CONFERENCE REPORT

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The 2nd IAAF International Consensus Conference "Nutrition for Athletics"

Monaco, April 18-20 2007

IAAF President Lamine Diack with the conference participants

Introduction

In a practical expression of its commitment to helping athletes in all countries achieve their performance, personal and health goals, the IAAF organised the 2nd International Consensus Conference on Nutrition for Athletics in Monaco from 18 to 20 April 2007.

The stated aim of the conference, which was supported by IAAF Official Partner Coca Cola, was to help shape the priorities of both the IAAF Medical and Anti-Doping Commission and the International Olympic Committee's working group on nutrition over the next few years. The presentation and discussion of papers prepared by expert teams in 12 key areas reflected the research and advancements in knowledge that have taken place since the first IAAF conference on this topic in 1995.

At the end of the conference, a statement integrating the presentations was issued.

Entitled Nutrition for Athletics: The 2007 Consensus Statement of the IAAF, it includes the conclusion that "well-chosen foods will help athletes train hard, reduce risk of illness and injury, and achieve their performance goals".

However, "individualisation" was probably the most used word at the conference, spanning almost all the presentations. The participants seemed to agree that the amount of energy, protein, carbohydrate, fat, micronutrients and water in the foods eaten by athletes should be according to individual needs. General recommendations can be made, but these should be implemented on a case by case basis, according to the athlete's stage of maturation, sex, genetic factors, training stimuli and environmental factors as well as information gained from monitoring body composition, blood (iron) parameters, sweat loss, etc.

The following summaries of the key points from the presentations and discussions at the conference give background and insight to the thinking that shaped the consensus statement.

Nutrition for sprints

Presenter: Kevin Tipton (GBR)

Although nutrition for the sprint events has not received as much attention as it does in distance running, it can have a profound effect on recovery from training and competition, training adaptations and power-to-weight ratio. General recommendations for all sprinters are, at best, useless. Very specific guidelines cannot and should not be given for macronutrient intakes Individual needs should be considered and only ranges should be given.

Recommendations for use of specific foods to ward off drowsiness or improve reaction time cannot be given at this time because of a lack of data to either support or discount the effects.

Race day foods and drinks should be individually tested so that the chance of GI (gastro-intestinal) discomfort is minimised. Careful consideration of what not to eat is probably more important than what to eat.

Although weight training is an important component of a sprinter's programme, it should be noted that optimal mass does not equal a maximal mass. Changes is muscle mass will be induced by training plus nutrition. Protein balance does not become positive without provision of exogenous amino acid sources. This can be obtained from foods as well as from special products. A relatively small amount of exogenous amino acids, probably 10-15g of a mixed protein, results in a positive protein balance. Leucine does not seem to have an effect when enough carbohydrate and protein provided. Energy balance is just as important, if not more so, for muscle hypertrophy as protein intake. Weight training should never be done in a glycogen depleted state, since there is evidence that this will reduce the maximal anabolic response.

Total protein needs are dependent on the timing of ingestion, type of protein, other nutrients ingested and training stimuli. It has been shown that athletes have a need for more than 1.7g/kg/day, although it should be noted that this requirement is measured in the most extreme activities, like Tour de France cycling. Most athletes do not need this amount and many consume this amount in their habitual diet without the need to supplement. Supplements might be useful for convenience or accuracy of ingested amounts. Because of adaptive responses, a higher protein intake results in greater protein oxidation. If protein intake is reduced suddenly, the oxidation rate remains high for some time and the athlete risks short-term negative protein balance.

The side effects of high protein intake have been largely overestimated. Risks reported in the literature include kidney damage and bone demineralisation. Kidney damage has never been shown in otherwise healthy individuals. Bone contains a large amount of protein and, in fact, bone collagen responds similarly to muscle proteins following ingestion of a protein source. However, there is no rationale for advocating protein intakes above 1.7g/kg/day. Furthermore, high protein intake might compromise carbohydrate intake, which should be sufficient to maintain glycogen stores during periods of training and racing (~ 5g/kg/day, but dependent on the amount and intensity of training). There was discussion about post-exercise protein breakdown. It was hypothesised that protein breakdown might not be a bad thing as it might have a role in muscle remodeling. Clearly, more research is needed.

