IJCNP : (Indonesian Journal of Clinical Nutrition Physician)

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INDIVIDUALIZED HIGH-PROTEIN DIETARY COUNSELING DURING CHEMOTHERAPY IN GASTROINTESTINAL CANCER: A SYSTEMATIC REVIEW OF NUTRITIONAL AND FUNCTIONAL OUTCOMES

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Abstract

Background: Patients with gastrointestinal cancers undergoing chemotherapy are highly susceptible to treatment-related malnutrition and skeletal muscle loss due to reduced dietary intake, metabolic stress, and systemic inflammation. Adequate protein intake is critical for maintaining muscle mass, functional capacity, and treatment tolerance; however, achieving sufficient intake during chemotherapy remains challenging. Individualized dietary counseling has been proposed as a strategy to address these barriers, yet its specific effects on nutritional and functional outcomes have not been systematically synthesized. **Objective**: This systematic review aimed to evaluate the effects of individualized, protein-oriented dietary counseling on nutritional intake, muscle mass, functional outcomes, and treatment tolerance in adults with gastrointestinal cancers receiving chemotherapy. **Methods**: A systematic search of PubMed, the Cochrane Library, and ScienceDirect was conducted to identify interventional studies involving individualized dietary counseling focused on improving protein intake during chemotherapy. Eligible studies included adult patients with colorectal or gastric cancer and reported outcomes related to dietary intake, nutritional status, skeletal muscle mass, muscle strength, physical function, quality of life, or chemotherapy tolerance. Due to heterogeneity in interventions, populations, and outcome measures, a narrative synthesis was performed. **Results**: Five interventional studies met inclusion criteria. Across studies, individualized dietary counseling consistently improved energy and protein intake compared with usual care. Several interventions were associated with improved nutritional status indicators, including PG-SGA scores and serum albumin. Improvements in quality of life and symptom control were frequently reported. Preservation of skeletal muscle mass and improvements in handgrip strength were observed primarily in studies employing intensive, structured counseling with regular follow-up, whereas counseling alone was insufficient to prevent muscle loss in some metastatic or advanced disease settings. Evidence regarding objective functional outcomes remained limited. **Conclusion**: ndividualized, protein-oriented dietary counseling during chemotherapy is associated with improved dietary intake, nutritional status, and patient-reported outcomes in adults with gastrointestinal cancers. Benefits on muscle mass and functional preservation appear to depend on disease stage, inflammatory burden, and intervention intensity. These findings support early integration of individualized dietary counseling into oncology care while highlighting the need for further well-designed studies focusing on standardized functional outcomes.

Keywords: gastrointestinal cancer; individualized dietary counseling; protein intake; muscle mass; chemotherapy

Received : 19 December 2025
Accepted : 22 May 2026
Publish : 17 Juni 2026

Introduction

Gastrointestinal cancers, particularly colorectal and gastric malignancies—continue to represent a major global health burden, both in incidence and mortality.[1] With the increasing adoption of multimodal treatment, including systemic chemotherapy, radiotherapy, and combination regimens, patients are living longer but are simultaneously exposed to prolonged periods of treatment-related physiological stress. Chemotherapy, a cornerstone of gastrointestinal cancer management, frequently induces a range of upper and lower gastrointestinal toxicities such as dysgeusia, mucositis, anorexia, nausea, early satiety, and diarrhea.[2] These therapy-induced disturbances in food intake often manifest early during treatment cycles and progressively worsen with cumulative dose exposure. As a result, patients experience a steady erosion of their nutritional status, which can undermine treatment tolerance, limit therapeutic benefit, and jeopardize survival.

Malnutrition and cancer-associated cachexia are particularly prevalent among individuals with gastrointestinal malignancies, owing to the dual burden of tumor-induced metabolic dysregulation and chemotherapy-driven catabolism.[3] Cachexia in this population is characterized not only by unintentional weight loss but also by a disproportionate reduction in lean body mass, especially skeletal muscle, even in the presence of stable or modestly reduced body weight. Evidence indicates that muscle loss in gastrointestinal cancer is neither a late-stage phenomenon nor confined to palliative contexts; rather, it may begin early in the disease trajectory and accelerate during chemotherapy cycles.[4] This progressive decline in skeletal muscle mass is clinically significant because it interferes with physical function, compromises immune competency, increases susceptibility to infection, and heightens the risk of severe treatment-related toxicities.[5]

