Original Study

Auditory Reaction Time, Visual Reaction Time and Whole Body Reaction Time in Athletes

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Abstract

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. Present study was conducted in healthy controls and athletes between 18-25 years with 50 subjects in each group. Auditory reaction time for Beep tone and Click was determined using right and left hand. Visual reaction time for Red and Green light was determined using right and left hand. Whole body reaction time was determined in Right, Left, Front and Back direction. Statistical analysis was done using Z-test. There was significant decrease in auditory, visual and whole body reaction time in athletes as compared to healthy controls. Shorter reaction time in athletes could be due to improved concentration and alertness, better muscular coordination, improved performance in the speed and accuracy task. Reaction time in specific movements improves as a result of extensive practice of those concerned movements in athletic events. Therefore reaction time improving training sessions have to be held for athletes to develop fine motor skills.

Keywords

reaction time, auditory, visual, whole body, athletes

Introduction

Speed of movement and quick reactions are prized qualities in athletics. For example, this factor partly determines how successful a basketball player or a soccer player can be, on defense. When the offensive player makes his move, the difference between a slow and a fast reaction by the defensive player can determine his success or failure. Both offensive and defensive players are often hindered by slow reactions because they are not able to demonstrate the quickness necessary to outmaneuver their opponents. Similar examples could be stated in connection with tennis, badminton, football, and several other court and field games. Further, reaction time is of obvious importance in all combative activities.

The reaction time is often overlooked and usually under-estimated element in the selection of athletes for different sports. 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. A sprinter who can start faster than other contestants; a baseball catcher who can react faster to the change in the direction of the motion of the ball; a ping pong player who is always in the right place at the right time- all have a definite advantage over slower reacting men[1].

Since performance of an athlete is directly linked with

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duration of reaction time, athletes and coaches are starting to realize importance of reaction time in sports performance. Because of this realization, research is necessary to scientifically show athletes and coaches the effect of reaction time on their sports performance so that it will be useful to screen a large population for physical fitness. The study of relation of the reaction time to motor skill performance in sport is not new, but in the past not much attention was given to elite athletes.

Hence in view of above, this study, "Study of auditory reaction time, visual reaction time and whole body reaction time in athletes" is undertaken which will scientifically contribute to the field of reaction time and will be the foundation for future studies in this regard.

Objectives of the Study

1. To determine the auditory reaction time, visual reaction time and whole body reaction time in normal healthy individuals and in athletes.
2. To compare auditory reaction time, visual reaction time and whole body reaction time of healthy individuals with athletes.
3. To find out any differences and if present, it's statistical significance and to analyze the reason for the observed facts.

Material and Methods

The study was carried out in the Department of Physiology, Dr. V. M. Govt. Medical College, Solapur, Maharashtra. The study population of either sex with same age was divided into two groups as follows:

No.	Group	No. of subjects	Age group (yr)
I	Normal healthy controls	50	18-25
II	Athletes	50	18-25

Group I: Normal healthy controls

Healthy subjects were selected from undergraduate students and interns of Medical College.

Exclusion criteria:

1) History of smoking, alcoholism
2) Those having diminished hearing or vision and color blindness

Group II: Athletes

All the athletes were selected from students of various Colleges of Arts, Science and Commerce faculty.

The athletes were practicing regularly. Most of them have participated in athletic events at University level.

Inclusion criteria:

1) Those participated in any of the athletic events at University/District level like –running, long jump, high jump etc.
2) Those doing regular practice of athletic event minimum for 2-3 hrs. per day.
3) Those doing regular practice minimum for 2 yrs.

Exclusion criteria:

1) Those having any sports injury to limbs
2) Those not practicing regularly
3) Those who have left practicing for minimum one year.
4) Having history of smoking, alcoholism
5) Having any cardiovascular, respiratory diseases
6) Those having diminished hearing or vision and color blindness
7) Subjects suffering from any psychiatric disorder affecting their psychomotor abilities.

The subjects were well informed about the procedure of determination of reaction time and written consent was obtained. The detail history, general and systemic examination of each subject was carried out. Acuity of vision for near and distant vision, tests for color blindness were carried out. Acuity of hearing was tested with tests of hearing. Reaction time task was carried out in the morning from 9 A.M. to 11 A.M. under similar conditions an hour after light breakfast.

