Nutrición Hospitalaria

Efecto de una fórmula oral inmunomoduladora sobre la sarcopenia y la calidad de vida en pacientes ambulatorios con cáncer

Effect of an oral inmunoenhanced formula on sarcopenia and quality of life in ambulatory patients with cancer

10.20960/nh.05654

06/23/2025

OR 5654

Effect of an oral inmunoenhanced formula on sarcopenia and quality of life in ambulatory patients with cancer

Efecto de una fórmula oral inmunomoduladora sobre la sarcopenia y la calidad de vida en pacientes ambulatorios con cáncer

Daniel de Luis, David Primo, Olatz Izaola, Juan José López Gómez

Department of Endocrinology and Nutrition. Hospital Clínico Universitario & Centro de Investigación de Endocrinología y Nutrición. Facultad de Medicina. Universidad de Valladolid. Valladolid, Spain

Received: 29/11/2025
Accepted: 16/05/2025
Correspondence: Daniel de Luis Román. Servicio de Endocrinología y Nutrición. Hospital Clínico Universitario. Av. Ramón y Cajal, 3. 47003 Valladolid, Spain

Conflict of interest: The authors declare no conflict of interest.

Artificial intelligence: The authors declare that they did not use artificial intelligence (AI) or any AI-assisted technologies in the elaboration of the article

ABSTRACT

Background: cancer patients are a group of high risk of malnutrition and sarcopenia. Inmunoenhanced oral nutritional supplements (ONS) can improve this complex situation.

Objective: the objective of our study was to assess the effectiveness of an inmunoenhanced oral nutritional supplements (ONS) on

sarcopenia and quality of life (QoL) in ambulatory patients with cancer and malnutrition.

Material and methods: 158 ambulatory patients with cancer were recruited. A biochemical, anthropometric, impedance measurement, nutritional survey, muscle ultrasound and EQ5D quality of life test were performed before and after 12 weeks of intervention with 2 bricks per day of an immunoenhanced ONS.

Results: the mean age was 69.2 ± 10.9 years (n = 158). At baseline, 43.7 % were classified as severe malnutrition with GLIM criteria; following the intervention, 33.7 % were reclassified as severe malnutrition status (p = 0.013). After dietary intervention, handgrip strength (1.7 ± 0.3 kg; p = 0.02), proteins (0.7 ± 0.2 g/dL; p = 0.01), albumin levels (0.8 ± 0.2 g/dL; p = 0.03), skeletal muscle index (5.4 ± 0.1 kg/m^2; p = 0.01), appendicular skeletal mass (3.2 ± 0.3 kg/m^2; p = 0.02) and appendicular skeletal mass index (2.5 ± 0.3 kg/m^2; p = 0.01) improved. At the beginning of the study, 29.1 % of the patients presented according to the EWGSOP2 criteria, which decreased to 20.9 % after nutritional treatment (p = 0.01). The overall EQ-5D index score did not demonstrate a significant improvement following 12 weeks of supplementation. Analysis of the EQ-5D dimensions showed a significant improvement in the percentages ("no problems") ofmobility dimension and usual activities dimensions.

Conclusions: the use of an inmunoenhanced ONS in real-world life study with patients with cancer shows a beneficial effect on nutritional parameters, sarcopenia and quality of life.

Keywords: Quality of life. Cancer. Immunomodulatory formula. Sarcopenia.

RESUMEN

Antecedentes: los pacientes con cáncer son un grupo con alto riesgo de desnutrición y sarcopenia. Los suplementos nutricionales

orales (SON) con componentes inmunoestimulantes pueden mejorar esta compleja situación.

Objetivo: el objetivo de nuestro estudio fue evaluar la efectividad de un suplemento nutricional oral inmunoestimulante (SON) en la sarcopenia y la calidad de vida (QoL) de pacientes ambulatorios con cáncer y desnutrición en un entorno clínico real.

Material y métodos: se reclutaron 138 pacientes ambulatorios con cáncer y desnutrición que recibieron 2 envases de un ONS inmunoestimulante al día. Se realizaron evaluaciones bioquímicas, antropométricas, bioimpedancia, encuestas nutricionales, ecografía muscular y un test de calidad de vida EQ-5D antes y después de 12 semanas de intervención.