The pathophysiology underpinning this muscle loss is multifactorial. Tumor-induced inflammatory cytokines, chemotherapy-induced oxidative stress, and reduced dietary protein intake intersect to accelerate muscle proteolysis.[5,6] In addition, cyclic fatigue, reduced appetite, gastrointestinal symptoms, and

psychological distress further limit dietary intake, leading to an energy–protein mismatch that the body attempts to compensate for by breaking down muscle tissue. Because skeletal muscle governs strength, mobility, metabolism, and tolerance to treatment, its deterioration has profound implications on outcomes. Patients with poor muscle reserves are more likely to experience dose-limiting toxicities, chemotherapy interruption, prolonged hospitalizations, and poorer survival.[6] These clinical consequences underscore the importance of strategies that preserve or restore muscle mass during treatment.

Protein intake is central to mitigating muscle catabolism. Adequate protein supports muscle protein synthesis, promotes recovery from treatment cycles, and provides a buffer against treatment-induced catabolic pathways.[7] However, achieving optimal protein intake is particularly challenging for patients undergoing chemotherapy, who often struggle with symptoms that reduce palatability, appetite, and tolerance for high-protein foods. This has led to increasing attention on individualized high-protein dietary counseling, in which trained dietitians work closely with patients to tailor nutrition strategies based on symptom patterns, food preferences, treatment schedules, and evolving functional needs. Unlike generalized diet brochures or unstructured advice, individualized counseling is dynamic and emphasizes food-based solutions that align with the patient's lived experience and daily fluctuations in intake.[8]

Despite growing interest in personalized nutrition therapy, the existing evidence landscape is heterogeneous and often difficult to interpret. Prior studies have combined interventions such as oral nutritional supplements (ONS), enteral nutrition, parenteral nutrition, group education, or mixed modalities under broad categories of “nutrition support,” making it challenging to determine the specific contribution of individualized dietary counseling to clinically relevant outcomes.[9] Many reviews have also reported outcomes in aggregate, such as body weight, appetite scores, or general nutritional indices, without isolating key functional indicators such as skeletal muscle index (SMI), handgrip strength, or objective physical performance. Moreover, interventions vary considerably in frequency, intensity, and structure, with some relying solely on symptom-driven advice and

Received : 19 December 2025
Accepted : 22 May 2026
Publish : 17 Juni 2026

IJCNP : (Indonesian Journal of Clinical Nutrition Physician) 2026, 7:1 Hal 1 - 20

others incorporating comprehensive escalation frameworks.

Given that skeletal muscle mass, physical function, and treatment tolerance are strong determinants of survival and quality of life in gastrointestinal cancer patients, it is critical to understand whether individualized high-protein dietary counseling can meaningfully influence these outcomes.[10] Yet, a focused synthesis of studies examining food-based, protein-oriented, individualized counseling, distinct from supplement-only or formula-based nutritional interventions, remains lacking. Addressing this gap would help clarify the role of dietary counseling as an essential supportive measure during chemotherapy, highlight practices that yield the greatest benefit, and inform future intervention design.

Therefore, this systematic review aims to consolidate and critically evaluate the available evidence on the effects of individualized high-protein dietary counseling on nutritional and functional outcomes in adults with gastrointestinal cancers undergoing chemotherapy. By focusing on interventions designed to increase dietary protein intake through tailored counseling, and by prioritizing outcomes related to muscle mass, strength, and physical performance, this review seeks to advance current understanding and provide a more precise foundation for clinical practice and future research.

Methods

Search Strategy

A systematic literature search was conducted to identify interventional studies evaluating individualized, protein-oriented dietary counseling in adults with gastrointestinal cancers undergoing chemotherapy. Three electronic databases—PubMed, the Cochrane Library, and ScienceDirect—were searched from inception until December 2025. These databases were selected to capture clinical nutrition, oncology, and interventional research across medical and allied health disciplines.

