Impact of eye exercises technique in combination with cognitive psycho motor training on visual reaction time among badminton players.
-An Experimental Study

By

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In

SPORTS

Under the Guidance of

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ABHINAV BINDRA SPORTS MEDICINE & RESEARCH INSTITUTE

Bhubaneswar, Odisha

2022-2024

DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation entitled **Impact of eye exercises technique in combination with cognitive psycho motor training on visual reaction time among badminton players -An Experimental Study** is a bonafide and genuine research work carried out by me under the guidance of **Dr Deepak Kumar Pradhan Assistant Professor, Abhinav Bindra Sports Medicine and Research Institute, Bhubaneswar**

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And above all, I can't ignore the blessings of LORD GANPATI in completing this dissertation on time.

Date:

Place : **Signature of the candidate**

Ansuman Chinara

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LIST OF ABBREVIATIONS USED

- **BMI –** Body Mass Index
- **FRT –** Finger Reaction Time
- **RXN SPEED –** Reaction Speed
- **VRT –** Visual Reaction Time
- **WBRT –** Whole Body Reaction Time

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ABSTRACT

Title: Impact of Eye Exercises Technique in Combination with Cognitive Psycho motor Training on Visual Reaction Time Among Badminton Players: An Experimental Study

Background & Objectives: Visual reaction time (VRT) is a critical aspect of performance in fast-paced sports like badminton. This study aimed to evaluate the effects of eye exercises and cognitive psycho-motor training on improving VRT in young badminton players. The specific objectives were to measure the pre- and post-intervention reaction times using two accessible and cost-effective outcome measures: the Finger Reaction Test (FRT) and the Whole Body Reaction Test (WBRT).

Methods: The study involved 40 participants (male and female) aged 9-15 years, with 36 completing the intervention after 4 participants dropped out due to not meeting the inclusion criteria. Pre- and post-reaction tests were conducted using the FRT (ruler drop test) and WBRT (alternate hand wall toss test). FRT consisted of two components: average score on a ruler (in cm, up to 30 cm) and reaction speed calculated in seconds. The intervention included 10-minute daily eye exercises and 30-minute cognitive psycho motor training, three times a week, for eight weeks. The pre- and post-test results were statistically analyzed using paired t-tests in SPSS 29 Software.

Results: The mean age of the participants was 12.889 ± 1.563, and the mean BMI was 20.62192. The within-group comparison showed a significant improvement in VRT post-intervention. FRT mean scores decreased from 18.229 cm to 13.444 cm, with a mean difference of 4.785 ($p < 0.05$). FRT reaction speed improved from

0.1908 seconds to 0.1628 seconds (mean difference 0.028, $p < 0.05$). WBRT scores improved from 24.5 to 26.33, with a mean difference of 1.833 ($p < 0.05$).

Conclusion: This study demonstrates that a combination of eye exercises and cognitive psycho motor training significantly enhances visual reaction time in young badminton players. These findings suggest that incorporating such interventions into regular training programs can help improve performance and reaction times in fast-paced sports.

Keywords: Eye exercises; cognitive psycho motor training; visual reaction time; badminton players; Finger Reaction Test; Whole Body Reaction Test.

Impact of eye exercises technique in combination with cognitive psycho motor training on visual reaction time among badminton players -An Experimental Study

INTRODUCTION

Badminton is a global sport, demands quick, powerful shots and to move around very quickly in order to catch the shuttlecock. Considered one of the quickest racket games internationally [1].

Badminton has an initial speed for the shuttlecock that surpasses movements like these in other sports. For instance, in world tournaments, singles and doubles matches have had their fastest speeds recorded as 417 km/h and 426 km/h respectively demonstrating its pace and reaction time following each hit [2].

Players must continuously adjust their body position and react to the shuttlecock's movement throughout the game [3]. In badminton, players must have good visual skills so as to judge where an opponent is located and make tactical shots. Visual functions can help in perceiving opponents' moves like approaching fast enough towards the net thus avoiding unadvised shots [8].

Research indicates that a player in a defensive position has merely 0.1 seconds to respond to an opponent's attack [4].

This demands constant court analysis, compelling the player to react with precision and speed [5]. Consequently, sports like badminton, table tennis, and squash are categorized as reaction sports. [6]

Reaction time, defined as the interval between a given stimulus and the onset of movement, is crucial in these sports. This process involves receiving stimuli via receptors, transmitting information through nerves to the brain, and then from the brain to the muscles to execute a movement. The central nervous system in the brain processes this information more efficiently than the peripheral nervous system. [6]

Visual reaction time specifically refers to the duration taken to respond to a visual stimulus. It is a reliable indicator of the central nervous system's processing rate and its subsequent motor response. This can determine a person's alertness level, as the speed of response to a stimulus is contingent on reaction time. [7]

Various factors such as age, gender, hand dominance, central versus peripheral vision, practice, fatigue, fasting, exercise, personality type, and medical condition influence reaction time [7]. In badminton, players need to excel in visual abilities to accurately assess the opponent's position and make strategic shots. Visual function helps identify the opponent's movements, such as approaching the net, enabling players to avoid ill-advised shots [8].

The eye plays an important role in sports activities, especially in racket sports. There are six muscles responsible for eye movement: the superior rectus muscle, inferior rectus muscle, lateral oblique muscle, medial rectus muscle, superior oblique muscle, and inferior oblique muscle [10].

The phrase "Keep your eyes on the ball," frequently repeated by coaches, it highlights the importance of visual input. The eye transmits information to the brain, which interprets it and sends signals to the body's limbs, all within a split second. If

this transmission is inaccurate, incomplete, or ill-timed, it leads to sub-optimal performance [11].

Visual training, a relatively new technique in sports, can enhance performance across different sports [9].

Vision is one of the most important special senses and is the primary source of external information. The role of vision in our everyday lifestyles is immense. [16]

Our eyes need regular exercise in order to keep them healthy, just like any other muscle in the body.[14] Regular eye exercises can alleviate symptoms of visual fatigue, especially in individuals engaged in activities demanding prolonged visual concentration, such as badminton players. Regular eye exercises can reduce visual fatigue by improving blood circulation and relieving strain on the eyes, particularly in sports where rapid eye movements and sustained focus are necessary. In badminton, players are required to constantly shift their gaze from the shuttlecock to different areas of the court, which can lead to eye strain. Reducing this strain through eye exercises can enhance overall visual comfort, allowing players to maintain their focus and reaction speed over longer periods.[14]

In addition to standard static visual acuity, other visual abilities such as dynamic vision, stereo acuity, accommodation, vergence, saccadic and pursuit eye movements, hand-eye coordination, reaction time, and peripheral vision can significantly enhance performance in fast-paced sports. [15]

Systematic eye exercises can strengthen the ocular muscles and improve visual stability, potentially reducing the risk of sports-related visual injuries. [24]

Reaction time is one of the most important cognitive abilities or response times which refers to the span between when we perceive something and respond to it. This depends on perception, processing and response.[15]

Cognitive sports psycho motor training is recognized for improving various psychological factors essential for successful sports performance. These include mindset, confidence, motivation, and mental toughness. Additionally, it helps reduce performance anxiety, enhances skill development, and improves skill execution. This type of training focuses on how players process incoming information, make decisions, and execute movements at the optimal speed required for a given split-second situation [17]. Cognitive psycho motor training often includes drills that require quick decision-making and rapid motor responses to stimuli. This type of training enhances reaction times by improving the brain's ability to process information quickly and translate it into immediate physical actions, which is particularly beneficial for athletes in fast-paced sports like badminton [25]

NEED OF THE STUDY

1. Visual reaction time is a crucial factor in badminton, as players need to quickly process visual information and respond with appropriate actions during fast-paced rallies.

2. There is limited research specifically targeting badminton players and the impact of specialized training on their reaction times, By focusing on badminton players, this study will provide sport-specific insights, offering tailored training recommendations that can enhance performance in this particular sport

3. While research has focused on psychological skills for performance and emotion regulation, there is a lack of research on whether enhancing core cognitive abilities improves sports performance.

4. There is limited published research regarding the relationship between sports and cognitive functions in children.

5. Previous research has explored various interventions to improve reaction time in athletes, But none of those studies focused on the improvement of reaction time specifically targeting young badminton players aged (9-15)

6. No study has ever been made on the combined effects of eye exercises and cognitive psycho-motor training. Most of the studies normally isolate these interventions, thereby making it hard to understand their synergistic impact. Whereas exercises to the eyes bring about improved visual acuity and focus, cognitive psycho-motor training enhances coordination and reaction time. The combined effect study would give a comprehensive training protocol with maximum performance benefits.

