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THE RELATIONSHIP BETWEEN DEPRESSION, ANXIETY AND VISUAL REACTION TIMES IN ATHLETES

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AUTHORS: Yavuz H.U.[1], Oktem F.[2]

[1] Near East University Faculty of Medicine, Department of Sports Medicine, Turkey
[2] Hacettepe University Faculty of Medicine, Department of Pediatric Mental Health and Diseases, Turkey

Reprint request to:
H. Ulas Yavuz
Near East University Hospital
Department of Sports Medicine
Mersin 10 Turkey Lefkosha, Turkey
E-mail:ulasyavuzmd@gmail.com

ABSTRACT: The aim of the study was to evaluate depression, state and trait anxiety scores and visual reaction times, and to define the impact of these variables on each other in swimmers and track and field athletes. One hundred athletes participated in this study including 25 female and 25 male national level swimmers and track and field athletes. Application of Spielberger's State-Trait Anxiety Inventory, Beck Depression Inventory (BDI) and Donder's Reaction Time Test to all participants revealed no significant relationship among obtained data except for a correlation between state and trait anxiety and depression scores ($r = 0.53$, $r = 0.73$ respectively, $p < 0.001$). The mean trait anxiety score in female athletes was higher than that in males (42.60 ± 8.04 and 38.66 ± 7.13 respectively, $p < 0.05$), whereas no gender differences were found for simple, choice or recognition reaction times and depression or state anxiety scores. Even though clinical depression and anxiety may affect the reaction times in patients, these results suggest that there is no correlation between anxiety and depression scores and reaction times in healthy athletes.

KEY WORDS: anxiety, depression, reaction time, athletes

INTRODUCTION

An athlete's mental state has long been thought to play a crucial role in his or her ability to perform sport-specific tasks. Players who are evenly matched in physical skills often rely upon their psychological skills to gain an advantage over their opponents [12]. A complex and contrasting relationship has been highlighted between mood states, anxiety and motor performances [5,7,8,41]. In tasks with high information content, such as psychomotor ability or complex reaction time tasks, state anxiety can produce a slowing down of the information processing and motor strategies [5]. However, in more simple tasks depending greatly on automatic abilities, state anxiety improves attention [5,29,31], leading to better performances. Trait anxiety favours the processing of information of stimulus-response tasks, but not that of controlled tasks that require strategic processes [6,29].

It has been shown that moderate state anxiety improves performance in visual and auditory response time both at the reaction time and movement time level [19]. This agrees with previous data demonstrating that state anxiety increases arousal [28] and attention [6,31], which can modulate sensory processing [14].

While anxiety could lead to improved reaction time, global slowing would predict that depressed subjects will perform in a consistently (and proportionately) slow manner when compared to the controls, regardless of the difficulty or type of task. The pathophysiology that underlies global slowing is not yet known [30].

Reaction time (RT) performance of depressed people is generally worse than that of non-depressed controls, which indicates that a dysfunction of information processing accompanies the depressive states [3,35]. Depressed patients show greater difficulty and slower performance as the task complexity increases [30] compared to control participants. Patients with major depressive disorder typically exhibit slowed psychomotor reaction times in tasks that require effortful processing [20].

Impaired concentration, especially impaired selective attention [18], is a common symptom of major depressive disorder [10,33]. Azorin et al. demonstrated that RT was longer for depressed than for control participants and was affected both by visual signal intensity and stimulus–response compatibility [3].

Apart from the above-mentioned evidence in favour of interrelations between reaction time and anxiety on one hand and depression on the other, anxiety and depression are also highly associated in both unselected and clinical populations [2,11,25] and youth [16]. In many cases, anxiety and depression are associated with different aspects of information processing. For example, explicit memory bias has been consistently associated with depression, but is rarely associated with anxiety, and the dot-probe task has more often been found to be influenced by anxiety than by depression [43]. It cannot simply be assumed from here that the correlates of anxiety and depression will be similar, and the differential information processes associated with anxiety and depression continue to be of particular relevance to discussions on these mood states [2,27]. Moreover, discrepancies between the information processing correlates of anxiety and depression form one of the main challenges to cognitive models that ascribe processing biases in anxiety and depression to similar mechanisms [43].

In spite of established evidence in favour of a strong correlation between anxiety and depression [2,16,25,45], information on interrelations among anxiety, depression and reaction time is limited and this information mostly comes from studies with clinical populations. Knowledge about these interrelations in athletes is even more limited. This study was conducted to evaluate and compare the interactions among anxiety, depression and reaction time in swimmers and track and field athletes, which would provide valuable information for understanding psychophysiological factors affecting sport performance.

MATERIALS AND METHODS

Participants were national or international level athletes (N=100), 25 male and 25 female in each of the branches of swimming and track and field, varying from 17 to 25 years of age (M=20.50 ± 2.93), drawn from Anıttepe indoor swimming pool and Naili Moran Athletics field, Ankara, Turkey. All the athletes were same level athletes who were competing in the first league of their branches and they were all university students or graduates.

