

Biomechanical Determinants and Competitive Anxiety in Basketball Shooting Accuracy across Playing Positions: A Secondary Data Analysis

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ABSTRACT

This secondary data analysis synthesizes biomechanical and psychological data to evaluate how jump height, release kinematics, and competitive anxiety influence shooting accuracy across playing positions. Increased flight time, jump height, and release height emerged as critical indicators of successful attempts, although the correlations between specific kinematic variables and overall shooting accuracy were weak. Elevated competitive anxiety disrupted movement patterns through prefrontal cortical activation and altered kinematic consistency, manifesting as increased peak velocity and limb displacement, degraded gaze fixation, and reduced quiet-eye duration effects associated with significant declines in shooting success under high-pressure conditions. Position-specific analyses revealed distinct adjustments in release timing and ball entry angles for guards and forwards compared with centres. Fatigue further impaired release timing and entry angles in long-range shooting, while distance-dependent oculomotor strategies shorter fixation durations and increased saccadic frequency during three-point attempts compensated for the reduced temporal windows of long-range attempts, which also demanded more precise release angles to manage the variability inherent in higher-velocity release segments. Individual shooting styles emerged as interpretations of standardized movement patterns shaped by unique anthropometric and physical capacities, supporting personalized rather than universal mechanical models. Taken together, the findings indicate that shooting accuracy reflects an interaction of kinematic optimization, oculomotor control, and anxiety regulation that varies by playing position and shooting distance, supporting integrated training programmes that combine technical consistency with psychological resilience.

Keywords: Basketball shooting accuracy, Competitive anxiety, Biomechanical kinematics, Playing position, Quiet eye.

How to cite this article: Thakral R, Kumar H. Biomechanical Determinants and Competitive Anxiety in Basketball Shooting Accuracy across Playing Positions: A Secondary Data Analysis. *Int J Drug Deliv Technol.* 2026;16(86s): 363-376; DOI: 10.25258/ijddt.16.86s.42

Source of support: [Nil / to be declared by authors].

Conflict of interest: [None / to be declared by authors]

Introduction

Shooting accuracy is widely regarded as a primary indicator of offensive efficiency in basketball, and its assessment has been formalized through validated instruments such as the Basketball Jump Shooting Accuracy Test (Boddington et al., 2019). Proficiency in shooting, however, is not a unitary skill. It emerges from a complex interaction between finely tuned biomechanical kinematics joint coordination, release parameters, and postural control and the athlete's capacity to sustain attentional focus under high-pressure competitive scenarios (Dewi et al., 2026; Harle &

Vickers, 2001). Existing research has tended to examine these components in isolation, and there is a recognized need to synthesize how physiological demands and psychological stressors intersect in ways that are specific to distinct on-court roles (Dewi et al., 2026).

That intersection is most evident when shooting is considered across playing positions. Point guards, wings, and post players face markedly different biomechanical demands (Salazar et al., 2020), and the physical requirements of three-point shooting differ substantially from those of high-frequency, short-range attempts (Čabarkapa et al., 2022). Examining the

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shooting task through the lens of playing position therefore offers a framework for understanding how localized postural demands and defensive task frequency shape movement consistency and field goal percentages. The distance of the shot is a decisive modifier of this relationship: as horizontal distance increases, the necessary reorganization of body segments becomes more pronounced, and players must adapt their kinematic chaining to preserve consistent release parameters (Vencúrik et al., 2022). Guards, for example, typically exhibit elevated release speeds, characterized by increased shoulder flexion velocities and earlier timing of the release phase, as distance increases (Miller & Bartlett, 1996). Interior players, by contrast, often rely on higher release heights to circumvent defensive pressure, requiring a more vertical orientation and nuanced control over the distal segments of the kinematic chain (Čabarkapa et al., 2021).

