

## Featured Article

# Review of anti-inflammatory dietary recommendations for adults and active aging populations who are able to engage in high-intensity exercise for weight control purpose

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### Abstract:

High-intensity interval training, (HIIT) (sometimes called high-intensity circuit training when exercise activities are mixed), has gained recent research attention. Research has demonstrated that this higher-intensity experience has biochemical/hormonal implications that are more beneficial than conventional cardiovascular training for weight management/loss purposes. For many adults, joint pain and mild systemic inflammation makes taking advantage of a high-intensity exercise experience too uncomfortable. The following is a review of dietary literature from the perspective of inflammation. Three elements: fructose (sugar), wheat, and dairy, are specifically identified as both commonly incorporated into the western diet, and potential contributors to chronic mild systemic inflammation. This review highlights which systems of the body are affected, and then provides recommendations for dietary changes via limiting these three elements as well as citing dietary supplement countermeasures.

*Keyword: high-intensity, exercise, HIT, HIIT, weight loss, inflammation, diet*

### Introduction

Deconditioning and disease states often affiliated with aging have more in common with lack of activity than just getting older. Osteoporosis, for example, primarily discussed as an older adult dysfunction, can occur in children who are confined to bed-rest. Organizations, dietitians, physicians, and sports scientists who address these dysfunctions have promoted exercise recommendations for the dysfunctions, but actual participation in these prescribed activities is poor. According to the Surgeon General's report on physical activity, only 15 percent of U.S. adults engage in physical exercise on a regular basis (3 times per week) during leisure time (US Surgeon General, 1996). Some studies suggest that reasons for this poor adherence include lack of time in the schedules, as well as lacking the proper venue to engage in the activity. There may be a more subtle reason however.

### Chronic Mild Inflammation

Globally, humans are now suffering from what is broadly referred to as chronic inflammation. Millions of these people do not know the cells in their bodies are irritated and unable to function properly. This is an emerging topic with researchers as many of these inflammatory dysfunctions have been present for as long as hundreds of millions of people have been eating a western diet which has been shaped traditionally by what products and foods

were easiest and least expensive to farm and easy to process into packaged food products. In the late 1980's, the US Department of Agriculture and the Food and Drug Administration published the recommendation that humans would be healthier on a low-fat diet. This low-fat recommendation led to higher carbohydrate consumption. Populations chose carbohydrate concentrated diets consisting of primarily refined sugar and refined grains because these foods are easier to farm, and cheap to transport with a longer shelf life. These being primarily wheat based products and refined sugar based products. Within 10 years of these dietary guidelines, the rate of diabetes in America went up three-fold. The following are statistics showing indicators of increases in chronic inflammatory disease:

- According to the Centers for Disease Control and Prevention (CDC) prevalence of obesity among adults is approximately 66 percent. A recent study from Johns Hopkins University School of Medicine concluded that if we were to continue at the present rate, "by 2048, all American adults would become overweight or obese" (Wang, et al. 2008).
- The sixth ranked chronic human disease is allergic reaction, and hay fever/pollen allergies have doubled in developed countries over the past 30 years.
- The rate of asthma has doubled in the last 20 years and despite more advanced medical care, more lives were ended as a result

of asthma in the year 2000 then in the year 1970 - Arthritis, joint pain, and joint dysfunction affects 43 million people in the United States, approximately 20 percent of the population, and by 2020 this number will increase by 50 percent. It is essential to point out that the number of people diagnosed with joint pain is small compared to the millions more who have undiagnosed pain in joints.

When considering the above statistics, many of these dysfunctions begin without warning, and are a direct result of joint inflammation, excess mucus production from gastrointestinal inflammation, immune system inflammation, and general cellular inflammation. Individuals are less likely to exercise as they age, and lack of leisure time may not be the only reason. The above statistics all correlate to less physical activity from breathing difficulties with asthma and allergies, to joint inflammation which can contribute to a decreased desire for exercise. Simply put, adults may be less likely to exercise because exercise has become more painful.

Discomfort/pain may be nonspecific enough that individuals do not get diagnosed with any specific dysfunction, but just lack the interest in engaging in exercise. Pain and discomfort in functional movement is not something that individuals can necessarily ignore, as pain is sensed by the central nervous system (the process of neural inhibition engages, and that limits motor neuron engagement).

