012	24.91 \pm 2.305*	30.03 \pm 2.220	30.07 \pm 2.05@
S	29.55 \pm 1.804	24.85 \pm 2.476*	29.44 \pm 2.395	25.28 \pm 2.317*	28.90 \pm 2.369	28.93 \pm 1.946@
SC	31.42 \pm 2.151	22.33 \pm 3.149*	29.34 \pm 2.350	25.13 \pm 2.837*	28.83 \pm 2.437	28.93 \pm 1.946@

P: PETTLEP Imagery; T: Traditional; C: Control; Values are expressed as mean \pm SD; CSA: Competitive State Anxiety; CSa: Cognitive state anxiety; S: Somatic; SC: Self Confident; *: pre vs post ($p<0.01$); @: pre vs post ($p>0.05$).

Table 3. Kruskal-Wallis test and post hoc comparisons of csai score between groups.

Analysis	Group	Mean	Test Statistic	Std. Error	Z	p (Sig)	adjusted p (Sig)
Kruskal-WallisTest	C	80.30	$\chi^2=62.524$			0.00	
	T	38.19					
	P	28.15					
Post Hoc	P - C		52.148	6.944	7.510	0.00	0.00
	T - C		42.112	6.996	6.020	0.00	0.00
	P - T		10.036	6.830	1.469	0.142	0.425

P: PETTLEP Imagery; T: Traditional; C: Control; *: $p<0.01$.

The most significant SCn change was in group P, where the pre mean: 118.97 ± 7.410 and post 136.00 ± 5.673 saw an increase of 17.03 points ($p=0.00$), and in group T there was an increase of 12.97 points; conversely, in group C there was an increase of 0.36 points (Table 4). According to Figure 2, group P showed the most significant increase in self-confidence, followed by group T,

while the control group encountered the minimal decline ($p=0.00$).

The Kruskal-Wallis test showed a significant difference in self-confidence scores among the groups ($\chi^2=54.427$, $p<0.01$, $\eta^2=0.50$). Post hoc analysis indicated significantly higher self-confidence in both the PETTLEP and traditional groups compared to the control (adjusted $p<0.01$),

while the difference between PETTLEP and traditional was not significant ($p=0.518$). Power

analysis indicated high statistical power (>0.95) (Table 5; Figure 3).

Table 4. Changes in self-confidence after intervention.

Variable	P		T		C	
	Pre	Post	Pre	Post	Pre	Post
SCn	118.97 \pm 7.410	136.00 \pm 5.673*	120.53 \pm 5.50	133.50 \pm 5.951*	121.47 \pm 5.673	121.83 \pm 5.736@
O	34.33 \pm 2.976	37.06 \pm 2.179*	34.50 \pm 2.907	36.13 \pm 2.225@	35.07 \pm 2.840	35.10 \pm 2.771@
I	23.03 \pm 2.494	25.39 \pm 1.657*	23.44 \pm 1.999	25.13 \pm 1.601\$	23.77 \pm 1.906	23.87 \pm 1.548@
SL	27.67 \pm 2.965	32.03 \pm 2.352*	27.94 \pm 2.782	31.50 \pm 2.463*	28.07 \pm 2.778	28.07 \pm 2.651@
NW	19.67 \pm 2.570	24.39 \pm 2.449*	20.38 \pm 2.600	23.69 \pm 2.191*	19.97 \pm 2.606	20.00 \pm 2.477@
SA	14.27 \pm 2.503	17.12 \pm 2.547*	14.28 \pm 2.453	17.06 \pm 2.577*	14.60 \pm 2.458	14.80 \pm 2.250@

P: PETTLEP Imagery; T: Traditional; C: Control; Values are expressed as mean \pm SD; SCn: Self Confident; O: Optimistic; I: Independent; SL: Sportsman-like; NW: Not Worrisome; SA: Self-Adaptable; *: pre vs post ($p<0.01$); \$: pre-post ($p<0.05$); @: pre vs post ($p>0.05$).