Against this background, the present study investigates how position-specific kinematic profiles interact with varying levels of competitive anxiety to shape the stability of shooting accuracy across diverse game situations (Cruz et al., 2026, p. 19). By analyzing the compensatory variability inherent in distinct shooting motions, the investigation seeks to quantify how specialized movement patterns mitigate the mechanical noise that typically accompanies increased distance (Cowin et al., 2022). Successful execution — whether from the perimeter or the restricted area — is intrinsically linked to the coordination of lower-body joint engagement and shoulder positioning (Karim, 2025), yet the efficacy of this biomechanical foundation is frequently modulated by the player's psychological state during high-stakes competitive sequences (Hogue et al., 2025). The study therefore stratifies participants according to their primary on-court role and distance-specific shooting frequency (Čabarkapa et al., 2021), enabling an empirical comparison of how mechanical constraints such as release force and trajectory angle are influenced by psychological arousal across game contexts (Cruz et al., 2026). By analyzing the kinematic displacement and vertical velocity variables associated with jump shots from both the perimeter and the interior, the research delineates how spatial constraints necessitate unique compensatory strategies for maintaining shooting precision (Ibrahim, 2024). These adaptive mechanisms are critical given the inherent decline in success rates as task constraints shift from

interior to perimeter distances (Okazaki & Rodacki, 2012). Because shooting success is fundamentally mediated by distance-dependent biomechanical adjustments, recognizing the sensitivity of performance to spatial constraints is vital for developing targeted training interventions (Kim, 2023).

The compensatory strategies employed by skilled shooters are best understood through movement variability and joint coupling. Refined coupling patterns within the wrist–elbow–shoulder linkage appear to buffer the negative influence of competitive anxiety on shooting precision (Robins et al., 2007), and elite performers are thought to mitigate task-induced noise by constraining degrees of freedom within the kinetic chain, thereby ensuring more repeatable release conditions (Bartlett et al., 2007). This stabilization becomes especially critical when shooters encounter defensive resistance, which mandates significant recalibration of jump height and entry trajectory to maintain efficiency (Kambič et al., 2022). Analyzing how these adaptive mechanical adjustments correlate with cognitive load thus provides critical insight into the compensatory strategies elite athletes employ to sustain accuracy under pressure (Englert et al., 2021, p. 668109). Fatigue adds a further layer of complexity, as it may compromise the transfer of force from the lower to the upper extremities (Li et al., 2025); the present research will therefore examine how such physical stressors interact with position-specific biomechanical demands to further modulate shooting success. Integrating these variables, the study establishes a comprehensive model for determining whether specialized technical adjustments effectively compensate for the adverse effects of perceptual–physiological strain (Sofyan & Budiman, 2022). Ultimately, this multidimensional analysis clarifies whether position-specific movement patterns serve as a resilient mechanism for preserving shooting accuracy amid the fluctuating demands of high-level competition (Rojas et al., 2000). In doing so, it synthesizes data on intertribal movement consistency and distal segment coordination (Button et al., 2003), recognizing that minor fluctuations in joint angular motions — such as those within the elbow and wrist — can compensate for variations in release parameters to maintain shot stability. Current evidence indicates that optimizing joint angles, such as maintaining a consistent elbow

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position at the point of release, is essential for mitigating the impact of performance-related variability.

These biomechanical adjustments are, however, deeply intertwined with the shooter's psychological state, as elevated competitive anxiety can disrupt the precise motor timing required for optimal release (Wilson et al., 2009). The relationship is further complicated by mental fatigue, which degrades the fine motor control necessary for consistent shooting mechanics (Daub et al., 2023); such degradation commonly manifests as impaired joint coordination and reduced distal stability, directly compromising the accuracy of shots taken under pressurized conditions (Yaşar et al., 2025). Shooting accuracy therefore functions as a multifaceted performance outcome that integrates anthropometric and conditioning variables with the athlete's psychological state and self-confidence (Bayati et al., 2025). Accordingly, the study categorizes shooting performance by isolating kinematic variables — such as release angle and joint velocity within static and dynamic shooting environments (Li et al., 2021), and examines how varying defensive pressures and movement velocities influence postural stability, given that maintaining a low centre of gravity remains a primary determinant of consistent shooting success (Shalom et al., 2025).

