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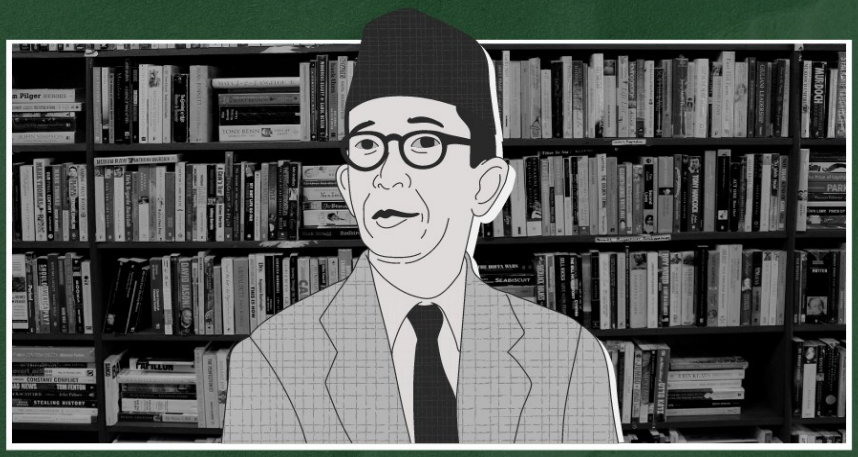

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The Contribution of Mental Fatigue and Cognitive Flexibility to Decision Accuracy During Fast-Break Situations in Youth Handball Players

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Abstract

General Background: Competitive handball requires rapid information processing and appropriate tactical responses under constantly changing playing situations. **Specific Background:** During fast-break attacks, young players must interpret teammates' and opponents' positions and select an appropriate response within limited time, while psychological strain may reduce concentration and adaptive thinking may support tactical selection. **Knowledge Gap:** The combined contribution of these two cognitive and psychological variables to tactical choices among Iraqi youth players remains insufficiently examined. **Aims:** This study assesses their individual relationships with fast-break decision performance and constructs a regression model explaining tactical response quality. **Results:** A descriptive correlational predictive design included all 16 youth players from Al-Kufa Sports Club during the 2025–2026 season. Data were collected using a mental fatigue scale, the Cognitive Flexibility Inventory, and an expert-rated fast-break decision test. Psychological strain was negatively correlated with tactical response scores ($r = -0.712$), whereas adaptive thinking was positively correlated with them ($r = 0.689$). The combined model was statistically significant, $F = 16.41$, $p = 0.001$, and explained 71.6% of the variance in performance scores. Regression coefficients confirmed negative contribution from strain ($B = -0.63$, $p = 0.004$) and positive contribution from adaptive thinking ($B = 0.38$, $p = 0.011$). **Novelty:** The study integrates two cognitive-psychological variables within one predictive model for high-tempo attacking situations. **Implications:** Youth preparation programs should incorporate psychological recovery strategies and executive-function exercises alongside technical and physical training.

Highlights:

- Higher strain corresponded with poorer tactical choices at $r = -0.712$.
- Adaptive thinking corresponded with better responses at $r = 0.689$.
- The combined regression model explained 71.6% of performance variance.

Keywords: Mental Fatigue, Cognitive Flexibility, Decision-Making Accuracy, Fast Attack.

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Introduction

Sports training science and psychological and cognitive sciences are being combined and greatly influencing modern athletic performance development. In competitions success is no longer attributed exclusively to physical and technical capacities but is now tied to the efficiency of mental processes, controlling an athlete's perception of changes in situation and his/her reaction's speed. Handball is a fast-paced team sport with many changing situations, the players will need to make accurate decisions in short timeframes, particularly in the fast breaks which are one of the most powerful weapons to ensure the offensive dominance.

Decision making is a complicated executive function that relies on an individual's ability to see environmental stimuli, analyze options and choose the best possible response to the competitive situation. This process is shaped by several psychological and cognitive factors, such as mental fatigue, and cognitive flexibility. Mental fatigue is a reduction in mental function's efficiency that develops during a period of generally substantial effort devoted in thought and concentration to a task[1]. This translates to slower rate of information-processing, a shorter focus span and poorer quality of motor decisions. One of the higher order executive functions of the brain, cognitive flexibility is an athlete's ability to alter their thought processes, make multiple switches among alternatives, and quickly adopt new thinking when there are changes. This helps enhance the quality of decision making in a competitive environment[2].

In fact, current ideas in sports neuroscience and sports psychology focus on how these cognitive and skillbased mechanisms are integrated as a critical component to sports success. Training the executive functions has become an integral component of the athletes' preparation in the context of team games, particularly when the quick perception and response of the athlete are essential. It is this fast break in handball that is most negatively influenced by such functions, because this is where the ability to perceive the position of the opponents and teammates, analyse the flow of the game and make the optimal choice in the shortest time of possible plays is crucial[3].