The search strategy combined terms related to gastrointestinal malignancy, chemotherapy, and individualized nutrition intervention. Although the primary search terms emphasized colorectal cancer, gastric cancer was retained as an eligible population due to shared pathophysiological mechanisms of treatment-related malnutrition and muscle loss. No language restrictions were applied during the search

process.The database-specific search strategies were as follows: PubMed:(colorectal OR "colon cancer") AND (chemotherapy OR "adjuvant chemotherapy" OR "palliative chemotherapy" OR chemoradiotherapy) AND ("nutrition intervention" OR "nutritional counseling" OR "dietary counseling" OR "nutrition education") AND ("protein intake" OR "energy intake" OR PG-SGA OR SMI). Cochrane Library:(colorectal OR "colon cancer") AND chemotherapy AND ("nutrition intervention" OR "nutritional counseling" OR "dietary counseling"). ScienceDirect: "colorectal cancer" AND chemotherapy AND ("nutrition intervention" OR "dietary counseling"). Reference lists of included studies were manually screened to identify any additional eligible articles.

Eligibility Criteria

Studies were included if they met all of the following criteria: (1) adult participants aged ≥18 years with gastrointestinal cancer (colorectal or gastric); (2) receiving systemic chemotherapy, chemoradiotherapy, or radiotherapy with concurrent or sequential chemotherapy; (3) an intervention consisting of individualized, patient-centered dietary counseling delivered by a dietitian or trained nutrition professional, with explicit emphasis on improving protein intake; (4) comparison with usual care, standard dietary advice, or non-individualized nutrition counseling; and (5) reporting at least one outcome related to dietary intake, nutritional status, skeletal muscle mass, muscle strength, physical function, quality of life, or chemotherapy tolerance. Studies were excluded if nutrition support relied exclusively on oral nutritional supplements, enteral nutrition, or parenteral nutrition without a structured individualized counseling component, or if the intervention was not delivered during active oncologic treatment.

Study Selection

Titles and abstracts were screened independently by two reviewers according to the predefined eligibility criteria. Full-text articles were subsequently assessed for inclusion. Discrepancies during the selection process were resolved through discussion and consensus.

Received : 19 December 2025
Accepted : 22 May 2026
Publish : 17 Juni 2026

IJCNP : (Indonesian Journal of Clinical Nutrition Physician) 2026, 7:1 Hal 1 - 20

Data Extraction

Data extraction was performed independently by two reviewers using a standardized extraction framework. Extracted information included study design, setting, sample size, cancer type and stage, oncologic treatment, details of the individualized dietary counseling intervention (including frequency, duration, and escalation strategies), comparator characteristics, and reported outcomes. Any disagreements in data extraction were resolved through discussion until consensus was reached.

Quality and Risk-of-Bias Assessment

The methodological quality of included studies was assessed using design-appropriate tools. Randomized controlled trials were evaluated using the Cochrane Risk of Bias tool, while the non-randomized study was assessed using methodological criteria addressing selection bias, intervention integrity, outcome measurement, and attrition.

Risk of bias was categorized as low, moderate, or high based on the number and severity of concerns across assessed domains. Risk-of-bias assessments were used to inform interpretation of findings but were not applied as exclusion criteria.

Data Synthesis

Given the heterogeneity in study design, intervention intensity, outcome measures, and clinical context, quantitative meta-analysis was not feasible. A narrative synthesis was therefore undertaken. Findings were summarized according to key outcome domains, including dietary intake, nutritional status, muscle mass, functional outcomes, quality of life, and chemotherapy tolerance. Differences in counseling intensity, frequency, and escalation strategies were considered as potential sources of heterogeneity.

Protocol Registration

This systematic review has been registered in the PROSPERO database with registration number CRD420261294516.

