A Concept Paper: The Effect of Glycemic Index on Weight Management in Female Athletes

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ABSTRACT
The aim of this study is to determine glycemic index and weight management in female athletes. This is a randomised cross-over study investigating the effects of the following *ad libitum* low and high GI diet with 50% energy from CHO for 4 weeks on insulin sensitivity and blood lipids in overweight female's athletes. All subject needs to report to the laboratory for preliminary test and the actual experimental trials. The test will involve the measurement of body composition, RMR, fasting blood and ECG of the subject. Subjects will be explain thoroughly about the exercise protocol and equipment used during the experimental trials. The expected outcome for the study is to identify and plan better strategies for weight loss in female athletes. Hence, the result will produce a proper way of planning a program to suit the needs of athletes. The glycemic index was not identified as risk factors for overweight and adiposity in this cross-sectional study.
Keywords: Glycemic index, body weight management, female athletes

1.0 Introduction

The glycemic index (GI) is a tool available to rank foods based on the speed at which the carbohydrate contain enters the blood stream (Jenkins, Wolever, Taylor, Barker, Fielden, Baldwin, Bowling, Newman, Jenkins & Goff (1981). It has replaced the simple vs. complex classification of carbohydrate rich foods; a system that assumed the blood sugar response of a food was totally dictated by its chemical structure which is simple carbohydrates would be digested quickly and causing a rapid increase in blood sugar (glucose) while complex carbohydrates would be digested slowly promoting a flatter and more sustained blood sugar response.

Twenty years later, the argument over the clinical significance and practical application of the glycemic index remains. The glycemic index is the subject of heated debate between scientists who support its use as a tool for controlling blood sugar levels and preventing disease and those who believe that methodological concerns with its measurement and insufficient evidence of long-term benefit make it premature to incorporate the glycemic index concept into dietary recommendations for the public (The American Institute for Cancer Research, 2009).

Many athletes and others who are not necessarily overweight still would like to lose weight to ensure that they can perform to the maximum and success in their chosen sports. Previous study by Walberg-Rankin (2000), most active people must focus on dietary change to lose weight because they already have high rates of energy expenditure. In a range of competitive sports, it is considered beneficial to achieve low levels of body fat while maintaining their lean body mass. The researcher said, the metabolic effects of this process have been given little context within athletics, such as physique sports (i.e. bodybuilding, figure), combat sports (i.e. judo, wrestling), aesthetic sports (i.e. gymnastics, figure skating), and endurance sports.

A study on elite female gymnasts and runners reported an average body fat percentage (BF %) of 13.72% for the entire sample, with subgroups of middle-distance runners and artistic gymnasts averaging 12.18% and 12.36%, respectively (Deutz et al, 2000). Elite female runners have also reported percent body fat levels below 10% (Wilmore et al, 1977). Energy deficits and extremely low levels of body fat present the body with a significant physiological challenge. It has been well documented that weight loss and energy restriction result in a number of homeostatic metabolic adaptations aimed at decreasing energy expenditure, improving metabolic efficiency, and increasing cues for energy intake (Dulloo and Jacquet, 1998; Maclean et al, 2011; Maclean et al, 2006).

Not all active people who desire weight loss should be counselled to lose weight especially for female athletes. For example, it is questionable that a lean female runner at 13% body fat could maintain good health by losing more weight. Rapid weight loss has been proven to negatively affect a number of health-related parameters. Briefly, it can lead to acute cardiovascular dysfunctions (Allen et al, 1977), immunosuppression (Kowatari et al, 2001), lowered bone density (Prouteau et al, 2006), impaired thermoregulation (Oppliger et al, 1996), impaired cognitive function (Choma et al, 1998), negative mood state (Degoutte et al, 2006), hormonal unbalance (Roemmich and Sinning, 1997), temporary growth impairment (Roemmich and Sinning, 1997), poor nutritional status (Horswill et al, 1990), increased injury risk (Green et al, 2007) and increased risk of developing eating disorders (Steen and Brownell, 1990; Oppliger et al, 1997).

Although some studies have demonstrated that rapid weight loss impairs high-intensity performance (Fogelholm et al, 1993; Hickner et al, 1991; Horswill et al, 1990), no negative effects have been observed (Artioli et al, 2010; Klinzing and Karpowicz, 1986) if athletes are allowed to recovery for at least 3-4 hours from weight loss (i.e., they are allowed to eat and drink as much as they want before the performance tests take place).

