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Structural Equation Modeling of the Effect of Sport Mental Energy on Athletic Success: The Mediating Role of Cognitive Flexibility in Iraqi Volleyball Players

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ABSTRACT

The present study aimed to examine the structural relationships between sport mental energy, cognitive flexibility, and athletic success among volleyball players. This research employed a descriptive–correlational design of the cross-sectional type. The statistical population consisted of all male volleyball players in Diwaniyah City, Iraq. A sample of 230 participants was selected through convenience sampling. Data were collected using standardized questionnaires measuring sport mental energy, cognitive flexibility, and athletic success. Data analysis was conducted using SPSS version 26 and AMOS version 23 through the structural equation modeling (SEM) approach. The findings indicated that the proposed conceptual model demonstrated a good fit, and all main and sub-hypotheses were supported. The results showed that sport mental energy had a direct and positive effect on athletic success (path coefficient = 0.352, $p < 0.001$). Cognitive flexibility also exerted a significant direct effect on athletic success (path coefficient = 0.625, $p < 0.001$). Furthermore, the mediating role of cognitive flexibility in the relationship between mental energy and athletic success was confirmed. Path analysis revealed that the indirect effect of sport mental energy on success through cognitive flexibility was statistically significant (indirect coefficient = 0.364, $p = 0.001$). Overall, the results of this study highlight the simultaneous importance of psychological resources (mental energy) and cognitive abilities (flexibility) in enhancing athletes' performance and success. These findings provide useful guidance for coaches and sport psychologists in designing effective educational and psychological interventions.

Keywords: *sport mental energy, cognitive flexibility, athletic success, structural equation modeling, volleyball.*

1. Introduction

In the contemporary field of sport psychology, the enhancement of athletic performance is increasingly viewed not only through physiological and biomechanical mechanisms but also through the lens of cognitive and psychological resources that regulate athletes' behavior, attention, and motivation. Among these, the construct of *athletic mental energy* has emerged as a critical determinant of optimal functioning, representing a multidimensional psychological resource encompassing motivation, confidence, concentration, vigor, calmness, and energy (1). Mental energy in sport contexts reflects an athlete's capacity to maintain goal-directed effort, sustain focus, and manage emotional states during performance (2). As competition levels intensify, the ability to regulate internal cognitive and affective processes becomes increasingly vital for maintaining consistent performance outcomes (3).

Early research in exercise and performance science emphasized physiological mechanisms of fatigue and endurance (4), yet later theoretical developments proposed that performance limitations also stem from mental and cognitive fatigue (5). This paradigm shift introduced the concept of mental energy as an explanatory variable bridging the physiological and psychological domains of athletic functioning (6). Subsequent studies revealed that athletes with higher levels of mental energy demonstrate greater resilience, higher motivation, and enhanced ability to sustain concentration under competitive stress (7). Within this context, mental energy functions as a meta-resource, supporting both executive control and self-regulatory behavior (8).

The notion of *executive function*—encompassing cognitive flexibility, inhibitory control, and working memory—has been identified as a key mediator between cognitive processes and motor performance (9). Cognitive flexibility, a component of executive functioning, allows athletes to adapt to dynamic game situations, shift strategies, and generate creative solutions when under pressure (10). This adaptability is particularly relevant in open-skill sports such as volleyball, soccer, and basketball, where environmental demands fluctuate rapidly (11). The interdependence between cognitive flexibility and athletic performance underscores the importance of integrating psychological and cognitive training alongside physical conditioning.

Emerging empirical evidence highlights how sport-specific cognitive abilities influence tactical decision-making, attention control, and error correction during play (12, 13). For example, inhibitory control and attentional switching have been shown to explain variance in game performance among youth athletes (13). In volleyball, cognitive flexibility facilitates quick decision-making during unpredictable ball trajectories and opponent maneuvers, making it an essential determinant of success (14). Similarly, studies on soccer and tennis players confirm that the interplay between executive functions and perceived exertion contributes significantly to technical accuracy and overall performance (15).

