



Winter Sports

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About Winter Sports

A winter sport is a sport commonly played during the winter season on snow or ice. The temperature of the winter sports performed in an outdoor environment range from -25°C to 10°C , while the temperature of those performed indoors average 5°C to 10°C . Sport-specific training and competition for many winter sport athletes commonly requires some degree of exposure to higher altitude (2,600 to 3,500m). The nutrition priorities in winter sports result from training and competing at altitude in cold weather, which place extra demands on the body due to environmental stress and metabolic challenges.

The winter sports that are part of the Olympic Winter Games include biathlon, bobsleigh, curling, ice hockey, luge, skating, skeleton, and skiing. Within skiing, there are five disciplines and these include alpine, cross-country, ski jumping, Nordic combined, freestyle and snowboarding.

This fact sheet will provide a background on the nutritional implications for skiing, specifically the effects of altitude and cold exposure as these are unique aspects of these sports. Failure to eat and drink appropriately during training and competition will result in premature fatigue, which can compromise performance and increase the risk of injury.

Seasons

The preparation phase of the annual year occurs from May to late October with a European Summer Grand Prix for Nordic combined and Ski Jumping held in August. The winter competition starts at the end of October and concludes in late March.

Olympic Games and World Championship are held during the month of February and occur in three out of the four-year cycle. The off-season is held during the month of April. Each athlete competes in approximately 30 to 45 events over a five-month winter season. 15 to 20 of the competitions are World Cup events. The competition characteristics vary with each event as the terrain, weather, snow conditions, and frequency of competition create a variety of physical challenges for the skier.

Physical characteristics

Body composition requirements and energy systems differ greatly with each winter sport. The winter sports that require low body weight are Nordic combined and ski jumping. Nordic combined athletes are at least 5kg and ski jumpers 10kg below their ideal body weight. Computer simulation shows that the jump length decreases by approximately 1m/kg of increased weight. There is a tendency for very young athletes to compete in international competitions because they generally weigh less than their older athletes of similar height. Delayed growth and maturation has also been observed in ski jumpers as well as extreme weight loss and eating disorder cases.

Maximal anaerobic power is seen as an important determinant of ski jumping performance as the sport involves the production of one powerful movement, which occurs at take-off. Nordic combined athletes require a high aerobic power and anaerobic capacity for cross-country skiing and maximal anaerobic power for ski jumping. Because endurance exercise is not an option for assisting in weight loss because of its effect on explosive power, athletes only use energy restriction to reduce and maintain weight.

Historically cross-country skiers were described as tall and lean individuals. The physical structure of cross-country skiers has changed over the last twenty years with them now reported as muscular and having average height. Cross-country skiing is an endurance sport requiring a high aerobic and anaerobic capacity. Cross-country skiers have the highest VO_2 max of all endurance athletes.

Successful alpine skiers appear tall and heavy with a high lean tissue mass. In general, slalom skiers tend to be lighter and leaner than speed skiers in events such as downhill and “super-G”. Increased body weight may be of some benefit in alpine skiing due to gravitational forces that, at least in part, are dependent on body mass, regardless of composition. Peak anaerobic power is identified as a significant predictor of successful skiing performance.

No scientific data are available on the physique and physiological characteristics of mogul and aerial skiers. Because many aerialists have a gymnastics background, it is expected that physique characteristics are similar to gymnasts, particularly female athletes, although aerialists appear older and heavier. Energy metabolism in freestyle skiing for both events is expected to receive a large contribution via anaerobic energy pathways due to their high intensity and short duration. Energy for the aerialist is predominantly provided by the ATP-CP system due to the short duration of a jump (6 to 7 seconds), while the mogul skier relies to a greater extent on muscle glycogen.

Training Diet

The most important nutritional factors to consider when working with winter sport athletes are the cumulative effect of cold and altitude that may lead to increased energy expenditure, greater reliance on blood glucose and muscle glycogen, and exacerbated fluid loss.

Upon ascent to altitude, the sympathetic nervous system is up-regulated. This hypoxia-induced rise in catecholamines is both acute and chronic, with the main objective to preserve blood flow and oxygen delivery to tissues and organs. The acute rise in epinephrine results in changes in heart rate, stroke volume, and cardiac output. The norepinephrine rise occurs later, peaking by day seven at altitude and remaining elevated through the course of exposure. The elevation of norepinephrine leads to an increase in ventilation, vasoconstriction, as well as blood and vascular pressure.

Altitude exposure is frequently accompanied by weight loss caused, at least in part, by negative energy balance due to appetite suppression and increased energy expenditure. Work in the cold may increase energy requirements, with 10 to 15% of the rise in energy expenditure probably accounted for by the inefficiency of exercising in heavy snow and thermoregulation. In addition to ambient temperature, wind chill, radiation from the sun and humidity can influence the physiological strain of defending core temperature in the cold.

It has previously been demonstrated that fuel selection at high altitude shifts to a greater use of blood glucose for men both at rest and during exercise compared to sea level. It has also been shown that carbohydrate oxidation may be elevated up to six-fold during shivering thermogenesis. This rise in carbohydrate oxidation is provided by greater plasma glucose turnover, muscle glycolysis, as well as glycogenolysis.