7. Most studies make use of high-end and very expensive equipment for the measurement of reaction time, like computerized systems and motion capture equipment. Such methods are accurate but sometimes impractical or even inaccessible for all training environments. There is definitely a need for research that uses more accessible and cost-effective methods like the FRT (ruler drop test) and WBRT (alternate hand wall toss), easily adoptable by coaches and trainers.

AIM OF THE STUDY

To determine whether incorporating eye exercises into cognitive psycho motor training enhances visual reaction time in badminton players.

OBJECTIVES OF THE STUDY

1. To compare the Pre and Post intervention Finger Reaction Test (FRT) measured by the ruler drop test among badminton players.
2. To compare the Pre and Post intervention Whole Body Reaction Test (WBRT) measured by the alternate hand wall toss test among badminton players.
3. To assess the impact of eye exercises combined with cognitive psycho motor training on the visual reaction time of badminton players.
4. Evaluate the extent of improvement in visual reaction time resulting from the combined intervention.
5. Establish a baseline comparison to measure the added benefits of incorporating eye exercises into cognitive training.

HYPOTHESES

Null Hypothesis: The inclusion of eye exercises as a supplementary component to cognitive psycho-motor training will lead to no significant improvement in visual reaction time among badminton players compare to those who receive cognitive psycho-motor training alone.

Alternative Hypothesis: The inclusion of eye exercises as a supplementary component to cognitive psycho-motor training will lead to significant improvement in visual reaction time among badminton players compare to those who receive cognitive psycho-motor training alone.

REVIEW OF LITERATURE

- **Chansrisukot G . et.al (2015)** conducted a study on. "**Cognitive Psychological Training in Combination with Explosive Power Training Can Significantly Enhance Responsiveness of Badminton Players**". The aim of the study is to determined the combined effect of cognitive psychological training (CPT)and explosive power training (EPT) on Reaction Time (RT), Movement Time (MT), and responsiveness in terms of Response Time (RP) in badminton players. Forty club level male badminton players were randomly placed into 4 groups of 10, and trained 3 d·wk-1 for 8 wks. The control group engaged in Normal Badminton Training (NBT) while the 1st group engaged in CPT and NBT, the 2nd group engaged in EPT and NBT, and the 3rd group engaged in combined CPT, EPT, and NBT. The findings indicate that the decreases in Response time in the 2nd and 3rd group were not different, but was statistically ($P<0.05$) better than the 1st and control group. It was concluded that supplementary training with combined CPT and EPT can reduce both RT and MT.

- **Nitin B. Gosewade. et.al (2014)** conducted a study on **"Effect of Various Eye Exercise Techniques along with Pranayama on Visual Reaction Time."** The objective of the study was to study the effect of eye exercise techniques along with kapalbhati pranayama on Visual Reaction Time (VRT). The results of the study suggest that simple eye exercises along with pranayama helps in improvement of visual reaction time.

- **Dan Alexandru SZABO et.al (2021)** conducted a study on **"Testing the eye-hand coordination and reaction speed in children aged between 10–14 years old"** which consists of performing two tests, namely the Ruler drop test and the Alternate hand wall toss test, which aims at the reaction speed of the dominant and non-dominant hand and also the hand-eye coordination capacity of the subjects. The study showed that the female has a higher reaction speed when using the non-dominant hand than the males.

- **Maruth Sukmooncharen.A.L Prak et.al (2022)** conducted a study on **"Effects of Visual Training on the Reaction Time among Badminton Athletes"** This study aims to identify the effects of visual training on the reaction time among badminton athletes using two reaction time tests, namely, the Whole-Body Reaction Time (WBRT) and the Finger Reaction Time (FRT).According to the findings of this study, it can be concluded that there is a difference in the reaction time of the treatment group as well as the control group after undergoing intervention training for the past eight weeks. In addition, the findings of the study also indicate that visual training does affect a person's reaction time as well.

- **Maman Paul et.al (2011)** conducted a study on **"ROLE OF SPORTS VISION AND EYE HAND COORDINATION TRAINING IN PERFORMANCE OF TABLE TENNIS PLAYERS"** The study evaluated the effects of sports vision and eye hand coordination training on sensory and motor performance of table tennis players. 45 University level table tennis players were randomly divided into 3

equal groups of n=15. The experimental group underwent 8 weeks of sports vision and eye hand co-ordination training. The placebo group read articles pertaining to sports performance and watched televised table tennis matches, while the control group followed only routine practice sessions for 8 weeks. Measures of visual function and motor performance were obtained from all participants before and immediately after 8 weeks of training. Statistically significant pre to post training differences were evident by better improvement in visual variables and motor performance for the experimental group as compared to placebo and control.

- **Ilona Bidzan-Bluma et.al (2018)** conducted a study on "**Physical Activity and Cognitive Functioning of Children: A Systematic Review"** They present studies that demonstrate the influence of physical activity on health, especially a positive correlation between sports and cognitive functions. The keywords "children, cognition, cognitive function, physical activity, and brain" were searched for using PsycInfo, Medline, and Google Scholar with publication dates ranging from January 2000 to November 2017

  Out of the 617 results, 58 articles strictly connected to the main topics of physical activity and cognitive functioning were then reviewed. The areas of attention, thinking, language, learning, and memory were analyzed relative to sports and childhood. Results suggest that engaging in sports in late childhood positively influences cognitive and emotional functions

- **Courtney C. Walton et.al (2018)** conducted a study on "**The Potential Role for Cognitive Training in Sport: More Research Needed"** The study reported on the potential role for cognitive training in sport. The text discusses the importance of cognitive functions in sports performance and the potential benefits of cognitive training (CT) for athletes. While research suggests that elite athletes already possess superior cognitive abilities, the effectiveness of CT in improving athletic performance is still uncertain. Studies have shown mixed results, with some indicating improvements in decision-making and shooting accuracy. However, more research is needed to determine the impact of CT on athletes, including the use of active control groups, optimal dosing, and integration with physical tasks. Additionally, the development of objective indices of sporting performance and the use of VR environments for testing cognitive skills are recommended to advance this field.

- **DONDU UGURLU et.al (2021) "Examination of the Effects of Autogenic Training on the Reaction Time Performance of the National Badminton Athletes"** The study aims to examine the effects of autogenic training applied for 8 weeks on the visual and auditory reaction time performances of national badminton athletes.

  The participants were 15 male badminton players aged 18-23 from Malatya province.

  Autogenic training was applied to the experimental group for 8 weeks, 3 days a week, after warming up. The control group continued their regular training. Pre-test and post-test were applied to determine the effects of the training. No statistically significant difference was observed between the right- and left-hand

visual reaction times and the right- and left-hand auditory reaction times of the experimental and control groups.

The study concludes that autogenic training does not significantly affect the visual and auditory reaction time of national badminton athletes

- **Dipanwita Ghosh (2023)** conducted a study on **"Does eye exercises along with physical training helps in achieving better sports performance? Effect of vision therapy on basketball players"** Study aims to determine prevalence of binocular vision anomalies and effect of vision therapy on basketball players. Total 32 basketball players from Bharati Vidyapeeth University, Pune, were assessed. Examinations included detailed history taking, visual acuity, Refraction, Slit lamp evaluation, and orthoptic evaluation. 21 players with non-strabismic binocular vision anomalies were detected after 4 weeks of home and office therapy. Vision therapy included accommodative therapy, convergence therapy, eye hand coordination exercises, reaction time, saccades. Sports performance was judged objectively by Johnson Basketball test and subjectively by questionnaire. Detail orthoptic evaluation was performed after 4 weeks and 8 weeks of vision therapy. Results showed significant improvement in sports performance post therapy.

METHODOLOGY

Method of data collection

- **Study design**: Experimental study
- **Study population**: Badminton players
- **Sampling technique**: purposive sampling
- **Sample Size**:- 40 as per G*power software
- **Study setting**: Badminton academies in Bhubaneswar
- **Study duration**: 1Year

    - Ethical clearance- 6months

    -Sample selection, data collection-4 months

    -Statistical analysis, results, discussion- 2 months

Materials Used

- Reaction ball
- Tennis ball
- Wooden ruler scale
- Stopwatch
- Pencil
- Table and chair
- Snellen chart (18.5cm x 10cm)

Inclusion Criteria

- Age- 9-15
- Gender - Both (male and female)
- Players with a minimum of two years of regular badminton training and participation in competitive matches.
- Training at least four times a week.
- Participant not undergone any specific cognitive training targeting visual reaction time in the past six months.
- Participants with normal or corrected-to-normal vision
- No history of surgery on the limbs or musculoskeletal disorder in a span of 1 year prior.

