

Comparison of Visual and Auditory Reaction Time in Physically Active and Inactive Male and Female Adolescents: An Observational Study

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Abstract

Reaction time is the interval time between the presentation of a stimulus and the initiation of the muscular response to that stimulus. Reaction time measurement helps in determining sensory motor association and performance of an individual. It determines the alertness of a person because how quickly a person responds to a stimulus depends on his reaction time. Physical activity increases the alertness of the body and hence is an important parameter in cases of visual and audio reaction time.

Objective: Primary to Compare Visual and Auditory Reaction Time in Physically Active and Inactive Male and Female Adolescents, Secondary- (1) To classify adolescents into physically active and inactive children using the PAQ-A questionnaire; (2) To assess the visual and auditory reaction time in both the physically active and inactive adolescents.

Methods: The study was carried out in 67 physically active and inactive adolescents (age 13 to 15). There were 48 boys (physically active-36 and physically inactive-12) and 19 (physically active-12 and physically inactive-7). Auditory and visual reaction time was recorded by reaction time apparatus by Anand Agency-Pune. Physical Activity Score was carried out by PAQ-A (Physical Activity Questionnaire in Adolescents).

Results and Conclusion: Comparison of reaction time was done using unpaired t test. Physically active adolescents showed a lower reaction time as compared to the lesser physically active adolescents for Auditory Reaction Time (ART) $t=0.412$ ($p<0.05$) and Visual Reaction Time (VRT) $t=1.355$ ($p<0.05$) which indicates statistical significant value. Thus it can be concluded that physical active adolescents have shorter reaction time indicating better ability to respond to a stimulus, as compared to physically inactive.

Keywords: Visual reaction time; Auditory reaction time; Physically active; Physically inactive; Adolescents; Gender

Introduction

What is Reaction Time? It is the interval time between the presentation of a stimulus and the initiation of the muscular response to that stimulus [1].

Human body has its response to various external environmental stimuli. Human body gives a desired & purposeful voluntary response to different types of stimuli. Reaction is a purposeful voluntary response to stimulus [2]. There is certain time lapse between application of stimulus and appropriate motor response. Reaction time has physiological significance and is a simple and non-invasive test for peripheral as well as central nervous structures. Reaction time measures indirectly the processing capability of central nervous system. Apart from integrity of CNS, there are various factors on which the reaction time is dependent on. They are type of reaction time experiment, type of stimulus and stimulus intensity, arousal, age, gender, left vs. right hand, central vs. peripheral vision, practice and errors, fatigue, fasting, distraction, alcohol intake, order of presentation, finger tremors, personality type, exercise, punishment, stimulant drugs, brain injury, illness and others factors [3].

Reaction time measurement also helps in determining sensory motor association and performance of an individual. It determines the alertness of a person because how quickly a person responds to a stimulus depends on his reaction time. It is the ability to detect, process, and respond to a stimulus [4].

Reaction time depends on various factors

Perception: Seeing, hearing, or feeling a stimulus with certainty is essential to having good reaction time.

Response: Motor agility is necessary in order to be able to act and have good response time.

If any part of these processes is altered, reaction time will be affected as a consequence. In other words, if one of the athletes had poor reaction time, they would have a disadvantage against the other runners. Reaction time necessarily includes a motor component.

Physical activity increases the alertness of the body and hence is an important parameter in cases of visual and audio reaction time. Also vice versa reduced reaction time shows the good and alert nervous system [5].

However, studies have been done on the relation between gender and visual and auditory reaction times, no studies have been made with a combined relationship between gender and physical activity with audio-visual reaction time in regular school going adolescents [6,7].

Children who are directly not involved in any athletic activity but have their interest and participation in the school sport activities are taken in consideration too. Adolescence is the age which is constantly in phase of change. Reaction time will give the children a feedback of

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their own physiology and motivate them towards a physically active and healthy life [6-8].

Studies in this crucial phase it is very important to enlighten the adolescents about various factors that can affect their reaction time. Just as the pediatric approach to adolescence has led to major advances in biosocial approaches to the field of human development, so the study of topics in the transition phase of adolescence is likely to lead to major breakthroughs.

And hence it is important to find out the relationship between visual and auditory reaction time and physical activity and gender in regular school going adolescents.

Methodology

Inclusion criteria

Regular school going children including both girls and boys between the age group of 13-15 who actively participated in sports, who were interested in sports as well as those disinterested in sports were considered.

