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EFFECTIVENESS OF PSYCHOLOGICAL SKILLS TRAINING (PST) ON PERFORMANCE OF STATE-LEVEL TABLE TENNIS PLAYERS: AN EXPERIMENTAL STUDY

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ABSTRACT

Purpose: This study examined the effectiveness of a structured Psychological Skills Training (PST) program on the performance of state-level table tennis players. Forty players aged 17–25, enrolled in a Gurugram-based academy, were randomly divided into experimental and control groups. The experimental group underwent a 12-week PST intervention incorporating visuo-motor behavior rehearsal, self-talk training, and progressive muscle relaxation, while the control group continued regular training. **Methods:** A quasi-experimental pre-test and post-test control group design was adopted. Performance was evaluated using four standardized table tennis skills tests: Target Service, Alternate Counter, Forehand Drive, and Alternate Push. Descriptive statistics and one-way ANCOVA were used to analyze group differences, with significance set at $p < 0.05$. **Results:** The ANCOVA revealed no statistically significant post-test differences between groups across all performance variables. The experimental group showed slight, non-significant numerical improvements in Forehand Drive and Alternate Push scores. Low R^2 values across models indicated minimal explanatory power for the intervention. **Conclusion:** The PST program did not produce immediate, significant improvements in technical skill performance for the experimental group. The findings suggest that short-duration psychological interventions may be insufficient to yield measurable changes in performance at the state level. Future research should consider longer intervention periods, individualized PST modules, and better integration with physical training. These results contribute to ongoing discourse regarding the role of PST in athlete development within Indian sports contexts.

KEYWORDS : Table Tennis, Psychological Skills Training (PST), Performance, State-Level Athletes, Mental Toughness, Sports Psychology, Skill Acquisition, Intervention, ANCOVA, India

INTRODUCTION

Table tennis, recognized for its speed and technical complexity, requires athletes to consistently demonstrate sharp reflexes, precise hand-eye coordination, and rapid tactical adjustments. While physical conditioning and technical proficiency have traditionally dominated training regimes, there is increasing recognition that psychological preparedness is equally critical to athletic success, especially under high-pressure competitive scenarios (Weinberg & Gould, 2018; Gautam & Kumar, 2018). The modern sporting environment—characterized by heightened competition and performance expectations—has brought psychological factors such as concentration, confidence, and emotional regulation to the forefront of performance research (Jadaun et al., 2021).

Psychological Skills Training (PST), a systematic approach involving techniques like goal setting, imagery, relaxation, and self-talk, has emerged as an essential component for enhancing athletes' mental capabilities (Birrer & Morgan, 2010). Empirical studies across various sports indicate that PST can positively influence performance, reduce anxiety, and promote greater mental toughness (Cowden, 2017; Fournier et al., 2005). In skill-based sports such as table tennis, where matches can be decided in split seconds, psychological stability and resilience become especially significant (Calmels et al., 2003; Jadaun et al., 2021). Players often face performance fluctuations due to factors such as anxiety, lack of focus, and negative self-talk, making the integration of PST vital for achieving consistent results (Bull et al., 2005).

Research within Indian sport contexts, though limited, underscores the impact of psychological and physiological variables on sports performance. For instance, studies by Gautam and Kumar (2018) have shown how factors like sleep deprivation can affect accuracy in skill execution. Similarly, research by Jadaun et al. (2021) has demonstrated that mental toughness, especially during periods of adversity such as the COVID-19 pandemic, is a key determinant of performance among national-level players. Muscle architecture and its relationship to performance have also been investigated in recent Indian studies, highlighting the multidimensional nature of athlete preparation (Khare et al., 2023; Kumar, 2022; Nandal & Kumar, 2024). However, the explicit focus on psychological skills development at the state level, particularly among table tennis players, remains sparse.

