

A Policy Framework for Strengthening the Nutritional Safety of Gluten-Free Diets in Patients with Celiac Disease

Mohammed Rostami-Nejad¹, Nastaran Asri²

1. Celiac Disease and Gluten Related Disorders Research Centre, Research Institute for Gastroenterology and Liver Diseases, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

2. Gastroenterology and Liver Diseases Research Center, Research Institute for Gastroenterology and Liver Diseases, Shahid Beheshti University of Medical Sciences, Tehran, Iran

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Mohammad Rostami-Nejad

E-mail:

m.rostamii@gmail.com

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Abstract

Background and Objective: The lifelong gluten-free diet (GFD) is the sole treatment for celiac disease (CD). However, GFDs are often nutritionally inadequate, leading to micronutrient deficiencies that cause long-term complications. This study aims to propose a comprehensive policy framework to mitigate the iatrogenic nutritional risks of GFDs and improve CD management.

Material and Methods: This policy framework analysis derived evidence from the Jadhkaran et al. (2025) study and a targeted literature search (PubMed/MEDLINE, Scopus, Web of Science), focusing on GFD nutritional composition, deficiency patterns, adherence barriers, provider knowledge gaps, and existing policy measures.

Results and Conclusion: This study identified five key drivers of micronutrient deficiency in CD patients on a GFD: poor nutritional composition of gluten-free products, limited access to dietary counseling, economic barriers, healthcare provider knowledge gaps, and poor dietary adherence. Based on these findings, a three-pillar policy framework was developed, including mandatory food fortification combined with subsidized supplements, healthcare providers' training, and standardized national screening with annual micronutrient panels. Implementing the proposed three-pillar policy framework offers a practical, evidence-based strategy to reduce nutritional harm, improve long-term health outcomes, and transform CD care from reactive gluten avoidance to proactive nutritional safety.

Keywords: Celiac disease; Gluten-free diet; Micronutrient deficiencies; Public health policy; Nutritional fortification; Clinical screening

1. Introduction and statement of the problem

Celiac disease (CD) is a chronic autoimmune enteropathy triggered by gluten ingestion in genetically predisposed individuals and affects approximately 1% of the global population [1, 2]. The cornerstone of CD management is lifelong adherence to a strict gluten free diet (GFD) [3]. However, as highlighted by Jadhkaran et al. [4], gluten free products are often highly processed, enriched with fats and sugars to enhance palatability, and characteristically low in essential fiber, vitamins, and minerals [4, 5]. Consequently, individuals adhering to a GFD are at considerable risk of micronutrient deficiencies, including iron, calcium, zinc, vitamin D, and B vitamins, which may lead to long-term complications such as osteoporosis, anemia, neurological dysfunction, and impaired immune regulation [4, 6].

Despite its central therapeutic role, the GFD increasingly poses an underrecognized public health challenge: a substantial burden of micronutrient deficiencies that necessitates urgent and explicit incorporation into national nutrition policies and standardized clinical management frameworks.

The lack of effective national support policies leaves these nutritional risks systematically unaddressed. Therefore, the central issue of this article is how nutrition policy can strengthen the nutritional safety of gluten-free diets and improve long-term health outcomes for celiac disease patients.

2. Methods

This article is derived from a main research project previously published by Jadhkaran et al., 2025 [4]. That original study was a comprehensive review of nutraceuticals in celiac disease, summarizing the mechanistic roles of polyphenols, omega-3 fatty acids, vitamins, minerals, plant-based enzymes, and dietary amino acids in modulating gluten toxicity, intestinal barrier function, inflammation, oxidative stress, and gut microbiota. The present manuscript builds on that evidence to propose nutritional policies addressing gluten-free food accessibility and economic burdens, supplemented by a review of policy measures from selected countries and Iran-specific challenges. Also, other evidences were identified through a targeted search of peer-reviewed literature and relevant clinical guidelines in PubMed/MEDLINE, Scopus, and Web of Science, supplemented by hand-searching the reference lists of key papers.