2.1 Challenges for Weight Loss

2.1.1 Genetic Predisposition

According to O'Connor and Slater (2011), the identification of a genetic profile which may predispose an individual to lean mass gain and success in strength power sports has become an area of recent research interest. As with body fatness, it is likely that a series of genes or a polygenic profile may better describe the predisposition to high lean mass and success in strength/power sports. Together, these findings demonstrate that genes not only have a strong influence on natural physique but also modify the responsiveness to strategies such as diet and/or exercise to influence characteristics such as fat and lean mass.

Genes potentially influence physique at a number of levels through energy storage and mobilisation, fuel oxidation at rest and during physical activity through to taste and food preference, appetite and inclination to be physically active (O'Connor and Slater, 2011). A number of susceptibility genes have been identified as influencing physique, increasing the likelihood of a particular phenotype but not necessarily its expression, which is also influenced by environmental factors (Bray et al., 2009).

2.1.2 Gender and Pubertal Influences

Study by O'Connor and Slater (2011), during puberty, the physique changes and there is a significant increase in stature and body mass. In boys there is an increase in lean mass while in girls greater deposition of body fat prevails. Some of the pubertal physique changes may be beneficial immediately (e.g. increases in stature, total and lean mass) while others may be detrimental (e.g. increases in total body mass, especially if fat). Pubertal changes commence and develop at different rates. Some children enter puberty early and this is often an advantage for sports where greater stature, lean mass and strength are important (e.g. football or swimming). Early pubertal development may be a disadvantage especially for girls in aesthetic sports (e.g. rhythmic gymnastics or ballet dancing) if there is a substantial and rapid increase in body fat.

2.1.3 Training and Appetite

The amount of energy expended by athletes is effective by a wide range of factors including training intensity, duration, frequency and modality. Periodization (programmed blocks of variation in training intensity, duration and frequency), which differs energy expenditure, often quite widely from week to week, can also make it difficult for athletes to consume an appropriate amount of energy to support training needs and simultaneously manage physique goals (O’Connor & Caterson, 2010). Athletes may also compensate for high training energy expenditures by extending nocturnal sleep and/or increased sedentary periods or naps throughout the day.

Although additional research is required, studies suggest that higher intensity exercise blunts short-term appetite compared with lower intensity, even when total work performed is identical (King et al., 1994). Mechanisms are unclear but may relate to differentiate in metabolites or appetite-related hormones (e.g. lactate, adrenaline, leptin, ghrelin) or change in body temperature. Surprisingly, anecdotal evidence for a greater appetite after swimming has not been evaluated but there is evidence from at least one study suggesting exercise in cold versus neutral water temperature stimulates greater post-exercise energy intake. This effect of temperature needs further confirmation. Some studies also report an influence of gender, with evidence of greater compensation of energy after exercise in women than men. The crucial part of maintaining energy reserves in women for reproductive purposes has been proposed as an explanation of these differences but the impact of gender on exercise-related appetite remains largely unexplored and requires further research.

3. Methodology

3.1. Study One **:** Glycemic Index and Body Weight Management

Objective : To look on different effects of glycemic index on lipid profile on body composition.

Design : HGI and LGI meals provide on first day;
- blood fasting measurement
- meal will be given (breakfast and lunch)
- blood taken every 30 minutes
- after 4 weeks intervention (record the food intake every 3 days within the 4 weeks)

After baseline measurements, subjects were randomized to a four-week intervention period that consisted of breakfast meals of either LGI or HGI (breakfast items were provided). Subjects consumed a LGI or HGI breakfast at 8:30 a.m. and usual lunch at 12:30 p.m. Subjects were instructed to maintain their habitual intakes for the other meals (ad libitum). Follow-up calls were made every three days to subjects to assist with compliance. The two intervention periods were separated by a washout period of 30 days.