Exclusion criteria

Any student having any sports injury to limbs, non-cooperative, having any known neuromuscular disorder, having any known cardiovascular, respiratory diseases, having diminished hearing or vision and color blindness or any student suffering from any psychiatric disorder affecting their psychomotor abilities were excluded from the study.

Method

Approval was taken from the Ethical committee regarding the project. A screening for inclusion and exclusion criteria was done and sample population was selected. A brief orientation lecture was conducted to provide basic information about the study. A written consent was taken from the selected candidates.

The study was carried out in Snehalaya English Medium School (Ahmednagar). 67 students including boys and girls were selected considering the inclusion and exclusion criteria.

The study was performed in a time span of 3-4 hours per day for two consecutive days. The students were evaluated individually for their physical activity using the PAQ-A and then tested one by one for the auditory and visual reaction time with the help of the auditory-visual reaction time apparatus.

The subject sat on one side of the machine whereas the therapists sit on the other side.

The subject was well informed about the instructions and taken consent for the same.

For PAQ-A score: It is a 5 point questionnaire with 1 being the lowest score and 5 being the highest score. It is a questionnaire that finds the level of physical activity in the last 7 days. The questionnaire consists of 9 questions. A mean of all the questions is taken (except qs.9) to get the final score. For item 1 and 8 a mean is calculated separately for a composite PAQ-A score. The other 6 questions are questions where the level of physical activity is rated between 1 to 5. A mean of the entire 8 components is taken in order to get the final score.

For reaction time: Audio-Visual Reaction Time Apparatus-designed by Anand Agencies, Pune was used. Reliability and validity

of this instrument was investigated in another previously conducted study. However the results were not published by those investigators R.T. Apparatus gives simple discriminatory and choice reactions for visual and auditory stimuli with built in chronoscope. It features two visual and two auditory stimuli. Two response keys and a ready signal. Switches for selecting Right or Left response key for any stimulus is provided. Chronoscope is a 4 digit Chronoscope. With least count of 1/1000 sec. Works on 230 V AC. The instrument has the transistorized chronoscope showing time up to four decimal places and hence is accepted accurate and reliable enough for the purpose of this study.

After familiarizing the subject with the instrument and after repeated practice Auditory Reaction Time (in msec) for Beep tone and Click was determined for the dominant hand of the child. The procedure was repeated for three times and three readings which appeared on the display were noted. The average of the three was taken as subject's best auditory reaction time and was recorded in the subject's record profile. The same procedure was followed for determination of visual reaction time (in msec) for Red and Green stimuli using both hands.

For auditory stimulus: There are two types of sound stimulus, low and high pitch sound. Both the commands were given to the subject at different times and told to indicate by pressing the button when he/she perceives the sound (ART).

For visual stimulus: There are again two colors of light were given for visual stimulus. Red and green. Both the stimuli were given to the subject at different times and told to indicate by pressing the button when he/she sees the color (VRT).

Results

All the statistical analysis was done by using unpaired t test Figure 1 and Tables 1-6.

Total number of students-67

Physically Active Males-36

Physically Active Females-12

Physically Inactive Males-12

Physically Inactive Females-7

It is seen that there is significant difference between the physically active and inactive male as well as female adolescents. Physical activity does play a major role in determining the reaction time. Hence it can be said that positive correlation was found between physical activity and reaction time.

Whereas it is observed that there is no significant difference seen between physically active males and females or physically inactive males and females. This reflects that gender did not play a role in the reaction time of the subject.

Discussion

In the present study, it was found that there was a statistically significant difference in ART and VRT amongst physically active and inactive adolescents. However, age and gender did not a significant effect on reaction time in these participants.

Audio-visual reaction time is the time taken by an individual to react to an auditory or visual stimulus respectively. A quicker response which is seen in this study in the more physically active students is due to the quickness of response which depends on the integrity of cell communication, sensory perception, central processing and

Sr. no	Population	Number	Mean PAQ-A score	Mean Auditory Reaction Time		Mean Visual Reaction Time	
				Tone	Click	Red	Green
1	Physically Inactive Females	12	1.901	0.311	0.271	0.298	0.301
2	Physically Active Females	7	3.234	0.168	0.174	0.175	0.175
3	Physically Inactive Males	12	2.00	0.324	0.287	0.300	0.300
4	Physically Active Males	36	3.47	0.158	0.158	0.158	0.158

Table 1: Mean auditory and visual reaction time in physically active and inactive male and female adolescents.