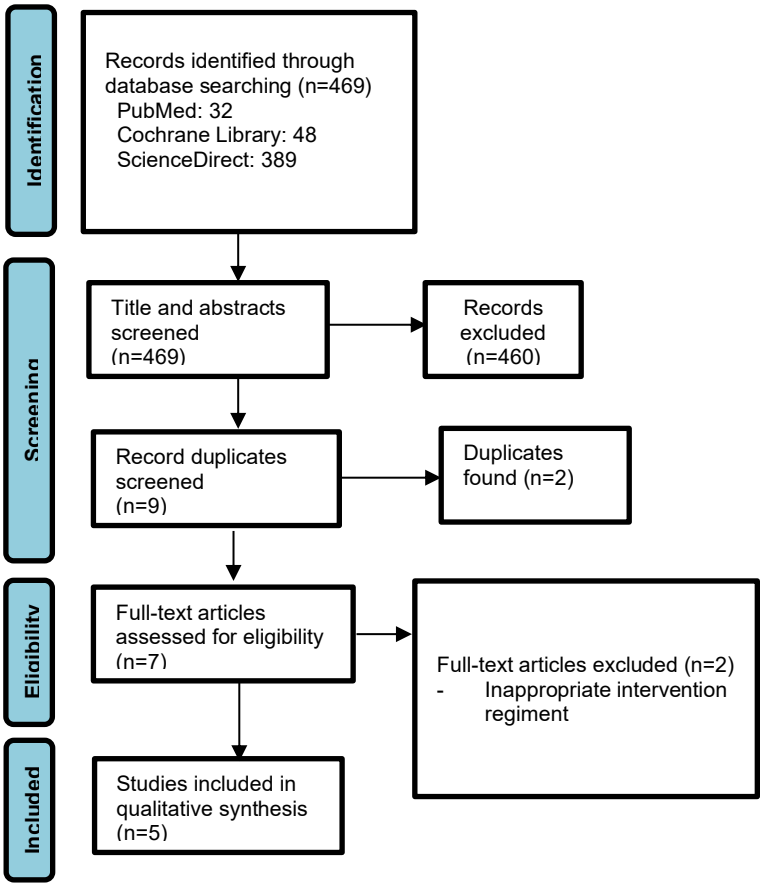

Figure 1. Diagram flow of literature search strategy for this systematic review

Received : 19 December 2025
Accepted : 22 May 2026
Publish : 17 Juni 2026

IJCNP : (Indonesian Journal of Clinical Nutrition Physician) 2026, 7:1 Hal 1 - 20

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Table 1. Characteristics and findings of the included studies evaluating individualized high-protein or protein-oriented dietary counseling in adults with gastrointestinal cancers undergoing chemotherapy.

First Author (Year)	Country	Study Design	Population & Cancer Type	Oncology Treatment	Intervention: Individualized Dietary counseling (Food-Based ± ONS/EN)	Comparison (Usual Care)	Protein Intake Target / Achieved	Outcome Measures	Key Results	Summary of Findings	Risk of Bias
Abu Zaid et al. (2016)[11]	Malaysia	RCT	62 adults with colorectal cancer on outpatient chemotherapy	Standard regimens in Malaysian oncology practice	Intensive individualized dietary + lifestyle counseling, tailored menus, protein-dense food strategies, symptom management; ONS allowed but not primary intervention	Standard written nutrition advice (no tailored counseling)	↑ Protein & energy intake across cycles (significant $p < 0.05$)	PG-SGA, body weight, dietary intake	Intervention group showed ↑ protein intake, ↑ energy intake, improved PG-SGA, better weight stability	High-intensity individualized counseling improves nutrition status during chemotherapy	Low
van der Werf et al. (2020)[12]	Netherlands	RCT	92 mCRC patients initiating first-line chemotherapy	CAPOX, FOLFOX, FOLFIRI	Dietitian-delivered individualized dietary counseling, food-based strategies; ONS/EN only if indicated; counseling synchronized to chemo cycles	Usual care: basic pamphlet-type advice	Higher protein/energy intake trend but not statistically significant	CT-based SMA/SMI, weight, toxicity, PFS, OS	No significant difference in skeletal muscle loss; NC did not improve toxicity or PFS/OS	Counseling improved intake but could not prevent muscle loss during chemotherapy	Low
Ravasco et al. (2012)[13]	Portugal	RCT	111 colorectal cancer patients	Radiotherapy ± adjuvant chemotherapy	Individualized food-based counseling, tailored to symptoms and protein/energy needs; frequent review and adjustment	Group B: ONS; Group C: usual diet	Counseling group maintained highest protein intake (~74 g/day)	Nutritional intake, QoL, toxicity, long-term survival	Counseling group had best QoL, lowest toxicity, and highest long-term survival	Tailored food-based counseling superior to ONS or usual care	Low
Park & Choi-Kwon (2012)[14]	South Korea	Prospective controlled study (non-randomized)	34 CRC patients on palliative chemotherapy	Palliative regimens (varied, not specified)	Individualized dietary counselingeach chemotherapy cycle; focus on increasing dietary protein & energy; symptom-targeted modifications; ONS allowed	Usual care without individualized counseling	Significant ↑ protein + energy intake at week 3 & 6 ($p < 0.05$)	Dietary intake, serum albumin, body weight, nutritional status	Intervention group ↑ albumin, ↑ intake, improved nutritional status; control worsened	Structured dietary counseling improves intake and nutritional biomarkers	Moderate

