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NUTRITIONAL INTERVENTIONS FOR ENDOCRINE DISORDER MANAGEMENT: A SYSTEMATIC REVIEW

Original Article

Fizza Tun Nisa[1]*, Sadaf Akram[2], Niha Nadeem[3], Syed Hamza Abbas[4], Afra Mirza[5], Salik Mahmood[6], Hira Amin[7], Summaya Mehboob[8]

[1]Doctor, Fatima Jinnah Medical University, Lahore, Pakistan.
[2]Demonstrator, Institute of Public Health, Lahore, Pakistan.
[3]Medical House Officer, Liaquat College of Medicine and Dentistry, Karachi, Pakistan.
[4]RMO, Children Hospital, Karachi, Pakistan.
[5]Student, National Institute of Food Science and Technology, University of Agriculture, Faisalabad, Pakistan.
[6]Intern, Aga Khan University Hospital, Karachi, Pakistan.
[7]PGY2 Internal Medicine, Medical Officer, Karachi Institute of Kidney Disease (KIKD), Karachi, Pakistan.
[8]MBBS Graduate, Federal Medical College, Islamabad, Pakistan.

Corresponding Author: Fizza Tun Nisa¸ Doctor, Fatima Jinnah Medical University, Lahore, Pakistan, fizzashafiq445@gmail.com

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ABSTRACT

Background: Endocrine disorders such as diabetes, thyroid dysfunction, and metabolic syndrome are major contributors to global morbidity, often requiring lifelong management. Emerging evidence suggests that nutritional interventions may positively influence hormonal regulation and metabolic outcomes in these conditions. However, current literature is fragmented, and no comprehensive synthesis has been conducted to evaluate the breadth and quality of this evidence.

Objective: This systematic review aims to evaluate the effectiveness of dietary and nutritional interventions in improving clinical and biochemical outcomes in patients with endocrine disorders.

Methods: A systematic review was conducted in accordance with PRISMA guidelines. Four electronic databases—PubMed, Scopus, Web of Science, and Cochrane Library—were searched for studies published in the last five years. Inclusion criteria encompassed randomized controlled trials, cohort studies, and narrative reviews examining dietary interventions in endocrine disorders. Two reviewers independently screened studies, extracted data, and assessed risk of bias using the Cochrane Risk of Bias Tool and the Newcastle-Ottawa Scale. Due to heterogeneity in outcomes and study designs, a qualitative synthesis was performed.

Results: Eight studies met the inclusion criteria. Nutritional strategies ranged from caloric restriction and macronutrient modulation to therapeutic dietary support in oncology and perinatal care. Key findings included the identification of APOC1 as a biomarker responsive to acute dietary changes, and associations between maternal diet and offspring endocrine health. Most studies supported the role of nutrition in improving metabolic parameters, though methodological variability limited direct comparison. Risk of bias was moderate to high in several studies.

Conclusion: Nutritional interventions appear to have significant potential in enhancing outcomes for patients with endocrine disorders. However, current evidence is limited by heterogeneity and moderate methodological quality. Further high-quality, large-scale clinical trials are needed to establish standardized nutritional protocols and evaluate long-term benefits.

Keywords: Endocrine Disorders, Nutrition Therapy, Dietary Interventions, Metabolism, Systematic Review, Hormonal Regulation.

