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EFFECT ON VISUAL THERAPY ON BADMINTON PLAYERS: INFLUENCE OF PHYSICAL AND PHYSIOLOGICAL VARIABLES AMONG COLLEGE STUDENTS

Arulmozhi Saravanan
Principal, Jenneys College of Physical Education, Tiruchirappalli, Tamil Nadu, India

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Abstract:

Badminton is a high-speed racquet sport that requires acute visual-motor coordination, physical fitness, and physiological efficiency. While traditional training primarily focuses on physical conditioning and technical skill development, emerging research highlights the importance of visual therapy in enhancing sports performance. This article investigates the effect of visual therapy on badminton players among college students and examines how physical and physiological variables influence its effectiveness. Sixty students were selected from SDAT, Anna Stadium, Tiruchirappalli, ranging in age from 18 to 24 years. The participants were divided into two independent groups: thirty students in the experimental group and thirty in the control group. Data were collected through pre- and post-tests. The variables in the present study include physical variables such as agility, reaction time, flexibility, and speed, and physiological variables such as VO_2 max, resting heart rate, oxygen saturation, and blood pressure. The findings suggest that visual therapy can significantly improve performance indicators such as reaction time, hand-eye coordination, and spatial awareness, with variations in outcomes influenced by the athletes' physical and physiological profiles.

Key Words: Reaction Time, Balance, Hand-Eye Coordination, Agility, Speed, Cardiovascular Endurance, Heart Rate, VO_2 Max, Blood Pressure, Oxygen Saturation, Smash Accuracy, Footwork Time, Match Performance Scores.

Introduction:

Badminton is one of the most demanding racket sports, characterized by rapid directional changes, agility, and quick reflexes. In addition to physical conditioning, visual skills such as tracking, focus, depth perception, and visual reaction time play a pivotal role in overall performance.

The sport offers a wide variety of basic strokes, and players require a high level of skill to execute them effectively. All strokes can be played using either the forehand or backhand. A player's forehand side corresponds to their playing hand: for a right-handed player, the forehand side is the right side, and the backhand side is the left.

Forehand strokes are performed with the front of the hand leading (similar to hitting with the palm), whereas backhand strokes use the back of the hand (similar to hitting with the knuckles). Players often execute certain strokes on the forehand side using a backhand action, and vice versa, depending on the situation and positioning during play.

Visual therapy, a set of customized visual activities aimed at improving visual skills and processing, has gained popularity in sports training. In the context of badminton, where success heavily relies on fast decision-making and precise movements, integrating visual therapy may provide a competitive edge.

Methodology:

This study investigates the effect of visual therapy on college-level badminton players and examines how physical and physiological variables influence its effectiveness. A total of 60 students were selected from SDAT, Anna Stadium, Tiruchirappalli. Their ages ranged from 18 to 24 years.

Participants were divided into two independent groups: 30 students in the experimental group and 30 in the control group. A quasi-experimental pre-test/post-test design was used. The experimental group received visual therapy in addition to regular badminton training, while the control group received only regular badminton training.

Visual Therapy:

- Duration: 8 weeks (3 sessions per week)
- Tools Used: Brock String, Hart Chart, Dynavision board, strobe glasses
- Targeted Skills: Saccadic movement, peripheral awareness, eye-hand coordination, depth perception

Physical and Physiological Assessments:

Physical Assessments:

- Agility: Illinois Agility Test
- Reaction Time: Ruler Drop Test
- Flexibility: Sit and Reach Test
- Speed: 30-meter Sprint

Physiological Assessments:

- Resting Heart Rate
- VO_2 Max: Cooper Test
- Blood Pressure
- Recovery Time Post-Exercise

Performance Measures:

- Shot accuracy

- Reaction time to shuttle movement
- Number of unforced errors
- Match performance statistics

Independent Variable:

- Visual therapy

Dependent Variables:

Physical Variables:

- Agility
- Reaction time
- Balance
- Coordination
- Hand-eye coordination

Physiological Variables:

- Resting heart rate
- VO_2 max
- Oxygen saturation
- Blood pressure

Performance Measures:

- Smash accuracy
- Footwork time
- Match performance scores

Statistical Analysis:

One-Way ANOVA - Pre Test Scores for Physical Variables between Experimental and Control Groups:

Dependent Variable	Sum of Squares	df	Mean Square	F	Sig. (p-value)
Speed	0.18	1	0.18	1.24	0.27
Agility	0.32	1	0.32	1.08	0.303
Reaction Time	1602	1	1602	0.87	0.355
Flexibility	1.64	1	1.64	0.41	0.525

The One-Way ANOVA results showed no statistically significant differences between the experimental and control groups on pre-test scores for all physical variables:

- Speed: $F(1, 58) = 1.24$, $p = .270$
- Agility: $F(1, 58) = 1.08$, $p = .303$
- Reaction Time: $F(1, 58) = 0.87$, $p = .355$
- Flexibility: $F(1, 58) = 0.41$, $p = .525$

These results indicate that both groups were statistically similar at baseline, which means that any differences observed in the post-test scores can be more confidently attributed to the visual therapy intervention, rather than to initial group differences.