Trait and state anxiety and depression levels of the subjects were determined using Spielberger's Trait-State Anxiety Inventory [38] and Beck Depression Inventory [4] respectively, prior to daily training.

Reaction time tests were computer-administered with Psych/Lab for XP 1.0 [1] 'Donders RT Test' software program that obtains RTs under several different conditions. The subject was seated before a computer and instructed to focus on a "1" in the centre of the screen. The right index was placed on the "/" key, and the left index finger was placed on the "Z" key. In the simple reaction time condition (Donders Type A), an "X" appears intermittently in a box to the right of the "1" and the subject was instructed to press the "/" key as quickly as possible. If the response was too slow, incorrect, or if no key was pressed when one was required, a short tone was presented. In the second condition, recognition reaction time (Donders Type C), a box is present to the left and to the right of the "1" and an "X" may appear in either box. The instruction is to press the "/" key if the "X" appears in the right box. The task is more difficult due to the necessity of monitoring the left box and having to inhibit a response with the right finger, and is thought to engage executive functioning. In the third condition, choice reaction time (Donders Type B), a box is present to the left and to the right of the "1" and an "X" may appear in either box. The instruction is to press the "/" key with the right finger if the "X" appears in the right box or press the "Z" key with the left finger if the "X" appears in the left box. Conditions were presented in a fixed order with the following parameters: 10 practice trials/condition; 30 test trials/condition; a 500 ms inter trial interval; 100 ms minimum allowed RT; and 1,500 ms maximum allowed RT. When responses were faster or slower than the criteria, the trial was repeated. Based on all test trials within each condition, averaged means and standard deviations were derived for analyses. The results of the combined block test results were then transferred into a Windows-style spreadsheet application (as the Psych/Lab for XP software is limited to storing just one participant data file at a time).

Data were analysed by analysis of variance (two-way ANOVA) to detect significant differences between means. Correlations were performed for evaluating the data by using statistical application software SPSS v.12.

RESULTS

In total 100 athletes answered BDI, STAI and SSAI and performed Donder's visual reaction time test. The age range of participants was 17 to 25 years (20.50 ± 2.93) and there was no statistically significant difference in the average age between genders.

As shown in Table 1 the simple reaction time was the shortest reaction time component measured (276.85 ± 44.43) whereas the choice reaction time was the longest (326.80 ± 39.46). The recognition reaction time fell between these two (313.70 ± 49.21).

TABLE 1. DESCRIPTIVE VALUES OF ANXIETY, DEPRESSION AND REACTION TIMES

Simple RT	276.85 ± 44.43
Choice RT	326.80 ± 39.46
Recognition RT	313.70 ± 49.21
State Anxiety	36.05 ± 8.50
Trait Anxiety	40.63 ± 7.81
Beck Depression Scores	8.92 ± 7.21

TABLE 2. COMPARISON OF REACTION TIMES BETWEEN MALE AND FEMALE ATHLETES AND SWIMMING AND TRACK AND FIELD

	Simple RT	Choice RT	Recognition RT
Female	285.18 ± 45.08	332.99 ± 41.32	321.70 ± 43.74
Male	268.52 ± 42.61	320.61 ± 36.88	305.70 ± 53.38
Swimming	281.21 ± 52.16	327.64 ± 43.22	316.78 ± 55.97
Track and Field	272.48 ± 35.06	325.95 ± 35.72	310.62 ± 41.72

Means of state and trait anxiety and depression scores are also shown in Table 1.

No significant difference between male and female athletes or athletes of swimming and track and field were found for simple, choice or recognition reaction times (Table 2).

No significant difference between male and female athletes or athletes of swimming and track and field were found for state and trait anxiety or Beck depression scores (Table 3).

TABLE 3. COMPARISON OF STATE AND TRAIT ANXIETY AND BECK DEPRESSION SCORES BETWEEN MALE AND FEMALE ATHLETES AND SWIMMING AND TRACK AND FIELD

	State Anxiety	Trait Anxiety	Beck
Female	37.58 ± 8.05	42.60 ± 8.04*	9.62 ± 7.21
Male	34.52 ± 8.75	38.66 ± 7.13	8.22 ± 7.22
Swimming	35.64 ± 10.09	39.14 ± 8.54	8.00 ± 8.14
Track and Field	36.46 ± 6.63	42.12 ± 6.77	9.84 ± 6.09

Note: *P<0.05

TABLE 4. THE RELATIONSHIP AMONG ANXIETY, DEPRESSION AND REACTION TIMES (RT)

	State Anxiety	Trait Anxiety	Beck Depression
Simple RT	r = 0.12	r = 0.02	r =- 0.09
Choice RT	r = 0.15	r = 0.06	r = -0.06
Recognition RT	r = 0.16	r = -0.01	r = -0.08

TABLE 5. THE RELATIONSHIP BETWEEN ANXIETY AND DEPRESSION

	Trait Anxiety		Beck Depression	
State Anxiety	r = 0.64	P<0.001	r = 0.53	P<0.001
Trait Anxiety			r = 0.73	P<0.001

The results of the analysis were constructed to make comparisons between all of the measures used in this study (Table 4). No significant relationship was found among state-trait anxiety levels, depression levels and the simple, choice and discrimination reaction times (p>0.05).

