Grains and Health: Misinformation and Misconceptions

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Topic Highlights

- Claims suggest that wheat is the product of genetic research and that we are eating genetically altered wheat. In reality, genetically modified wheat is not sold legally anywhere in the world.
- Claims suggest that wheat and its gluten have changed and that is why celiac disease, an autoimmune disorder, is on the rise. While celiac disease rates are increasing, and theories abound, no one is uncertain as to why.
- Claims suggest that wheat is addictive. There are no data to support claims that removing wheat from the diet results in withdrawal symptoms.
- Claims suggest that wheat causes uncontrollable overeating. Existing data show that ingestion of wheat protein causes the release of satiety hormones.
- Claims suggest that wheat ingestion leads to a host of mental health issues. There are scanty scientific data to support these claims.
- Claims suggest that wheat causes obesity and diets that eliminate wheat and other carbohydrates are the most effective way to lose weight. In reality, any significant weight loss that occurs with these diets is due to the reduction in total calories from any source, not just wheat or carbohydrates.
- Claims suggest that the elimination of wheat from the diet results in the cure or improvement of many health conditions. In reality, many of these conditions are made better by weight loss and not specifically the elimination of wheat.
- Claims suggest that the nutrient contribution of wheat and grains can easily be obtained from other food groups. While it is true that these nutrients are found in other foods, studies on nutritional quality indicate that diets without whole and enriched grains are often lacking in these nutrients.
- Food and nutrition professionals need to be able to counter unfounded theories about wheat and other grains with sound science and unbiased, critical thinking.

Learning Objectives

- To identify current controversies surrounding wheat, grains, and health.
- To describe scientific evidence regarding wheat, grains, and health.
- To understand the important role that food and nutrition professionals play in dispelling common misinformation and misconceptions about wheat and grains.

Introduction

Recently, grain consumption, especially wheat, has been blamed for obesity, diabetes mellitus, other chronic diseases, food addiction, and impaired brain function. Popular press books such as Wheat Belly by William Davis, the Paleo Diet by Loren Cordain, and Grain Brain by David Perlmutter and other authors and food bloggers claim that eliminating grains is the key solution to improving health. A review of nutrition and medical literature suggests a different scenario. This article provides a review of the scientific evidence regarding grains and health to dispel misinformation and misconceptions. This piece will focus on wheat because it has been subject to the most misinformation.

Wheat Breeding and Genetics

Wheat originated in the Middle East thousands of years ago. According to the Food and Agriculture Organization (FAO), wheat is grown on more land area than any other commercial crop and continues to be the most important food grain source for humans. Together, rice, wheat, and corn provide over half of the world’s calories.

Popular press authors and food bloggers suggest that wheat is the product of genetic research, and today, we are eating genetically altered wheat. They contend that wheat and its gluten have changed to be less healthy because of breeding practices. In fact, wheat breeding is an age-old practice. Significant advances in plant breeding occurred in the 1940s with the work of Norman Borlaug and others, using traditional techniques (non-genetically modified organisms). Lines selected provide increased yield through disease, drought, and insect resistance, especially in developing countries. Despite assertions to the contrary, these lines were produced by crossing wheat varieties with other wheat varieties from all over the globe. In 1970, Dr Borlaug with his so-called green revolution won the Nobel Peace Prize for his wheat and grain breeding programs, which produced grains with high yields that grow under a wide variety of conditions and help address world food supply challenges.

It is also alleged that genetic modification of wheat has made it less healthy and has changed the gluten proteins. This is untrue for two reasons. First, no ill effects can come from genetically modified wheat because there is none sold legally anywhere in the world. Second, recent studies from USDA labs and labs at the University of Saskatchewan and studies in Europe using grains from seed banks going back as far as Canadian Red Fife in 1857 show wheat gluten has not changed.

Concern has been raised about the use of hybrid dwarf wheats. They now comprise 99% of the wheat grown world-wide. Short-straw naked (dwarf) wheats are one of the
advances that were part of the green revolution. They increased yield for two reasons: (1) wheat varieties with long, spindly straws lodge, meaning that the kernel head is heavy and falls to the ground, making harvest difficult, and (2) shorter straw means that inputs, for example, water and nutrients, go into making wheat kernels rather than straw.