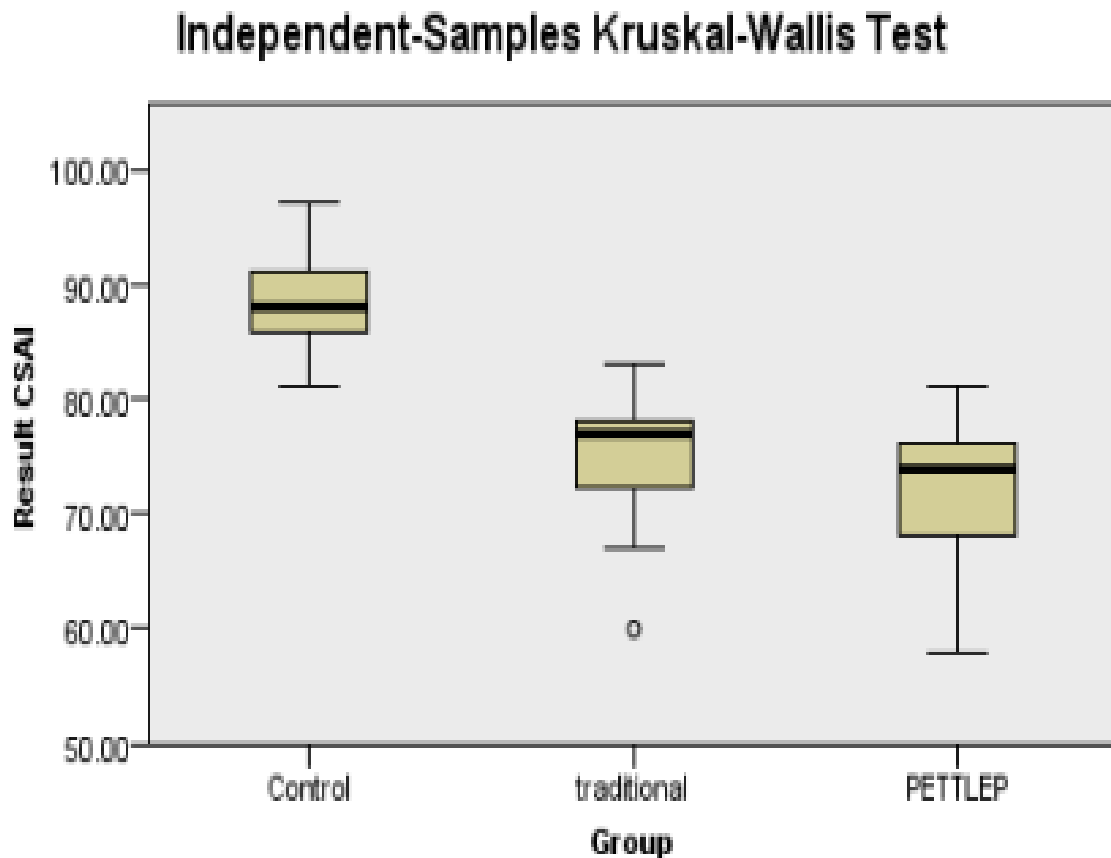


Figure 2. Comparison of competitive anxiety in three groups after being given intervention with statistical test results of 62.524 and p -value 0.00.

Table 5. Kruskal-Wallis test and post hoc comparisons of self-confidence score between groups.

Analysis	Group	Mean	Test Statistic	Std. Error	Z	p (Sig)	adjusted p (Sig)
Kruskal-WallisTest	C	17.85	$\chi^2=54.427$			0.00	
	T	57.19					
	P	66.50					
Post Hoc	P - C		48.650	6.946	7.004	0.00	0.00
	T - C		39.338	6.998	5.622	0.00	0.00
	P - T		9.312	6.831	1.363	0.173	0.518

P: PETTLEP Imagery; T: Traditional; C: Control; *: $p<0.01$.