Creatine can enhance power and increase muscle mass, however the extra weight gain can negatively impact performance. The most important effect of creatine seems to be that more work can be done during high intensity training programmes. Data remain equivocal, but, importantly, none of the available studies has reported impaired performance. Furthermore, some data indicate increased glycogen storage when carbohydrate is co-ingested with creatine.

Buffering agents such as bicarbonate and ,-alanine are not recommended at this time for sprint events. Despite wide use in elite 400m runners, effects have rarely been shown under one minute of exercise. There is a rationale with regard to increased training outputs, but adaptive responses might be compromised.

Nutrition for middle-distance running

Presenter:Trent Stellingwerff (SUI)

Middle-distance running is at the cross roads of training stimuli used for running events. After nearly matching the mileage of marathon runners in the base phase, middle-distance runners proceed to almost the intensity used by sprinters during the racing season. The different phases of the training programme require different amounts of energy and different macronutrient content. Towards the racing season, the total energy needs are not as high as during base training. However, because of the intensity of training, the relative reliance on CHO use is higher. Protein needs also differ between seasons. The recommended fat intake is based on estimated total energy needs minus CHO and protein needs.

Buffering agents are effective for maintaining blood and intracellular pH. Much research has been done on bicarbonate. Many studies have shown positive effects in events ranging from one to 15 minutes duration. A “chronic” supplementation of bicarbonate can be applied and has been proven successful in keeping blood bicarbonate elevated for several days. This protocol might be especially useful in persons prone to GI distress after acute bicarbonate loading. Recently there have been studies on ,-alanine. Alanine combines with histidine to form carnosine. This is one of the few dipeptides in the muscle with the right dissociation curve to buffer the intramuscular fluid. Administration of alanine has been shown to improve the amount present in the cells. Similar small, but significant, performance benefits have been reported compared to bicarbonate.

Middle-distance runners and other athletes should be warned against the use of pseudoephedrine. Although the substance itself is not on the WADA-list, use may lead to a positive test for one of the metabolites, which are banned.

As much of the training of a middle-distance runner is intense, above 75% VO_2max, carbohydrate should be the primary fuel. Moreover, the weight training that is often done alongside the running relies heavily on anaerobic ATP production, with declines in muscle glycogen reported of 25-40% after a multiple set resistance exercise bout. Future studies should answer the present questions about optimal timing of different training stimuli and concurrent nutritional status.

The endurance training typically used in the base period relies more on fat metabolism and usually energy expenditure is higher than in the other training phases. The absolute and relative contributions of fat can be highest in this period but should probably only still be around 2g/kg/day or around 30% of total energy. Carbohydrate intake can remain around 7-10g/kg/day. Lower total energy expenditure towards racing season makes the relative contribution of carbohydrate higher in this phase. Protein intake needs to increase with increased mileage and resistance training. However, protein needs will never be more than 1.7g/kg/day. Most athletes consume this amount of protein in their normal diet, so there is no need for extra protein.

Strategies to maximise glycogen recovery between sessions include taking 1.2 to 1.5g/kg/hour in the first two hours after training. There is still debate over whether inclusion of protein can benefit recovery. Data show either no difference or enhanced protein balance as well as subsequent performance and muscle protein degradation markers. No negative effects of protein in a recovery meal have been reported. Inclusion of protein seems prudent at a dose of about 0.1g of essential amino acids per kg body mass. This would translate to about 14g of whole protein from milk. No difference has been shown between protein from foods or from supplements.

Nutrition for long-distance running

Presenter: Louise Burke (AUS)

Over history, long-distance running has been in the front line of sport nutrition research and application. The introduction of carbo-loading in the late 1960s was one of the first well-known nutrition strategies for enhancing performance. Since then, the technique has evolved into a two-to three-day protocol and recently, supra-maximal glycogen stores, comparable to the values previously reported, have been shown after just 36 hours.

Long-distance runners are characterised by high maximum oxygen uptake, very low levels of body fat and minimal muscle development of the arms and upper torso. Especially "hot weather" race winners tend to be small and light. Females usually have to push their body weight further from their natural shape than male runners. However, the penalty is also greater. Some develop eating disorders, osteopenia and chronic menstrual dysfunction.

The carbohydrate needs of distance runners are complex and multi-factorial. Some studies that have shown benefits of training in a low glycogen state, however, there are well-described potential disadvantages of this strategy such as increased risk of illness or injury, reduced capacity to train and reduced well-being. Training in a low glycogen state is not recommended at this time and distance runners should follow established carbohydrate intake guidelines.