Popular press authors imply that new wheat varieties and their proteins are unique or harmful in some way. Further, they posit that 5% of the proteins in wheats are unique, meaning they are found in neither parent, and that this unexpected genetic rearrangement results in altered proteins with potentially toxic effects. It is important to consider that plants can only express proteins that they have the genetic code to produce. Creating a unique protein requires a mutation of the DNA or RNA. While environmental conditions can promote or inhibit the expression of certain proteins, it cannot code for proteins that are not in the genome. Therefore, hybridization of wheat does not create unique proteins.

Ancient wheats such as einkorn are held as models of what we should eat because they have not been hybridized and because of their protein makeup. In fact, one author says that einkorn contains 28% protein compared with average protein contents of 12–15% in modern wheats and that ancient wheats did not cause the symptoms that new varieties do. However, studies carried out at the University of Saskatchewan where ancient and other varieties of wheat were grown on adjacent plots actually show that the crude protein content of einkorn is 18% and that of other ancient and modern varieties had protein values ranging from 16.3% to 17.5%. This fits well with the USDA World Wheat Collection, which shows approximately a threefold variation in protein content of wheat from 7% to 22%, with one-third of this under genetic control and two-thirds of this controlled by environmental conditions.

Celiac and Related Disorders

Celiac disease is on the rise, as are other autoimmune diseases, in Western countries. This fact is documented in the scientific literature. Studies by Mayo Clinic gastroenterologist Joe Murray and colleagues compared celiac titers in blood samples from the recent US Air Force recruits with stored blood samples taken from recruits more than 50 years ago. The analysis showed 0.2% of recruits had the gene for celiac disease in 1950 compared with 0.9% of recent recruits, which is a quadrupling of the incidence rate. Data from Finland also show an increase from 1% to 2% or a doubling of the rate of celiac disease incidence in that population. While celiac disease rates are increasing, it is uncertain whether this is due in part to better identification and awareness of the disease, as well as a myriad of other dietary, immunologic, and environmental changes, especially those that impact the microorganisms and integrity of the gut. Some theories include the ‘clean’ theory, poor diets overall, overuse of antibiotics and other drugs especially acid-lowering drugs, lack of breast-feeding, and frequent use of Cesarean sections.

Davis and other popular press authors posit that the reason for the increase in celiac disease is attributed to the fact that celiac disease-triggering proteins are expressed at higher levels in current wheat varieties than found 50 years ago. Such authors suggest that high-molecular-weight (HMW) glutenins and higher levels of gliadin of modern wheat are the problem. While studies show that the immune system reacts to breakdown products of HMW glutenins, data are lacking that show that these proteins trigger more reactions than those of ancient wheats or even wheat varieties from 50 years ago. Interestingly, gliadins are found in higher amounts in ancient versus modern wheats.

Gluten-containing grains are also implicated in non-celiac gluten sensitivity (NCGS). This newly recognized disorder has no medically agreed-upon test to confirm a diagnosis, and therefore, its existence and incidence are subject to much debate. The best estimates are that 4–6% of the population may have NCGS. NCGS is thought to be present in about 5% of irritable bowel syndrome cases and may cause the rash, dermatitis herpetiformis, which can be seen in some celiac patients.

Allergens

Wheat has long been categorized as one of the ‘big eight’ allergens (the most common allergens in Western countries). Despite beliefs that the incidence is much higher, only 0.5% of children and adults in the United States suffer from wheat allergy, which can be caused by any number of proteins in wheat. Glutenins are the most frequent allergens, but gliadins, especially gamma-gliadin, result in the most severe allergic reactions. A particular protein, omega-5 gliadin, is responsible for wheat-dependent, exercise-induced anaphylaxis and may be the offending protein in the wheat allergies of young children. There are also reported allergies to albumins, globulins, and enzyme inhibitors. Interestingly, delayed introduction of solid foods including grains such as wheat and rye has been found to be responsible for greater allergic sensitization in young children.

