PVM
NUTRITIONAL SCIENCES

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DIABETES AND EXERCISE

Physical activity at any level plays an important role in diabetes management. The basic nutritional requirements for optimising performance in the diabetic athlete are not different to that of the non-diabetic athlete, but it requires skill to monitor changes in insulin and/or carbohydrate levels in order to optimise blood glucose levels.

Insulin is a hormone produced by the pancreas. It is mainly responsible for controlling blood glucose levels, through a regulatory effect on carbohydrate metabolism. It carries glucose over cell membranes to be utilized for fuel by the cell. It further inhibits the conversion of glycogen to glucose in the liver and stimulates the synthesis of muscle glycogen after exercise. In the absence of diabetes, insulin is released according to the body's requirements to control "blood glucose". There are different types of diabetes, which need different treatments. The type, the amount of food consumed as well as the type of physical activity is the most important factors influencing controlling strategies.

In *type 1 diabetes* there is an absence of insulin and it needs to be injected daily. In *type 2 diabetes* insulin resistance causes a decrease in glucose uptake by cells as well as insulin-mediated storage of glycogen. Because glucose is the preferred energy source of most body cells, a decreased uptake signals the production of more insulin by the pancreas via a few consecutive reactions. Eventually the pancreas is unable to secrete enough insulin causing insulin deficiency. Type 2 diabetes is normally treated with oral medication. However, if uncontrolled, type 2 diabetic subjects may eventually require insulin treatment.

BEFORE YOU START...
The American Diabetes Association and the American College of Sports Medicine issued a joint statement recommending that patients planning to do high to moderate intensity exercise should undergo graded testing if one or more of the following criteria apply:

- Age > 35 years
- Type 2 diabetes > 10 year duration
- Type 1 diabetes > 15 year duration
- Presence of additional risk factors for cardiovascular disease (CVD)
- Presence of micro-vascular disease (retinopathy or nephropathy, including micro-albuminuria)
- Peripheral vascular disease
- Autonomic neuropathy

WHAT SHOULD YOUR BLOOD GLUCOSE LEVELS BE BEFORE EXERCISE
Blood sugar levels should ideally be between 4-8 mmol/L before exercising. Exercising with high blood glucose levels disrupts normal metabolic control and will elevate blood glucose levels even further. This will lead to poor performance and can even be dangerous. It is best to postpone exercise if blood glucose levels are above 10-14 mmol/L, especially if urinary ketones are present.

If blood glucose levels are too low it is advisable to consume carbohydrates before exercise

FOOD INTAKE BEFORE AND DURING EXERCISE

Muscle contraction, increased blood flow and an increased body temperature cause the body to be more responsive to insulin during exercise. Factors that effect blood glucose in response to exercise include:

- Type, intensity and duration of exercise
- Degree of metabolic control before exercise (pre-exercise blood glucose level)
- Type, dosage and timing of exogenous insulin (where applicable)
- Site of insulin injection (where applicable)
- Timing and composition of last meal before exercise
- Environmental conditions e.g. hot/cold weather

Because there are a number of factors that may influence blood sugar levels, it is recommended that individuals with diabetes learn to control their blood sugar levels systematically by keeping track of each exercise session's duration and intensity as well as their blood glucose levels. It is also recommended that they learn to identify physical responses to hypoglycaemia so that it can be recognised immediately.

Instant and sustained acting carbohydrates are advised 30-60 minutes *before* exercise, especially for intense, short bursts of exercise. This could be in the form of a ***PVM Energy bar, Octane 4.0, Octane XTR*** or the ***Octane Gel.***

Slowly absorbed carbohydrates 2-3 hours *before* exercise in combination with moderate amounts of protein and little fat will help to regulate blood glucose levels during sustained physical activity. This will typically mimic a meal. If you are unable to eat, you may use **Fusion.**

The amount of carbohydrates required *during* exercise is dependant on blood glucose levels. Athletes are encouraged to monitor blood glucose concentrations before and after exercise to determine the magnitude of adjustments in insulin dosage and food which are needed for different types of exercise. Table 1 provides a guide on the amount of carbohydrates that should be consumed depending on exercise intensity and blood glucose levels.

