

Determining the Validity and Reliability of the Arabic Version of the Cognitive Flexibility Questionnaire Among Iraqi Volleyball Players: A Psychometric Study

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ABSTRACT

Cognitive flexibility, as one of the core components of executive functions, plays a crucial role in adapting and responding to changing and challenging conditions and is considered a key factor influencing success in team sports such as volleyball. The instrument commonly used to assess cognitive flexibility is the Cognitive Flexibility Questionnaire. The aim of this study was to determine the validity and reliability of the Arabic version of the Cognitive Flexibility Questionnaire developed by Dennis and Vander Wal (2010) and to examine its applicability among male volleyball players in Iraq. The statistical population consisted of 230 male volleyball players with at least three years of regular training experience, selected through convenience sampling. Data were collected using the translated 20-item version of the Cognitive Flexibility Questionnaire. Construct validity was assessed using Confirmatory Factor Analysis (CFA), and reliability was evaluated using Cronbach's alpha coefficient and Composite Reliability (CR) in AMOS and SPSS software. The significance level was set at 0.05. The results supported the goodness-of-fit indices of the three-factor structure of the questionnaire (GFI = 0.90, CFI = 0.93, RMSEA = 0.07, $\chi^2/df = 2.5$). Moreover, the internal consistency of the entire questionnaire was reported as 0.89, and for its subscales, it ranged between 0.83 and 0.87, indicating high validity and reliability of the instrument in the studied population. Therefore, the Arabic version of this questionnaire demonstrates appropriate applicability for use in sports psychology research and the assessment of cognitive flexibility among Arabic-speaking populations. It is recommended that longitudinal studies be conducted to examine long-term stability.

Keywords: cognitive flexibility, confirmatory factor analysis, questionnaire, volleyball players

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Introduction

Cognitive flexibility, a crucial aspect of executive functioning, refers to an individual's ability to shift perspectives, adapt to changing environments, and modify cognitive strategies in response to new demands

or unexpected conditions (1). As one of the fundamental executive processes, cognitive flexibility enables adaptive behavior, problem-solving, and self-regulation in both everyday life and professional contexts, including athletic performance. Within the cognitive architecture of human functioning, flexibility allows individuals to alternate between mental frameworks efficiently and adjust their behaviors in dynamic situations (2). This adaptability becomes particularly important in high-stress or rapidly changing contexts such as competitive sports, where quick adjustments to opponents' strategies, environmental conditions, and task demands are required for optimal performance.

In the domain of cognitive psychology, researchers have long recognized cognitive flexibility as an essential mechanism underlying creativity, learning, and resilience (3). It reflects the broader capacity of the executive system to coordinate attention, working memory, and inhibitory control to manage novel challenges. Diamond's model of executive functions situates cognitive flexibility as one of three core components—alongside working memory and inhibitory control—that collectively support goal-directed behavior (1). Recent findings also highlight its contribution to emotional regulation and decision-making, particularly under conditions of uncertainty (2).

In the athletic context, cognitive flexibility contributes to the athlete's ability to monitor ongoing performance, evaluate situational cues, and make quick, adaptive decisions (4). Elite athletes are often distinguished from novices by their superior executive function profiles, including working memory, attentional control, and flexibility in switching between cognitive sets (5). Volleyball, as a fast-paced, open-skill sport, requires continuous information processing, anticipation, and motor adjustments to unpredictable stimuli such as ball trajectory and opponent movement (6). Hence, the evaluation of cognitive flexibility among volleyball players can provide valuable insights into psychological factors that contribute to athletic excellence and adaptability in dynamic team environments.

Research demonstrates that sports training can enhance cognitive flexibility and executive control through repetitive exposure to complex motor and decision-making tasks (7). Athletes often develop superior attentional shifting and cognitive adaptability due to the demands of situational variability inherent in open-skill sports such as volleyball and soccer (4). Similarly, meta-analytic evidence suggests that trained athletes outperform non-athletes in various domains of cognitive control and processing speed, emphasizing the role of physical training in cognitive development (5). However, despite such evidence, most available instruments assessing cognitive flexibility were developed and standardized in Western contexts, raising questions about their cultural and linguistic appropriateness when applied to non-Western populations (8).