Addiction and Overconsumption of Food

Popular press authors and bloggers suggest that wheat is the world’s most destructive dietary ingredient because during its digestion, it breaks down into peptides that act as exorphins (exogenous opioids). These authors assert that wheat is unique in this role. Studies conducted by the National Institutes of Health (NIH) in 1979 show that digestion of wheat proteins can produce peptides that interact with opioid receptors. However, the claim that wheat is unique in this regard is incorrect, as these same studies show that other food proteins also produce peptides that interact with opioid receptors. Hydrolysates of milk proteins (alpha-, beta-, or kappa-casein; alpha-lactalbumin; beta-lactoglobulin; and lactotransferrin) show the highest opioid activity. In addition to milk proteins and wheat gluten, rice albumin, bovine serum albumin, and even a protein from spinach all produce peptide fragments capable of interacting with opioid receptor ligands. It is important to consider that the studies indicating wheat’s possible opioid potential were conducted either in vitro or by feeding the preformed peptides, not by feeding wheat itself. Studies feeding wheat foods, not hydrolysates, must be conducted to
determine the actual effects of peptides from gluten digestion. Some studies have also reported beneficial effects of these peptides. If bioavailable, they have the potential to help control blood pressure and to improve learning performance.

Another theory promulgated by popular press authors and bloggers is that wheat opioids are highly addictive causing individuals to lack control of their eating, with subsequent removal of wheat from the diet producing withdrawal symptoms. The controls over hunger and satiety are complex being affected by many mechanisms from physical feelings of fullness (stomach distention) to neuroendocrine, psychosocial, and sensory factors. While some suggest specific foods such as sugars and fats are addictive, evidence is weak and scarce, with no human data. Similarly, there are no data to support claims that removing wheat from the diet results in withdrawal symptoms.

Claims from Davis and others that wheat causes uncontrollable overeating conflict with existing data that show wheat protein ingestion causes the release of satiety hormones cholecystokinin and glucagon-like peptide 1. Wheat and pea proteins show a stronger ability than other sources to stimulate the release of both hormones. Some data suggest that consumption of proteins such as those in gluten may be a good dietary strategy for weight management.

**Mood, Mental ‘Fogginess,’ Autism, Attention-Deficit/ Hyperactivity Disorder, and Schizophrenia**

A common assertion in the popular press is that wheat ingestion alters mood and causes mental ‘fogginess.’ There are little data showing that wheat consumption alters mood or mental acuity. In a small study of patients with celiac disease, a gluten-restricted diet failed to improve neurological symptoms. In contrast, increased serotonin is associated with a sense of well-being and elevates mood. In a study of malnourished Indian primary school children, wheat biscuits added to their diets actually improved cognitive ability. There are data suggesting adding lysine to grain-based diets may reduce measures of anxiety. In a study of Syrians with marginal diets based primarily on wheat, the addition of lysine, wheat’s limiting amino acid, reduced symptoms of anxiety. This study supports the fact that complementary plant proteins are needed in grain-based diets low in complete proteins.

Wheat is also alleged to cause of autism spectrum disorder, attention-deficit/hyperactivity disorder (ADHD), and schizophrenia. Case reports and other narratives suggest there may be a link between autism and celiac disease. However, documentation in the medical literature is scarce. Regarding autism, there is only one randomized clinical trial and its findings showed no significant difference in symptoms due to gluten removal from the diet. A review considered the ‘gold standard’ in the medical literature concluded that there are no randomized trials that support the claim. The efficacy of this diet is inconclusive.

Similarly, studies examining the relationship between wheat and ADHD are lacking, even though sensitivity to a range of foods, including wheat, has been suggested in a number of case reports. Studies with very small numbers of subjects show no improvement in ADHD symptoms with a gluten-free diet. Screenings for celiac disease in a clinical report (no control group) involving 67 people diagnosed with ADHD showed the incidence to be slightly higher than the population as a whole with 1 out of 7 (vs. slightly < 1 in 10) having celiac disease. These celiac disease-positive participants showed a significant decrease in ADHD symptoms.