Living and training at altitude increases the athletes need for adequate iron stores in order for haematological adaptations to occur. Although well managed today, iron deficiency and depletion remain the most prevalent nutritional deficiency in winter sports.

Fluid needs

Fluid requirements are higher in the cold compared to temperate environments, as cold air contains less water than warmer air, even if relative humidity is the same. Thus, cold exposure leads to a small but significant increase in respiratory water loss. In addition, cold temperatures can result in an impaired thirst response and increased diuresis, possibly leading to dehydration.

Nordic combined and ski jumping athletes compete in the European Summer Grand Prix and athletes wear their winter suits during summer training and competition. Consequently, fluid requirements are elevated due to a high sweat rate.

Hydration can sometimes be as impractical as undesirable, due to restricted access to fluids, coupled with a reluctance to drink in the cold, or fear of the need to urinate (as toilets may be inaccessible!). While there are no specific recommendations for fluid replacement during exercise in the cold and/or at altitude, below are some tips to keep athletes hydrated on the snow.

Sports drinks: can encourage fluid intake and can assist with fluid retention, reducing the need to urinate while on snow. They also provide carbohydrate to help meet fuel needs.

Fluid temperature: fluid intake is usually reduced when fluids are very cold (or frozen). Cool fluids (10 to 15°C) are generally preferred during strenuous sessions but in very cold conditions, warmer fluids may be more inviting. Try packing a thermos or insulated drink containers to prevent the temperature dropping to very low levels.

Good fluid choices: include flavoured milk, juice, hot chocolate/Milo, soup, hot apple cider or meal replacement shakes like Sustagen® Sport are suitable for recovery.

What should I eat/drink during competition?

Energy provided for cross-country skiing performance is predominantly supplied by aerobic metabolism and the utilization of carbohydrate and fat. For cross country events longer than 15kms, sport drinks should be provided to the athletes. Transporting large volumes of fluid onto the ski course and keeping the temperature of the beverages at 10 to 20°C is challenging. It is recommended that warm sports drinks be carried in leak-proof containers that have thermal covers.

For the other skiing events, fluid is provided at the end of the first and final run or jump. Carbohydrate-rich snack foods should be available to athletes if needed. However, food is usually eaten if there is a race delay due to weather conditions.

Suggested snack options:

- fruit i.e. banana or mandarin (easy to peel/eat)
- breakfast/muesli bars
- sports bars/gels
- English muffins/sweet muffins
- dried fruit and nut mixes
- jam/peanut butter sandwiches
- lollies
- soup/hot chocolate/Milo® in thermos
- liquid meal supplements (e.g. Sustagen®)

One thing to remember when packing snacks and drinks is that liquids freeze and bars get hard to chew! So, pack a thermos with warm liquids and place a heat pack around bars, lollies and gels. Socks can be handy to keep bars in, too! Thermal bowls are also available and will keep hot meals hot if sealed well. If training, you can also keep these foods packed into pockets and jumpers so that your own body heat keeps these foods edible.

What about recovery?

Due to the large anaerobic contribution to alpine and freestyle skiing performance, a high rate of glycogen utilization is likely to occur during a day of intense ski training. Glycogen stores can be reduced by 50% after a typical day of training for skiing. For cross country skiing, fatigue during a prolonged training session or ski-race is often associated with the near or complete depletion of glycogen stores. Because of this, recovery of these stores should start as soon as possible after prolonged and/or high-intensity training and racing.

A further challenge to the skiers is the delay in returning to accommodation after training, which may slow recovery time and affect the next day's training. Have snacks and meals handy – suggestions for recovery include:

- warm soup + bread rolls
- cheese & vegemite sandwiches
- pasta with tomato based sauce
- meat & veg stir fry with rice
- 2-min noodles with tuna
- porridge made with milk

N.B. Pasta, rice etc can be kept warm in thermal bowls/containers and hot water for noodles or powdered soup will stay hot in a thermos.

Other Nutrition Tips

Alcohol: If athletes are going to drink, then do so in moderation. Excess consumption can impair recovery and rehydration and can indirectly (or directly) impact on individual performance. Make sure that recovery and rehydration goals are met before consuming alcohol.

Iron levels: Some athletes may have problems with low iron levels, especially females with low iron intakes. Iron levels should be checked regularly during heavy training or if fatigue levels are unusual. See our fact sheet on [Iron Deficiency in Athletes](#) and speak to a Sports Dietitian on how to increase iron in your diet.

Travel: Winter sports elite athletes are often required to spend up to six months a year overseas. Some considerations include: planning ahead and packing regular food items; knowing the culture of your destination and what to select when eating out; think about how to access to specialised sports foods e.g. Sustagen Sport® that you use when training at home. For details regarding travel nutrition issues see the travel section of the AIS nutrition website: <http://www.ausport.gov.au/ais/nutrition/factsheets/travel2>

How to Get Involved

Australia is becoming internationally recognised in freestyle, snowboard and alpine skiing. Presently the Australian Government is supporting Australians involvement in sliding sports and cross country skiing. To cover the sports nutrition aspects in winter sports, the integration of a sports dietitian into a team is essential. To get involved, Sport Dietitians need to travel, witness and understand the sports and the challenges the athletes' experience.

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