The Relationship between Gut Health and Obesity

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Abstract

The composition of the human gut microflora is established within the first year of life and the transformation to adult microbiota is triggered by multiple internal and external factors, including one's diet. This paper is designed to provide an overview of the most current research findings related to the impact that gut microbes and gut hormones have in relation to obesity. To provide the information revealed in various research studies about the possible mechanisms in which particular microbes and hormones influence satiety and weight.

Keywords: obesity, body mass index, gut microbiota, metagenomic approaches, appetite regulation, peptide YY, microbiome, Bacteroidetes, Firmicutes

Introduction

As a Registered Dietitian for over 17 years my focus has been on weight loss, since obesity prevalence is rampant. Based on the results from the National Health and Nutrition Examination Survey (NHANES) of 5,555 adult men and women 20 years of age and older (Flegal, 2010), the prevalence of obesity in 2007-2008 is 32.2% among men and 35.5% among women. According to the NHANES III data, in the U.S., 54.9% of U.S. adults aged 20 and older are either overweight (body mass index-BMI of 25.0-25.9) or obese (BMI ≥ 30) (Katz, McHorney & Atkinson, 2001). Having a BMI of over 30, which defines obesity, increases risk for chronic disease, including coronary heart disease, non-insulin-dependent diabetes mellitus, hypercholesterolemia, hypertension, ischemic stroke, certain cancers (e.g., breast, colon), sleep apnea and degenerative arthritis. A further societal impact, being obese poses an increased likelihood of not

finding a spouse and could lead to having a lower income (Katz, McHorney & Atkinson, 2001).

Throughout my schooling in my Dietetic Internship and my Master's of Science program in Foods & Nutrition, the topic related to gastrointestinal (GI) health and obesity had never been addressed. Thankfully the spark came into my head during a presentation titled, "When in Doubt, Follow the Gut" at the Food as Medicine Conference in Bethesda, Maryland, to investigate whether the focus of keeping the GI tract healthy will help a person lose weight and become lean, in a healthy BMI range of less than 25.

The correlation with gut health and obesity is still in the infancy stage of research based on the antiquated way of assessing organisms in the GI tract (microbiota). "We are only starting to get an insight into the effect of diet on the composition and activity-and in turn, the effect on human health-of the gut microbiota" (Louis, P., Scott, K.P., Duncan, S.H. & Flint, H.J., 2007). Formerly, our studies were just based on conventional microbiological techniques, such as selective culturing, which is not considered a reliable assessment tool for analyzing the full spectrum of microbes present in the gastrointestinal tract (DiBaise, J., Zhang, H., Crowell, M., Krajmalnik-Brown, R., Decker, G.A. & Rittmann, B.E., 2008). Assessing the microbial community "has long remained a challenge owning to the limitations of culturing and isolation techniques" (Mariat, D., Firmesse, O., Levenez, F., Guimaraes, V.D., Sokol, H., Dore, J., Corthier, G. & Furet, J.P., 2009). Researchers have just recently been able to assess the gut microbiota more thoroughly and accurately using metagenomic approaches and current molecular methods, such as the quantitative PCR technique (DiBaise, J., Zhang, H., Crowell, M., Krajmalnik-Brown, R., Decker, G.A. & Rittmann, B.E., 2008; Mariat et al, 2009).

DiBaise et al. define metagenomics as "the study of all genes existing within the human genome and within the gut microbial genomes." Mariat et al explain that the quantitative PCR method allows "for a detailed description of the complex composition of the human intestinal microbiota which can serve as a basis to monitor gut microbiota changes in connection with diet or health." Through utilizing the metagenomic and molecular approaches, we can now have a greater understanding of the ways in which microorganisms impact the human gut and how we can alter one's microflora to strengthen their gastrointestinal system which can lead to an overall improvement in one's health.

Microbes Relationship with Weight Gain Versus Weight Loss.

