Comparison of the Executive Functions and Mental Toughness of Elite Women's Basketball Players with the Statistical Parameters of the InStat Scout System

Kata Németh[1]*, József Márton Pucsok[2], László Rátgéber[1], László Balogh[2]

Abstract

In addition to physical skills and fundamental coordination, success in ball sports is significantly influenced by athletes' ability to process information within complex and rapidly changing environments. Executive functions are pivotal for enhancing sports performance. This study elucidates that superior mental toughness, and executive functions contribute to improved sports outcomes. The research assessed the mental toughness of elite Hungarian women's basketball players in the first division using the Sports Mental Toughness Questionnaire (SMTQ) and evaluated their executive functions with the Vienna Test System (VTS) Determination Test (DT). Twenty professional players, with an average age of 24 years (range: 19-35 years), were randomly selected for the study. The sample comprised 14 field players and six center players, with 16 Hungarian and four foreign players. These athletes compete at an elite level in Hungary's first division and engage in an average of nine weekly training sessions (range: 8-10). The SMTQ and DT tests were administered before daily training sessions between August and September 2022. Data were analyzed using the JASP statistical program, and correlation calculations were performed with the Scipy v1.7.1 module under Python v3.9.7. The results were compared with international statistical data from the InStat Scout system. The findings indicate that the SMTQ and executive functions (DT) of the participating team members were above average. Specifically, field players demonstrated a higher number of correct responses in decision-making situations compared to center players. The athletes' strength was evidenced by their high SMTQ scores and superior performance on various DT aspects, including executive functions, reactive stress tolerance, and missed reactions. Players with higher SMTQ and DT scores were more likely to excel in the InStat Scout system. Incorporating SMTQ and VTS methods into psychological training for ball-sport athletes could be beneficial. Further research across different populations and team sports is recommended to integrate these findings into athletes' mental preparation strategies.

Keywords: Basketball, Executive Functions, Mental Toughness, Sports Mental Toughness Questionnaire, Determination Test, InStat Scout System.

Introduction

Basketball is one of the most widely played team sports globally, typically ranking as the second most popular sport with approximately 450 million registered players (Rátgéber et al., 2019). Effective training programs for basketball integrate cultural, biological, and psychological aspects of human physical activity (Carbinatto et al., 2011). Success in ball sports extends beyond physical skills and fundamental coordination; it also relies on athletes' ability to process information within complex and rapidly evolving contexts. Proficient team players exhibit exceptional spatial awareness and must be capable of swift adaptation, strategic adjustments, and reaction inhibition. Executive functions are crucial for decision-making, particularly under time constraints. During a game, basketball players need to assimilate substantial amounts of information (Vestberg et al., 2012). Research by Penner et al. (2012) indicates that cognitive development can be enhanced through cognitive interventions in healthy individuals. Performance is significantly affected by biological factors, training, nutrition, and environmental influences such as experience (Bragazzi et al., 2020).

High performance in sports is often characterized not only by general physical fitness but also by psychological readiness (Balogh, 2014). Different sports require distinct skill sets (Furley & Wood, 2016). Historically, exceptional athletes have been primarily assessed based on physical prowess, but there is a growing recognition of the importance of cognitive factors in sports performance (Furley et al., 2016). Athletes must navigate rapidly changing environments, processing extensive external information and making swift decisions. Executive functions are crucial in achieving high performance.

[1] University of Pécs, Doctoral School of Health Sciences, Pécs, Hungary, Email: nemeth.kata.1989@gmail.com
[2] University of Debrecen, Institute of Sport Sciences, Debrecen, Hungary.
*Correspondence: nemeth.kata.1989@gmail.com

Research involving twins suggests that genetic factors predominantly influence executive functions, yet there is evidence indicating that physical exercise can enhance these cognitive abilities (Sakamoto et al., 2018). High-performance athletes demonstrate optimal mental, cognitive, affective, and emotional functioning (Németh & Balogh, 2020) (Figure 1).

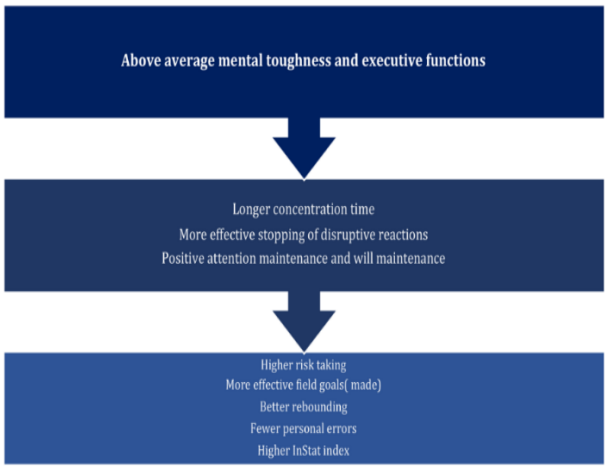

Figure 1: The Relationship between Mental Toughness and Executive Functions.

This study aimed to explore the relationship between executive functions, mental toughness, and performance scores from the InStat Scout System. The investigation began with a comprehensive review of relevant literature, followed by an examination of the study's significance and novelty. The methodology was detailed thoroughly, and the results were analysed to draw pertinent conclusions, with an emphasis on the practical implications of the findings. Additionally, the study provides recommendations for future research areas.

