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The Impact of Gluten-Free Diet on Hormonal Balance

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ABSTRACT

This study investigated how a gluten-free diet affects hormones, with particular emphasis on cortisol, thyroid, insulin, and sex hormones. Background: For medical diseases such as non-celiac gluten sensitivity, wheat allergy, and celiac disease, a gluten-free diet is important. The main area of concern for research is how a gluten-free diet can affect hormone levels and related health consequences. A review of the body of research on this topic, including studies on hormone regulation and the impact of dietary modifications, is a part of the methodology. These findings imply that a gluten-free diet may have an impact on hormone levels, which may affect metabolism, weight, and general health. These implications include the need for additional studies, particularly in those with autoimmune illnesses, to completely comprehend the relationship between a gluten-free diet and hormone regulation.

1. INTRODUCTION

A diet that does not include gluten protein is known as gluten-free diet. Grains, such as wheat, barley, rye, and triticale hybrids of wheat and rye, contain gluten. Managing the symptoms of celiac disease and other gluten-related medical problems requires a gluten-free diet. Those who have not been diagnosed with a gluten-related medical problem are also big fans of gluten-free diets. The main advantages of this diet are improved health, weight loss, and higher energy intake.

Notably, some individuals have dietary requirements for gluten avoidance. A gluten-free diet is necessary for three medical conditions: wheat allergy, nonceliac gluten sensitivity, and celiac disease. Gluten consumption causes damage to the small intestine in celiac disease, a dangerous autoimmune ailment that can cause a hereditary predisposition. The only known therapy is a lifelong gluten-free diet, which is thought to affect one in 100 people worldwide. Allergy to foods containing wheat is known as wheat allergy.

The symptoms of an allergic reaction can range from minor to fatal and may include breathing

difficulties, nausea, hives, swelling, itching, or irritation of the mouth or throat [1-4]. Similar gastrointestinal symptoms, such as nausea, vomiting, diarrhea, and stomach discomfort, are occasionally observed in patients with celiac disease and wheat allergies. Anemia, arthritis, osteoporosis, depression, and migraines are just a few of the many symptoms and illnesses that can be caused by celiac disease. Children are the most affected by wheat allergies, which typically occur before adulthood. Steers clarified anything that contained wheat during the primary treatment course.

Non-celiac gluten sensitivity, also known as gluten intolerance, is the primary cause of gastrointestinal discomfort. Unlike celiac disease, it is a less severe ailment that does not harm the small intestine lining. Furthermore, unlike wheat allergies, it does not cause allergic reactions or anaphylaxis. However, it remains unclear whether the immune system is involved in non-celiac gluten sensitivity. Recent studies have found that specific hormones are altered when a person adopts a gluten-free diet. Hormones are chemical messengers in the body that are members of the endocrine system.

The hormones that the body requires for a variety of purposes are produced and secreted by the glands that constitute this system. These regulate a wide range of physiological processes, from intricate systems, such as growth and sexual development, to necessities, such as hunger and emotion. Fifty distinct glands and organs secrete hormones [1-4].

The management and prevention of obesity, metabolic syndrome, and lipoprotein levels may also be affected by a gluten-free diet. Type 2 diabetes and cardiovascular disease are two major health risks that can be exacerbated by metabolic syndrome. This was because of a chronically unhealthy diet and insufficient exercise.

A gluten-free diet may lower this risk because it alters hormone levels. Eating fewer potentially low-nutritional items, such as wheat-based foods like bread and pasta, is another advantage of the diet. Hence, eliminating gluten from one's diet may help reduce overindulgence and promote the ingestion of wholesome nutrient-dense foods.

Cells release signaling chemicals called hormones, which have a significant impact on cellular functions in other parts of the body. Growth, development, metabolism, sexual function, and mood are just a few of the numerous activities that hormones have an impact on. Several health issues can arise from an imbalance in the hormone levels. Functional endocrinology involves the study of how nutrition and food affect hormonal homeostasis. This study examined how various endocrine glands in the body are affected by specific diets and how this might cause imbalances in hormone production.

