

12-1-2015

## The Effects of Nutrition Pertaining to Fitness and Health

Daniel Swem  
*Indiana State University*

Follow this and additional works at: <https://scholars.indianastate.edu/uhp-fac>



Part of the [Amino Acids, Peptides, and Proteins Commons](#)

---

### Recommended Citation

Swem, Daniel, "The Effects of Nutrition Pertaining to Fitness and Health" (2015). *University Honors Program*. 8.

<https://scholars.indianastate.edu/uhp-fac/8>

This Article is brought to you for free and open access by the Honors College at Sycamore Scholars. It has been accepted for inclusion in University Honors Program by an authorized administrator of Sycamore Scholars. For more information, please contact [dana.swinford@indstate.edu](mailto:dana.swinford@indstate.edu).

# **The Effects of Nutrition Pertaining to Fitness and Health**

Daniel Swem, Indiana State University

## **Abstract**

The current research is focused on how nutrition influences both fitness and health. It is important to understand the difference between the two terms. Fitness relates to a person's ability to perform specific tasks whereas health is a condition of being free of disease or illness. Pertaining to fitness, this study primarily focuses on cardiovascular endurance, muscular strength, and body composition. (The other components of physical fitness are muscular endurance and flexibility). This research will attempt to answer some highly researched questions. How important is the timing of pre-exercise and post-exercise meals? What foods are beneficial for those seeking to improve cardiovascular endurance, muscular strength, and body composition? How does diet alone influence body composition, fat mass, and fat-free mass? The primary mode used to answer these questions will be investigation into relevant literature. Much research has already been conducted on these topics. The leading studies find an acute positive correlation to carbohydrate ingestion and improved cardiovascular endurance. Other studies have found that protein ingestion aids in the recovery of muscular strength exercises. Lastly, a reduction of carbohydrates, while not engaging in exercise, has been shown to improve body composition.

*Key Words:* fitness, body composition, carbohydrates, protein

## **Introduction:**

For many individuals, exercise can be a scary thing. Some have never entered a gym, stepped foot on a track, or picked up a ball of any sort outside of maybe gym class. We all know that exercise is good for our health, but seldom does it cross our minds. There's so much that goes into exercise too. What clothes do I need to wear? Do I need a gym membership? How much of my diet needs altering? The later question has been possibly the most debated in literature. And for the beginner that is seeking to make a change, this could possibly be the scariest thought of all. Truth be told, most people don't give a second thought to the foods that go into their bodies. The popular thought tends to be, "If I eat fast food or too many sweets, I can just burn them off at the gym." I've heard this statement too many times in my life. I've been running cross country and track since the 8<sup>th</sup> grade, and I used to believe this was true. But as I grew older and attended college, I realized it was a lie. Burning off the calories we consume is actually a lot harder than it seems. After running a few miles, that lunch from McDonalds might still be hanging around. Three and a half years of studying exercise science and being a student athlete has sparked my interest on this topic.

In regards to aspiring exercise enthusiasts, most aren't aware of proper nutritional guidelines and recommendations. It's true that exercise will burn the calories ingested from junk foods. However, there is obviously a better alternative. Take this as an example; If I put a second rate brand of motor oil in a car, it surely will still run. But if a better quality of oil is used, the car will run more efficiently and perhaps for a longer duration. The same is true for our bodies. If we put simple foods such as candy, soda, or processed foods into our bodies it will still use those calories. On the other hand, if we consume higher quality foods with more nutrients, then our

bodies will run more efficiently. We may have more energy for daily tasks, our bodies might fight off disease at a higher rate, and we may be able to exercise at a higher intensity.