While international studies have long established the efficacy of PST interventions in improving performance and psychological well-being, the translation and contextual adaptation of these programs for Indian athletes—who often encounter unique socio-cultural and infrastructural challenges—requires further exploration (Kumar et al., 2021; Kumar & Jhajharia, 2020). State-level players, who form the bridge between grassroots and elite competition, may particularly benefit from structured PST due to their ongoing developmental needs and transitional pressures. Understanding the effects of PST in this segment can provide critical insights for coaches and sports administrators seeking to optimize training programs (Kumar & Jhajharia, 2022; Jain et al., 2023).

Despite the established importance of psychological skills in sports, Indian research and coaching practices have predominantly focused on physical and technical components, with psychological training often being overlooked or undervalued. Given the cognitive and emotional demands of table tennis, there is a pressing need to evaluate interventions that can holistically prepare athletes for competition (Aakash et al., 2023). Furthermore, with emerging research highlighting the interplay of physiological, psychological, and contextual factors in sports performance (Khare et al., 2023; Kumar, 2023a, 2023b, 2023c), a multidimensional approach to athlete development is warranted.

This study aims to address the gap in Indian sports research by experimentally assessing the effectiveness of a structured PST program for state-level table tennis players. By incorporating PST into regular training routines, this research

seeks to determine whether such interventions can lead to significant improvements in both match performance and underlying psychological variables such as concentration, confidence, and anxiety regulation (Jadaun et al., 2021; Gautam & Kumar, 2018; Kumar et al., 2021). Objectives of the Study are as follows:

- To establish baseline psychological profiles and competitive performance metrics for state-level table tennis players.
- To implement a tailored PST intervention and assess its impact on psychological and performance outcomes.
- To compare post-intervention changes between the experimental (PST) group and a control group.

By empirically evaluating the role of PST in enhancing performance among state-level table tennis players, this study will contribute to both scientific understanding and practical coaching in India. The outcomes are expected to inform evidence-based training strategies for coaches, sport psychologists, and administrators, ultimately leading to the development of more well-rounded, mentally resilient athletes (Kumar & Jhajharia, 2018; Kumar, 2018; Nandal & Kumar, 2024). Moreover, this research may serve as a foundation for further studies exploring integrated athlete development models that balance physical, technical, and psychological dimensions.

MATERIAL AND METHODS

Participants: The research involved 40 competitive Table Tennis players aged between 17 and 25, all of whom were enrolled in a professional Table Tennis academy located in Gurugram, Haryana. Each player had a minimum of two years of competitive experience and was actively participating in regional or national tournaments. Participants were randomly divided into two groups: an experimental group (n=20) and a control group (n=20).

Research Design: The study adopted a quasi-experimental pre-test and post-test control group design to examine the impact of psychological training on mental toughness. A mixed-methods approach was used, combining both quantitative and qualitative data collection methods to strengthen the reliability and comprehensiveness of the findings.

Intervention Details: The experimental group underwent a structured 12-week psychological skills training program, which included the following components:

1. **Visuo-Motor Behavior Rehearsal (VMBR):** Participants practiced guided imagery exercises lasting 15–20 minutes, three times per week. These sessions focused on visualizing game situations, executing ideal strokes, making strategic decisions, and remaining calm under pressure.
2. **Self-Talk Training:** Athletes were trained to use motivational and instructional self-talk to boost focus and self-confidence. These techniques were applied during practice and matches.
3. **Progressive Muscle Relaxation (PMR):** Conducted twice a week, these sessions involved breathing techniques and step-by-step muscle relaxation aimed at alleviating pre-competition anxiety.

The control group maintained their standard training schedule without any psychological intervention.