A diet that does not include gluten is known as gluten-free diet. The grain varieties include triticale, rye, barley, and wheat, all of which contain gluten. Since gluten can trigger an immunological response in the small intestine, it is typical for those with celiac disease to avoid it. This immune response can cause malnutrition over time by destroying the lining of the small intestine and obstructing absorption of vital nutrients. However, body hormones are also affected by gluten [1, 4-11]. People with gluten-related conditions, such as celiac disease, wheat allergy, and non-celiac gluten sensitivity, are the main target audience for a gluten-free diet. The main characteristics and factors of the gluten-free diet are as follows:

Gluten Elimination: All gluten-containing foods, such as bread, pasta, and baked products made from wheat, barley, rye, and their derivatives, are prohibited in the diet [12, 13].

Considerations for Nutrition: GFDs are crucial for CD management; however, because they frequently include less protein and micronutrients than gluten-containing goods, they can result in imbalanced intake and nutritional deficiencies [12, 13].

Fortification: The absence of vital minerals in gluten-free products can exacerbate vitamin deficiencies, particularly in older adults who may already be at risk in areas such as calcium, magnesium, vitamin D, and B-complex vitamins [12].

An increase in fats and carbohydrates: Gluten-free substitutes could include more fats and carbohydrates, which could cause nutritional imbalances and perhaps cause weight gain if not closely watched [12].

Variety of Foods: Deficits may result from the restriction of dietary diversity. To improve the nutritional profile of their diet, patients should include naturally gluten-free grains such as quinoa, amaranth, buckwheat, and sorghum [13].

Possibility of incomplete remission: Owing to accidental contamination and poor adherence, following a gluten-free diet (GFD) may not ensure full symptom remission or mucosal repair [13].

Regulations for Labeling: Under stringent labeling laws, items labeled as "gluten-free" must have fewer than 20 mg/kg of gluten, whereas "very low gluten" products may include up to 100 mg/kg [13].

Possible Health Hazards: While gluten-free diets can help those with gluten sensitivity, they can also cause nutritional shortages and dietary problems if not medically necessary [13].

Understanding the potential effect of a gluten-free diet on hormone levels and health repercussions makes research on the effects of a gluten-free diet on hormones possible. For those with medical issues such as non-celiac gluten sensitivity, wheat allergy, and celiac disease, this research may offer important new insights into the possible advantages of a gluten-free diet. It might also advance the knowledge of the wider range of effects that dietary changes, such as eating gluten-free food, can have on metabolism, hormone control, weight, and general health. The results of this study also emphasize the need for more research, especially in those with autoimmune diseases, to completely comprehend the relationship between a gluten-free diet and hormone regulation. This study aimed to investigate the effects of a gluten-free diet on hormone levels.

2. GLUTEN-FREE DIET

A gluten-free diet is a nutritional plan that eliminates gluten found in grains, such as wheat, barley, and rye. This is crucial for individuals with celiac disease, autoimmune conditions, non-celiac gluten sensitivity, or wheat allergy. The diet emphasizes naturally gluten-free foods, including vegetables, fruits, fish, meat, dairy, and certain grains, while steering clear of any food sources containing gluten such as bread, pasta, cereals, and many processed foods [14]. Still, there are concerns about the possible health effects of the diet, given its growing popularity among people without these illnesses [12]. Although it might be a healthy way of living, it can also result in dietary problems and vitamin shortages [12, 15]. A gluten-free diet can be useful for older people with gluten-related illnesses; however, it should be balanced to avoid nutritional deficits. An inadequate balance in a gluten-free diet can result in nutritional deficiencies, and older people may already be susceptible to certain deficiencies. Diets free of gluten may be rich in fat and low in fiber, and may be deficient in important vitamins and minerals such as calcium, magnesium, vitamin D, and B-complex vitamins. To maintain a balanced diet, older people should consume a range of pseudocereals and minor cereals as well as fortified gluten-free goods. In summary, older adults should adhere to a gluten-free diet under the supervision of a licensed dietician or other healthcare provider [12]. Those on a gluten-free diet must be on the lookout for hidden gluten sources in processed goods, because even trace levels of gluten can cause symptoms and intestinal damage. To guarantee the security and efficacy of treatment, diet requires rigorous adherence to gluten-free items and attention to cross-contamination. Studies have indicated that cross-contamination during processing or storage is a prevalent cause of gluten contamination in purported gluten-free products. Accordingly, items labeled as "gluten-free" should have a gluten content of fewer than 20 parts per million (ppm) to be safe for people with celiac disease [16]. Consequently, it is critical that people carefully weigh the advantages and disadvantages of gluten-free diets.

