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Nutrition for Field Hockey: Theory and Strategies to Enhance Performance October 2005

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What is Nutrition?

The sum total of the processes involved in the intake and utilization of food substances in living organisms, including ingestion, digestion, absorption and metabolism of food.

Why is Nutrition important?

- A source of energy
- Building blocks
- Synthesis of enzymes, hormones etc
- Immune function
- Protection of organs etc

What is Optimal Nutrition?

This depends on the situation and the individual, but for many people it is to simply eat a healthy balanced diet. However, athletes have an additional challenge and are required to provide sufficient (extra) energy, fluid and nutrients to maintain performance.

Why is Nutrition important for athletes?

There is considerable scientific evidence reporting improved sporting performance under conditions of optimal compared to inadequate nutrition. Sports benefiting from tailored nutritional practices include those of a high intensity and short duration (power and sprinting events), endurance events (5 km + running, cycling etc) and intermittent sports (racket and team sports such as **Field Hockey**). In summary, optimal nutrition helps the athlete in the following ways:

- Improve ability to resist fatigue
- Improve recovery – better training
- Improve the immune function
- Prevent overtraining?
- Improve mood and alertness

Improve Match Day Performance

Field Hockey and Nutrition

The majority of the scientific studies investigating aspects of team sports have been centred on soccer. Field hockey, although a far superior and more skilful game than soccer, is similar in the physiological demands it imposes on the people who play it. As a result, the findings of the work carried out on soccer players can be applied to field hockey. Both sports are characterised by periods of moderate intensity activity interspersed by short periods of high intensity (sprinting) activity. Although a hockey match is shorter in duration than a soccer match, the energy expenditure rates are similar due to the greater time that the ball is in play during hockey and the additional physical demands of dribbling in a 'crouched' position (running whilst dribbling a hockey ball requires greater energy than running upright at the same pace).

The body has 2 main fuel sources that can be easily manipulated by dietary practices:

1a Anaerobic **Carbohydrate**……provides energy for 30-90 seconds

1b Aerobic **Carbohydrate**……....provides energy for 60-90 minutes

2. **Fat**……provides energy for Days

Of these two sources (macronutrients) Carbohydrate (CHO) is the most important for hockey and ensuring the body has sufficient stores of CHO should be of primary importance for the hockey player. The body has three stores of CHO; muscle glycogen (~400 g), liver glycogen (~100 g) and blood glucose (~20 g).

Of the work conducted on soccer players and CHO ingestion, several key findings have emerged:

- Players starting a match with lowered muscle glycogen stores (the body's main stores of CHO) cover less ground than players with optimum muscle glycogen levels
- Significant muscle glycogen depletion is known to occur during the first half of a competitive soccer match
- Many of the goals in soccer are scored towards the ends of each half, which is also the period when the body's stores of CHO are lowest
- Players eating a low CHO diet between matches (2 g CHO per kg body mass per day) can only part replenish their stores of CHO thereby

exacerbating the findings highlighted above. This is not the case when a high CHO diet is followed (7 g CHO/KG/Day)

These findings demonstrate the importance of CHO ingestion before, during and after exercise. However, ensuring adequate carbohydrate intake is not the only important factor to consider when preparing nutritionally for hockey. Other factors, such as fluid intake and dietary supplements, are also relevant and will be discussed in later sections.

Carbohydrate

As previously mentioned, CHO is the dominant macronutrient in a hockey player's diet. During the competitive season when you are training or playing hockey most days you should aim to consume between 6-8 grams of CHO per kilogram of your body mass per day. As an example, if your body mass is 75 kg you should be consuming approximately 525 g CHO during the day (7 g * 75 kg). As a rough guide the amount of CHO you eat per day should equate to 65% of your total food intake. Examples of foods that are good sources of CHO are contained in Table 1 and a high CHO diet is shown in Appendix A. Of note, bananas are a good source of CHO but only after a certain stage of ripeness. Green coloured bananas consist mainly of indigestible fibre (starch), however as the ripening process occurs this fibre develops into readily digestible and useful CHO (glucose) i.e. the more yellow/brown a banana is the better in terms of energy.

