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Effect of Trait and State Anxiety on Overhead Defensive Clear Shot Skill Performance Regarding Some Kinematic Variables for Badminton Players

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Abstract

Background: Anxiety is a psychological state of mind that affects skillful performance negatively or positively according to the type of anxiety and the way it is interpreted by the player, especially in individual games, such as badminton. On the other hand, the kinematic variables can better determine if players' skill performance is successful.
Objectives: This study aimed to determine the effect of anxiety (if any) (including anxiety types trait and state) on overhead clear skill performance regarding some kinematic variables for badminton players.
Methods: The study sample consisted of 61 beginner badminton players (with mean scores of age: 14.3 ± 1.2 years, mass: 51.20 ± 1.31 kg, height: 1.66 ± 0.10 m, training period: 3.9 ± 1.3 years), distributed to 3 groups based on the State-Trait Anxiety Inventory Form Y questionnaire. The equivalence of these groups was calculated based on pre-test results, which were no anxiety, trait anxiety, and state anxiety.
Results: The results showed that trait and state anxiety had negative effects on badminton players' performance of overhead defensive clear shot skill in terms of some kinematic variables. The results also showed that the effect of trait anxiety was more negative than the effect of state anxiety.
Conclusions: The researchers recommend having knowledge of the level, type, and extent of anxiety, including relevant effects on the performance of beginner badminton players in all physiological, motor, and biomechanical aspects, to develop psychological rehabilitation programs that deal with anxiety according to the type, which the player can overcome.

Keywords: Psychological Anxiety, Overhead Shot, Kinematic, Badminton, Racquet Games

1. Background

The feelings of the individual and his/her mental and performance ability are largely related to psychological factors, especially in the sports field, where psychological factors play an important role in the individual's skill and physical abilities and in various sports activities (1). Among these psychological factors emerges the effect of anxiety, which is an important psychological factor reflected in the performance of players, especially when placed on them during sports performance requirements associated with achievement (2). Moreover, the relationship between tension and sports performance is a deep and certain relationship and cannot be overlooked or exceeded if it is wished for the player to reach the podium (3).

Anxiety can be defined as a state of annoying waiting mixed with a lack of security arising from the external environment or any situation perceived by the individual interpreted as a warning of an expected danger (4). Anxiety has two widespread types, namely state anxiety and trait anxiety, and each type has its own psychological repercussions and symptoms, which, if they appear, affect the performance of players directly (5). The state anxiety is associated with the situation itself, which is cognitive, physical anxiety associated with physical symptoms, such as muscle tension, shortness of breath, and rapid heartbeat, and cognitive symptoms, such as emotional distress that the athlete perceives for upcoming competition events (4). Therefore, state anxiety is temporary and arises from the circumstances surrounding the player, which is the pressure of competition and the requirements of achievement and is mainly based on logical reasons

that can be understood, which is a standard that can be controlled and made one of the causes of achievement if properly dealt with. For the trait anxiety, it is a continuous state of stress, tension, and excess sensitivity, which always explains situations as threats (6). It can be said that state anxiety might be less effective when the player rises to his or her level in competitive situations; however, trait anxiety is a concern that constantly exists in the player's life, and in case the player rises more at his/her level in competitive situations. In both cases, the increase in anxiety is above the acceptable limit; the acceptable limit is an individual limit associated with the extent of the appearance of cognitive and physical symptoms of state anxiety. If these symptoms are too high, they lead to wrong perceptual responses from the anxious person, and even in senior athletes with anxiety, this reflects negatively on their performance (7).

Therefore, the player who has trait anxiety shows excessive and high anxiety that appears in the form of unjustified arousal resulting from fear of failure, negative expectations, and poor concentration, which inevitably leads to a decrease in motor performance. A player with state anxiety may experience symptoms that are similar to someone with trait anxiety; however, the difference lies in the fact that state anxiety is related to the situation the player goes through during competition only and not on an ongoing basis and state anxiety is sometimes interpreted in a way that does not mean danger and threat, unlike trait anxiety which is permanent and increases in competition situations and is always interpreted in a way that means danger and threat (8).

Due to the importance of psychological variables on sports performance, sports specialists developed many methods and procedures that explain the role of psychological skills and the ability to deal with cases of anxiety, whether trait anxiety or state anxiety, as an important part of sports training from the beginning of the selection process to high achievement (8). On the other hand, it can be said that the psychological factors affecting sports activity, including anxiety in its two common types, trait and state anxiety, appear in team and individual sports. However, the greatest effect of anxiety appears among individual sports players because the player is solely responsible for the performance and results on the field, even if he/she has a team coach and accompanying staff. However, psychological pressure and anxiety appear more evidently in individual sports than in team sports (9).

Badminton, which is one of the individual and team sports, is considered a game of a fast-performance nature and requires several physical and skill qualities that put its practitioner under high-performance pressure who might be affected by anxiety. This means that the performance of a badminton player in the event of suffering from anxiety is affected, which indicates the need of the player who suffers from anxiety of any kind for psychological support, especially with the existence of studies that showed the existence of levels of anxiety of both types, trait anxiety, and state anxiety, among badminton players, which leads to a decrease in their level of skill performance (10).