Exclusion Criteria

- Novice players
- Players with current musculoskeletal injuries or conditions that could significantly impair their performance
- Visual impairment/ having refractive error.
- Snellen Chart score less than 6/6

PROCEDURE

Ethical clearance was obtained from the institutional ethical committee

⇩

NOC was taken from SAI Badminton academy Bhubaneswar.

⇩

Players were screened for inclusion and exclusion criteria.

⇩

Procedure were explained to all the participants in the study in their vernacular language

⇩

Informed consent form was obtained from the participants.

⇩

Demographic data was obtained which included (name,age,gender, address, years of playing badminton, any previous injuries)

⇩

Participants were allocated in a single group

⇩

Interventions were given to selected participants (8 weeks)

⇩

Test were performed Pre and Post interventions.

⇩

All data was recorded and analysed using the latest version of SPSS(version 29) software

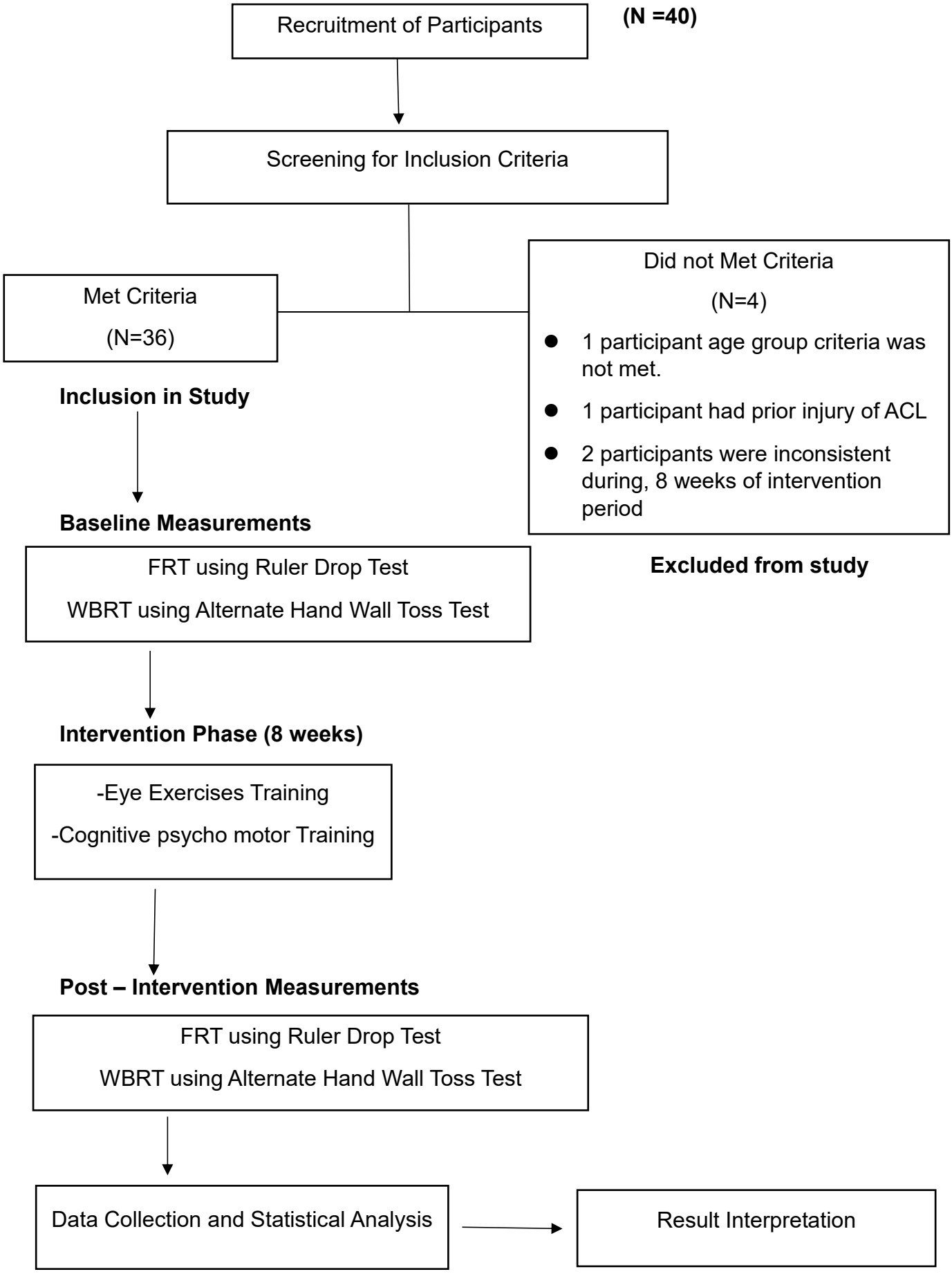


Fig.1: Flow Chart of the Study Procedure

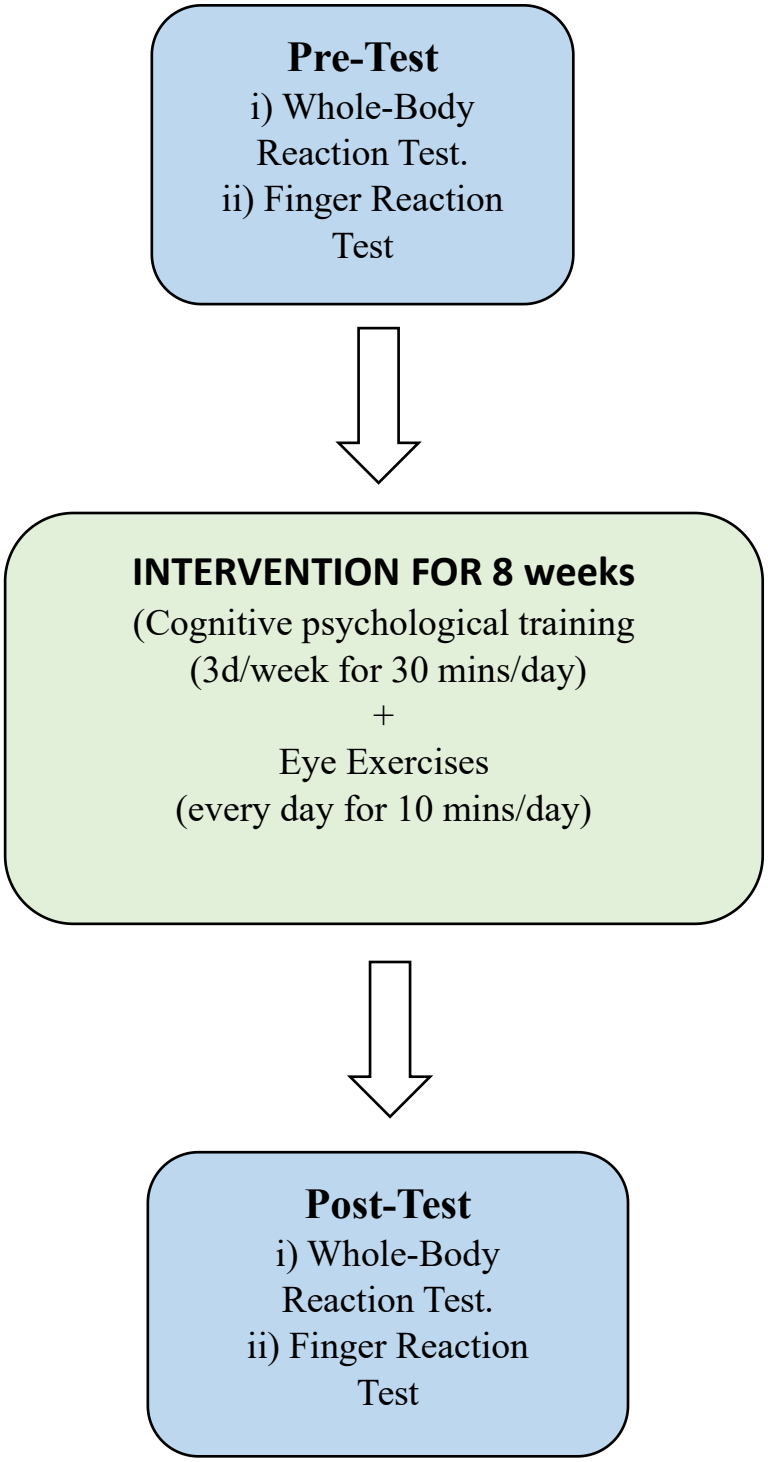


Fig.2: Conceptual framework of the study

OUTCOME MEASURES

1.FRT [finger reaction test] - (Ruler drop test)

Testing Procedure: The goal of this test was to time athletes' finger reaction time.