Research into mental fatigue or cognitive flexibility and sports performance has grown more commonplace but most of the studies examined mental fatigue or cognitive flexibility individually. The contribution of their combination in explaining the accuracy of the decision-making process in young handball players is still at a low level of research both alone and with others, especially in the Iraqi sports environment[3]. In this context, it is advisable to build a scientific model that helps explain the degree of effect of mental stress and mental flexibility on the accuracy of decision making, which is the purpose of the current research. This offers science-based data to be incorporated into a method of designing training programs that integrate into developing the tactical and cognitive skills of young players.

The Research Problem

Of the most complicated situations in handball, the fast attack is one. In this case, handball players have to react very quickly to the different variables involved, have high information processing capacity, and make the right decision in a short period of time. The researcher observed the training sessions and matches of youth team of Al-Kufa Sports Club and observed that significant differences could be observed in players' decisions in situation they played fast attacks. Even though they have the same physical and abilities, some make the right decision on how to tack the problem and some make some kind of passing, shooting or timing error.

To the researcher's belief the difference may not be physical or skill centered, but differences in mental stress and flexibility with player skill sets may be a factor. Mental stress may also reduce the player's attention span, information processing rate and cognitive flexibility may help to increase the player's adaptability to fleeing circumstances and capacity to make optimal choices.

Although these variables, alongside with others, seem to play important roles in affecting the accuracy of decision during fast break in handball, still there is limited studies to see their roles in this field with a specific group of handball players which are young in Arab and Iraqi region. This highlights the need for a scientific study that clarifies the nature of this contribution.

Therefore, the research problem is defined by answering the following question:

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To what extent do mental stress and cognitive flexibility contribute to the accuracy of decision-making during fast breaks among young handball players?

Research Objectives

1. Identify the level of mental stress among young handball players.
2. Identify the level of cognitive flexibility among young handball players.
3. To identify the level of decision-making accuracy during fast-break situations among young handball players.
4. To identify the relationship between mental stress and cognitive flexibility among the research sample.
5. To determine the extent to which mental stress contributes to explaining decision-making accuracy during fast-break situations.
6. To determine the extent to which cognitive flexibility contributes to explaining decision-making accuracy during fast-break situations.
7. To construct a regression model that explains decision-making accuracy based on the variables of mental stress and cognitive flexibility.

Research Hypotheses

1. There is a statistically significant correlation between mental stress and cognitive flexibility among young handball players.
2. Mental stress significantly contributes to explaining the variance in decision-making accuracy during fast-break situations.
3. Cognitive flexibility significantly contributes to explaining the variance in decision-making accuracy during fast-break situations.
4. The combination of mental stress and cognitive flexibility constitutes a statistically significant predictive model for explaining decision-making accuracy during fast-break situations among young handball players.

Research Scope

1. Human Scope: The human scope is defined as the players of Al-Kufa Sports Club's handball team (youth category) for the 2025–2026 sports season, totaling (16) players, who were selected purposively to form the research sample.
2. Spatial Scope: The research procedures were conducted in the sports hall of Al-Kufa Sports Club in Najaf Governorate, Republic of Iraq.
3. Temporal Scope: The research procedures were carried out during the period from July 4, 2025, to March 2, 2026.

Research Methodology and Field Procedures

1. Research methodology

The researcher adopted the descriptive approach using the Correlational Predictive Design method, due to its suitability to the nature of the research problem and its objectives. This approach aims to study the relationships between the variables, and to show the amount of contribution of the independent variables (mental stress and cognitive flexibility) in explaining the dependent variable (accuracy of decision-making during rapid attack situations), without interfering in or controlling the variables.

2. The research community and its sample

The research community included Kufa Sports Club handball players (youth category) participating in the sports season (2025-2026), who numbered (16) players.

Due to the small size of the community, the researcher adopted the Total Enumeration Sampling method, as all members of the community were selected to be the primary research sample, and thus the sample percentage reached (100%) of the research community.

The researcher stipulated that the sample members:

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a. Regularity in training units.
b. Free from injuries that affect performance.
c. Actual participation in official competitions.
d. Consent to participate in the study.

3. The devices, tools and means used

The researcher used the following tools:

a. Legal handball court.
b. Legal handballs.
c. Handball goal.
d. Training signs.
e. Electronic stopwatch.
f. Laptop.
g. High-resolution video camera (60 frames/second or more).
h. Camera tripod.
i. Kinovea video analysis software.
j. Data registration forms.
k. Pens and record books.
l. SPSS version (29).
m. Jamovi or JASP (optional).
n. A projector to display decision-making situations.