3. Results

Multiple factors contribute to the compromised nutritional status observed in celiac patients. First, gluten free products rely heavily on refined starches and added fats and sugars to mimic the texture of gluten containing foods, resulting in reduced levels of fiber, B vitamins, iron, and other critical micronutrients [4, 5]. Second, the majority of CD patients lack access to specialized dietary counseling, limiting their ability to make nutritionally informed food choices or apply appropriate preparation practices [7]. Third, economic and sociodemographic barriers, including elevated product costs, limited availability, and social discomfort around dietary restrictions, further impede adherence to a nutritionally adequate GFD [7]. Fourth, substantial knowledge gaps persist among healthcare professionals regarding CD management and its associated micronutrient deficiencies, contributing to inconsistent clinical monitoring [8]. Finally, poor adherence to GFDs results in persistent villous atrophy, exacerbating malabsorption and intensifying micronutrient deficiencies.[9]

Collectively, these factors highlight the need for a structured, policy driven approach that addresses both the nutritional shortcomings of GFDs and the systemic gaps in clinical practice.

4. Health Policy Framework

A coordinated multisectoral plan is required to mitigate micronutrient deficiencies and strengthen CD management. This framework is structured around three core pillars:

4.1. Production and Regulation of Fortified Gluten-Free Supplements and Foods

Micronutrients such as vitamins A, C, D, B-complex, zinc, selenium, and omega-3 fatty acids are essential for intestinal epithelial integrity, immune modulation, and TG2 downregulation. Therefore, policymakers should mandate minimum fortification standards across all commercially produced gluten-free products [4].

Additionally, governments are encouraged to subsidize specialized nutraceutical supplements, such as high

bioavailability multivitamins enriched with zinc and vitamin D, to reduce the financial burden on CD patients and ensure equitable access.

4.2. Mandatory Ongoing Training for Healthcare Providers

Health education authorities must implement compulsory, standardized training modules for gastroenterologists, primary care physicians, and dietitians regarding the nutritional management of CD. These modules should address:

- the spectrum of micronutrient deficiencies associated with CD;
- the role of micronutrients in modulating CD pathogenesis;
- appropriate indications for nutraceutical supplementation;
- identification of hidden gluten sources;
- and strategies for preventing cross-contamination [10].

As highlighted by ESPGHAN, patients must understand not only gluten avoidance but also the importance of maintaining a balanced GFD, an especially challenging task in institutional food environments [11, 12].

Professional societies, including the American Gastroenterological Association (AGA) and ESPGHAN, should revise clinical practice guidelines to include explicit recommendations for baseline and annual micronutrient panels for all CD patients, irrespective of symptom severity.

4.3. A Structured Screening and Monitoring Protocol

Health systems and payers should adopt a unified national surveillance program for CD. At diagnosis, all patients should undergo a comprehensive micronutrient panel, followed by repeat assessments at six months and annually thereafter. These data should be incorporated into a centralized registry to support longitudinal monitoring and public health planning. Patients presenting persistent deficiencies must be referred to registered dietitians for structured GFD evaluations and prescribed targeted nutraceutical interventions. Although the gluten-free diet remains the sole established treatment for CD, it imposes a significant, frequently overlooked risk of micronutrient deficiencies arising from nutritionally inadequate GFD products, inconsistent patient adherence, and systemic gaps in clinical monitoring and professional training. These deficiencies are not secondary findings; they represent a critical public health challenge that jeopardizes long-term disease outcomes.

To mitigate these preventable risks, nutrition policymaking must prioritize mandatory fortification of gluten-free foods, financial support for high-quality supplements, specialized provider education, and a standardized, nationwide screening infrastructure. Without decisive policy action, the current reliance on GFD-centered management will continue to expose celiac patients to avoidable nutritional harm, undermining the effectiveness of treatment and compromising long-term health (Figure 1).

The policy recommendations presented in this section are derived from the approved research project No. 43010988 with ethics code IR.SBMU.RETECH.REC.1403.214.