Athletic mental energy has been conceptualized as both a psychological and neurocognitive construct that energizes athletes' mental processes and regulates behavior under pressure (2). It integrates motivation, focus, and emotional control—dimensions that correspond with the core processes of self-regulation (16). Research indicates that athletes with high levels of mental energy exhibit superior self-regulation, faster recovery from setbacks, and enhanced capacity to sustain effort during prolonged competition (17). These findings align with evidence linking mental energy to well-being and engagement among competitive athletes (18).

Recent research trends emphasize that mental energy not only influences direct performance outcomes but also operates through cognitive mediators such as cognitive flexibility and executive control (19). The relationship between mental energy and flow experience—a state of optimal engagement and effortless control—is particularly noteworthy. Athletes experiencing higher mental energy report greater likelihood of achieving flow states, which, in turn, enhance their situational awareness and precision (20). Flow, as a transient psychological state of absorption, represents the culmination of effective energy allocation, self-regulation, and cognitive fluidity during performance (19).

Cognitive flexibility plays a vital role in supporting these processes by enabling athletes to adapt to unpredictable environmental conditions. Athletes with higher flexibility display superior performance consistency, particularly in dynamic and open-skill sports that require rapid information processing (21). Król and Gruszka (21) suggest that sustained sport training itself may enhance cognitive flexibility by fostering habitual switching between tactical strategies and environmental cues. Such adaptability enhances athletes' ability to anticipate opponents' actions and execute context-appropriate responses (22).

Moreover, the integration of cognitive and psychological dimensions of performance has been shown to affect athletic outcomes at multiple levels. For instance, Albaladejo-García et al. (23) demonstrated that inhibitory control is closely related to motor efficiency and precision across various sports disciplines. Similarly, Logan et al. (24) found that trained athletes outperform non-athletes in cognitive domains such as attention control and working memory, supporting the hypothesis that physical training enhances executive functions. These findings corroborate the notion that athletic performance depends not only on physical attributes but also on the cognitive systems that regulate attention and decision-making (12).

Volleyball, as a high-tempo open-skill sport, presents a unique environment for examining the interaction between mental energy and cognitive flexibility. Players are required to make split-second judgments while maintaining composure under pressure (14). Such conditions demand high levels of situational awareness, adaptability, and cognitive endurance. The ability to sustain attention and rapidly shift between tactical alternatives directly correlates with successful performance (25). Thus, cognitive flexibility and mental energy function as twin pillars of adaptive expertise in volleyball athletes.

Beyond individual differences, contextual factors such as sport type and training structure also modulate cognitive performance. Studies comparing open- and closed-skill athletes have shown that open-skill athletes—those engaged in sports like volleyball or soccer—exhibit superior cognitive flexibility and inhibitory control due to the continuous adaptation required during play (22, 26). These athletes must constantly process visual information, anticipate the actions of teammates and opponents, and regulate emotional responses (27). Consequently, both mental energy and cognitive flexibility become essential adaptive mechanisms in ensuring sustained athletic success (28).

Mental energy also relates to psychological resilience and motivational persistence under pressure. According to Singh et al. (7), the six-factor model of athletic mental energy—comprising motivation, confidence, concentration, vigor, calmness, and energy—mediates athletes' well-being in competitive contexts. Each factor serves a distinct yet complementary function: motivation sustains effort, confidence stabilizes emotional states, concentration channels cognitive resources, vigor counteracts fatigue, calmness preserves decision accuracy, and energy supports overall endurance. Collectively, these factors enable athletes to withstand stress and maintain consistent performance.