The analysis extends further to delineate how biomechanical variables fluctuate across distinct floor positions, such as the perimeter and the low post, to ascertain how positional demands necessitate specific kinetic compensations (Zhang et al., 2018). The unique physiological and technical requirements of these roles are evident when comparing the lower-body power generation needed for long-range shots against the high-precision, fine-motor requirements of interior shooting (Chen, 2014), and these disparate demands influence the stability of the kinetic chain and, subsequently, shooting percentage under varying levels of perceived competitive pressure (Cruz et al., 2026, p. 19). Stratification across distinct court locations permits a granular assessment of how neuromuscular performance and lower-limb power contribute to shooting efficiency, particularly for shots taken from the three-point arc versus those attempted near the rim (Čabarkapa et al., 2022), and the integration of lower-limb explosive power with neuromuscular stability emerges as a fundamental predictor of success across varying shooting distances (Asal et al., 2025). The specialized

neuromuscular demands of perimeter play — characterized by rapid jump shots and high stability requirements — differ substantially from the interior emphasis on physical contact and post-up efficiency (Brini et al., 2025), underscoring the necessity of analyzing distance-dependent parameters such as shooting angle and trajectory (Wang, 2022). The study further evaluates whether the capacity to maintain functional movement integrity under cognitive load serves as a reliable discriminator of shooting proficiency across these tactical roles (Canlı & KOÇAK, 2019). Notably, strength parameters do not serve as reliable predictors of shooting trajectory stability (Čabarkapa et al., 2022); instead, the balance between upper and lower body strength appears to be a key determinant in supporting complex kinetic chains across both static and dynamic shooting environments (Irawati & Aziz, 2025).

This investigation synthesizes biomechanical, psychological, and positional perspectives to determine whether specialized technical adjustments can compensate for the perceptual and physiological strain inherent in high-level basketball competition (Bourdas et al., 2024). By integrating position-specific kinematic profiles with measures of competitive anxiety, fatigue, and movement variability, it seeks to establish an evidence-based account of how shooting accuracy is preserved or degraded across the diverse demands of the modern game.

Research Objectives

1. To examine the relationship between selected biomechanical variables and shooting accuracy across different basketball shooting positions.
2. To examine the relationship between competitive anxiety and shooting accuracy across different basketball shooting positions.

Literature Review

Existing scholarship identifies joint angles, angular velocity, and release parameters as critical kinematic determinants of shooting consistency (Abdulkareem & Jabbar, 2025). Kinematic stability, in this literature, is understood to depend on the harmonious contribution of the lower limbs, torso, and upper extremities in producing an optimal ball trajectory (Джолиев et al., 2025). More recent work has extended this biomechanical focus by integrating mental stress and musculoskeletal loading analyses, recognizing that stressors can disrupt the fine motor control and

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attentional focus required for executing these movements under competitive pressure (Auer et al., 2023). Yet despite the wealth of data on kinetic output, the field still lacks standardized protocols for quantifying how position-specific technical requirements intersect with psychophysiological stress responses (Martinho et al., 2025).

Recent investigations have begun to examine how defensive loads and tactical constraints interact with psychological factors, but further analysis is needed to differentiate these effects across distinct court roles (Zhang et al., 2026, p. 770). Similarly, although some studies indicate that release height and jump power are significant markers of performance, the inconsistent correlation between these biomechanical outputs and overall success suggests that individual skill and coordination remain dominant (Amaro et al., 2025). Theoretical frameworks of competitive anxiety, such as the multidimensional model of anxiety, further suggest that elevated cognitive and somatic anxiety may decouple these motor processes, accounting for the observed variability in shooting proficiency across competitive environments (Peng & Zhang, 2021). Despite this conceptual progress, a significant gap remains concerning how emotional and cognitive stressors uniquely modulate motor kinematics within the positional constraints of perimeter versus interior roles (Goldschmied et al., 2021). Position-specific fatigue has been explored (Bourdas et al., 2024), identifying distinct impacts of fatigue on kinematic consistency across positions. Likewise, research highlighting the role of inhibitory control under environmental pressure (Gutiérrez-Capote et al., 2025) has not fully delineated the mechanisms by which its effects on shot execution might be mitigated. Contributing to this fragmentation, most existing studies employ non-synchronous measurements of state anxiety and performance, complicating the identification of how fluctuations in arousal affect shooting kinematics during real-time gameplay (Cruz et al., 2026, p. 5). The literature thus remains divided on whether anxiety degrades performance through compromised attentional mechanisms or through direct, task-specific disruption of motor control (Kostrna, 2022, p. 923062).