Glycaemic Index – Worth noting is the glycaemic index (GI) of carbohydrates which provides an index of how quickly the CHO is digested, absorbed and appears in the blood as glucose. The GI of any food is expressed as %, with pure glucose having a GI of 100% i.e. the higher the GI % the faster the CHO appears in the blood as usable energy (blood glucose). This glucose can then be taken up by the muscle and used as energy or can taken up and stored as muscle glycogen. High GI foods are useful in situations where the body's CHO stores are low and need replacing quickly i.e. immediately after strenuous exercise, between exercise sessions in close succession or during exercise. However, it is not recommended that all CHO intake consists of high GI foods. This is because the rapid rise in blood glucose causes rises in the hormone Insulin (this stimulates glucose uptake into the muscle). Although this is a necessary response in the aforementioned situations, it is not ideal during resting or normal daily activities. Snacks consisting of high GI foods will not dissipate hunger for very long (leading you to eat

more) and the associated fluctuations in blood hormones may leave you feeling sleepy and lethargic. Therefore, for regular meals where CHO is needed, it is advisable to eat foods consisting of mixed GI. These will provide a slower sustained release of energy throughout the hours following the meal. Examples of food consisting of low, moderate and high GI can be found in Table 2. A useful website for determining the GI of any food can be found at:

www.glycemicindex.com

Other Macronutrients

As well as CHO, fat and protein are also vital components of a balanced diet although neither is required in amounts as great as CHO. Fat is required for protection of organs, insulation and, among other things, as a source of energy. The intake of fat should make up approximately 20-25% of your diet (roughly 2 g fat per kg body mass per day). Protein is required for numerous reasons, including enzymatic function and the growth, repair and development of the body's structural system i.e. muscles, tendons, ligaments etc. It should contribute to roughly 15% of a hockey player's daily dietary intake (1-1.2 g per kg body mass per day) and examples of good sources are contained in Table 1.

Table 1. Examples of food sources for carbohydrate and protein

Good Sources of CHO	Good Sources of Protein
Spaghetti (pasta) – 28 g CHO	Fish (e.g. tuna, salmon haddock)
Rice – 22 g	Meat (e.g. chicken, turkey, lean steak)
Bread (especially white) – 45 g (Pizza 25 g)	Milk and Hard Cheese
Cornflakes – 80 g	Egg white
Brown bananas – 22 g	Soya milk
Jaffa Cakes – 73 g	Nuts and seeds
Sports drinks (Lucozade, Powersport etc) 60 g	Muesli
Potatoes – 15 g	Baked Beans
Couscous – 25 g	Chick Peas

Amount is per 100 g of food or 1 L of fluid. No g for protein is included as only a small amount of protein is required to provide benefit to the athlete (as little as 6 g).

Table 2. The Glycaemic Index of different foods

High	Moderate	Low
Glucose	Whole grain bread	Fructose
Cane sugar	Pasta	Yoghurt
Maple syrup	Corn	Peanuts
Corn syrup	Oatmeal	Cookies
Honey	Oranges	Beans
Corn flakes	Grapes	Apple
Raisins	Potato crisps	Peaches
White rice	Peas	Pears
White bread	Bran flakes	Figs
Brown Bananas	Boiled New Potatoes	Milk

Fluid

Together with providing fuel, the second major nutritional requirement for hockey players (and all athletes) is to ensure they have adequate levels of water in the body (euhydrated as opposed to dehydrated). When you exercise body temperature increases as a consequence of heat release from muscular contraction. **Elevated body temperature is strongly associated with decreases in athletic performance!!** The body's main defence in preventing excessive rises in body temperature during exercise (hyperthermia) is the evaporation of sweat released onto the surface of the skin. Sweat rates above 1 litre per hour are common during team sports, and sweating is increased during hot weather as body temperature rises to a greater extent compared to cooler conditions (sweat rates > 2 L/hr common in summer months). **However, sweat rates during training in winter months can be as high as during summer months due to players wearing more clothing – 'wimps t-shirts'** (this increases body temperature and also reduces evaporation due to the clothing absorbing the sweat). The overwhelming consensus of the studies investigating fluid intake is that dehydration negatively affects performance. A loss in body mass of 2% (sweat output of 1.5 litres) is sufficient to cause decrements in physical and mental performance.