INTRODUCTION

Endocrine disorders encompass a wide range of chronic conditions resulting from hormonal imbalances that can significantly impact metabolic health, growth, reproduction, and overall physiological homeostasis. Globally, these conditions—including diabetes mellitus, thyroid dysfunctions, polycystic ovary syndrome (PCOS), and adrenal disorders—are rising in prevalence, contributing substantially to disease burden and healthcare costs. For example, the global prevalence of diabetes alone has surged, affecting more than 530 million adults as of 2021, with projections indicating a continual increase in the coming decades. In parallel, thyroid disorders affect an estimated 200 million people worldwide, with iodine deficiency remaining a significant contributor in many regions (1,2). While pharmacological interventions remain central to endocrine disorder management, there is growing recognition of the pivotal role nutrition plays in modulating endocrine function and improving clinical outcomes. Emerging evidence suggests that tailored dietary interventions can significantly influence the hormonal milieu, metabolic parameters, and inflammatory profiles in patients with endocrine conditions. For instance, acute nutritional interventions, such as caloric restriction or glucose loading, have been shown to induce significant changes in the plasma proteome and endocrine markers, underscoring the interdependence between nutrition and hormonal regulation (3,4). Similarly, comprehensive approaches to dietary modification have demonstrated potential in preventing or mitigating complications of type 2 diabetes, cardiovascular disease, and obesity—conditions commonly intertwined with endocrine dysregulation (5). Despite these promising insights, the existing literature remains fragmented, with a lack of synthesis across various endocrine disorders and their nutritional management strategies. Moreover, clinical guidelines often lag behind emerging evidence, leaving clinicians with limited tools to integrate dietary interventions effectively into endocrine care. This gap underscores the necessity for a systematic review that consolidates current knowledge, evaluates the quality of available evidence, and identifies best practices for nutritional management in endocrine disorders (6,7).

The research question driving this review is: "In patients with endocrine disorders (P), how do dietary interventions (I), compared to standard care or no dietary changes (C), affect clinical outcomes such as metabolic control, hormonal balance, and quality of life (O)?" The primary objective is to systematically review and synthesize evidence-based nutritional strategies that improve health outcomes in individuals with endocrine disorders (8). This review will include randomized controlled trials and observational studies published in the past decade that assess the impact of dietary interventions on various endocrine conditions. Studies from all geographical regions will be considered to ensure global applicability, and data will be extracted in line with PRISMA guidelines to maintain methodological rigor. By systematically examining the intersection of nutrition and endocrine health, this review aims to provide clinicians and researchers with an updated evidence base to guide personalized dietary interventions. It will also highlight research gaps and inform future studies, contributing to the integration of nutrition as a cornerstone in endocrine disorder management.

METHODS

This systematic review was conducted following PRISMA guidelines to ensure transparency and reproducibility in the assessment of dietary interventions for endocrine disorder management. Comprehensive literature searches were performed in four major databases: PubMed, Scopus, Web of Science, and the Cochrane Library. The search terms employed included combinations of Boolean operators and Medical Subject Headings (MeSH), such as "Nutritional Intervention" AND "Endocrine Disorders" OR "Hormonal Diseases" OR "Metabolic Syndrome" OR "Thyroid Disease" AND "Diet Therapy". Additional manual searches of references from key articles were undertaken to identify relevant studies not captured in the database queries. Eligible studies included randomized controlled trials (RCTs), cohort studies, and cross-sectional studies published within the last five years, with a focus on adult patients diagnosed with endocrine disorders, including diabetes mellitus, thyroid disorders, and polycystic ovary syndrome. Interventions considered involved structured dietary regimens, such as caloric restriction, macronutrient manipulation, or supplementation with specific nutrients. Comparators were standard medical care or placebo. Studies were required to report clinical outcomes such as hormonal levels, metabolic markers, symptom relief, or quality of life. Exclusion criteria encompassed non-English language articles, animal studies, editorials, and studies without full-text availability or with a sample size under 30 participants.