Cross-cultural adaptation of psychological measures is critical for ensuring validity and comparability across diverse populations (9). The principles of ethical and methodological rigor outlined by the American Psychological Association emphasize the importance of cultural competence in psychological assessment, particularly when instruments are adapted into different languages and socio-cultural contexts. Cultural adaptation involves not only linguistic translation but also conceptual equivalence and psychometric validation, as cognitive constructs may manifest differently across cultural groups (8).

The Cognitive Flexibility Inventory (CFI) developed by Dennis and Vander Wal (2010) is among the most widely used instruments for measuring cognitive flexibility in adults (3). The CFI conceptualizes flexibility as comprising three core components: perceived controllability, perception of behavioral justification, and generation of alternative options. Since its introduction, the CFI has been adapted into several languages,

including Turkish (10), Japanese (11), Spanish (12), and Chinese (13). Each adaptation underscores the necessity of psychometric evaluation to confirm factorial structure, internal consistency, and construct validity across cultural settings. For instance, Çelikkaleli (2014) validated the Turkish version, reporting acceptable reliability and a three-factor structure consistent with the original version, while Oshiro et al. (2016) demonstrated conceptual equivalence in the Japanese adaptation. Similarly, López et al. (2024) provided evidence for the internal consistency and convergent validity of the Spanish version among university students.

In the Arab context, psychometric research on cognitive flexibility has been relatively limited. The recent validation of the Arabic Cognitive Flexibility Scale (Ar-CFS) among Saudi Arabian populations has provided important insights into cultural adaptability and factorial stability (14). Their findings emphasized the importance of culturally sensitive translation and back-translation procedures to preserve conceptual meaning and ensure semantic accuracy. However, the psychometric properties of the Cognitive Flexibility Questionnaire (CFQ) or Cognitive Flexibility Inventory (CFI) among Arabic-speaking athletes, particularly in Iraq, remain largely unexplored. Given the linguistic and cultural diversity within Arabic-speaking countries, further validation studies are essential to confirm whether existing Arabic versions retain their structural and reliability characteristics when applied to specific subpopulations such as athletes.

Empirical evidence suggests that cognitive flexibility plays a mediating role in athletic mental energy, performance, and flow state (15). In sports psychology, cognitive flexibility has been linked with improved strategic decision-making, resilience to failure, and better coping with competitive pressure. Flexible athletes are more likely to adjust tactics, reinterpret stressors positively, and maintain focus during uncertainty, leading to sustained performance under challenging conditions. Furthermore, the integration of mental energy and cognitive adaptability forms a key component of psychological preparedness for competition (15, 16).

The assessment of cognitive flexibility among athletes also contributes to the understanding of psychological resilience and learning capacity. Flexible cognition supports adaptive coping mechanisms, allowing athletes to reappraise setbacks and generate alternative strategies for improvement (16). This is consistent with the broader theoretical framework of executive functions, which emphasizes cognitive flexibility as a dynamic capacity enabling individuals to modify their actions and goals in alignment with changing environmental contingencies (2). Additionally, research has indicated that flexible individuals demonstrate higher engagement in learning and problem-solving contexts, showing better academic and athletic adjustment (17).

Sports that demand rapid perceptual shifts and strategic reasoning, such as volleyball, create natural laboratories for studying cognitive flexibility (6). Volleyball players must continuously monitor the movement of teammates and opponents, predict ball trajectories, and adapt to situational changes within milliseconds. These rapid transitions between offensive and defensive modes rely heavily on flexible attention and situational awareness. Consequently, the evaluation of cognitive flexibility within this athletic group is not only theoretically meaningful but also practically significant for developing cognitive training programs aimed at enhancing performance (18).

The psychometric validation of instruments in sports contexts requires adherence to rigorous methodological and ethical standards. The process typically involves translation, back-translation, and

expert review to ensure content and construct validity (9). Confirmatory Factor Analysis (CFA) is then employed to verify the factor structure, followed by the estimation of reliability indices such as Cronbach's alpha and Composite Reliability (CR). These steps ensure that the adapted instrument measures the intended constructs consistently across different samples. Studies such as those by Wu et al. (2024) and Parvaneh et al. (2021) have demonstrated the importance of local validation for psychological scales, especially in applied sport psychology where cultural values, language, and social expectations can shape athletes' cognitive processes (13, 19).

