



## EDITORIAL

# Does cognition play a role in injury prevention and return to play in the elite football player? A perspective from the field

## ¿Juega la cognición un papel en la prevención de lesiones y la vuelta al juego en el futbolista de élite? Una perspectiva desde el campo

Khatija Bahdur<sup>a</sup>, Ricard Pruna<sup>b</sup>, Henrico Erasmus<sup>c</sup>, Carles Pedret<sup>d,e,\*</sup>

<sup>a</sup> Nelson Mandela University, Port Elizabeth, South Africa

<sup>b</sup> F. C. Barcelona Medical Services, FIFA Excellence Centre, Barcelona, Spain

<sup>c</sup> University of Zululand, Kwadlangezwa, South Africa

<sup>d</sup> Clínica Mapfre de Medicina del Tenis, Barcelona, Spain

<sup>e</sup> Clínica Diagonal, Barcelona, Spain

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## Introduction

Cognitive ability is an important, and sometimes underrated, part of football performance. During a match, football players interact with multiple stimuli that target different sensory organs and triggers high cognitive demands that need to be linked with previous knowledge and experience and making and acting on decisions.<sup>1</sup>

A football match is dynamic with all these activities occurring instantaneously and any delays in the response possibly have a negative impact on performance.<sup>1</sup> Sequences in match play are not replicated, cannot be predicted with 100% accuracy and each player will approach a

situation in their own individual ways and rely on a combination of intuition, experience and laws which govern the game. Football matches also test other mental skills such as concentration, anxiety, attention shifting, muting negative thoughts and the subsequent physical reactions that accompany these skills.<sup>1</sup>

Johann Cruyff once said, "Football is a sport that you play with your brain".<sup>2</sup> The best players are the players who not only have the skill and tactical knowledge of the game but have enough perceptual and cognitive ability to outplay other players.<sup>2</sup>

Injury is common in elite football with significant consequences and re-injuries as a major concern. If we could be able to introduce strategies to reduce the risk of incurring to an injury or even to accelerate the recovery time after an injury and reduce the re-injury risk in players then, this can contribute greatly to the performance of the individual and the team.<sup>3</sup>

\* Corresponding author.

E-mail address: [drpedret@gmail.com](mailto:drpedret@gmail.com) (C. Pedret).

## Cognition skills and injury management

The first question that arises is if there could be a relationship between cognition and injuries during soccer matches. Game intelligence is a key part of performance and encompasses numerous parameters including information processing, experience, decision-making, reaction time, memory and recall, vision, sensorimotor processing, attention, anticipation, cognitive styles, time, and space perception. Potential stressful athletic situations can contribute to injury.<sup>4,5</sup> Stress leads to decreased neurocognitive and perceptual processes, increasing reaction times, and compromising game intelligence. Exposure to stressors for extended periods also decreases communication between the left and right hemisphere of the brain compromising decision-making. Decreased decision-making ability has been related to increased injury risk according to literature.<sup>1,6</sup>

Injury rate is higher in matches than during training so, it is important to analyse the additional risks associated during a match. One of the most important aspects is the fact that matches have higher levels of unanticipated actions, and training situations tend to be more controlled. The cognitive and decision-making elements as well as pressure situations linked with matches can result in changes in biomechanics and execution of actions.<sup>7</sup> This highlights the importance of cognitive training as a part of injury prevention. Skill levels also correlates with the changes in biomechanics during football actions in matches and in training.<sup>7</sup>

Stress management is one of the key tools used to both improve decision-making and subsequently decrease injury risk. Decreasing stress levels, it can be reduced the activation of the amygdala which improves the player attention and the decision-making process. Other interventions that have also given good results are aimed at teaching players how to improve attention and be more mindful in both training and matches.<sup>6</sup>

While attention itself is important, it is also important that players develop the skills to shift their attention. Players need to have sport specific knowledge and learn what, when and where to focus on it. There are periods in the game when players must broaden their focus and when to narrow it. Broad focus refers to accessing numerous stimuli and seeing the bigger picture, whereas a narrow focus is when a player zooms into specific stimuli. Players must also know when to broaden and narrow their attention. The ability to identify when and how to adjust attention can be taught during training by increasing a player's awareness to what type of information he needs in different situations. These skills should be included in talent development programmes. These skills can be taught by increasing their conscious awareness in training when starting out with cognitive training. Other interventions aimed at getting players learn to 'switch off' negative thoughts and also when to switch off during in-match breaks and refocus when is needed. Players can be taught these skills and use key words or phrases as triggers.<sup>1</sup> Self-talk is one of the greatest weapons a player has. In addition to helping players let go of mistakes and focus on the present, it can also translate into better body language and movements for the player.<sup>8</sup>