Once we understand that the foods that we consume is important, then many doors start to open up. However, like exercise, many people don't know a lot about proper nutrition. The goal of this thesis is to shed light on the effects that nutrition has on fitness and health. Fitness refers to the ability to accomplish specific skills, whereas health refers to the state of being free of disease or illness. Fitness is more sport related and health is more recreational. There are many components of fitness and health, but this research will focus on only three aspects. These aspects are cardiovascular endurance, muscular strength, and body composition. Throughout this research, the terms "aerobic" and "anaerobic" will be presented. Aerobic exercise is a mode of exercise that utilizes a lot of oxygen intake, like cardiovascular endurance. Anaerobic exercises use less oxygen. Resistance training, or muscular strength training, is a form of anaerobic exercise.

Like I mentioned earlier, many people don't understand the importance of nutrition, especially when exercise is also involved. The two should go hand in hand. At this point, a few crucial questions present themselves. How important are our pre-exercise and post-exercise meals? Are their specific foods that are better for aerobic exercise as opposed to anaerobic exercise? What impact does nutrition alone have on overall health? These are the questions that this thesis will attempt to answer. These questions have been highly researched so the amount of information is vast. One highly debated aspect of this topic is the timing of such meals. Along with looking into basic nutrition for each mode of exercise, I will also be investigating the importance of how when we eat certain foods. The primary mode of investigation will be examining literature. Accurate data will be collected from numerous peer reviewed articles.

Reviewing these articles will hopefully let us gain insight into the above research questions. The questions will be either supported or contradicted based on the findings within literature.

### **Brief Background:**

As previously mentioned, we will be looking into the effects that nutrition has on cardiovascular endurance, muscular strength, and body composition. Before looking into the research, there needs to be a basic understanding of each of these facets.

As we know, cardiovascular endurance is aerobic. This type of exercise is highly dependent upon oxygen consumption. Likewise, gains in overall muscle strength will not be as prominent. There are different modes to assess cardiovascular endurance. Jogging, running, biking, and doing the elliptical machine are all popular modes of aerobic exercise. Many of the research articles will utilize either running on a treadmill or biking on a stationary bike. It is easier to assess cardiovascular endurance via the use of one of these machines for the sake of convenience and cost. The basic standard for assessing aerobic capacity is estimating one's VO<sub>2</sub> max. This tells us the amount of oxygen being delivered to the muscle during exercise. Muscles need oxygen to function. That is why we breathe more rapidly when we complete hard exercises. VO<sub>2</sub> max is measured in milliliters of oxygen consumed per kilogram of body weight per minute (ml/kg/min). After that value is estimated, it can then be categorized, while also taking the individual's age into account.

Muscular strength is an anaerobic type of exercise. Although oxygen consumption is required, this type of exercise does not depend on oxygen nearly as much as aerobic activity does. Aerobic strength may improve while completing anaerobic exercises, but only to a slight degree. Resistance training is the most utilized mode of anaerobic exercise. By resistance training, we mean weight lifting. The most common method to assessing one's muscular strength

is by using a one repetition maximal lift, often abbreviated as “1-RM”. A 1-RM can be completed for just about any lift. Many researchers tend to utilize a 1-RM in exercises that require large muscle groups, such as the bench press, back squat, or leg press. The amount of weight lifted for each lift can then be categorized based off the lifter’s age.

The aspect of health that will be investigated is body composition. This is under the realm of health and not fitness because body composition isn’t a very accurate estimation of health for most athletes. Body composition primarily estimates percent body fat and body mass index, or BMI, which is measured by dividing a person’s weight (in kilograms) by their height (in meters squared). BMI is not accurate for many athletes because it doesn’t take into account how much of the person’s weight is muscle. There are a few ways to assess body fat percentage. Bioelectrical impedance analysis measures the resistance from one point of the body to another. The more resistance, the more body fat there is assumed to be. Underwater weighing and BodPods measure body volume using the principle of displacement. Lastly, we can use skinfold techniques and circumference measures of different landmarks on the body. Then we can plug the results into their appropriate equations and estimate one’s body fat percentage. Again, we can categorize each person based on their results and age group.