Wang et al. (2025)[15]	China	RCT	88 postoperative CRC stage II–III patients on CapeOX adjuvant chemotherapy	CapeOX (8 cycles)	Symptom-based individualized nutrition intervention, ESPEN 5-step escalation: (1) food-based counseling (2) + ONS if needed (3–5) EN/PN when required; weekly + per-cycle follow-up delivered in-person + WeChat	Conventional diet counseling + brochures	Achieved significantly higher protein & energy adequacy; improved GI symptom control	CT-SMI, handgrip strength, BMI, albumin/prealbumin, NRS2002, PG-SGA, chemo tolerance, grade ≥3 AEs, QoL (EORTC-C30)	IG had higher SMI, stronger HGS, better weight, better QoL, fewer grade III–IV AEs, higher RDI	Comprehensive individualized nutritional support improves muscle mass, strength, QoL, and chemo tolerance	Low

Received : 19 December 2025
Accepted : 22 May 2026
Publish : 17 Juni 2026

Results

Study Selection

The systematic literature search identified a total of 469 records, including 32 from PubMed, 48 from the Cochrane Library, and 389 from ScienceDirect. After title and abstract screening, 460 records were excluded due to irrelevance, most commonly because they involved non-gastrointestinal cancer populations, non-interventional designs, absence of individualized dietary counseling, or lack of chemotherapy exposure. Nine records proceeded to duplicate screening, of which two were identified as duplicates and removed.

Seven full-text articles were subsequently assessed for eligibility. Two studies were excluded at this stage because the nutritional interventions were not individualized or relied predominantly on enteral or parenteral nutrition without a structured counseling framework. Ultimately, five studies met all predefined inclusion criteria and were included in the qualitative synthesis (Figure 1).

Characteristics of Included Studies

The five included studies comprised three randomized controlled trials, one prospective non-randomized controlled study, and one randomized trial implementing a structured, stepped nutritional intervention model. In total, 387 adult patients with colorectal cancer undergoing active oncologic treatment were represented. Although gastric cancer was included in the eligibility criteria, no interventional studies exclusively involving gastric cancer met all inclusion criteria.

The clinical contexts varied across studies and included adjuvant chemotherapy, first-line chemotherapy for metastatic disease, palliative chemotherapy, radiotherapy with or without chemotherapy, and postoperative adjuvant chemotherapy. Sample sizes ranged from 34 to 111 participants. All interventions were delivered by dietitians or trained nutrition professionals and incorporated individualized dietary counseling tailored to patient symptoms, nutritional status, and treatment phase.

Across all studies, dietary counseling was primarily food-based. Oral nutritional supplements or enteral nutrition were introduced only when dietary intake targets were not achieved through counseling alone. The frequency and intensity of counseling varied considerably, ranging from education delivered at chemotherapy cycles to weekly or continuous follow-up throughout treatment.

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Dietary Intake and Nutritional Status

All included studies reported outcomes related to dietary intake and/or nutritional status. Across studies, individualized dietary counseling was associated with higher energy and protein intake compared with usual care or standard dietary advice. In several studies, these differences reached statistical significance, while others reported directional improvements without statistical testing or without statistically significant differences.

Abu Zaid et al. reported significantly higher protein and energy intake across chemotherapy cycles in the intervention group, accompanied by improvements in PG-SGA scores and greater weight stability compared with controls. Park and Choi-Kwon observed significant increases in protein and energy intake at weeks 3 and 6 of palliative chemotherapy, alongside improvements in serum albumin concentration and overall nutritional status. Ravasco et al. demonstrated that patients receiving individualized dietary counseling achieved higher and more sustained protein intake than those receiving oral nutritional supplements alone or usual diet.

In contrast, van der Werf et al. reported modest increases in protein and energy intake in the intervention group that did not reach statistical significance. Wang et al. reported significantly higher rates of protein and energy adequacy in the intervention group, along with improvements in nutritional screening scores and gastrointestinal symptom burden during adjuvant chemotherapy.

Muscle Mass, Strength, and Functional Outcomes

Objective measures of muscle mass and physical function were reported inconsistently across studies. Skeletal muscle mass was assessed using computed tomography–derived indices in two studies. Wang et al. reported significantly higher skeletal muscle index values at the completion of adjuvant chemotherapy in patients receiving individualized nutritional intervention compared with usual care. In contrast, van der Werf et al. observed no statistically significant difference in skeletal muscle loss between intervention and control groups during chemotherapy.