Protein requirement is elevated by long distance running and can be nearly twice the requirement of sedentary people (1.7g/kg/day). Nitrogen balance can be influenced by timing of protein intake, with better maintenance of nitrogen balance when protein is consumed after exercise.

Fat adaptation has been researched extensively, but no positive performance outcomes have been shown. A reduction in the ability to perform high intensity exercise has been shown. Fat adaptation should not be undertaken by marathon runners.

Fluid and carbohydrate should be consumed during races of 60 minutes and longer. The concentration of carbohydrate can be varied between 4 and 8%, according to priority of re-hydrating or re-fueling. It is not recommended to give more than 60 grams per hour, although higher absorption rates have been reported with mixed carbohydrate forms. However, this study was done in cyclists and the overall impression is that higher intakes would cause GI distress in most individuals. It was noted that the GI tract is highly adaptive and can get used to high carbohydrate and fluid intakes. This might be worth training, especially for marathon runners.

Iron deficiency often occurs in long-distance runners. Although there does not seem to be a higher incidence than in the general population, iron deficiency can hinder performance and should be avoided. Regular screening of serum ferritin is warranted. Iron supplementation should only be commenced after diagnosis of low serum ferritin and/or low haemoglobin. At this time there is no certainty about whether intra-muscular iron injections offer advantages over oral iron supplementation. However, there is a risk of anaphylactic shock and iron overload, so oral iron supplementation should be preferred.

The only supplement to have shown consistently beneficial effects on long-distance running performance is caffeine. Doses of 3-5mg/kg show similar effects to doses of 7mg/kg. However, doses of 9 mg/kg actually hindered performance.

Combined events, throws, jumps

Presenter: Linda Houtkooper (USA)

A pyramid was used as a visual tool to show the importance of the different aspects of sport nutrition. The base of the pyramid should be a healthy diet, the middle layer consists of nutrition around training and at the very top there is place for specific supplementation.

It is recommended that jumpers, throwers and combined-event athletes have a nutrition plan for competition days. This plan should be practiced in training. After a competition, there should be a debriefing to evaluate and improve the plan.

Limited studies have assessed the nutritional needs of jumpers, throwers and combined events athletes. Data on both intake and needs are scarce, so it is hard to draw conclusions. Extrapolation of data from exercise protocols that mimic these events should be used to come to specific recommendations. Micronutrient intake should meet at least DRI (daily recommended intake).

Goals for nutrition during training periods include 1) meeting energy needs, 2) timing of consumption of adequate fluid and electrolyte before, during and after exercise to ensure proper hydration, 3) timing consumption of carbohydrate intake, 4) timing consumption of adequate protein intake, 5) consuming effective and safe nutritional and dietary supplements and ergogenic aids.

Adequate hydration can be achieved by taking about 500ml of cool fluid about two hours before exercise. The nature of these events often allows athletes to consume fluid in between attempts. Athletes should be warned not to over-consume fluid so that they gain weight. In fact, there might be a benefit from slight dehydration in the jumping events. This is often seen in practice. There is some rationale behind this, but definitive data are lacking at this time. If chosen, deliberate dehydration should be practiced in training, never be more than 3% body weight and be closely monitored. Heat cramps are associated with dehydration, so individuals prone to heat cramps should not dehydrate. After competition, athletes should adequately re-hydrate and refuel.

The supplements that can be of value to throwers, jumpers and combined-event athletes are caffeine, bicarbonate (for the 800 or 1500m in the heptathlon/decathlon), and creatine. Supplement use should be monitored closely and be checked for doping contamination.

Physique and performance in athletic events

Presenter: Helen O'Connor (AUS)

People have very different genetics and variations are on a wide continuum from naturally very lean to virtually impossible to achieve weight goals. In some athletics events, success is only likely within a relatively small range of body shapes and sizes and international-level competitors in different events have different physiques. For instance, 400m runners tend to be the tallest of all track runners. Taller people have an advantage in high jumping because they have a higher centre of mass. Other physical characteristics, like power-to-weight ratio, limb length, energy expenditure and heat exchange, all have impact on performance. Some characteristics, like height, cannot be changed while others, like weight and body fat, can be manipulated by diet and training.