Equipment used -Meter stick / ruler, Table and chair

The therapist placed the ruler between the athlete's dominant hand's outstretched index finger and thumb, flushing the top of the athlete's thumb with the ruler's zero centimeter line.

When the ruler was released, the therapist instructs the athlete to grab it as soon as possible.

The athlete gripped the ruler with his index finger and thumb as soon as the therapist loosens it.

The therapist detected the measurement between the bottom of the ruler and the top of the athlete's thumb, the position of the ruler was taken.

The test was repeated twice, and the mean value was evaluated in evaluation. The following standard data can be used for this test.

Rating	**Score (30 cm)**
Excellent	<7.5 cm
Above Average	7.5cm-15.9cm
Average	15.9cm-20.4cm
Below Average	20.4cm-28cm
Poor	>28cm

Table 1 : Standard data of ruler drop test.

The algorithm to calculate the reaction speed is: -

$d = Vt + 1/2at^2$

t= Sqrt(2d/a)

d= distance in centimeters

V = initial velocity = 0

a = acceleration due to gravity = 9.81

t = time in seconds.

Fig.3: Ruler drop test

2. WBRT [whole body reaction test]- (ALTERNATE HAND WALL TOSS)

ALTERNATE HAND WALL TOSS test was an assessment tool used for hand-eye coordination and response time.

Participants threw a ball against the wall with one hand during axillary movements and tried to catch it with the other hand.

Purpose: To measure hand-eye coordination and response time

Equipment used: Tennis ball, smooth and solid wall, measuring tape, stopwatch

Procedure: Placed a mark 2 meters distance from the wall.

The athlete was standing behind the line, facing the wall.

The ball was thrown towards the wall in an underarm motion from one hand and tried to catch it with the other hand. Then again threw the ball back to the wall and catch it with the original hand.

Scoring: This table lists the general scores of the wall throw test based on the number of successful catches in 30 seconds

Rating	**Score in 30 second**
Excellent	>35
Good	30-35
Average	20-29
Fair	15-19
Poor	<15

Table 2: General Score of Alternate hand wall toss test.

Fig.4: Alternate Hand Wall Toss Test

INTERVENTION

- **EYE EXERCISES**

Palming :-

Participant had rub their palms over each other to make them warm and closed the eyes and cover them with the palms, allowing the fingers to cross on the forehead. The hands have to be cupped so that no pressure is put on the eyeballs. After that the participant opened the eyes and see if any light is getting in. If so, the hands moved so that no light enters and then closed the eyes again. The warmth of the hands, combined with blocking out all light, relaxes the pair of tense eyeballs.

Figure of 8 :-

Participant imagined there was a large figure of 8 away 8-9 feet from them, then moved the eye in the direction of a infinity loop for about 30 seconds then switched the direction.

Pencil push ups :-

The participant held a pencil/participant's thumb on outstretched arm midway between eyes, instruction was given to the participant to try to keep the single image of the pencil while slowly moving the pencil toward the nose till it is not possible to see the pencil in a single image anymore, then the participant was asked to move it slowly away to the closest point where there is a single image of pencil achieved

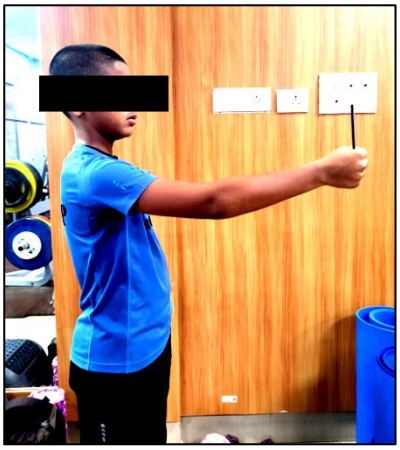
Near and far focusing :-

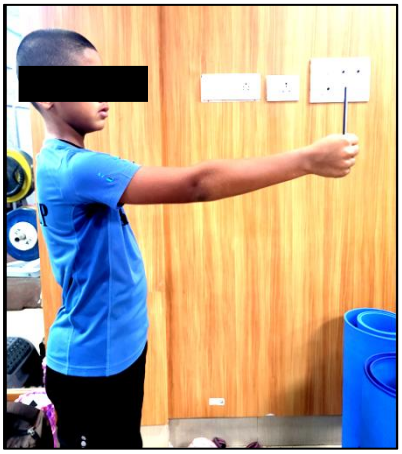
Participant had held two pencils in front of the face–one about 7.5 cm away, the other at arms length. Then they focused on one pencil with eyes, then blink and focused on other. Participant repeated this process 20 times.

Shifting :-

Shifting was necessary to avoid eye strain. Subject had pretended that he/she was looking at the center of a giant clock with face straight ahead. Kept the head still all the while, subject looked up as far as possible towards the 12 O'clock position, held for 2 seconds, then moved the gaze clockwise at 3' O'clock, then 6' O clock, then 9' O clock and returned to 12' O clock position. Then repeats the cycle anticlockwise. Subject practiced this three times clockwise and three times anticlockwise, alternately.


(a)Palming





(b)Pencil push ups


(C)Near and far focusing

Fig.5 Eye Exercises

- **Cognitive psycho-motor training**

Training 1 – Drop and Catch Drill.

- The participant looked at the reaction ball while holding it.
- The ball was released.
- The participant anticipated the ball's bouncing trajectory and tried to catch it as fast as possible during the first bounce.

Training 2 – Wall Toss Drill.

- The participant squatted facing a wall at about twice the lunge distance while holding the reaction ball.
- The ball was thrown against the wall.
- The participant anticipated the ball's bouncing trajectory and tried to catch it as fast as possible during the first bounce.

Training 3 – Wall Roll Drill.

- The participant squatted facing a wall at about twice the lunge distance while holding the reaction ball.
- The ball was thrown against the wall at a low level.
- The participant anticipated the ball's bouncing trajectory and laterally lunged toward the ball, trying to catch it as fast as possible during the first bounce.

Training 4 – Left or Right Drill.

- The participant stood at a lunge distance in front of the therapist, with a reaction ball in each hand spread wide apart.
- The participant anticipated which side the ball would be randomly released from and its trajectory.
- The participant lunged toward the dropping ball to catch it as fast as possible before it touched the ground.

Training 5 – Ball Drop Drill.

- The participant stood at about twice the lunge distance in front of the therapist with a reaction ball in one hand.
- The participant anticipated the ball's trajectory as it bounced from a random drop height.
- The participant lunged toward the bouncing ball to catch it as fast as possible during the first bounce.



Training 1 – Drop and Catch Drill.


Training 2 – Wall Toss Drill.


Training 3 – Wall Roll Drill

Training 4 – Left or Right Drill

Training 5 – Ball Drop Drill.

Fig: 6 Cognitive psycho-motor training

SAMPLE SIZE ESTIMATION

The Sample Size was calculated using the G*power Software with,

Effect size d = 0.60

α err prob = 0.05

Power (1-β err prob) = 0.95

The total sample size calculated was 39.

STATISTICAL ANALYSIS

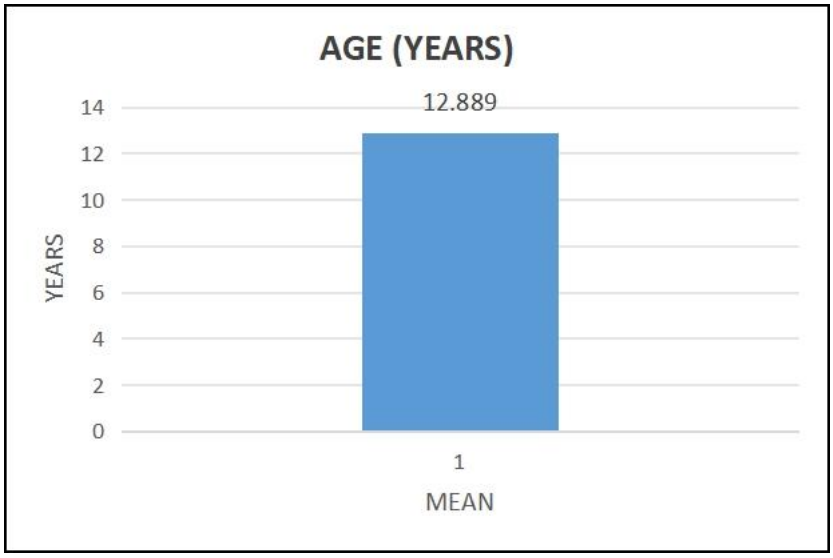
- Data collected in fragmented form was presented in an orderly manner and tabulated form in Excel.
- Statistical Analysis was performed using SPSS statistical package of social sciences version 25.
- The normality of the data was found using Shapiro-Wilk Test.
- The sample were normally distributed, the mean and standard deviation within the group was found using Paired t-test.
- The level of significance (p-value) kept at ≤ 0.05.