Schizophrenia’s link to gluten was noticed during World War II when a British physician observed decreased admissions for this disorder. Dr. Dohan theorized that this decrease correlated with decreased wheat consumption imposed by rationing and postulated links between wheat, celiac disease, and schizophrenia. Part of the theory suggests that wheat ingestion affects tight junctions and reduces the gut’s capacity to prevent the entry of exogenous substances, thus allowing the development of schizophrenia and other mental conditions. It is also known that schizophrenia incidence increases in the presence of any autoimmune disease or a history of severe infections. It is thought that the antibodies produced can impact the brain. In some studies, a subset of schizophrenia patients show elevated gliadin antibodies. However, classic celiac disease diagnostics, either antibodies or gene markers, were not found in higher rates in schizophrenia patients than in the public at large.

A comprehensive review looking at the connection between gluten and schizophrenia showed that gluten withdrawal resulted in a drastic reduction or full remission of symptoms but only among a small subset of schizophrenia sufferers. Thus, in a small group of schizophrenia patients, removal of wheat may be helpful but not the miracle cure indicated by Davis and others.

**Obesity and Weight Loss**

Obesity rates have increased dramatically around the world since the 1970s. Obesity rates in the United States have increased by 214% since 1950. Davis and other popular press authors note that obesity was rare in the 1950s and cited increased wheat consumption as a cause. It is true that wheat consumption increased from 1970 to 2000; however, it dropped between 2000 and 2014. Importantly, these authors failed to note that during this same period, portion size and caloric intake have increased dramatically while physical activity has decreased and screen time has increased. In fact, in 2008 in the United States, there were on average 600 more calories available per person than in 1970.

Food bloggers and popular press authors suggest that the proliferation of wheat products in the diet parallels increased weight and central obesity. Central obesity, also known as visceral adipose tissue (VAT), has increased in the population and is a cause for concern due to its association with higher rates of diabetes, high blood pressure, heart disease, and certain forms of cancer. While VAT has increased, it is not true that wheat causes this condition or that the elimination of wheat will cure this condition. It is well documented that no one food or food group is responsible for VAT. Instead, ingesting too many calories of any kind coupled with too little exercise will...
result in VAT. Recent data from the Framingham Heart Study cohort refute claims that wheat increases VAT. Those who had the least VAT ate two servings per day of refined grains and three servings per day of whole grains.

For many years, various low-carbohydrate diets have been recommended as the most effective way for individuals to lose weight. It is not surprising that eliminating wheat from the diet has recently been considered to be the ‘holy grail’ of weight loss regimens using low-carbohydrate diets. While it is true that low-carbohydrate diets have been shown to cause more rapid weight loss than other diets in the first 6 months, these diets do not result in greater weight loss over time. In addition, low-carbohydrate diets often result in more dropouts than other diets that are more balanced and do not eliminate entire food groups. Any significant weight loss that occurs with these diets cannot be attributed to the ‘magic’ of eliminating grains, but instead, it is due to the reduction in total calories from any source.

**Grain Foods and the Glycemic Index**

The glycemic index (GI) is a measure that compares the blood glucose response produced by 50 g of available carbohydrate from a food with the blood glucose response produced by 50 g of glucose. Popular press authors and food bloggers correctly noted that wheat bread has a GI that is higher than table sugar. However, GI is most often misunderstood because it is used to compare very different amounts of food. For example, 50 g of table sugar (approximately three tablespoons) would yield 50 g of available carbohydrate. In contrast, 50 g of available carbohydrate from whole wheat bread is much more than 50 g of bread since bread is not all carbohydrate and not all the carbohydrate is available. Thus, it would take 144 g of whole wheat bread (5.1 slices at 28 g per slice) or 111 g of white bread (3.9 slices) to yield 50 g of available carbohydrate.

**Grain Foods and Other Diseases**

Popular press authors and bloggers claim that elimination of wheat from the diet results in the cure or improvement of many conditions including diabetes, coronary heart disease, multiple sclerosis, rheumatoid arthritis, asthma, acid reflux, irritable bowel syndrome, ulcerative colitis, acne, and other rashes. However, many of these conditions are made better by weight loss, so attributing improvement to wheat removal is overly simplistic and is likely an inaccurate deduction. A number of meta-analyses and reviews show that those who eat grains and whole grains have lower risk or most chronic diseases with a recent one showing a reduction in both the risk of cardiovascular and all-cause mortality.