Reducing weight in athletes should be done with a high carbohydrate diet, to support training and glycogen recovery. Nutrient density should be high and energy intake should never drop below 30kcal or 125kJ/kg fat free mass. A lower energy density (energy/g food) of the diet is also advised. Reduced carbohydrate diets are very popular in the general population and also in the athlete community. Studies have shown improved weight loss compared to low-fat diets, but these have never included athletes. The well-described advantages of sufficient carbohydrate in athletes will probably negate possible positive effects of low-carbohydrate diet weight loss therefore carbohydrate intake should not be under 5g/kg/day. However, carbohydrate intake advice should be individualised and not be interpreted as a license to eat unlimited amounts of carbohydrate.

Low Glycemic Index diets can have effect for athletes who want to lose weight. A possible negative effect is reduced glycogen resynthesis. Protein is the most satiating of all macronutrients. Protein also induces the highest thermogenesis. Protein needs are higher on an energy restricted diet. Therefore, a relatively high protein intake can have a role in an energy restricted diet. However, if protein intake becomes too high, carbohydrate intake might be compromised.

Dairy intake has effect on body composition. Different mechanisms have been proposed. The calcium forms fatty acid soaps from the triglycerides and some is excreted. Conjugated linolic acid might have a role and other mechanisms have been proposed, but more research needs to be done to elucidate the mechanism.

Athletes should be advised on basic diet and foods. This way, a more accurate diet can be prescribed. Also, the athlete should know how much to consume on rest days, when injured or when in a transition phase. The extra food can be given per hour of exercise.

Surface anthropometry is recommended as the most practical and safe method to assess and track changes in body composition. When measuring skinfolds, it is advised to give a confidence interval. This shows the athlete a more realistic figure.

The female athlete triad

Presenter: Melinda Manore (USA)

The female athlete triad consists of three interrelated health problems: amenorrhea, eating disorders and osteoporosis. New research shows that each component can occur on a continuum. In addition to the primary issues, these three can lead to other health problems: growth might be impaired (but catch-up growth has been shown in elite gymnasts), delayed menarche has been shown in lean dancers, low fuel availability suppresses reproductive function and stress fractures occur more often in amenorrheic athletes.

Screening for disorders of the triad should include a menstrual history, physical activity history and current activity level, diet history and current dietary behaviour in relationship to weight and sport expectations, and family history, especially mother's age of menarche. Treatment should consist of improving the energy balance. This can be done by increasing energy intake or reducing energy expenditure.

In healthy young adults, energy balance is met at an energy availability of about 45kcal(188 kJ)/kg Fat Free Mass/day. For most athletes, energy availability should be in the range of 30-45kcal/kgFFM/day for weight loss and around 45kcal/kgFFM/day for weight maintenance and above this amount for growth and glycogen loading. Commercial products for estimating energy intake, energy expenditure, and fat free mass can be used for calculating energy availability.

When energy availability drops below 30kcal(125 kJ)/kgFFM/day, the body suppress-

Nutrition for athletics: The 2007 IAAF Consensus Statement

Athletics consists of a range of events requiring varying inputs of technique, strength, power, speed and endurance. Well chosen foods will help athletes train hard, reduce risk of illness and injury, and achieve performance goals, regardless of the diversity of events, environments, nationality and level of competitors. General recommendations can be made, but these should be implemented on an individual basis, according the athlete's stage of maturation, sex, periodisation phase, training programme and competition goals. A qualified sports nutrition professional can help athletes find practical ways to achieve their nutrition goals despite a busy lifestyle, gastrointestinal issues and the challenges of travel. Appetite and thirst are not always good indicators of energy and fluid needs, and athletes will benefit from a personalised eating and drinking plan.

Athletes should consume a wide variety of foods that meet their energy needs and provide optimum amounts of carbohydrate, protein, fat, vitamins, minerals and other important food components. The energy requirements of training vary according to the type and duration of sessions which in turn change across training cycles. Some athletes naturally achieve their ideal physique as a result of heredity and training, but others must manipulate energy and nutrient intake to achieve desired changes in lean mass and body fat. Energy-restricted diets require careful selection of nutrient-dense foods to ensure that nutrient needs are met. Low energy availability should be avoided, as it can impair performance and adaptation to training as well as being harmful to reproductive, metabolic and immune function, and bone health.