4. The measurement tools used

a. measuring mental stress

1) Mental Fatigue Scale (MFS)[4]

The researcher used the mental stress scale adopted in sports studies, and it consists of a set of items that measure:

- Feeling mentally exhausted.
- Low concentration.
- Slow thinking.
- Decreased alertness.

2) Correction method:

- A five-point Likert scale is used.
- From (1) to (5).
- The total score represents the level of mental stress, and the higher the score indicates the higher the level of mental stress.

b. Measuring Cognitive Flexibility Inventory (CFI)[5]

The scale consists of 20 items distributed across two dimensions:

- Alternatives
- Control
- The player responds using a five-point Likert scale.
- A higher score indicates higher cognitive flexibility.

c. Testing Decision Accuracy During a Fast Break[6]

This test is the dependent variable in the study.

1) Test Name: Fast Break Decision Accuracy Test
2) Objective: To measure decision accuracy during a fast break.
3) Equipment:
    - Handball court.

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- Four attackers.
- Three defenders.
- Balls.
- Camera.
- Whistle.

4) Procedure
   - The player stands in the center of the court.
   - After the starting signal, the fast break begins.
   - Various situations arise during the run.

5) Recording

   The performance is reviewed by three handball experts.

   If the decision is correct, the player receives:

   - (2) points.

     If the decision is acceptable:

   - (1) point.

     If the decision is incorrect:

   - (0) points.

   The final average of the experts' scores is calculated.

d. The reconnaissance experience

The researcher conducted a reconnaissance experiment on (6/25/2025) with (5) players from outside the main research sample, in order to achieve the following objectives:

1) Ensure the validity of the tests.
2) Determine the time required for tests.
3) Ensure the clarity of the instructions.
4) Ensure that the devices are valid.
5) Staff training.
6) Detecting potential obstacles.

The exploration experiment showed that all tests could be implemented without any difficulties requiring modification.

e. The Main Experiment

The main experiment was conducted from July 4, 2025 to March 2, 2026, according to the following steps:

1) Explaining the research objectives to the players.
2) Signing consent forms.
3) Distributing mental stress scale.
4) Administering the cognitive flexibility scale.
5) Giving the players a rest period.
6) Conducting a decision-making accuracy test.
7) Recording all trials.
8) Evaluating performance by experts.
9) Entering data into SPSS.

f. Statistical Methods

The researcher used SPSS Version 29 to process search data and extract results.

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Results and Discussion

A. Results

Table 1. Shows the descriptive statistics for the research variables

Variables	Number (N)	Mean	Std	Lowest value	Highest value
Mental stress	16	31.81	5.24	22	41
Cognitive flexibility	16	72.94	7.13	60	84
Decision-making accuracy	16	81.38	6.52	68	91

The data indicates that the players showed an average level of mental stress, a good level of cognitive flexibility, with a relatively high accuracy in decision-making during the fast attack.

Table 2. Shows the Shapiro-Wilk test for normality

Variables	W	Sig.
Mental stress	0.964	0.734
Cognitive flexibility	0.952	0.541
Decision-making accuracy	0.971	0.812

All (Sig.) values are greater than (0.05), indicating that the data follow a normal distribution, and therefore parametric tests can be used.

Table 3. Shows Pearson correlation coefficients between the research variables

Variables	Mental stress	Cognitive flexibility	Decision-making accuracy
Mental stress	1.000	-0.561*	-0.712**
Cognitive flexibility	-0.561*	1.000	0.689**
Decision-making accuracy	-0.712**	0.689**	1.000

* Significant at (0.05)

** Significant at (0.01)

The data show a strong negative relationship between mental stress and decision-making accuracy, and a strong positive relationship between cognitive flexibility and decision-making accuracy.

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Table 4. Shows the model summary of multiple regression

R	R^2	Adjusted R^2	Std. Error
0.846	0.716	0.672	3.41

The results indicate that mental stress and cognitive flexibility together explain approximately 71.6% of the variance in decision-making accuracy.

Table 5. Shows the analysis of variance for regression (ANOVA)

Source of variation	Sum of squares	df	Average of squares	F	Sig.
Regression	381.62	2	190.81	16.41	0.001
Residual	151.14	13	11.63		
Total	532.76	15			

Table 5 shows that the regression equation is statistically functional, indicating the ability of the two independent variables to accurately predict decision-making.