Review of the Related Literature

Executive Functions in Basketball

Executive functions are high-level cognitive processes that help individuals respond effectively to novel situations (Gilbert & Burgess, 2008; Muthuswamy & Varshika, 2023). These include working memory, inhibitory control, and cognitive flexibility (Carlson et al., 2013; Mujiatun et al., 2022). Athletes must stay alert and retrieve relevant information timely (Almayali et al., 2023; Vaeyens et al., 2008). Given humans' limited information processing capacity (Broadbent, 2013; Knudsen, 2007), executive functions are crucial for success in team sports, where players must rapidly anticipate and adapt to changing conditions. In basketball, players manage vast amounts of information and must focus on the most relevant details for optimal performance, often limiting their ability to consider every possible scenario (Furley et al., 2010; Valla, 2022). Singer et al. (2001) characterized selective attention as a double-edged phenomenon in ball sports. It helps athletes manage potential distractions but also presents challenges. In basketball, attention and quick reaction abilities are crucial (Németh & Balogh, 2021). As a team sport, basketball frequently necessitates the simultaneous execution of multiple skills (Furley et al., 2010; Hassain et al., 2024). Elite athletes must possess not only tactical and social competencies but also specific cognitive skills (Liu et al., 2022; Németh et al., 2021). They must adapt to sudden and diverse stimuli and make the most effective decisions. The InStat Scout System offers valuable and reliable insights into various performance metrics during basketball games (Wagner et al., 2014).

Mental Toughness in Basketball

Mental toughness is crucial for athletes, helping them push beyond comfort zones, overcome setbacks, and endure intense stress (Cajide, 2023; Rátgéber et al., 2019). It provides a psychological edge, enhancing consistency, determination, and focus under pressure (Newland et al., 2013). While largely innate, mental toughness can be developed through experience (Liew et al., 2019; Shallal et al., 2023). It involves self-belief, confidence, positivity, and a commitment to learning and risk-taking. Mental toughness correlates positively with risk-taking, psychological well-being, optimism, and coping skills (Crust & Keegan, 2010; Nicholls et al., 2009; Stamp et al., 2015), and is linked to higher performance levels in elite athletes. Loehr (1985) defined mental toughness as the athlete's capacity to optimally utilize energy during critical events and to positively navigate challenging or stressful situations. Training cognitive skills enhances mental toughness, which, according to Kobasa (1979), comprises three dimensions: control, commitment, and challenge. Individuals with high mental toughness exhibit calmness, composure, low anxiety, and strong self-confidence, and are capable of skill development (Mack & Ragan, 2008).

Environmental factors significantly influence mental toughness, often through psychological needs. Connaughton et al. (2008) recommend that coaches create environments exposing athletes to competition-related stressors, as such conditions can foster the ability to overcome adversity (Mahoney et al., 2014; Torma & Balogh, 2021). Psychological needs impact performance through mental toughness (Fourie & Potgieter, 2001). Athletes with high mental toughness can employ trainable self-regulation strategies to enhance mental resilience and sustain competitive performance over time (Meggs et al., 2014). Basketball, in particular, demands significant psychological skills (Rátgéber et al., 2019). Nicholls et al.

(2008) found significant gender differences in mental toughness, indicating that gender plays a crucial role in this attribute.

Elite and Novice Athletes

Experience is a key research area in cognitive sciences (Gobet, 2000). Experienced athletes excel in decision-making and risk assessment, showing quicker change detection, better inhibition of inappropriate responses, and improved stimulus-response planning (Macquet & Fleurance, 2007; Nakamoto & Mori, 2012). They constantly evaluate situations, create new opportunities, and make swift decisions while inhibiting pre-planned actions (Vestberg et al., 2012). Expert athletes significantly outperform novices in mental abilities, including response suppression and maintaining alertness (Sosa González et al., 2013; Verburgh et al., 2014). Cognitive performance improves with athletic experience, leading to enhanced attention tasks (Vaughan et al., 2019; Vaughan & Edwards, 2020). Greater athletic experience, positive affect, and enhanced executive functions are typically associated with improved performance (Vaughan & McConville, 2021) Although our study did not include comparisons with amateur athletes, it involved younger and less experienced players (19-21 years). It was observed that stress tolerance differs between novice and professional athletes, with the latter demonstrating superior stress tolerance. There is a notable relationship between stress tolerance and decision-making quality. Addressing the spectrum of stress-related emotional experiences—both negative (e.g., anxiety, anger) and positive (e.g., self-confidence, relief)—is crucial for optimal performance (Andersen, 2012).

The InStat Scout System

Numerous studies have investigated performance indicators in basketball that influence match outcomes (Escudero-Tena et al., 2021). The InStat Scout System is a dependable method for performance evaluation (Silva & Marcelino, 2023), offering a distinct parameter for accurately assessing player performance and the significance of their actions. This system employs an automated algorithm to evaluate each player's contribution to the team's success. It features a comprehensive statistical database platform, which includes global video footage for analysis and provides detailed reports on teams, players, and coaches. The InStat Scout System tracks players' performance with and without the ball, assesses attack efficiency, calculates offensive and defensive indices, records pre-shot combinations, and evaluates players using the InStat index formula (Santos et al., 2020). It offers a detailed video summary of players' offensive and defensive actions, requiring players to meet specific time and action thresholds to calculate the InStat index. The aggregated game results are then reported and entered into the InStat Scout system.

Significance of the Study

Sports Mental Toughness Questionnaire (SMTQ)

The SMTQ is widely utilized by researchers to assess mental attributes in sports (Andersen, 2012). The SMTQ represents a significant advancement in psychometrically robust tools for measuring general mental toughness (Sheard et al., 2009). It evaluates overall mental toughness and its subcomponents through 14 items rated on a 4-point Likert scale from "not at all true" to "very true" (Goddard et al., 2019). In this study, both Hungarian and foreign basketball players completed the SMTQ, with scores exceeding the international average for the 16-20 and 21-35 age groups.