Moreover, from a cultural competence perspective, the adaptation of psychological tools in Arabic-speaking countries aligns with global efforts to diversify psychological science and ensure equitable representation of non-Western populations (8). Validating cognitive assessments in local contexts enhances the accuracy of diagnostic and research outcomes and supports the development of culturally grounded interventions. This is particularly important in Iraq, where sports psychology is an emerging discipline and empirical tools for assessing executive and emotional functioning remain scarce. The aim of this study was to determine the validity and reliability of the Arabic version of the Cognitive Flexibility Questionnaire among Iraqi male volleyball players.

Methods and Materials

Study Design and Participants

This study was a cross-sectional research conducted to examine the psychometric properties of the Cognitive Flexibility Questionnaire. From a temporal perspective, it was a cross-sectional study; in terms of nature, it was quantitative; and in terms of purpose, it was applied–developmental. The study was conducted in the field using a self-report questionnaire as the primary data collection instrument.

The statistical population consisted of male volleyball players residing in Iraq who had at least three years of regular training experience and had participated in at least one official provincial or club competition. Based on Cochran's formula and considering an estimated population of approximately 500 individuals, a sample size of 230 participants was selected using the convenience sampling method. The mean age of participants was 24.5 years ($SD = 3.2$), and the mean sports experience was 5.8 years ($SD = 2.1$). All participants were male. The inclusion criteria were: (1) age over 18 years, (2) at least three years of regular volleyball practice, and (3) providing informed consent to participate in the study. The exclusion criteria were: non-Arabic speakers and incomplete questionnaire responses.

After finalizing the Arabic version of the Cognitive Flexibility Questionnaire, the necessary permissions were obtained from the Iraqi Volleyball Federation and the Ethics Committee of Islamic Azad University, Khorasgan Branch, Isfahan (Ethics Code: IR.IAU.KHUISF.REC.1403.433). The questionnaire was then digitized via Google Forms and distributed, in coordination with the federation, to 230 male volleyball players aged 18 and above who were selected through convenience sampling.

Participants received detailed explanations regarding the study's objectives and procedures and provided informed consent before responding to the demographic form and the Cognitive Flexibility Questionnaire. Data were collected online and subsequently subjected to statistical analysis. All ethical considerations—including respect for human dignity, confidentiality of information, and informed participation—were fully observed.

Data Collection

a) Demographic Information: The demographic form collected participants' age, years of sports experience, playing position, absence of physical and psychological injuries, nonuse of special medications, and absence of visual or auditory impairments.

b) Cognitive Flexibility Scale: The research instrument was the 20-item Cognitive Flexibility Questionnaire developed by Dennis and Vander Wal (2010), scored on a 7-point Likert scale ranging from *strongly disagree* to *strongly agree*. Items 2, 4, 7, 9, 11, and 17 were reverse-scored. For translation into Arabic, the back-translation method was employed according to international standards. First, the original English version was independently translated into Arabic by two bilingual translators familiar with psychological terminology. Then, two additional translators—unaware of the original version—back-translated the Arabic version into English. The back-translated version was compared with the original questionnaire, and any conceptual or cultural discrepancies were reviewed and resolved by a five-member expert committee consisting of sport psychology specialists, a linguist, and a translator. To assess content validity, the final version was presented to 10 experts in sport psychology who evaluated the clarity, simplicity, relevance, and necessity of each item. The Content Validity Index (CVI) for the entire questionnaire was 0.92, and the Content Validity Ratio (CVR) based on Lawshe's formula for 10 experts was 0.78—both within acceptable ranges. Finally, the questionnaire was administered to a pilot group of 30 participants to identify and correct potential comprehension problems in the items. These individuals did not participate in the main study.

Data Analysis

Data were analyzed using SPSS version 26 and AMOS version 23. Descriptive statistics were used to describe demographic characteristics. Reliability was evaluated using Cronbach's alpha coefficient and Composite Reliability (CR). Construct validity was assessed through Confirmatory Factor Analysis (CFA) using the Maximum Likelihood Estimation (MLE) method. Model fit indices including CMIN/DF, GFI, CFI, and RMSEA were examined.