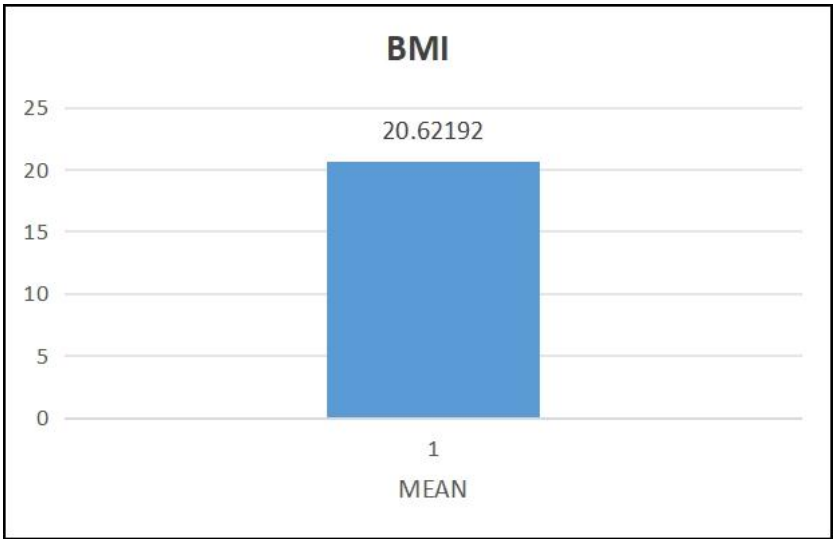
RESULTS

The study analyzed the impact of eye exercises combined with cognitive psycho motor training on visual reaction time in badminton players using two outcome measures: Finger Reaction Test (FRT) and Whole Body Reaction Test (WBRT)

The FRT pre-test mean of 18.229 cm improved to 13.444 cm post-test (mean difference: 4.785, $p < 0.05$), FRT Reaction Speed Pre-test mean of 0.1908 seconds improved to 0.1628 seconds (mean difference: 0.028, $p < 0.05$).And the WBRT Pre-test mean of 24.5 catches improved to 26.33 catches post-test (mean difference: 1.833, $p < 0.05$).

Fig 7: Graphical Representation of Mean Age and Mean BMI



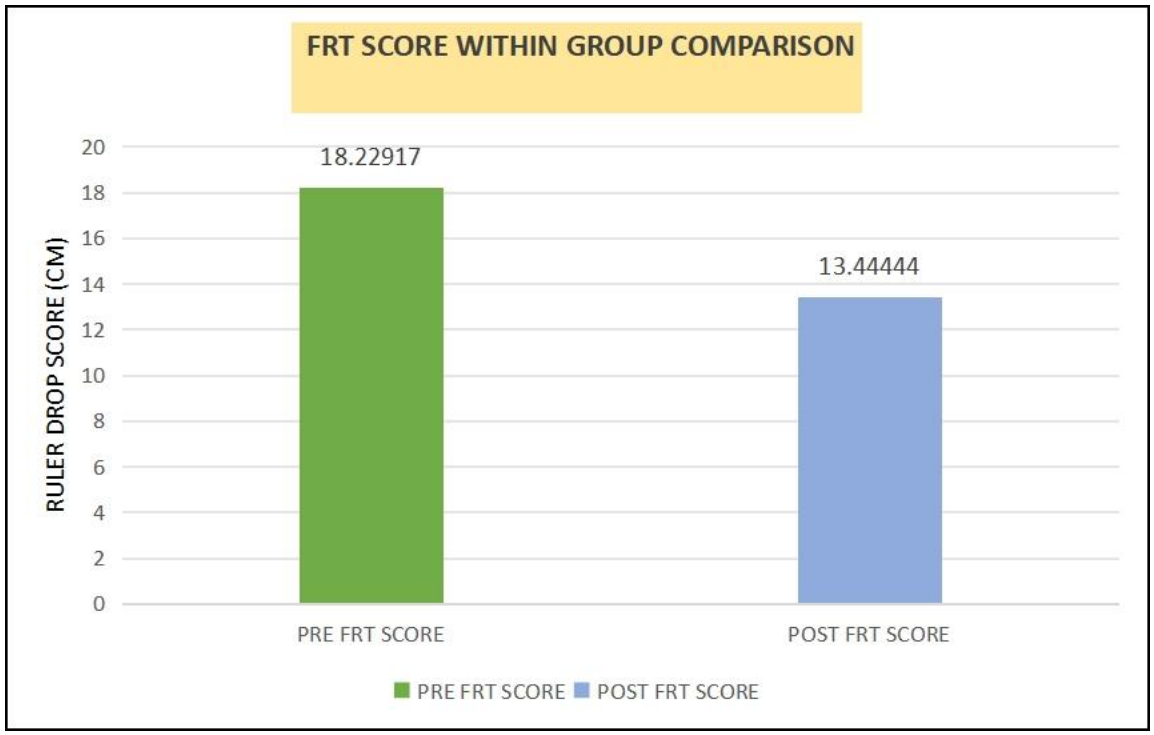


- The current study included 36 participants aged 9 years to 15 years. Figure represents the Mean Age of total sample (N=36) is 12.889±1.563 and the Mean BMI is 20.62192

Table 3: Finger Reaction Test within group comparison

TEST	N	Mean Value		Std deviation		Mean difference	P Value
		PRE	POST	PRE	POST		
FRT	36	18.229	13.444	5.429	5.087	4.785	0.00

Fig 8: Graphical representation of FRT score within group comparison

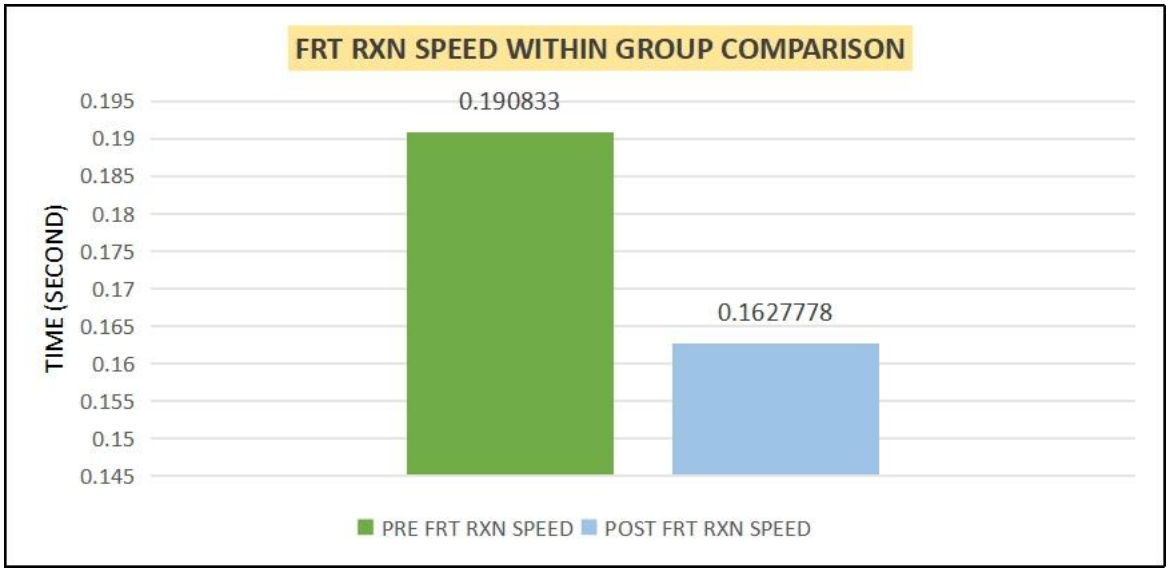


- Table 3 and figure 8 show the within group comparison of pre and post intervention of Finger Reaction Test (FRT) found improvement in visual reaction time among badminton players with pre-test mean 18.229±5.429, post-test mean 13.444±5.087, mean difference 4.785 and the p values of <0.05, which is statistically significant.