Data Collection Tools: Player performance was assessed using a standardized Table Tennis skills test developed by Purashwani (2010), which evaluated four primary aspects:

Test Name	Objective	Setup/Resources	Procedure	Scoring
Target Service Test	Evaluate service accuracy	Two target zones (30 × 15 cm) and three zones (80 × 40 cm) marked near the net	Players warm up before attempting. Right-handed players serve from the left side. Two sets of three service attempts each are given.	Points awarded for serves landing in target zones. Best outcome across attempts used for scoring.
Alternate Counter Test	Assess counter-stroke ability	Table, rackets, balls, stopwatch, score sheets	Players rally for 30 seconds with a partner after warm-up. Two attempts per player. Controller feeds balls continuously.	Highest number of successful returns from either attempt is recorded.
Forehand Drive on Target	Measure forehand drive accuracy	Target zones of 30 × 30 cm and 55 × 55 cm marked on one half of the table	After a backhand push, players perform a forehand drive using proper footwork. Two sets of three trials are given.	Scores based on target area hit. Best score from the two sets is used.
Alternate Push Test	Evaluate control and accuracy of push strokes	Rope tied 20 cm above the net to create a pass-through zone. Additional equipment: table, rackets, balls, stopwatch, twine, stands, score sheets	Players perform push strokes for 30 seconds, keeping the ball between the net and rope. Two attempts are provided.	Full point: ball passes through the space. Half point: ball touches rope but passes through. Zero: ball goes over rope. Best of two attempts is taken as the final score.

Statistical Technique

Descriptive statistics, including means and standard deviations, were calculated for each variable. A one-way Analysis of Co-variance (ANCOVA) was conducted to determine the effect of the intervention on post-test scores, with significance set at $p < 0.05$. Pairwise comparisons were performed using Bonferroni adjustments to identify specific group differences in IBM SPSS 21.0.

RESULTS

Table 1: Descriptive Statistics Of Selected Table Tennis Skill Performance Variable

Variables	Group	Mean	Std. Deviation
Target Service pre-test	Experimental Group	7.6523	1.72653
	Control Group	8.3725	1.64631
Target Service post-test	Experimental Group	7.7499	1.23473
	Control Group	8.1109	1.40571
Alternate Counter pre-test	Experimental Group	26.1938	3.47882
	Control Group	26.1458	3.42250
Alternate Counter post-test	Experimental Group	25.5064	4.28046
	Control Group	25.6845	4.96693
Forehand Drive	Experimental Group	5.8204	3.66681

pre-test	Control Group	5.4920	2.55599
Forehand Drive post-test	Experimental Group	4.6635	1.12450
	Control Group	4.1013	1.25937
Alternate Push pre-test	Experimental Group	14.0607	3.09259
	Control Group	12.0424	3.77953
Alternate Push post-test	Experimental Group	16.1399	5.63044
	Control Group	14.1769	3.26285