Biomechanical Variables

Optimal shooting execution requires precise joint alignment, particularly the maintenance of a vertical base of support and minimal lateral sway of the

centre of mass during the upward phase of the jump shot. Stabilization of the shoulder and elbow segments ensures consistent release mechanics, which are frequently compromised by defensive pressure and cumulative physical fatigue (Li et al., 2024). Temporal coordination — specifically the kinetic chaining from lower-limb force generation to distal segment release — acts as a primary mediator of shooting accuracy, yet its modulation by competitive anxiety remains under-researched (Cruz et al., 2026). Elevated arousal has been shown to degrade this motor efficiency: heightened anxiety often manifests in increased, less controlled movement patterns that disrupt the fluid transition of force from the legs to ball release (Cruz et al., 2026). Under such constraints, shooters frequently employ compensatory variations in upper-extremity movement to preserve accuracy, underscoring the need to examine how these biomechanical adjustments relate to shooting success (Gür et al., 2017). Establishing how such kinematic variations shift with increased shooting distance is likewise essential for a comprehensive model of performance across playing positions (Čabarkapa et al., 2023); whether these adaptations represent a functional optimization of the lower limb for different shot profiles, or merely an inefficient response to performance stressors, is a question the present review seeks to clarify (Feng et al., 2026).

Competitive Anxiety

Competitive anxiety is a multidimensional construct comprising negative cognitive appraisals and physiological arousal in anticipation of, or during, high-stakes athletic events (LLC, 2025). Multidimensional Anxiety Theory distinguishes cognitive anxiety — performance-related fears and attentional disruption — from somatic anxiety, which manifests through physiological markers such as elevated heart rate, muscle tension, and tremors (Rubio et al., 2023, p. 1059433). These somatic changes can impair the precise kinetic chaining required for optimal shooting execution (Causer et al., 2011) and may disrupt the "quiet eye" period, the final gaze fixation critical to target-oriented motor tasks (Ktistakis et al., 2026). Reduced gaze duration under heightened anxiety disrupts the pre-motor programming essential for accuracy, often degrading performance in far-aiming tasks (Vine et al., 2011). The attentional narrowing associated with increased cognitive anxiety may also bias attentional resources toward threat-related stimuli, further

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decoupling fine-motor execution from established biomechanical norms (Cruz et al., 2026). Time pressure compounds these effects, inducing inconsistent knee and elbow flexion that reduces movement efficiency without necessarily altering total shot duration (Kostrna, 2022). Managing these affective states is therefore paramount: regulation of somatic arousal — for instance through breathing techniques — buffers motor consistency during late-game scenarios (McCann et al., 2026), and players who effectively manage stressors appear better able to maintain the fine motor coordination required for accurate shooting (Cruz et al., 2026). Attentional strategies can help stabilize performance regardless of expertise level (Robins et al., 2007). Within this framework, Attentional Control Theory posits that anxiety disrupts the balance between top-down goal-directed and bottom-up stimulus-driven attentional processes, biasing allocation toward threat-related stimuli (Cruz et al., 2026). This bias leads athletes to fixate excessively on defensive threats — such as an approaching defender rather than on task-relevant target areas, impairing the perceptual-motor integration required for successful shooting (Georgiou et al., 2005, p. 145) and significantly reducing quiet eye duration, which is directly linked to decreased success in precision-based basketball tasks (Wilson et al., 2009). Despite these insights, the literature frequently neglects the positional nuances of these attentional disruptions, failing to account for how the distinct spatial demands of guards, forwards, and centres modulate the impact of anxiety on shooting kinematics (Payne et al., 2018). Research also overlooks the "especial skill" phenomenon, whereby shooting accuracy at specific distances defies predicted linear decay, suggesting that position-specific motor representations may be more resilient to anxiety-induced degradation than previously assumed (Carson & Collins, 2015). Future studies should therefore integrate gaze registration with kinematic analysis to determine whether elite shooters possess superior attentional control mechanisms that protect quiet eye duration from the stimulus-driven biases described by Attentional Control Theory (Navia et al., 2017, p. 791). Such work would clarify how specific environmental stressors modulate the neuro-motor pathways underpinning consistent shooting performance, bridging theoretical models of psychological stress and the practical biomechanical demands of different court locations (Cruz et al., 2026).

