
Chapter 1

Does Nutrition Affect Performance?

Does nutrition affect soccer performance?

Nearly every soccer training or coaching publication talks about the importance of proper nutrition and adequate hydration. Coaches, exercise scientists and nutritionists all argue that in order to achieve peak performance, a proper diet is a must.

There is no doubt that training and competing require the soccer player to expend tremendous amounts of energy. This energy must be replaced by the foods eaten. However, does it really matter what kinds of foods are eaten or is it just a matter of consuming enough calories? Do the types of foods eaten actually affect performance on the pitch?

To answer these questions, it is important to approach the relationship between diet and performance from a broad perspective. The history of diet and performance explains how the fundamental concepts of sport nutrition evolved. As for research, there is a wealth of evidence linking diet and athletic success in other sports. In addition, research shows how proper diet can improve or diminish soccer-specific performance.

Why are more goals scores near the end of the match?

It is fairly clear that more goals are scored near the end of a match than at the beginning. Several research studies and technical reports clearly show that more goals are scored as the match progresses. For example, Figure 1-1 was taken from the Technical Report of the 2010-2011 UEFA Champions League competition. The data show an undeniable trend in goals scored during the later minutes of the match. Why is this? Why are more goals scored in the final 15 minutes than at any other time

of the match?

That is a very difficult question to answer definitively because there are so many variables involved. Substitutions patterns and tactical strategies clearly play a role. Trailing teams often substitute an attacking player for a defender and may “throw everyone forward” to equalize. As teams are pushing forward they may score or they leave themselves vulnerable to being scored on. These changes could certainly lead to greater goal scoring after the 60 minute mark. Thus, there may be strategic reasons why more goals are scored late in the match.

Fatigue probably also plays an important role. As both defenders and attackers fatigue, mistakes become more likely. Defensive mistakes can be quite critical as the result can be a goal conceded. Fatigue is also going to be more of an issue in a less fit player. If that player is in the back, the chances of giving up a goal increase.

Perhaps the more important question is how can a team put themselves in a position where they are less likely to concede a critical goal or score a game winner in the closing minutes? If fatigue plays a role in the score line at the end of a match, it stands to reason that avoiding fatigue can improve the chances of securing the desired match outcome.

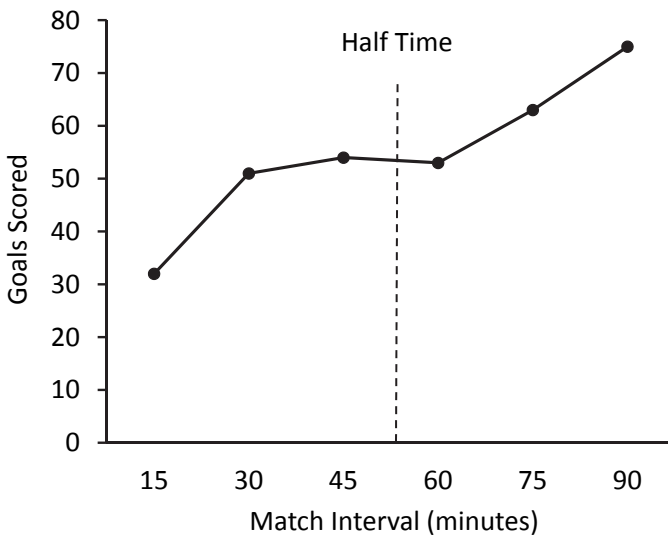


Figure 1-1 *The number of goals scored during 15 minute match intervals. The data used in this figure were taken from the UEFA Champions League Technical Report 2010/11.*

One way to avoid fatigue is through fitness training. Another is through the diet. Research clearly shows that players who follow a solid nutritional plan are better able to perform at the end of a match than competitors with a poor diet. High intensity running, shot velocity, decision making as well as goal scoring and defending at the end off a match are all improved through a solid diet. Those who do not follow sound nutritional advice often suffer from fatigue, lethargy and loss of skill. A simple change in diet could increase the team's chances of scoring and improve their ability to defend effectively. What you eat can influence how you play. Preparing well for a match means training properly. However, it also means eating the right foods, in the right amounts and at the proper times.