Table 4: Finger Reaction Test (Reaction Speed) within group comparison

TEST	N	Mean Value		Std deviation		Mean difference	P Value
		PRE	POST	PRE	POST		
FRT - RXN SPEED(SEC)	36	0.1908	0.1628	0.305	0.302	0.028	0.00

Fig 9: Graphical representation of FRT RXN SPEED within group comparison

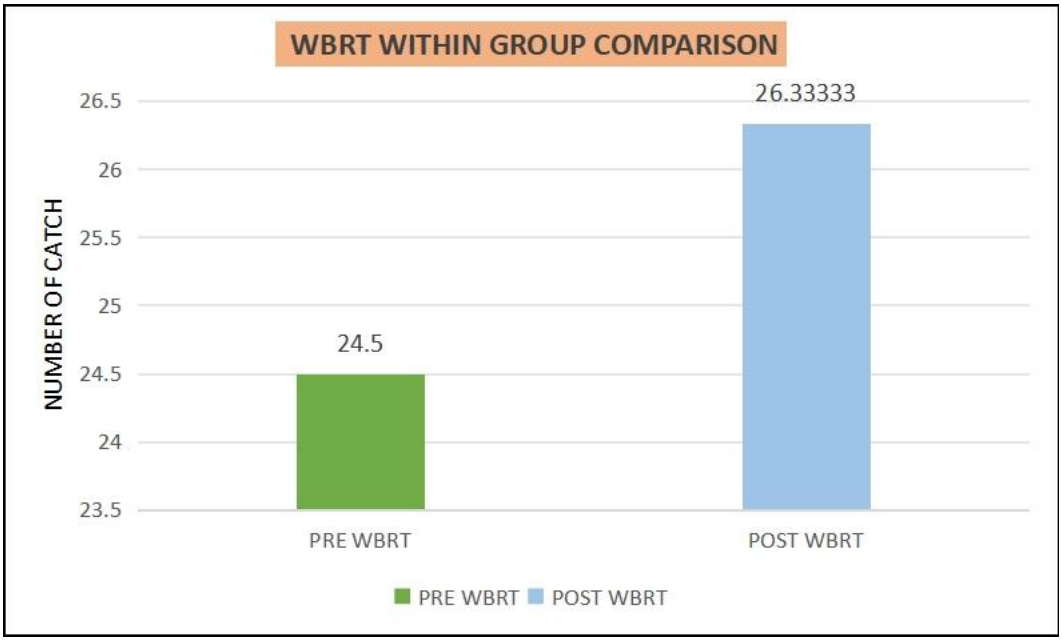


- Table 4 and figure 9 show the within group comparison of pre and post intervention of Finger Reaction Test (Reaction Speed) (FRT RXN SPEED) found improvement in visual reaction time among badminton players with pre-test mean 0.1908±0.305, post-test mean 0.1628±0.302, mean difference 0.028 and the p values of <0.05, which is statistically significant.

Table 5: Whole Body Reaction Test within group comparison

TEST	N	Mean Value		Std deviation		Mean difference	P Value
		PRE	POST	PRE	POST		
WBRT	36	24.500	26.333	4.246	3.891	1.8333	0.02

Fig 10: Graphical representation of WBRT within group comparison



- Table 5 and figure 10 show that, there was a statistically significant improvement in visual reaction time within group when comparing pre and post intervention score of whole-body reaction test (WBRT) among badminton players with pre-test mean 24.5±4.246, post-test mean 26.333 ± 3.891, mean difference 1.833 and p value <0.05

DISCUSSION

The present study aimed to evaluate the impact of eye exercises combined with cognitive psycho motor training on visual reaction time (VRT) among young badminton players aged 9-15 years. Reaction time is a critical factor in sports performance, particularly in fast-paced sports like badminton, where the ability to quickly respond to visual stimuli can significantly influence the outcome of the game. By utilizing two distinct outcome measures—the Finger Reaction Test (FRT) and the Whole-Body Reaction Test (WBRT)—this study provides a thorough assessment of how these targeted interventions can improve VRT.

The study involved 36 young badminton players aged 9-15 years. Initially, participants underwent pre-intervention tests using two outcome measures: the Finger Reaction Test (FRT), which included measuring the average distance (in centimeters) on a ruler drop test and calculating reaction speed (in seconds), and the Whole-Body Reaction Test (WBRT), assessed via the alternate hand wall toss test.

Participants then received interventions over eight weeks. The intervention included daily 10-minute eye exercises and cognitive psycho motor training sessions held three times a week for 30 minutes each.

After the intervention period, the same two tests (FRT and WBRT) were administered as post-tests to evaluate changes in visual reaction time. The pre- and post-intervention results were compared within the group to assess the effectiveness of the combined training regimen on improving reaction time.

The age group of 9-15 years was chosen because this period represents a critical developmental phase where motor skills, coordination, and cognitive processing are

rapidly evolving. At this stage, the nervous system is highly adaptable, making it an ideal time to introduce interventions aimed at enhancing reaction time and coordination. Improvements during this period are likely to have a lasting impact on athletic performance as these young athletes continue to develop. Furthermore, targeting this age group ensures that foundational skills are strengthened early, potentially leading to better long-term sports performance.[23]

The results of the FRT showed a significant improvement in visual reaction time after the intervention, which included daily eye exercises and cognitive psychomotor training three times a week. The mean FRT score decreased from 18.229 cm in the pre-test to 13.444 cm in the post-test, indicating a quicker response to visual stimuli. This reduction in mean reaction time by 4.785 cm is statistically significant, with a p-value of <0.05, suggesting that the improvements observed are likely due to the intervention.

The study also measured reaction speed during the FRT, calculated based on the distance in centimeters. Here too, there was a significant improvement, with the reaction speed decreasing from 0.1908 seconds in the pre-test to 0.1628 seconds in the post-test (mean difference of 0.028 seconds, $p < 0.05$). These findings are consistent with the belief that both eye exercises and cognitive psycho motor training can enhance the neurological and cognitive processes involved in responding to visual stimuli .

Eye exercises are designed to improve visual acuity, eye-hand coordination, and dynamic vision, all of which are essential for athletes. Previous studies have shown that such exercises can lead to significant improvements in reaction times, particularly in tasks that require fine motor skills [20]. The cognitive psychomotor

training further enhances this effect by improving the brain's processing speed and the efficiency of motor responses [21]. The combined effect of these two interventions likely accounts for the significant improvements observed in the FRT results.

The WBRT results also indicated significant improvements post-intervention. The mean score increased from 24.5 in the pre-test to 26.33 in the post-test (mean difference of 1.833, $p < 0.05$), reflecting an enhancement in the participants' ability to respond to visual stimuli with whole-body movements. This outcome suggests that the interventions not only improved fine motor skills but also had a positive impact on gross motor coordination and overall body agility, which are crucial for badminton players.

The WBRT measures an athlete's ability to perform quick, coordinated movements in response to visual cues, which is essential in sports that require dynamic body movements. The significant improvement observed in this study aligns with previous research that has demonstrated the effectiveness of cognitive psychomotor training in enhancing both fine and gross motor skills [22]. These findings suggest that the combination of eye exercises and cognitive training provides a comprehensive approach to improving various aspects of reaction time, contributing to better overall athletic performance.

Eye exercises are known to stimulate the brain's visual pathways, enhancing neural plasticity. This is linked to improved processing speed of visual stimuli, leading to faster reaction times. Neuroplastic changes in response to visual training have been shown to optimize visual-motor coordination and reaction speed in athletes[25] . Cognitive psycho motor training improves attention, focus, and the ability to process visual information quickly, which directly impacts reaction time. Focused attention

increases the athlete's capacity to anticipate and react to the shuttlecock, enhancing visual reaction time[27]. Eye exercises are also known to improve peripheral vision and depth perception, which are essential for tracking fast-moving objects in sports. Enhanced peripheral vision allows players to react faster to visual cues from multiple directions[28]. Repetitive motor training conditions the body's reflexes, leading to quicker visual-motor responses. Studies have shown that motor learning principles, when combined with visual stimuli, lead to faster and more accurate responses in athletes[29].

While the results of this study are promising, several limitations must be considered. The sample size of 36 participants, while adequate, is relatively small, and the age range of 9-15 years may limit the generalizability of the findings to other age groups. Additionally, the study focused exclusively on badminton players, which may limit the applicability of the results to athletes in other sports.

