

## Hydroneutritional aspects of football

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Hydration and nutrition are very important aspects of football. A brief analysis of the physiological characteristics of football (using soccer as an example) indicates that all power systems/metabolic pathways are activated during match play, muscle glycogen being the primary energy substrate. Various hydroneutritional factors, such as glycogen depletion or dehydration could induce fatigue and hinder performance of football players. However, the onset of fatigue can be delayed by adopting sound hydroneutritional strategies before, during and after football training and/or competition. The main aims of these strategies are to optimize muscle and liver glycogen stores on a regular basis; stay well hydrated at all times; and take advantage of every opportunity to ingest fluids and fuels during matches.

KEYWORDS: soccer, physiology, fatigue, glycogen, carbohydrate, fluid.

### INTRODUCTION

Sound hydration and nutritional strategies have been shown to be performance-determining factors in prolonged, continuous moderate-to-high intensity exercise. Although the impact of these strategies on performance during intermittent, high-intensity exercise that characterizes football (soccer) has not been extensively studied, there is enough scientific evidence available to suggest that football-specific hydroneutritional strategies can have a major impact on performance. The purpose of this article is to provide, based on the specific physiological characteristics and energetic demands of football, and considering the hydroneutritional factors that could contribute to fatigue in football, a series of guidelines on hydration and nutrition for enhancing the performance of football players.

### PHYSIOLOGICAL CHARACTERISTICS OF FOOTBALL

Like most team sports, football can be described as intermittent high intensity exercise. From a physiological perspective, the sport is characterised by the long distances covered by the players during match play (8 to 12 km), but also the variable activity pattern (>800 activity changes per match, including walking, jogging, cruising, sprinting, backing, jumping, tackling and heading)<sup>4,11</sup>. This activity pattern determines to a great extent the physiological requirements of football. As shown by physiological measurements conducted during match play, these requirements include not only a high aerobic capacity, but also a high glycolytic capacity and a well-developed phosphocreatine breakdown/resynthesis system<sup>1,3</sup>.

### HYDRONEUTRITIONAL FACTORS THAT COULD PRODUCE FATIGUE IN FOOTBALL

Muscle glycogen depletion has been shown to cause a reduction in the distance covered by football players during the second half of a match<sup>12</sup>, but its influence on football specific skills has not been well established. Dehydration, on the other hand, is directly related to reduced exercise capacity, increased perception of effort, and deterioration of mental performance and football skill performance<sup>8</sup>. Other hydroneutritional factors that could produce fatigue in football include hypoglycemia, other mechanisms of "central fatigue" involving neurotransmitters, hyponatremia, and gastrointestinal discomfort and upset<sup>2</sup>.

### HYDRONEUTRITIONAL STRATEGIES BEFORE COMPETITION

The "Scandinavian dissociated diet", a carbohydrate (CHO) loading regime consisting of three days of CHO depletion by means of very low CHO intake (20%), followed by three days of very high CHO intake (80%) is a classical strategy to increase muscle glycogen content before endurance competition. However, a modified strategy consisting of increased CHO intake during the

week prior to competition without the previous depletion phase, coupled with tapered training seems to be more appropriate for football, given that competition usually takes place on a weekly basis.

Recommendations before competition include<sup>2</sup>:

- ensure an adequate initial muscle glycogen content, choosing CHO-rich foods low in fiber to avoid gastrointestinal problems (7-10 g CHO/kg/day),
- ensure an adequate hydration status, consuming extra fluids in the days prior to competition,
- the pre-event meal should increase CHO availability (1-4 g CHO/kg),
- choose CHO-rich foods or drinks with low Glycemic Index,
- drink 300-600 ml with the pre-event meal, then 150-300 ml every 15-20 minutes up until 45-60 minutes before the event,
- drinking 300-400 ml (5 ml/kg) immediately before the event could induce gastric distension and enhance gastric emptying,
- practise all pre-competition nutritional strategies.

### HYDRONUTRITIONAL STRATEGIES DURING COMPETITION

Both fluid and CHO intake may have an influence on performance during football. A negative fluid balance is a common feature during football matches, given that the rules of the sport limit the opportunity for players to rehydrate. In addition, the intermittent nature of football has been shown to delay gastric emptying<sup>6</sup>. Moreover, scientific evidence indicates that repeated CHO drink intake during either simulated or actual football has beneficial effects on high intensity exercise capacity at the end of a match, and also on the results of soccer specific skill tests<sup>9,10</sup>.

Recommendations during competition include<sup>2</sup>:

- drink 150-300 ml (2-3 ml/kg) every 15-20 minutes, depending on climatic conditions, sweat rate and gastric tolerance,
- plan to consume 30-60 g CHO per hour, choosing a cool (10-15°C) palatable drink with a concentration of 5-7%,
- the type of CHO is not very important, but fructose and galactose alone are not recommended; maltodextrins and other sugar combinations are a good option, as long as fructose is not the main component,
- avoid fibre, protein, high CHO concentration and high osmolality,
- practise all hydronutritional strategies before trying them in competition.

**HYDRONUTRITIONAL STRATEGIES AFTER TRAINING/COMPETITION**

Fluid and CHO ingestion should start as soon as possible after a training session or a match. If adequate amounts of CHO are not ingested within two hours of exercise, muscle glycogen synthesis is significantly delayed thereafter<sup>5</sup>. This has important implications when multiple training sessions take place each day, or repeated matches are played during a tournament. Whereas some factors (e.g. depleted glycogen stores, immediate CHO intake and adequate amounts of CHO) enhance the rate of muscle glycogen restoration, other factors have little influence (e.g. gentle exercise, spacing of CHO intake, other nutrients in meals) or a detrimental effect (e.g. muscle damage, delayed CHO intake, inadequate amounts of CHO, reliance on foods with a low Glycemic Index, prolonged and high-intensity exercise)<sup>2</sup>. Moreover, to achieve fluid balance after exercise-induced dehydration, fluid ingestion should amount to 150% of fluid losses and electrolytes should be added to the ingested drink<sup>7</sup>.

Recommendations after training/competition include<sup>2</sup>:

- ingest 1-1.5 g CHO/kg every two hours for rapid post-exercise recovery of muscle glycogen,
- ingest 7-10 g CHO/kg/day to maintain adequate daily muscle glycogen content,
- initially choose "dense" CHO with high Glycemic Index (e.g. low-fibre drinks, energy bars)
- time between meals has no influence as long as enough CHO is ingested,
- muscle damage hinders glycogen storage, increasing CHO needs,
- in the 2-4 hours post-exercise, drink the equivalent to 150% of fluid losses, choosing cool (10-15°C) flavoured drinks with CHO and electrolytes,
- when fluid losses are large (> 2 l), add Na to rehydration drinks (2-5 g/l),
- avoid fluids containing caffeine and alcohol, and hot environments.

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