Recent evidence "suggests that the gut microbiota affects nutrient acquisition and energy regulation. Its composition has also been shown to differ in lean versus obese animals and humans" (DiBaise, J., et al, 2008). The strong association between specific microbes and their impact on obesity that have been identified are Firmicutes and Bacteroidetes, which have been revealed in numerous studies. Research conducted by Mariat, D. et al demonstrated particular microbes in people who are obese compared to others who are lean. "The microbiota in obese subjects shows an elevated proportion of Firmicutes and a reduced population of Bacteroidetes" (Mariat et al, 2009). "It is unknown why obese people have more Firmicutes" (DiBaise et al, 2008). Interestingly with weight loss, the ratio of bacteria changed significantly, so just by losing weight can impact the quantity and type of microbes present. "A decreased Firmicutes/Bacteroidetes ratio has been directly related to weight loss" (Mariat, et al, 2009).

Certain characteristics of the gut microbiota have been shown to contribute to a person's likelihood to be overweight or obese. Even at a young age, becoming overweight at age 7 or older have shown to have lower levels of certain microbes, particularly lower Bifidobacteria and higher levels of Staphylococcus aureus, compared to children who kept a healthy weight" (Ley, R., 2010). Research is demonstrating that reshaping the gut microbiota can promote change in a person's weight. "The metabolic activities of the gut microbiota facilitate the extraction of calories from ingested dietary substances, help to store these calories in host adipose tissue for later use and provide energy and nutrients for microbial growth and proliferation" (DiBaise et al, 2008). Studies are showing that the gastrointestinal microbial composition impacts "insulin resistance, inflammation, and adiposity via interactions with epithelial and endocrine cells" (Ley, R., 2010). If the proper balance of microbes is present, an increased caloric expenditure can result, helping a person achieve more weight loss.

Microbes influence metabolism throughout the body, thus influences how much fat is stored, powerful information that can contribute to solving the obesity epidemic. Specifically, the "presence of a microbiota increases serum levels of glucose and short chain fatty acids", which increases insulin production contributing to an increased storage of fat (Ley, R., 2010). In addition, gut microbes have been correlated with "initiating the inflammation and insulin resistance associated with obesity" (Ley, R., 2010).

The Brain and Gut Communicate.

"The gut communicates with the brain using endocrine signals to coordinate energy intake and expenditure" (Ley, R., 2010). There is an apparent evolutionary relationship between the brain and the gut. Gut peptides have been found in the

hypothalamus and hypothalamic peptides have been discovered in the gut (Le Roux, C. & Bloom, S., 2005). "Gut hormones also seem to have important functions in the central nervous system" (Le Roux, C. & Bloom, S., 2005). When the nutrients that are consumed from food have contact with the mucosa, that stimulates the secretion of gut hormones which regulate gut "motility, secretion and absorption, and provide feedback to the central nervous system on the availability of nutrients" (Le Roux, C. & Bloom, S., 2005).

The amount of nutrients that are communicated as being present, influences food intake regulation. "The first gut hormone found to act as a satiety signal in this way was cholecystokinin" (Le Roux, C. & Bloom, S., 2005). An amino acid peptide called Peptide YY (PYY) "appears to control food intake by providing a powerful feedback on the hypothalamic circuits" (Le Roux, C. & Bloom, S., 2005). Following the consumption of food, PYY is released into the circulation and has an important role in regulating food intake. Research has demonstrated that "overweight and obese individuals require more energy" (about 225 more calories) to feel completely satiated compared to those who are of normal weight. Researchers have attributed one contributing factor to a decreased satiety level with the quantity of PYY present. "Obese subjects have a PYY deficiency that would reduce satiety and could thus reinforce their obesity" (Le Roux, C., Batterham, R., Aylwin, S., Patterson, M., Borg, C., Wynne, K., Kent, A., Vincent, R., Gardiner, J., Ghatei, M. & Bloom, S., 2006). Thus exploring the possibility to increase essential satiety peptides and hormones could lead to decreasing obesity by decreasing overall caloric intake through influencing a person's sense of satisfaction post food consumption.

What We Eat Influences Our Microflora.