A look back at the athletic diet

Diet and performance have been closely linked since the ancient Greeks began competing in the first Olympics. At that time, the Greek diet was largely vegetarian. Cereals, fruits, vegetables, nuts and beans were the major components of the diet. Meat was not found on many menus, partly because of economic reasons. Also many meat animals were domesticated and used for work, milk or wool rather than for food.

As for athletes, there are a few written accounts of their diets. The Spartan Olympic champion, Charmis was said to have trained almost entirely on dried figs. Perhaps as a sprinter, Charmis benefited from the sugar found in figs and what would be considered a high carbohydrate diet. On the other hand, Milo of Croton whose feats of strength and wrestling prowess were legendary, included large amounts of meat in his diet. The addition of protein in the diet may have aided Milo in developing muscle mass and strength. Interestingly, late in his career, a younger competitor thwarted Milo's attempt at a seventh Olympic wrestling title. This younger athlete was able to extend the match and eventually win when fatigue overcame the champion. Perhaps Milo's high protein diet left him without the necessary energy stores to compete in what seems to have amounted to an endurance event.

As is the case today, supplements and nutritional aids were quite common in ancient times. Athletes ate items like lion hearts because they were believed to impart bravery, speed and strength. Mushrooms, certain berries and herbs as well as wine were consumed to enhance physical and mental performance and to stave off pain. Athletes may have also benefited from the added carbohydrates found in berries and wine.

Fast-forward to the early 20th century as the field of sport nutrition began to evolve. In 1924, researchers measured blood glucose from the first 20 finishers of the Boston Marathon. They found that hypoglycemia (low blood glucose or low blood sugar) was related to fatigue, stupor and lack of concentration. The following year, these same athletes were given high carbohydrate meals during the days before the race and supplemented with pre-race candy. At the end of the race, blood glucose was maintained. Also, feelings of fatigue and mental exhaustion were avoided.

Later, in 1932, famed exercise scientists D.B. Dill and H.T. Edwards found that giving their dog “Joe” a carbohydrate supplement in the form of candy had remarkable effects on performance. With the supplement, Joe exercised for 17 hours, nearly three times longer than without the candy.

About this same time, protein was found to be important for improving some types of athletic performance. Several studies found that increasing protein in the diet did not affect endurance performance. However, it could enhance muscle mass and strength gains when eaten as part of a weight training program. This eventually led to the development of “training tables” for strength and power athletes that consisted of large amounts of beef and milk.

Despite the research linking carbohydrates and athletic performance, many performers were slow to capitalize on this concept. In the 1936 Berlin Olympics, the pre-event diet for most athletes was high in protein and consisted of beef, chicken and eggs. There were however, some exceptions to this high protein menu. Athletes from Britain, Holland and Finland regularly ate porridge; Italians dined on pasta and the Japanese teams diet included large amounts of rice. Fruits and vegetables provided a rich source of vitamins and minerals. Nevertheless, when compared to their national average, most Olympic athletes at these games ate higher amounts of protein and fat and fewer carbohydrates. This probably reflects the emphasis on high protein foods that also contain significant amounts of fats such as beef and pork.

Today, sports nutrition has evolved into an intricate science. Athletes now know that diet plays a critical role in achieving peak performance. They also understand that proper nutrition is not simply a matter of calories consumed and that an effective diet is not constant for all sports. Specific components depend on the energy requirements of the sport and the goals of the training program. That is, nutritional needs of the weightlifter, marathoner and archer differ. Also, the pre-event meals

for a sprinter, endurance athlete and skill performer may differ.

Back to the original question, does diet affect soccer performance? The history of sports nutrition and activities similar to soccer show benefits of a proper diet to performance. Endurance as well as sprint performance can be maximized by an emphasis on a diet rich in carbohydrates from breads, fruits and vegetables that also includes protein found in meats, beans, and dairy products.