Vienna Test System (VTS), Determination Test (DT)

Evaluating cognitive abilities is crucial for sports that involve dynamic and complex skills. Basketball, in particular, demands constant adaptation and effective decision-making. The VTS offers an objective assessment of athletes' cognitive competencies, providing a valid and reliable measure of their ability to manage stress and recognize and capitalize on opportunities under pressure (Kiss & Balogh, 2019). The VTS is a computer-based, interactive assessment tool that examines various psychological features relevant to athletes. Its main strengths lie in its validity and reliability, making it effective for identifying personality traits and cognitive and psychomotor skills (Ong, 2015). The VTS assesses both quantitative and qualitative aspects of decision-making, attention, and concentration—key areas for basketball performance—and serves as a valuable complement to subjective evaluation methods (Ong, 2015). The DT evaluates executive functions, attentional capacity, stress tolerance, and reaction speed in response to unpredictable acoustic and visual stimuli (Ong, 2015). It features two types of acoustic stimuli (high and low pitches) and adjusts presentation speed based on the athlete's reaction speed and accuracy. Andrade et al. (2020) utilized the VTS to study 80 young soccer players, finding that attention positively correlates with tactical behaviour efficiency. This relationship suggests that heightened attention improves tactical responses. Table 1 illustrates these findings by comparing attention levels with tactical behaviour efficiency, highlighting the positive impact of attention on performance. Research using VTS in basketball remains limited.

Schrödter et al. (2023) investigated 86 novice and elite referees using five assessments focused on time-and-spatial anticipation, anticipation speed, visual orientation, and spatial working memory. Their findings revealed that elite referees significantly outperformed novices in spatial anticipation (Table 2). In our study, we examined four key variables: average reaction speed, number of correct responses, number of incorrect responses, and number of missed responses. The number of correct responses indicates the respondent's ability to accurately and swiftly choose the right action under pressure. Incorrect responses reflect the athlete's susceptibility to confusion under stress, while missed responses suggest difficulties in maintaining attention during high-pressure situations, potentially leading to disengagement (Kiss et al., 2019).

Table 1

Attention and Tactical Behaviour Efficiency of the Players (Andrade et al., 2020).

Measure	Mean	Standard Deviation	Standard Error
COG - total correct reactions	57.86	7.96	0.89
COG - total incorrect reactions	31.29	11.19	1.25
COG - total incorrect non-reactions	22.14	7.96	0.89
FUT-SAT - accuracy percentage of the tactical actions	81.59	9.37	1.05

Table 2

Results of VTS Visual Tests among Elite, Amateur, and Novice Referees (Schrödter et al., 2023).

	Expertise Level							
	Elite Referees		Amateur Referees		Novices			
	M	SD	M	SD	M	SD	η^2	p
The Vienna Test System								
Spatial working memory	10.27	2.31	8.80	2.63	10.57	2.19	0.090	0.020
Visual orientation	16.15	1.69	15.83	1.62	16.20	1.63	0.011	0.648
Perceptual speed	23.67	4.58	22.83	3.22	24.37	3.62	0.040	0.261
Time anticipation	91.27	44.80	88.80	73.82	101.93	32.86	0.016	0.522
Spatial anticipation	62.04	12.84	84.83	18.22	82.03	18.92	0.259	<0.001

Note: Professional referees (n = 26; n = 9 for perceptual speed), amateur referees (n = 30), and students (n = 30). Time anticipation and spatial anticipation lower scores represent comparatively better performance. Scores for spatial anticipation are measured in median deviations in millimetres, scores for time anticipation are measured in median deviation in hundredths of a second, and scores for spatial working memory, visual orientation, and perceptual speed are measured as correct responses. Significant results: $p < 0.01$.

Due to the fixed duration and adaptive nature of the test, incorrect or missed responses extend the presentation time for subsequent stimuli, potentially reducing the total number of stimuli presented. Consequently, a higher percentile rank for incorrect or missed responses correlates with increased frequency of these responses. Our study is innovative in its focus on the relationship between executive functions, mental toughness, and InStat statistical scores in basketball, an area previously unexplored. Research on the neuropsychological and neurophysiological functions of basketball players, or athletes from various team sports, remains limited (Montuori et al., 2019; Schumacher et al., 2018). While Chiu et al. (2020) investigated behavioural and cognitive electrophysiological differences among basketball players based on playing position, their study used Syn-Amps Electroencephalography (EEG) and the E-prime 2.0 neural stimulation system, whereas our research addresses a gap in this specific area of sports performance.

Purpose of the Study

The primary objective of this study was to explore the correlation between InStat Scout System scores and mental toughness levels in basketball players. We hypothesized that players with higher mental toughness scores would exhibit a greater percentage of correct responses on the decision test. Additionally, we aimed to analyse differences in performance based on player positions, categorizing participants into two distinct groups: field players and centre players.

Methods

Participants of the Study

The study involved twenty professional female basketball players, randomly selected, with an average age of 24 years (range: 19–35 years). The sample comprised fourteen field players and six centre players, including sixteen Hungarian and four international athletes. These players compete at an elite level in Hungary's top division, with an average of nine weekly training sessions (range: 8–10). None of the participants reported color blindness, dyslexia, psychiatric issues, or neuropsychological deficits that could impede their performance on the DT. All participants were briefed on the test procedures and provided informed consent. The sampling method used was stratified, multistage random sampling, ensuring that the sample's characteristics closely mirrored those of the larger population. This approach involved selecting items proportionally from each predefined stratum (age, position), with each individual having a non-zero probability of inclusion, thereby ensuring representativeness and minimizing bias.