Future research should aim to replicate these findings in a larger and more diverse sample, including athletes from different sports and age groups. Explore whether the interventions have different effects for males and females. Longitudinal studies could also be conducted to assess the long-term effects of the interventions and determine whether the improvements in reaction time are sustained over time or if ongoing training is required to maintain these gains. Moreover, exploring the impact of varying the intensity and duration of the interventions could provide further insights into optimizing training protocols for different populations.

The combination of these two types of training appears to have a synergistic effect, leading to significant improvements in both fine and gross motor reaction times. This

suggests that a multifaceted approach, addressing both visual and cognitive aspects, may be more effective than focusing on a single type of training.

In conclusion, this study provides evidence that a combination of eye exercises and cognitive psycho motor training can significantly improve visual reaction time in young badminton players. The interventions, which are both practical and effective, have the potential to enhance athletic performance by improving the ability of athletes to respond quickly and accurately to visual stimuli. The findings suggest that incorporating such training into regular athletic programs could be beneficial, particularly in sports where quick reflexes and motor coordination are critical.

CONCLUSION

This study concluded that a combination of eye exercises and cognitive psycho motor training significantly improves visual reaction time (VRT) in young badminton players aged 9-15 years. Over eight weeks, participants showed marked improvements in both fine and gross motor responses, as evidenced by significant reductions in Finger Reaction Test (FRT) scores and enhanced Whole Body Reaction Test (WBRT) performance. The choice of FRT and WBRT as outcome measures proved effective due to their accessibility and cost-effectiveness, making them suitable for practical application in various training settings. The inclusion of both male and female participants ensured the findings were broadly applicable across genders. Overall, the study highlights the importance of integrating these training methods into regular athletic programs to enhance reaction speed and accuracy, ultimately improving sports performance. These results suggest that such interventions could be crucial for young athletes' development, offering them a competitive advantage.

CLINICAL IMPLICATION

This study demonstrates that a combination of eye exercises and cognitive psycho motor training can significantly improve visual reaction time (VRT) in young badminton players.

The clinical implications of these findings are substantial for sports training and rehabilitation. Incorporating eye exercises and cognitive psycho motor training into regular training regimens could serve as a low-cost, accessible method to enhance reaction times, potentially improving performance and reducing the risk of injury. The statistically significant results in both FRT and WBRT suggest that these interventions can lead to measurable improvements in both fine and gross motor skills, which are critical for young athletes in fast-paced sports like badminton.

This study provides a framework for developing tailored training programs that focus on specific aspects of visual and motor skills, thereby maximizing athletic performance. These findings could be extended to other sports where reaction time is crucial, offering a broader application of the interventions tested in this research.

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ANNEXURE 1

CONSENT FORM

TITLE:- THE IMPACT OF EYE EXERCISE TECHNIQUE IN COMBINATION WITH COGNITIVE PSYCHO-MOTOR TRAINING ON VISUAL REACTION TIME AMONG BADMINTON PLAYERS

I _____(name of the participant) willingly and voluntarily agree to participate in the research study under the direction of **Mr Ansuman Chinara** and is mentioned in his study which is taking place under the Guidance of **Dr. Deepak Kumar Pradhan** Assistant Professor, Abhinav Bindra Sports Medicine And Research Institute (ABSMARI)

I understand that the purpose of the study is to see **"The Impact of eye exercises technique in combination with cognitive psycho motor training on visual reaction time among badminton players"**. I understand there is no risk involved to my health and if any, it is being explained to me. I understand that I have the right to seek information regarding the study and contact Mr. Ansuman Chinara. I understand that my confidentiality and anonymity are protected and further I have the right to terminate my participation at any time without giving any reason. I have read and received a copy of this consent.

_____ _____

(Name and signature of participant) (Name and signature of Investigator)

Place:

Date:

ANNEXURE-2

PROFORMA

Name:-

Age:- Gender:-

Contact No:-

Playing Experience:-

Hand Dominance:-

Height:-

Weight:-

PRE-DATA

FRT				WBRT
Attempt 1	Attempt 2	Mean	RT (sec) $d= vt + 1/2at^2$	

POST-DATA

FRT				WBRT
Attempt 1	Attempt 2	Mean	RT (sec) $d= vt + 1/2at^2$	

_____ _____

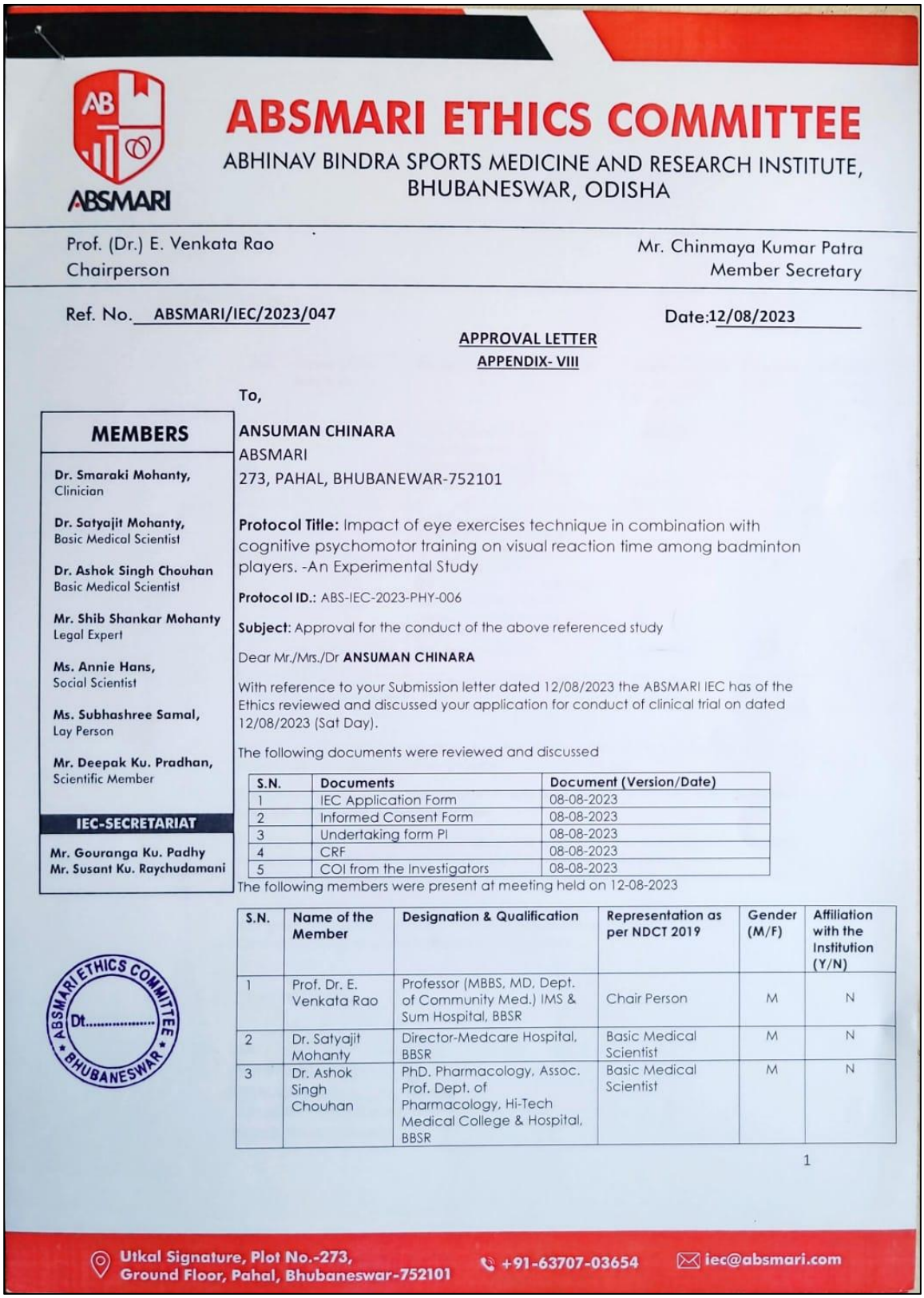
Name and Sign of Participant Sign of Investigator

Place:

Date:

ANNEXURE-3

ETHICAL CLEARANCE LETTER



ABSMARI ETHICS COMMITTEE

ABHINAV BINDRA SPORTS MEDICINE AND RESEARCH INSTITUTE,
BHUBANESWAR, ODISHA

Prof. (Dr.) E. Venkata Rao
Chairperson

Mr. Chinmaya Kumar Patra
Member Secretary

Ref. No. ABSMARI/IEC/2023/047

Date: 12/08/2023

APPROVAL LETTER

APPENDIX- VIII

To,

ANSUMAN CHINARA
ABSMARI
273, PAHAL, BHUBANEWAR-752101

MEMBERS

Dr. Smaraki Mohanty, Clinician

Dr. Satyajit Mohanty, Basic Medical Scientist

Dr. Ashok Singh Chouhan Basic Medical Scientist

Mr. Shib Shankar Mohanty Legal Expert

Ms. Annie Hans, Social Scientist

Ms. Subhashree Samal, Lay Person

Mr. Deepak Ku. Pradhan, Scientific Member

IEC-SECRETARIAT

Mr. Gouranga Ku. Padhy
Mr. Susant Ku. Raychudamani

Protocol Title: Impact of eye exercises technique in combination with cognitive psychomotor training on visual reaction time among badminton players. -An Experimental Study

Protocol ID.: ABS-IEC-2023-PHY-006

Subject: Approval for the conduct of the above referenced study

Dear Mr./Mrs./Dr **ANSUMAN CHINARA**

With reference to your Submission letter dated 12/08/2023 the ABSMARI IEC has of the Ethics reviewed and discussed your application for conduct of clinical trial on dated 12/08/2023 (Sat Day).