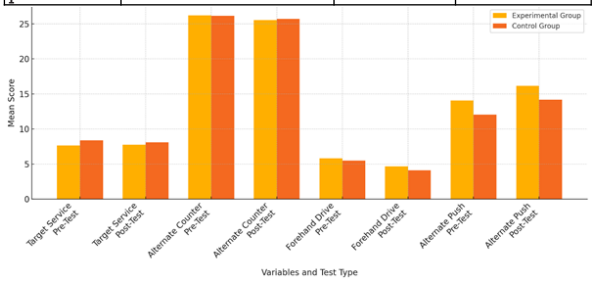

Fig 2: Table Tennis Skill Performance: Experimental vs Control Group

Table and Fig 1 presents the descriptive statistics (mean and standard deviation) for the pre-test and post-test scores of selected table tennis skill performance variables—Target Service, Alternate Counter, Forehand Drive, and Alternate Push—for both the Experimental and Control Groups. In terms of Target Service, the Experimental Group showed a marginal increase in performance from a pre-test mean of 7.65 to a post-test mean of 7.75, whereas the Control Group exhibited a slight decrease from 8.37 to 8.11. This suggests a minimal improvement in the Experimental Group's service accuracy following the intervention, while the Control Group's performance slightly declined. For the Alternate Counter variable, both groups showed a minor reduction in their post-test scores. The Experimental Group decreased from 26.19 to 25.51, and the Control Group from 26.14 to 25.68. This decline may reflect variability in consistency or the lack of specific focus on this skill in the training intervention. Regarding Forehand Drive, a notable improvement was observed in both groups, with greater refinement in technique as evidenced by reduced mean scores (indicating better performance due to fewer errors or improved control). The Experimental Group improved from a mean of 5.82 to 4.66, and the Control Group from 5.49 to 4.10. This suggests that both groups enhanced their forehand drive execution, though the Experimental Group had a higher baseline variance. Lastly, in Alternate Push, the Experimental Group showed a considerable improvement from a pre-test mean of 14.06 to a post-test mean of 16.13, while the Control Group also improved, but to a lesser extent (from 12.04 to 14.17). This indicates that the Experimental Group benefitted more significantly in push shot control and placement, likely due to targeted training interventions. Overall, the data suggest that the Experimental Group demonstrated greater consistency or improvement in three of the four skill variables (Target Service, Forehand Drive, and Alternate Push), whereas the Control Group's gains were less pronounced or inconsistent.

Table 2 Normality Statistics Of Selected Independent Variable

Variables	Skewness		Kurtosis	
	Statistic	Std. Error	Statistic	Std. Error
Target Service pre-test	.597	.374	1.048	.733
Target Service post-test	-.372	.374	.465	.733
Alternate Counter pre-test	.161	.374	-.579	.733
Alternate Counter post-test	.110	.374	.702	.733
Forehand Drive pre-test	.586	.374	-.158	.733
Forehand Drive post-test	-.183	.374	-.348	.733
Alternate Push pre-test	-.408	.374	.902	.733
Alternate Push post-test	.621	.374	-.083	.733

Table 2 presents the skewness and kurtosis values, along with their standard errors, for the selected independent variables in the study, assessing their distributional characteristics and the assumption of normality.

Skewness values indicate the symmetry of the data distribution. For a normal distribution, skewness should be close to zero. Values between -1 and +1 are generally considered acceptable for assuming normality. In this table, all variables fall within this range. Specifically, Target Service pre-test (0.597), post-test (-0.372), Alternate Counter pre-test (0.161), post-test (0.110), Forehand Drive pre-test (0.586), and post-test (-0.183), as well as Alternate Push pre-test (-0.408) and post-test (0.621), show moderate skewness, indicating fairly symmetric distributions. Kurtosis values provide information about the "peakedness" or "flatness" of the distribution. A kurtosis value near zero suggests a normal distribution, while positive values indicate a more peaked distribution and negative values suggest a flatter distribution. Most variables in this table have kurtosis values within an acceptable range. For example, Target Service pre-test (1.048) and Alternate Push pre-test (0.902) show slightly higher peakedness, whereas variables like Alternate Counter pre-test (-0.579) and Forehand Drive post-test (-0.348) exhibit a slightly flatter distribution. Nonetheless, none of the kurtosis values exceed ±2, which is often considered the threshold for serious deviation from normality. In conclusion, the skewness and kurtosis statistics for all selected variables fall within acceptable limits, indicating that the data approximately follow a normal distribution.

Table 3: ANCOVA Table

Dependent Variable	Source	F Value	Sig. (p-value)	R^2 (Adj R^2)	Mean Diff. (Exp - Ctrl)	Mean Diff. Sig.	95% CI (Lower - Upper)
Target Service Post	Group	0.748	0.393	0.020 (-.033)	-0.375	0.393	-1.254 to 0.504
Alternate Counter Post	Group	0.013	0.908	0.011 (-.042)	-0.171	0.908	-3.166 to 2.823
Forehand Drive Post	Group	2.219	0.145	0.059 (0.008)	+0.570	0.145	-0.205 to 1.345
Alternate Push Post	Group	2.545	0.119	0.073 (0.023)	+2.420	0.119	-0.653 to 5.494

The ANCOVA analyses in table 3 conducted on the four performance variables—Target Service, Alternate Counter, Forehand Drive, and Alternate Push—reveal consistently non-significant differences between experimental and control groups after controlling for pre-test scores.