2.1. Wheat Allergy

A particular immunological response to wheat proteins, known as wheat allergy, is characterized by T-helper type 2 activation and the possibility of both IgE- and non-IgE-mediated reactions [17]. It may manifest as contact hypersensitivity, respiratory allergies, or food allergy [18]. The mainstay of treatment is to avoid wheat, and the diagnosis is based on oral food challenges, specific IgE detection, and medical history [17]. Various components of wheat grains contain allergens that cause these reactions, such as lipid transfer proteins, omega5-gliadins, α-amylase/trypsin inhibitors, and LMW-glutenins [18].

2.2. Non-Celiac Gluten Sensitivity

When gluten is consumed, it can cause gastrointestinal and/or extra-intestinal symptoms (known as

non-celiac gluten sensitivity, or NCGS) that are relieved by following a gluten-free diet, but do not correspond with celiac disease or wheat allergy [19, 20]. Currently, no specific serological marker is available; hence, diagnosis is made by exclusion [19]. Several clinical and pathological signs are linked to this condition; thus, reliable biomarkers are required to distinguish NCGS from other related illnesses [21]. Further research in this area is necessary because the pathophysiology of NCGS is not fully understood [22].

2.3. Celiac Disease

Gluten ingestion causes the autoimmune disease celiac disease, which has several types and manifestations [23]. This can result in several symptoms including inflammation, which necessitates a rigorous gluten-free diet [24]. Duodenal biopsy and positive serology have been used to diagnose various illnesses [25]. Celiac disease has historically been more common in European communities, but it is anticipated that Asian populations will see a rise in the frequency of the disease due to increased dietary gluten consumption in their diets [26].

Although a gluten-free diet is the main treatment course, more studies are being conducted to investigate the different strategies [27].

3. HORMONES

Chemical messengers called hormones control several physiological functions in the body [28, 29]. They can be released by the glands and delivered to target organs via the circulatory system, where they attach to particular receptors and alter cellular activity [28].

Hormones affect several organ systems and are essential for preserving homeostasis [30].

3.1. Gluten-Free Diet Effects on Hormones

It is complicated and unclear how a gluten-free diet (GFD) affects the hormone levels. Some studies have indicated possible advantages, such as the restoration of bone and mineral metabolism in individuals with celiac illness [31]. Others warn against dietary deficits and mental health issues as two possible harmful effects of diet [32]. It is currently unknown what part a GFD plays in non-celiac individuals with autoimmune thyroid disorders, multiple sclerosis, psoriasis, or type 1 diabetes [33]. According to previous research, a gluten-free diet may have an indirect effect on hormone levels in the body through its effects on inflammation and gastrointestinal health. Increased inflammation is associated with gluten consumption, which can affect the hormone levels. The removal of gluten from diet has the potential to reduce inflammation and create a more hormonally balanced environment. Hormones related to appetite regulation, metabolism, and immunological function can be affected by changes in the composition of gut microbiota caused by a gluten-free diet. In addition, a gluten-free diet might enhance the absorption of nutrients, which may affect the balance of hormones. Through their effects on inflammation, gut health, and nutrient absorption, these indirect mechanisms suggest that dietary interventions, including the adoption of a gluten-free diet in individuals with gluten-related disorders, may have implications for hormonal balance. However, further research is necessary to fully understand the direct effects of a gluten-free diet on hormone levels [34].

3.2. Potential Hormonal Impacts

Research indicates that Gluten can affect several hormones, including sex hormones (e.g., testosterone and estrogen), insulin (blood sugar regulation), cortisol (stress response control), thyroid hormones (metabolism regulation), and ghrelin/leptin (hormones that increase appetite). Hormone fluctuations can affect immunological response, mental stability, energy levels, sleep hygiene, reproductive health, and general health [31-34].