Study Design

Participants completed the SMTQ and DT tests before daily training sessions between August and September 2022. They were all included in the InStat Scout database, and results from the 2021/22 season were used for analysis. Each player's InStat index, which factors in game actions and events, was analysed using JASP for statistical calculations, providing both frequentist and Bayesian analysis methods. Correlation calculations were performed with the Scipy v1.7.1 software package under Python v3.9.7. The SMTQ scores, assessing mental

toughness, followed a normal distribution with a reliability close to the appropriate range. The sample mean (M=43.53, SD=5.57) was comparable to the international average reported by x` (Table 3).

Table 3

Construct Validity of the SMTQ, a Three-Factor, 14-Item Model (Sheard et al., 2009)

	Confidence		Constancy		Control		Total Mental Toughness	
Factor	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*
				Competitive Standard				
International (n=79)	2.82	18.22	1.95	13.97	2.60	11.34	5.57	43.54
National (n=150)	3.70	17.49	1.95	13.79	2.62	10.77	6.08	42.06
Country/Provincial (n=479)	3.17	16.48	2.15	12.73	2.24	10.77	5.45	39.99
Club/Regional (n=434)	3.00	15.27	2.18	12.69	2.20	10.80	5.35	38.76
				Gender				
Male (n=778)	3.12	17.03	2.27	12.92	2.32	10.92	5.67	40.88
Female (n=364)	3.05	14.65	1.95	12.99	2.25	10.61	5.29	38.25
				Age Group				
16-18 years (n=272)	15.81	3.56	2.23	12.90	2.29	10.71	5.88	39.43
19-20 years (n=505)	16.06	3.16	2.06	12.85	2.28	10.86	5.32	39.77
21-24 years (n=231)	16.59	3.00	2.20	12.87	2.29	10.51	5.85	39.98
25+ years (n=134)	17.50	3.36	2.35	13.49	2.36	11.44	5.77	42.43

Note, Data from combined samples (N=1142)

Results

The results from the SMTQ questionnaire reveal deviations from international and age-specific averages. For 16-20-year-olds, the international average is 39.60 (SD=5.60), whereas the athletes in this study scored 45.33 (SD=4.73). For the 21-27 age group, the international average is 41.21 (SD=5.81), while the athletes scored 42.29 (SD=4.48). These results indicate that the mental toughness of the basketball players is above average, excelling in confidence, perseverance, and leadership. The decision test, which measures cognitive abilities, shows a strong correlation between athletes' confidence and performance, particularly in ball sports where processing speed in dynamic contexts is critical. Both executive functions and reactive stress tolerance were above average across teams. The mean score for correct answers in the decision test was 82.00 for outfield players and 81.17 for centre players, suggesting that outfield players had a slightly higher rate of correct responses. The number of incorrect reactions indicates the tendency to confuse responses and reflects the ability to sustain concentration on simple tasks over extended periods. The athletes assessed had an average score of 47.7 points, with a broad range of results (10 to 100). This suggests that, generally, women athletes are capable of maintaining adequate concentration for prolonged durations. The number of missed reactions, on the other hand, measures the ability to maintain attention and persist in high-pressure situations. The results showed a mean of 30.05 missed reactions, with values ranging from 5 to 71. Despite this variation, players generally demonstrate the capacity to minimize distractions and maintain focus under stress.

The Pearson correlation analysis revealed a significant, moderately strong correlation between reactive stress tolerance and the number of failed reactions (r=0.53). Additionally, a strong correlation was found between the number of failed reactions and overall reaction performance (r=0.58). Although SMTQ scores showed a weak correlation with the InStat Scout statistic for "Field goals made" (p=0.39), younger players in the study exhibited higher confidence and better performance compared to their older counterparts. This suggests that mentally resilient athletes, who are more adept at managing risks, tend to have more frequent and successful fielding attempts. Thus, mental toughness appears to facilitate enhanced performance and greater risk-taking behaviour in games. Analysis of SMTQ sub-items revealed a moderately strong negative correlation between the "control" perspective and age (r=-0.55), indicating that older players may experience higher anxiety and lower confidence. Additionally, a moderately strong Spearman correlation was found between "perseverance" and the InStat Scout "percentage of Field Goals" (p=0.41), suggesting that players who are more committed and responsible achieve better field goal percentages. Age did not influence these results, consistent with findings by Toros

et al. (2023), who reported no significant relationship between age and SMTQ scores.

We also analysed plus/minus indicators from the InStat Scout basketball statistics program, assessing their distribution for normality. The mean plus/minus values did not reveal significant differences between player positions. This indicator reflects team performance trends when a player is substituted, with a higher plus value being desirable. Pearson correlation analysis showed a strong correlation between player height (and weight) and the number of rebounds (offensive rebounds: r=0.78, defensive rebounds: r=0.80) and blocks (r=0.56), indicating superior performance in these metrics by centres. The number of missed reactions (r=-0.52) and incorrect reactions (r=-0.57) exhibited a moderately strong negative correlation with the number of fouls, indicating that players who can better concentrate and maintain attention tend to commit fewer personal fouls. Such players are more effective in anticipating and responding in both defensive and offensive situations. Additionally, erroneous reactions showed a moderately strong correlation (r=0.53) with minutes played per game, suggesting that the impact of action factors varies by position; for instance, fouls have a greater effect on field players' indices compared to centres. The InStat index demonstrated moderate correlations with several statistical parameters, including playing time (r=0.51), successful field goal attempts (r=0.07), rebounds (offensive rebounds: r=0.45, defensive rebounds: r=0.55), and height (r=0.55). Notably, a significant relationship was observed between the average score and missed reactions: a 1% reduction in missed reactions correlates with an approximate 0.1% increase in the InStat index score (Table 4).