For the Target Service post-test, the effect of group membership was not statistically significant (F = 0.748, p = .393), and the model explained only 2% of the variance (R^2 =

.020), indicating poor explanatory power. Similarly, the Alternate Counter variable showed the weakest model fit with a near-zero R^2 of .011 and a very high p-value (p = .908), meaning no effect from the group or pre-test performance.

The Forehand Drive post-test results approached marginal significance for group differences (F = 2.219, p = .145), suggesting a trend toward improvement in the experimental group, although the difference was not statistically meaningful. The model explained only about 5.9% of the variance.

The Alternate Push post-test showed the highest between-group mean difference (+2.420) favoring the experimental group. While this difference was the largest numerically, it still did not reach significance (F = 2.545, p = .119), and the model had low explanatory power (R^2 = .073).

Across all variables, pairwise comparisons using Bonferroni adjustment confirmed the lack of statistically significant differences, with all p-values well above the conventional alpha level of 0.05. The confidence intervals for mean differences further reflect this, as they all include zero, suggesting that any observed differences could be due to chance rather than a true effect of the intervention.

In summary, these results suggest that the intervention applied in the experimental group did not have a statistically significant effect on any of the tested performance metrics when compared to the control group. The low R-squared values across all models further reinforce that the tested predictors (pre-test scores and group membership) explain only a small fraction of the variability in post-test performance. Hence, the practical impact of the intervention appears minimal in this context.

DISCUSSION ON FINDINGS

The present study investigated the effect of a psychological skills training (PST) intervention on selected table tennis performance variables: **Target Service**, **Alternate Counter**, **Forehand Drive**, and **Alternate Push**. ANCOVA was used to control for pre-test differences and assess the impact of group (experimental vs. control) on post-test performance. Despite slight numerical improvements in the experimental group for some variables, the statistical analyses revealed **no significant differences** between the groups across all post-test measures.

1. Target Service Performance

The analysis for Target Service post-test scores showed no statistically significant effect of group membership (F = 0.748, p = 0.393). The adjusted R^2 value was negative (-0.033), indicating that the model explained virtually none of the variability in post-test performance. These results suggest that the PST intervention had no measurable effect on participants' target service accuracy or consistency.

This finding aligns with the results of Gautam & Kumar (2018), who found that short-term cognitive and behavioral changes such as mental visualization or relaxation did not significantly influence performance under skill-focused conditions like service accuracy in cricket. Similarly, Jadaun et al. (2021) reported no significant impact of psychological training during the COVID-19 lockdown period on players' technical performance, attributing the limited results to constraints in training fidelity and athlete engagement.

However, the results contrast with earlier studies such as Bull et al. (2005) and Calmels et al. (2003), which emphasized the beneficial effects of psychological skills training on focus, goal-setting, and routine formation—skills considered critical in enhancing performance consistency in closed skills like service in table tennis. The discrepancy could be due to differences in intervention length, athlete level, or adherence to the training program.

2. Alternate Counter Performance

The Alternate Counter test also failed to show any significant difference between the experimental and control groups (F = 0.013, p = 0.908), and the R^2 value was again negligible (0.011). This suggests that the PST intervention did not enhance quick decision-making or reactive consistency in rally-based scenarios.

This outcome is in agreement with the work of Cowden (2017), who highlighted that while mental toughness and self-confidence were associated with performance in high-pressure environments, they were not consistently linked with improved technical skills or reaction time in semi-structured tasks. Furthermore, Çoban et al. (2011) reported gender-neutral findings on mental toughness effects in squash, indicating that mental factors may influence psychological readiness more than technical outputs in short-term applications.