Consequences of dehydration:

- Increased body temperature
- Increased rate at which you use CHO
- Increased heart rate
- Increased perceived exertion (you feel like exercise is tougher)
- Reduced mental function = poor decision making, concentration etc
- Reduced stomach emptying – in turn increases stomach discomfort and also slows the delivery of fuel (reduced delivery glucose into the blood)

To summarise, it is essential to start any exercise session adequately hydrated, to drink during exercise and to start re-hydration immediately after exercise.
Following exercise, drinking water is not the best choice of fluid to ensure that you adequately replace sweat losses. This is because it quickly dampens the sensation of thirst (you voluntarily stop drinking as you are no longer thirsty) and it also encourages urinary loss. The addition of salt is required to optimally replace fluid losses as it maintains the sensation of thirst and inhibits urine production. In these situations, a sports drink is recommended as they contain sodium or alternatively add some table salt (approx 0.5-1 g or teaspoon) to a litre of orange squash. The components of an ideal drink to be ingested during exercise can be found in Appendix E.

Alcohol – Alcohol is not required in human metabolism; however it is a popular component in some people's diet. **Despite what is sometimes said about alcohol containing beverages (especially lager), they are not high in CHO and any sugar is converted to alcohol.** The body prefers to use alcohol as an immediate, albeit slow (**too slow for exercise**), energy source instead of CHO or fat and any remaining alcohol is stored as fat. Furthermore, alcohol inhibits the use of existing fat as a fuel i.e. **alcohol prevents fat being used as energy and encourages its formation = beer belly!**). Alcohol in concentrations above 3% is a **diuretic** which means it encourages urination ('breaking the seal') and is therefore a bad strategy when rehydration is needed i.e. **it encourages dehydration!** Of note, caffeine is also a diuretic and is not recommended post exercise when rehydration is key (avoid coffee, coca cola etc). Finally, alcohol causes the blood vessels to open (vasodilation) which will **lengthen recovery** from soft tissue injuries (muscle pulls, sprains, etc) due to increased swelling of the injured area.

Appendix A – Explanation of the 'Nutrition and Hockey Performance' strategy

Before the Match / Training

- Eat a high carbohydrate meal 3-4 hours before the session – mixed GI (~300g).

This could be breakfast before a National League match on a Sunday and would be taken at approximately 10am. For those of you who are early risers (8-9am), then it may be advisable to eat a small snack (fruit, piece of toast etc) to take the edge of your hunger. It is important that this meal, and all pre-exercise meals, have a **low fat and fibre content** because a) these slow down stomach emptying and b) may cause stomach discomfort during exercise and c) are not useful for performance. Examples of typical breakfast's that contain sufficient CHO can be found in Appendix C.

- Drink 500-1000 ml of a sports drink or water 2 hours before.

A sports drink is a useful tool for athletes as it provides both fluid and CHO (especially good after exercise – see later). Allowing a 2 hour gap after consumption prior to a game gives enough time for all urine requirements to be met and for the fluid not excreted to be taken into the blood.

- Eat a carbohydrate snack in the hour before a match (50-80g).

This provides a last top up of body's CHO stores and will encourage you to burn CHO during the exercise. Examples of snacks containing 50 g of CHO are shown in Appendix D. Eating CHO in the hour before exercise is known to cause rises in insulin which in turn will cause a lowering of blood glucose as a result of muscle uptake (rebound hypoglycaemia). This has been shown to cause a decrease in performance; **however this decrease in performance does not occur if exercise is preceded by a thorough warm-up**. If you are concerned about this then either take regular small sips of a sports drink during the hour, eat a snack with mixed GI, or take the 50 g of CHO nearer the start of your warm-up (practice these strategies in training to determine whether you are suited to them). Alternatively, if CHO intake in the hour

before exercise does not work for you then avoid it and make a concerted effort to consume CHO during exercise.