#### **Superior Exercise can be Made Possible When Addressing Inflammation**

When suggesting a type of exercise in this review, specific prerequisites must be met to be practical and effective for adults:

1. Once chronic inflammation is addressed, individuals can move without, or with less pain, and thus are capable of higher intensity activities.
2. Adherence will be greater if exercise time is short.
3. Due to the western diet, in addition to inflammation, caloric intake, is on average too high. An emphasis must be placed on weight and stored body fat management.

There have been trends with exercise professionals in the past to promote greater interest in lower intensity/low impact activities (Fletcher, et al. 1996). New research is showing significantly greater benefit from less exercise, but with high intensity. This is especially the case for programs that focus on weight loss (fat loss) (Boutcher, 2010). Individuals perform high intensity actions and get to muscular exhaustion as quickly as possible, rest for a brief period of time, then repeat the activity numerous times. This is commonly called High Intensity Interval Training (HIIT). The benefits of HIIT are attractive for two reasons; 1. More effective for weight loss, and 2. Less time consuming than the standard Low-Intensity Cardiovascular Training (LICT). The LICT type of exercise activity may be difficult, or impossible for an individual who has chronic inflammation, or even mild inflammation. The following sections will discuss dietary and supplement changes that can be made, so individuals can engage in higher intensity exercise with greater comfort.

Groundbreaking research by Trapp showed a non-exercising control group, a moderate exercising group that performed LICT type exercise for 30 min three times per week, and a HIIT group. The HIIT study subjects performed 8-second sprints on a stationary bicycle, then rested for 12 seconds before repeating. The process lasted 20 minutes after the subjects could train up to this point, but this only accounted for 8 minutes of actual exercise, with the balance of the time being rest. Despite the actual exercise lasting half the time, the HIIT subjects in the study lost 11.2% of total fat mass in the body while the LICT subjects experienced no fat loss. Collectively, these results demonstrate that HIIT intermittent sprinting compared to traditional cardiovascular training is a more effective and efficient way of controlling body fat/composition (2008).

Some early critics of HIIT suggested that this approach to exercise would not affect cardiovascular health, thereby should not be recommended. Later, HIIT was shown to actually have greater positive affect on the cardiovascular system than lower-intensity LICT type exercise (Rognmo, et al. 2004). Other criticism cites the lack of caloric usage during HIIT protocols. As the caloric usage does not follow pace with the body fat lost from the exercise, HIIT must have a fat loss (weight loss) mechanism beyond the simple math of looking at calories burned versus calories taken in.

HIIT, instead of acting on calorie usage as the primary mechanism for effect, creates a release of hormones that trigger the body to metabolize body fat at a more rapid rate. Human growth hormone (HGH) modulates fuel metabolism, reduces total fat mass and abdominal fat mass, and has been a potent stimulus of lipolysis (the breakdown of lipids) (Thomas, et al. 2013). In 1990 the US Army performed tests looking at exercise intensity and HGH secretion. The results did not look at body fat, only to HGH for its healing effects. The study found that rapid bursts to muscular exhaustion, followed by 1 min of rest, then repeated showed the highest levels HGH secretion compared to other lower intensity protocols (Kraemer). This corresponds to tests done showing HGH secretion comparisons between HIIT and LICT where the HIIT group showed triple the amount of HGH in the blood after the exercise compared with the LICT group (Vanhelder, 1984). To look at the caloric usage and long-term implications of HIIT, King separated two test groups, one performing standard LICT, and the other performing HIIT intervals. Instead of looking at one protocol then the other, King chose to engage in each with identical caloric usage. Each group performed exercise by using only 300 calories per exercise session. The HIIT group was done with their exercise in half of the time that the conventional training group took, but the resting metabolic rates of the groups became different. The HIIT group had a significantly higher level of caloric usage while resting 24 hours after their exercise sessions, where the LICT group had no change (2001).

**Recommendation:** Exercise intensity is relative to the individual. When examining what type of exercise to engage in to apply this intense interval model, physical limitations must be considered. Also, the primary goal is rapid exhaustion of muscles, not necessarily the speed of movement. What may not look like a sprint to an observer could be one for the individual performing the sprint. In order to accelerate this effect, one particular dietary supplement has shown positive results in published research. Gamma-aminobutyric acid (GABA) is a naturally occurring neurotransmitter that is synthesized as a dietary supplement. GABA has been seen to increase HGH blood levels

both at rest and after exercise beyond placebo group (Powers, et al. 2008). The following are some other dietary supplements and dietary support that can potentially aid in the comfort and effectiveness of the performance of HIIT activities:

N-acetyl-L-cysteine (NAC) inhibits virus replication and expression of pro-inflammatory molecules, and has been seen to improve lung function by breaking up mucus (Tirouvanziam, et al. 2006; Geiler, et al. 2010).

