Auditory and visual reaction time among young athletes and nonathletes: A comparative study

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Abstract—Fast sensory perception plays a crucial role in the better performance of athletes, requiring a great need for attention and research. Some researchers found faster reaction time in athletes than nonathletes, whereas other studies are inconclusive on the relation between reaction time and athlete performance. Therefore, the present study was designed to compare the reaction time among athletes with non-athletes. A total of 50 participants, 25 athletic and 25 nonathletic included in this study. The visual and auditory reaction time was recorded online and further analyzed. The visual reaction time was shorter among athletes than nonathletes and no gender difference was observed. The years of practicing sports and body mass index play a positive correlation, but a significant correlation was observed between auditory reaction time and body mass index. Therefore, it is advisable for students to engage in regular sports activities.

Keywords—Auditory Reaction time, Athletes, Body Mass Index, Gender, Nonathletes, Visual Reaction time

I. INTRODUCTION
Sensory perception plays a crucial role in the better performance of athletes, requiring a great need for attention. The better sensory and cognitive response provides athletes an advantage for promptness and precise control of any sport and enables players to anticipate and plan appropriately and perform optimally [1,2,3]. The sensory perception, decision-making, and quick response for any upcoming event in sport can simply be measured by auditory and visual reaction time. Reaction time (RT) is the time taken by any subject to respond to sound or visual stimuli. There are several events in sports, that need a quick response to an unexpected fast arrival of visual and auditory stimuli [4,5].

Research study revealed that athletes have faster visual reaction time scores as compared to non-athletes, with visual anticipation time, athletes had fewer errors and a higher consistency compared to non-athletes [6]. Regular training and sports shorten visual and auditory RT, since sports events require more concentration [7]. A comparative study of healthy controls, athletes, and patients with type 1 diabetes mellitus, found athletes better perform than controls and type -1 diabetes mellitus, and no gender differences were not observed [8].

Athletes’ competency is in multidimensional contexts, while vision is the dominant sensory system, where auditory information also plays an important role in performance [9]. Auditory information improves shot power discrimination in Tennis, soccer, or volleyball [10] predicts hits in fencing [11], and anticipates movement in basketball [12], and visuomotor reaction speed in badminton players [13]. These findings highlight the relevance of auditory information in sports and the necessity for research into the relationship between visual and auditory information. As sensory perception plays a crucial role in the better performance of athletes, requiring a great need for attention and research. There are several research found faster reaction time in athletes than nonathletes [14,15], whereas some studies are inconclusive on the link between reaction time and athlete performance [16,17]. Therefore, the present study was designed to compare the reaction time among athletes with non-athletes. This research also finds any association of gender with reaction time. The present research further explores any association between auditory and visual reaction time, as well as any connection between body mass index (BMI), years of sports practice, and reaction time.

II. MATERIAL AND METHOD
The present study was conducted on 50 subjects out of which 25 were nonathletes and 25 were athletes. After obtaining consent from participants, both males and females belonging to the age group 15-20 years were randomly selected for the study. The subjects suffering from any acute or chronic illness, smokers, alcoholics, taking any drug, or having any visual, hearing, or cognitive impairment were excluded from the study. All participant's height and weight were taken and body mass index (BMI) was calculated using Quetelet’s index [18].

Online visual reaction time (VRT) measurement: In the present study the visual reaction time was measured by using a virtual red-yellow-green traffic light program. First, the yellow light turned on before the start of each trail. To begin, the experiment participants should click an on-screen button to the right of the traffic light, on which written: “Click here to start”. For each trial, this button should be clicked, and the red light is illuminated for a variable amount of time, up to seven seconds. When the red light turns off automatically the green light is illuminated. At this time the subject must click the on-screen button as fast as possible; by doing so the subject’s reaction time was recorded online automatically. After the practice trial, the program runs five times, displays both the raw data (values for each trial), and computes the average reaction time to a thousandth of a second. The visual reaction time is further converted in milliseconds for analysis, by multiplying it by thousand. This program is easy to use and is readily available to anyone with internet access [19].
Online auditory reaction time (ART) measurement: In a simple auditory RT (ART) task after variable time intervals, the sound is played for 30 seconds to the participant through the speakers of the laptop. The task is to press the spacebar as soon as the sound is heard by participants. All the subjects were thoroughly acquainted with the procedure and a practice trial was given to every subject before recording the ART. Five readings of each sound stimulus were taken, and the average of all ART for each stimulus was recorded by software [19].