Audio-Visual Reaction Time

Audio-Visual Reaction Time Apparatus- designed by Anand Agencies, Pune- was used for determination of auditory as well as visual reaction time. After familiarizing

the subject with the instrument and after repeated practice Auditory Reaction Time (in msec) for Beep tone and Click was determined for both right and left hand. The procedure was repeated for three times and three readings which appeared on the display were noted. The least reading of the three was taken as subject's best auditory reaction time and was recorded in the subject's record profile. The inter stimulus interval was randomly adjusted between 5-10 seconds. The same procedure was followed for determination of visual reaction time (in msec) for Red and Green stimuli using both hands.

Whole Body Reaction Time

It was determined using whole body reaction time apparatus which has four parts namely-

a. Central Boards – for keeping right and left foot,

b. Stepping Boards marked LEFT, FRONT, RIGHT and BACK which are placed in respective four directions a step away from central boards

c. Stimulus Board

d. Digital Chronoscopes-two in number which measure time in seconds

After familiarizing the subject with the instrument and after repeated practice, the subject was asked to move a step from the central board to the corresponding stepping board immediately in response to blinking of the arrow on the display box.

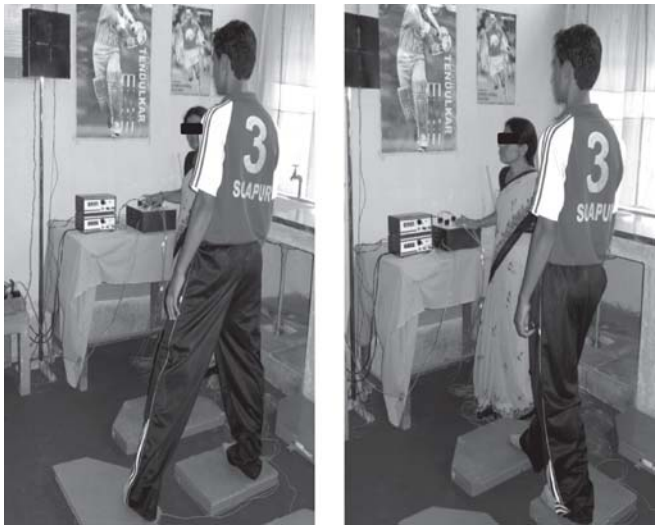

Fig. 1
Determination of Whole body reaction time

The time taken to lift the leg in response to stimulus (T1) and the time taken to keep the leg on corresponding stepping board (T2) were measured with the help of digital chronoscopes. Thus the (T1) gives the time taken by the subject to initiate an action and (T2) gives the time taken to complete the action. The time between the onset of stimulus and to initiate the action (T1) was reaction time proper and the total time from the onset of the stimulus to completion of the action (T2) was the response time. The difference between the response time and reaction time proper (T2 – T1) was the movement time[2].

Table 1
Showing Auditory and Visual Reaction Time (msec)

			Controls	Athletes	Z Value	p Value	S/NS
Auditory Reaction Time	TONE	Right	134.16±12.08	129.24±9.46	2.26	0.02	S
		Left	137.84±12.18	133.3±9.56	2.07	0.02	S
	CLICK	Right	134.38±12.78	129.54±7.90	2.27	0.02	S
		Left	133.02±13.35	127.96±11.72	2.01	0.05	S
Visual Reaction Time	RED	Right	142.28±10.16	136.14±16.63	2.22	0.02	S
		Left	144.38±11.58	138.24±14.98	2.29	0.02	S
	GREEN	Right	142.94±11.45	135.74±21.35	2.10	0.02	S
		Left	143.8±12.23	137.44±15.88	2.24	0.02	S

S: Significant NS: Non-Significant

Table 2
Showing Whole Body Reaction Time (sec)

		Controls	Athletes	Z Value	p Value	S/NS
Reaction Time	Front	0.410±0.09	0.338±0.09	3.75	<0.01	S
	Back	0.510±0.07	0.294±0.10	11.85	<0.01	S
	Right	0.422±0.06	0.302±0.11	6.27	<0.01	S
	Left	0.432±0.1	0.322±0.10	5.20	<0.01	S
Movement Time	Front	0.306±0.17	0.250±0.08	2.03	0.05	S
	Back	0.350±0.20	0.266±0.08	2.71	<0.01	S
	Right	0.432±0.13	0.222±0.08	8.99	<0.01	S
	Left	0.354±0.17	0.250±0.11	3.54	<0.01	S
Response Time	Front	0.762±0.15	0.588±0.11	6.29	<0.01	S
	Back	0.916±0.12	0.538±0.14	13.70	<0.01	S
	Right	0.776±0.15	0.524±0.16	7.79	<0.01	S
	Left	0.764±0.15	0.572±0.16	6.03	<0.01	S

S: Significant NS: Non-Significant

In this way reaction time proper, movement time and response time for all four directions were determined.