Tyrosine is a naturally occurring precursor to neurotransmitters. It has stress reducing capabilities and has been seen to aid in weight loss seen in animal trials (Hao, et al. 2001).

Epimedium has been shown to up-regulate genes associated with nitric oxide production, meaning greater blood flow, and faster recovery (Ma, et al. 2011).

#### Known Dietary Contributors of Chronic Inflammation:

##### 1. Fructose (sugar)

There are two types of sugar: fructose and sucrose. They are different, but are typically found together. For the purposes of this review, we are focusing on fructose, not sucrose. Fructose occurs naturally in fruits and vegetables, and when digested in its natural state, the rate at which the fiber digests moderates the rate that the fructose digests. This process protects from allowing the fructose to digest at a more rapid rate. When fructose is refined, and the fiber/cellular structure is removed, it naturally grows with the digestion of fructose and becomes toxic to insulin receptors damaging their ability to properly process glucose properly. This describes the beginning stages of metabolic disease, and leads to type2 diabetes. The inflammatory nature of fructose involves elevated levels of uric acid and higher blood pressure (Nguyen, et al. 2008, Johnson, et al. 2009). Uric acid is an easily measured marker of chronic inflammation and at high levels is the cause of Gout, a dysfunction of debilitating joint inflammation and pain (Leyva, et al. 1998). Individuals who regularly ingest refined sugar/fructose will have a degree of chronic inflammation, even if not to levels that would show a debilitating dysfunction like gout, or high blood pressure.

**Recommendation:** Limit or eliminate refined sugar/fructose consumption. Some theorize that humans have a natural desire for fructose, as nothing in nature that has fructose is poisonous to humans (Lustig, 2009). When an individual desires something with the taste of fructose (sugar, or sugar substitute) it is advisable to consume fruits or vegetables in their natural state.

##### 2. Wheat Grain Based Foods

Wheat is one of the most consumed grains throughout the world and makes up a significant part of the world diet. Historically, dietary guidelines in Europe and the United States advise individuals to consume "whole" grain products daily. Wheat grains contain proteins sometimes called "anti-nutrients." These anti-nutrients are wheat gluten and wheat lectin, and in humans can trigger dysfunction/disease (De Punder, & Pruimboom, 2013). This section is not about celiac disease or gluten intolerance specifically, but rather that general inflammation can potentially be caused by wheat and wheat gluten. The following studies found wheat to allow for a biochemical environment of chronic inflammation, leading to autoimmune disease:

##### Effects of Rapid Digestion of Carbohydrates and the Brain

Wheat grain is one of the most difficult grains for the human body to digest. This is why humans only consume wheat after it is ground into a powder, and then bleached (wheat flour). Some dietary experts would refer to this process as pre-digestion. One of the largest problems with consuming wheat flour involves the rate at which the calories are absorbed by the digestive system due to this "pre-digestion" processing. This rapid digestion can contribute to elevations of blood sugar, which, published August 8, 2013, in the New England Journal of Medicine indicated shrinkage of the human brain, anxiety, dementia as well as a relationship to Alzheimer's disease (Crane, et al. 2013). Dr. David Perlmutter, in his recently published book, Grain Brain, illustrates how this study as well as others indicate that gluten intolerance/intolerance to wheat is not simply a digestive issue. He shows that many different neurological dysfunctions are linked to wheat/gluten consumption (2014, Hadjivassiliou, et al. 2010). Individuals on a high-fat diet have a 44 percent risk reduction for developing dementia as opposed to individuals with the standard U.S. Government recommended high carbohydrate diet (Roberts, et al. 2012).

**Recommendation:** Limit or eliminate wheat and wheat based product consumption. Mild systemic inflammation that is indicated can potentially be a contributing factor to many other dysfunctions. From what is understood to date in the academic literature, the anxiety and general emotional stress that is linked to wheat consumption alone can negatively impact an individuals desire to engage in HIIT or any type of exercise.