Diet and exercise performance

Performing well in a soccer match requires a significant endurance component. That is, fitness plays a key role in how well the player plays, especially at the end of the match. There is a long history of research showing how diet can affect endurance performance. Since the beginning of the 20th century, scientists have shown that exercise lasting 60-90 minutes requires a considerable amount of energy. The sources of energy used during exercise (primarily carbohydrates) are stored within the muscle as well as in other locations within the body. The amount of energy stored, depends largely on the athlete's diet. Diets high in carbohydrates result in greater storage whereas high fat diets leave energy stores wanting. Research indicates that athletes who have greater carbohydrate stores at the beginning of endurance completion can exercise longer and perform more high intensity work during the later stages of competition.

Not only does the pre-event diet affect performance, providing carbohydrate supplements during activity can greatly improve the athlete's ability to compete. A third area where diet affects endurance performance is during recovery. Research shows that taking in carbohydrates shortly after prolonged exercise replenishes energy stores much more effectively than consuming fats and proteins. This routine ensures that the endurance athlete is prepared to train or compete on days following long-term exercise.

There is also a growing body of research pointing to the brain's role in diminished physical performance resulting from poor nutrition. Both muscle and the brain rely on carbohydrates as a fuel source. The Boston Marathon studies performed in the 1920's hinted that as blood glucose declines during exercise, feelings of fatigue occur. By providing carbohydrates before and during the race prevented these psychological effects from affecting performance. This is a common response often seen in athletes in a fatigued state. A lack of "energy" and feelings of "being

off” are often seen in players said to have “low blood sugar”. More recent research shows that as the athlete depletes carbohydrate stores and develops hypoglycemia, psychological factors such as mood state, cognitive function and decision-making can be impacted. That is, it becomes more difficult to keep one’s “head in the game” when blood glucose drops. By providing adequate nutrition, many of these negative effects on the mental side of performance can be minimized.

The mental consequences of low blood glucose are more complex than simple psychology and motivation. There may be a biological link. Because the brain uses carbohydrates as a fuel, hypoglycemia affects the central nervous system and its ability to fully activate muscle contractions. This in turn, prevents the athlete from giving a maximal effort. Fortunately, a proper diet can help the player avoid this situation. Starting a match with adequate energy supplies and providing carbohydrate supplements during play can help prevent the brain from limiting performance.

Diet and soccer performance

It’s clear that diets lacking carbohydrates can affect both muscle and brain during exercise lasting the length of a typical soccer match. Poor nutritional choices can lead to both mental and physical fatigue across a wide variety of sports and physical activities. The earliest piece of evidence indicating that diet affects soccer performance is a study done in 1973. In this study, a single team was followed for an entire season. Prior to 20 matches, players were given a glucose syrup supplement and during the other 20, no additional nutrition was provided. As expected, glucose syrup ingestion prevented the decline in blood glucose that typically occurs over the course of the match. As for performance, there was a steady increase in goals scored in the second period and a decline in goals allowed when the team drank the glucose syrup (see Figure 1.2). In fact, for the final 15 minutes of the glucose matches, more than twice as many goals were scored compared to the control matches. Also, nearly zero goals were allowed.

That same year, researchers found that when players ate a low carbohydrate diet, a smaller portion of the match was spent performing high intensity running and more time spent walking, compared to a player who ate a normal diet. This link between diet and performance was later extended by a group of Swedish researchers. They found that increasing the carbohydrate content of the diet resulted in 33% more high intensity activity during the match. Thus, it is clear that diet, specifically the

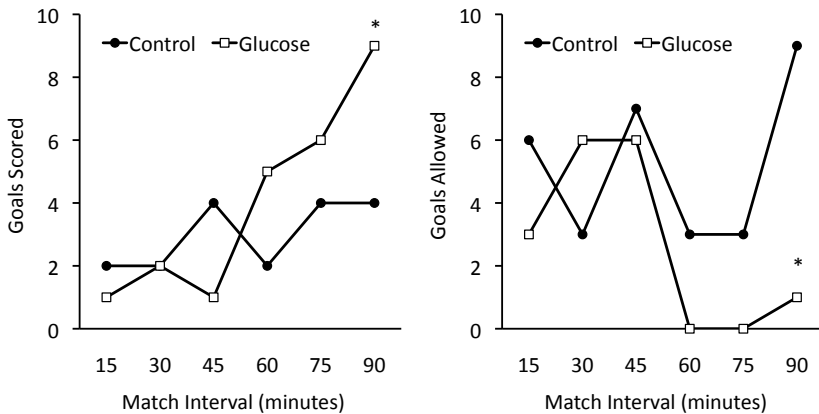


Figure 1.2 *The effects of a pre-match glucose syrup supplement on the number of goals scores and goals conceded. From Muckle (1973)*