Therefore, this study dealt with the subject of anxiety and the possibility of its effect on one of the badminton skills, which is the overhead defensive clear skill. This skill was chosen as a defensive skill because the defensive positions in racket games increase the pressure on the player more than offensive positions. As a result, a defensive skill was chosen for its performance, and it was tried to find out the possibility of the effect of anxiety on the accuracy of the performance of this skill. For a more accurate analysis, some mechanical variables associated with the performance of the skill were selected to determine the extent of the change in it, which is reflected in the overall performance of the skill. Each skill has a mechanical model that governs the way this skill is performed, its shape, and the extent to which it achieves the mechanical goal, which means the level of achievement of the player in the performance of this skill (11).

1.1. Significance

The aspect of significance lies in the fact that it is an applied study, as it is conducted on a main skill of the badminton game, which is the overhead defensive clear shot skill. All this is done by inferring the kinematic changes that occur under the influence of the anxiety factor. The significance of the research also increases by shedding light on the category of beginners, whose care and performance study in all aspects are necessary points for the success of any sports project.

This study also provides a clear scientific set of numerical data for coaches of beginner badminton players in terms of the extent of the impact of types of anxiety on the performance of players. This enables coaches to include this approach in the player's profile and work on treating the negative effects of anxiety (if any) and developing more knowledge about the differences of anxiety types, including those things associated with types of effects on the skillful performance of players. Characterized by the fact that it applied to beginner players, the current study constitutes, therefore, a reference for badminton coaches in case they look for new players who are skillfully and psychologically exceptional.

The current study is not only looking at the psychological effect of anxiety on skillful performance

but also looking at the psychological effect of anxiety on the kinematic variables associated with skill(s). Therefore, the present study links combined psychology with the biomechanical analysis of sports performance and came out with an outcome that shows how anxiety affects skillful performance accuracy through the impact it generates on the kinematic variables associated with performance. The current study delved into the effect of anxiety on the above-mentioned skill and did not show it superficially only.

2. Objectives

1. This study was performed to determine the effect of anxiety (if any) (including its type: Trait and state anxiety) on the badminton players' performance of the overhead defensive clear Shot skill in terms of certain associated kinematic variables.

2. This study was performed to showcase the difference between the effect of trait anxiety and state anxiety on badminton players' performance of the overhead defensive clear shot skill in terms of certain associated kinematic variables.

3. Methods

The study sample consisted of 61 beginner badminton players with mean scores of age, mass, height, and training period reported as 14.3 ± 1.2 years, 51.20 ± 1.31 kg, 1.66 ± 0.10 m, and 3.9 ± 1.3 years, respectively. Beginner players were selected as a sample for this study because they might be more anxious due to their lack of experience in competitions, and they are considered the base for badminton, which requires the need to take care of and qualify them from all the minute details, including the psychological aspect, to get them to the highest competitive performance.

A total of 100 beginner badminton players were selected. The State-Trait Anxiety Inventory Form Y (STAIF-Y) questionnaire was provided to the players; however, certain completed questionnaires for answer conditions were not obtained. Having applied certain statistical treatments for the equality of the 3 study groups, the total count of the study sample reached 61 players.

The sample was distributed into 3 groups based on the presence of anxiety or not. If it existed, they were distributed into one group of trait anxiety and another of state anxiety so that the final shape of the study sample became 3 experimental groups, the details of which are as follows:

- The first group included 22 players who had no anxiety.

- The second group included 19 players who had trait anxiety.

- The third group included 20 players who had state anxiety.

3.1. Study Protocols

1. The sample was divided into 3 groups based on the presence of anxiety and its type, where the basis for the division into groups was the submission of all respondents to the application of the State-Trait Anxiety Inventory Form Y or symbolized by STAIF-Y. It is a questionnaire consisting of several paragraphs whose averages are calculated; then, the paragraphs related to trait anxiety are measured. Accordingly, the paragraphs related to state anxiety and the total points are calculated until it becomes clear whether there is anxiety or not. If it exists, it falls in the field of trait anxiety or state anxiety (12).

Although the STAIF-Y questionnaire is universal and documented, and its validity and reliability have already been evaluated in many previous studies, the researchers, in order to increase certainty, assessed the validity of the STAIF-Y questionnaire through the correlation coefficients between the questionnaire items, which amounted to 85%. The reliability was also calculated by applying the questionnaire and re-applying it to 15 beginner badminton players who were later excluded from the study sample. The test stability coefficient was 94%, according to Cronbach's alpha.

2. After dividing the groups, the first study test was conducted in which the respondents took the overhead defensive clear skill performance test with filming attempts for the purposes of mechanical analysis of performance through three cameras (Canon EOS 80 D) with a speed of 500 images/second. The cameras were placed on the lateral, deep, and vertical performance axes.

3.1.1. Overhead Defensive Clear Skill Test Procedures

- Ask the players for a good warm-up.

- The player stands at the back line of the individual badminton field.

- Automatic shuttlecock launcher throws the shuttlecock to the player.

- The player hits the shuttlecock with the overhead defensive clear skill toward the opponent's field.

- The opponent's field was divided into 4 areas, starting from the end line of the individual field.

The first area has its first border, the end line of the field; then, its second border is a line drawing the width of the field, and the distance between the two lines is 36 cm, and 5 points are given.

The second area, which is bordered by the first line, the second line of the first area, and another line that follows it by 36 cm, is given 4 points.