Sr. no	Gender	Mean Age	No of Samples	PAQ-A Score		Auditory Reaction Time		Visual Reaction Time	
				Mean	SD	Tone	Click	Red	Green
1	Female	13	6	Mean	2.307583	0.266778	0.234444	0.260167	0.264056
				SD	0.732	0.132	0.067	0.095	0.082
2	Male	13	17	Mean	2.848458	0.223686	0.203804	0.209843	0.210725
				SD	0.698	0.111	0.074	0.085	0.081
3	Female	14	6	Mean	2.859084	0.257889	0.219222	0.240667	0.244
				SD	0.720	0.130	0.066	0.100	0.112
4	Male	14	13	Mean	3.221811	0.201667	0.193692	0.197928	0.195897
				SD	0.867	0.101	0.080	0.089	0.082
5	Females	15	7	Mean	2.065106	0.252429	0.250619	0.257429	0.257952
				SD	0.548	0.081	0.077	0.082	0.088
6	MALE	15	18	Mean	3.270708	0.176222	0.17563	0.175793	0.176296
				SD	0.891	0.068	0.067	0.068	0.071

Table 2: Mean and standard deviation auditory and visual reaction time with respect to gender and age distribution.

			Mean	t value	p value	Significant /Nonsignificant
Females	Art-Tone	Inactive	0.311388889	0.0026	0.0004	Extremely significant
		active	0.168333333			
Females	Art-Click	Inactive	0.271055556	0.0009	0.0051	Extremely significant
		active	0.174809524			
Females	Vrt-Red	Inactive	0.298333333	0.0009	0.0033	Extremely significant
		active	0.175285714			
Females	Vrt-Green	Inactive	0.301972222	0.0009	0.0032	Extremely significant
		active	0.175761905			

Table 3: Comparison of auditory and visual reaction time in physically active and inactive females.

			Mean	t value	p value	Significant /Nonsignificant
Males	Art-Tone	Inactive	0.324333333	8.054	<0.0001	Extremely significant
		active	0.158453704			
Males	Art-Click	Inactive	0.287916667	8.343	0.0012	Extremely significant
		active	0.158027778			
Males	Vrt-Red	Inactive	0.300688889	8.304	<0.0001	Extremely significant
		active	0.158233333			
Males	Vrt-Green	Inactive	0.300916667	9.073	<0.0001	Extremely significant
		active	0.158092593			

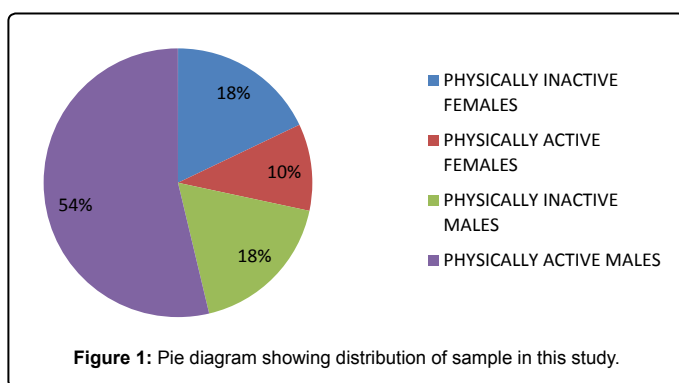
Table 4: Comparison of auditory and visual reaction time in physically active and inactive males.

			Mean	t value	p value	Significant /Nonsignificant
Physically Active	Art-Tone	Male	0.158453704	0.4216	0.2114	Not significant
		Females	0.168333333			
Physically Active	Art-Click	Male	0.158027778	0.2289	0.0752	Not significant
		Females	0.174809524			
Physically Active	Vrt-Red	Male	0.158233333	1.355	0.2585	Not significant
		Females	0.175285714			
Physically Active	Vrt-Green	Male	0.158092593	1.490	0.3594	Not significant
		Females	0.175761905			

Table 5: Comparison of auditory and visual reaction time in physically active males and females.