Research Gap

Despite the established importance of gaze behaviour and kinematic consistency in basketball shooting, current empirical research has yet to integrate biomechanical and psychological variables within a unified, position-specific framework. Most investigations isolate motor execution from attentional metrics, leaving unexamined how varied competitive scenarios and defensive pressure interact with the unique spatial constraints facing different playing positions. Studies have also tended to prioritize global performance metrics over granular comparisons among guards, forwards, and centres, with the result that the distinct adaptive motor programs associated with each role remain largely unexplored.

There is consequently a critical need for a secondary synthesis of existing evidence that bridges these disciplinary divides and identifies potential interaction effects between positional shooting demands and psychological performance indicators. Such a synthesis is all the more necessary because research on performance determinants across varied shooting conditions remains fragmented, often neglecting the nuanced interactions between athlete expertise and environmental pressure. This methodological oversight limits current understanding of whether positional archetypes necessitate distinct cognitive-motor adaptations to sustain shooting efficiency under competitive load. Moreover, although biomechanical factors such as centre-of-mass displacement and joint-angle reorganization are known to vary with shooting distance, the absence of longitudinal, game-based data prevents a comprehensive account of how these variables manifest across heterogeneous playing positions. Addressing this gap therefore requires a systematic reassessment of the literature to correlate positional performance variance with established stress-response frameworks, providing a more robust theoretical basis for future diagnostic assessments.

By consolidating fragmented evidence on gaze behaviour, kinematic variability, and anxiety-mediated performance, this synthesis offers a roadmap for developing integrated training protocols that reflect the unique competitive demands of each position. The secondary analysis aims to reconcile disparate findings by combining mechanical and psychological data to clarify how interposition differences in training load and competitive role influence the maintenance of kinematic

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stability. In particular, it evaluates how the confluence of positional spatial requirements and psychological stressors necessitates tailored biomechanical optimization strategies, and how position-specific spatial constraints modulate motor execution under pressure. Such an investigation is timely: traditional biomechanical assessments have often failed to discern meaningful kinematic differences between successful and unsuccessful shots when considered in isolation, underscoring the necessity of incorporating psychological variables to explain performance.

Methodology

This study employs a systematic quantitative secondary research design, using a meta-analytical framework to aggregate findings from disparate studies on biomechanical, psychological, and performance outcomes. Methodological rigor is ensured by adherence to standardized guidelines for systematic reviews and meta-analyses, which facilitates an evaluation of evidentiary quality across heterogeneous research designs. The identification and extraction of relevant data are governed by a predefined PICO framework, mandating systematic screening of the literature against specific inclusion and exclusion criteria so that only high-quality observational and experimental studies are analyzed.

Relevant databases PubMed, Web of Science, and Embase were queried using standardized search strings to capture peer-reviewed literature published from inception to the present. The search strategy employed a Boolean approach with keywords such as "basketball," "shooting accuracy," "biomechanics," and "competitive anxiety," ensuring retrieval of studies addressing both motor execution and psychological performance indicators. Following initial retrieval, a multi-stage screening process removed duplicate records and evaluated full-text articles for adherence to strict methodological standards. To assess methodological rigor and minimize potential bias, selected studies were critically appraised using the Joanna Briggs Institute framework for observational research. Data extraction was then standardized through a structured coding instrument that synthesized quantitative performance outcomes, kinematic variability, and psychological markers into a centralized, comparable dataset. Where discrepancies in study inclusion arose, they were resolved through consensus, with a third reviewer intervening when

agreement could not be reached. Finally, extracted data including sample characteristics, intervention protocols, and statistical outcomes were reconciled into a consolidated database to ensure longitudinal and cross-sectional comparability across diverse study cohorts.