carbohydrate content of the diet, affects the ability of the player to perform at a high intensity throughout the match. Perhaps this improved ability to work harder lead to the improved goal differential shown in Figure 1.2.

More recent studies also show that carbohydrate supplementation, usually in the form of a beverage can help the player maintain technical performance as he or she begins to fatigue. As the match progresses and fatigue sets in, several technical aspects of the game begin to deteriorate such as passing ability, dribbling and shot speed and accuracy. By providing carbohydrates before and during the course of the match, many of these adverse effects can be minimized and technical skill maintained For example, giving players carbohydrates helps them maintain their shot velocity, precision and accuracy during the later stages of a match (Figure 1.3). In addition, other studies show that carbohydrate supplementation can help the athlete maintain a positive mental state.

Perhaps most convincing is a recent study that looked at the effect of low and high carbohydrate diets on match performance. In this study, two teams played each other on two occasions with one team eating a solid diet high in carbohydrates and the other eating a high fat diet for 3 days prior to competing. In both matches, the team that ate the high carbohydrate diet covered 17% more distance (1300m) and had an aggregate goal differential of 5-2. Clearly, the solid diet resulted in greatly improved performance on the field.

The evidence linking diet and soccer-specific performance is compelling. Based on nearly 40 years of research, science has shown that the

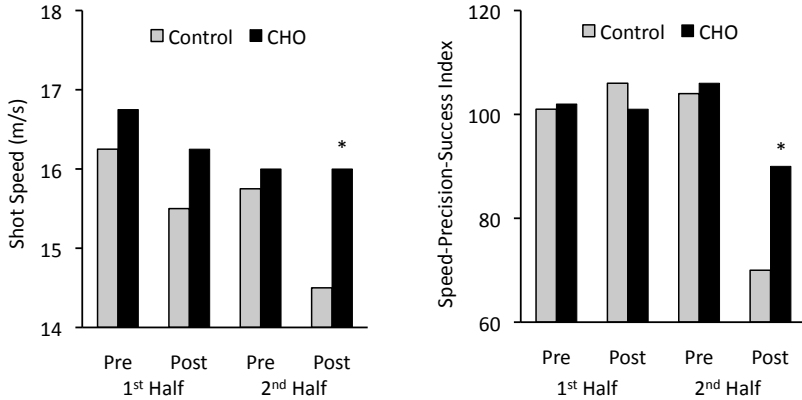


Figure 1.3 *The effects of carbohydrates (CHO) on shot velocity and an index of shot velocity, accuracy and success. From Russell et al. (2012). Note how carbohydrates benefit the player near the end of the match.*

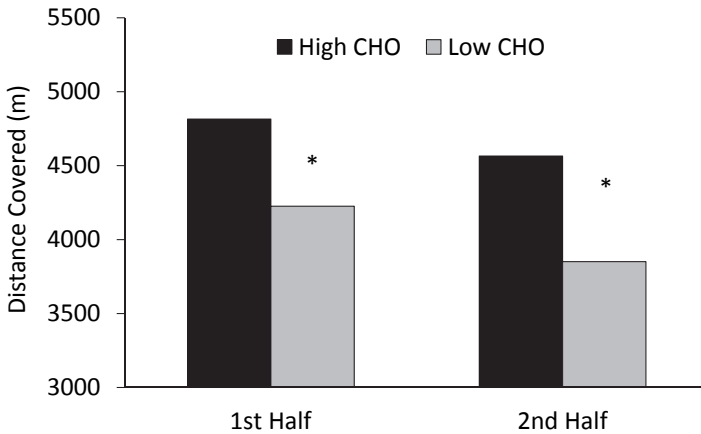


Figure 1.4 *The effects of high and low carbohydrate diets (CHO) on physical performance (distance covered) during a match. From Sougialis et al. (2012).*

composition of a player's diet has a significant influence on performance. What the player eats on a daily basis as well as immediately before, during and after the match can affect him or her both physically and mentally.

