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ИССЛЕДОВАНИЕ НЕЙРОФИЗИОЛОГИЧЕСКОГО ВЛИЯНИЯ ОКСИТОЦИНА НА РЕЗУЛЬТАТЫ КОМАНДНЫХ ВИДОВ СПОРТА

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AN INVESTIGATION INTO THE NEUROPHYSIOLOGICAL INFLUENCE OF OXYTOCIN ON TEAM SPORTS PERFORMANCE

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Аннотация. В статье исследуется нейрофизиологическое влияние окситоцина на результаты командных видов спорта, подчеркивается его роль в модуляции социальных эмоций, процессов восприятия и командной динамики. Окситоцин (ОТ) усиливает эмпатию, доверие, сотрудничество и социальную мотивацию членов команды, способствуя сплоченности и единству. Он улучшает интерпретацию невербальных сигналов и усиливает внимание к выражению лица, способствуя улучшению координации и коммуникации в команде на местах. Кроме того, ОТ укрепляет сплоченность и самобытность команды благодаря своей связи с этноцентрическими тенденциями, влияя на общую динамику команды и результаты работы. Понимание роли этого гормона в формировании спортивных результатов в командных видах спорта дает ценную информацию для оптимизации коллективной эффективности и повышения спортивных достижений.

Ключевые слова: окситоцин, эмпатия, сотрудничество, командные виды спорта.

Abstract: This article explores oxytocin's neurophysiological impact on team sports performance, highlighting its role in modulating social emotions, perceptual processes, and team dynamics. Oxytocin (OT) enhances empathy, trust, cooperation, and social motivation among team members, fostering cohesion and unity. It refines the interpretation of nonverbal communication cues and intensifies attention toward facial expressions, promoting improved team coordination and communication on the field. Additionally, OT reinforces team cohesion and identity through its association with ethnocentric tendencies, influencing overall team dynamics and performance outcomes. Understanding the hormone's role in shaping team sports performance offers valuable insights for optimizing collective efficacy and enhancing athletic achievements.

Keywords: oxytocin, empathy, cooperation, team sports.

Experiencing and expressing social emotions constitute fundamental aspects of human interaction, particularly within the context of social contexts, where emotions play a crucial role in guiding behavior, communication, and motivation (Plutchik, 2001). These emotional states result from a complex interplay of cognitive processes, past experiences, outward behaviors, and physiological responses, not only shaping individual experiences but also influencing those around them (Bartz, 2020, Mischenko, 2020).

Prosocial behavior emerges as a significant determinant of team performance in sports, serving as a means to convey social objectives and foster collaboration within team dynamics, thereby influencing both intra-team cooperation and competitive interactions. Athletes demonstrate a propensity for heightened emotional expression and sharing, underscoring the importance of emotions in sporting contexts (Snyder, 1990).

Despite the emphasis on negative emotions in sports literature, recent research highlights the profound impact of positive emotions on various cognitive processes, including attentional focus, cognitive functioning, and interpersonal engagements. Essential psychological factors such as motivation, commitment, and responsibility are integral to achieving athletic excellence, with sport satisfaction serving to bolster these qualities (McCarthy, 2011).

Among the neuropeptides implicated in positive emotional regulation and social behavior, oxytocin emerges as a prominent candidate, exerting significant influence over social motivation, trust, empathy, emotional intelligence, and altruism. Particularly in team sports, the ability to perceive and interpret the mental states of teammates and opponents assumes paramount importance, facilitating effective collaboration and decision-making toward common objectives.

Oxytocin's involvement in enhancing psychological skills essential for optimizing team performance underscores its potential as a pivotal neurochemical mediator in sports settings.

Social motivation stands as a foundational human imperative, intricately intertwined with various group affiliations such as family, culture, religion, nationality, community, politics, and occupation, with oxytocin emerging as a pivotal biological determinant of social motivation (Alvares, 2010).

Oxytocin serves as a mediator in numerous brain structures, including the amygdala and hypothalamus, which are intricately involved in processing and generating emotional responses. In humans, OT plays a crucial role in regulating positive social behaviors and cognitive functions, encompassing mate choice, bonding, parenting, sexual behavior, social memory, recognition, and attachment (Campbell, 2010).