Table 6. shows the regression coefficients

Variables	B	Beta	t	Sig.	VIF
Constant	95.14	—	8.72	0.000	—
Mental stress	-0.63	-0.521	-3.44	0.004	1.46
Cognitive flexibility	0.38	0.447	2.95	0.011	1.46

The results indicate that high mental stress is associated with decreased decision-making accuracy, while cognitive flexibility contributes to improving it, with no multicollinearity problem (VIF < 5).

B. Discussion

The descriptive results showed that the study participants achieved varying levels in the variables of mental stress, cognitive flexibility, and decision-making accuracy. This reflects the complex nature of performance in handball, where physical and technical abilities intertwine with psychological and cognitive abilities to determine a player's efficiency during competitive situations[7]. This variation indicates that players, despite undergoing the same training program, differ in their ability to cope with mental stress and process information, which is reflected in the quality of decisions made during fast-paced attack situations[8].

Furthermore, the results of the Shapiro-Wilk normal distribution test showed that the data followed a normal distribution, indicating the suitability of using parametric statistical tests such as Pearson's correlation coefficient and multiple linear regression[9]. This enhances the reliability of the statistical analyses used to interpret the relationships between variables and confirms that the results obtained reflect a statistical pattern that can be relied upon to explain the phenomenon under study[10].

The results of the correlation coefficients showed a negative relationship between mental stress and decision-making accuracy, while a positive relationship was found between cognitive flexibility and decision-making accuracy. This can be explained by the fact that high levels of mental stress deplete the cognitive resources responsible for attention, focus, and working memory, thus reducing the speed of information processing and impairing the player's ability to choose the appropriate response in a timely manner[11]. Conversely, cognitive flexibility represents one of the higher executive functions that enables

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the player to quickly change thinking strategies, adapt to changing situations, and choose the most suitable tactical alternative, which positively impacts the accuracy of decision-making during fast breaks[12].

The results are similar to contemporary sports psychology models, which suggest tactical performance in team sports is as much determined by the effectiveness of the brain's executive processes as by physical or team skills. The lower the mental stress and the higher the cognitive flexibility, the better the player can perceive the situation in time, analyze various options, make proper decisions in the face of time pressure and competition[13].

Additionally, the results of the multiple regression model revealed that mental stress and cognitive flexibility explained a significant amount of variance in decision making accuracy, highlighting that mental stress and cognitive flexibility are among the most important factors to affect tactical performance in a fast break situation[14]. This result demonstrates that decision-making is not influenced by a single factor, but rather is the outcome of the interaction of several mental and psychological processes that work together during athletic performance[15].

From the results and analysis of variance (ANOVA) obtained from the regression model it can be seen that the regression model is considered as statistically significant in that the two independent variables do actually explain the one dependent variable and not just random relationships[16]. Incorporating cognitive and psychological aspects into handball player training programs can lead to a rise in the quality of decisions made during game, particularly in situations where players have to perceive and respond quickly[17].

The regression coefficient table revealed that mental stress had a negative impact on decision making accuracy, and cognitive flexibility had a positive impact. In addition, the variance inflation factors (VIF) values indicated that there was no problem of multicollinearity between the 2 independent variables, thus further affirming the reliability of the statistical model used[18]. This result indicates that each variable explains a different aspect of the variance in decision-making accuracy, and that each retains its explanatory significance even when included with the other variable in the same model[19].

The results generally confirm that improving performance in handball should not be limited to developing physical and technical abilities, but should also include training programs aimed at reducing the effects of mental fatigue and developing cognitive flexibility and executive functions in players[20]. This is expected to contribute to increased decision-making efficiency and improved execution of fast breaks, which will positively impact the team's competitive performance.

Conclusions

1. Reduced mental fatigue is associated with improved decision-making accuracy during fast breaks in young handball players.
2. Cognitive flexibility contributes to enhancing players' ability to make appropriate decisions in changing tactical situations.
3. There is a correlation between mental fatigue and cognitive flexibility, reflecting the impact of mental state on the efficiency of a player's cognitive processes.
4. Mental fatigue and cognitive flexibility together constitute two variables capable of explaining a significant proportion of the variance in decision-making accuracy.
5. Attention to psychological and cognitive aspects is a fundamental element in developing tactical performance, alongside physical and technical preparation.

Recommendations

1. Include training programs for young handball players that focus on developing cognitive flexibility and executive functions.
2. Monitor mental fatigue levels regularly using scientific measures and work to minimize its impact by adjusting training loads and recovery periods.
3. Create scenarios that are fast and challenging to attack in a time and cognition limited environment, to promote speed and accuracy in decision making.
4. As other studies continue, the researchers should strive to expand on the statistical modeling they developed and incorporate additional cognitive, psychological and physiological factors that might

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affect athletic decision-making abilities, while expanding on the number of subjects studied from varied age and competitive abilities of child athletes.

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