3.3. Sex Hormones

The effects of a gluten-free diet on weight, activity, and gut bacteria may affect estrogen and progesterone

levels. Research has demonstrated that modifications in exercise and calorie restriction can affect endogenous sex hormones associated with breast cancer [35]. Gluten and other dietary components may also affect the testosterone metabolism [36]. Estrogen levels are regulated by the gut flora, which is affected by a gluten-free diet [37]. Furthermore, ghrelin levels may increase owing to the loss of estrogen after menopause, which could result in weight gain [38]. Consequently, although there is no concrete evidence connecting a gluten-free diet to variations in estrogen and progesterone levels, the possible effects of diet on weight, activity, and gut flora may have an indirect effect on these hormone levels. Further research is required to fully understand the possible impact of a gluten-free diet on sex hormones.

3.4. Cortisol

According to previous research, a gluten-free diet may result in compositional alterations in food, which could lower its quality and increase the risk of inflammation [39]. The unique gluten effects of non-celiac gluten sensitivity (NCGS) are still debated, with some studies showing no evidence of any particular or dose-dependent effects of gluten [39]. It is crucial to consider how nutrition affects cortisol levels, because some food ingredients affect cortisol levels, especially in stressed individuals. Cortisol levels have not been thoroughly investigated, and it is plausible that they may be indirectly influenced by the effects of diet on inflammation and composition [40].

3.5. Thyroid Hormones

The thyroid gland produces hormones that are vital molecules that control metabolism, growth, and energy production. Triiodothyronine (T3) and thyroxine (T4) are two primary thyroid hormones. The pituitary gland and hypothalamus control these hormones through a feedback mechanism. Thyrotropin-releasing hormone (TRH) is released in the brain in response to low thyroid hormone levels. This triggers the pituitary gland to release thyroid-stimulating hormone (TSH), which, in turn, causes the thyroid gland to generate more T3 and T4. Thyroid hormone imbalances can cause several health problems, including hyperthyroidism (hormone overproduction) and hypothyroidism (insufficient hormone production) [41].

The medical world is starting to pay more attention to how a gluten-free diet affects thyroid health, especially for people with autoimmune thyroid disorders such as Hashimoto's thyroiditis [42]. There is a link between autoimmune thyroid diseases and celiac disease. In some cases, a gluten-free diet may improve thyroid function [41]. According to previous studies, gluten cutting may lower thyroid antibody levels, enhance nutrient absorption, and reduce inflammation, all of which may lower the risk of thyroid dysfunction. Although research on the impact of a gluten-free diet on thyroid function is ongoing, tailored dietary treatments may benefit thyroid function, especially in patients with autoimmune thyroid disorders [42]. No direct effect on thyroid hormones: According to previous research, there is no direct correlation between gluten-free diet and thyroid hormone concentration. Therefore, removing gluten from the diet may not be sufficient to solve the problem of inadequate thyroid hormone production in patients with Hashimoto's disease. Decrease in antithyroid antibodies: According to some studies, a gluten-free diet may cause a decrease in anti-tissue transglutaminase antibody (which is linked to antithyroid antibodies). This decrease may reduce thyroid autoimmunization. Impact on thyroid function through Indirect Effects: Although gluten-free diet may not directly influence thyroid hormone levels, it has been hypothesized that thyroid health may indirectly benefit from the diet's anti-inflammatory properties through a reduction in inflammatory cytokines. Possible advantages for some patients: A gluten-free diet has been linked to a reduction in antithyroid antibodies and a partial improvement in gastrointestinal symptoms in some people with chronic lymphocytic thyroiditis [43]. More research is necessary to fully understand the complex interaction between a gluten-free diet and thyroid hormones in Hashimoto's disease.