Muscle strength, assessed using handgrip strength, was reported in a single study. Wang et al. demonstrated significantly greater handgrip strength at the end of chemotherapy in the intervention group compared with controls. Other studies did not

Received : 19 December 2025
Accepted : 22 May 2026
Publish : 17 Juni 2026

report objective measures of muscle strength or physical performance.

Overall, objective functional outcomes were reported in a limited number of studies, with skeletal muscle mass assessed in only two studies and handgrip strength reported in one study, while other measures of physical performance were largely absent.

Quality of Life and Chemotherapy Tolerance

Quality of life outcomes were reported in three studies. Ravasco et al. observed significantly better quality of life scores across multiple domains in patients receiving individualized dietary counseling compared with those receiving oral nutritional supplements or usual diet. Wang et al. reported significant improvements in global and functional quality of life scores in the intervention group during adjuvant chemotherapy. Abu Zaid et al. reported improvements in patient-reported nutritional well-being following intensive counseling.

Chemotherapy tolerance outcomes were inconsistently reported. Wang et al. demonstrated fewer grade III–IV adverse events, higher relative dose intensity, and fewer treatment delays in the intervention group compared with usual care. Other studies did not formally assess chemotherapy tolerance using standardized toxicity grading or dose intensity metrics.

Discussion

Interpretation of Findings

This systematic review synthesized evidence from five interventional studies evaluating individualized, protein-oriented dietary counseling in adults with gastrointestinal cancers undergoing chemotherapy. Taken together, the findings reveal a clear pattern: when nutrition support is personalized, continuous, and explicitly targeted toward protein adequacy, patients demonstrate improved nutritional intake, better maintenance of nutritional status, and clinically relevant enhancements in quality of life and treatment tolerance. Although the degree of benefit varied between studies, the overall direction of effect remained consistent across diverse clinical contexts, suggesting that individualized dietary counseling represents a robust and adaptable strategy for addressing the metabolic challenges of chemotherapy.

The most compelling data arose from Wang et al., who implemented a well-structured model of individualized counseling with escalation to ONS, enteral, or parenteral nutrition where necessary. This approach produced measurable improvements in skeletal muscle index (SMI) and handgrip strength, outcomes that are notoriously difficult to influence during chemotherapy,

given the strong inflammatory and catabolic pressures associated with cytotoxic treatment.[5,6] The ability of such an intervention to preserve lean mass reinforces the theory that protein-focused dietary strategies, when implemented intensively and early, may counteract some of the mechanisms driving cancer-related muscle loss.

By contrast, van der Werf et al. found no significant difference in muscle mass preservation despite increased intake. This lack of structural change underscores that dietary counseling alone may not be sufficient in advanced disease or in patients with pre-existing inflammatory cachexia. Nevertheless, even in this study, individualized counseling improved overall energy and protein intake and contributed to better PG-SGA scores, which remain powerful indicators of treatment tolerance, risk of toxicity, and functional outcomes.[3]

The pattern across all studies suggests that individualized dietary counseling exerts its most consistent effects on behavioral and intake-related outcomes, such as energy adequacy, meal frequency, symptom management, and satisfaction with diet. These improvements may indirectly influence physical functioning, fatigue, and quality of life, even if structural markers like muscle mass do not always demonstrate immediate change. Moreover, across the reviewed trials, patients who received individualized counseling were less likely to experience high-grade toxicities, treatment delays, or significant clinical deterioration, outcomes with major implications for chemotherapy success.

Comparison With Existing Literature

The results of this review are consistent with broader literature highlighting the central role of structured nutrition intervention in oncology. International guidelines from ESPEN emphasize that early, individualized nutrition support is essential in mitigating the negative metabolic consequences of cancer and its treatment.[3,8] The observed improvements in nutritional adequacy and PG-SGA scores echo findings from large observational cohorts showing that proactive nutrition intervention can improve functional status, reduce complications, and enhance treatment adherence.[4–6]

Where this review extends current knowledge is in its isolation of individualized dietary counseling—as distinct from supplement-based or formula-driven strategies. Previous reviews have often combined heterogeneous interventions,

Received : 19 December 2025
Accepted : 22 May 2026
Publish : 17 Juni 2026

making it difficult to determine whether counseling specifically contributes to improved outcomes.[9] By focusing on patient-centered, food-based counseling, this review demonstrates that personalized dietetic engagement has a unique and meaningful impact independent of supplement provision.