An adequate carbohydrate intake is necessary to support intensive and consistent training with lowered risk of illness and injury. Guidelines for daily intakes are about 5-7 grams per kg body mass during periods of moderate training up to about 10 g/kg during heavy training or fuelling up for competition. Protein intake should be sufficient to optimise adaptation to both strength and endurance training, but intakes of more than 1.7 g/kg/d are not necessary for any athlete. Strategic timing of meals or snacks that provide these macronutrients around training sessions may help to optimise fuel availability, promote adaptation to training and enhance recovery.

Preparation for competition should include strategies to ensure muscle fuel stores that are appropriate to the event. Carbohydrate intake during exercise can be of value for events lasting longer than about 1 h, and refuelling between events on the same day is important. Each athlete should develop a competition plan that is practical and provides benefits for their performance. Carbohydrate loading is beneficial for prolonged events and can be achieved by 2-3 d of high carbohydrate intake and training taper. A depletion phase or fat adaptation is not necessary.

Athletes should also have an individualised hydration strategy for training and competition. They should start appropriately hydrated and consider the need and opportunity to consume fluid during and between activities. Generally, an athlete's fluid plan should limit total fluid deficits to less than about 2% of body mass, particularly when co mpeting in a hot environment. Unless previously dehydrated, athletes should not over-drink before or during exercise such that they gain weight. Hyperhydration may detract from performance in weight-sensitive events and may lead to the serious problem of hyponatraemia. Rehydration after training or competition requires replacement of both water and salts lost in sweat.

Athletes must respond to changes in needs for energy, nutrients and fluid in new situations such as hot or cold environments, altitude and travel across time zones. Travel requires planning to cope with effects of the journey, different food cultures, changed access to foods and the risk of gastrointestinal disturbances. Youth athletes and their parents and coaches should be aware of the importance of nutrition for optimising health, growth and performance. Youth athletes may need special education, encouragement or supervision to achieve appropriate energy intake, fluid needs related to exercise, and adoption of nutrient-rich meal patterns.

When everyday foods are impractical, specialised foods can help athletes achieve nutrition goals. Supplements do not compensate for poor food choices. Some supplements may benefit performance, but athletes are cautioned against the use of these products without first conducting an individual risk-benefit analysis. Athletes are advised to seek assurances regarding quality control of supplement manufacture to ensure freedom from contamination with toxic or doping substances. Supplements should not be used by youth athletes except where clinically indicated and monitored.

Good food choices will contribute to success in athletics and to health and enjoyment of life.

Monaco, April 20 2007

es reproductive function, bone turnover and other physiological processes. Energy availability of amenorrheic athletes has been shown consistently under 30kcal/kgFFM/day. Low energy availability can be caused by eating disorders. Eating disorders are life-threatening, clinical mental illnesses that require medical and psychiatric treatment.

Clinical menstrual disorders are easy to detect. Sub-clinical disorders are not that obvious and the underlying etiology is often uncertain. Medical tests are required for proper diagnosis and adequate treatment.

Low gynecological age (years since menarche) is associated with occurrence of amenorrhea in athletes: it was found in 9% of marathon runners with gynecological age of 15 years or more and 67% among those who were younger.

Bone strength and the risk of fracture depend not only on bone minerals but also on bone protein. Nevertheless, osteoporosis is diagnosed on the basis of bone mineral density (BMD) alone. Estimating bone fracture risk in pre-menopausal women is hard because of many confounding factors.

Amenorrheic athletes report low intake of total energy, protein and fat and higher intake of fibre. Micronutrient deficiency occurs more often in amenorrheic athletes than in eumenorrheic athletes. Deficiencies in calcium and iron are most common. Use of a broad spectrum low dose multi-vitamin/mineral supplement might be warranted.

Nutrition for the young athlete

Presenter: Flavia Meyer (BRA)

Adequate nutrition for youth athletes is important to enhance performance, avoid injury and ensure optimal growth, maturation and bone health. It is particularly important for young athletes to meet the energy demands for growth and for exercise and they have increased needs for protein (per kg bodyweight) and calcium.

Carbohydrate intake in young athletes should be enough to replenish glycogen stores. It is unclear whether glycogen supercompensation has similar effects in children as in adults. Fat intake should be according to general health guidelines with about 35% of energy coming from fat with less than 10% from saturated fats. Young people have been shown to have higher fat utilisation than adults. Protein intake should be higher than for non-athletic peers. An intake of about 1.4g/kg/day is advised.