Within the sphere of sports, characterized by emotionally charged social interactions pivotal for achieving athletic excellence, oxytocin assumes considerable significance for the expression of social emotions and the intricate processes of emotional perception, facial expression, and gaze recognition. The exhibition of a specific emotional state by an individual holds the potential to influence the emotional experiences, sentiments, and behaviors of others, thus shaping the collective emotional dynamics within sports teams (Parkinson, 1996).

Human empathy encompasses both cognitive and emotional dimensions, referring to an individual's capacity to cognitively and emotionally engage with the perceived experiences of others (Shamay-Tsoory, 2011). Cognitive empathy entails the ability to comprehend and appreciate the psychological perspective of others, discerning their emotional states and understanding their cognitive processes. On the other hand, emotional empathy involves experiencing emotional responses to the shared experiences of others, encompassing processes such as emotional contagion and shared pain (Shamay-Tsoory, 2011). In the realm of sports, athletes often rely on their ability to perceive and understand the internal states of others to anticipate their behaviors and actions, whether it be their teammates or opponents.

A study conducted by Hurlemann delved into the impact of oxytocin on empathy, utilizing the Multifaceted Empathy Test (MET) to gauge both cognitive and emotional empathy behaviors. The findings revealed that intranasal administration of OT led to heightened emotional empathy responses, irrespective of whether the stimuli were positive or negative, particularly in men, whose responses approximated those of women not administered with oxytocin. Additionally, a positive correlation was observed between plasma hormone levels and the degree of empathy (Barraza, 2009). Subjects exposed to emotionally charged videos exhibited a notable increase in plasma oxytocin levels, up to 47% above baseline, contrasting with those exposed to emotionally neutral videos, where OT levels remained unchanged.

Oxytocin exhibits gender-specific effects, with females displaying distinct responses compared to males following its administration (MacGill, 2017, Davidenko, 2024). Specifically, females administered with oxytocin exhibit accelerated reactions to socially relevant stimuli in comparison to males who receive the hormone. Moreover, subsequent to OT administration, females demonstrate heightened amygdala activity in the face of threatening stimuli, whereas males do not manifest a similar increase in amygdala activation. This gender discrepancy may stem from the influence of gonadal hormones, particularly estrogen, which augments threat processing in females by stimulating oxytocin release from the hypothalamus and enhancing receptor binding in the amygdala. Conversely, in mice, testosterone has been shown to directly inhibit oxytocin, potentially serving an evolutionary function by mitigating mental obstacles associated with activities like hunting and defense against intruders, which typically necessitate empathic challenges (Murphy, 1987).

Oxytocin's influence on fear and emotion processing extends to its modulation of neuronal activity within brain regions involved in facial perception and emotional expression recognition. Research indicates heightened brain activity in regions such as the left amygdala, gyrus fusiforme, and gyrus temporalis superior in response to fearful facial expressions, while activation in the gyrus

frontalis inferior increases in response to angry and happy faces (Petrovic, 2008). These areas play crucial roles in evaluating emotional cues, guiding gaze, and housing mirror neurons. Furthermore, OT exerts differential effects on distinct amygdala regions, suppressing activity in the lateral and dorsal regions during fear responses while enhancing activation in other areas during happiness responses (Gamer, 2010). This modulation of amygdala activity by oxytocin not only attenuates fear responses but also redirects attention towards positive social stimuli, promoting a more positive emotional state.

Notably, intranasal administration of OT has been associated with enhanced recognition of facial expressions of disgust, which are evolutionarily linked to the concept of contagion, suggesting oxytocin's involvement in heightening sensitivity to cues associated with potential threats to survival. Additionally, further investigations have unveiled oxytocin's role in enhancing the recognition of fear expressions, with individuals receiving OT showing improved ability to identify such expressions compared to those receiving a placebo (Fischer-Shofty, 2010, Romanova, 2022). This highlights OT's broader impact on emotional processing and social cognition.

The exchange of social emotions, facilitated by emotional transmission, plays a pivotal role in fostering trust, nobility, and altruism, which are fundamental psychological processes observed within group sports settings, contributing to enhanced team cohesion. Team cohesion, defined as the collective unity of a group in pursuit of shared objectives and the fulfillment of members' emotional needs, is a dynamic phenomenon crucial for effective team performance (Carron, 1998). Research indicates a positive association between high levels of team cohesion and improved athletic performance (Carron, 2004).