Empirical evidence further supports the mediating role of cognitive flexibility in linking psychological resources to performance outcomes. Cognitive flexibility facilitates adaptive responses by allowing athletes to reframe challenges, inhibit ineffective strategies, and generate alternative solutions during gameplay (10). In turn, this adaptability enhances mental energy utilization, fostering an upward spiral of psychological functioning and athletic success (9). As athletes engage in deliberate practice, feedback integration, and reflective self-monitoring, their mental energy and flexibility co-evolve, forming the foundation of psychological endurance (29).

The development of cognitive flexibility and executive functions can be viewed as both a product and a predictor of sport participation. Engagement in structured athletic activity contributes to improved neural efficiency, attentional control, and metacognitive awareness (8, 9). Conversely, athletes who exhibit higher levels of these cognitive traits are better equipped to learn complex motor skills, adapt to stressors, and manage fatigue (12, 15). As noted by McAuley et al. (16), executive functions also play a key role in self-regulatory processes that govern motivation and exercise adherence.

In the domain of team sports, the interaction between collective energy and individual cognition further emphasizes the relevance of mental energy. Volleyball requires players to coordinate seamlessly, maintain situational awareness, and regulate interpersonal emotions during rapid exchanges (30). The cognitive demands of team-based dynamics necessitate high flexibility and resilience to sustain optimal group performance. Thus, understanding how individual-level cognitive resources such as flexibility mediate the relationship between mental energy and athletic success provides critical insight into effective training design (12).

Finally, theoretical frameworks such as Loehr's "Full Engagement" model (6) underscore the importance of balancing mental, emotional, and physical energy to achieve peak performance. Athletes capable of maintaining this balance demonstrate greater adaptability, focus, and emotional control. Similarly, Cook and Davis (2) emphasized that mental energy functions as a measurable

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psychological construct that influences behavioral persistence and decision-making under fatigue. Integrating these theoretical insights with modern neurocognitive evidence highlights a multidimensional model of sport performance that accounts for both psychological and cognitive mediators (5).

In light of this theoretical and empirical background, it becomes evident that sport mental energy and cognitive flexibility jointly influence athletic success. However, limited research has investigated the mediating role of cognitive flexibility in the relationship between mental energy and athletic achievement, particularly within volleyball contexts in developing countries. Therefore, the present study aims to model the structural relationship between sport mental energy and athletic success through the mediating role of cognitive flexibility among volleyball players in Iraq.

2. Methods and Materials

2.1. Study Design and Participants

The present research is a descriptive study based on modeling. In terms of nature, it is quantitative, and in terms of purpose, it is applied. The study was conducted using a field method and implemented through a questionnaire survey. The statistical population consisted of all male volleyball players in Diwaniyah City, Al-Qadisiyyah Province, Iraq, who had participated regularly in volleyball training for at least three years and had taken part in at least one official provincial or club competition. The statistical sample included 230 male athletes over the age of 18, selected through a convenience sampling method from the target population.

Initially, to select the participants, the researcher visited sports clubs in Diwaniyah City, Al-Qadisiyyah Province, and, after obtaining consent from club managers and head coaches, attended their training sessions. During briefing sessions, after fully explaining the objectives and procedures of the study and obtaining informed consent from the athletes, they completed the demographic questionnaire and the related research instruments. During the distribution, completion, and collection of the questionnaires, the researcher was present to address any questions or ambiguities raised by the athletes regarding the items. At the end of the process, after expressing gratitude to the participants, the collected data were entered into statistical analysis.

2.2. Measure

Sport Mental Energy Scale (1): This scale measures six dimensions of mental energy—confidence, motivation, concentration, vigor, calmness, and energy—across 18 items, with three items for each dimension. The scoring follows a 6-point Likert scale ranging from 1 (“strongly disagree”) to 6 (“strongly agree”).