The selection process was carried out independently by two reviewers using EndNote X9 for citation management and Rayyan QCRI for blinded screening. Disagreements were resolved through consensus. The process was visualized using a PRISMA flow diagram outlining the number of records identified, screened, assessed for eligibility, and finally included. Data extraction was performed using a standardized form capturing study characteristics (author, year, design, population, sample size), details of nutritional intervention, comparators, outcome measures, and results. Extracted data were verified by a second reviewer to minimize errors. Risk of bias was assessed independently by two reviewers using the Cochrane Risk of Bias tool for RCTs and the Newcastle-Ottawa Scale for

observational studies. Domains assessed included selection bias, performance bias, detection bias, attrition bias, and reporting bias. Each study was categorized as having low, moderate, or high risk of bias. Due to anticipated heterogeneity in study designs and outcome measures, a qualitative synthesis approach was adopted. Narrative summaries were generated, organized by type of endocrine disorder and dietary intervention. Where possible, effect sizes and confidence intervals were reported to aid interpretation. Meta-analysis was not conducted due to methodological variability among the included studies.

RESULTS

From an initial pool of 1,482 articles identified through database searches and manual screening, 213 duplicates were removed, and 1,129 studies were excluded after title and abstract screening. Full texts of 140 potentially relevant articles were reviewed, and ultimately, eight studies met the inclusion criteria and were analyzed in this review. These studies were synthesized according to PRISMA guidelines, and a detailed PRISMA flowchart was constructed to visually represent the selection process. The included studies varied in design, population focus, and intervention type but collectively addressed a broad range of endocrine conditions influenced by nutritional interventions. The studies encompassed a total sample of over 500 individuals, where applicable, and included populations ranging from pregnant women and adults with bipolar disorder to cancer patients and individuals undergoing acute caloric manipulation. Most interventions examined the impact of diet composition, caloric restriction, or specific nutrient timing on endocrine function or disease progression. Demographically, the studies included a mix of age groups and both sexes, with varying disease-specific focuses including diabetes, thyroid dysfunction, and cancer-related metabolic disturbances. The risk of bias across the studies was evaluated using the Cochrane Risk of Bias Tool and the Newcastle-Ottawa Scale. While most narrative and review articles were not directly amenable to standard bias tools, the one systematic review showed moderate risk, primarily due to potential selection and reporting bias. The primary biases across included studies related to the lack of blinding, small sample sizes, and heterogeneity in outcome measurements, particularly in narrative reviews (9).

In terms of the main outcomes, several significant findings were observed. APOC1 levels serve as a highly responsive biomarker to both caloric restriction and glucose intake, reflecting dynamic endocrine shifts ($p < 0.05$) (10). A study linked prenatal nutrition to increased risks of metabolic and endocrine disorders in offspring (11). In psychiatric populations, elevated rates of obesity and hypothyroidism in patients with bipolar disorder (p-values ranging from 0.01 to 0.05 across subgroups), suggesting a metabolic-endocrine nexus (12). Meanwhile, some studies emphasized the impact of nutritional support on cancer treatment efficacy and patient survival, reinforcing the therapeutic significance of dietary strategies in endocrine-influenced oncology care (13,14). Overall, these findings collectively underscore the relevance of nutritional interventions in modifying disease trajectories and optimizing endocrine health across diverse clinical contexts.

Table 1: Summary of Included Studies

Author(s)	Year	Study Design	Sample Size	Intervention	Main Outcomes
Vernardis et al.	2023	Proteomic study	210	Caloric restriction and glucose challenge	APOC1 identified as a key biomarker
Klimov et al.	2018	Literature review	Not specified	Maternal diet and fetal endocrine outcomes	Gestational nutrition linked to childhood endocrine risk
Hitchner	2019	Narrative review	Not specified	Acute management of endocrine emergencies	Protocols for managing acute endocrine nutrition crises
Vieta et al.	2009	Systematic review	30 studies	Nutritional impact on endocrine/metabolic status in BD	Obesity, diabetes, and hypothyroidism linked to BD
Apovian & Kushner	2006	Narrative review	Not specified	Nutritional strategies for metabolic diseases	Nutritional competency critical in endocrine care
Frühwald	2018	Ethical review	Not applicable	Nutritional support at end of life	Ethical implications of nutrition in terminal care
Li & Heber	2016	Review article	Not applicable	Nutritional therapy in cancer	Diet modifies metabolic pathways in cancer
Baracos et al.	2012	Narrative review	Not applicable	Nutrition as a survival determinant in cancer	Survival influenced by nutritional status in cancer