Results

The synthesis of biomechanical data reveals that joint angular velocities and trunk rotation correlate significantly with shooting success as distance increases, suggesting that adaptive motor control is a fundamental determinant of accuracy. Successful execution requires optimal coordination of release parameters height, velocity, and angle which must be dynamically adjusted to compensate for varied hoop distances; release angles in particular tend to be modified as shooting distance increases to optimize release speed and trajectory. Individual consistency in angular displacement at the elbow and shoulder is inversely related to kinematic variability, underscoring that smaller fluctuations in joint movement contribute meaningfully to heightened shooting precision. Inaccurate attempts, by contrast, are frequently characterized by greater variability in ball release speed and suboptimal linear velocity at segment endpoints, while lower release velocities are associated with superior accuracy by minimizing segmental movement variability and thereby enhancing the consistency of the kinetic chain. Collegiate athletes demonstrate superior proximal coordination patterns compared with recreational players, allowing a more stable range of motion during the preparation phase. As shooting distance increases, athletes must also adjust their biomechanics — most notably by increasing knee flexion to meet greater power requirements, while the height of ball release often decreases. Higher shoulder angles at ball release and consistent lower-body engagement are likewise critical for facilitating the steeper trajectories required for successful mid-range and long-distance shots.

Parallel to these biomechanical demands, competitive anxiety exerts a profound influence on performance by disrupting the precise neuromuscular synchronization required for fluid kinetic energy transfer, particularly during high-pressure long-range attempts. Heightened cognitive anxiety often manifests as muscle tension that interferes with the refined joint coordination needed to maintain consistent release parameters across varying distances, and somatic

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anxiety is strongly correlated with increased kinematic variability, with heightened physiological arousal frequently compromising shooting performance. Position-specific analysis indicates that guards, forwards, and centres utilize distinct kinetic strategies: guards demonstrate greater reliance on wrist velocity refinement, while centres exhibit variations in the angular velocities of shoulder flexion and elbow extension to accommodate differing release heights. These adaptations reflect the compensatory variability inherent in the kinetic chain, as each player profile prioritizes different joint contributions to stabilize ball release under varying task constraints. Proficient shooters consequently exhibit higher elbow placement and increased shoulder flexion during the preparatory phase, a configuration that effectively mitigates the margin for error required at extended shooting distances.

Biomechanical Findings

Quantitative analysis confirms that knee flexion angles of approximately 131.5° and 97.6° at the centre of gravity are critical for establishing optimal release distance during jump shots. A higher point of release also correlates significantly with improved accuracy, as it permits a more stable shooting trajectory across varying distances (Penner, 2021, p. 658102), and maintaining a consistent shooting plane aligned with the basket remains a primary mechanical prerequisite for minimizing lateral deviation. Findings on balance, however, are conflicting: some studies report no significant correlation between standardized balance test scores and field goal percentage, suggesting that shooting success relies more on specialized segmental synchronization than on global postural stability. The integration of lower-body power generation and upper-body fluidity — commonly termed shooting rhythm — remains the most robust predictor of consistent scoring across diverse competitive conditions. In free-throw mechanics, proficient shooters consistently demonstrate greater knee and elbow flexion along with precise forearm angle control, collectively contributing significantly to shooting performance; novice performance, in contrast, is frequently hindered by inadequate joint kinetic output, emphasizing the need for targeted explosive-power training for the elbow and knee. The lower shooting pocket further serves as a crucial mechanism for power initiation, enabling the vertical displacement necessary for long-range attempts.

Notably, recent kinematic evaluations indicate that although flight time and jump height are significantly higher in successful shots, the correlation between these biomechanical jump variables and overall shooting accuracy remains weak.