The improvements in muscle mass observed in Wang et al. align with emerging evidence that nutritional adequacy during chemotherapy is closely linked to preservation of lean mass and improved physical functioning.[16,17] Meanwhile, the sustained quality-of-life benefits reported by Ravasco et al. mirror recent clinical trials demonstrating that tailored nutrition programs can reduce fatigue, improve appetite, and enhance global health domains throughout radiotherapy and chemotherapy.[18]

It is also consistent with contemporary research indicating that unchanged muscle mass does not necessarily signify lack of clinical benefit. Inflammation, treatment burden, and metabolic derangements may limit structural muscle changes even when functional outcomes or quality-of-life measures improve.[19] Moreover, modest increases in protein intake, even if insufficient to fully halt muscle loss, may still support faster recovery between chemotherapy cycles and reduce susceptibility to high-grade toxicities.[20]

In short, this review reinforces and refines the existing literature: individualized counseling is most beneficial when implemented early, delivered frequently, and integrated into the broader cancer care pathway.

Potential Biological and Behavioral Mechanisms

The benefits observed across included studies likely arise from a combination of biological support, behavioral reinforcement, and symptom-responsive dietary adaptation.

Biologically, adequate protein intake supports muscle protein synthesis, reduces the activation of ubiquitin–proteasome pathways, and moderates systemic inflammation, all of which play central roles in muscle preservation during cancer treatment.[5,7] By proactively tailoring dietary strategies to each patient's symptom burden, individualized counseling ensures that protein intake remains adequate even during periods of anorexia, taste alterations, or gastrointestinal discomfort, symptoms that typically impair food-based protein consumption during chemotherapy.[2]

From a behavioral standpoint, frequent counseling sessions strengthen patient engagement, reinforce adherence, and encourage problem-solving around barriers

to intake. This behavioral reinforcement is especially important during chemotherapy, where motivation and appetite fluctuate dramatically. Regular contact with dietitians allows for dynamic adjustments to meal plans, ensuring dietary strategies remain feasible and acceptable.

Mechanisms also extend to gut–brain interactions, where improved dietary intake and symptom control may influence appetite regulation, fatigue perception, and emotional well-being. Moreover, individualized counseling often incorporates practical strategies, such as symptom-triggered food substitutions, texture modifications, meal timing adjustments, and culturally appropriate protein sources, that are rarely addressed through generic diet sheets or supplement-driven regimens.

Finally, improved tolerance to chemotherapy seen in several studies is likely mediated by better energy balance, more stable lean mass, enhanced immune function, and reduced inflammatory burden, all factors that influence the pharmacodynamics and toxicity profile of cytotoxic agents.[6] These multifaceted mechanisms highlight the holistic impact of individualized nutrition support.

Clinical Implications

The findings of this review have important implications for clinical practice. First, they highlight a critical gap between guideline recommendations and real-world practice: although leading oncology societies advocate early dietitian involvement, many cancer centers still adopt reactive approaches to nutrition management, intervening only after significant weight or muscle loss occurs.[3,8] This review clearly indicates that proactive, individualized, protein-focused counseling is more effective than late nutritional rescue.

Second, individualized counseling should be integrated within chemotherapy workflows, ensuring that patients are assessed and supported at each treatment cycle. Such integration aligns with evidence showing that nutrition-related deterioration often occurs early during treatment and accelerates without ongoing monitoring.[4]

Third, the structured, stepped-care approach used by Wang et al. provides an exemplary model: beginning with food-based counseling and escalating only when necessary. This strategy balances patient-centered care with resource stewardship and avoids unnecessary reliance on supplements unless clinically indicated.

Finally, individualized counseling offers a culturally adaptable, low-cost intervention

Received : 19 December 2025
Accepted : 22 May 2026
Publish : 17 Juni 2026

IJCNP : (Indonesian Journal of Clinical Nutrition Physician) 2026, 7:1 Hal 1 - 19

with cross-setting feasibility, including in low-resource environments where access to ONS or enteral therapy is limited. Given the widespread burden of gastrointestinal cancers, integrating dietitians into oncology teams may represent one of the most impactful supportive-care strategies available.