Table 4

Correlations and Relationships between Variables

RST		r=0.53													
NMR	r=0.53		r=0.58												
NIR		r=0.58				r=0.46				r=0.53					
SMTQ											r=0.39				
Cons.												r=0,41			
Age			r=0.46												
H									r=0.55		r=0.58		r=0.79	r=0.80	r=0.56
W									r=0.43		r=0.58		r=0.63	r=0.62	r=0.50
II							r=0.55	r=0.43		r=0.51	r=0.07		r=0.45	r=0.55	
Min.			r=0.53						r=0.51						
FGM				r=0.39			r=0.58	r=0.58	r=0.07						
FG%					r=0.41										
OR							r=0.79	r=0.80	r=0.45						
DP							r=0.63	r=0,62	r=0.55						
B							r=0,56	r=0.50							
CORR.	**RST**	**NMR**	**NIR**	**SMTQ**	**Cons.**	**Age**	**H**	**W**	**II**	**Min.**	**FGM**	**FG%**	**OR**	**DP**	**B**

RST: Reactive Stress Tolerance
NMR: Number of Missed Reactions
NIR: Number of Incorrect Reactions
SMTQ: Sports Mental Toughness Questionnaire
Cons: Constancy
H: Height
W: Eeight
II: InStat index
Min: minute
FGM: Field Goals Made
FG%: Field Goals Made %
OR: Offensive Rebound
DP: Defensive Rebound
B: Block
CORR: Correlation

Discussion

Executive functions play a crucial role in optimizing sports performance. High scores on measures of working memory capacity among basketball players suggest enhanced ability to focus attention and filter out irrelevant information. Given the complexity of game situations, as evidenced by the DT test, effective attentional control is critical for problem-solving and minimizing errors. The DT test not only serves as a predictor of attentional control but also indicates the likelihood of performance failures. Effective prioritization of relevant visual and auditory information is essential for basketball players to excel. Athletes with higher scores on the SMTQ and superior performance on various aspects of the DT test—such as

executive functions, reactive stress tolerance, and the number of missed reactions—demonstrate a greater ability to manage distractions. The InStat index, which reflects a player's value to the team, aligns with higher SMTQ scores and enhanced executive functions, indicating that athletes with robust mental attributes and fewer missed reactions are more valuable assets to their teams.

Conclusion

Mental toughness is essential for success in team sports like basketball. Players with higher attention test scores tend to excel in statistical performance indicators, such as effective rebounding. Our analysis of SMTQ scores revealed no significant difference between field and centre players, although field players generally achieved higher scores and better performance. Higher SMTQ scores are associated with improved decision-making and responsibility, resulting in a higher percentage of successful field goals. Players demonstrated the ability to maintain focus and manage distractions effectively, with field players performing better on the Determination Test compared to centre players. The SMTQ and Determination Test could be valuable tools in selecting basketball players, complemented by other psychological assessments like the PPI, MTQ, and TTS. Future research with larger sample sizes could provide a comprehensive psychophysiological profile of athletes based on gender and playing position.

Funding: This research was supported by the "Tématerületi Kiválósági Program-Egészség alprogram (TKP 2021-EGA-20)" project.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board (or Ethics Committee) of the Ministry of Human Capacities, Deputy State Secretariat for National Medical Services, Health Administration Department (46290-1/2017/EKU, 2017.08.29.).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. Written informed consent has been obtained from the athletes to publish this paper.

Data Availability Statement: The data used in the study were stored on data storage devices and paper.

Conflicts of Interest: The authors declare no conflict of interest.

References

Almayali, H. H. M., Al-Sharifi, Z. H. M., & Haddawee, A. H. (2023). Reflection of Organizational Commitment and Organizational Trust in Psychological Flourishing in Iraqi Heis. *International Journal of eBusiness and eGovernment Studies, 15*(4), 54-88. https://www.agbioforum.org/sobiad.org/menuscript/index.php/ijebeg/article/view/1869

Andersen, M. B. (2012). Who's Mental, Who's Tough and Who's Both?: Mutton Constructs Dressed up as Lamb. In *Mental toughness in sport* (pp. 69-88). Routledge. https://www.routledge.com/Mental-Toughness-in-Sport-Developments-in-Theory-and-Research/Gucciardi-Gordon/p/book/9780415857819

Andrade, M. O. C. d., González-Víllora, S., Casanova, F., & Teoldo, I. (2020). The attention as a key element to improve tactical behavior efficiency of young soccer players. *Revista de psicología del deporte, 29*(2), 0047-0055. https://ddd.uab.cat/record/225800

Balogh, L. (2014). *To Be in the Zone - Stress and Sport Performance.* https://doi.org/10.13140/RG.2.1.1638.6643

Bragazzi, N. L., Khoramipour, K., Chaouachi, A., & Chamari, K. (2020). Toward sportomics: Shifting from sport genomics to sport postgenomics and metabolomics specialties. Promises, challenges, and future perspectives. *International Journal of Sports Physiology and Performance, 15*(9), 1201-1202. https://doi.org/10.1123/ijspp.2020-0648