### **Investigation of the Literature:**

First, we will look at the specifics behind cardiovascular endurance. As previously mentioned, this type of exercise requires a vast amount of oxygen intake. Since this type of exercise requires being active for a long period of time, we know that a lot of energy will be used up during the exercise bout. Carbohydrates are very dense macronutrients. The body can pull a lot of energy from them. We know that sugar is found in carbohydrates. The stored form of carbohydrate within the body is called glycogen, which is stored within the muscle. Upon

completing an exercise bout, muscle glycogen levels will be depleted. It is for this reason that the majority of the literature surrounding endurance training is based around carbohydrates. One popular belief about carbohydrates is the idea of “carb loading”. This method is used by many endurance athletes. The thought behind the belief is that ingesting a lot of carbohydrates within the days leading up to an event will aid performance in that event. Some of the research suggests that eating a low glycemic index diet prior to exercise will help with performance (Wu, 2006). The glycemic index refers to how quickly a food raises blood glucose. A low glycemic index food has lower amount of carbohydrates than a high glycemic index food. In that study, men that ate low glycemic index foods three hours prior to running had slightly faster times than the men that consumed a higher glycemic index diet. The ingestion of carbohydrate within the days leading up to a competition has also been shown to improve performance in events that last for at least 90 minutes (Hargreaves, 2004). There are unlimited carbohydrate stores within the body, so this macronutrient is always readily available to be converted into energy. Increasing the amount of carbohydrate prior to a competition will have an impact on performance. There is a caveat with this theory however. Since there are unlimited carbohydrate stores in the body, anything that isn’t used will be converted into fat. Too much “carb loading” can be detrimental.

Carbohydrate ingestion prior to an exercise bout has also been shown to have positive effects on the body. It is recommended that about 1.5 grams per kilogram of body weight of carbohydrate ingested within 30 minutes following endurance training is adequate to replenish lost glycogen stores (ACSM, 2000). Proper protein and fat intake following exercise has also been shown to increase recovery (ACSM, 2000). The focus should be on eating a balanced diet. Experienced individuals will need slightly more of each macronutrient due to the nature of their sport, but the

key is to not focus on one of them. Carbohydrates, protein, and fats are all important for endurance athletes, before and after exercise.

Next, we will look at the research behind anaerobic activity. As discussed earlier, this type of exercise does not utilize as much oxygen as aerobic activity does. Resistance training is a primary mode of anaerobic activity. Typically, resistance training involves much more rest between exercises that we see in aerobic exercise. Because of this, much less energy is expended with anaerobic activity. Different energy systems are utilized for anaerobic versus aerobic exercise. Where individuals that complete endurance training will be highly dependent upon carbohydrates for energy, individuals that complete resistance training will be more dependent upon protein. Supplements have been highly discussed with this field. Most of the pre-exercise supplements used by weight lifters contain a lot of amino acids, which are compounds that form protein when they bind together. The thought behind taking these supplements, often called “pre workout”, is that by increasing amino acid content before a workout, the muscles will have more energy and thus be able to lift more. Also, the hope is to increase hormonal response to aid in performance. Many studies have focused on this concept. Hoffman et al completed an experiment outlining pre-exercise supplements and its effects on resistance exercise. They reported that by taking a protein supplement just 10 minutes prior to resistance training can have an acute effect on performance by increasing insulin and growth hormone (Hoffman, 2008). There is also evidence that supports that pre-exercise supplements can have an effect on muscle recovery within the hours prior to working out. One such study done by Tipton et al illustrates this idea. They reported that amino acid delivery during and within 1 hour after exercise were significantly greater in individuals that consumed a protein supplement prior to resistance training (Tipton, 2001). In the previous two studies, the researchers focused primarily on single