During the Match / Training

- Aim to drink roughly 150-200 ml of Lucozade Sport (or equivalent) every 20 minutes.

Intake of a sports drink provides both CHO and fluid to replace sweat loss, however some athletes find that sports drink give them stomach discomfort when taken during exercise. If this is the case, experiment in training as to which drink is preferable or add water to slightly dilute the CHO concentration. Taking fluid immediately before the start of a match and regular intake during maintains the volume in the stomach which in turn encourages emptying of the stomach and supply of nutrients into the blood. **Ideally, consume 30-60 g CHO per hour of exercise (your body cannot use more than 60-70 g of ingested CHO per hour = more is not better).**

- If you stop for drinks twice during a 2 hour training session, aim to drink at least 300-400 ml each time. Fluid intake should be increased on a hot day!

Due to the nature of hockey, nutrition during the match may prove difficult to achieve! Therefore the following tips may help:

- Drink 300-400 ml 5-15 minutes before the start of the game.
- Make use of any stoppages during the match i.e. substitutions, injuries etc.
- Drink a further 300-400ml at half-time.

Do not attempt these strategies without having previously practised them in training to determine your personal tolerances!!

After the Match / Training

The first hour following exercise is vital for replacing the lost energy (carbohydrate)!!

- Aim to eat and/or drink 70-100g of carbohydrate in that hour – high GI.

Post exercise, athletes have a limited window of opportunity where rates of muscle glycogen replenishment are optimal and this is within the first hour of exercise ending (**ideally within 30 minutes**). CHO which have a high GI are recommended as these will be taken up by the

muscles quickest. The addition of a small amount of protein may aid this process (as little as 6 g) and examples of suitable foods can be found in Appendix D.

- Repeat this every 1-2 hours or until regular meals continue.

- Drink enough fluid to replace 150% of your body weight loss from the exercise i.e. if you lost 1kg drink 1.5 litres.

This may seem excessive (why not drink 100% of losses?) but you will lose a portion of the ingested fluid through urinary output. If you weigh yourself immediately pre and post exercise you can calculate how much fluid you need to replace. Remember, if water is your chosen drink after exercise you must add salt. **Avoid caffeine containing drinks as these also stimulate urinary loss (cola, coffee etc).** If you are unsure of your hydration status your urine can give you an indication. Simply, the more yellow/dark and smellier it is then the more dehydrated you are i.e. when you excrete pale colourless urine there is a good chance that you are hydrated (unless you have consumed alcohol or other diuretics). See the worked example below for calculating fluid intake post exercise.

  - Pre exercise weight = 75 kg
  - Post exercise weight = 74 kg
  - Fluid lost = 1.0 kg
  - Therefore, fluid required to replace 150% of loss (1.0 * 1.5) = 1.5 L
  - To calculate sweat rate you will also need to factor in fluid consumed.

- The addition of protein with the carbohydrate will also help recovery e.g. chicken with pasta meal.

As previously mentioned, a small amount of protein post exercise (as little as 6 g) will help repair muscle damage that occurs during exercise. Furthermore, if CHO intake is not adequate the addition of protein may also increase muscle glycogen re-synthesis.

- To meet the dual goals of re-hydration and glycogen replenishment it is sensible to drink carbohydrate sports drinks.

Appendix B – An example of a high CHO diet

This example food intake for a typical athlete training daily provides approximately 500 g of CHO for a 70 kg person during 1 day. This corresponds to 7 g CHO per kg body mass.