The readings of VRT and ART were taken between 8 a.m. and 10 a.m. in a quiet, well-illuminated secluded room. The display of the online VRT and ART test screen is shown below in Figure 1.

![Test Number Reaction Time](image)

**Figure 1:** VRT and ART tests presented on a laptop screen respectively

The sample size was calculated at least 24 subjects for each of the sedentary and regular exercise groups at alpha error 0.05 and power 80% assuming a minimum difference of means to be detected 15ms in VRT between the sedentary lifestyle and regular exercise group with standard deviation 18.5 (as per seed articles) [20]. Therefore, for the study purpose total of 50 subjects were taken, 25 subjects for the athlete group and 25 for the nonathlete group.

**Statistical Analysis:** The ART and VRT values were taken in an Excel sheet and the mean and SD were calculated. The unpaired student’s ‘t-test’ was applied to compare ART and VRT in athletes and non-athletes. The relation between ART, VRT, age of experience of sports, and BMI was inferred by the Pearson correlation coefficient. The statistical analysis was carried out by primer version 7. P < 0.05 was statistically significant.

### III. RESULTS

The present study was conducted on twenty-five athletic and non-athletic subjects respectively with the age range 15 to 20 years. Both athletic and nonathletic were within the normal BMI range and the majority of participants were females (Table 1).

<table>
<thead>
<tr>
<th>Variables</th>
<th>Athletic (n=25)</th>
<th>Nonathletic (n=25)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>Average Age (years)</td>
<td>18.1</td>
<td>18.64</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>162.6</td>
<td>168.2</td>
</tr>
<tr>
<td>Weight (Kg)</td>
<td>58.72</td>
<td>59.88</td>
</tr>
<tr>
<td>BMI</td>
<td>22.29</td>
<td>21.06</td>
</tr>
</tbody>
</table>

The VRT was statistically significantly lower among athletes than non-athletes, similarly, ART was also less in athletes than non-athletes with any significant effect (Table 2, Figure 2).

<table>
<thead>
<tr>
<th>Reaction time (ms)</th>
<th>Athletic (n=25)</th>
<th>Nonathletic (n=25)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>VRT</td>
<td>332.8 ± 40.99</td>
<td>372.12 ± 63.93</td>
<td>0.013*</td>
</tr>
<tr>
<td>ART</td>
<td>263.24 ±59.30</td>
<td>293.56 ± 66.93</td>
<td>0.096</td>
</tr>
</tbody>
</table>

VRT= visual reaction time, ART- auditory reaction time, *=p-value<0.05 (significant)

There was no gender difference was observed for the overall reaction time values of both athletic and non-athletic participants. VRT was slightly less in females than males without any statistically significant difference, while no difference was observed in ART (Table 3, Figure 2).
Table 3: Comparison of Overall Reaction Time Values of Male and Females

<table>
<thead>
<tr>
<th>Reaction time (ms)</th>
<th>Male (n=16) Mean ± SD</th>
<th>Female (n=34) Mean ± SD</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>VRT</td>
<td>361.87 ±53.81</td>
<td>348.67 ± 61.99</td>
<td>0.468</td>
</tr>
<tr>
<td>ART</td>
<td>271.93 ± 70.08</td>
<td>277.96 ± 66.14</td>
<td>0.769</td>
</tr>
</tbody>
</table>

VRT = visual reaction time, ART = auditory reaction time

Similarly, no gender difference in VRT and ART was observed in athletic (Table 4), and nonathletic (Table 4, 5).

Table 4: Comparison of Reaction Time in Athletes Male and Females

<table>
<thead>
<tr>
<th>Reaction time (ms)</th>
<th>Male (n=7) Mean ± SD</th>
<th>Female (n=18) Mean ± SD</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>VRT</td>
<td>343.28 ±15.98</td>
<td>328.72 ± 46.64</td>
<td>0.294</td>
</tr>
<tr>
<td>ART</td>
<td>236.42 ± 25.97</td>
<td>273.66 ± 65.06</td>
<td>0.159</td>
</tr>
</tbody>
</table>