The following documents were reviewed and discussed

S.N.	Documents	Document (Version/Date)
1	IEC Application Form	08-08-2023
2	Informed Consent Form	08-08-2023
3	Undertaking form PI	08-08-2023
4	CRF	08-08-2023
5	COI from the Investigators	08-08-2023

The following members were present at meeting held on 12-08-2023

S.N.	Name of the Member	Designation & Qualification	Representation as per NDCT 2019	Gender (M/F)	Affiliation with the Institution (Y/N)
1	Prof. Dr. E. Venkata Rao	Professor (MBBS, MD, Dept. of Community Med.) IMS & Sum Hospital, BBSR	Chair Person	M	N
2	Dr. Satyajit Mohanty	Director-Medcare Hospital, BBSR	Basic Medical Scientist	M	N
3	Dr. Ashok Singh Chouhan	PhD. Pharmacology, Assoc. Prof. Dept. of Pharmacology, Hi-Tech Medical College & Hospital, BBSR	Basic Medical Scientist	M	N

ABSMARI ETHICS COMMITTEE Dt..... BHUBANESWAR

1

Utkal Signature, Plot No.-273, Ground Floor, Pahal, Bhubaneswar-752101 +91-63707-03654 iec@absmari.com

ABSMARI ETHICS COMMITTEE

ABHINAV BINDRA SPORTS MEDICINE AND RESEARCH INSTITUTE,
BHUBANESWAR, ODISHA

Prof. (Dr.) E. Venkata Rao
Chairperson

Mr. Chinmaya Kumar Patra
Member Secretary

Ref. No. ABSMARI/IEC/2023/047

Date: 12/08/2023

MEMBERS

Dr. Smaraki Mohanty, Clinician

Dr. Satyajit Mohanty, Basic Medical Scientist

Dr. Ashok Singh Chouhan Basic Medical Scientist

Mr. Shib Shankar Mohanty Legal Expert

Ms. Annie Hans, Social Scientist

Ms. Subhashree Samal, Lay Person

Mr. Deepak Ku. Pradhan, Scientific Member

IEC-SECRETARIAT

Mr. Gouranga Ku. Padhy
Mr. Susant Ku. Raychudamani

S.N.	Name of the Member	Designation & Qualification	Representation as per NDCT 2019	Gender (M/F)	Affiliation with the Institution (Y/N)
4	Dr. Smaraki Mohanty	Asst. Prof-IMS & Sum Hospital/MBBS, MD (Community Med)	Clinician	F	N
5	Mr. Chinmaya Kumar Patra	Principal-ABSMARI, MPT	Member Secretary	M	Y
6	Mr. Shiba Sankar Mohanty	Junior Counsel-Lt. Ramachandra Sarangi's Chamber / BA LLB	Legal Expert	M	N
7	Ms. Annie Hans	Disability Inclusive Development Co-Ordinator in Humanity and Inclusion (India/Nepal/Srilanka). /MA in Social Work	Social Scientist	F	N
8	Ms. Subhashree Samal	Ret. Reader-Pol Sc.	Lay Person	F	N
9	Mr. Deepak Kumar Pradhan	Asst. Prof-ABSMARI, MPT	Scientific Member	M	Y

This is to confirm that only members who are independent of the Investigator and the Sponsor of the trial have voted/ provided opinion on the trial.

This Committee approves the documents and the conduct for the trial in the presented form with necessary recommendation.

The ABSMARI IEC must be informed about the progress of the study, any SAE occurring in the course of the study, any changes in the protocol and patient information/informed consent and requests to be provided a copy of the final report.

The ABSMARI IEC follows procedures that are in compliance with the requirements of ICH (International Conference on Harmonization) guidance related to GCP (Good Clinical Practice) and applicable Indian regulations.

ABSMARI ETHICS COMMITTEE * BHUBANESWAR * Dt.....

Yours sincerely,

Mr. Chinmaya Kumar Patra
Member Secretary

Member Secretary
ABSMARI ETHICS COMMITTEE
ABSMARI Ethics Committee
Pahal, Bhubaneswar

2

Utkal Signature, Plot No.-273,
Ground Floor, Pahal, Bhubaneswar-752101
+91-63707-03654
iec@absmari.com

ANNEXURE-4

MASTERCHART

SR.NO	AGE	GENDER	DOMINANCE	PRE					POST				
				FRT				WBRT	FRT				WBRT
				1ST	2ND	AVG MEAN	RXN SPEED		1ST	2ND	AVG MEAN	RXN SPEED	
1	15	M	R	12	6	9	0.14	28	14	5	9.5	0.14	32
2	15	M	R	21	16	18.5	0.19	28	18	16	17	0.19	30
3	14	M	R	23	16	19.5	0.2	24	26	11	18.5	0.19	28
4	10	M	R	30	29	29.5	0.25	20	28	25	26.5	0.23	24
5	15	M	R	14	17	15.5	0.18	24	15	13	14	0.17	30
6	10	M	R	24	22	23	0.22	24	22	21	21.5	0.21	28
7	15	M	R	12	15	13.5	0.17	29	13	6	14.5	0.17	31
8	11	M	R	12	13	12.5	0.16	18	14	12	13	0.16	22
9	11	M	R	29	16	22.5	0.21	20	27	13	20	0.20	24
10	11	M	R	27	30	28.5	0.24	21	25	28	26.5	0.23	22
11	10	M	R	19	13.5	16.25	0.18	25	17	13	15	0.18	28
12	11	M	R	10	5	7.5	0.12	25	11	5	8	0.13	28
13	13	F	R	19	16	17.5	0.19	26	15	17	16	0.18	28
14	12	F	R	21	5	13	0.16	28	6	7	6.5	0.12	31
15	15	M	L	11	15	13	0.16	30	13	4	8.5	0.13	30
16	13	F	R	26	13	19.5	0.20	33	10	16	13	0.16	37
17	12	F	R	25	22	23.5	0.22	23	13	12	12.5	0.16	19
18	12	F	R	29	17	23	0.22	19	7	15	11	0.15	25
19	15	F	R	6	5	5.5	0.11	25	7	5	6	0.11	26
20	13	F	R	19	18	18.5	0.19	18	12	3	7.5	0.12	30
21	13	F	L	11	16	13.5	0.17	27	12	7	9.5	0.14	24
22	12	F	R	22	26	24	0.22	22	15	13	14	0.17	22
23	13	F	R	30	20	25	0.23	24	13	15	14	0.17	25
24	14	F	R	22	20	21	0.21	25	12	13	12.5	0.16	27
25	12	M	R	24	13	18.5	0.19	26	10	6	8	0.13	24
26	13	F	R	17	30	23.5	0.22	18	16	25	20.5	0.20	25
27	13	M	R	16	16	16	0.18	28	8	12	10	0.14	30
28	12	F	R	20	10	15	0.18	20	17	11	14	0.17	22
29	13	M	R	18	13	15.5	0.18	24	12	13	12.5	0.16	23
30	14	M	L	14	24	19	0.20	26	6	13	9.5	0.13	24
31	12	F	R	27	11	19	0.20	18	20	14	17	0.19	20
32	13	F	R	27	22	24.5	0.22	19	18	12	15	0.18	23
33	14	M	R	13	16	14.5	0.17	34	6	8	7	0.12	30
34	15	M	R	22	19	20.5	0.20	28	15	11	13	0.16	26
35	15	M	R	20	18	19	0.2	30	12	9	10.5	0.15	28
36	13	M	L	24	13	18.5	0.19	25	8	16	12	0.16	22