Resultados: se incluyó un total de 138 pacientes con una edad media de 69,2 ± 10,9 años. Al inicio del estudio, el 43,7 % fueron clasificados con desnutrición severa según los criterios de GLIM. Tras la intervención, el 33,7 % permanecieron en estado de desnutrición severa (p = 0,013). Después de la intervención dietética se observaron mejoras en la fuerza de prensión manual (1,7 ± 0,3 kg; p = 0,02), proteínas totales séricas (0,7 ± 0,2 g/dL; p = 0,01), niveles de albúmina (0,8 ± 0,2 g/dL; p = 0,03), índice de masa muscular (5,4 ± 0,1 kg/m²; p = 0,01), masa muscular apendicular (3.2 ± 0,3 kg/m²; p = 0,02) y índice de masa muscular apendicular (2,5 ± 0,3 kg/m²; p = 0,01). Al inicio, el 29,1 % de los pacientes presentaban sarcopenia, cifra que disminuyó al 20,9 % tras el tratamiento nutricional (p = 0,01). El índice global de EQ-5D no mostró una mejora significativa después de las 12 semanas de suplementación. Sin embargo, el análisis de las dimensiones del EQ-5D evidenció una mejora significativa en los porcentajes “sin problemas” de las dimensiones de movilidad y actividades habituales.

Conclusiones: el uso de un SON inmunoestimulante en un estudio de vida real de pacientes con cáncer muestra un efecto beneficioso en los parámetros nutricionales, la sarcopenia y la calidad de vida.

Palabras clave: Calidad de vida. Cáncer. Fórmula inmunomoduladora. Sarcopenia.

INTRODUCTION

Malnutrition is a common complication among patients with cancer, primarily due to the oncological process itself and the treatments administered, including radiotherapy, surgery, and/or chemotherapy (1). This condition is linked to elevated morbidity and mortality rates, an increased likelihood of complications (2), extended hospitalizations (3), suboptimal responses to the aforementioned adjuvant therapies (3), and a diminished quality of life (QoL) (4). Patients with cancer are consequently at an elevated risk of developing sarcopenia, a condition that worsens all the previously described outcomes (5). In sarcopenia there is a loss of muscle mass and functionality, the situation worsening when malnutrition is associated with an underlying inflammation pattern. (6). These metabolic disruptions are largely attributed to the overproduction of pro-inflammatory cytokines (7). Recently, novel formulations containing defined amounts of essential amino acids, omega-3 fatty acids, and nucleotides have been developed to enhance immune function. These formulations are commonly referred to as immunonutrition or pharmaconutrition, reflecting their pharmaceutical-like effects compared to standard nutritional support (8). The intricate interplay of inflammation, immune responses, and nutritional status observed in patients with cancer has prompted researchers to investigate whether specific nutrients, provided in supraphysiological doses as part of these defined nutrient combinations, could serve as substrates to modulate the inflammatory response and clinical outcomes (9).

Some studies in patients with cancer have demonstrated that nutritional counseling significantly enhances energy and protein intake, as well as quality of life (QoL) scores (10,11). The European

Society for Parenteral and Enteral Nutrition (ESPEN) guidelines (12,13) advocate for the use of inmunoenhanced formulas in patients with cancer and oral nutritional supplements (ONS) have shown efficacy in routine clinical practice (14). However, limited studies have specifically assessed the role of inmunoenhanced oral nutritional supplements (ONS) in ambulatory patients with cancer (15-17). Notably, no studies in the literature have investigated the impact of inmunoenhanced ONS on sarcopenia and QoL in outpatients with cancer (15).

The objective of our study was to assess the effectiveness of an inmunoenhanced oral nutritional supplements (ONS) on sarcopenia and quality of life (QoL) in ambulatory patients with cancer and malnutrition within a real-world clinical setting.

MATERIALS AND METHODS

Subjects

Data were prospectively collected over 12 weeks at a single hospital from ambulatory patients with cancer who were not receiving surgical treatment during the study period. The study included 138 patients with cancer and malnutrition. Malnutrition was evaluated with (Global Leadership Initiative on Malnutrition) (GLIM) criteria (18). Participation required providing written informed consent after reviewing the study protocol. Exclusion criteria included a formal contraindication for oral nutrition, a life expectancy of less than six months, planned surgical treatment within three months of the study, psychological conditions potentially interfering with product consumption, allergy or intolerance to any ingredient in the formula, or any condition that, in the investigator's judgment, could hinder the evaluation of the formula or pose an undue risk to the patient. The study was approved by the Clinical Trials Committee of HCUV (PI17-491), and all participants provided written informed consent before initiating the study protocol.