Broadbent, D. E. (2013). *Perception and communication.* Elsevier. https://doi.org/10.1037/10037-000

Cajide, B. V. (2023). The Cyborg as Contemporary Architectural Design Strategy. *Rita: Revista Indexada de Textos Académicos,* (19), 38-51. https://redfundamentos.com/article-view.php?id=4

Carbinatto, M. V., Moreira, W. W., Nunomura, M., Tsukamoto, M. H., & Nista-Piccolo, V. (2011). Paradigms shift in sport sciences: body's focus. *International Journal of Sport and Health Sciences, 5*(8), 1049-1053. https://edisciplinas.usp.br/pluginfile.php/6599971/mod_resource/content/1/1.%20Paradigma%20Corpo%20e%20Ciencias%20do%20Esporte%20.pdf

Carlson, S. M., Zelazo, P. D., & Faja, S. (2013). Executive function. https://drive.google.com/file/d/16MrxZb21_J8l6XFCjCZigIlmhxLM0eMV/view

Chiu, Y.-K., Pan, C.-Y., Chen, F.-C., Tseng, Y.-T., & Tsai, C.-L. (2020). Behavioral and cognitive electrophysiological differences in the executive functions of taiwanese basketball players as a function of playing position. *Brain Sciences, 10*(6), 387. https://doi.org/10.3390/brainsci10060387

Connaughton, D., Wadey, R., Hanton, S., & Jones, G. (2008). The development and maintenance of mental toughness: Perceptions of elite performers. *Journal of Sports Sciences, 26*(1), 83-95. https://doi.org/10.1080/02640410701310958

Crust, L., & Keegan, R. (2010). Mental toughness and attitudes to risk-taking. *Personality and Individual Differences, 49*(3), 164-168. https://doi.org/10.1016/j.paid.2010.03.026

Escudero-Tena, A., Rodríguez-Galán, V., García-Rubio, J., & Ibáñez, S. J. (2021). Influence of the specific position on the final result of the match in professional basketball. *Revista de Psicología del Deporte.* https://psycnet.apa.org/record/2023-30747-003

Fourie, S., & Potgieter, J. R. (2001). The nature of mental toughness in sport. *South African Journal for Research in Sport, Physical Education and Recreation, 23*(2), 63-72. https://doi.org/10.4314/sajrs.v23i2.25860

Furley, P., Memmert, D., & Heller, C. (2010). The dark side of visual awareness in sport: Inattentional blindness in a real-world basketball task. *Attention, Perception, & Psychophysics, 72*(5), 1327-1337. https://doi.org/10.3758/APP.72.5.1327

Furley, P., & Wood, G. (2016). Working memory, attentional control, and expertise in sports: A review of current literature and directions for future research. *Journal of Applied Research in Memory and Cognition, 5*(4), 415-425. https://doi.org/10.1016/j.jarmac.2016.05.001

Gilbert, S. J., & Burgess, P. W. (2008). Executive function. *Current biology, 18*(3), R110-R114. https://doi.org/10.1016/J.CUB.2007.12.014

Gobet, F. (2000). Long-term working memory: A computational implementation for chess expertise. In. Universal Press. https://www.researchgate.net/publication/49400718

Goddard, K., Roberts, C.-M., Anderson, L., Woodford, L., & Byron-Daniel, J. (2019). Mental toughness and associated personality characteristics of Marathon des Sables athletes. *Frontiers in Psychology, 10*, 2259. https://doi.org/10.3389/fpsyg.2019.02259

Hassain, M. F., Al-Issa, M. S., Al Hiali, T., Al Majidi, A. R. J., Alqiraishi, Z. H. A., Mohamed, A. F., Abdulridui, H. A., Harfouch, M. A., Al-Ameri, M. M., & AlTalb, M. K. S. (2024). Cross-Sectional Research on the Factors Influencing the Mental Health of Basketball Players. *Revista de Psicología del Deporte (Journal of Sport Psychology), 33*(1), 436-445. https://rpd-online.com/index.php/rpd/article/view/1591

Kiss, B., & Balogh, L. (2019). A study of key cognitive skills in handball using the Vienna test system. https://doi.org/10.7752/jpes.2019.01105

Knudsen, E. I. (2007). Fundamental components of attention. *Annu. Rev. Neurosci., 30*(1), 57-78. https://doi.org/10.1146/annurev.neuro.30.051606.094256

Kobasa, S. C. (1979). Stressful life events, personality, and health: an inquiry into hardiness. *Journal of Personality and Social Psychology, 37*(1), 1. https://doi.org/10.1037/0022-3514.37.1.1

Liew, G. C., Kuan, G., Chin, N. S., & Hashim, H. A. (2019). Mental toughness in sport: Systematic review and future. *German Journal of Exercise and Sport Research, 49*(4), 381-394. https://doi.org/10.1007/s12662-019-00603-3

Liu, F., Han, J., Wang, Y., & Jin, Y. (2022). The later status and impact factors of physical activity among patients after percutaneous coronary intervention in China. *American Journal of Health Behavior, 46*(6), 654-663. https://doi.org/10.5993/AJHB.46.6.8

Loehr, J. E. (1985). *Athletic excellence: Mental toughness training for sports.* Forum publishing company. https://archive.org/details/athleticexcellen0000jame/page/242/mode/2up

Mack, M. G., & Ragan, B. G. (2008). Development of the mental, emotional, and bodily toughness inventory in collegiate athletes and nonathletes. *J Athl Train, 43*(2), 125-132. https://doi.org/10.4085/1062-6050-43.2.125

