Leptin and Its Role in Eating Disorders

Eating disorders have always been an intriguing topic. The unique combination of social, psychological and biological components really make it challenging to narrow down a specific cause or reason for an eating disorder. Nonetheless, a lot of attention is focused on the psyche and its role in the development of an eating disorder. Often times, psychological factors such as distorted self-image, depressed mood and or stress to name a few can increase the risk of falling into an eating disorder problem. I, on the other hand, suggest that one’s biochemistry and physiological processes can play a very important role as well. As a Dietetics major, human physiology, in relation to food, has always been a really interesting topic for me. When learning about eating disorders in class, I could not help but wonder about the body’s metabolism and how that may play a role in an eating disorder. Is it possible that our cellular metabolism communicates with our thought process? Is there a way that we can be genetically predisposed to an eating disorder? These are questions I asked myself as I began my research for this paper.

When researching, I came across the hormone leptin. I had never heard of this hormone beforehand, but its background intrigued me very much. According to the review article titled *Leptin in Anorexia and Cachexia Syndrome* by Diana R. Engineer and Jose M. Garcia, leptin “is a product of the obese gene secreted by adipocytes (fat cells) in proportion to fat mass. It decreases food intake and increases energy expenditure” (1). Its purposes include signaling to the brain that you have had enough food to eat, increasing caloric expenditure by increasing the body’s energy, and regulating body weight. The aforementioned review article and another article called *Neuroendocrine Dysregulation of Food Intake in Eating Disorders* by Palmiero Monteleone, Eloisa Castaldo, and Mario Maj both suggest that leptin is a key component in one’s body weight. After reading both articles thoroughly, I have concluded that the levels of the
hormone leptin, can be an important factor in the development of an eating disorder. In fact, individualswith eating disorders have shown to have lower levels of the hormone leptin than individuals without eating disorders.

When doing research on the hormone leptin, I came across plenty of articles that contained very good data. One article that I found to be very informational was the review article *Leptin in Anorexia and Chachexia Syndrome* by Diana R. Engineer and Jose M. Garcia. In this article, leptin was termed the “body mass regulator” (Engineer, Garcia 2012). It regulates body mass by communicating through the central nervous system to decrease food intake and increase energy expenditure (Engineer, Garcia 2012). Leptin travels through the blood-brain barrier and keeps a communication pathway between some peripheral organs. There are receptors for this hormone in the hypothalamus of the brain, the liver, pancreas, kidney, bone marrow and skeletal muscle (Engineer, Garcia 2012). Additionally, leptin is also a part of other “metabolic pathways” such as “growth hormone (GH) signaling, insulin sensitivity and lipogenesis” (Engineer, Garcia 2012). It is also a part of other important factors; including “insulin sensitization” that occurs along the periphery that is aside from body weight. In a study that was done on leptin-deficient (ob/ob) mice, the leptin dose injections led to a change where dose-dependent serum glucose levels dropped in comparison to the fed ob/ob control group (Engineer, Garcia 2012).

When the leptin receptor gene is inactivated, or leptin mutation levels stop, the body automatically falls into a false perception of starvation and energy expenditure drops significantly. This dramatic change results in obesity. On the other hand, a 10% increase in body weight leads to a 300% increase in leptin concentrations. When leptin levels rise, food intake drops and energy expenditure increases “via physical activity and thermogenesis” (Engineer, Garcia 2012).
Leptin insufficiency can result from diet and lifestyle changes for long periods of time. This insufficiency causes fat accumulation to increase and energy expenditure to decrease. Additionally, it can also lead to impaired memory, hyperglycemia, neuroendocrine disorders and hyperinsulinemia to name a few (Engineer, Garcia 2012). The crossing of leptin through the blood-brain barrier is regulated by daily mealtimes, body fat, and aging to name a few of the various factors. In essence, when fasting, the transportation of leptin to the brain is reduced significantly (Engineer, Garcia 2012). Also, there are certain proteins in the blood that can bind to leptin and reduce the levels available for the brain. For instance, the hepatic C-reactive protein that is increased in obesity can bind to the leptin and reduce the amount available to cross the blood-brain barrier. (Engineer, Garcia 2012). It is believed that because central leptin insufficiency is involved in leptin signaling in obesity, gene therapy and central gene administration has improved energy homeostasis, prevented diet-induced obesity and metabolic syndrome in mice (Engineer, Garcia 2012).