There has been a growing interest in understanding how intranasal oxytocin administration influences trust and generosity in human behavior. Exploring the intricate mechanisms underlying these social dynamics sheds light on the neurobiological basis of prosocial behaviors and interpersonal interactions. OT is implicated in the promotion of trust among individuals (Kosfeld, 2005). Experimental evidence from both economic studies involving monetary transactions and non-monetary interpersonal interactions suggests that oxytocin administration fosters heightened levels of trust (Mikolajczak, 2010). Furthermore, the hormone has been found to elicit increased demonstrations of generosity in individuals, further emphasizing its role in shaping prosocial behaviors.

In neuroeconomics experiments, intranasal oxytocin has been found to significantly increase generosity in the Ultimatum Game, where participants are prompted to consider the perspectives of others (Zak, 2007). However, OT's effect on altruism, as measured by the Dictator Game, appears to be less pronounced (Domes, 2007). The nuanced interplay between oxytocin and empathy may underlie these differential effects, with OT potentially enhancing perspective-taking and empathy in individuals (Domes, 2007).

Understanding the neurobiological mechanisms underlying human social behaviors is a complex endeavor, with oxytocin emerging as a key regulator of ingroup bonding and intergroup dynamics. OT has been associated with the formation of positive attitudes, such as bonding, toward individuals with similar characteristics, categorizing them as "in-group" members, while individuals with dissimilar traits are often classified as "out-group" members. This phenomenon is particularly evident in societal categorizations based on race, where individuals receiving nasally administered oxytocin exhibit heightened reactions to in-group members displaying pain compared to out-group members with similar expressions (Sheng, 2013). Additionally, OT promotes in-group trust, cooperation, and defensive but non-aggressive behavior toward competing out-groups. In a sport context, this would imply stronger team coherence and trust.

Oxytocin's influence extends beyond individual preferences to intergroup dynamics, particularly during conflicts between members of different groups. Studies have shown that individuals administered with OT display increased defense-motivated responses toward in-group members during conflicts, indicating a heightened sense of protection for vulnerable in-group members (De Dreu, 2010).

Moreover, oxytocin is associated with subjective preference alterations to align with in-group ideals over out-group ideals. This in-group bias is observed not only in smaller social groups but also on a broader scale, such as national identity. Research conducted in the Netherlands revealed that the hormone amplified in-group favoritism while diminishing acceptance of individuals from other ethnicities and foreigners. Additionally, OT has been linked to increased attachment to national symbols, suggesting a potential role in fostering xenophobic tendencies (Ma, 2014). These findings underscore the multifaceted impact of oxytocin on social behaviors and group dynamics, highlighting its role in promoting in-group cohesion and trust while influencing responses to out-group members.

The exchange of positive emotions among group members plays a vital role in fostering cooperation, a fundamental component of sports team performance (Barsade, 2002). Effective cooperation hinges not only on individual motivation but also on the assurance that others share a similar commitment to collaboration. Oxytocin can enhance cooperation, particularly when individuals possess prior social information about their counterparts and when strong incentives for cooperation are present. However, in the absence of established social connections, oxytocin may paradoxically decrease cooperation.

Investigations into the immediate behavioral and emotional consequences of social isolation in virtual team activities have shed light on oxytocin's role. Findings indicate that individuals ostracized from the group exhibit a heightened motivation to reintegrate compared to those who remain within the group (Alvares. 2010). OT amplifies the desire to reconnect with the same group members, thereby enhancing social engagement. Furthermore, communal social experiences and shared celebrations have been linked to improved team performance, particularly evident in contexts such as penalty strokes (Moll. 2010). This association may be attributed to the elevation of hormone levels and its subsequent influence on behavioral tendencies, underscoring the intricate interplay between oxytocin, social interactions, and team dynamics in sports.

Recent evidence suggests that oxytocin may also play a role in promoting ethnocentric behavior, which involves combining trust and empathy within in-groups while exhibiting suspicion and rejection toward outsiders. This phenomenon adds another layer to our understanding of OT's effects on social dynamics, highlighting its potential impact on team cohesion and interactions within sports settings.

