

# Complex Relationships Between Food, Diet, and the Microbiome



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## KEYWORDS

- Celiac disease • Diet • Food • Functional GI disorders • Microbiome • Nutrition
- Obesity • Women's health

## KEY POINTS

- Diet is a risk factor in several medically important disease states: obesity, cardiovascular disease, diabetes, celiac disease, and functional gastrointestinal disorders.
- Modification of diet can prevent, treat, or alleviate some of the symptoms associated with these diseases and improve general health.
- It is important to provide patients with simple dietary recommendations in order to increase the probability of successful implementation.
- Women can play an important role in maintaining family health by making informed dietary decisions.
- The gut microbiome may play a role in some gastrointestinal disorders. However, better designed studies are required to differentiate correlation from causation in this emerging area.

## INTRODUCTION

For the vast majority of human evolution, our ancestors had been hunter-gatherers, migrating to take advantage of seasonal food availability from wild plants and animals. With the advent of agriculture approximately 10,000 to 12,000 years ago, humans began to take active roles in food production, which paved the way for major societal changes, such as the establishment of complex social organizations and the development of science, technology, and medicine. Since the dawn of agriculture, humans have been breeding plants and animals, actively selecting for particular, desirable traits of their food. However, recent major technological advances in food production—from agricultural practices, food harvesting, processing, preservation, and

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distribution—have inadvertently led to the modern world's greatest threat to human health: obesity.

In the United States, greater than two-thirds of adults are classified as overweight (body mass index [BMI] of 25.0–29.9 kg/m<sup>2</sup>), and more than one-third are classified as obese (BMI of 30 kg/m<sup>2</sup> and greater).<sup>1</sup> In 2010, the annual medical costs associated with obesity in the United States were estimated at 160 billion dollars, with indirect costs associated with obesity estimated at another 450 billion dollars. The obesity epidemic correlates closely with major changes in food production practices and consumption patterns. Currently, less than 20% of Americans consume what would be considered a healthful diet, which should include multiple daily servings of vegetables and fruits along with lean protein sources. Most Americans now consume most of their daily calories from processed foods, which includes the preponderance of prepared foods purchased from restaurants or grocery stores.<sup>2</sup>

Physicians are witnessing a significant change in another chronic disease that may also be related to alterations in dietary habits. Celiac disease is an immune-mediated enteropathy that manifests in some genetically susceptible individuals (HLA-DQ2 and/or HLA-DQ8) on exposure to dietary gluten: protein complexes found in wheat, rye, and barley. The prevalence rate of celiac disease in the 1950s was approximately 0.02%, and today is closer to 1% or greater.<sup>3</sup> Historically, celiac disease was diagnosed in childhood; however, now diagnosis is becoming more common at nearly any age. The explanation for this dramatic increase in prevalence remains unclear. There does not appear to have been an increase in overall wheat consumption during this period of time; however, major changes to the way in which cereal grains are processed for modern foods have led some to speculate that modifications associated with processing may be responsible for the increased prevalence of celiac disease. It is certain that changes in human population genetics cannot account for the increased prevalence, because celiac disease susceptibility genes remain at stable frequencies (~30%) within the US population.

Functional gastrointestinal disorders (FGIDs), which are defined as symptoms arising from the gastrointestinal tract without an identifiable structural or biochemical cause,<sup>4</sup> represent other processes that may also be related to diet. Irritable bowel syndrome (IBS) is the most common FGID, affecting an estimated 15% of the general population in Western countries and 11% worldwide.<sup>5</sup> The vast majority of afflicted individuals report at least one food trigger.<sup>6,7</sup> Women with IBS report more food items as potential triggers for their symptoms than men. Furthermore, individuals that report more food triggers have lower quality-of-life scores and more severe IBS symptoms.<sup>6</sup> An intriguing recent study by Fritscher-Ravens and colleagues<sup>8</sup> demonstrated real-time mucosal changes after exposure to certain food antigens using confocal laser endomicroscopy in IBS patients. In the group of individuals that experienced mucosal changes with food antigen application, dietary elimination of this specific food antigen led to dramatic improvement or complete resolution of their IBS symptoms that was durable at 1 year of follow-up. This work strongly suggests that food is playing a major role in the cause of IBS symptoms and provides a potential method to identify specific food triggers that could allow physicians to make better dietary recommendations for their patients.

Many patients seek guidance for dietary changes they can implement in an effort to alleviate their symptoms, but often lack the knowledge or motivation to implement these recommendations. Furthermore, because of the complexity of diet and food choices, getting people to embrace and adhere to major dietary changes is difficult. As a society, we seem to have lost sight of the fact that our diet is a major determinant of our health, health expectancy, life expectancy, and overall quality of life and can be a powerful tool in preventing disease and ameliorating symptoms of disease.

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