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Effect of 4 week exercise program on hand eye coordination

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Abstract
Background & Aim: Many researches show that various sports activities improve hand eye coordination (HEC) which is essential in many sports. The present study is conducted to evaluate the effectiveness of exercises to improve HEC.
Materials and Methods: Total 32 participants were selected for research via convenient random sampling method. Two groups of 16 students were formed. Table tennis ball was used as a tool to evaluate HEC. 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: Experimental group showed significant improvement compare to control group after the 4 weeks of exercise program. Paired t-test was done to assess the improvement.
Conclusion: Both the exercise can be used to improve the hand eye coordination.

Keywords: Hand eye coordination (HEC), exercise, sports

1. Introduction
Hand-eye coordination is an important characteristic in athletics and other physical activities, whether it involves hitting a ball with a bat or hitting the head of a nail with a hammer [1]. Hand eye coordination rely on three systems: the gaze system responsible for locating and fixating task-relevant objects, the motor system of the limbs to carry out the task, and the visual system to supply information to the other two. All three systems are under the control of a fourth system, the schema system, which specifies the current task and plans the overall sequence of actions. These four systems have separate but interconnected cortical representations [2].
Vision is one of the several sensory organs which receive information from the external environment. After receiving the information it is being analyzed in brain and efferent are being sent for corrective actions. Therefore correct visual registration is important for effective hand-eye coordination training [3].
It has been seen that successful athletes generally have better skill, accuracy and spatio-temporal constraints on visual information acquisition [4]. As such if two similar athletes meet in competition and one has a better trained visual system, the athlete with enhanced visual system will perform better [4]. Sport activities often have a close relationship between perception and action therefore temporally constrained sport tasks require that players extract the most valuable source of visual information and use this information to quickly anticipate the opponent's movement outcome [5], which is applicable in the case of dynamic sports like table tennis, badminton, basketball etc. This involves an instantly varying visual environment.
It is therefore important for visual systems, nervous system and musculoskeletal system to be functioning at advanced levels for better performance of players.
Sports like table tennis, badminton, baseball etc. require a high degree of hand-eye coordination. In particular, many sports utilize some tool or implement such as a baseball bat, tennis racquet, etc., in order to hit a moving object, often a ball of a particular size and material. A Person participating in one of these sports needs to develop not only good hand-eye coordination but excellent reflexes and judgment in adapting to certain quick or unexpected ball movements. Learning to anticipate these movements and respond quickly and accurately is the difference between the overall success and failure [6].

A common technique for training hand/eye coordination, especially in athletics, involves repetitive physical movements performed in real time. For instance, golfers develop their ball striking ability by striking golf ball with golf clubs, in like manner as when they are playing a round of golf [1].

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 Hand eye coordination. This study demonstrates the effectiveness of exercises to improve Hand eye Coordination.

2. Material and method

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

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 hand eye coordination. 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 HEC. To evaluate HEC, Hand eye coordination test was done with the use of table tennis ball and revaluation was done after four weeks.

2.2 Materials used

Table tennis bat, table tennis ball, bouncing ball, stop watch.

2.3 Procedure for Hand eye coordination

Before testing all participants did a warm-up as part of their training. After warm-up participants were asked for the eye-hand coordination test. Standardization of the test was realized in a protocol that included a detailed description for materials, set-up, demonstration, training-phase, testing-phase and registering test scores. Players were instructed to throw a table tennis ball to a wall with one hand and to catch the ball correctly with the other hand as frequently as possible in 30 seconds [7]. The players were free to use overhand and/or underhand techniques or a combination of both for throwing and catching [7]. Consequently, players were able to use their best motor performance strategies for optimal results. The distance between wall and subject was kept 1 meter [7]. Test included a training-phase and a testing phase. Players were familiarized with the test during the training phase; they practiced throwing and catching of the ball six times only before the first attempt [7]. Procedural inaccuracies were corrected during this phase [7]. In the testing-phase, the highest number correctly caught balls in 30 seconds of three attempts were registered and average of those three readings was considered as a final outcome[7]. No feedback was given during the testing-phase [7]. The total time for testing was about 5–10 minutes per participants.