The assumptions of the analysis were tested, including handling missing data (mean substitution), detection of outliers (Mahalanobis distance), normality (skewness and kurtosis), and multicollinearity (Variance Inflation Factor, VIF). The significance level was set at 0.05.

Findings and Results

The present study was conducted on 230 male volleyball players in Iraq. The primary objective of this research was to determine the validity and reliability of the Arabic version of the Cognitive Flexibility Questionnaire.

Based on the results of the Confirmatory Factor Analysis (CFA), the three-factor structure of the Arabic version of the questionnaire demonstrated good model fit indices (GFI = 0.90, CFI = 0.93, RMSEA = 0.07, $\chi^2/df = 2.5$) (Table 1). The fit indices of the CFA model for the Arabic version indicated an adequate alignment of the three-dimensional structure of the questionnaire.

Table 1. Fit Indices of the Confirmatory Factor Analysis (CFA) Model for the Arabic Version of the Cognitive Flexibility Questionnaire

Fit Index	Observed Value	Acceptable Value	Status
GFI	0.94	> 0.90	Acceptable
IFI	0.96	> 0.90	Acceptable
CFI	0.95	> 0.90	Acceptable
TLI	0.94	> 0.90	Acceptable
RMSEA	0.07	< 0.08	Acceptable
CMIN/DF	2.9	< 5	Acceptable
χ^2	496.76	—	—

These indices indicate that the factorial model of the Cognitive Flexibility Scale exhibited a satisfactory fit, confirming its construct validity. The factor loadings of the items in the Cognitive Flexibility Questionnaire are presented in Figure 1, demonstrating appropriate item loadings on their respective factors.