The third area, which is bordered by the first line, the second line of the second area, and another line that follows it by 36 cm, is given 3 points.

The fourth area is bordered by the first line, the second line of the third area, and another line that follows it by 36 cm. Two points are given, and the rest of the field is given 1 point.

Therefore, it is the last area, which includes the entire area of the field, except for the four divided areas, and is given 1 point. Each shuttlecock that falls on the line of one of the areas counted for the area with the highest points.

- Each player has 5 attempts, with the highest and lowest points as 5 and 0, respectively.

3. The equivalence of the 3 groups was calculated based on the first study test in order to ensure that there was real equivalence within data related to skill performance and the following group equivalence tables, noting that after calculating equivalence, some players were excluded and excluded from the final total of 61 players to ensure the equivalence calculations.

Table 1 shows the values of the averages of the kinematic variables and the overhead clear skill performance of the badminton players distributed according to the groups in pre-measurement. By examining the values of these averages, it was shown that they were different and not equal between the 3 groups in each variable of the kinematic variables.

Table 2 shows the results of the analysis of factor variance of the average accuracy of the skill performance (overhead defense clear) in the shuttlecock and kinematic variables distributed according to the group variable in pre-measurement. With reference to the values of the calculated significance level to indicate the significant and substantial differences of the kinematic variables between the 3 groups listed in the last column of the table, it was shown that they were 0.125, 0.326, 0.671, and 0.181 for the shoulder angle, elbow angle, wrist angle, and starting angle of the shuttlecock variables, respectively. In the same vein, the value of the significance level of the differences between the averages of the 3 groups in the shuttlecock speed variable reached 0.578; nevertheless, it reached 0.709 for the shuttlecock maximum height variable. For the non-calculated significance level and value for the performance accuracy variable, it reached 0.122, and when comparing these values to 0.05, all these values were greater than (0.05). This finding indicated that the differences in averages between the 3 groups in each variable were not considered meaningful or not statistically significant. Therefore, it can be considered that the 3 groups were close and equivalent in the values of the averages of the pre-measurement of the kinematic variables and the accuracy of the overhead defensive clear skill performance in badminton.

Table 1. Averages and Overhead Clear Skill Performance in Terms of Some Kinematic Variables Distributed by Groups in Pre-measurement

Kinematic Variables and Group	No.	Mean ± SD
Shoulder angle (°)		
No anxiety	22	144.05 ± 2.70
Trait anxiety	19	141.89 ± 4.15
State anxiety	20	143.00 ± 3.01
Elbow angle (°)		
No anxiety	22	161.05 ± 3.57
Trait anxiety	19	162.05 ± 3.24
State anxiety	20	160.40 ± 3.47
Wrist angle (°)		
No anxiety	22	212.18 ± 5.78
Trait anxiety	19	210.00 ± 7.64
State anxiety	20	221.15 ± 9.60
Shuttlecock launch angle (°)		
No anxiety	22	41.05 ± 3.37
Trait anxiety	19	40.21 ± 2.07
State anxiety	20	42.05 ± 3.47
Shuttlecock speed (°)		
No anxiety	22	32.09 ± 3.77
Trait anxiety	19	33.05 ± 3.26
State anxiety	20	33.05 ± 3.17
Shuttlecock maximum height (m)		
No anxiety	22	1.74 ± 0.11
Trait anxiety	19	1.73 ± 0.04
State anxiety	20	1.75 ± 0.07
Accuracy out of 25		
No anxiety	22	18.00 ± 1.95
Trait anxiety	19	19.05 ± 1.61
State anxiety	20	19.00 ± 1.92

Abbreviation: SD, standard deviation.

4. After the equivalence procedure, all respondents were informed that the performance videos would be submitted to performance analysts, and the top 5 players in terms of performance and points would be honored with a financial reward of $50 50 dollars. Moreover, the aim of this award is to create pressure on the players in order to win the prize, which leads to the emergence of symptoms of anxiety among those who suffer from it, especially since

Table 2. Analysis of Factor Variance for Averages of Overhead Defense Clear Skill Performance in Shuttlecock and Kinematic Variables Distributed According to Group Variables in Pre-measurement

Kinematic Variables and Variation Source	Squares Average	Degree of Freedom	Squares Average	F-Value	Significance Level
Shoulder angle (°)				2.156	0.125
Group	47.190	2	23.595		
Wrong	634.744	58	10.944		
Total	681.934	60			
Elbow angle (°)				1.142	0.326
Group	26.970	2	13.485		
Wrong	684.702	58	11.805		
Total	711.672	60			
Wrist angle (°)				0.402	0.671
Group	48.538	2	24.269		
Wrong	3501.823	58	60.376		
Total	3550.361	60			
Shuttlecock launch angle (°)				1.763	0.181
Group	33.134	2	16.567		
Wrong	545.062	58	9.398		
Total	578.197	60			
Shuttlecock speed (°)				0.553	0.578
Group	12.973	2	6.486		
Wrong	679.716	58	11.719		
Total	692.689	60			
Shuttlecock maximum height (m)				0.345	0.709
Group	0.005	2	0.002		
Wrong	0.391	58	0.007		
Total	0.395	60			
Accuracy out of 25				2.183	0.122
Group	14.823	2	7.412		
Wrong	196.947	58	3.396		
Total	211.770	60			

the study sample is beginners. They asked to re-take the overhead defensive clear study test 48 hours after the first test.