Visualisation and relaxation interventions and strategies can also be used to reach the objectives. Visualisation

enables the body to go through physiological changes without any movement and to store the patterns in the temporary memory. These patterns can then be converted into the short or long-term memory.<sup>1</sup> Teaching players to relax before and during matches decreases stress and anxiety levels and can reduce their risk of injury.

Another important question is how previous injury history is related to cognition and how it might affect injury risk. It is well known that one of the most important risk factors of an injury in sport is a previous history of injury. Previous injury is usually viewed from a physical and/or musculoskeletal perspective. However, there are also psychological impacts associated with injuries. Players who have returned from an injury may experience higher levels of stress and anxiety as a result of their fear of having a re-injury or a new injury. This can influence the players confidence in their body to execute actions that they assume that might lead to a recurrence of the injury.<sup>1,9</sup> Findings that can suggest relationships between psychological factors and an increased risk to injury should also be investigated and incorporated into injury prevention strategies.

Normally, injury prevention techniques are focused on controlling the training loads and intensities, but the type of training and how it is done is also important. For example, it is recommended that conditioning programmes must incorporate proprioceptive, balance (static and dynamic) training, plyometric training, strength and resistance training, eccentric training, decreasing bilateral and reciprocal muscle imbalances, core training and stabilisation exercises, co-ordination training, dynamic and reactive neuromuscular control, exercises to increase stability of the ankle and knee, visuo-perceptual training, flexibility, agility, body and special awareness and technique (running and football skill) training.<sup>10-16</sup> The mentioned forms of training must incorporate functional training and should include cognitive and perceptual elements when it is possible.

Regarding concussion as a previous injury, it is expected that concussions would impact cognitive ability, but there is also evidence indicating that neuromuscular imbalance can have a negative impact on cognitive skills as well.<sup>17</sup> The question is if practically significant improvement in cognitive performance can also help minimise injury risks?

The next important questions which arises is if cognitive training can be integrated into normal training inside and outside the field. Concerning training on the soccer field, the most important aspect is the warm-up which is a vital component of all training sessions and matches. Numerous things must be considered when designing the warm-up. The physical and mental state of the players, training loads of the previous day, weather, intensity, and type of planned training session. It is important to observe players during the warm-up. It is very frequent that players perform a warm-up just mechanically because they have done it so many times before and, instead of focusing on the quality of their warm-up they just desire to get through it. This fact can compromise muscle activation. Warm-ups should vary almost every day and should include exercises that can create the right atmosphere for the training session ahead. Coaches must also know when to use intensive and when to use extensive warm-ups.

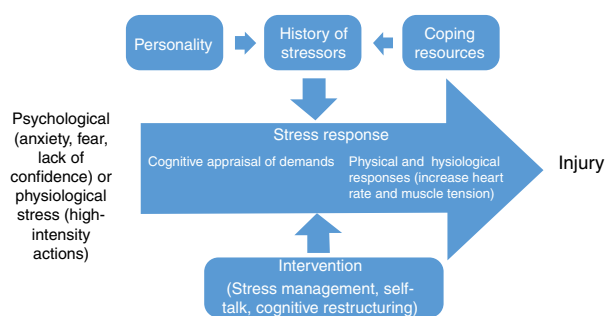
Normally injury prevention, visual skills exercises and mental skills exercises are incorporated into the warm-up.

Warm-ups must meet the neuromuscular needs for every specific sport, it should be dynamic in nature, and focus on the muscles and movements required for the activity that follows. The intensity should be monitored. Finally, warm-ups incorporate both physical and mental elements of the game.<sup>18</sup>