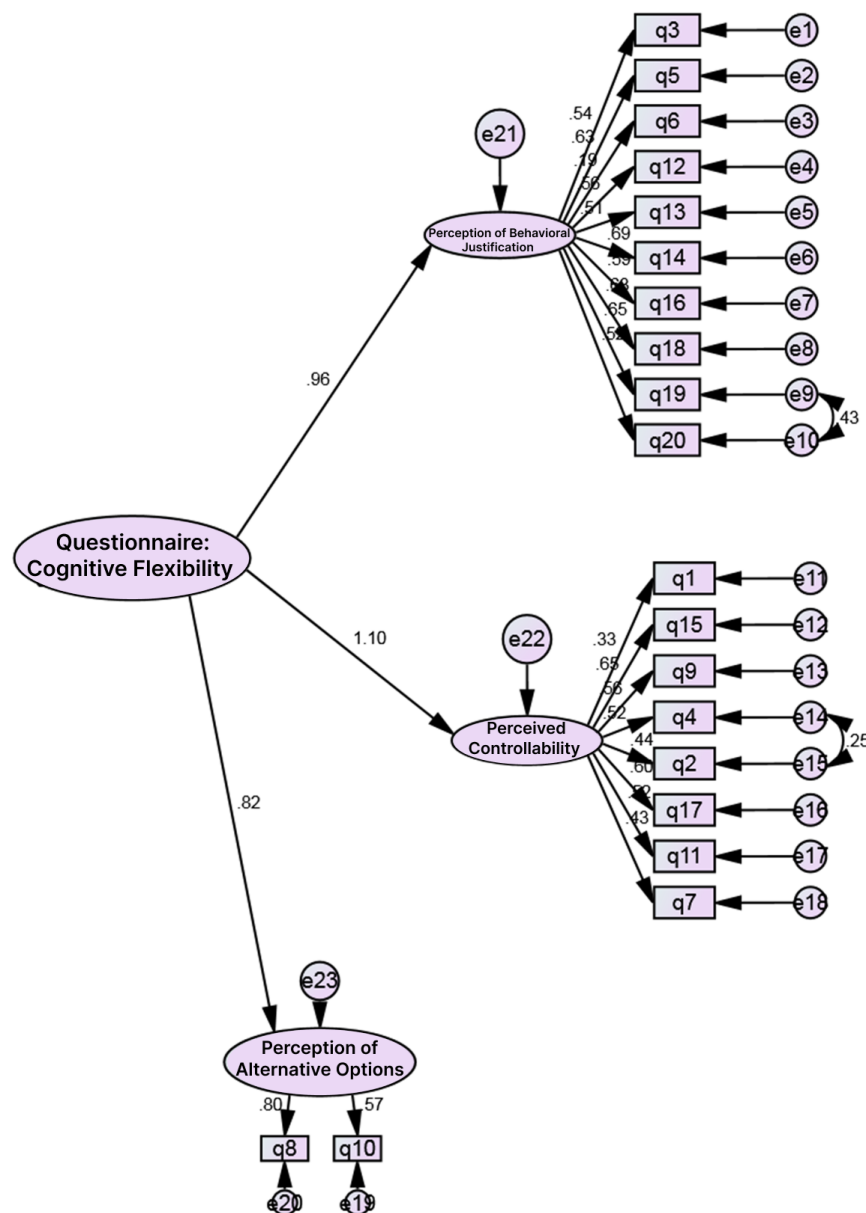


Figure 1. Factor Structure of the Cognitive Flexibility Scale

The reliability indices were also within acceptable ranges. Cronbach's alpha coefficient for the entire questionnaire was 0.89, and for the three subscales, the values were 0.85, 0.83, and 0.87, respectively (Table 2).

Table 2. Reliability of the Arabic Version of the Cognitive Flexibility Questionnaire

Composite Reliability (CR)	Cronbach's Alpha	Subscale
> 0.70	0.89	Total Questionnaire
> 0.70	0.85	Factor 1 (Perceived Controllability)
> 0.70	0.83	Factor 2 (Perception of Behavioral Justification)
> 0.70	0.87	Factor 3 (Generation of Alternative Options)

The high Cronbach's alpha and test–retest coefficients confirmed the instrument's validity and stability, indicating strong internal consistency. Additionally, the Composite Reliability (CR) for each factor exceeded 0.70, suggesting strong internal coherence. These findings confirm the reliability of the Arabic version in the current sample. Therefore, the Arabic version of the Cognitive Flexibility Questionnaire demonstrates excellent and dependable reliability coefficients.

Discussion and Conclusion

The primary purpose of this study was to determine the validity and reliability of the Arabic version of the Cognitive Flexibility Questionnaire (CFQ) among Iraqi male volleyball players. The results of the confirmatory factor analysis (CFA) confirmed the three-factor structure of the questionnaire, indicating that the translated version maintained the original conceptual framework of Dennis and Vander Wal's (2010) instrument (3). The model fit indices—including GFI = 0.90, CFI = 0.93, RMSEA = 0.07, and $\chi^2/df = 2.5$ —demonstrated a good level of construct validity. Additionally, the internal consistency coefficients for the total scale ($\alpha = 0.89$) and its subscales (ranging from 0.83 to 0.87) indicated high reliability and internal homogeneity. These psychometric outcomes align with the original validation and subsequent adaptations of the Cognitive Flexibility Scale (CFS) and Inventory (CFI) in different linguistic and cultural contexts, confirming the robustness of the instrument in measuring the cognitive flexibility construct across populations (10-12).

The finding that the Arabic version retained a consistent three-factor structure (perceived controllability, perception of behavioral justification, and generation of alternative options) underscores the cross-cultural stability of the cognitive flexibility construct. This is consistent with prior international validation studies that confirmed the universality of the underlying dimensions of cognitive flexibility across samples from Western and Asian cultures (11-13). For example, Wu et al. (2024) reported comparable internal consistency and factorial integrity of a cognitive flexibility-related scale among Chinese adolescents, highlighting the stability of executive function constructs across distinct cultural systems. Similarly, López et al. (2024) demonstrated the cross-linguistic reliability of the Spanish version of the Cognitive Flexibility Scale, suggesting that cultural adaptation does not necessarily distort the theoretical structure of cognitive constructs. Thus, the current results confirm that cognitive flexibility—as a psychological capacity for adaptive thinking and behavioral regulation—transcends linguistic and cultural boundaries when properly translated and psychometrically tested.