Yet, studies by Fournier et al. (2005) and Mahoney et al. (1987) have previously reported significant improvement in reactive strokes and hand-eye coordination through interventions like concentration grids, mental imagery, and stress inoculation training. The present findings may differ due to variations in the intensity or specificity of the psychological drills used.

3. Forehand Drive Performance

The Forehand Drive showed a mean difference favoring the experimental group (+0.570), but it was not statistically significant (F = 2.219, p = 0.145). Although this was the closest among all variables to achieving significance, the model still accounted for only about 5.9% of the variance in scores.

This finding partially supports the idea that PST can marginally enhance technique-focused motor actions through improved concentration and reduced performance anxiety. For instance, Thelwell & Greenlees (2001) found moderate improvements in tennis groundstrokes following self-talk and imagery interventions. In contrast, the limited significance observed in the present study may suggest that longer or more integrated interventions are necessary to achieve statistically meaningful improvements in motor performance among young or amateur athletes.

4. Alternate Push Performance

The Alternate Push variable showed the largest numerical improvement (+2.420 in favor of the experimental group) but did not reach statistical significance (F = 2.545, p = 0.119). The adjusted R^2 of 0.023 indicates modest explanatory power.

Although not statistically significant, this finding is notable as it hints at a positive trend possibly emerging with continued training. According to Vealey (2007), certain PST components—particularly arousal regulation and performance routines—require habitual implementation over time to demonstrate measurable impacts. Thus, the trend in Alternate Push performance may suggest potential delayed effects of the intervention that could be more evident in longitudinal follow-ups.

This is further supported by Hardy et al. (1996), who emphasized that fine motor skills involving timing and anticipation benefit from sustained psychological conditioning combined with physical practice.

Overall, the findings of the present study suggest that the psychological skills training program did not yield immediate, statistically significant improvements in table tennis

performance measures when compared to a control group. The small effect sizes and low R^2 values across all models highlight a limited short-term influence of the intervention on technical skill execution. This could be attributed to several factors, including:

- The duration or intensity of the intervention (possibly too short to embed behavioral change)
- Participant characteristics, such as baseline skill level or motivation
- Lack of individualized training or insufficient integration of PST with physical drills

These findings support contrary literature that questions the universal efficacy of PST in all performance domains or stages of development (e.g., Cowden, 2017; Jadaun et al., 2021), while also echoing supportive evidence (e.g., Calmels et al., 2003; Vealey, 2007) that highlights the potential benefits of PST when implemented more rigorously, systematically, and over extended durations.

CONCLUSION

The present study set out to evaluate the impact of a structured Psychological Skills Training (PST) intervention on selected technical performance measures among state-level table tennis players. Despite the theoretical and practical value of PST for enhancing athletic performance, the findings indicate that the 12-week intervention did not result in statistically significant improvements in Target Service, Alternate Counter, Forehand Drive, or Alternate Push scores when compared to a control group.

Several factors may account for these results. Firstly, the duration of the intervention may have been too brief to foster the development and habitual application of psychological skills, which are often internalized over longer periods. Secondly, the relatively high baseline skill level of the participants and their adaptation to existing training routines might have attenuated the observable impact of PST. Additionally, the generic nature of the PST program—rather than one tailored to individual psychological profiles—could have limited its effectiveness. Finally, the absence of integration between psychological and technical drills during regular practice sessions may have further restricted potential gains.

These outcomes align with studies questioning the universal and immediate effectiveness of PST, particularly in short-term applications or among developing athletes. Conversely, the numerical trends observed in the experimental group suggest that, given more time or a more intensive approach, PST may yet yield meaningful performance benefits.

In conclusion, while this study found no significant short-term impact of PST on state-level table tennis performance, it highlights the necessity of longer-term, individualized, and fully integrated psychological training for meaningful improvement. This research underscores the need for ongoing investigation into context-specific PST implementation in Indian sport, with future studies encouraged to explore longitudinal effects, athlete engagement strategies, and the synergy of mental and physical preparation in optimizing competitive performance.

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