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Effect of 4 week exercise program on visual reaction time

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Abstract
Background & Aim: Many researches show that sports activity reduces Visual Reaction Time (VRT), which is a reliable indicator of rate of processing of sensory stimuli by central nervous system. The present study is conducted to evaluate the effectiveness of exercises to improve VRT.
Materials and Methods: Total 32 participants were selected for research via convenient random sampling method. Two groups of 16 students were formed. Ruler drop method was used to evaluate the VRT. Experimental group performed specific exercises weekly twice for four weeks. Control group was not given any exercises. Re-evaluation was done after four weeks.
Result: Paired t-test was done to assess the improvement. Experimental group did not show significant improvement compare to control group after the 4 weeks of exercise program.
Conclusion: Dosage of both the exercises must be increased to get the significant improvement in the Visual Reaction Time (VRT).

Keywords: Visual reaction time (VRT), exercise, sports

1. Introduction
Reaction time is defined as interval of time between presentation of stimulus and appearance of appropriate voluntary response in subject [1]. Reaction time acts as a reliable indicator of rate of processing of sensory stimuli by central nervous system and its execution in the form of motor response [2]. Reaction time can be broken down into three parts. The first is perception time, which is time for the application and perception of the stimulus and giving the necessary reaction to it. The second is decision time, which signifies the time for giving an appropriate response to the stimulus. The third is motor time, which is the time for compliance to the order received [3].
Speed of movement and quick reactions are prized qualities in athletics. Reaction time is often overlooked and usually under- estimated element in athletic selection. In sports and games, in which movements of a participant are conditioned by signals, by movements of opponents, or by motion of the ball, reaction time is of great importance [4]. Reaction time is affected by factors such as age, gender, number of simultaneous stimuli, nutrition, physical activity, training and physical fitness and fatigue [4]. Most sports depend on an excellent eye-hand coordination, which in turn is directly related to the speed of visual reaction time and motor response [5].
Sports such as table tennis, badminton, tennis and squash have been classified as reaction sports [6]. In table tennis specifically, the incredible speed of the ball and the short distance it travels between opponents allows a very minimal amount of time to react and execute shots. Table Tennis player has to give proper and quick response during the game. They have to strike the ball in proper direction [7] the reaction times of athletes in different sports show variations. The reaction times of high performance sprinters were found to be shorter than those of low performance sprinters [3].
Reaction time study is an important method used for central information processing speed and fast coordinated peripheral movement response. It is an external indicator of the ability of the nervous system to receive process and initiate a response to incoming stimuli. Responses that take more time to initiate are assumed to require longer information processing times. Measurement of Reaction Time is a common method to evaluate psychomotor fitness.

One persistent finding in literature is the slowing of responses with age and faster Reaction Times in males as compared to females [2, 8].

By the practice of motor movements, muscular coordination and speed of movement can be improved which would improve movement time. Long lasting improvement in performing skilled motor movements can be achieved by training and retraining and repeated practicing [9].

Research indicates that visual motor- response can be improved through training and this is shown through the positive impact of training observed during sports performance [10]. It is known that athletes have better reaction times than non-athletes. Reaction time is a decisive factor affecting success in sporting competitions. Reaction time can be improved to a certain extent by warm-up and exercise. Exercise induces arousal that supports alertness to external environmental stimuli in highly trained athletes [3].

The effect of exercise on visual reaction time needs to be studied, as the existing data on the benefit of aerobic exercise on psychomotor functions is insufficient. Indian data on this subject is also very limited [8].

1.1 Objectives

Significance of study: As it is known that proper fitness is required to excel in sports, but very few literature is available about role and importance of Visual Reaction Time. This study demonstrates the effectiveness of exercises to improve Visual Reaction Time.

2. Material and method

This randomized control study was carried out in the Department of Physiotherapy of P.
P. Savani University (Surat, Gujarat, India).