In team sports, the accurate interpretation of others' emotions is paramount for effective communication and the transmission of social goals among teammates. The ability to perceive visual cues, particularly through directed gaze, plays a crucial role in identifying favorable action opportunities within the sporting environment. For instance, soccer players executing penalty kicks are perceived as more skilled and threatening when they display a higher frequency of glances toward the goalkeeper (Greenlees. 2008).

Communication in team settings often centers around the eyes, which serve as a focal point for establishing interpersonal trust and conveying emotional messages (Haxby. 2002). Understanding the nuances of body language and movements is essential for effective communication and learning through imitation. Oxytocin facilitates the focusing of gaze on socially relevant information, thereby enhancing the perception and recognition of others' emotions.

OT also aids individuals in making accurate assumptions about the internal states of others and adjusting their behavior accordingly. The RMET ("reading the mind in the eyes test") evaluates one's ability to discern the emotional mental state of others based on subtle facial cues. Administration of oxytocin has been associated with improved performance on the RMET compared to a placebo (Baron-Cohen, 2001). Additionally, research by Bartz et al. suggests that the hormone enhances emotional empathy, particularly in individuals with limited social experience (Bartz. 2010).

Moreover, oxytocin administration has been linked to prolonged and more frequent fixation of gaze on human faces, especially in the eye region, particularly when faces exhibit calm expressions

(Guastella, 2008). This finding underscores OT's role in enhancing emotion recognition, interpersonal communication, and socially oriented behaviors among individuals participating in team sports.

Oxytocin's impact on sensitivity to living objects' movements, rather than inanimate objects, holds significant implications for performance in collegiate sports (Keri, 2009). While previous studies investigating oxytocin's role in emotion recognition have primarily focused on facial expressions, recent research suggests that body language perception is equally crucial. Emotional body signals convey important information over greater distances than facial expressions and are vital for effective communication among athletes in competitive and training environments.

In team sports, athletes must decipher emotional body expressions to understand their teammates' intentions and emotions, particularly when communication occurs over long distances. Unlike facial expressions, which provide insights into the psychological state of an individual, body expressions offer cues about actions and volitional displays, which are particularly relevant for team sports performance. Understanding an opponent's confidence, competitiveness, and concentration through body language perception can significantly influence athletes' strategies and performance outcomes. Thus, enhancing athletes' ability to interpret emotional body language may offer valuable insights into optimizing performance in collegiate sports.

In the realm of competitive sports, envy and gloating often emerge as prominent social emotions, fueled by the intensity of rivalry among athletes. Experimental investigations have revealed that oxytocin amplifies feelings of envy in scenarios involving unfair monetary gains, while also heightening sensations of gloating when one's monetary rewards surpass those of fellow participants. This nuanced manifestation contradicts the conventional notion that the oxytocin system is solely associated with positive prosocial behaviors.

Indeed, OT's impact extends beyond facilitating prosocial interactions, encompassing instances of dishonesty and ethnocentrism within in-group dynamics. Studies have indicated that hormone administration can precipitate elevated rates of dishonest behavior, particularly when such actions are perceived to benefit one's in-group members (Shalvi, 2014). Furthermore, controlled experiments exploring the biological mechanisms underlying moral conduct have shown that oxytocin tends to promote dishonesty, particularly when the outcomes favor the collective interests of the individual's group over individual pursuits (Shalvi, 2014).

While oxytocin promotes in-group trust, cooperation, and defensive aggression towards external rivals, it concurrently evokes feelings of envy and gloating, underscoring its multifaceted and intricate effects. While fostering in-group cohesion is indispensable for bolstering social and professional unity in team sports, the potential emergence of negative behaviors like envy and aggression necessitates a careful balance. This delicate equilibrium underscores the complex role of oxytocin in shaping ethical conduct and group dynamics within the competitive landscape of team sports.

Conclusions: Oxytocin, a neuropeptide with widespread influence on brain structures, plays a pivotal role in modulating behavior, cognition, and affective states. Its primary association with prosocial behavior and positive emotions underscores its significance in fostering collective sentiment, cohesion, and coordination among members of sports teams.

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