3.6. Insulin Hormone

Insulin, which is produced by pancreatic beta cells, controls blood glucose levels by promoting the

uptake of glucose into cells for use as fuel or storage. It plays a critical role in glucose metabolism by affecting the absorption of glucose, amino acids, and fatty acids, and preventing the breakdown of stored glucose, protein, and fat. Type 1 and type 2 diabetes are caused by immune system disruption, which affects the insulin levels. Insulin promotes the conversion of glycogen into glucose by interacting with other hormones such as glucagon to maintain blood glucose levels within a specific range. Through several different processes, a gluten-free diet can affect insulin hormone levels. First, it may affect insulin sensitivity. This is evident in patients with GH deficiency, who may have altered insulin sensitivity due to alterations in body composition. Insulin Sensitivity and the Gluten-Free Diet: Research indicates that people with non-celiac gluten sensitivity or celiac disease may benefit from increased insulin sensitivity when they adopt a gluten-free diet. This improvement in insulin sensitivity may be related to a decrease in oxidative stress and inflammation, which are linked to illnesses related to gluten. Gluten and Insulin Reaction: In individuals without gluten-related diseases, gluten may not directly affect the insulin levels. However, some gluten-containing meals, such as refined grains, may cause blood sugar levels to jump quickly, which may affect how the body responds to insulin. Individual Variability: To completely comprehend the association between gluten intake and insulin response in the general population, further research is necessary. It is crucial to remember that the effects of a gluten-free diet on insulin sensitivity may differ among individuals [44, 45]. The hormone glucagon-like peptide-1 (GLP-1), which increases insulin secretion and enhances glucose tolerance, can be affected by diet [46]. Consuming whole-grain foods, which are frequently part of a gluten-free diet, has also been demonstrated to enhance postprandial glucose and insulin homeostasis [45]. The function of glucagon in glucose metabolism and its role in the etiology of diabetes indicate a possible correlation between glucagon levels and a gluten-free diet [47].

The gluten-free (GF) diet may regulate insulin levels through several mechanisms.

Intestinal Permeability Reduction: By reducing intestinal permeability, a gluten-free diet prevents food particles such as gliadin from passing through the intestinal barrier and getting to the pancreas. This decrease in permeability can lessen the inflammatory reactions that type 2 diabetes (T2D) patients may have, which can result in insulin resistance and beta cell malfunction [48].

Effect on the Gut Microbiome: The GF diet changes the gut microbiota makeup, increasing good bacteria like Lactobacillus and lowering bad ones. For instance, inulin, which is frequently present in gluten-free goods, can function as a prebiotic, encouraging the growth of good gut bacteria. Improved insulin sensitivity and metabolic health are linked to a healthy gut environment, which can result from these changes [48, 49].

Reduction of beta cell stress: Pancreatic beta cells are susceptible to stress from gluten peptides, which can result in loss and malfunction. A GF diet may lessen this stress by cutting out gluten, which would preserve beta cell function and improve insulin secretion [48].

Fiber in the diet: Compared to items that include gluten, many gluten-free products have less dietary fiber. Blood sugar regulation and insulin sensitivity can be enhanced by increasing fiber consumption, especially soluble fibers (such as inulin). Fiber slows down the digestion and absorption of carbs, blood sugar, and the insulin response increases more gradually [49].

Weight management: Weight reduction or maintenance is possible with a gluten-free diet, which is important for insulin sensitivity. Insulin resistance is linked to excess body weight, particularly around the abdomen. Insulin levels can be controlled by a healthy weight and well-balanced gluten-free diet [49].

4. CONCLUSION

In conclusion, hormone levels, particularly those of sex hormones, cortisol, thyroid, and insulin, may be directly affected by a gluten-free diet. However, patients with Hashimoto's disease may benefit from a gluten-free diet in certain cases, especially when it comes to lowering anti-thyroid antibodies and easing gastrointestinal symptoms, and it seems to have no direct effect on thyroid hormone levels. This may affect insulin sensitivity and insulin levels, especially in individuals with gluten-related illnesses. Although those with certain medical issues require a gluten-free diet, keep in mind that you also need to ensure that you are

receiving all the nutrients you need for general health and well-being. Further research is necessary to understand the association between hormone regulation and gluten-free diet.

CONFLICTS OF INTEREST

No conflict of interest was disclosed by the authors.

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