Cognitive Flexibility Inventory (10): This questionnaire includes 20 items and measures three aspects of cognitive flexibility: (a) the tendency to perceive difficult situations as controllable (perceived controllability), (b) the ability to recognize multiple alternative explanations for life events and human behavior (perceived justification of behavior), and (c) the capacity to generate several alternative solutions for difficult situations (perceived alternatives). The instrument demonstrates appropriate factorial structure, convergent validity, and concurrent validity. It uses a 7-point Likert scale ranging from 1 (“strongly disagree”) to 7 (“strongly agree”). Items 2, 4, 7, 9, 11, and 17 are reverse-scored. The scoring procedure specified for the CFI involves reverse coding the designated items and summing the numerical response values to obtain a total score. Higher scores indicate greater cognitive flexibility, while lower scores reflect higher cognitive rigidity.

Sport Success Scale: This scale consists of 29 items that assess the components of psychological performance, attention, technique, error sensitivity, commitment, and progress. It employs a 6-point Likert scale ranging from 1 (“strongly disagree”) to 6 (“strongly agree”).

2.3. Data Analysis

The data collected in this study were analyzed using SPSS version 26 and AMOS version 23 at a significance level of $\alpha < 0.05$, employing both descriptive and inferential statistics. Initially, descriptive statistics for demographic and research variables, as well as the necessary assumptions, were presented. At the inferential level, structural equation modeling (SEM) based on the covariance approach was used to test the research hypotheses, and the model parameters

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were estimated using the maximum likelihood (ML) method.

3. Findings and Results

The findings indicated that among the participants, 131 individuals (57%) were aged between 20 and 25 years, and 99 individuals (43%) were aged between 18 and 20 years. In terms of athletic experience, 125 participants (54.3%) had less than five years of experience, while 105 participants (45.7%) had between five and ten years of experience. The descriptive statistics of the research variables for the two groups are presented in Table 1.

Table 1

Descriptive Statistics of Research Variables

Variable	Mean	Standard Deviation	Minimum	Maximum
Sport Mental Energy	68.95	9.66	18	108
Confidence	11.27	2.22	3	18
Motivation	11.08	2.30	3	18
Concentration	11.84	2.18	3	18
Vigor	11.86	2.17	3	18
Calmness	11.25	2.30	3	18
Energy	11.39	2.27	3	18
Cognitive Flexibility	98.72	15.96	20	140
Perception of Behavioral Justification	49.5	10.07	10	70
Perceived Controllability	40.9	7.25	8	56
Perception of Multiple Alternatives	8.32	2.06	2	14
Sport Success	116.51	17.54	29	174
Psychological Performance	20.05	4.51	5	30
Attention	20.66	4.55	5	30
Technique	15.46	4.43	4	24
Error Sensitivity	20.17	5.15	5	30
Commitment	19.19	4.97	5	30
Progress	20.03	4.79	5	30

Before applying structural equation modeling (SEM) to test the hypotheses, the required assumptions—including missing data, outliers, normality, and multicollinearity—were examined and confirmed.

The structural equation model of the effect of sport mental energy on athletic success, with the mediating role of cognitive flexibility among Iraqi volleyball players, shows an acceptable level of model fit. The fit indices of the research model are presented in Table 2, and the conceptual model is illustrated in Figure 1.

Table 2

Model Fit Indices

Fit Index	Acceptable Level	Obtained Value	Status
GFI	> 0.90	0.903	Acceptable
IFI	> 0.90	0.931	Acceptable
PCFI	> 0.50	0.771	Acceptable
CFI	> 0.90	0.93	Acceptable
PNFI	> 0.50	0.738	Acceptable
RMSEA	< 0.08	0.071	Acceptable
CMIN/df	< 5	2.53	Acceptable
p-value	—	0.001	—
df	—	87	—
χ^2	—	219.729	—

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The results in Table 2 show that all model fit indices exceed the acceptable thresholds. The relative chi-square (χ^2/df) was 2.53, which is below 5, and the Root Mean Square Error of Approximation (RMSEA) was less than 0.08, indicating a satisfactory fit. The R^2 value demonstrates the proportion of variance explained for the endogenous latent variables. The coefficient of determination for the variable of athletic success was 0.77, suggesting that the exogenous and mediating variables (sport mental energy and cognitive flexibility) explain 77% of the variance in athletic success. This indicates a strong explanatory power for the dependent variable.