			Mean	t value	p value	Significant /Nonsignificant
Physically Inactive	Art-Tone	Male	0.324333333	0.2898	0.7953	Not significant
		Females	0.311388889			
Physically Inactive	Art-Click	Male	0.287916667	0.6171	0.6209	Not significant
		Females	0.271055556			
Physically Inactive	Vrt-Red	Male	0.300688889	0.06870	0.7162	Not significant
		Females	0.298333333			
Physically Inactive	Vrt-Green	Male	0.300916667	0.03199	0.9831	Not significant
		Females	0.301972222			

Table 6: Comparison of auditory and visual reaction time in physically inactive males and females.



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 between normal healthy controls and physically active controls.

The findings of our study indicate that regularly exercising healthy adolescents with higher activity score and the difference between the two groups was statistically significant.

The significant decrease in reaction time (auditory, visual reaction time) in physically active controls can be explained on the following basis:

1. Improved concentration and alertness.
2. 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.
3. Better muscular co-ordination.
4. Improved performance in the speed and accuracy task.
5. Decreased psychological tension.
6. Developing alertness and better contact of mind with body, which seems to be responsible for better performance of the individuals.
7. Establishment of new motor performance.
8. Increased vagal tone of adolescents with greater muscle tension and behavioral features which distinguish the active from the inactive.

These findings confirm the effect of physical activity on improving RT which is supported by literature review done in this regard:

1. Devi and Madhuri [1] concluded that the VRT and ART were significantly different in Sedentary and Regularly exercising Medical students.
2. Jyothi et al. [2] observed that Reaction time was significantly less in runners when compared to controls
3. Jadhav et al. [3] found out that long-term regular practice of Sudarshan Kriya Yoga improves health and well-being of an individual and enhances the reaction times. Yoga is involved in restoring the under activities of the parasympathetic nervous system & GABA systems. This restoration may be partly through the stimulation vagal nervous.
4. Jain et al. [4] found out that regularly exercising medical students have faster RTs as compared to medical students with sedentary life styles. Thus, he strongly suggested that regular exercising to be encouraged in both male and female medical students to improve their efficiency levels.
5. Palashikar et al. [5] observed that agility was significantly more in basketball players as compared to healthy controls and hence reaction time was significantly less in basketball players as compared to healthy controls.
6. Ghuntla et al. [6] in his study of 'A comparison and importance of auditory and visual reaction time in basketball players' suggested that Reaction time decreases by practice. Skills can be improved by practice. Sports person can practice regularly to improve their reaction time and ultimately their performance.
7. Garg et al. [7] found out that Auditory and visual reaction times are better in aerobic exercisers as compared to non-exercisers irrespective of age and gender.
8. Parekh et al. [8] found that the reaction time for auditory and visual stimuli is less in aerobic exercisers than controls.
9. Hascelik et al. [9] observed that in volleyball players physical conditioning exercises affected their physical fitness positively and moreover auditory and visual reaction times were shortened
10. Malathi and Parulkar [10] studied and concluded that 6 weeks yoga asana training programme accelerated the concentration power of the subject and hence allow the stimulus to produce the response in a shortened time. VRT and ART showed a significant reduction.

Also in this study no correlation was found between gender and reaction time. This has been supported by the following studies-

1. Deyand and Daokar [11] found that auditory and visual RTs did not differ significantly in either gender both before and after the administration of caffeine.

2. Nikam and Gadkari [12] observed that VRT and ART in females were longer as compared to males for both the age groups (young and old), but not statistically significant.
3. Shenvi and Balasubramanian [13] found out that no statistically significant difference was observed in the response to high and low pitch sound stimuli in both sexes.
4. However, Karia et al. [14] concluded from the study that reaction time is less in boys than girls.
5. Jain et al. [4] found out that there was a significant difference between RT of male and female medical students ($p < 0.001$)

And hence this study shows that with the increase in the level of physical activity there can be a reduced auditory and visual reaction time which would help the adolescents in their transition phase by increasing agility, concentration and performance. Reaction time as seen in various studies is also a parameter for selection and performance in sports. Lower the reaction times better the performance [9-14]. The young adolescents should therefore be encouraged to be more physically active which would help them not only in their sports but also in their academics and future life. Adolescents with a lower PAQ-A score had a higher reaction time and vice versa.

The limitations of this study being that equal number of samples were not obtained for the four distinguished groups. In future, interventional study can be conducted in which the effect of physical activity as an intervention can be done in different age populations.

Conclusion

Physically active adolescents showed a lower reaction time as compared to the lesser physically active adolescents. Hence physical activity does play a major role in determining the reaction time. Hence a student must be encouraged towards a more physically active routine for better cognitive function and alertness.

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