Strengths of the Review

A major strength of this systematic review is its tight methodological focus. By restricting inclusion to interventions based on individualized, protein-oriented counseling, it isolates the direct impact of tailored dietary strategies. In addition, full-text verification of each included study and careful comparison with predefined outcomes minimized misclassification and enhanced accuracy.

The inclusion of diverse outcomes, nutritional intake, biochemical parameters, muscle mass, strength, quality of life, and treatment tolerance, allowed for a comprehensive synthesis that extends beyond traditional markers such as body weight. This multidimensional lens reflects real-world oncology practice, where nutrition affects not only structural status but also functional resilience and the ability to sustain chemotherapy.

Limitations

Several limitations must be acknowledged. The eligible evidence base remains small, with only five interventional studies meeting inclusion criteria. Sample sizes were modest and often limited to single-center cohorts, reducing generalizability. Considerable heterogeneity existed across interventions, disease stages, and outcome definitions, complicating direct comparisons and precluding meta-analysis.

Only two studies reported CT-based skeletal muscle measurements, and only one assessed handgrip strength, limiting the strength of conclusions regarding functional capacity. Additionally, most included trials focused on colorectal cancer, leaving uncertainty regarding applicability to gastric or pancreatic malignancies, where metabolic derangements may be more severe.

Intervention fidelity was variably reported, and adherence to recommended protein intake was inconsistently measured. Furthermore, although individualized counseling appears effective, the optimal frequency, duration, and delivery mode of such interventions remain unclear.

Future Directions

Future research should aim to address these gaps by conducting multicenter randomized controlled trials with larger sample sizes and standardized nutrition protocols. Emerging

evidence suggests that multimodal strategies, combining individualized dietary counseling with resistance exercise, anti-inflammatory interventions, or targeted amino acid supplementation, may yield synergistic benefits.[19,20] These combined approaches should be rigorously tested, especially in populations at high risk of chemotherapy-induced sarcopenia.

It will also be important to evaluate digital or hybrid delivery models, such as telehealth, mobile apps, and remote monitoring, to enhance scalability and overcome logistical barriers, particularly in resource-limited settings. Additionally, studies should incorporate implementation science frameworks to understand real-world adoption and sustainability of individualized nutrition programs in oncology.

Finally, future trials should prioritize functional outcomes, including SMI, handgrip strength, gait speed, and patient-reported physical functioning, as these are increasingly recognized as independent predictors of survival and treatment success.[10] Together, such efforts will help clarify the role of individualized high-protein dietary counseling as a standard component of modern cancer care.

Conclusion

This systematic review indicates that individualized, protein-oriented dietary counseling during chemotherapy is associated with improved dietary intake, nutritional status, and patient-reported outcomes in adults with gastrointestinal cancers. While consistent benefits were observed for energy and protein adequacy and quality of life, preservation of skeletal muscle mass and functional strength was demonstrated primarily in settings involving early-stage disease and intensive, structured counseling interventions.

Importantly, the magnitude and consistency of benefit appear to be context-dependent, influenced by disease stage, inflammatory burden, and the frequency and intensity of dietary counseling. These findings support the early integration of individualized dietary counseling into routine oncology care as a component of supportive treatment, while underscoring that its effects should be interpreted as exploratory and hypothesis-generating rather than definitive. Further well-designed studies using standardized functional outcomes are needed to clarify optimal intervention strategies and to define how dietary counseling can be most effectively implemented across different clinical settings.

Received : 19 December 2025
Accepted : 22 May 2026
Publish : 17 Juni 2026

IJCNP : (Indonesian Journal of Clinical Nutrition Physician) 2026, 7:1 Hal 1 - 19

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Acknowledgement

N/A.

Competing Interest

The authors declare that there are no competing interests related to the study

Authors' Contribution

Author 1 – proposed and concepted the manuscript topic, and gave critical suggestions to the final draft.
Author 2 – edited and revised the manuscript.
Author 3 – drafted the original manuscript and critically revised the manuscript.
All authors have agreed with the final revisions of the manuscript and took parts in giving critical revision of the manuscript.

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Received : 19 December 2025
Accepted : 22 May 2026
Publish : 17 Juni 2026

IJCNP : (Indonesian Journal of Clinical Nutrition Physician) 2026, 7:1 Hal 1 - 19