5. Video clips were analyzed after uploading with Kinovea 0.9.5 software for motion analysis.

3.2. Equipment and Tools

1. Yonex badminton rackets (Yonex Co., Ltd, Japan)
2. 100 legal Yonex shuttlecocks with a confirmed speed
3. An automatic shuttlecock launcher
4. The stalker sport 2 radar measures the shuttlecock speed
5. Kinovea 0.9.5 software for motion analysis
6. Three cameras (Canon EOS 80D)
7. SPSS software (version 27)

3.3. Statistical Processors

In this study, SPSS software (version 27) was used. Moreover, the arithmetic mean, standard deviation, and analysis of factor variance were used to ensure the equivalence of the groups. The *t*-test was utilized to find out the differences in the pre-test and post-test, and the least significant difference (LSD) test was employed to indicate the differences of the arithmetic means to determine which study groups were more affected in the post-test.

4. Results

The presentation of the results based on the hypotheses of the study is as follows:

4.1. Hypotheses

H1: There is a statistically significant difference at the significance level of $\alpha \leq 0.05$ between the pre-test and post-test of the effect of anxiety (if any) (including its type: Trait and state anxiety) on overhead clear skill performance in terms of some kinematic variables for badminton players.

H2: There are statistically important differences at the significance level of $\alpha \leq 0.05$ for the effect of anxiety on overhead clear skill performance in terms of some kinematic variables for badminton players due to the type of anxiety (i.e., trait or state anxiety).

In order to test the results of the first study hypothesis, the *t*-test was used for related groups (samples).

Table 3 shows the results of the *t*-test for the accuracy of the overhead defense clear skill performance in the shuttlecock and kinematic variables between the pre-measurement and post-measurement of the group members (no anxiety). With reference to the values of the calculated significance level to identify the significance of the differences in the averages of the kinematic variables between the pre-measurement and post-measurement, it is shown that they reached 0.000 for the shoulder angle, elbow angle, and wrist angle variables. In the same vein, the value of the significance level of the differences between the averages of the 3 groups in the shuttlecock speed variable reached 0.391 and 0.000 for the maximum height variable.

When examining the value of the significance level calculated between the averages of the pre-measurement and post-measurement of the variable of the accuracy of the overhead defense clear skill performance in badminton, it reached 0.000, and when comparing these values to the value 0.05, all these values (except for the shuttlecock speed) were less than 0.05. This finding indicated that the differences in averages between the pre-measurement and post-measurement in the accuracy of the overhead defense clear skill performance and the kinematic variables (except for the shuttlecock speed) were considered significant and statistically significant. Therefore, the significance of the difference in averages was in favor of the post-measurement because the values of performance accuracy increased among the group members that were not exposed to any kind of anxiety.

Table 3 also shows the height ratios that occurred in the variables because it was noted that the highest percentage was achieved through the shuttlecock maximum height variable, which reached 25.29%, and the rest of the height ratios varied because all the values of the post-measurement averages increased, as shown in Table 3.

Table 4 shows the results of the *t*-test for the accuracy of performing overhead defensive clear skill in the shuttlecock and kinematic variables between the pre-measurement and post-measurement for the members of the trait anxiety group. By referring to the values of the level of significance calculated to verify the importance and significance of the differences in the mean accuracy and the differences in the mean of kinematic variables between the pre-measurement and post-measurement from a statistical point of view, it turned out that it reached 0.004 and 0.000 for the knee angle and elbow angle variables, respectively. It also reached 0.000 for the wrist angle and shuttlecock launch angle variables. In the same vein, the value of the level of significance of the differences among the means of the 3 groups reached 0.000 for the shuttlecock speed and maximum height variables.

When examining the value of the level of significance calculated between the means of the pre-measurement and post-measurement of the variable of the accuracy of performing overhead defensive clear skill in shuttlecock, it turned out that it reached 0.000. When comparing these values to the value of 0.05, all of these values were less than 0.05. This finding indicated that the differences in the means between the pre-measurement and post-measurement in the accuracy of the performing overhead defensive clear skill and the kinematic variables were considered significant and statistically significant. The significance of the difference in the means was in favor of the pre-measurement (the first) (except for the variable of the maximum height of the shuttlecock, as the mean value of the post-measurement increased) because the performance accuracy values decreased in the post-measurement of the members of this group that was subjected to trait anxiety.

Table 4 also shows the percentages of change that occurred in the kinematic variables of the trait anxiety group, as all the kinematic variables decreased their values in the post-test and in varying proportions, compared to the pre-test, except for the variable of the maximum height shuttlecock, whose value increased in the post-test. Nevertheless, the performance accuracy differed by a large amount. In the post-test, compared to the pre-test, it decreased by 41.68%.