Managing cognitive aspects in players is often used during periods away from the training soccer field and generally this is related to managing psychological stress. To manage physiological and psychological stress are key elements in preventing injuries.<sup>19</sup> Physiological stress can be monitored by keeping track of internal loads and physiological parameters such as heart rates, breathing rates, muscle soreness, and fatigue blood markers. External loads such as number of high-intensity actions, accelerations, distances covered, etc. can also be considered to provide information on physiological stress. It is important that technical teams identify periods when players are under high physiological stress and fatigue, in order to adjust individual and team workloads during training macro and micro cycles and periodisation plans, as well as to help decide which recovery techniques to use and when to use them.<sup>20</sup> Players recovery period is another important way of managing physiological stress and thus it is important for injury prevention. Recovery techniques can vary from cheaper options such as proper cool-down strategies and flexibility sessions, ice baths, massage, good sleep strategies, nutritional strategies, use of compression garments and can extend to more expensive equipment such as the use of hyperbaric chambers.<sup>21</sup>

A key point in the duration of the recovery time and the return to play process is the cognitive appraisal. After an injury the focus is normally on players to make them be physically ready to play again at the same level than before the injury, but it is also important that a player believes that he is really ready and has the mindset to play. The cognitive skills of a player can impact both the physical and the psychological recovery outcomes and dictate the emotional response during the rehabilitation process. Improving cognitive skills can, in this way, affect the behavioural responses and contribute to the success of the recovery plan.<sup>22</sup> Teaching players skills such as positive talk can improve their confidence and help them stay motivated through the recovery process.<sup>1,22</sup>

Managing physiological and psychological stress is also important for football performance and injury prevention. Injuries are more likely to occur when players feel depressed,<sup>23</sup> angry or are faced with feelings of loss and grief and even stand with homesickness.<sup>23</sup> Psychological interventions should be an important part of the injury prevention programmes. High levels of stress and anxiety impact the players' perceptual (through narrowing peripheral vision, distracting visual and auditory cues), cognitive (impairs decision, making, attention shifting, spatial recognition etc.), physical and physiological (increases muscle tension, decreases reaction time) performance. There are fewer injuries after stress management training. So, the improvement of mental skills and the ability to control them can be translated into both physiological and psychological changes.<sup>24,25</sup> A study which examined soccer players with at-risk psychosocial profiles showed significant positive results in terms of decreasing injury incidence after applying an injury prevention programme considering these strategies.<sup>26</sup>



**Figure 1** Cognitive appraisal of demands in stress response. Adapted from Williams J & Anderson M. 1998.

The intervention strategy consisted on training in 6 mental skills over a period of nineteen weeks during the competitive season. In addition, this mental skills training included elements of imagery and visualisation, positive self-talk, and use of relaxation techniques that have shown success in decreasing injury incidence.<sup>24</sup> Ivarsson et al. in 2013 in a study with professional Swedish soccer players concluded that sports medicine clinicians could implement a preseason stress assessment to adjust players' training loads to prevent potential injuries and fatigue.<sup>27</sup>

Another factor is anxiety, and it is important to control it. High levels of anxiety can lead to players feeling greater amount of muscle tension and may lead to fatigue and motor co-ordination problems compromising their ability to execute their actions and increasing the risk of injury.<sup>4,24</sup>

Pain is another element worth mentioning. In order for pain to be felt, it must be perceived which requires a cognitive process where attention is directed to the noxious stimulus. Pain is a warning signal and by paying attention to it, the brain can take conscious of an external aggression and perform a reflex action to manage the injury or, even better, to deal with the injury mechanism.<sup>28</sup> Focused attention is also an important cognitive skill.<sup>1</sup> It is useful, not only in performance but also in dealing with injuries. Sometimes players need to pay attention to their pain to be conscious of it to prevent further injury, but some other times this attention should be diverted from the sensation of pain (i.e. during the treatment or rehabilitation process).<sup>28</sup> With coaches that still have traditional views, playing with and through pain is valued (Fig. 1).<sup>29</sup>

It is well known that physical training effects are reversible when training stops or decrease, but it is still unknown the longevity and the reversibility of cognitive skills and interventions. More research must be done in this area to understand how often and for how long cognitive interventions should last and how they should progress.

In conclusion injury prevention techniques do not work on a one size fits all philosophy. It is important to consider gender, age (both chronological and biological particularly for youth players and soon has to be described the cognitive age), genetics, level of play, and other individual characteristics.<sup>15</sup> While the focus is often on the physical, here is evidence indicating that the cognitive and mental characteristics of an individual can also lead directly and indirectly to injuries. Thus, it is important that these factors are considered when designing and implementing injury

prevention programmes and helping players with injury management.

## Conflict of interests

Authors declare that they don't have any conflict of interests.

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