The relatively high factor loadings in the Arabic version indicate that the items effectively captured the intended latent variables of cognitive flexibility among athletes. This outcome supports the theoretical

proposition that athletes, especially those engaged in open-skill sports like volleyball, possess higher levels of adaptive cognition due to constant engagement in unpredictable, fast-paced environments (4, 7). Koch and Krenn (2021) observed that athletes in open-skill sports (e.g., volleyball, basketball, and soccer) demonstrate superior executive functioning—including task switching and attention shifting—compared to athletes in closed-skill disciplines such as swimming or track events. This finding provides a meaningful context for interpreting the strong psychometric performance of the Arabic CFQ among volleyball players. The cognitive demands of volleyball—requiring quick re-evaluation of game conditions and flexible decision-making—likely facilitated the participants' comprehension of the instrument's items and their alignment with the construct of cognitive adaptability.

Furthermore, the results of this study align with the findings of Król and Gruszka (2023), who emphasized that systematic sports training enhances athletes' cognitive flexibility by promoting neural efficiency and adaptive cognitive control. Their research suggested that regular engagement in complex motor tasks and decision-making activities strengthens the neural mechanisms underlying flexibility. The current findings therefore reinforce the notion that volleyball training environments, characterized by strategic adaptability and rapid situational assessments, contribute to the development of cognitive flexibility, and that this psychological construct can be accurately measured using an Arabic-language tool in this athletic population.

The psychometric soundness of the Arabic CFQ also parallels the findings of AbuDujain et al. (2024), who validated the Arabic Cognitive Flexibility Scale among Saudi Arabian participants. Their study demonstrated similar reliability indices and factorial stability, confirming the cross-cultural applicability of flexibility assessments in Arabic-speaking populations. The present research extends these findings to the Iraqi athletic context, indicating that the Arabic adaptation retains its internal consistency and structural coherence even in performance-oriented groups such as volleyball players. This strengthens the argument that cognitive flexibility, as measured by the CFQ, possesses both conceptual and empirical generalizability across various Arab cultural subcontexts.

The observed Cronbach's alpha and composite reliability values above 0.80 indicate excellent internal consistency, aligning with reliability standards recommended in psychometric literature (17). Lin and Huang (2018) noted that reliability coefficients above 0.70 denote acceptable internal consistency, while values exceeding 0.80 indicate strong homogeneity among items measuring the same construct. Accordingly, the Arabic CFQ meets and surpasses these criteria, affirming the reliability of its measurement across subscales. Additionally, the CFA model's indices demonstrate that the translated questionnaire successfully captured the multidimensional nature of cognitive flexibility, reinforcing construct validity consistent with the original design by Dennis and Vander Wal (2010) (3).

Cognitive flexibility serves as a foundational component of executive functions and is intricately linked to self-regulation and goal-oriented behavior (1, 2). Diamond (2006) described it as the capacity to adjust thinking in response to changing rules or environmental contingencies—a skill essential not only for academic and occupational success but also for athletic performance. In the sports domain, athletes who demonstrate cognitive flexibility are better able to manage competition-related stress, shift between strategies, and recover from performance errors (15, 16). The results of this study, confirming the reliability

and validity of the Arabic CFQ, thus have broader implications for understanding the role of cognitive adaptability in optimizing athletic functioning.

The findings also support the integrative framework proposed by Martins and Gonçalves (2022), who emphasized that cognitive flexibility operates as a psychological resource promoting effective decision-making and emotional regulation in high-demand environments. Their review highlighted that flexible individuals exhibit superior adaptability to shifting work and social contexts, paralleling how athletes dynamically adjust to evolving competitive scenarios. By confirming the psychometric validity of an Arabic measure of cognitive flexibility, the current research contributes to this theoretical model, providing a reliable assessment tool for evaluating cognitive adaptability in athletes.

Moreover, the study's outcomes are consistent with the conceptual linkage between cognitive flexibility and mental energy in sports performance (15). Yarayan et al. (2025) found that athletes with higher levels of cognitive flexibility were more likely to experience a "flow state," characterized by focused immersion and optimal performance. This psychological phenomenon arises when cognitive and emotional systems operate synergistically, allowing athletes to adapt seamlessly to competitive challenges. The Arabic CFQ, therefore, may serve as a valuable measure for identifying cognitive flexibility as a predictor of mental energy and flow in Arab athletic populations.