Results

Data collection of 50 athletes and 50 healthy age matched subjects was obtained. Analysis was done using Z- test. **Table 1** shows the results of auditory and visual reaction time and **Table 2** displays the results of whole body reaction time between healthy controls and athletes. The values of auditory, visual, and whole body reaction time are significantly less in athletes as compared to healthy controls.

Discussion

The ability of an animal to cope with the environmental changes for the survival and existence (homeostasis) depends on the response given by the animal. The quickness of response depends on the integrity of cell communication, sensory perception, central processing and motor response.

Response time is supposed to be the best factor for the maintenance of homeostasis. This fact provided an impetus to investigate the reaction time tasks for auditory and visual stimuli as well as the whole body reaction time between normal healthy controls and athletes.

Reaction time is defined as the interval of time between the presentation of the stimulus and the initiation of the response[3]. Movement time is the time that elapses between the beginning of a movement and its completion. Movement time starts where reaction time ends. Response time is a combination of reaction time and movement time. It is the total time that elapses from the onset of the stimulus until the movement is completed[4].

The significant decrease in reaction time (auditory, visual, and whole body reaction time) in athletes can be explained on the following basis:

- ❖ Improved concentration and alertness
- ❖ Arousal induced as a result of exercise supports alertness to external environmental stimuli in highly trained athletes. The effects of exercise on arousal could be linked to neurophysiological changes such as level of plasma catecholamines with exercise duration or intensity.
- ❖ Better muscular co-ordination
- ❖ Improved performance in the speed and accuracy task

- ❖ Decreased psychological tension
- ❖ Developing alertness and better contact of mind with body, which seems to be responsible for better performance of the individuals
- ❖ Establishment of new motor performance
- ❖ An adaptive increase in mitochondrial content and respiratory capacity of those skeletal muscles which were being used during the exercise training leading to sparing of glycogen and increased capacity to oxidize fatty acid
- ❖ Prolongation in work time
- ❖ Delay in fatigue and increase in enzymatic activity
- ❖ Increasing oxidation of ketones and increased removal
- ❖ Improved cardiac efficiency due to training mainly on account of an increase in cardiac stroke output associated with more complete emptying of heart during systole
- ❖ Reduction in the ventilation minute volume at high rates of work on account of an improved muscle blood flow and an increase in intracellular enzymes
- ❖ Increased vagal tone of athletes with greater muscle tension and behavioral features which distinguish the trained from the untrained

Thus, these beneficial effects in athletes are responsible for their faster reaction time performance.

Results supporting our study were also observed by other workers.

- ❖ N Parekh[5] *et al* (2004) observed that reaction time for auditory and visual stimuli were less in aerobic exercisers as compared to control
- ❖ Prabhjot Kaur[6] *et al* (2006) found that athletes performed better than controls for auditory as well as visual reaction time tasks
- ❖ Spirduso[7] (1975) showed that athletes which are physically active have less reaction time and movement time, hence exhibit reduced whole body reaction time as compared to non-athletes. This was attributed to faster central nervous system processing times producing faster muscular movements in athletes.
- ❖ Kioumourtzoglou E[8] *et al* (1997) assessed whole body reaction time in elite athletes and compared with the age matched controls and showed that values of whole body reaction time were lesser for elite groups of athletes as compared to the values of control groups. They explained the presence of systemic differences between elite athletes and nonathletes on motor abilities related to experiences in sports.

Reaction time in specific movements improves as a result of extensive practice of those concerned movements. Tripp[9] claims that practice reduces decision time by eliminating incorrect decisions and enables the correct decision to be made more efficiently. Due to increase in level of participation in a specific event the reaction time tends to decrease. If an act is practiced enough a conditioned reflex may develop. For example, a sprinter may develop conditioned reflex to a pistol shot. Similar examples could be given in connection with numerous other performances and skills of different games and sports.

Therefore reaction improving training sessions have to be held for athletes to develop their fine motor skills.

Maunsell JHR[10] *et al* (2002) concludes that directing attention to a particular location in the visual field improves detection and discrimination, and shortens reaction times in that location relative to others.

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