Table 3

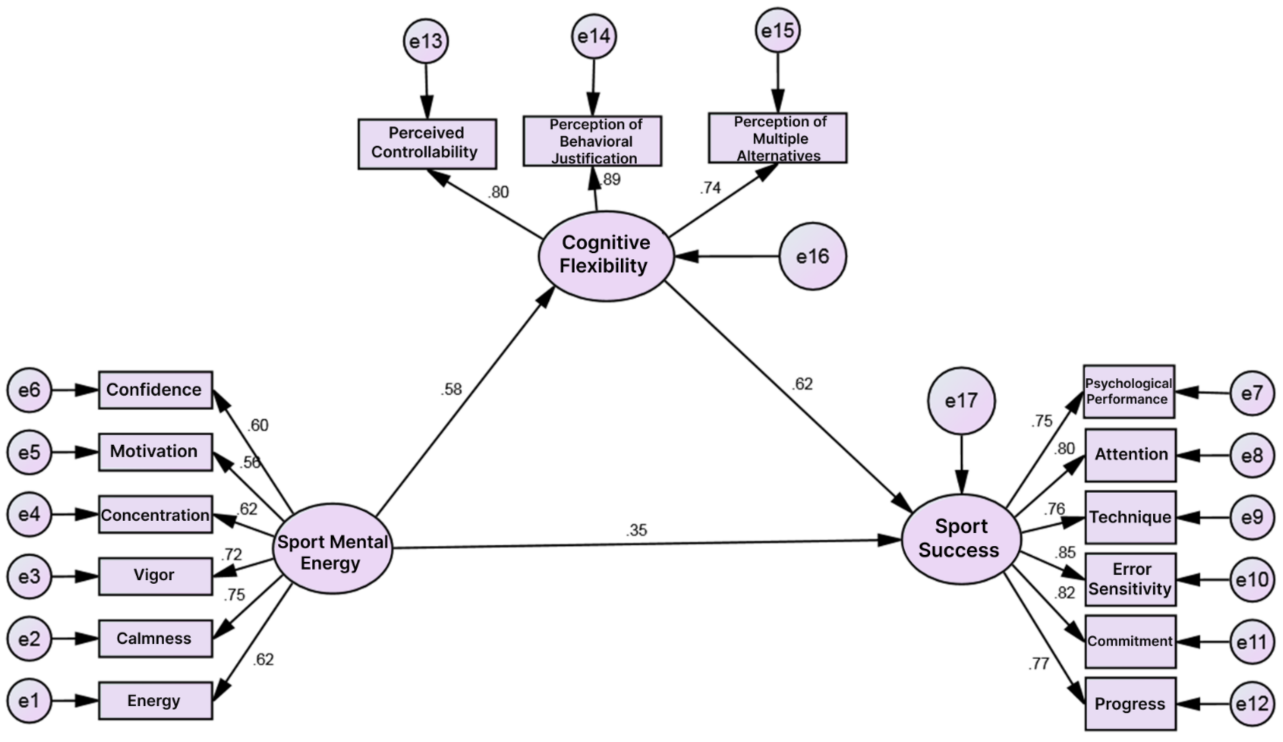
Direct and Indirect Effects among Variables in the Structural Model

Path	Standardized Coefficient (β)	Standard Error	Unstandardized Coefficient	Critical Ratio	Lower Bound	Upper Bound	Significance Level
Sport Mental Energy → Athletic Success	0.352	0.135	0.659	4.88	–	–	0.001
Cognitive Flexibility → Athletic Success	0.625	0.048	0.39	8.19	–	–	0.001
Sport Mental Energy → Cognitive Flexibility	0.583	0.270	1.74	6.45	–	–	0.001
Sport Mental Energy → Cognitive Flexibility → Athletic Success	0.364	–	0.68	–	0.27	0.78	0.001