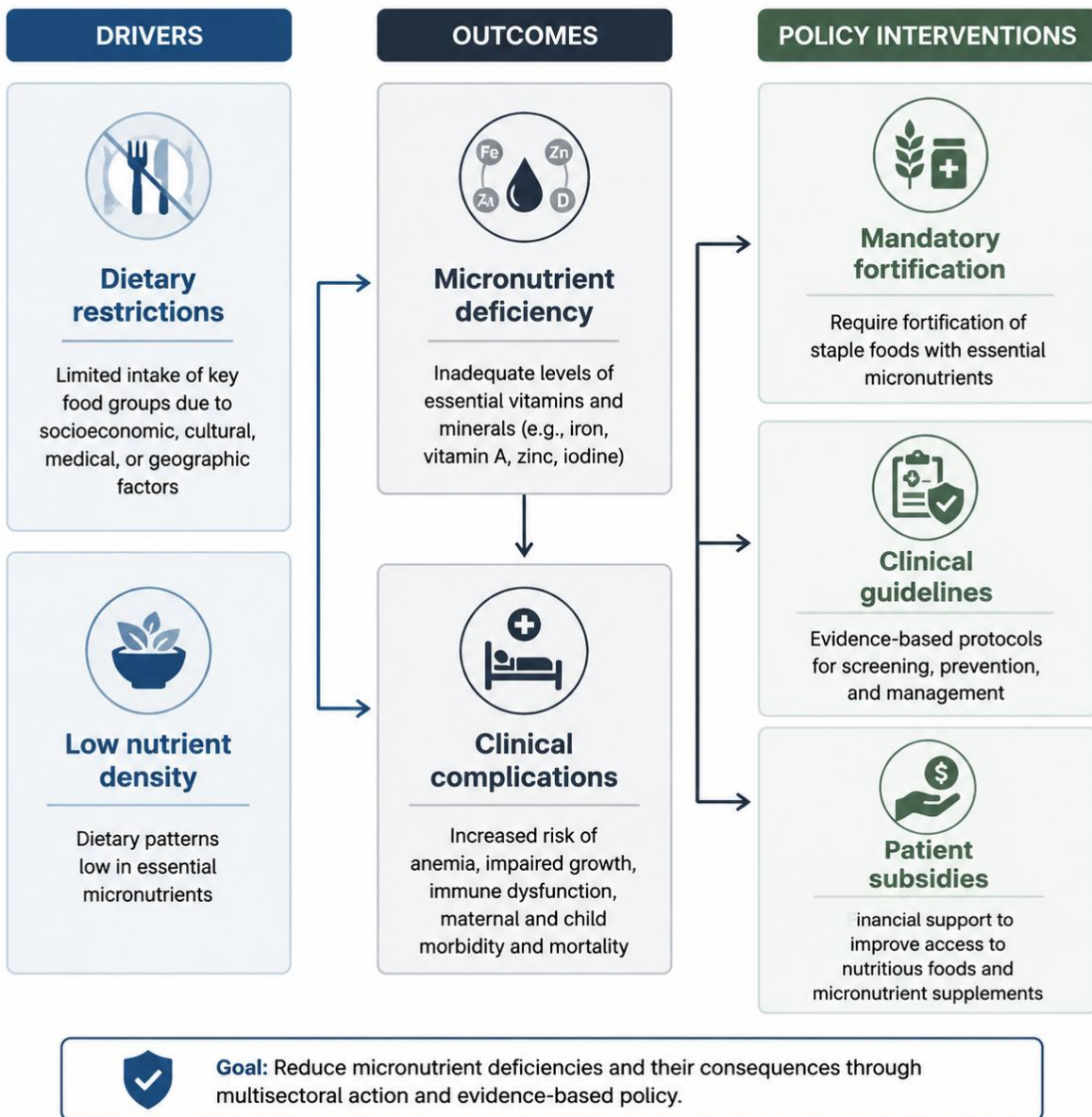


Figure 1. Conceptual framework of micronutrient deficiency risk and policy responses in celiac disease

5. Declarations

5.1. Acknowledgement

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5.2. Conflict of Interest

All authors declare no conflict of interest.