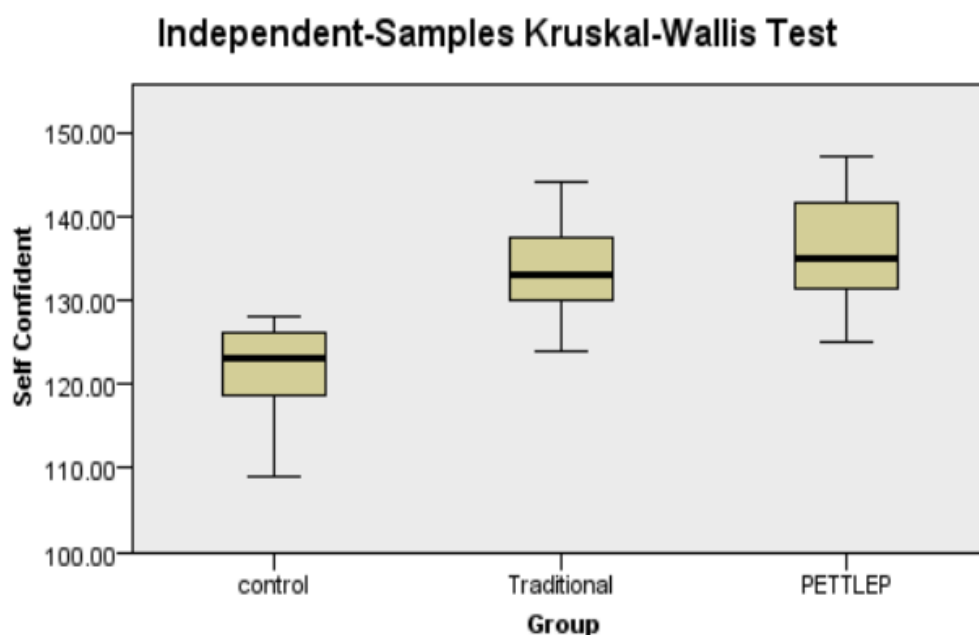


Figure 3. Comparison of self-confidence in three groups after being given intervention with statistical test results 54.427 and p-value 0.00.

DISCUSSION

Sport Imagery Ability. This study involved 95 adolescents aged 12-17 years (mean age = 14.53), consisting of 80 boys and 15 girls, with all male-dominated groups. The results showed that basic Sport Imagery Ability (SIA), which includes Strategy Imagery (SI), Goal Imagery (GI), Influence Imagery (AI), and Skill Imagery (SkI), varied across the three groups. The traditional (T) group showed the highest overall SIA score (48.44 ± 3.61), followed by the control (C) group (47.40 ± 3.29), while the PETTLEP (P) group had the lowest score (34.73 ± 3.09). The T group also scored highest in all SIA subcomponents. This variation in basic imagery ability is important, as it may have influenced the intervention outcomes. The significantly lower baseline values in the PETTLEP group suggest that the improvements observed during the intervention may be related to the effectiveness of the PETTLEP protocol and the initial capacity for development. Participants in this group may have benefited more due to the structured and novel nature of the PETTLEP method, which may have a greater impact given their initially limited imagination capabilities.

Imagery Ability is a key characteristic of athletes and is crucial in improving sports performance and motor learning when integrated with physical training (19, 20). It is a

psychological skill involving the mental simulation of actions, supporting cognitive and motivational functions (13). Components such as strategy, goal, affect, and imagination skills support athletes mentally practicing skills, planning actions, regulating emotions, and improving focus and performance (13, 21). Goal imagery, in particular, has been associated with increased motivation, goal-setting ability, and training adherence (22).

The analysis also suggests that imagination training contributes not only to psychological preparation but also to physiological readiness. Previous research has shown that Imagination can improve muscle strength and neuromuscular coordination, albeit to a lesser extent than direct physical training (23, 24). In this context, Imagination may serve as an additional training method, especially during periods of injury or limited physical activity (25).

PETTLEP Imagery on Competitive Anxiety in Badminton Athletes. The results of this study demonstrate that the PETTLEP imagery intervention significantly reduced competitive anxiety (CSAI) scores by 17.61 points. Traditional imagery also decreased (13.69 points), although the reduction was smaller than that observed with PETTLEP imagery. In contrast, the control group showed no significant change ($p=0.637$). These findings confirm the

effectiveness of imagery-based interventions, particularly PETTTLEP, in alleviating competitive anxiety among athletes (10, 13).

A Kruskal-Wallis test revealed a significant difference in CSAI scores among the three groups ($\chi^2=62.524$, $p<0.01$, $\eta^2=0.57$), indicating a large effect size. Post hoc analysis showed that both the PETTTLEP and traditional imagery groups had significantly lower CSAI scores compared to the control group ($p<0.01$), although no significant difference was found between PETTTLEP and traditional imagery ($p=0.425$). Power analysis confirmed the robustness of these results, with high statistical power (>0.95). These outcomes further validate the impact of PETTTLEP imagery on improving psychological readiness and reducing performance-related anxiety.

PETTTLEP imagery may be more effective than traditional methods due to its structured simulation of competition scenarios, which incorporates physical, cognitive, and emotional elements. This supports psychological preparedness and enhances stress management skills (26). Competitive anxiety, which encompasses pre-competition worry and physiological arousal, can negatively influence athletic performance (6). PETTTLEP imagery helps athletes adapt to these stressors by engaging them in task-relevant and emotionally regulated mental simulations.