The case of Ramadan

When trying to understand the effects of proper nutrition on performance in a sport as complex as soccer, it is often helpful to look at a condition where the diet is restricted. During the month of Ramadan, Muslim players fast during the daylight hours. Typically two meals are eaten during the day, one before sunrise and the other after sunset. Depending on the player's location and the season of the year, daylight can last up to 18 hours. This represents a considerable gap in the day without any food. Given that soccer enjoys tremendous popularity with those of the Muslim faith, several studies on the effects of the Ramadan fast on performance have been conducted.

During the Ramadan month, the total calories consumed as well as the percentages of fats, proteins and carbohydrates do not vary appreciably. As a result, players typically maintain their body weight. However, because meals are eaten only early in the morning and late in the evening rather than spread out over the course of the day, many players experience symptoms of headaches, loss of concentration and fatigue. As a result, most players feel that the dietary restrictions of Ramadan adversely affect both training and match performance. This is especially true if matches and training sessions are held late in the day, long after the morning meal and prior to the evening meal. Studies on performance back up these perceptions. During Ramadan, players typically suffer declines in endurance, sprint and power performance, a loss of technical skills and impaired psychomotor function (such as reaction time).

A more important issue associated with the Ramadan fast is increased injury risk. Despite the fact that Muslim players who fast have similar training load and intensity as players who do not fast, they suffer more acute and overuse injuries during Ramadan. They also tend to experience greater muscle soreness in the days following intense training or match play. Thus, dietary habits and the timing of meals can have consequences for the player that may be more serious than poor play.

The studies on Muslim players during the Ramadan fast show that negatively altering the diet can adversely impact performance. Even though the components of a solid diet may be in place, spending much of the day in a fasted state negatively affects the player. These results can also be applied to youth players. Many eat a weak "grab-and-go" breakfast on their way to school, often before sunrise. During the day, they may skip lunch then head to training in the afternoon. Based on the studies of the

Ramadan fast, it is not surprising that these young athletes have difficulty performing. Without proper nutrition, they are left feeling tired and lethargic.

Soccer and nutrition

Back to the original question posed at the beginning of the chapter. Does nutrition affect performance? When considering both circumstantial and direct evidence, it is clear that diet impacts player performance on the pitch. Nearly 40 years of research shows that high carbohydrate meals and carbohydrate supplements can improve endurance performance as well as technical abilities and decision making. Also, diets that are high in fats or nutritional plans that include long periods without food can leave the players performance lacking.

The investment in a high carbohydrate diet along with carbohydrate supplementation is likely to pay dividends during the later stages of the match. As fatigue sets in, players who follow a sound nutritional plan will be able to compete at a higher intensity, maintain technical abilities, stay mentally focused and make correct decisions. As a result, teams that take advantage of a solid nutritional plan may benefit by scoring more goals or by conceding fewer, especially in the final stages of the match.

The bottom line is, what players eat and when they eat impacts performance on the field. One could easily make the case that diet is one of the more important aspects of the game. It is certainly one of the simplest ways to improve performance. By following a few fundamental guidelines, keeping track of what they eat and how they play then making key changes in their diet, players can develop their own nutritional strategy to maximize performance.

TAKE HOME POINTS

1. Historically, ancient athletes competed largely on vegetarian diet of grains, fruits, nuts and vegetables.
2. Early in the 20th century, researchers began to understand the importance of carbohydrates, as a part of the regular diet and during competition.
3. There are three key pieces of evidence linking a high carbohydrate diet to peak performance on the pitch, especially during the later stages of the match:
 - Less physical and mental fatigue
 - Increased high intensity activity and maintained technical skills
 - More scoring opportunities created and improved defending.

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