Young athletes should be screened for low mineral intake, especially of iron and calcium. Iron deficiency is a common problem in adolescents. Dietary iron intake and bio-availability should be optimised. Blood parameters should be monitored and corrected if necessary. Calcium intake of 1300mg is recommended for children from 9-18 years to achieve positive calcium balance.

Dehydration has more profound effects in youths than adults. Even mild dehydration (as little as 1-2% of body weight) should be avoided since it impairs performance and therefore young athletes should be encouraged to drink to compensate for sweat loss. Adding flavour, sodium and carbohydrate to re-hydration solutions improves voluntary fluid ingestion and will aid absorption.

There is no evidence of growth retardation in athletics. Growth retardation has been shown in female gymnasts however, in that population catch-up growth was reported during periods of rest or decreased training.

In general, not much is known about the long-term health consequences of supplement use in youth and therefore these should not be taken under the age of 18. However, it is recognised that supplements are used by young athletes. Care should be taken that when they insist on using supplements, knowledgeable health professionals assist in choosing the type, brand and dosage of supplements.

Fluid needs for training and competition in athletics

Presenter: Susan Shirreffs (GBR)

Hydration status affects performance. Different events have different fluid needs. General guidelines for all events are to ensure euhydration by consuming about 500ml of fluid with sodium or sodium containing foods 2 hours before exercise. In the hours after exercise, 150% of the water lost should be provided to adequately re-hydrate. A scale can be used to estimate sweat losses. Competition hydration plans should be practiced during training.

The main concern in the sprint events is that warm-up and pre-race activities might result in a sub-optimal hydration status. Also, training in a warm environment or wearing heavy clothing can result in dehydration. There might be some advantage in commencing a race somewhat dehydrated, since this can positively influence power-to-weight ratio. However, no more than 2-3% of body weight should be lost. A higher degree of dehydration will negatively impact performance.

Middle- and long-distance runners should always start their training and races euhydrated. For runs longer than 10km, there is a rationale for consuming fluids during exercise. Drinks should not have high energy density or osmolality. General guidelines for the amount of fluid replacement will be meaningless, since individual sweat rate and sweat sodium content vary greatly.

In the jumping events, no clear effect of mild dehydration has been found. If hypo-hydration does not reduce muscle force production or power then it may improve jumping performance. However, systematic research is required for confirmation.

There is no rationale for throwers to commence their competition hypo-hydrated. Studies show that accuracy, but not speed, of cricket bowlers was worse after dehydration. Throwers should aim to stay euhydrated, but beware not to over-drink during the long hours on the track.

Combined event athletes should aim to start their competition euhydrated and try to keep within 2% body weight loss during the day. Fluid can be ingested between attempts or between events. Athletes should beware not to over-drink, so that body weight is gained during the day. Sodium should be ingested in the form of sodium containing fluids or in the form of sodium containing foods. Recovery of body water lost during the first day of a combined event competition may be one of the recovery priorities for many of these athletes.

Fatigue and illness in athletes

Presenter: Myra Nimmo (GBR)

Recommendations to keep immunity high include: maintain energy equilibrium, keep CHO stores high, have a moderate amount of fat in the diet, stay well hydrated. Use of vitamin C and Á-tocopherol is equivocal, with some positive findings. However, it should be noted that anti-oxidants might dampen the training adaptation.

Adequate nutrition before, during and after training and competition is a key element of maintaining health and warding off early fatigue and possible immuno-suppression. A period of immuno-suppression after an intense exercise bout is inevitable and can last up to 72 hour. However, it can be attenuated by proper nutrition.

The cytokine IL-6 can lead to fatigue and poor sleep quality and have profound negative effects on performance. Low glycogen and other training and life stressors can elevate IL-6. IL-6 seems to play a central role in acquired immunity. It is considered the “switch” from innate to acquired immunity. IL-6 can only be active when bound to the receptors IL-6R and gp130. It is therefore important to look not only at levels of IL-6, but also at levels of IL-6R and gp130.

IL-6 seems to serve as an energy sensor: low glycogen levels prior to exercise elevate IL-6 compared to placebo controls and CHO feeding during exercise attenuates IL-6 release. When IL-6 was administered prior to exercise, it induced an increased sensation of psychological and physical fatigue, possibly through central mechanisms.