VRT = visual reaction time, ART = auditory reaction time

Table 5: Comparison of Reaction Time in Non-athletes Male and Females

<table>
<thead>
<tr>
<th>Reaction time (ms)</th>
<th>Male (n=9) Mean ± SD</th>
<th>Female (n=16) Mean ± SD</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>VRT</td>
<td>376.33 ±66.87</td>
<td>369.75 ± 62.09</td>
<td>0.807</td>
</tr>
<tr>
<td>ART</td>
<td>299.55 ± 80.40</td>
<td>290.18 ± 57.73</td>
<td>0.738</td>
</tr>
</tbody>
</table>

VRT = visual reaction time, ART = auditory reaction time

There was a positive correlation between VRT and ART and contributed only 8% of the variance. The years of practicing sports also positively influenced VRT and ART, explaining only 6%, and 4% variance respectively. The BMI statistically significantly (p=0.04) influenced the ART with the 30% variance contributed by BMI. The VRT is not significantly influenced by BMI, as only a 6% variance was observed (Figure 3).
VRT = visual reaction time, ART = auditory reaction time, BMI = body mass index

Figure 3: Correlation of visual and auditory reaction time (VRT, ART) with BMI and years of practicing sports.
IV. DISCUSSION:
The present study was conducted on auditory and visual reaction times among 25 athletes and 25 non-athletes to explore potential differences in cognitive processing speed and motor responses. The visual and auditory stimulus information is transmitted from sensory neurons to the central nervous system and the participants respond back by motor movements of the hand. This study found that athletes exhibit faster reaction times compared to non-athletes, especially visual reaction time. Gender did not influence the response time for both athletic and nonathletic participants. A study conducted in Turkey found male adolescent children's reaction time is better than female children. They connect their findings that motor skills could be developed more in males than in females for adolescents [21]. Jain et al. found males have faster RTs as compared to females for both auditory as well as visual stimuli [20]. Whereas, in the present study, no gender difference was observed for both nonathletes and athletes. A study compared reaction times of athletes and sedentary individuals with different somatotypes and a statistically significant difference was found in VRT scores of balanced ectomorph athletes and both VRT and ART scores of endomorphic mesomorph athletes when compared with sedentary individuals [7]. Similarly, in the present study, VRT was significantly less among athletes, and ART was also reduced numerically for sports persons. Research by Kemp [22] shows that an auditory stimulus takes only 8–10 ms to reach the brain, but on the other hand, a visual stimulus takes 20–40 ms. Therefore, since the auditory stimulus reaches the cortex faster than the visual stimulus, the ART is faster than the VRT. visual reaction time is around 331 milliseconds as compared to the mean auditory reaction time of around 284 milliseconds. Similar to Kemp's findings in the present study, the auditory response is faster than the visual, as the athlete's participants' VRT was 333 msec and ART 263 msec. In contrast to the above finding, research conducted by Yagi et al. [23], found that VRT is faster than ART. A cross-sectional study conducted on school bus drivers found that with an increase in BMI, auditory reaction time also increases but the data obtained were statistically not significant [24]. Similarly, in the present study, a significant positive correlation was observed between ART and BMI.

Possible Explanation: There are several possible explanations for faster response time among athletes. Spirido [25] asserted that less reaction time of athletes as compared to nonathletes was due to faster central nervous system processing, which results in faster muscular movement in times athletes. Gavkare et al [26] suggested that fast reaction time in athletes might be related to improved attention, better muscular coordination, and greater efficiency in speed and accuracy challenges. Furthermore, because motor response execution is a physical activity, it seems reasonable that those who practice more sports may have developed greater motor response-ability [27]. It is also believed that those who exercise at moderate to extreme levels have greater rates of cerebral blood flow. Because of the greater supply of essential nutrients such as oxygen and glucose, higher blood flow in the brain improves cognitive performance [28,29].

V. CONCLUSIONS
The present study finds that athletes exhibit faster visual reaction times compared to non-athletes, while gender does not appear to have a significant impact on auditory and visual reaction times in both athlete and non-athlete groups. Interestingly, auditory and visual reaction times are related to each other, though not to a statistically significant degree. Furthermore, years of athletic experience show a positive correlation with response time, but this relationship does not reach statistical significance. Of note, participants' Body Mass Index (BMI) demonstrates a positive association with both auditory and visual response times. Specifically, higher BMI values are linked to delayed auditory responses, indicating that individuals with greater body mass tend to exhibit slower auditory reaction times. Considering these findings, it is advisable for students to engage in regular sports activities. Doing so not only enhances physical and cognitive abilities but also leads to shorter response times.

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REFERENCES