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 supposed to tap bouncing ball with ground with one hand. Fifty taping should be done with one hand and then repeat fifty taping with opposite hand. After one set of exercise, 2 minutes of rest was given and then again same exercise was performed.

Exercise no 2: Participant was supposed to tap the table tennis ball with table tennis bat in the air in vertical direction. Participant was instructed to tap the ball in air for fifty times with right hand as well as left hand. Then 2 minutes of rest was given to participants and then again 50 repetitions were done with both hands one by one.

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	Gender	Dominance		Participants	Mean age in years
			Rt	Lt		
1	Control	Male	02	00	02	17.50
		Female	12	02	14	17.85
2	Experimental	Male	01	01	02	18.50
		Female	13	01	14	18.07

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	11.81	14.55875
Variance	86.1832	75.87145167
Observations	16	16
Pearson Correlation	0.753633529	
Hypothesized Mean Difference	0	
Df	15	
t Stat	-1.7347293	
P(T<=t) one-tail	0.051641552	
t Critical one-tail	1.753050356	
P(T<=t) two-tail	0.103283104	*P*>.05
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	12.60625	17.58
Variance	57.24729167	55.72830667
Observations	16	16
Pearson Correlation	0.866244105	
Hypothesized Mean Difference	0	
Df	15	
t Stat	-5.116442194	
P(T<=t) one-tail	6.32428E-05	
t Critical one-tail	1.753050356	
P(T<=t) two-tail	0.000126486	*P*<.05
t Critical two-tail	2.131449546	

The pre to post training results of paired t-test for Hand eye coordination showed a statistically significant improvement in experimental group (t=0.00012, $p<0.05$) as compared to control group (t=0.11197, $p>0.05$) which presented non-significant variation.

4. Discussion

Coordination is defined as "the integration of the nervous and the muscular systems to produce correct, graceful, and harmonious body movements" [8].

Hand-eye coordination is essential elements in many movement forums and motor skills and tie directly into the national standards for physical education [9]. Hand eye coordination is important to the physical educator because specifically, the basic development and mastery of these skills allows one to engage productively in additional motor skill development, to increase overall motor skill proficiency and facilitate participation in a variety of lifetime sporting and fitness-related activities.

Physical educators have used a variety of traditional activities, e.g., catching, striking, dribbling, to develop hand-eye coordination over the years[10] but there is lack of concrete evidence.

A review of related literature on hand eye coordination showed that rarely any study has been conducted to find effectiveness of exercise on hand eye coordination. One of studies has been done to find the effectiveness of cup stacking activity on hand eye coordination. And in that study, cup stacking activity has improved the hand eye coordination significantly among the participants [11].

In one study, researchers have found the positive effect of swimming on hand eye coordination and found that swimming can also improve the hand eye coordination [12]. But as all sports players cannot have access to swimming pool or may not be feasible for them do to swimming regularly the result of this study will help them as here mentioned exercises are simple and can be done anywhere with minimum available equipment.

In another study, researcher has used hand eye coordination test as a part of talent identification in table tennis [7]. They selected table tennis players from local, regional and national training center [7]. And their study showed that hand eye coordination test with table tennis ball with 1 meter distance from the wall demonstrated better discrimination between national, local and regional players [7]. So from that we can conclude that national players has better hand eye coordination compare to regional and local level players [7]. So if we improve hand eye coordination of players it will improve their skills and game [7]. Because good hand eye coordination increases the player's ability to perform complex movement, respond effectively to external stimuli and create fluent movement.

Thus the results of this study indicate that specifically designed exercises might be a valuable component of the physical education curriculum and is a viable activity for the development of hand-eye coordination. It would be desirable to extend this study with a larger sample.

4.1 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 Hand eye coordination 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 hand eye coordination in sports players. These exercises can be incorporated for the players of table tennis, carom, baseball, badminton etc.

5.1 Limitation

Limitation of study was limited number of exercises and small sample size.

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