Ensuring adequate glycogen and delaying depletion of glycogen is clearly a key goal for athletic events.

Overtraining is defined as an accumulation of training and/or non-training stress that results in a long-term (weeks and months) decrease in performance. Overtraining is associated with an increased incidence of infections, persistent sore muscles, general malaise and disturbed sleep. The etiology is complex and the syndrome's the existence has even been challenged.

Chronic stress can cause elevated IL-6 levels, which in turn can cause a disturbed balance in T-helper cells. This will lead to increased susceptibility to viral infections. At present, there is no clear guidance on the cause, the identification or the remedy for the overtraining syndrome. Despite many possible markers, a good psychological test (Profile of Mood States) still seems to be the most accurate measure of overtraining.

Different deficiencies have an effect on fatigue and immune system. Energy deficiency can cause a reduction in memory T-cells. Elevated fatty acid availability may decrease immune function by increasing the amount of prostaglandin. Too little fat in the diet can cause immuno-suppression as well.

Supplements

Presenter: Ron Maughan (GBR)

The knowledge level of athletes concerning sports nutrition is not good and very much influenced by the supplement industry. Advertorials are often seen as a good source of information. In general, the supplement industry is better in communicating their message than are scientists.

It is recognised that because of limitations in research design it is very hard to prove if a strategy or supplement works. "No proven effect" is not the same as "proven no effect". There might be an effect that cannot be detected by present research methodology.

Athletes should be warned against indiscriminate use of supplements. The risk of contamination of supplements with substances that are on the WADA list is very real. Some dishonest producers put substances like ephedrine in their supplements to make it work. Other supplements are cross-contaminated because doping substances have been produced in the same production line.

It is reassuring that only 4% of elite athletes buy supplements online, where most contaminated supplements are sold. However, purchase in a regular store is by no means a guarantee that the supplement is doping free. Even a disclaimer on the label offers no certainty. It should be concluded that there is no such thing as a risk-free supplement. However, risk can be minimised by buying from reputable manufacturers. Use only supplements with at least some scientific evidence.

In Germany and The Netherlands, the anti-doping authorities have made a list of checked product-batch combinations. This offers athletes the best risk reduction. Hopefully, other countries will implement a similar system.

Innovations in training and nutrition

Presenter: John Hawley (AUS)

The "train low, compete high" paradigm of glycogen levels has been challenged by a new study that shows no benefit of training in a low-glycogen state. Although some genes involved in training adaptations were enhanced after training in the low glycogen state, this does not mean athletes should adopt the practice. It could have deleterious effects on the ability to train hard and recovery from training, could be a possible risk factor for overtraining and could impact the immune system. Training in a low glycogen state is not recommended for strength training, as there is a proven negative effect on gene expression. It was noted that in practice, many top distance runners do an early morning run in a fasted state.

Athletes are advised to consume about 10 grams of protein in the early (<3h) phase of recovery to improve net protein balance. Some discussion took place about the role of muscle catabolism after exercise and that there might be some rationale for not dampening the catabolism by adding extra protein. No effect of extra protein on muscle glycogen is to be expected when ample CHO is provided. The addition of protein in a CHO drink during exercise remains equivocal. It seems that when enough carbohydrate is provided, the addition of protein is futile. There is no generally accepted mechanism for the added protein to have an ergogenic effect.

Athletes training at altitude should have their blood iron parameters measured about one month before their training camp. In case of deficiency, iron stores can be replenished before departure. No iron supplementation should be given without an indication of deficiency.

The anorexic effect of altitude can have a negative effect on energy balance. Strategies to improve energy intake include increasing meal frequency and decreasing protein intake. Protein is highly satiating and induces more thermogenesis than the other macronutrients. Therefore, low protein intake can enhance energy intake. Negative protein balance is worsened by an energy deficit. Increasing meal frequency is advised.

Oxidative stress is enhanced in altitude training. There might be some rationale for the use of extra anti-oxidants. Foods that contain anti-oxidants are advised. The use of supplements remains controversial, since it might inhibit training adaptation, and act as pro-oxidant in high dosages. Athletes should not use bicarbonate at altitude, since it might induce acute mountain sickness. Altitude exposure induces higher fluid losses. This should be balanced by a higher fluid and sodium intake. The role of omega-3 fatty acids remains equivocal.