Macquet, A.-C., & Fleurance, P. (2007). Naturalistic decision-making in expert badminton players. *Ergonomics, 50*(9), 1433-1450. https://doi.org/10.1080/00140130701393452

Mahoney, J. W., Gucciardi, D. F., Ntoumanis, N., & Mallet, C. J. (2014). Mental toughness in sport: Motivational antecedents and associations with performance and psychological health. *Journal of Sport and Exercise Psychology, 36*(3), 281-292. https://doi.org/10.1123/jsep.2013-0260

Meggs, J., Ditzfeld, C., & Golby, J. (2014). Self-concept organisation and mental toughness in sport. *Journal of Sports Sciences, 32*(2), 101-109. https://doi.org/10.1080/02640414.2013.812230

Montuori, S., d'Aurizio, G., Foti, F., Liparoti, M., Lardone, A., Pesoli, M., Sorrentino, G., Mandolesi, L., Curcio, G., & Sorrentino, P. (2019). Executive functioning profiles in elite volleyball athletes: Preliminary results by a sport-specific task switching protocol. *Human Movement Science, 63*, 73-81. https://doi.org/10.1016/j.humov.2018.11.011

Mujiatun, S., Effendi, I., & Badawi, A. (2022). Sharia Financial Technology (Fintech) Management Model in Indonesia. *Cuadernos de Economía, 45*(128), 145-156. https://cude.es/submit-a-manuscript/index.php/CUDE/article/view/297

Muthuswamy, V. V., & Varshika, G. (2023). Role of Empathy and Ethical Competence in Job satisfaction of Employees at Indian workspaces. *International Journal of Instructional Cases, 7*(1), 135-160. https://ijicases.com/menuscript/index.php/ijicases/article/view/53

Nakamoto, H., & Mori, S. (2012). Experts in fast-ball sports reduce anticipation timing cost by developing inhibitory control. *Brain and Cognition, 80*(1), 23-32. https://doi.org/10.1016/j.bandc.2012.04.004

Németh, K., & Balogh, L. (2020). The relationship between arousal zone, anxiety, stress and sports performance. *Stadium-Hungarian Journal of Sport Sciences, 3*(2). https://doi.org/10.36439/SHJS/2020/2/8603

Németh, K., & Balogh, L. (2021). The relationship between decision-making and Game Intelligence with Basketball Statistics. *Stadium-Hungarian Journal of Sport Sciences, 4*(1). https://doi.org/10.36439/shjs/2021/1/9535

Newland, A., Newton, M., Finch, L., Harbke, C. R., & Podlog, L. (2013). Moderating variables in the relationship between mental toughness and performance in basketball. *Journal of Sport and Health Science, 2*(3), 184-192. https://doi.org/10.1016/j.jshs.2012.09.002

Nicholls, A. R., Polman, R. C., Levy, A. R., & Backhouse, S. H. (2008). Mental toughness, optimism, pessimism, and coping among athletes. *Personality and Individual Differences, 44*(5), 1182-1192. https://doi.org/10.1016/j.paid.2007.11.011

Nicholls, A. R., Polman, R. C., Levy, A. R., & Backhouse, S. H. (2009). Mental toughness in sport: Achievement level, gender, age, experience, and sport type differences. *Personality and Individual Differences, 47*(1), 73-75. https://doi.org/10.1016/j.paid.2009.02.006

Ong, N. C. H. (2015). The use of the Vienna Test System in sport psychology research: A review. *International Review of Sport and Exercise Psychology, 8*(1), 204-223. https://doi.org/10.1080/1750984X.2015.1061581

Penner, I.-K., Vogt, A., Stöcklin, M., Gschwind, L., Opwis, K., & Calabrese, P. (2012). Computerised working memory training in healthy adults: A comparison of two different training schedules. *Neuropsychological Rehabilitation, 22*(5), 716-733. https://doi.org/10.1080/09602011.2012.686883

Rátgéber, L., Betlehem, J., Calleja-Gonzalez, J., & Ostojic, S. M. (2019). Basketball for Health: Should We Hop and Shoot for a Remedy? In *Mayo Clinic Proceedings* (Vol. 94, pp. 364-365). Elsevier. https://doi.org/10.1016/J.MAYOCP.2018.11.010

Sakamoto, S., Takeuchi, H., Ihara, N., Ligao, B., & Suzukawa, K. (2018). Possible requirement of executive functions for high performance in soccer. *PloS One, 13*(8), e0201871. https://doi.org/10.1371/journal.pone.0201871

Santos, J., Mendez-Domínguez, C., Nunes, C., Gómez, M. A., & Travassos, B. (2020). Examining the key performance indicators of all-star players and winning teams in elite futsal. *International Journal of Performance Analysis in Sport, 20*(1), 78-89. https://doi.org/10.1080/24748668.2019.1705643

Schrödter, R., Schwarting, A., Fasold, F., Schul, K., & Klatt, S. (2023). The Relevance of General Spatial Anticipation Skills for Basketball Referees. *Applied Sciences, 13*(5), 2991. https://doi.org/10.3390/app13052991

Schumacher, N., Schmidt, M., Wellmann, K., & Braumann, K.-M. (2018). General perceptual-cognitive abilities: Age and position in soccer. *PloS One, 13*(8), e0202627. https://doi.org/10.1371/journal.pone.0202627