A notable reduction was also observed in the cognitive anxiety component, with the PETTTLEP group showing a decrease of -3.82 points. This suggests that PETTTLEP's structured and context-specific visualization enhances attentional focus and reduces mental distraction. These results align with previous findings indicating that well-designed mental training programs can mitigate cognitive stress and improve performance consistency (19, 27, 28). PETTTLEP imagery facilitates better anticipation of competition demands and promotes mental resilience by improving decision-making, reducing worry, and sharpening focus (20, 29). Although the traditional imagery group also experienced a reduction in cognitive anxiety (-5.31), the PETTTLEP group's results suggest more consistent and targeted benefits due to its multisensory and task-congruent design (19, 30).

Regarding somatic anxiety, the PETTTLEP group demonstrated a significant reduction (-4.7), slightly greater than the decrease seen in the traditional imagery group (-4.16). The control

group again showed no significant changes ($p=0.882$). These findings suggest that PETTTLEP imagery not only helps regulate cognitive symptoms of anxiety but also addresses physiological manifestations such as muscle tension, heart rate, and nervousness (27, 29). One possible explanation is that PETTTLEP increases interoceptive awareness and simulates physical readiness through realistic mental rehearsals. Although no physiological biomarkers (e.g., cortisol levels, heart rate variability) were measured in this study, future research should explore these mechanisms directly to validate the proposed physiological regulation pathways (20, 26).

A significant reduction was also observed in self-confidence-related anxiety, with the PETTTLEP group decreasing by 9.09 points. The traditional imagery group showed a smaller decline of 4.21 points, and the control group exhibited no significant changes ($p=0.476$). These findings emphasize the role of PETTTLEP in enhancing athletes' self-belief and mental composure under pressure (20, 28). Increased self-confidence contributes to better concentration, calmness, and execution during competition, suggesting that structured mental training can effectively buffer anxiety's negative impact on performance.

Overall, the Kruskal-Wallis analysis confirmed that the PETTTLEP imagery intervention significantly reduced competitive anxiety compared to the control group, supporting previous studies showing its psychological benefits in sports settings (13, 23). PETTTLEP imagery proved to be more effective than traditional imagery in reducing cognitive and somatic anxiety and improving self-confidence among badminton athletes. Its in-depth, structured, and ecologically valid approach offers greater psychological advantages by engaging athletes in realistic, multisensory simulations of performance contexts.

PETTTLEP Imagery on Self-Confidence in Badminton Athletes. The PETTTLEP imagery intervention significantly improved self-confidence by 17.03 points, outperforming traditional imagery, which showed a 12.97-point increase. In contrast, the control group showed no significant change. These findings confirm the critical role of imagery in enhancing self-confidence among athletes, consistent with prior research (20, 28). A Kruskal-Wallis test revealed

a significant difference in self-confidence scores among the three groups ($\chi^2=54.427$, $p<0.01$, $\eta^2=0.50$), indicating a large effect size. Post hoc analysis showed that both PETTLEP and traditional imagery groups had significantly higher self-confidence than the control group (adjusted $p<0.01$), while no significant difference was found between the PETTLEP and traditional groups ($p=0.518$). The high statistical power of the analysis (>0.95) reinforces the reliability of these findings.

Analysis of subcomponents showed that optimism increased more in the PETTLEP group ($\uparrow 2.73$) than in the traditional group ($\uparrow 1.63$), with no significant changes observed in the control group ($p=0.461$). This indicates that PETTLEP imagery is more effective in reinforcing positive expectations and enhancing an athlete's outlook (20). Similar trends were observed in other subcomponents: independence ($\uparrow 2.36$ vs. 1.69), sportsmanship ($\uparrow 4.36$ vs. 3.56), and lack of worry ($\uparrow 4.72$ vs. 3.01), further demonstrating the advantages of PETTLEP's multisensory and context-specific design (31, 32).

Interestingly, baseline scores on the Sports Imagery Ability Questionnaire (SIAQ) were highest in the traditional group, followed by the control group, and lowest in the PETTLEP group. This disparity may have influenced outcome differences, particularly regarding self-confidence and anxiety responses. The relatively low SIAQ in the PETTLEP group may reflect less prior exposure to imagery training, making the structured PETTLEP intervention more novel and impactful. Future studies should control for initial SIAQ scores or include them as covariates to isolate the intervention's effects better.