Just by consuming more carbohydrates, such as whole grains can have a positive effect on the amount of probiotics in our gastrointestinal tract, for example "Bifidobacteria showed a significant reduction with decreased carbohydrate intake," so including some high fiber carbohydrates in your diet can increase the presence of friendly bacteria (Duncan, S., Belenguer, A., Holtrop, G., Johnstone, A., Flint, H. & Lobley, G., 2007). Specifically, eating "whole grains, spinach, cauliflower, carrots, wheat bran, apples, broccoli, beans, figs and pears" helps promote overall digestive health (Schiedel, 2009). Also, adding "light green, dark green and yellow colored vegetables" provide specific antioxidants that help strengthen the gastrointestinal tract, especially "protects the stomach from cancer" (Schiedel, 2009).

In addition to eating high fiber carbohydrates, fermented foods also helps improve the overall beneficial microflora balance in the gut. Choosing foods that contain probiotics, including lactobacilli and bifidobacteria improves gut motility, sensation and helps the lining of the colon stay healthy. Foods that contain probiotics include, yogurt, kefir, miso and sauerkraut strengthening the GI tract. Other fermented foods that aid in restoring proper digestive flora include pickles, chutney, sourdough bread and kombuchu tea (Grimes, 2010).

Working complementary with probiotics is to eat the food that nourishes the natural internal growth of probiotics, which are prebiotics, an excellent source of soluble fiber, including "bananas, garlic, asparagus, Jerusalem artichokes, honey, leeks and onions" (Schiedel, 2009). Supplementing with probiotics has been shown to be helpful too in improving gut health. "Probiotic exposure results in distinct changes in the

microbiome with associated metabolic alterations in a variety of tissues affecting energy, lipid, and amino acid metabolism" (DiBaise et al, 2008). Food products that are labeled as a source of prebiotics most often contain inulin (a natural source of soluble dietary fiber extracted from chicory root) that is added in yogurt, kefir and multigrain crackers.

Including certain foods, called 'carminatives' also help the digestive process by preventing or relieving flatulence, in turn helps strengthen the integrity of the GI tract (Schiedel, 2009). The body needs to be de-stressed to be healthy so does the gut- a soothed gut leads to a strong gut. Some GI soothing foods include caraway, cardamom, cinnamon, fennel, ginger, peppermint leaf and oil, nutmeg and cooked oatmeal (Schiedel, 2009). Many of these foods include herbs that work synergistically with specific foods to aid in their digestion, such as cumin, which helps digest black beans. Furthermore, including raw food (which contains digestive enzymes and nutrients) and drinking filtered water throughout the day to stay well hydrated helps with proper digestion (Grimes, 2010).

Preliminary research is also showing the benefits of phenols coming from cranberry, grape and raspberry juices that help prevent pathogens, such as salmonella from growing in the GI tract (Schiedel, 2009). According to a 2007 study conducted at the University of Missouri, red wine and grape juice help preserve the beneficial probiotics and get rid of the pathogens, particularly H.pylori, E.coli, Salmonella and Listeria (Daniels, 2007). Researchers from University of Missouri demonstrated that the phytochemical, reseveratrol in red wines including Cabernet, Zinfandel and Merlot exemplify anti-microbial properties defending against food-borne pathogens (Daniels, 2007).

An overall GI supportive action to take is to keep excess weight off. Excess abdominal fat, "specifically increases pressure on the lower esophageal sphincter, which separates the stomach from the esophagus", increasing GI distress and promotes heartburn (Schiedel, 2009). Specifically including foods that are high in monounsaturated fat improves insulin sensitivity, which helps reduce body fat storage and helps prevent the accumulation of abdominal fat (Paniagua, J.A., Gallego De La Sacristana, A., Romero, I., Vidal-Puig, A., Latre, J.M., Sanchez, E., Perez-Martinez, P., Lopez-Miranda, J. & Perez-Jimenez, F. , 2007). Monounsaturated fats include avocado, extra-virgin olive oil, olives, dark chocolate, sunflower oil, walnuts, almonds, ground flaxseed and sunflower seeds.

Summary

Existing evidence definitely warrants further exploration and assessment of the human gastrointestinal microbial ecology. Research is directing action towards modifying a person's gut microbiota to treat people who are overweight or obese. Having more accurate assessment tools to identify the environmental and genetic factors that determine individual characteristics of one's microbiota is warranted. More research is also needed to determine what actual dietary changes and supplements healthcare practitioners could recommend to their patients and clients to implement into their lifestyle for weight loss success.

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