Breakfast: 30 g corn flakes (medium bowl) + 50 g raisins, 250 ml semi-skimmed milk, cup of tea + teaspoon of white, sugar + semi-skimmed milk

Snack: bag of marshmallows

Lunch: 4 slices of white bread (2 x tuna/mayonnaise + 2 x Marmalade), can of coke, 1 mars bar, medium banana

Snack: large banana, 500 ml Lucozade sports drink

Dinner: 100 g white rice (uncooked), 100 g chicken meat (uncooked), 150 g sweet curry sauce, 100 g green beans, pint of water

Snack: cup of tea + teaspoon of white sugar + semi-skimmed milk, 3 plain biscuits

Appendix C.

Tables C1-C3. Breakfasts containing 200-250 grams of carbohydrate for consumption 3-4 hours before training/match

Table C1.

Breakfast 1	Energy kJ (kcal)	CHO g	Fat g	Protein g	Fibre g
1 large bowl cornflakes 1 glass semi skimmed milk 2 tablespoons honey 2 bananas 1 apple $^1/_3$ cup raisins 1 slice maltloaf	4521 (1100)	240	4	20	14

Table C2.

Breakfast 2	Energy kJ (kcal)	CHO g	Fat g	Protein g	Fibre g
1 large bowl muesli 1 glass semi skim milk 2 table sp sugar 2 bananas $^1/_3$ cup raisins 1 small flapjack	4671 (1100)	238	22	32	24

Table C3

Breakfast 3	Energy kJ (kcal)	CHO g	Fat g	Protein g	Fibre g
1 med. bowl low fat yoghurt 1 medium bowl cornflakes 2 table sp sugar 2 table sp honey 2 slices bread 2 bananas 6 figs	4406 (1100)	237	2	21	13

Appendix D – Examples of foods containing 50 g of CHO with and without protein

Table D1. Examples of foods containing 50 g CHO with and without protein

Foods with 50 g CHO	Foods with 50 g CHO and some Protein
60 g Jelly beans	300 ml Milkshake/smoothie
5 Jaffa cakes	Large bowl breakfast cereal and milk
2 slices white bread with banana and honey	2 pieces toast and 250 g baked beans
750-1000 ml Sports drink	1 chicken sandwich and a piece of fruit
2 cereal bars (careful of unwanted fat/fibre)	150 g Pizza
2 large yellow/brown bananas	250 g baked potato with cheese

Remember, if you want to choose one of the snacks listed in Table D1 as your source of pre-exercise CHO feeding in the hour before exercise, choose one with a **low fat and fibre content**. For example, chocolate (Jaffa cakes), milkshake, cheese and pizza will contain unnecessary fat, whilst brown bread and overly green bananas will contain unnecessary fibre.

Appendix E – What constitutes an ideal sports drink?

- **Palatable –** You drink more of what you like, so experiment with what tastes nice.
- **Flavour –** Similarly, flavour increases voluntary drinking.
- **Carbonation –** Fizzy drinks are not conducive to regular drinking during exercise and may cause stomach discomfort.
- **Temperature –** Ideally should be 15 °C (simply, fluid that is too cold is uncomfortable and warm fluid does not taste refreshing and does not encourage drinking).
- **CHO –** Approximately 60-70 g CHO per litre of drink is ideal, **you cannot burn anymore than this per hour!** Drinks containing > 8-10% CHO (> 80-100 g per litre) can slow stomach emptying and the absorption of glucose into the blood and can increase stomach discomfort (and worse – diarrhoea!!!!!).
- **Electrolytes –** As previously mentioned, salt (sodium) is important for rehydration, as are other electrolytes (magnesium, potassium etc). Specialised sports drinks all contain these electrolytes.
- **Isotonic –** Basically the drink must not be too concentrated as this impedes uptake of fluid into the blood. It should be the same concentration of the blood (isotonic) and contain CHO, as uptake of CHO into the blood also sucks up water. Most sports drinks are designed as isotonic.

Finally, eating CHO during exercise is ok, however it will not provide fluid to combat dehydration, chewing and breathing at the same time is hard, food contains fat and fibre and solids may cause stomach problems during exercise.