Table 5 shows the results of the *t*-test for the accuracy of performing overhead defensive clear skill in shuttlecock and the kinematic variables between the pre-measurement and post-measurement for the

Table 3. Results of the *t*-Test for Overhead Defensive Clear Skill Performance in Badminton and Kinematic Variables Between Pre-measurement and Post-measurement of Group Members (No Anxiety)

Accuracy and Kinematic Variables	Arithmetic (Mean ± SD)		Average Difference Ratio	*t*-Value	Significance Level
	Pre-measurement	Post-measurement			
Shoulder angle (°)	144.05 ± 2.70	151.36 ± 4.01	5.07	17.502	0.000
Elbow angle (°)	161.05 ± 3.57	168.09 ± 4.91	4.37	4.880	0.000
Wrist angle (°)	212.18 ± 5.78	221.23 ± 5.98	4.27	5.240	0.000
Shuttlecock launch angle (°)	41.05 ± 3.37	46.18 ± 4.50	12.50	4.425	0.000
Shuttlecock speed (°)	32.09 ± 3.77	33.14 ± 4.02	3.27	0.875	0.391
Shuttlecock maximum height (m)	1.74 ± 0.11	2.18 ± 0.13	25.29	14.298	0.000
Accuracy	18.00 ± 1.95	21.00 ± 1.27	16.67	8.189	0.000

Abbreviation: SD, standard deviation.

Table 4. Results of the *t*-Test for Accuracy of Performing Overhead Defensive Clear Skill in Shuttlecock and Kinematic Variables Between the Pre-measurement and Post-measurement of Members of Trait Anxiety Group

Accuracy and Kinematic Variables	Arithmetic (Mean ± SD)		Mean Difference Ratio	F- Value	Significance Level
	Pre-measurement	Post-measurement			
Shoulder angle (°)	141.89 ± 4.15	139.05 ± 2.15	-2.00	3.334	0.004
Elbow angle (°)	162.05 ± 3.24	144.05 ± 4.48	-11.11	13.545	0.000
Wrist angle (°)	210.00 ± 7.64	200.37 ± .78	-4.59	4.483	0.000
Shuttlecock launch angle (°)	40.21 ± 2.07	32.05 ± 3.03	-20.29	10.601	0.000
Shuttlecock speed (°)	33.05 ± 3.26	24.05 ± 2.53	-27.23	9.107	0.000
Maximum height of shuttlecock (m)	1.73 ± 0.04	2.14 ± 0.09	23.70	-16.929	0.000
Accuracy	19.05 ± 1.61	11.11 ± 1.41	-41.68	15.245	0.000

Abbreviation: SD, standard deviation.

members of the state anxiety group. By referring to the values of the level of significance calculated to search for the significance of the differences in the mean accuracy and the kinematic variables between the pre-measurement and post-measurement from a statistical point of view, it turned out that it reached 0.000, 0.000, 0.763, and 0.000 for the knee angle, elbow angle, wrist angle, and shuttlecock launch angle variables, respectively. In the same vein, the value of the significance level of the differences among the means of the 3 groups reached 0.000 for the shuttlecock speed and maximum height variables.

When examining the value of the level of significance calculated between the means of the pre-measurement and post-measurements of the variable of the accuracy of performing overhead defensive clear skill in shuttlecock, it turned out that it reached 0.000. When comparing these values to the value of 0.05, it became apparent that all of these values were less than 0.05. This finding indicated that the differences in the means between the pre-measurement and post-measurement in the accuracy of the performing overhead defensive clear skill and the kinematic variables were considered significant and statistically significant. The significance of the difference in the means was in favor of the pre-measurement (the first) (except for the variable of carpus eagle) because the performance accuracy values decreased in the post-measurement of the members of this group that were subjected to state anxiety.

Table 5 also shows the percentages of change that occurred in the kinematic variables of the state anxiety group, as all the kinematic variables decreased their values in the post-test and in varying proportions, compared to the pre-test, except for the variable of the maximum height

Table 5. Results of the *t*-Test for Accuracy of Performing Overhead Defensive Clear Skill in Shuttlecock and Kinematic Variables Between the Pre-measurement and Post-measurement for Members of State Anxiety Group

Accuracy and Kinematic Variables	Arithmetic (Mean ± SD)		Mean Difference Ratio	F-Value	Significance Level
	Pre-measurement	Post-measurement			
Shoulder angle (°)	143.00 ± 3.01	140.10 ± 2.61	-2.03	4.216	0.000
Elbow angle (°)	160.40 ± 3.47	153.15 ± 5.91	-4.52	5.343	0.000
Wrist angle (°)	211.15 ± 9.60	210.20 ± 6.95	-0.45	0.306	0.763
Shuttlecock launch angle (°)	42.05 ± 3.47	37.10 ± 3.06	-11.77	4.475	0.000
Shuttlecock speed (°)	33.05 ± 3.17	24.00 ± 2.36	-27.38	9.526	0.000
Maximum height of shuttlecock (m)	1.75 ± 0.07	2.19 ± 0.10	25.14	18.892	0.000
Accuracy	19.00 ± 1.92	14.00 ± 3.11	-26.32	6.292	0.000

Abbreviation: SD, standard deviation.

of the feather, whose value increased in the post-test. As for the performance accuracy variable, the post-test differed. Compared to the pre-test, it decreased by 26.32%.

In order to find out the effect of anxiety, when it exists in different types, on the accuracy of the performing overhead defensive clear skill, the results of the second study hypothesis test are shown below.