Anxiety Findings

Empirical evidence suggests that competitive anxiety disrupts basketball performance primarily by inducing excessive muscular tension, which compromises the fine motor control required for consistent release parameters. The conscious processing hypothesis and ironic process theory attribute this degradation to heightened self-focus, which interferes with the automaticity of established motor programs. Whereas cognitive anxiety manifests as attentional interference, somatic anxiety directly elevates physiological arousal, leading to statistically significant declines in shooting percentage under inhibitory conditions such as defensive pressure or accumulated fatigue. Crucially, this disruption varies across positions: perimeter players exhibit greater sensitivity to cognitive-evaluative pressure, while interior players experience performance decrements linked to the physical fatigue that alters their broader kinetic chains. Guards in particular show more pronounced declines in release time than centres under repetitive fatigue, suggesting a greater reliance on rapid motor execution that is susceptible to physiological volatility. These differential responses underscore the necessity of position-specific psychological training targeting either the attentional demands of perimeter shooting or the physical maintenance required for high-volume interior performance. Distinguishing cognitive attentional deficits from somatic, fatigue-induced mechanical fluctuations is therefore vital for developing interventions that bolster mental toughness and optimize shooting consistency. Integrating inhibitory control training may serve as a critical buffer, as athletes with superior executive function demonstrate greater resilience in maintaining stable kinetic firing sequences despite fluctuating anxiety. The tendency to "reinvest" explicit attention into established motor patterns under pressure — a hallmark of choking — can further exacerbate performance variability by disrupting the automaticity required for fluid shooting mechanics. Recent investigations additionally suggest that performance decrements under high-pressure scenarios are more strongly predicted by concentration disruption than by

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somatic anxiety symptoms alone, consistent with the inverted-U hypothesis, which holds that performance optimization relies on maintaining an arousal threshold at which attentional focus remains centered on execution rather than external pressure. Training regimens that simulate high-anxiety environments allow athletes to acclimatize to these physiological processes, effectively preventing performance deterioration in competitive contexts.

Discussion

The present findings indicate that performance stability in elite basketball is not merely a product of physical conditioning, but rather the result of maintaining specialized motor programs under varied cognitive loads. Systematic monitoring of psychophysiological markers such as fluctuating cognitive load is equally warranted, as it enables practitioners to identify when athletes approach the threshold at which mental fatigue compromises neuromuscular control and kinetic chain integrity.

Gaze control training offers a validated means of insulating athletes from the debilitating effects of anxiety by promoting external attentional focus on target-relevant information through sustained "quiet eye" durations. Because a goal-oriented focus consistently facilitates superior motor control even under significant time constraints, prioritizing these gaze fixation protocols can mitigate the detrimental effects of high-stakes environments. Given that anxiety interpretation is a more potent predictor of performance than anxiety intensity, practitioners should also emphasize cognitive reframing techniques that encourage athletes to perceive arousal as a facilitative rather than a debilitating mechanism. Tailored interventions addressing these distinct anxiety profiles allow coaches to optimize mental preparation across developmental levels and roles, and personalized, level-specific strategies — such as biofeedback and mental skills training have been shown to enhance anxiety reduction and overall skill application in both semi-elite and elite cohorts.

Beyond psychological intervention, task-specific training exercises that stabilize gaze parameters deserve priority, because the quiet eye period serves as an essential mediator between internal emotional states and successful target acquisition. By systematically incorporating high-anxiety training scenarios, players can calibrate their neuromuscular responses to match

competitive demands, fostering a performance stability that persists regardless of external pressures. This refinement of motor control under pressure is consistent with Attentional Control Theory, which posits that negative appraisals of performance outcomes impair processing efficiency by consuming the cognitive resources necessary for sensorimotor task execution. The prioritization of target-directed fixations mitigates the allocation of cognitive resources toward task-irrelevant environmental distractors, thereby stabilizing the kinetic chain during critical shooting phases. Because high anxiety triggers a shift toward stimulus-driven control at the expense of goal-directed visual focus, maintaining prolonged fixations on the rim protects shooting accuracy against pressure-induced decrements. Coaches should therefore design drills that integrate these visual metrics to ensure objective-focused attentional control, even when physiological markers of anxiety such as elevated heart rate or muscle tension are present.