5.3. Using chatbots: Portions of this manuscript were edited for clarity and English-language style using an AI-assisted language tool (ChatGPT, OpenAI). The authors

reviewed and revised all outputs and take full responsibility for the content.

5.4. Authors' Contributions

Mohammed Rostami-Nejad: Conceptualization, Methodology, Supervision, Validation, Project administration, Data curation, Writing – review & editing.

Nastaran Asri: Conceptualization, Methodology, Data curation, Writing – original draft, Writing – review & editing.

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چارچوب سیاستی برای تقویت ایمنی تغذیه‌ای رژیم‌های غذایی بدون گلوتن در بیماران مبتلا به بیماری سلیاک

محمد رستمی نژاد^{۱*}، نسترن عصری^۲

۱. مرکز تحقیقات بیماری سلیاک و اختلالات مرتبط با گلوتن، پژوهشکده بیماری‌های گوارش و کبد، دانشگاه علوم پزشکی شهید بهشتی، تهران، ایران.
۲. مرکز تحقیقات بیماری‌های گوارش و کبد، پژوهشکده بیماری‌های گوارش و کبد، دانشگاه علوم پزشکی شهید بهشتی، تهران، ایران.

چکیده

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نویسنده مسوول

محمد رستمی نژاد

پست الکترونیک:

m.rostamii@gmail.com

سابقه و هدف: رژیم غذایی بدون گلوتن مادام‌العمر تنها درمان بیماری سلیاک است. با این حال، این رژیم اغلب از نظر تغذیه‌ای ناکافی است و منجر به کمبود ریزمغذی‌ها می‌شود که عوارض طولانی‌مدتی به دنبال دارد. هدف این مطالعه، ارائه یک چارچوب جامع سیاست‌گذاری برای کاهش خطرات تغذیه‌ای ناشی از درمان با رژیم بدون گلوتن و بهبود مدیریت بیماری سلیاک است.

مواد و روش‌ها: این تحلیل چارچوب سیاست‌گذاری بر اساس شواهد حاصل از مطالعه جهدکاران و همکاران (۲۰۲۵) و جستجوی هدفمند در پایگاه‌های PubMed/MEDLINE و Scopus و Web of Science انجام شد و بر ترکیب تغذیه‌ای رژیم بدون گلوتن، الگوهای کمبودها، موانع پیروی از رژیم، شکاف‌های دانشی ارائه‌دهندگان خدمات سلامت و اقدامات سیاستی موجود متمرکز گردید.

یافته‌ها و نتیجه‌گیری: این مطالعه پنج عامل کلیدی در ایجاد کمبود ریزمغذی‌ها در بیماران سلیاکی تحت رژیم بدون گلوتن شناسایی کرد: ترکیب تغذیه‌ای ضعیف محصولات بدون گلوتن، دسترسی محدود به مشاوره تغذیه، موانع اقتصادی، شکاف دانشی ارائه‌دهندگان سلامت و پیروی ضعیف از رژیم. بر اساس این یافته‌ها، چارچوب سیاستی سه‌ستونی شامل غنی‌سازی اجباری مواد غذایی همراه با تأمین مکمل‌های یارانه‌ای، آموزش ارائه‌دهندگان سلامت، و غربالگری ملی استاندارد شده با پانل سالانه ریزمغذی‌ها تدوین گردید. اجرای چارچوب سه‌ستونی پیشنهادی، راهبردی عملی و مبتنی بر شواهد برای کاهش آسیب‌های تغذیه‌ای، بهبود پیامدهای سلامت طولانی‌مدت و تغییر رویکرد مراقبت از سلیاک از صرف اجتناب غیرفعال از گلوتن به ایمنی تغذیه‌ای فعال فراهم می‌کند.

واژگان کلیدی: بیماری سلیاک؛ رژیم غذایی بدون گلوتن؛ کمبود ریزمغذی‌ها؛ سیاست سلامت عمومی؛ غنی‌سازی مواد مغذی؛ غربالگری بالینی