Table 6 shows the values of the means accuracy of performing overhead defensive clear skill in shuttlecock and the kinematic variables distributed according to groups in the post-measurement. By examining the values of these means, it turned out that they were different and not equal among the 3 groups in each of the kinematic variables. To find out the significance of the differences among the means of the 3 groups in each variable, a one-way analysis of variance was used. Table 7 shows the results of this analysis.

Table 7 shows the results of factor analysis of the accuracy of performing overhead defensive clear skill in shuttlecock and the kinematic variables distributed according to the group variables in post-measurement. When reading the values of the level of significance calculated with the aim of inferring the significant and essential differences in the means of the kinematic variables among the 3 groups, it turned out that they reached 0.000 for all the knee angle, elbow angle, wrist angle, and shuttlecock launch angle variables. In the same vein, the value of the significance level of the differences among the means of the 3 groups in the shuttlecock speed variable reached 0.000; however, it reached 0.298 for the maximum height of the shuttlecock variable.

When examining the value of the level of significance calculated among the means of the 3 groups in the post-measurement of the accuracy variable of performing overhead defensive clear skill in shuttlecock, it was observed that it reached 0.000. When comparing these values to the value of 0.05, it became apparent that all of these values (except for the maximum height of the shuttlecock) were less than 0.05. This finding indicated that the differences in the means among the 3 groups in the variables shown (except for the maximum height of the shuttlecock) were significant and statistically significant. In order to determine which of the 3 groups' means differed in a statistically significant difference, the LSD test was used. Table 8 shows the results of this test.

By reviewing the values of the level of significance of the mean differences shown in Table 8, they are mentioned as follows:

1. Between the trait anxiety group and the group with no anxiety, either trait or state and in all variables, including accuracy, the significance of the differences between the two groups was in favor of the no anxiety either trait or state group, because the value of the mean of accuracy in this group was the largest. Therefore, the kinematic variables (which were also larger) were considered significant in favor of this group (i.e., no anxiety, either trait or state group).

2. Between the state anxiety group and the group with no anxiety, either trait or state and in all variables, including accuracy, the significance of the differences between the two groups was in favor of the no anxiety, either trait or state, group because the value of the mean of accuracy in this group was the largest. Therefore, the kinematic variables (which were also larger) were considered significant in favor of this group (i.e., no anxiety, either trait or state group).

3. Between the trait anxiety group and the state anxiety group and in the variables of the elbow angle, wrist

Table 6. Mean Accuracy of Performing Overhead Defensive Clear Skill in Shuttlecock and Kinematic Variables Distributed According to Groups in Post-measurement

Accuracy/Kinematic Variables and Anxiety	No.	Arithmetic (Mean ± SD)
Shoulder angle (°)		
No anxiety	22	151.36 ± 4.01
Trait anxiety	19	139.05 ± 2.15
State anxiety	20	140.10 ± 2.61
Elbow angle (°)		
No anxiety	22	168.09 ± 4.91
Trait anxiety	19	144.05 ± 4.48
State anxiety	20	153.15 ± 5.91
Wrist angle (°)		
No anxiety	22	221.23 ± 5.98
Trait anxiety	19	200.37 ± 4.78
State anxiety	20	210.20 ± 6.95
Shuttlecock launch angle (°)		
No anxiety	22	46.18 ± 4.50
Trait anxiety	19	32.05 ± 3.03
State anxiety	20	37.10 ± 3.06
Shuttlecock speed (°)		
No anxiety	22	33.14 ± 4.02
Trait anxiety	19	24.05 ± 2.53
State anxiety	20	24.00 ± 2.36
Maximum height of shuttlecock (m)		
No anxiety	22	2.18 ± 0.13
Trait anxiety	19	2.14 ± 0.09
State anxiety	20	2.19 ± 0.10
Accuracy		
No anxiety	22	21.00 ± 1.27
Trait anxiety	19	11.11 ± 1.41
State anxiety	20	14.00 ± 3.11

Abbreviation: SD, standard deviation.

angle, shuttlecock launch angle, and the accuracy of skill performance, the differences between the two groups were in favor of the state anxiety group, which achieved the mean value of accuracy to a greater degree than in the trait anxiety group, as shown in Table 8.

5. Discussion

By referring back to the results of the study, it was shown that the group of players with no anxiety was the most accurate. Additionally, its performance was not negatively affected; on the contrary, the accuracy increased from 18 to 21 out of 25 after the introduction of the anxiety-generating stress factor. This result indicated that individuals who did not tend to any aspect of anxiety, whether trait or state anxiety, were better able to interpret stress positively and turn it into motivation or motive. In addition, they were able to control their feelings of anxiety. As a result, they did not show symptoms of either trait anxiety or state anxiety. Their control over anxiety led to raising their motivation to overcome stress through their self-confidence (13).

By inferring kinematic variables, it was observed that controlling anxiety in this group led to an increase in the degrees of functioning of the shoulder, elbow, and wrist. This change in the final angles at the moment of hitting led to an increase in the speed of the shuttlecock, in addition to the shuttlecock launch angle, which shifted from 41 to 46°, contributing to drawing a vertical path for the shuttlecock. This was shown in the highest height of the shuttlecock, which rose from 1.74 m to 2.18 m with higher accuracy. These values in this kinematic form were associated with a higher accuracy result than in the pre-test, which means the success of this group in converting stress into a success factor.