Nutrition for travel

Presenter: Tom Reilly (GBR)

Travel across time zones and jet lag can have a profound effect on sleep, digestion, well-being and performance. It is easier to travel westbound than eastbound, since our biological rhythm in “free-running” conditions spans about 25 hours.

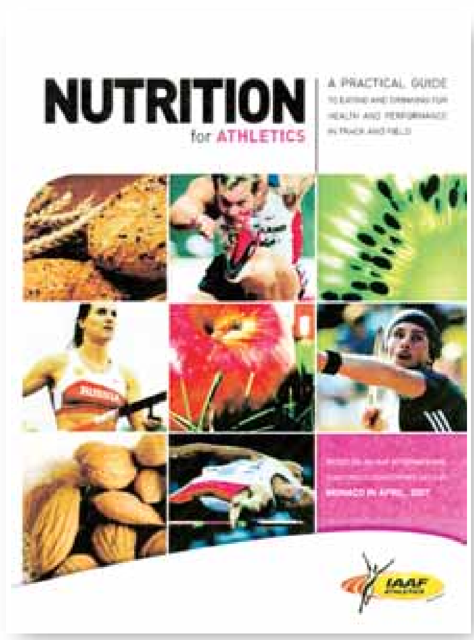
Pharmacological approaches for dealing with time changes are not recommended for athletes and emphasis should be laid on behavioural strategies. Athletes should strive to arrive in the new time zone well in advance of their event. Pre-adjustment to the new time zone can be commenced before departure by going to bed either early for eastbound flights or late for westbound flights. Light and exercise can have influence on the circadian rhythm.

The influence of diet remains equivocal. Adequate timing of meals, adjusted to the new time zone, can have an effect. At this time, timing seems much more important than macronutrient content of the meals.

Athletes are prone to dehydration because a lot of fluid is lost just by breathing the dry air in an airplane. An estimate fluid intake of 15-20cl/hour should be acceptable. Habitual coffee consumers can take coffee in moderation. Alcohol should be avoided. Athletes should be encouraged to bring their own food supplies to compensate for the menu provided by the airline that is often low in volume and fibre.

Exposure to light or avoidance of light can be a powerful tool for adjustment to the new time zone. Training can have an effect on adjustment, but it seems to be more powerful for phase delay (eastbound) than for phase advance (westbound).

Caffeine is often used, but the effects are ambivalent: it reduces daytime sleepiness, but



also impairs recovery time. Sleeping agents are often advocated. Because the right timing of intake is difficult, the advantages are equivocal.

Athletes can face several challenges at the destination of travel. Changed environmental factors, like heat or altitude, reduced or enhanced (all you can eat buffets) access to foods, eating from fast food restaurants or other facilities not tailored to the needs of the athletes, reduced hygiene standards, all make it difficult for athletes to maintain a healthy diet. Meal plans and timing should be organised in advance. Portable and non-perishable foods can be taken along to replace important items that otherwise would be missing. A broad spectrum, low dose multi-vitamin/mineral supplement can be given to compensate for restricted intake of nutrient rich foods.

As many as 60% of athletes who travel internationally develop diarrhoea. Performance may be affected during an attack and for some time afterwards. Athletes should avoid high-risk foods and tap water, even for brushing teeth. Personal hygiene, especially washing hands before meals, is important to lower the risk. Treatment is symptomatic in most cases. Fluid and electrolyte should be replaced. A bland diet low in fat and avoiding dairy and alcohol is recommended. If the condition is severe or persists for more than 48 hours antibiotics may be required.

General Conclusion

In addition to the consensus statement issued at the end of the conference, the IAAF and Coca Cola have prepared two key products designed to help the athletics community. The first is a CD that contains the full papers from each section of the conference as well as a video recording of the presentations. The second is a 36-page booklet entitled Nutrition for Athletics – A Practical Guide, which will be available n six languages (Arabic, Chinese, English, French, Russian and Spanish). Based on the papers presented at the conference, it documents the most up to date knowledge and provides detailed advice for athletes in simple and easy to understand language under the following headings:

- General principles: nutritional goals & eating strategies
- Event specific nutrition
- Eating strategies

Copies of the CD and booklet will be sent to all IAAF Member Federations. Individual copies will be available from 1 November 2007 and can be ordered from the IAAF website www.iaaf.org.

Reported by Peter Res

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