The superior outcomes of the PETTLEP group may also be attributed to a higher congruence between imagery content and real performance contexts, which fosters increased self-referential processing and behavioral alignment. This is consistent with recent findings emphasizing the ecological validity of imagery interventions (19). Adaptability, another critical self-confidence component, also increased most in the PETTLEP group ($\uparrow 2.85$), followed by the traditional group ($\uparrow 2.78$), with no significant change in the control group. These findings are supported by previous studies highlighting PETTLEP competition's ability to simulate the psychological demands of competition (30).

Self-confidence is a key factor distinguishing successful from unsuccessful athletes, influencing both mental readiness and performance outcomes (7). Optimism plays a similar role in enhancing performance. Athletes using PETTLEP imagery showed a significantly greater increase in optimism ($\uparrow 2.73$) than those using traditional methods ($\uparrow 1.63$), reinforcing the effectiveness of PETTLEP in building positive psychological states (20). These findings align with previous research linking PETTLEP imagery to improved psychological resilience, self-efficacy, and athletic performance (10, 32). Additionally, PETTLEP has been shown to reduce anxiety and depression, contributing to improved mental well-being (20, 33).

The independence subcomponent also improved significantly in the PETTLEP group ($\uparrow 2.36$), compared to the traditional group ($\uparrow 1.69$), with no change in the control group. This outcome aligns with prior findings that PETTLEP imagery enhances self-efficacy and reduces self-blame in sports such as basketball and karate (10, 34). It also aids psychological skills development and emotional regulation (32). Sportsmanship, which reflects ethical behavior, emotional control, and discipline during competition, showed the largest increase in the PETTLEP group ($\uparrow 4.36$), followed by the traditional group ($\uparrow 3.56$), while the control group showed no change. This suggests PETTLEP's superiority in promoting psychological resilience and behavioral integrity under pressure (32). The immersive and structured nature of PETTLEP imagery—incorporating emotional and sensory elements—may contribute to these improvements (31).

The "lack of worry" subscale, which includes confidence in expressing opinions, fearlessness in competition, and mental strength, also improved more in the PETTLEP group ($\uparrow 4.72$), compared to the traditional imagery group ($\uparrow 3.01$), with no significant change in the control group. PETTLEP's structured approach effectively reduces anxiety by enabling athletes to simulate competition environments vividly (20).

Self-adaptability, defined as the athlete's ability to manage social interaction, overcome nervousness, and adjust to challenges such as injuries or career transitions, showed the greatest improvement in the PETTLEP group ($\uparrow 2.85$), followed by the traditional imagery group ($\uparrow 2.78$), and no significant changes in the control group. Prior studies have shown PETTLEP

imagery to be more effective than traditional methods in developing adaptability and performance among karate athletes (32, 35). In summary, the PETTLEP imagery intervention demonstrated superior effects on self-confidence and its key psychological subcomponents compared to both traditional imagery and control conditions. These findings reinforce PETTLEP's value as a comprehensive and context-sensitive strategy for improving psychological preparedness and performance in athletes.

CONCLUSION

This study suggests that PETTLEP imagery effectively reduces competitive anxiety and increases self-confidence in adolescent badminton athletes. Compared to traditional imagery and a control condition, PETTLEP resulted in greater improvements in cognitive and somatic anxiety and self-confidence-related components. These effects are likely due to the structured, multisensory, and performance-specific training design supporting psychological readiness. However, although these findings suggest short-term psychological benefits, this study did not assess actual performance outcomes or long-term retention of mental skills. Future research should examine the impact of PETTLEP imagery on athletic performance, psychological resilience over time, and its applicability across sports and levels of competition.

APPLICABLE REMARKS

- The PETTLEP imagery technique effectively reduces competitive anxiety and enhances self-confidence in adolescent badminton athletes. Its structured and context-specific approach makes it suitable for integration into psychological training programs. Future research should explore its long-term effects and potential links to performance outcomes.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Helmi Akmal Fauzan. Acquisition of data: Helmi Akmal Fauzan. Analysis and interpretation of data: Helmi Akmal Fauzan. Drafting the manuscript: Helmi Akmal Fauzan, Wini Hadiyani. Critical revision of the manuscript for important intellectual content: Helmi Akmal Fauzan, Wini Hadiyani. Statistical analysis: Herman Subarjah. Administrative, technical, and material support: Dewi Dolifah. Study supervision: Komarudin.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this paper.

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The Institutional Review Board (IRB) of STIKep PPNI West Java has granted ethical authority for this study with approval number III/041.1/KEPK-SLE/STIKEP/PPNI/JABAR/II/2024.

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ARTIFICIAL INTELLIGENCE (AI) USE

Quillbot and Consensus AI were used.

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