Sobel Test Statistic = 2.13; Sobel Significance = 0.016; VAF = 0.51

Figure 1

Structural Model of the Effect of Sport Mental Energy on Athletic Success with the Mediating Role of Cognitive Flexibility in Iraqi Volleyball Players



Based on the results presented above, the standardized coefficient (β) for the direct effect of sport mental energy on athletic success was 0.352, with a critical ratio of 4.88 ($p < 0.001$), indicating a statistically significant positive

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relationship. This demonstrates that as athletes' mental energy increases, their athletic success also rises. The standardized coefficient for the direct effect of cognitive flexibility on athletic success was 0.625, with a critical ratio of 8.19 ($p < 0.001$), confirming a strong and significant positive influence. This implies that athletes with higher cognitive flexibility achieve greater competitive success due to their enhanced adaptability and decision-making skills. Additionally, the standardized coefficient for the direct effect of sport mental energy on cognitive flexibility was 0.583, with a critical ratio of 6.45 ($p < 0.001$), demonstrating that sport mental energy significantly predicts athletes' cognitive flexibility levels—indicating that energized athletes can think and act more flexibly during play. Finally, the indirect effect of sport mental energy on athletic success through the mediating role of cognitive flexibility was 0.364 ($p < 0.001$), with a Sobel test statistic of 2.13 ($p = 0.016$) and a variance accounted for (VAF) index of 0.51, confirming partial mediation. The bootstrap confidence interval (0.27 to 0.78) excluded zero, reinforcing the statistical robustness of the mediation effect. Collectively, these results reveal that sport mental energy exerts both direct and indirect influences on athletic success, with cognitive flexibility functioning as a partial mediator that enhances the overall effect, thereby underscoring the intertwined importance of psychological energy and adaptive cognition in achieving superior athletic performance.

4. Discussion and Conclusion

The present study tested a structural model in which athletic mental energy (AME) exerts both direct and indirect effects on athletic success via cognitive flexibility among Iraqi volleyball players. The model exhibited acceptable fit (e.g., CFI = 0.93; RMSEA = 0.071) and strong explanatory power for athletic success ($R^2 = 0.77$). Path analysis showed that AME had a positive direct effect on athletic success ($\beta = 0.352$, $p < .001$) and a substantial effect on cognitive flexibility ($\beta = 0.583$, $p < .001$), while cognitive flexibility, in turn, strongly predicted athletic success ($\beta = 0.625$, $p < .001$). Mediation tests (bootstrap and Sobel) indicated a significant indirect effect of AME on success via cognitive flexibility ($\beta_{indirect} = 0.364$, $p < .001$), with VAF = 0.51, signifying partial mediation. Taken together, these findings suggest that athletes higher in mental energy tend to succeed more partly because they can adapt their cognition and behavior more flexibly to changing game demands (1, 10).

Our direct AME → athletic success effect aligns with contemporary evidence that mental energy—encompassing confidence, motivation, concentration, vigor, calmness, and energy—facilitates goal-directed behavior under pressure and sustains attentional resources in competition (1, 2). The size and significance of the direct path are consistent with reports that the six-factor AME model contributes to athletes' performance and well-being in competitive settings by stabilizing affect and sharpening focus (7). In volleyball specifically, field evidence indicates that higher mental energy predicts better competitive performance, offering sport-specific convergent validity for the present results (14). Research in adjacent team sports also suggests that AME promotes flow experiences—which are linked to effortless control and superior execution—further explaining performance variance beyond physical abilities alone (19, 20). These convergences reinforce the interpretation that AME is not merely an affective state but a meta-resource that fuels sustained attention, emotional composure, and motivation during fast-paced rallies (3, 6, 8).