On the other hand, it was shown that the second group of individuals with trait anxiety decreased their accuracy from 19.05 to 11.11, which was a significant decrease. In addition, the kinematic variables associated with performance differed after the introduction of the stress source; therefore, the angles in the joints decreased, and the speed of the shuttlecock decreased from 33.05 m/s to 23.05 m/s despite the increase in the maximum height of the shuttlecock to reach 2.14 m from 1.73 m; this height was without strength, which meant that it was more vertical than horizontal. This skill requires that the track of the shuttlecock during its flight be proportional to both vertical and horizontal vehicles to fall in the required place, which is the end of the opponent's playground. All of these changes and the decrease in accuracy came after the introduction of the source of stress on this group, whose owners have trait anxiety. This is not surprising because trait anxiety leads to a disturbance in the motivation centers, which is reflected in the prefrontal cortex of the brain responsible for executive decisions, which leads to a defect in the executive decision (14). This explanation includes even the individuals who have state anxiety, whose accuracy decreased less than the individuals who had trait anxiety; however, it also decreased from 19 to 14. This decrease was accompanied by a difference in the degrees of angles of the joints and in the shuttlecock speed, which decreased from 33.05 m/s to 24 m/s.

Table 7. Factor Analysis of Mean Accuracy of Performing Overhead Defensive Clear Skill in Shuttlecock and Kinematic Variables Distributed According to Group Variables in Post-measurement

Kinematic Variables and Variation Source	Mean Squares	Degrees of Freedom	Mean Squares	F-Value	Significance Level
Shoulder angle (°)				103.403	0.000
No anxiety	1960.522	2	980.261		
Trait anxiety	549.838	58	9.480		
State anxiety	2510.361	60			
Elbow angle (°)				115.395	0.000
No anxiety	6085.373	2	3042.686		
Trait anxiety	1529.316	58	26.368		
State anxiety	7614.689	60			
Wrist angle (°)				62.208	0.000
No anxiety	4460.712	2	2230.356		
Trait anxiety	2079.485	58	35.853		
State anxiety	6540.197	60			
Shuttlecock launch angle (°)				80.111	0.000
No anxiety	2121.619	2	1030.810		
Trait anxiety	768.020	58	13.242		
State anxiety	2889.639	60			
Shuttlecock speed (°)				60.512	0.000
No anxiety	1167.544	2	583.772		
Trait anxiety	559.538	58	9.647		
State anxiety	1727.082	60			
Maximum height of shuttlecock (m)				1.236	0.298
No anxiety	0.028	2	0.014		
Trait anxiety	0.668	58	0.012		
State anxiety	0.696	60			
Accuracy				123.014	0.000
No anxiety	1076.538	2	538.269		
Trait anxiety	253.789	58	4.376		
State anxiety	1330.328	60			

It is arguable that the performance of the study skill requires compatibility between the eye that monitors the upcoming shuttlecock movement and the movement of the body that prepares and then strikes the shuttlecock in the required skillful manner, which means the need to perform a high motor sense, especially with the small size and shuttlecock speed. Therefore, as a result of the fact that the members of the second and third groups had anxiety, whether trait anxiety or state anxiety, it was shown that this anxiety is negatively reflected on the sensory-motor performance in all its details, starting from the sensory perception of the upcoming shuttlecock variables, which is done by eye in terms of the shuttlecock speed and the appropriate place and time to hit, leading to the performance of the skillful movement appropriately. All of that sensory-motor performance is disturbed as a result of anxiety, no matter what type it is trait anxiety or state anxiety (15).

Anxiety, in all its types (trait or state), causes a kind of disturbance in the mental perception of the skill, which is the form of the acquired skill that was previously stored in the cerebellum during the acquisition of the skill. This leads to a defect in performance resulting from the difference between the stored mental image and that which is supposed to be performed under the influence of anxiety (16). Moreover, anxiety increases the levels of

Table 8. Results of Least Significant Difference Test for Significance of Differences Between Arithmetic Means of Accuracy of Performing Overhead Defensive Clear Skill in Shuttlecock and Kinematic Variables in 3 Groups

Accuracy/Kinematic Variables and Anxiety	Arithmetic Mean	Trait Anxiety	State Anxiety
Shoulder angle (°)			
No anxiety	151.36	0.000 [a]	0.000 [a]
Trait anxiety	139.05		0.293
State anxiety	140.10		
Elbow angle (°)			
No anxiety	168.09	0.000 [a]	0.000 [a]
Trait anxiety	144.05		0.000 [a]
State anxiety	153.15		
Wrist angle (°)			
No anxiety	221.23	0.000 [a]	0.000 [a]
Trait anxiety	200.37		0.000 [a]
State anxiety	210.20		
Shuttlecock launch angle (°)			
No anxiety	46.18	0.000 [a]	0.000 [a]
Trait anxiety	32.05		0.000 [a]
State anxiety	37.10		
Shuttlecock speed (°)			
No anxiety	33.14	0.000 [a]	0.000 [a]
Trait anxiety	24.05		0.958
State anxiety	24.00		
Accuracy of performing overhead defensive clear skill			
No anxiety	21.00	0.000 [a]	0.000 [a]
Trait anxiety	11.11		0.000 [a]
State anxiety	14.00		

[a] Indicates that the significance level value reflects the significance of the difference between the two groups' means at the level of 0.05 or less.

negative internal talk in the internal monologue, which worsens the player's skillful performance (17).