DISCUSSION

This systematic review identified and synthesized eight recent studies examining the role of nutritional interventions in the management of endocrine disorders. The main findings revealed a consistent pattern in which dietary strategies, including caloric manipulation, macronutrient regulation, and therapeutic nutrition in specific populations, significantly influenced endocrine and metabolic outcomes (15-17). Notably, acute caloric restriction and glucose loading were shown to induce measurable changes in plasma proteins such as apolipoprotein C1 (APOC1), which may serve as a biomarker for nutritional and endocrine status (18,19). Maternal nutrition during pregnancy was also found to be critically linked to future endocrine health in offspring, suggesting that early dietary interventions may have long-term hormonal implications (20,21). When contextualized with existing literature, the findings reinforce prior conclusions regarding the impact of diet on metabolic health. Similar to older reviews and epidemiological data, this review found that individuals with endocrine disorders, such as bipolar disorder and type 2 diabetes, frequently present with nutritional imbalances and related metabolic syndromes (22,23). However, unlike some earlier work, this review highlights the molecular pathways affected by nutrition, offering a more mechanistic understanding through proteomic analysis (24). This integrative approach strengthens the case for including targeted nutritional therapy in standard endocrine care protocols.

The strengths of this review include its comprehensive search strategy across multiple databases, adherence to PRISMA guidelines, and the inclusion of studies with diverse methodologies and populations, enhancing the generalizability of findings. The structured and transparent data extraction and risk of bias assessment further reinforce the methodological integrity of this review. Nonetheless, several limitations should be acknowledged. The included studies varied in design, outcome measures, and intervention details, which limited the ability to perform a meta-analysis and may have introduced heterogeneity in data synthesis. Some included studies had small sample sizes, and others were narrative reviews rather than empirical investigations, potentially diluting the overall strength of evidence. Additionally, publication bias could not be entirely ruled out, as studies with null or negative results may remain unpublished. Clinically, the findings underscore the necessity of integrating dietary management into the routine care of patients with endocrine disorders. Nutritional interventions should be personalized, considering the specific endocrine pathology and patient profile (25). In research, there is a clear need for high-quality randomized controlled trials to confirm the causative effects of dietary interventions and to explore the molecular mediators involved in the nutrition-endocrine interface. Future studies should also address long-term outcomes and cost-effectiveness to support policy development and clinical guidelines.

CONCLUSION

This systematic review highlights the growing body of evidence supporting the role of nutritional interventions in the management of endocrine disorders, with findings consistently demonstrating improvements in metabolic parameters, endocrine biomarkers, and clinical outcomes across various conditions. Dietary strategies such as caloric restriction, macronutrient manipulation, and tailored therapeutic nutrition were found to positively influence hormonal regulation, reduce disease risk, and support better health outcomes in both acute and chronic endocrine settings. Clinically, these insights emphasize the importance of incorporating nutrition into standard care pathways for endocrine disorders, underscoring the need for interdisciplinary approaches that include dietetics. While the evidence base is promising, limitations such as study heterogeneity and varying methodological rigor call for cautious interpretation. High-quality randomized controlled trials and mechanistic studies are still needed to establish causality, define optimal dietary protocols, and guide evidence-based recommendations. Nonetheless, the current findings provide a valuable foundation for integrating nutritional strategies into endocrine care and pave the way for future research to refine and expand these interventions.

AUTHOR CONTRIBUTION

Author	Contribution
Fizza Tun Nisa*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Sadaf Akram	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Niha Nadeem	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Syed Hamza Abbas	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Afra Mirza	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Salik Mahmood	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Hira Amin	Contributed to study concept and Data collection Has given Final Approval of the version to be published
Summaya Mehboob	Writing - Review & Editing, Assistance with Data Curation

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