Cultural adaptation is another crucial dimension addressed by this study. Translating and validating the CFQ for Arabic-speaking athletes responds to the broader call for culturally competent psychological instruments (8, 9). The American Psychological Association (2017) emphasizes the importance of cultural sensitivity in psychological testing, particularly to ensure fairness and contextual appropriateness. Sue et al. (2009) further argued that culturally adapted tools enhance the ecological validity of psychological assessments and reduce biases that might otherwise distort measurement outcomes. The current research adheres to these ethical and methodological principles by using rigorous translation-back-translation procedures, expert evaluations, and empirical validation through CFA. As a result, the Arabic CFQ not only aligns with international psychometric standards but also respects linguistic and cultural nuances relevant to Iraqi athletes.

Additionally, the results corroborate prior findings from studies on cognitive assessments in different cultural contexts (11, 12). For instance, Oshiro et al. (2016) demonstrated that the Japanese adaptation of the CFS preserved factorial integrity and cultural relevance, while López et al. (2024) reported consistent psychometric outcomes for the Spanish version. The present validation thus extends this global body of evidence, suggesting that the CFQ is a psychometrically stable and adaptable instrument across diverse languages and sociocultural environments.

It is also notable that the present findings are consistent with those of Parvaneh et al. (2021), who emphasized the importance of verifying the psychometric robustness of psychological instruments in Iranian athletes. Their study on the Athletic Mental Energy (AME) Questionnaire demonstrated that linguistic adaptation alone is insufficient; empirical validation through CFA and reliability analysis is essential for ensuring scientific accuracy (19). The current research applies similar methodological rigor to the Arabic CFQ, reinforcing its credibility as a psychometrically sound tool for assessing cognitive flexibility among athletes.

In light of the above findings, the validated Arabic CFQ can be considered a reliable and valid measure for examining cognitive flexibility in Arabic-speaking athletic populations. This version demonstrates strong factorial stability, high internal consistency, and conceptual coherence, making it suitable for use in both research and applied sport psychology settings. The results collectively confirm that cognitive flexibility represents a stable, measurable construct that can be assessed cross-culturally when culturally competent psychometric practices are observed.

Despite its contributions, the present study has several limitations. First, the use of a convenience sample limits the generalizability of the findings to the broader population of athletes in Iraq or other Arabic-speaking countries. Second, the study focused exclusively on male volleyball players, which restricts the applicability of the results to female athletes or participants in other sports disciplines. Third, data collection relied on self-report measures, which may be influenced by social desirability or response bias. Additionally, the study did not examine test–retest reliability over time, leaving the long-term stability of the instrument unverified. Finally, cultural factors specific to the Iraqi context—such as dialectal variations and educational background—could affect item interpretation, suggesting the need for further cross-validation.

Future studies should replicate this research across different athletic populations, including both genders and a variety of sports types (open- and closed-skill). Longitudinal designs are recommended to evaluate the temporal stability of the Arabic CFQ and its sensitivity to training-related cognitive changes. Researchers should also explore the predictive validity of cognitive flexibility in relation to athletic performance, resilience, and psychological well-being. Comparative studies across Arabic-speaking countries would further clarify cultural influences on cognitive flexibility and contribute to developing normative data for the region. Incorporating neurocognitive measures, such as task-switching paradigms or fMRI, could enhance the multidimensional understanding of flexibility in athletic cognition.

Practitioners in sport psychology can use the Arabic CFQ as a diagnostic and developmental tool for assessing cognitive adaptability among athletes. Coaches and performance psychologists can integrate cognitive flexibility training into sports preparation programs to enhance decision-making and resilience under pressure. The instrument may also assist in identifying athletes who struggle with adaptability, enabling targeted interventions that foster psychological flexibility. Moreover, the scale can serve as an evaluation tool in applied research and athlete counseling within Arabic-speaking contexts, supporting evidence-based practices that promote mental agility and performance optimization.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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