The relationships between both trait and state anxiety and depression scores were statistically significant (p<0.001) (Table 5).

DISCUSSION AND CONCLUSION

Our findings for the reaction times are parallel to the literature. The pioneer reaction time study was that of Donder [13]. He showed that a simple reaction time is shorter than a recognition reaction time, and that the choice reaction time is longest of all. This is in line with many studies concluding that a complex stimulus (e.g., several letters in symbol recognition vs one letter) elicits a slower reaction time [9,15,26].

No significant difference between male and female athletes or athletes of swimming and track and field were found for simple, choice or recognition reaction times (Table 2). In the past, a large number of studies were done in different sports branches on different reaction times of athletes and different results have been reported by Kosinski [23]. Our results may be due to the similarity of the nature of athletics and swimming sports or differences in methods used.

Although there was no statistically significant difference for simple, recognition and choice reaction times, state anxiety and depression between genders (p>0.05), trait anxiety was found to be higher in women (42.60 ± 8.04) than in men (38.66 ± 7.13) (p<0.05). The related literature shows that female athletes reported greater mean scores on measures of social anxiety than male athletes and male and female non-athletes [40]. Similarly, Storch, Roberti, & Roth [39] found female adolescent and college students to report higher rates of social anxiety than their male peers.

Although lacking statistical significance, state and trait anxiety and depression scores were higher in the track and field group (p=0.056). It has been stated that swimming could reduce depression symptoms and therefore can be used alone or with other sports to reduce depression [44]. In contrast to the positive effects of the sport on depression, swimmers showed high levels of anxiety associated with performance [21]. So the relations and effects are complicated and can be easily affected by many other factors.

There are data suggesting that anxiety could favour, or at least not alter, the processes of information of relatively simple tasks, such as reaction time; and adverse changes in mood states could modulate performance negatively, at least in extreme environmental conditions such as high altitude [5]. Trait anxiety could favour the processing of information of stimulus-response tasks in anxiogenic conditions, but not that of complex motor skills requiring strategic processes [6]. Paradoxically, in anxiogenic conditions, improvement of performance occurs at movement time, but not at reaction time [19].

There are many studies showing that depressed subjects are slower than normal controls in reaction time tasks, which indicates that a dysfunction of information processing accompanies the depressive states [22,24,32]. However, it is not clear whether depression affects all stages of information processing or only some of them. In contrast, a relatively large group (N=123 patients) of young, unmedicated outpatients with mild to moderate unipolar depression had largely intact cognitive functions [17]. Thus, the specific deficits found across studies appear sometimes inconsistent and contradictory. Our data did not show any correlation between depression scores and reaction times and none of the subjects in our study were clinically depressed. The most frequent explanation for the differing results relates to between-subject differences (age, presence of clinical depression, presence of psychosis; medications; psychomotor retardation; length and severity of illness; comorbidities; etc.) [30].

With regard to the remaining variables, however, a significant relation between anxiety and depression (p<0.001) was observed

(Table 5). These findings are parallel with the related literature [37,45]. There are data suggesting that anxiety could favour simple information processing such as reaction time [5]. There are also many studies showing that depressed subjects are slower than normal controls in reaction time tasks [22,24,32]. Paradoxically, it has been shown that symptoms of anxiety are frequent in patients with major depressive disorder [2,16,25,37,45]. This is a hard situation to explain. Some researchers have examined mood using dimensions other than anxiety and depression. For example, the Positive and Negative Affect Scales (PANAS) divide mood into two largely independent dimensions: positive effect, which is characterized by enthusiastic alertness; and negative effect, which is characterized by subjective distress [42]. There has already been some research showing that these dimensions of mood can be associated with distinct effects on information processing [36].

Investigation of these relationships is important in furthering knowledge and understanding of physiological factors affecting athletes' well-being and sporting performance. Although the effects of mood states on reaction time were known to some degree in the clinical population, the related knowledge in athletes is even more limited. The findings of the present study suggest that the level of depression and anxiety does not affect the reaction times, but depression and anxiety scores may be correlated in healthy athletes. It is very important to follow up the mood changes of athletes to prevent them from becoming extremely anxious or depressed since mood changes are very important not only for performance but also for general health of the athletes. If it is possible to manipulate the psychology of the athlete to improve the reaction time tasks, it will also be possible to improve athletic performance.

To understand the complex mechanisms of reaction time tasks, and also the relationships among depression, state and trait anxiety, and reaction times, studies need to be continued.

Conflict of interest

None

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