exercises. Hoffman utilized 75% of the individual's 1-RM of the back squat while Tipton used the leg press and leg extension. The effects that pre-exercise supplements have on a high intensity, full-body exercise routine were studied by Sharp and Pearson. Within this study, participants completed the leg press, leg curl, leg extension, bench press, military press, latissimus pull-down, and dumbbell curl, and triceps pull-down at 80% of their estimated 1-RM. They reported that the group that consumed the amino acid supplement prior to resistance training had higher testosterone levels and decreased cortisol and creatine-kinase levels, which can lead to increased performance and decreased risk of injury (Sharp, 2010). Another highly discussed aspect regarding protein supplementation is which type of protein is most effective in bringing about these increases in performance and recovery. There are so many different kinds of protein supplements available, but which ones carry the best results? Popular forms of protein, within supplements and the classic western diet, include whey protein, soy protein isolate, and casein, which is typically found in milk. Tang et al recently studied the effects of these popular forms of protein. They studied the effects that each of these three proteins have on muscle recovery. They found that whey protein was most effective on muscle protein synthesis because it was more rapidly metabolized within the body (Tang, 2009). Protein is an important part of a weight lifter's diet. It can have an acute effect on performance if taken prior to exercise and can aid in recovery after exercise. It is generally recommended to consume about 1.7 grams of protein per kilogram of body weight per day (ACSM, 2000). Protein requirements can be met through diet alone, but supplementation can add more benefits. Again, a balanced diet will be more effective than just focusing in protein alone, but extremely active individuals will need more protein in their diet than the general population.

Body composition is our last area of interest. Many aspects associated with body composition that have been highly researched are Body Mass Index (BMI), bone density, fat mass, fat free mass and percent body fat. It is commonly known that physical activity has great influence on body composition. Nutrition's effect on body composition is possibly less known to the general public. Typically, longitudinal studies are most effective when attempting to find correlations with body composition. Longitudinal studies take place over the course of multiple years. One such study conducted by Ilich et al researched correlations between nutrition, body composition, and physical activity to skeletal development. They conducted a 7-year longitudinal study researching adolescent females. They reported that, although not as strong as hormonal or hereditary influences, nutrition had a significant impact on bone mineral density and other anthropometric measures (Ilich, 1998). Calcium, protein and phosphorous were the leading nutrients that affected these changes. One of the arguments against studying adolescents is that they haven't fully developed physically. It might be more accurate to study an older population. Foster-Schubert et al recently conducted a similar study on over 400 post-menopausal women. All the women in this study had BMIs that classified them as obese. They completed a year-long analysis on the effects that nutrition, exercise, and the combination has on weight and body composition. Their findings were quite interesting. They reported that from consuming a reduced-calorie, low-fat diet alone, subjects lost about 8.5% weight loss. The exercise only group lost about 2.4% weight loss (Foster-Schubert, 2014). Improvements in BMI, percent body fat, and waist circumferences were also observed. This study is pivotal for those seeking to lose weight. Although the highest reductions are seen when combining a proper diet with exercise, diet alone can make a big difference. Reduction in fat, sugars, and carbohydrates can lead to weight loss. In the typical western diet, many foods contain processed sugars, fats,

carbohydrates, and other unnatural substances that can be detrimental to one's health if consumed. Fried foods are also quite popular. The excess oils and fats from these types of foods can lead to massive weight gain and various other health issues. Many of these foods can be addictive, causing us to indulge ourselves and over eat. However, we know that an improvement in our diet alone can, and will, lead to weight loss. Reducing certain fats, sugars, and carbohydrates can improve BMI, body fat percentage, circumference measures, and possibly prevent against a number of health issues associated with being obese. Again, it is best to improve one's diet and become physically active.