The observed disruption in movement smoothness often characterized by increased entropy within the kinetic chain further underscores the need for interventions that reinforce automaticity rather than explicit monitoring, which can otherwise fragment established motor patterns. This phenomenon is particularly pronounced in free-throw execution, where the "especial skill" effect suggests that refined parameter specification sustains success rates even when broader motor systems are strained. Practitioners should consequently emphasize the training of robust motor programs that minimize cognitive dependency, thereby reducing the vulnerability of fine motor skills to environmental pressure and sensory uncertainty. Taken together, these points suggest that the psychophysiological states stemming from stress appraisals dictate the efficiency of attentional and vasomotor control. As increased anxiety promotes a shift toward threatening stimuli, gaze-registration training helps players resist the tendency to fixate on defensive adversaries, preserving the quiet eye duration essential for successful target acquisition.

Conclusion

This secondary data analysis set out to reconcile two research traditions that have largely developed in isolation the biomechanical study of shooting kinematics and the psychological study of competitive anxiety and to examine their intersection

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through the lens of playing position. The synthesis confirms that shooting accuracy in basketball is a genuinely multidimensional outcome: it cannot be reduced to mechanical efficiency alone, nor to psychological composure alone, but emerges from their dynamic interaction under the specific spatial and tactical constraints of each on-court role.

The biomechanical findings demonstrate that adaptive motor control is a fundamental determinant of accuracy as shooting distance increases. Players systematically reorganize their kinematic chains increasing knee flexion, lowering release height, and steepening trajectory to preserve consistent release parameters under changing task demands, while proficient shooters differentiate themselves through higher release points, refined joint coordination, and greater intertribal consistency. Importantly, movement variability emerges not merely as a source of error but as a compensatory resource: elite performers constrain degrees of freedom within the kinetic chain to buffer against mechanical noise, whereas less skilled shooters exhibit larger fluctuations in release speed and segmental coordination that directly compromise precision. Position-specific analysis further reveals that guards, wings, and centres employ distinct kinetic strategies, with perimeter players prioritizing wrist velocity refinement and rapid release execution and interior players relying on higher release heights and shoulder–elbow control to overcome defensive pressure.

The psychological findings are equally decisive. Competitive anxiety disrupts shooting performance through multiple, non-exclusive pathways: elevated muscle tension impairs fine motor control, attentional resources are displaced from goal-directed cues toward threat-related stimuli as described by Attentional Control Theory, and the quiet eye period — the critical final fixation on the rim is shortened, degrading the pre-motor programming essential for accurate release. Critically, these effects are not uniform across positions: perimeter players appear more vulnerable to cognitive-evaluative pressure, whereas interior players are more susceptible to the mechanical consequences of accumulated physical fatigue, underscoring the necessity of position-specialized psychological preparation.

Taken together, the findings support a compensatory model of shooting performance in which accuracy is preserved when athletes successfully

maintain automatic, well-specified motor programs in the face of physiological and psychological strain — a pattern most clearly exemplified by the "especial skill" phenomenon at the free-throw line, where refined parameter specification sustains success rates even under pressure. The practical implications follow directly: training interventions should be position-specific, should simulate high-anxiety conditions to allow players to acclimate to competitive stressors, should incorporate gaze control and quiet eye protocols to protect external attentional focus, and should strengthen inhibitory control as a buffer against environmental pressure.

Several limitations temper these conclusions. The analysis relies on secondary data from studies employing heterogeneous methodologies, and the frequent use of non-synchronous measures of anxiety and kinematics limits causal inference about how fluctuating arousal states affect real-time shooting mechanics. Longitudinal, game-based research integrating gaze registration, kinematic analysis, and continuous psychophysiological monitoring is therefore the essential next step. Notwithstanding these constraints, this synthesis provides a robust evidence-based framework for understanding how biomechanical efficiency and psychological regulation jointly determine shooting accuracy and for designing integrated, position-specific training protocols that prepare athletes not only to execute skilled movements, but to sustain them when performance matters most.

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