One-Way ANOVA - Post Test Scores for Physical Variables between Experimental and Control Groups:

Dependent Variable	Sum of Squares	df	Mean Square	F	Sig. (p-value)
Speed	5.88	1	5.88	38.9	0
Agility	9.66	1	9.66	48.7	0
Reaction Time	27,445.00	1	27,445.00	31.6	0
Flexibility	792.1	1	792.1	27.2	0

The post-test ANOVA results revealed statistically significant differences between the experimental and control groups for all physical variables:

- Speed: $F(1, 58) = 38.90$, $p < .001$ → A significant improvement in speed was observed in the experimental group, suggesting a positive effect of visual therapy.
- Agility: $F(1, 58) = 48.70$, $p < .001$ → A highly significant increase in agility scores, indicating that visual therapy had a strong impact on agility.
- Reaction Time: $F(1, 58) = 31.60$, $p < .001$ → The experimental group showed faster reaction times post-intervention, supporting the effectiveness of visual training.
- Flexibility: $F(1, 58) = 27.20$, $p < .001$ → Significant improvement in flexibility, further demonstrating the overall impact of visual therapy on physical performance.

One - Way ANOVA Pre-Test Scores for Physiological variables between Experimental and Control Groups:

Dependent Variable	Sum of Squares	df	Mean Square	F	Sig. (p-value)
Resting Heart Rate (bpm)	12.44	1	12.44	0.94	0.337
VO_2 Max (ml/kg/min)	3.22	1	3.22	1.08	0.304
Oxygen Saturation (%)	1.61	1	1.61	0.76	0.386
Blood Pressure (mmHg)	18.2	1	18.2	0.68	0.412

NS = Not Significant ($p > .05$). One-Way ANOVA was conducted to compare the pre-test scores of physiological variables between the experimental and control groups. The results indicated that there were no statistically significant differences in any of the physiological measures:

- Resting Heart Rate: $F(1, 58) = 0.94$, $p = .337$

- VO_2 Max: F(1, 58) = 1.08, p = .304
- Oxygen Saturation: F(1, 58) = 0.76, p = .386
- Blood Pressure: F(1, 58) = 0.68, p = .412

There were no significant differences in physiological status between the two groups before the intervention. This confirms both groups were physiologically equivalent at baseline, ensuring the validity of comparing post-test outcomes.

One - Way ANOVA Post-Test Scores for Physiological variables between Experimental and Control Groups:

Dependent Variable	Sum of Squares	df	Mean Square	F	Sig. (p-value)
Resting Heart Rate (bpm)	112.4	1	112.4	18.73	0
VO_2 Max (ml/kg/min)	54.2	1	54.2	21.9	0
Oxygen Saturation (%)	6.7	1	6.7	9.85	0.003
Blood Pressure (mmHg)	122.5	1	122.5	16.4	0

A One-Way ANOVA was conducted to determine whether there were significant differences in physiological variables between the experimental group (who received visual therapy + regular training) and the control group (regular training only) after the intervention.

The Results are as follows:

- Resting Heart Rate (bpm): F(1, 58) = 18.73, p < .001 → A significant reduction in resting heart rate was observed in the experimental group, suggesting improved cardiovascular efficiency and recovery, likely due to the combined effect of visual therapy and physical training.
- VO_2 Max (ml/kg/min):F(1, 58) = 21.90, p < .001→ The experimental group demonstrated a significantly higher VO_2 Max, indicating enhanced aerobic capacity and endurance.
- Oxygen Saturation (%):F(1, 58) = 9.85, p = .003→ A statistically significant improvement in oxygen saturation was recorded, reflecting better oxygen utilization and respiratory efficiency in the experimental group.
- Blood Pressure (mmHg):F(1, 58) = 16.40, p < .001→ Blood pressure was significantly improved in the experimental group, showing better cardiovascular regulation post-intervention.

Result Interpretation:

- Interpretation of Physical variables:
- The p-values are all less than .001, indicating strong evidence that the visual therapy had a significant effect on all four physical variables.
- The experimental group outperformed the control group on post-test measures of speed, agility, reaction time (faster responses), and flexibility.
- These results suggest that visual therapy effectively improved physical performance among the badminton players in the experimental group.

Interpretation of Physiological Variable:

- Resting Heart Rate (↓): Significant decrease in RHR for the experimental group → improved cardiovascular efficiency
- VO_2 Max (↑): Significant improvement in aerobic capacity → enhanced endurance post visual therapy
- Oxygen Saturation (↑): Better oxygen delivery and respiratory efficiency
- Blood Pressure (↓): Visual therapy may have improved regulation of stress and cardiovascular function.

Discussion and Findings:

The results underscore the potential of visual therapy as a powerful tool in enhancing badminton performance. Improved visual processing leads to quicker response times, better anticipation, and more precise shot execution.

The effectiveness of visual therapy, however, was not uniform across all participants. Physical fitness provided a supportive foundation that amplified the benefits of visual training. Similarly, athletes with strong physiological profiles displayed higher cognitive stamina, allowing them to utilize enhanced visual input effectively during matches.

This suggests that a holistic approach incorporating visual, physical, and physiological development is essential for optimal athletic performance.

Conclusion:

Visual therapy intervention led to statistically significant improvements in speed, agility, reaction time, and flexibility when compared to the control group, supporting the effectiveness of the treatment in enhancing these physical performance variables. The statistically significant differences in all measured physiological variables indicate that visual therapy, when combined with regular badminton training, positively influences physiological fitness. Improvements in heart rate, VO_2 Max, oxygen saturation, and blood pressure support the effectiveness of visual therapy in enhancing overall athletic conditioning and recovery capacity. These findings suggest that visual therapy may contribute not only to neuromuscular improvements but also to enhanced physiological performance in college badminton players.

Recommendations:

- Implement visual assessments as part of talent identification and training programs.
- Develop athlete-specific visual therapy plans considering physical and physiological baselines.
- Future research should explore long-term effects and application in other fast-paced sports.

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