4. Expected Outcome / Significance

4.1 Strategies for Weight Loss

4.1.1 Macronutrient Manipulation

According to O'Connor and Slater (2011), total energy intake and expenditure are accepted as the most influential environmental factors regulating body mass. Consumption of energy above daily requirements results in gains of body mass and inadequate energy intake results in loss. Although energy requirements can be assessed directly by measuring body heat production or estimated via a number of indirect methods including calorimetry (oxygen cost measurement), the wide variation in energy requirement even at rest, make accurate prediction of individual energy needs challenging. Energy expenditure at rest is strongly and positively correlated with lean mass (higher lean mass, higher energy expenditure) but is also influenced by age, gender and individual metabolic factors that are under genetic control. Resting metabolic rate (RMR) can be estimated via a number of prediction equations (e.g. Harris- Benedict, Schofield, Cunningham equations) which are sometimes used to investigate the plausibility of reported energy intake in the clinical setting. Most of these equations have not been validated in elite athletes and may not accurately reflect RMR in this population (Manore & Thompson, 2010).

Dietary energy is provided by the macronutrients, with each delivering a different amount of energy (known as the Atwater factors) per gram: protein 17 kJ/g; fat 37 kJ/g; carbohydrate 16 kJ/g; alcohol 29 kJ/g. Until the 1990s it was unconditionally accepted that each kilojoule consumed had the same value regardless of which macronutrient it came from (i.e. a kilojoule from carbohydrate was equal to one from fat or protein).

The optimal macronutrient distribution required to promote weight loss is still controversial and many research studies are now dedicated to understanding the potential influence and benefits of macronutrient manipulation. The pendulum has swung towards research on lower carbohydrate, higher protein, and moderate fat diets for weight management in the general population. Athletes are also experimenting with this approach and there is evidence of them adopting moderate (e.g. the Zone diet) through to extremely low-carbohydrate diets such as Atkins diets to reduce weight and fat.

4.1.2 Reduced CHO diets

Reduced carbohydrate diets (e.g. Atkins, Zone and South Beach diets) are currently popular in the general community and with athletes. The mechanism underpinning the proposed efficacy of these plans is based on the reduction of glycaemic load, decreased insulin secretion and, for Atkins, the induction of ketosis stimulated by severe restriction of dietary CHO. A number of studies have now evaluated the efficacy of reduced carbohydrate diets, most notably the Dr Atkins programme (low CHO, high protein and fat) on weight and fat loss.

Evidence suggests that there is a greater weight/fat loss in the short term (up to 3 months) and medium term (up to 6 months) compared with more traditional diets. However, these early results are not maintained and in the longer term (6–12 months), weight is regained (Sacks et al., 2009). Furthermore, weight loss is not superior to programmes which include professional support and behaviour modification (Wadden & Foster, 2000). Early weight (as opposed to fat) loss on Atkins results from glycogen depletion and associated water loss. Additional weight loss has been attributed to the satiating effects of a higher protein intake, which results in lower total energy consumption, not ketosis as originally proposed by (Sacks et al., 2009). Short-term success on Atkins has also been associated with adherence and this likely stems from the novelty, simplicity and monotony (limited food variety) of this style of eating. Studies specifically designed to evaluate the impact of food variety indicate that energy intake increases with the number of available foods (Stubbs et al., 2001).

4.1.3 Glycemic Index

Low glycemic index (GI) diets may enhance satiety (reviewed by McMillan-Price & Brand-Miller, 2006) and a recent systematic review of their use in obesity management suggests this approach has a small positive effect in promoting weight loss (Thomas et al., 2007). Unlike carbohydrate restriction, low-GI diets are associated with positive rather than negative health consequences, although the impact on glycogen stores and athlete performance from chronic use has not been evaluated. As with low-GI diets, high fibre diets are also associated with enhanced satiety and positive health benefits. In many (but not all) cases high-fiber foods are also low in GI. Use of a high-fiber low-GI meal plan is likely helpful to athletes who need to reduce energy intake, especially to combat hunger and provide greater meal volume. Strategic use of higher fiber snacks between meals may also be beneficial in reducing the build-up of hunger at main meals.

5.0 Conclusion

In conclusion, this study will create or promote weight-management strategies thru physical activity, changes in diet, and changes in behaviour as the keys to preventing and treating excess weight and obesity. The relative influence of high and low GI of foods on satiety and control the obesity. To ensure the effectiveness of GI intake, further study should be not only claims that the GI of the diet *per se* may have specific effects on body weight may therefore be misleading.

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