### **Conclusion:**

The purpose of this thesis was to investigate the effects of nutrition pertaining to fitness and health. The components of physical fitness that were examined were cardiovascular endurance and muscular strength. These types of exercise were classified as aerobic and anaerobic respectively. The component of health that was examined was body composition. Many different components make up body composition. Fat mass, bone density, fat free mass, BMI, circumference measure and percent body weight are some of the aspects of body composition. The main points of interest of the current research were the importance of pre-exercise and post-exercise meals, specific types of foods that are better for aerobic versus anaerobic exercise, and how nutrition alone can affect overall health. The main mode of investigation into these questions was to examine popular literature completed by individuals within the field of fitness and health. As far as pre-exercise and post-exercise meals are concerned, we learned that the timing of these meals is important for adequate performance and recovery. Aerobic activity generally requires more carbohydrates in the diet for more energy. A low glycemic index carbohydrate diet could possibly lead to increased performance in runners

(Wu, 2006). Carbohydrates consumed before and after endurance training can ensure the individual has the proper amount of energy for the event (Hargreaves, 2004). Anaerobic exercises, such as resistance training, require more protein than the general population is recommended. Protein supplementation before exercise can result in increased performance caused by hormonal increases and increased muscle activation (Hoffman, 2008). Also, a proper amount of protein following the exercise will help with recovery time (Sharp, 2010). As far as the type of protein supplement is concerned, whey protein is the best option because it is more rapidly absorbed than other types of proteins (Tang, 2009). Lastly, nutrition alone can influence health. A highly nutritious diet can positively impact the development in adolescents by aiding in the growth of bones (Ilich, 1998). Also, improving one's diet alone can lead to reductions in weight, BMI, percent body fat, and other anthropometric measures (Foster-Schubert, 2012). These implications can have an effect on numerous fields of study. Personal trainers must be aware of the importance of physical activity and must be knowledgeable on how different types of exercise bring about changes within the body. Dietitians must also have extensive knowledge of the various types of nutrients and how each affects the body. Doctors treating patients suffering from ailments associated with obesity need to be able to give effective behavior modification strategies that can help the patient lose weight and get healthy. This can also relate to our government. Perhaps more strict regulations on food processing and manufacturing can help the obesity rates decrease. More educational programs can outlining the importance of nutrition could be effective. Of course this information can be beneficial to the public as well. Not everyone understands the importance of nutrition when it comes to fitness and health. Some people think that they can eat whatever they want as long as they "burn it off" later. We can see that this isn't the case. Proper nutrition can have a positive effect on everyone.

## References

1. ACSM, ADA, and Dietitians of Canada. "Nutrition and Athletic Performance." *Medicine & Science in Sports & Exercise* 32.12 (2000): 2130-145. [Http://elearning.ice.ntnu.edu.tw/](http://elearning.ice.ntnu.edu.tw/). ACSM, ADA, Dietitians of Canada, 2000. Web. 2 Dec. 2015.
2. Chryssanthopoulos, Costas, and Clyde Williams. "Hochschulen Und Forschungsinstitute." *Nachr. Chem. Nachrichten Aus Der Chemie* 55.10 (2007): 1055. *Researchgate.net*. ResearchGate, Oct. 1997. Web. 1 Dec. 2015.
3. Creer, Andrew, Phillip Gallagher, and Dustin Slivka. "Influence of Muscle Glycogen Availability on ERK1/2 and Akt Signaling after Resistance Exercise in Human Skeletal Muscle." *Journal of Applied Physiology* 99.3 (2005): 950-56. [Http://jap.physiology.org/](http://jap.physiology.org/). American Physiological Society, 1 Sept. 2005. Web. 02 Dec. 2015.
4. Foster-Schubert, KE, CM Alfano, and CR Duggan. "Effect of Diet and Exercise, Alone or Combined, on Weight and Body Composition in Overweight-to-obese Post-menopausal Women." *Obesity* 20.8 (2012): 1628-638. *Obesity (Silver Spring, Md.)*. U.S. National Library of Medicine, 1 Aug. 2012. Web. 02 Dec. 2015.
5. Hargreaves, Mark, John A. Hawley, and Asker Jeukendrup. "Pre-exercise Carbohydrate and Fat Ingestion: Effects on Metabolism and Performance." *Journal of Sports Sciences* 22.1 (2004): 31-38. 7 Aug. 2003. Web. 2 Dec. 2015
6. Hoffman, Jay R., Nicholas A. Ratamess, and Ryan Ross. "EFFECT OF A PRE-EXERCISE ENERGY SUPPLEMENT ON THE ACUTE HORMONAL RESPONSE TO RESISTANCE EXERCISE." *EFFECT OF A PRE-EXERCISE ENERGY SUPPLEMENT ON THE ACUTE HORMONAL RESPONSE TO RESISTANCE EXERCISE* 22.3 (2008): n. pag. [Http://www4.netrition.com/](http://www4.netrition.com/). Journal of Strength and Conditioning Research, May 2008. Web. 2 Dec. 2015.
7. Ilich, Jasminka Z., Mario Skugor, and Thomas Hangartner. "Relation of Nutrition, Body Composition and Physical Activity to Skeletal Development: A Cross-Sectional Study in Preadolescent Females." *Journal of the American College of Nutrition* 17.2 (1998): 136-47. [Http://www.researchgate.net/](http://www.researchgate.net/). ResearchGate, 1998. Web. 2 Dec. 2015.
8. Kreider, Richard B., Maria Ferreira, and Michael Wilson. "Effects of Creatine Supplementation on Body Composition, Strength, and Sprint Performance." *Medicine & Science in Sports & Exercise* 30.1 (1998): 73-82. [Http://www.researchgate.net/](http://www.researchgate.net/). ResearchGate, Jan. 1998. Web. 2 Dec. 2015.
9. Paul, David, Kevin A. Jacobs, Raymond J. Geor, and Kenneth W. Hinchcliff. "No Effect of Pre-exercise Meal on Substrate Metabolism and Time Trial Performance During Intense Endurance Exercise." *01.Koch (149)2003.13* (2003): 489-503. *Www.humankinetics.com*. Human Kinetics, Inc., 2003. Web. 2 Dec. 2015.