**Nutrient Composition of Wheat and Grains**

Many diet authors bashing grains and wheat assert that the nutrient contribution of wheat and grains can easily be obtained from other foods. While it is true that most of the constituents of grains can be found in other foods, there are some issues. For example, grains provide many of the B vitamins. While it is true that these are found in other foods, studies on nutritional quality indicate that diets without whole and enriched grains are often lacking in these nutrients. The concern is especially important for folate. Folate fortification of grains has decreased neural tube defects and other neurological problems in North American populations by 50% since fortification of grains was mandated. Other compounds such as betaine are found in wheat and wheat bran and germ, the highest sources of this important phytochemical. Betaine is not widely distributed in the foods supply and has importance in human nutrition.

Diets without grains can have significant problems getting adequate dietary fiber and a good mix of fiber types. Wheat bran/fiber is used as the standard against which government agencies test the efficacy of a fiber in terms of laxation, as it is the fiber with significantly greater effect on laxation than fibers from fruits and vegetables. The same fiber in barley and oats with proved cholesterol-lowering properties is not widely found in many fruits or vegetables, and when found, its structure is such that it does not have cholesterol-lowering properties.

Further epidemiological studies show that cereal fiber reduces the risk of certain gut cancers while fruit and vegetable fibers do not. These data suggest that balance as prescribed in USDA MyPlate provides the best diet.

**Conclusion**

Numerous health problems including obesity, diabetes mellitus, other chronic diseases, food addiction, and impaired brain function have been attributed to grains such as wheat. A review of nutrition and medical literature reveals that there are little evidence to support claims that wheat and grains cause adverse health effects and chronic disease and much evidence to show that a balanced diet that includes wheat and grains, especially whole grains, reduces chronic disease risk and lowers overall mortality.

Popular press authors and food bloggers claim that eliminating wheat grains is essential for optimal health for all. While it is true that wheat and other gluten-containing grains must be eliminated for those with reactions to gluten and wheat because of celiac disease, allergies, or other conditions, it is not true that wheat and grain elimination is best for all. Further, it is also true that many diets contain too many calories and grain-based desserts and snacks contribute to excess calories, and it is not true that the grains and wheats are the culprit. Rather, it is the poor food choices that should be addressed. Data for elimination of grains for all are, at best, scanty and do not show scientific rigor. Food and nutrition professionals need to be able to counter unfounded theories about wheat and other grains with sound science and unbiased, critical thinking. This article provides a review of the scientific evidence regarding grains and health to dispel common misinformation and misconceptions.

**Exercise Assignments for Revision and Extension**

- Take a specific wheat controversy and describe the scientific evidence to support or refute this claim.
Model a diet with and without grains. Calculate the nutritional value of the model diet using a computer analysis to show what nutrients might be at risk. Show what foods would need to be consumed in larger quantities. If this were done, what would happen to calories?

Calculate the calories for 3 days of diets with wheat or grains included and the calories of that same diet without the wheat or grains. Show how much weight would likely be lost with the elimination of these products.

Go to a store and compare the cost, nutritional value, and eating quality of products that are labeled as gluten- or wheat-free with their gluten- or wheat-containing counterparts.

Exercises for Readers to Explore the Topic Further

Why is misinformation around diet so readily accepted?

Show the evidence supporting the use of wheat and grains in preventing any one of the chronic diseases. Assess this evidence in and evaluate evidence for their nonuse.

Assess the evidence associated with grains, carbohydrates, and brain function. How does this evidence compare with other nutritional impacts on the brain?

Use the GI tables and look up the values for wheat and grain staples such as sourdough and whole grain bread basmati rice and pasta. Explain why such products often with the same ingredients have varying GIs. Then look at the amount eaten for 50 g of carbohydrate and compare that and the nutritional quality of indulgent and other foods with lower GIs such as candy or chocolate cake. Using this research, explain when the GI might be useful for food selection and when it might not yield optimal nutrition choices.


Further Reading


USDA Wheat Yearbook.


Relevant Websites