The significant AME → cognitive flexibility path complements theory that positions mental energy as a driver of executive control processes—particularly when athletes must reframe problems, inhibit ineffective responses, and switch strategies swiftly under uncertainty (5, 9). From a mechanistic standpoint, AME may increase the availability of controlled processing and top–down regulation, enabling athletes to disengage from maladaptive attentional sets and adopt new task rules in real time (8). This is consistent with findings that athletes high in psychological skills and mental energy show greater courage and persistence, traits that likely co-occur with flexible cognitive operations during demanding sequences of play (17). Moreover, in samples of student-athletes, mental energy and sport engagement are closely linked, suggesting that energized athletes invest more deeply in the metacognitive regulation necessary to adapt their tactics—an antecedent of cognitive flexibility (18).

The robust cognitive flexibility → athletic success path corroborates a large literature on executive functions (EFs) and sport performance. Cognitive flexibility has been identified as a core EF supporting rapid task-switching, creative option generation, and context-sensitive decision-making—capabilities that are indispensable in open-skill sports such as volleyball (9-11). Meta-analytic and systematic evidence shows that trained athletes typically exhibit advantages in attentional control, working memory, and inhibitory processes that subserve superior tactical execution (23, 24). In youth and collegiate samples, inhibitory control and age-related EF development explain unique variance in game performance, emphasizing that cognition contributes independently of physical maturity (13). Evidence from tennis further links EF and perceived exertion to technical accuracy under fatigue, implying that flexible executive regulation preserves precision when physiological strain mounts (15). Together, these results converge with our findings by indicating that EF—particularly flexibility—plays a pivotal role in translating intentions and energy into successful, situation-appropriate actions (12).

The partial mediation observed here (VAF = 0.51) refines this picture by demonstrating that cognitive flexibility is a central pathway through which AME influences performance, while also leaving room for a meaningful direct effect of AME. In practical terms, athletes may perform better both because mental energy directly stabilizes arousal and attentional effort and because it indirectly enhances flexible control over strategies, attentional sets, and error correction (1, 10). This interpretation aligns with evidence that habitual participation in open-skill sports cultivates dominant cognitive functions tailored to the sport's environmental uncertainty, with volleyball, soccer, and basketball frequently demanding rapid switching and anticipatory control (22, 26). Comparative studies reveal that open-skill athletes tend to surpass closed-skill athletes in EF tasks, plausibly because constant exposure to variable stimuli trains flexibility and inhibition (25, 27). Longitudinally, sport training may itself develop cognitive flexibility, suggesting a reciprocal relationship: athletes with higher AME engage more, train harder, and thereby further enhance flexibility that, in turn, supports future success (21).

Our results also resonate with broader self-regulation models in exercise psychology, where EF supports adherence, effort allocation, and the management of fatigue—all of which are pivotal during extended matches and practice cycles (16). Historically, performance models emphasized physiological drivers of fatigue and adaptation (4); the present findings, however, join a growing body of work that situates cognitive and energetic states as co-determinants of performance end-points, particularly in the high-tempo, decision-heavy context of volleyball (5, 29). At the team and context level, volleyball demands continuous interpersonal coordination and situational awareness; studies of volleyball programs underscore how structured participation shapes healthy habits and readiness for intensive cognitive–motor tasks, further supporting the ecological validity of our model in this population (30).

Importantly, several strands of the literature provide specific bridges between AME, EF, and performance that further bolster the current mediation. First, the six-factor AME framework maps onto EF-supported processes: confidence and calmness reduce noise in decision processes; concentration and motivation channel limited attentional resources; vigor and energy sustain controlled processing during prolonged rallies (1, 7). Second, inhibitory control—often examined via stop-signal paradigms—has been shown to be a key determinant of sport skill execution and error monitoring, providing a plausible micro-process through which flexibility exerts its influence (23). Third, sport-type comparisons consistently suggest that the unpredictability intrinsic to volleyball preferentially selects—and trains—flexibility and inhibition, matching our observation that flexibility accounts for a large share of the AME–success relationship (11, 27). Finally, flow states, documented to arise more readily when mental energy and mindful attentional control are high, can be conceptualized as the experiential correlate of efficient EF deployment in play—a pattern reported in football and suggested to generalize to other open-skill sports (19, 20).