10. Sharp, Carwyn P.M., and David R. Pearson. "AMINO ACID SUPPLEMENTS AND RECOVERY FROM HIGH-INTENSITY RESISTANCE TRAINING." *Journal of Strength and Conditioning Research* 24.4 (2010): 1125-130. [Http://www.cstonline.ilstu.edu/](http://www.cstonline.ilstu.edu/). National Strength and Conditioning Association, 2010. Web. 2 Dec. 2015.
11. Tang, Jason E., Daniel R. Moore, and Gregory W. Kujbida. "Ingestion of Whey Hydrolysate, Casein, or Soy Protein Isolate: Effects on Mixed Muscle Protein Synthesis at Rest and following Resistance Exercise in Young Men." *Ingestion of Whey Hydrolysate, Casein, or Soy Protein Isolate: Effects on Mixed Muscle Protein Synthesis at Rest and following Resistance Exercise in Young Men* 107.3 (2009): 987-92. [Jap.physiology.org](http://jap.physiology.org). American Physiological Society, 1 Sept. 2009. Web. 02 Dec. 2015.
12. Tipton, Kevin D., Blake B. Rasmussen, and Sharon L. Miller. "Timing of Amino Acid-carbohydrate Ingestion Alters Anabolic Response of Muscle to Resistance Exercise." *Timing of Amino Acid-carbohydrate Ingestion Alters Anabolic Response of Muscle to Resistance Exercise. Am. J. Physiol. Endocrinol. Metab.* 281, E197-E206 281 (2001): E197-206. [Www.researchgate.net](http://www.researchgate.net). ResearchGate, 6 Mar. 2001. Web. 2 Dec. 2015.
13. Wu, Ching-Lin, and Clyde Williams. "A Low Glycemic Index Meal Before Exercise Improves Endurance Running Capacity In Men." *A Low Glycemic Index Meal Before Exercise Improves Endurance Running Capacity in Men* 2006.16 (2006): 510-27. [Www.humankinetics.com](http://www.humankinetics.com). Human Kinetics, Inc., 2006. Web. 2 Dec. 2015.