Table 1: Suggested carbohydrate intake

SUGGESTED CARBOHYDRATE (CHO) INTAKE		
Exercise intensity and duration	**Blood glucose (mmol/L)**	**Dietary CHO (g)**
Brief high intensity (<30 min)	6-10	No food required
Light (e.g. 30 min walk/ 60 min easy pace aerobics)	<6 >6	15 g No food required
Moderate (<45 min) (e.g. swimming, jogging)	<6 6-10 10-14 14+	30-45 g 15 g No food required Exercise not advised
Moderate (>60 min) (e.g. jogging, cycling)	10-14 plus reduced insulin dosage >13-14 and ketones >17 (no ketones)	10-15 g/h Exercise not advised Exercise not advised
Strenuous (<60 min) (e.g. kayaking, cycling)	<6 6-10 10-14 14+	45 g 30-45 g 15-30 g Exercised not advised
Strenuous (>60 min) (e.g. triathlon, marathon, cycling)	<6 6-10 10-14	50 g/h 25-30 g/h 10-15 g/h

PVM Energy bars, Octane 4.0, Octane XTR and the ***Octane Gel*** are suitable during exercise. The following conversion may help in the calculation of requirements:

- 1 ***PVM Energy bar*** contains ±26 g carbohydrates.
- 1 level scoop ***Octane 4.0*** and ***Octane XTR*** contains ±7 g carbohydrates
- 1 500ml bottle Octane contains 42g CHO (5scoops)
- 1 ***Octane Gel*** contains ±22 g carbohydrates

During exercise, it is advisable to have immediate access to rapidly absorbed carbohydrates (such as ***Octane 4.0, Octane XTR, Octane Gel*** or jelly babies) in case hypoglycemia should occur.

EATING AFTER EXERCISE

The first few minutes after exercise are crucial for the recovery of glycogen stores and the repair of muscle tissue. Fuel (glycogen) and fluid can be replaced with an appropriate solution like ***Reignite***. The increased insulin sensitivity caused by exercise lasts for several hours after exercise and therefore the risk of becoming hypoglycemic. Delayed hypoglycemia can occur 4-48 hours after exercise. To prevent hypoglycemia, sufficient amounts of carbohydrate should be consumed before, during and after exercise. If insulin is used, it may be necessary to reduce the next insulin dose after exercise. Delayed hypoglycemia often occurs during the night and if it occurs regularly, it can exacerbate fatigue in athletes. Waking up feeling tired and groggy in the morning may indicate that a hypoglycemic episode occurred during the night. If this is the case, special attention must be given to blood glucose monitoring.

The potential for nocturnal hypoglycemia is increased if exercise is followed by significant amounts of alcohol. Alcohol inhibits the release of glucose from the liver and this increases the risk for hypoglycemia. Excessive alcohol consumption inhibits the ability to recognize the symptoms of hypoglycemia. Athletes are advised to abstain from alcohol after exercise until all recovery needs are met.

OTHER GENERAL RECOMMENDATIONS

- Choose an enjoyable activity. Avoid those where a hypoglycaemic event may be extremely dangerous e.g. motor racing, single-handed sailing, etc.
- Exercise regularly, ideally at the same time each day. This makes it easier to predict blood sugar levels.
- Be consistent with meal times and insulin injections.
- Avoid heavy exercise during peak insulin action.
- Protect feet by wearing good-fitting shoes and cotton socks.
- Avoid activities that cause blisters.
- Carry medical identification and try to exercise with someone that knows about your diabetes.
- If hypoglycaemia is experienced, stop immediately and have some carbohydrates (follow the hypoglycaemia protocol).

INSULIN AND ANTI-DOPING POLICIES

Insulin promotes protein synthesis and inhibits protein breakdown. For this reason it has been misused as an anabolic agent by some athletes. It is illegal and dangerous. WADA anti-doping policies allow people with diabetes to use insulin and compete in official competitions. However, formal approval for therapeutic use must be obtained.

The basis of any diabetic treatment programme is a healthy lifestyle and eating habits. It is a way of life that the whole family can enjoy. For optimal diabetic control, following a healthy meal plan and maintaining a healthy body weight is important. Read the “healthy eating guidelines” for more detailed guidance.

Please note that this is only approximate guidelines. For a more individualised diet plan (taking age, length, body structure, gender, dietary preferences, training, etc. into account) or any other nutritional enquiries, please contact our Registered Dietician for assistance.