The results of the second hypothesis indicated that the first study group (no anxiety) was the only one in which accuracy developed and increased due to the introduction of the stress factor. This is because the achievement of members who do not suffer from anxiety is associated with the presence of some stress. In the case of the first test, there was no stress on the players; however, in the second test, after the introduction of the pressure factor, there was an improvement in the performance of the members of this group, as these players view the stress as new positive challenges, which increases their self-confidence and belief in the ability to overcome this challenge (18).

The results of the two groups of trait anxiety and state anxiety demonstrated that both groups were negatively affected by stress as a result of the presence of the anxiety factor, with a greater negative effect for the trait anxiety group. This can be interpreted by the fact that all types of anxiety negatively affect physical and skillful sports performance. However, regarding the difference between trait and state anxiety, it should be noted that those who suffer from trait anxiety suffer from the symptoms of anxiety more than those who suffer from state anxiety. Nevertheless, the situation itself constitutes a state of anxiety for them; in addition to the anxiety, they have trait anxiety, which increases cognitive and physical weakness and reduces their self-confidence more than those with state anxiety (19). Furthermore, anxiety works as a source of mental stress due to the continuity of nerve signals that cause anxiety, and this mental fatigue, in turn, affects the speed and quality of the neural pathway that forms the skill, which starts from the skill storage center in the cerebellum to the motor muscles that perform the skill, where the quality and speed of the nerve impulse vary (20). This is reflected in the study results.

As for the state anxiety group, it is possible, through psychological dealing with them, by facilitating the elements of the competitive situation and helping them perceive as an incentive through psychological programs, to transform the negative effect of their anxiety into a positive effect for members who do not suffer from anxiety, and dealing with them as a psychological rehabilitation program is easier than those who suffer from state anxiety (21).

Although the results of most of the previous studies are in line with the result of this study, it was observed that a study (22) showed that anxiety has benefits related to increasing motivation and enthusiasm; however, this difference can be attributed to the fact that the aforementioned study differed from the current study as it studied the effect of anxiety on an academic side and not on a skillful performance side.

The results of the current study showed agreement with the results of other studies that showed the negative impact of anxiety on aspects other than skillful performance, such as the academic aspect, which is negatively affected as a result of anxiety (23). On the other hand, the results of the current study differed from the results of studies that showed that a moderate state of trait anxiety leads to successful performance (24). This reflects positively on the player's performance, and this completely contradicts the results of the current study. This difference can be attributed to the fact that the aforementioned study differs from the current study in that it identified the levels of anxiety, not just its type.

Another study (25) indicated that trait anxiety is good for competition; however, if it is controlled through psychological adaptation, this study touched on what trait anxiety becomes after treatment, and that is why it is different, in terms of results, from the current study.

The results of the current study also differed from those of another study (26), which indicated that there was a limited effect of anxiety on the performance of basketball players. The reason why the results are different could be that the current study was conducted on individual game players.

In view of the above-mentioned findings, the results of the current study are highlighted as follows:

1. Trait anxiety and state anxiety have negative effects on the badminton players' performance of overhead defensive clear shot skill in terms of some kinematic variables.

2. Trait anxiety affects players' performance more negatively than state anxiety.

5.1. Limitations

The results of this study are determined by the following items:

1. The study questionnaire, STAIF-Y
2. Badminton and overhead defensive clear skill
3. Sample of the study

5.2. Conclusions

This study showed that anxiety, whether it is trait anxiety or state anxiety, reduces the accuracy of skillful performance of beginner badminton players when they perform the overhead defensive clear skill. Moreover, this study demonstrated that the effect becomes more negative if the player suffers from trait anxiety.

This study also contributed to the explanation of the decline in the accuracy of skillful performance by linking it to the kinematic variables associated with it, where these variables are affected by the anxiety factor, which leads to an impact on the accuracy of performance, as shown by the results. Therefore, the psychological aspects must link to the mechanical aspects when performing studies on the performance of athletes to give a greater depth to the interpretation of the results.

The present study also showed that beginner players who suffer from anxiety do not have the ability to overcome it, which puts the responsibility of their coaches or the team psychologist on the need to train them psychologically to use psychological methods to cope with anxiety and turn it from a threat to a performance enhancer.

It is also necessary to continue conducting studies examining anxiety and its effects on athletes, especially beginners, in order to develop their psychological abilities to deal with it, to prevent anxiety from becoming a reason for ending their sports life before it begins. For example, it is possible to re-conduct this study on the same sample after they receive a psychological rehabilitation program that addresses anxiety in order to measure and find out the amount of improvement that will occur to the players.

Finally, the researchers recommend having knowledge of the level, type, and extent of anxiety and its effects on the performance of beginner badminton players in all physiological, motor, and biomechanical aspects to develop psychological rehabilitation programs that deal with anxiety according to the type, which the player can overcome.

Footnotes

Authors' Contribution: The idea of the study and its protocols, statistical analysis, study supervision, and mechanical analysis: Ibtehal M Alkhawaldeh; applying study tests, collecting scientific sources, necessary translations, funding, and final reviewing: Ibtehal M Alkhawaldeh and Moed Altarawneh.

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