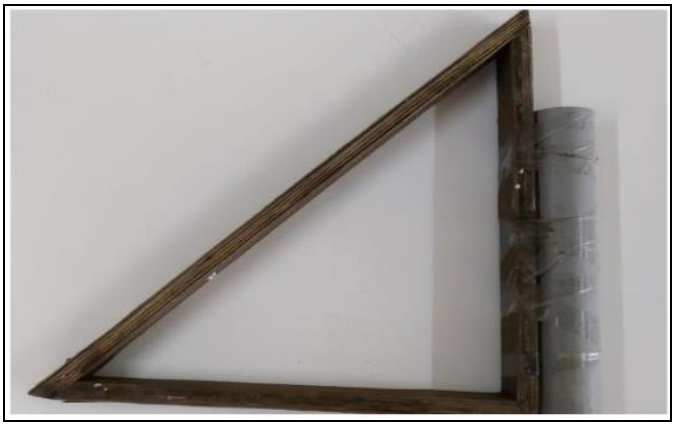

Fig 1: PVC pipe fixed on triangle wooden frame

2.1 Participants

Total 32 participants were selected from the campus of P. P. Savani University, Surat via convenient random sampling method. Information regarding personal and medical history was obtained, and detailed clinical examination of both groups was carried out in a predesigned format. Medical history was evaluated to rule out any medical or surgical disease that would affect Visual Reaction Time. Regular sports players were excluded from the study. Written informed consent was obtained prior to testing. Students were divided equally, 16 each, in experimental group and control group. Exercises were performed by experimental group weekly twice for four weeks. Control group is induced in this study to see the effect of repeated assessment and learning on VRT. To evaluate VRT, ruler drop test was done and revaluation was done after four weeks.

2.2 Materials used

Ruler drop test device, measuring stick, reaction ball, tennis ball, measure tape

2.3 Procedure for Visual Reaction time

Simple reaction time was evaluated using a measuring stick that was 60-cm long and marked in 1-mm increments. The participant sat in a chair and rested the elbow in 90 degree flexion, forearm in mid-prone position and lateral aspect of the palm of the dominant hand on the armrest with the fingers suspended off the edge. The measuring stick was hidden from view by suspending it vertically within a polyvinyl chloride (PVC) pipe that was 6.0 cm in diameter and open at the top and bottom. The ruler was positioned within the pipe so that the zero point was level with the lower open edge of the PVC pipe.

Fig 2: Finger positioning during ruler drop test method

The participant positioned the open hand against the open lower edge of the pipe so that the zero point of the ruler was directly above the thumb and index finger. Also, to standardize the starting position of the thumb and fingers during all trials, we asked thumb and fingers to remain constant. Once the participant was ready for testing, the researcher dropped the measuring stick from inside the pipe at self-generated random intervals (between 1 and 5 seconds) to prevent the participant from anticipating the time of release. Although it happened infrequent, if at any point the participant anticipated the release, the trial was repeated. An anticipatory grasp was determined to have occurred if movement of the thumb and fingers was noted just before the ruler was released. Once the ruler was released from inside the PVC pipe and visualized, the participant was required to catch it as quickly as possible with minimal movement of the hand from the starting position. The distance or length the

ruler had fallen before it was grasped was measured at the most superior aspect of the participant's thumb and was converted into a reaction time (in milliseconds) using the formula for a falling body (d ¼ ½gt2), where d is distance, g is acceleration due to gravity, and t is time. Exact equation is as below apart.

$R\text{\textit{ea}}\text{\textit{ing}} = \sqrt[2]{2.\ \text{\textit{fall}}/9.18}$ apart).

This was a critical step because the reaction time assessed in our study actually consisted of reaction time plus movement time. That is, we did not just measure the time that transpired between the presentation of the stimulus and the initiation of the muscular response to the ruler dropping (true reaction time) but rather we measured the time required to initiate the grasping motion as well as the time it took the fingers to come together and clutch the ruler (movement time). Therefore, it was important for the distance between the Given the smooth surface of the measuring stick, it was possible for the ruler to slip between the fingers when the participant attempted to grasp it, thus potentially increasing the reaction time for that trial. Therefore, any trial in which we noted slippage was discarded and repeated [12].

2.4 Exercises

Total two exercises were done by experimental group. Exercises were monitored by four volunteers. All four volunteers were trained to induce exercise in participants. Verbal instructions were also introduced to them which they can use during monitoring the exercise. Exercises were performed twice a week for four weeks. So total 8 sessions of exercises were received by experimental group.

Exercise no 1: Participant was standing 3 meter away from the volunteer facing to volunteer. And volunteer supposed to throw a reaction ball towards participants. Participant was instructed to try to catch a ball with using one hand or both hands. Total 20 repetitions were done and then 2 minutes of rest was given to participants. After rest again 20 repetition of exercise was done We calculate the average reading of 3 readings. Paired t-test was done in Microsoft excel 2010 to find the effectiveness of the treatment.

Exercise 2: Participants was standing 1 meter away from and facing the wall and volunteer was throwing ball from behind the subject. Participants need to catch ball with one hand or both hands and return it to subject. Total 20 repetitions of throwing the ball and catching the ball were done. Then subject was given 2 minutes of rest and again 20 repetitions were done.