Dimethylaminoethanol (DMAE) is a dietary supplement that improves the function of nerve membranes. The European Journal of Medical Research published a study showing electron encephalogram (EEG) brain scan analysis of users of DMAE having brain activity of improved emotional states and feelings of well being (Dimpfel, Wedekind, & Keplinger, 2003). Though not necessarily the same mechanisms, the improvement of emotional states can potentially address, in part, the anxiety linked to wheat consumption.

##### 3. Dairy

Cow dairy (dairy) has been a long running recommendation by governmental health agencies and the medical community. In the field of nutrition sciences, the dairy recommendation could possibly be one of the most contested recommendations. There is research on both sides in support of and recommending against its consumption. This subject is also confused with the production of dairy products from genetically modified cows, some of which are given different hormones and antibiotics throughout their lives. These elements of genetic modification, hormonal and chemical altering of the biochemistry of the cattle, ultimately end up being passed to the consumer. Much of what is studied as-to the health value of dairy may be contested because there are so many variations of dairy. Low-fat dairy products have sugar added, which may be compounding health complications of dairy or could be the predominant variable of dairy linked health dysfunction.

Dairy, as it is packaged and distributed to consumers includes calcium and is often fortified with vitamin D with the intention of enhancing the bone building, though in 1992 a study was published analyzing data taken from 16 countries, cross referencing dairy consumption with bone fracture rates. Results

of the study showed no link between dietary calcium intake and bone fracture reduction (Abelow, et al.). Some dietitians compare the human diet with the diet of animals in the wild that do not suffer from the chronic disease that humans do. These dietitians observe that humans are the only animal species that consumes the milk of another animal species, further observing that approximately 75% of the world's population cannot tolerate the digestion of dairy (Hertzler, et al. 1996). Much of the scientific literature has focused on a potential dysfunction, shown in the lack of certain enzymes, with the majority of humans as seen in this inability to digest dairy. Perhaps the dysfunction is not the inability to digest dairy, but instead the attempt to digest dairy. The following is a review of clinical literature linking dairy consumption to chronic inflammatory dysfunctions:

#### - Arthritis and Joint Inflammation

Sköldstam and Swedish researchers performed an observational study of 26 rheumatoid arthritis patients who consumed no dairy products for three months, then contrasted with the standard Swedish diet, which consists of dairy with every meal. The results in pain reduction were dramatic (2003).

#### - Intestinal Inflammation in Children

Cow's milk dairy may cause overt rectal bleeding or profound anemia intestinal bleeding in both infants and older children. A study published in the *Journal of Pediatric Surgery*, showed that children with rectal bleeding that were studied immediately alleviated the dysfunction after stopping cow dairy consumption (Willetts, et al. 1999).

#### - General Cellular Inflammation

Researchers have looked to children and their ability to sleep. Taking a group who have sleep dysfunctions stemming from breathing, and headache problems, then removing dairy from their diets has shown significant improvement in their conditions. The researchers concluded that, "dairy may play a major role in the development of allergies, asthma, sleep difficulties, and migraine headaches" (Kahn, et al. 1989).

#### - Cancer Links

Though there have been a number of links to cancer, the link to prostate cancer and dairy is one of the strongest. Researchers have shown that higher intakes of both calcium and dairy products may increase male risk of prostate cancer by 30 to 50 percent (Tseng, et al. 2005).

**Recommendation:** It is important to point out that though many individuals do not suffer from many of the dysfunctions seen linked to dairy consumption as described above, they may have low-levels of cellular inflammation that can be addressed by reducing or eliminating dairy from their diet.

#### Conclusion:

The above inflammatory elements, sugar/fructose, wheat, and dairy, are large sources of calories in the western diet. The attempt to limit or eliminate these three types of foods may lack some practicality as many products have them as binding agents, or just preparatory measures. Practical examples:

1. A breaded piece of fish has wheat in its breading.
2. A piece of meat served at a restaurant may come with a sauce over the top that could include all three, sugar/fructose, wheat, and dairy.

Certain dietary supplements can be recommended that can allow for greater freedom of movement, increased motivation to exercise, and a reduction of inflammation in order to exercise with higher intensity and take advantage of the HIIT activities as described. It is important for practitioners to focus on educating their patients on consequences of deconditioning that are normally associated with aging, as well as some of the more practical ways to avoid it.

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