Clearly, as presented in this review article, the discovery of ob/ob mice and leptin levels have provided evidence that there is indeed communication through hormones between the hypothalamus, regulation of food intake, energy metabolism and adipose tissue. Additionally, by altering gene transcription and neural plasticity, leptin regulates food intake through the ARC melanocortin system. In leptin-resistant Zucker-fatty rats, melanocortin-dependent anorexia was induced. (Engineer, Garcia 2012). The ARC acts by integrating the information it receives and altering the metabolism accordingly through “hormonal and neural pathways” (Engineer, Garcia 2012). Also, according to the article, enough evidence suggests that one of leptin’s main roles is to signal to the brain when the body is in a state of nutrient deficiency and fat loss, which tends to occur in anorexia. When this signal is made, the brain creates a response to compensate for the
loss by increasing appetite, decreasing energy expenditure and essentially regaining the weight. This mechanism, however, appears to be impaired in most chronic diseases, including eating disorders such as anorexia (Engineer, Garcia 2012).

Another interesting article that I found regarding the role of leptin in eating disorders, was one written by Palmiero Monteleone, Eloisa Castaldo and Mario Maj called *Neuroendocrine Dysregulation of Food Intake In Eating Disorders*. This article discussed both anorexia nervosa and bulimia nervosa. Both eating disorders were defined as “psychiatric disorders characterized by abnormal eating behaviors and imbalance of energy homeostasis” (Castaldo, Maj, Monteleone 2008). While anorexia nervosa results in severe food restriction and body weight loss, bulimia nervosa results in constant binge eating and purging episodes without weight loss (Castaldo, Maj, Monteleone 2008). Additionally, concerns about body image, weight, and shape are also characteristics of anorexia and bulimia. These appear to be mainly psychological and psychiatric disorders, however there are a number of biological factors that also play a role in eating disorders. The article suggests that the disruption of important biological factors such as neurotransmitters, neuropeptides and peripheral peptides, which are known to regulate food intake, is found in patients with eating disorders. (Castaldo, Maj, Monteleone 2008).

The article review specifically takes a look at adipokines, which includes the hormone leptin. According to the article, it has been proven that in underweight patients with anorexia nervosa, the levels of leptin in the plasma and the cerebrospinal fluid are consistently lower than normal. They are also are correlated with the patients body fat mass and body mass index (Castaldo, Maj, Monteleone 2008). In a study presented in the article, adolescent anorexic girls were given frequent blood sampling every 30 minutes overnight for 12 hours. They were being checked for their circulating leptin concentrations and the concentrations were being measured.
At the end of the study, low leptin levels were found as a result of decreased basal leptin secretion and nutritional status such as body mass index, percent body fat and insulin resistance (Castaldo, Maj, Monteleone 2008). The data from this study proves that in anorexia nervosa patients, circulating leptin is regulated by nutritional status and may play a role in the regulation of nutritionally regulated hormones (Castaldo, Maj, Monteleone 2008).

When body weight is recuperated, leptin levels stop alternating and tend to increase. In fact, in cases where body weight is regained too rapidly, the levels of leptin can become too disproportioned (Castaldo, Maj, Monteleone 2008). Additionally, excessive leptin concentrations can increase the risk of renewed weightloss. When compared to a healthy control group of women, anorexic women who have restored their weight have shown to have significantly lower leptin level concentrations. However, weight recovery is not always the main factor in high or low leptin concentrations (Castaldo, Maj, Monteleone 2008).

When it comes to patients with bulimia nervosa, circulating leptin concentrations have either increased, stayed normal or decreased. This can possibly be due genetics (Castaldo, Maj, Monteleone 2008). However, bulimia nervosa patients who have had the illness for a longer period of time or have had more frequent binge/purge episodes significantly decrease their secretion of leptin. Therefore, it can be concluded that binge eating and purging episodes can significantly and negatively reduce leptin production (Castaldo, Maj, Monteleone 2008). Also, when bulimia nervosa patients were on short-term refeeding, their blood leptin concentrations were not restored back to normal, compared to normal controls. The article concludes that in bulimia nervosa patients, the role of the hormone leptin as a signal of available energy storage is kept, where as in anorexia nervosa patients it is completely lost (Castaldo, Maj, Monteleone 2008).
Clearly, the hormone leptin is very important in the regulation of one’s metabolism. Although the levels of one’s blood-leptin concentration are not the determining factor of the development of an eating disorder, they can be affected as a result. Once the levels of leptin are affected, one’s metabolic capacity and ability is also greatly affected, which in turn can make the recovery of an eating disorder much more difficult. It is important to understand that the role of leptin in the human body is basically to communicate between the brain and most of the peripheral organs that are important in the regulation of metabolism. Once this communication pathway is impaired, the signals from the brain to slow down or increase energy expenditure and appetite are also affected. Therefore, it is in fact true that individuals with eating disorders have shown to have lower levels of the hormone leptin than individuals without eating disorders, however; one’s initial leptin concentrations are not necessarily the deciding factor.
References