Fig 3: Reaction ball

2.5 Data Analysis

We calculate the average reading of 3 readings. Paired t-test was done in Microsoft excel 2010 to find the effectiveness of the treatment.

3. Results

Total 32 subjects participated in research voluntarily. Demographic data is shown in table 1. The data was recorded from the described tests and was analyzed using the Microsoft Excel 2010 licensed version.

Table 1: Demographic data of subjects

Sr. No	Group	Gen der	Domin ance		Part icip ants	Mean age in years
			R t	Lt		
1	Control	Mal e	02	00	02	17.50
		Fe mal e	12	02	14	18.07
2	Experi mental	Mal e	01	01	02	18.50
		Fe mal e	13	01	14	17.85

Data were analyzed to determine if there was significant difference between pre to post training values and whether these changes were influenced by the particular training conditions. Statistical tests used to analyze the present study were paired t-test.

Table 2: Paired t-test values for control group

t-Test: Paired Two Sample for Means (Control group)		
	Variable 1	Variable 2
Mean	1.944375	1.92
Variance	0.117866 25	0.261066667
Observations	16	16

Table 2: Paired t-test values for control group

Pearson Correlation	**0.74185343**
Hypothesized Mean Difference	0
Df	15
t Stat	0.283035562
P(T<=t) one-tail	0.390509114
t Critical one-tail	1.753050356
P(T<=t) two-tail	0.781018229
t Critical two-tail	2.131449546

Table 3: Paired t-test values for experimental group

t-Test: Paired Two Sample for Means (Experimental group)		
	Variable 1	**Variable 2**
Mean	1.645	1.7725
Variance	0.204613333	0.170486 667
Observations	16	16
Pearson Correlation	0.777274954	
Hypothesized Mean Difference	0	
Df	15	
t Stat	- 1.751829285	
P(T<=t) one-tail	0.050107965	
t Critical one-tail	1.753050356	
P(T<=t) two-tail	0.100215929	
t Critical two-tail	2.131449546	

The pre to post training results of paired t- test for Visual reaction time showed a Sushil P Dube *et al.* in their study on simple visual reaction time in badminton players stated that those who practiced badminton had shorter visual reaction time when compared with those that did not. The differences in the reaction time values were statistically significant. This shorter reaction time in badminton players may result from regular training and its effects such as better muscular coordination, improved concentration, and alertness to external environment on their bodies. Ghuntla *et al.* found significant shorter visual reaction time among basketball players when compared with that in the control group. Mamoglu *et al.* found that the visual reaction time among professional soccer players was shorter when compared with that among part time soccer players. Bhabhor *et al.* also found shorter visual reaction time in table tennis players than that in healthy controls [11].

In our study we couldn't find the statistical significant improvement may be because of less dosage of exercise. Experimental group has shown the improvement but it is not statistical significant, which suggests that if dosage of exercise session would have increased, we could have found significant improvement.

Shirley S. M. Fong concluded in their study that the participating TKD (Taekwondo)- trained teenagers had a faster simple reaction time in the ruler-drop test than their untrained counterparts. Adolescent TKD practitioners demonstrate a faster simple reaction time than their untrained counterparts, although the two groups have similar levels of flexibility, muscular endurance, and body fat. TKD may thus be a suitable exercise for improving simple reaction time in adolescents, but may not be appropriate for improving general physical fitness in this population [12]. Another study by Monika Garg reported an improvement in reaction times irrespective of age and gender when subjects regularly exercised for 30 minutes in gymnasium [2]. while in present study duration of exercise was less than 15 min which could be the possible reason of insignificant improvement in visual reaction time.

Linford *et al.* (2006) reported that a 6-week training program significantly reduced reaction time of the peroneus longus muscle in healthy subjects3 while in present study 2 week of training program was lacking which could also be the possible reason of insignificant improvement. On the contrary, few studies supports the result of current study and have reported that exercise does not lead to a significant decrease in Reaction time [13, 14].

4. Practical application

As we know that sports is a complex science and difference between winner and runner up is now measured in milliseconds. So Athletes and coaches require new techniques and exercises which can improve their performance. Improvement in visual reaction time will also help them to improve their performance. These designed exercises are simple in nature that a person can perform independently in desired setting.

5. Conclusion

From this study we can conclude that mentioned 2 exercises can be used to improve the visual reaction time in sports players. Although significant improvement is not found in result but we can use this exercise to improve visual reaction time. These exercises can be incorporated for the players of table tennis, cricket, badminton etc.

5.1 Limitation

Limitation of study was limited number of exercises, less dosage of exercise, less frequency and small sample size.

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