Shallal, W., Zbidi, N. D., Hasan, S. M., Hussein, A. D., & Hafith, A. N. (2023). Investigation of the Effect of Clove Nanoparticles on Antibacterial Features and Shear Bond Strength of Orthodontic Adhesive Bonded to Human Premolars Teeth. *Journal of Natural Science, Biology and Medicine, 14*(2), 288-298. https://doi.org/10.4103/jnsbm.JNSBM_14_2_26

Sheard, M., Golby, J., & Van Wersch, A. (2009). Progress toward construct validation of the Sports Mental Toughness Questionnaire (SMTQ). *European Journal of Psychological Assessment, 25*(3), 186-193. https://doi.org/10.1027/1015-5759.25.3.186

Silva, H., & Marcelino, R. (2023). Inter-operator reliability of InStat Scout in female football games. *Science & Sports, 38*(1), 42-46. https://doi.org/10.1016/j.scispo.2021.07.015

Singer, R. N., Hausenblas, H. A., & Janelle, C. M. (2001). *Handbook of sport psychology*. John Wiley & Sons Inc. https://psycnet.apa.org/record/2001-01061-000

Sosa González, P. I., Oliver Coronado, J. F., & Alfonso Rosa, R. M. (2013). Assessment of psychological skills in young elite female handball players. In *2nd EHF Scientific Conference. Women and Handball: Scientific and Practical Approaches (2013), p*

353-357. European Handball Federation, Hoffingergasse. https://www.semanticscholar.org/paper/Assessment-of-psychological-skills-in-young-elite-Gonz%C3%A1lez-Coronado/56efb3a784110d1790f7158f4fec16d531c73ed8

Stamp, E., Crust, L., Swann, C., Perry, J., Clough, P., & Marchant, D. (2015). Relationships between mental toughness and psychological wellbeing in undergraduate students. *Personality and Individual Differences, 75*, 170-174. https://doi.org/10.1016/j.paid.2014.11.038

Torma, E. P., & Balogh, L. (2021). Breakable performance-The role of mental toughness in elite sport, International outlook. *Stadium-Hungarian Journal of Sport Sciences, 4*(1). https://doi.org/10.36439/shjs/2021/1/9498

Toros, T., Ogras, E. B., Okan, I., Temel, C., Keskin, M. T., Korkmaz, C., & Uluoz, E. (2023). Investigation the relationship between mental toughness and courage levels of sports sciences faculty students for sustainable performance. *Sustainability, 15*(12), 9406. https://doi.org/10.3390/su15129406

Vaeyens, R., Lenoir, M., Williams, A. M., & Philippaerts, R. M. (2008). Talent identification and development programmes in sport: current models and future directions. *Sports Medicine, 38*, 703-714. https://doi.org/10.2165/00007256-200838090-00001

Valla, L. G. (2022). Citizens' Perceptions of Security Issues: New and Old Actors in the National Security Framework. *Journal of Human Security, 18*(1), 18-28. https://doi.org/10.12924/johs2022.18010018

Vaughan, R., Laborde, S., & McConville, C. (2019). The effect of athletic expertise and trait emotional intelligence on decision-making. *European Journal of Sport Science, 19*(2), 225-233. https://doi.org/10.1080/17461391.2018.1510037

Vaughan, R. S., & Edwards, E. J. (2020). Executive function and personality: The moderating role of athletic expertise. *Personality and Individual Differences, 161*, 109973. https://doi.org/10.1016/j.paid.2020.109973

Vaughan, R. S., & McConville, C. (2021). Executive function and mood: The moderating role of athletic expertise. *Perceptual and Motor Skills, 128*(2), 672-691. https://doi.org/10.1177/0031512520987364

Verburgh, L., Scherder, E. J., van Lange, P. A., & Oosterlaan, J. (2014). Executive functioning in highly talented soccer players. *PloS One, 9*(3), e91254. https://doi.org/10.1371/journal.pone.0091254

Vestberg, T., Gustafson, R., Maurex, L., Ingvar, M., & Petrovic, P. (2012). Executive functions predict the success of top-soccer players. *PloS One, 7*(4), e34731. https://doi.org/10.1371/journal.pone.0034731

Wagner, H., Finkenzeller, T., Würth, S., & Von Duvillard, S. P. (2014). Individual and team performance in team-handball: A review. *Journal of sports science & medicine, 13*(4), 808. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4234950/

Sports Mental Toughness Questionnaire

Please rate the following statements according to how true they are for you.
1 = Not true at all
2 = Partly true
3 = Mostly true
4 = Completely true
Please read the statements carefully and give the answer that generally applies to you. Take your time answering any of the questions.

1.	I can regain my composure if I have momentarily lost it.	1	2	3	4
2.	I worry about performing poorly.	1	2	3	4
3.	I am committed to completing the tasks I have to do.	1	2	3	4
4.	I am overcome by self-doubt.	1	2	3	4
5.	I have an overwhelming confidence in my ability.	1	2	3	4
6.	I have what it takes to perform well while under pressure.	1	2	3	4
7.	I get angry and frustrated when things do not go my way.	1	2	3	4
8.	I give up in difficult situations.	1	2	3	4
9.	I get anxious by events I did not expect or cannot control.	1	2	3	4
10.	I get distracted easily and lose my concentration.	1	2	3	4
11.	I have qualities that set me apart from other competitors.	1	2	3	4
12.	I take responsibility for settings myself and challenging targets.	1	2	3	4
13.	I interpret potential threats as positive opportunities.	1	2	3	4
14.	Under pressure, I am able to make decisions with confidence and commitment.	1	2	3	4