From a measurement and conceptual standpoint, our findings are grounded in validated instruments and frameworks. The AME measure provides a psychometrically supported operationalization of the mental energy construct in athletes (1). The Cognitive Flexibility Inventory captures the appraisal and option-generation components of flexibility that are theoretically proximal to tactical switching and error-based updating during rallies (10). Classic and contemporary EF frameworks offer a coherent rationale for why flexibility should show strong associations with performance in settings marked by uncertainty and speeded choice (8, 9). Conceptualizations of mental energy from psychology and nutrition science converge in framing it as an accessible, regulable resource influencing persistence, decision speed, and emotional stability in sport (2, 3). Thus, both the observed effect sizes and the partial mediation are theoretically consonant with a multi-level account of performance that integrates energetic, cognitive, and contextual determinants (12, 24).

In sum, the discussion of our structural findings against the background of prior research suggests that AME acts as a catalyst for flexible executive control, which, in turn, is instrumental for achieving athletic success in volleyball's open-skill environment. The strength of the flexibility path, coupled with the residual direct AME effect, argues for dual-route interventions: one to build and stabilize athletes' mental energy and another to explicitly train flexible cognition and inhibitory control (14, 21, 23). Such a dual emphasis mirrors "full engagement" perspectives in applied sport psychology, where balanced mental, emotional, and physical resources are cultivated to enable consistently optimal performance (6). By situating AME and flexibility within a single, empirically supported model, the present research contributes to a more integrated, mechanistic account of how psychological resources are translated into competitive success in volleyball and related open-skill sports (22, 25, 26).

This study used a cross-sectional design, which limits causal inference regarding the directional influence of mental energy and cognitive flexibility on success. Sampling was conducted using convenience procedures in one Iraqi city, which may constrain generalizability to other regions, levels of competition, or female athletes. Self-report instruments are susceptible to common method variance and social desirability, and the absence of behavioral EF tasks or on-court cognitive metrics restricts multi-method triangulation. Finally, contextual moderators such as coaching climate, training load, sleep, and recent injury were not modeled, and sport-specific performance indicators were derived from global self-reports rather than objective match analytics.

Longitudinal and experimental designs should be employed to test causal pathways and training-induced change in mental energy and flexibility. Multi-method assessments that combine validated questionnaires with laboratory EF tasks and in-game perceptual–cognitive tracking would strengthen construct validity. Future models should incorporate moderators such as competitive level, role specialization, team cohesion, and coach leadership, and extend sampling to female athletes and diverse age groups. Intervention trials can compare the efficacy of AME-focused mental skills training versus flexibility-centered cognitive drills, as well as their additive or synergistic effects on performance and flow.

Practitioners should implement dual-route programs that (a) cultivate mental energy through routines targeting confidence, calmness, and concentration, and (b) build cognitive flexibility via variable practice, small-sided games, and decision-training under time pressure. Integrating brief mindfulness and recovery protocols can stabilize arousal and sustain attentional control across sets. Coaches may periodize cognitive challenges alongside physical load, track subjective energy and focus, and provide feedback that promotes adaptive reframing and rapid option generation during drills and match simulations.

Authors' Contributions

All authors equally contributed to this study.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethics Considerations

The study placed a high emphasis on ethical considerations. Informed consent obtained from all participants, ensuring they are fully aware of the nature of the study and their role in it. Confidentiality strictly maintained, with data anonymized to protect individual privacy. The study adhered to the ethical guidelines for research with human subjects as outlined in the Declaration of Helsinki.

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