All patients received two daily bricks of Atempero® (Vegenat HealthCare, Badajoz, Spain). The composition of this ready-to-drink oral nutritional supplement (ONS) (200 ml per serving) is detailed in table I. It delivers an energy density of 1.5 kcal/ml and contains protein sourced from casein (8.3 g per 100 ml). The fat content (5 g per 100 ml) includes 1.6 g polyunsaturated fats, providing 399 mg of eicosapentaenoic acid (EPA) and docosohexaenoico (DHA) per 100 ml. Additionally, it contains 1.7 g of fiber, 200 mg of nucleotides and 1 g of arginine per 100 ml.

At baseline and 12 weeks post-intervention, the following variables were assessed: body weight, height, body mass index (BMI), malnutrition stage with GLIM criteria (18), sarcopenia status based on the European Working Group on Sarcopenia in Older People (EWGSOP2) criteria (19), nutritional biochemistry, bioimpedance analysis (BIA), a three-day dietary record, adverse effects related to the formula, compliance, and quality of life using the EuroQol-5D (EQ-5D) assessment tool (20).

Anthropometric, BIA, sarcopenia, ultrasound evaluation and analytical assessments

Body weight and height were measured for all patients using an Omron® device (Model, LA, CA), and BMI was calculated using the formula: body weight (kg) / height (m^2). Body composition was evaluated through bioimpedance analysis (Akern EFG, Pisa, Italy). Resistance and reactance were determined and the phase angle was calculated. Skeletal muscle mass (SM), skeletal muscle mass index (SMI), appendicular skeletal muscle mass (ASM) and appendicular skeletal muscle mass index (ASMI) were calculated. Sarcopenia assessment followed EWGSOP2 criteria to identify confirmed cases based on probable sarcopenia criteria plus abnormal (skeletal muscle index) SMI detected through BIA (< 7.0 kg/m^2 for men, and < 5.5 kg/m^2 for women) (19). Ultrasound assessments in the dominant leg of the unilateral right rectus femoris muscle (RF) and

vastus intermedius muscle (VI) were performed using a portable ultrasound system with a 4-10 cm linear probe (Midray Z60, Madrid, Spain). The measurements were taken on the anterior thigh region while the patient lay supine with extended and relaxed knees. The acquisition site was located two-thirds along the length of the femur, between the anterior superior iliac spine and upper edge of patella. The circumference (RFC), area (RFA), X-axis (X-RF) and Y-axis (YRF) of the rectus femoris (RF) were measured. Finally, handgrip strength was measured with the Jamar dynamometer (J. A. Preston Corporation, New York, NY, USA) on the dominant hand.

Fasting blood samples were collected at baseline and after 12 weeks of nutritional intervention to analyse glucose, sodium, potassium, creatinine, albumin, prealbumin, C reactive protein and transferrin levels using a Hitachi analyser (ATM, Mannheim, Germany).

Nutritional intervention, compliance and quality of life assessment

At baseline, patients were instructed to consume two bricks of the prescribed oral nutritional supplement (ONS) daily (composition detailed in Table I). To evaluate dietary intake, participants completed three-day dietary intake records (two weekdays and one weekend day) at baseline and 12 weeks. Total average energy and macronutrient intake were calculated using DietSource 3.0 software (Nestlé®, Switzerland) with reference to national food composition tables (21). Total dietary intake was determined by combining ONS consumption with spontaneous food intake, as recorded in the dietary diaries. Patients documented the number of ONS servings consumed daily to monitor adherence. Daily physical activity was recorded by each patient in a self-administered questionnaire, with a final sum of physical activity scores.

Adverse events (AEs) were tracked throughout the study using a daily log. Gastrointestinal symptoms potentially related to ONS

consumption, such as diarrhea, nausea, and vomiting, were recorded as binary outcomes.

The EQ-5D tool was administered at baseline and after 12 weeks. This validated, non-disease-specific, and standardized instrument assesses quality of life across five dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Each dimension is rated on three severity levels (no problems, some problems, extreme problems). These responses are converted into a single summary score (EQ-5D index) using predefined value sets (20), ranging from 1 (optimal health) to 0 (worst health state). The test also has a visual scale that goes from 0 (worst quality) to 100 (best quality).

Statistical analysis

The sample size calculation was based on an expected improvement in the sarcopenia rate of 5 %. This calculation determined a required sample size of $n = 130$, assuming a type I error (α\alpha) of < 0.05 and 80 % statistical power. Quantitative variables following a normal distribution were analysed using paired or unpaired two-tailed Student's t-tests. For non-parametric variables, the Wilcoxon signed-rank test was applied. Qualitative variables were assessed using the Chi-squared test, with Fisher's correction applied when expected cell counts were $n < 5$. All statistical analyses were conducted using SPSS version 23.0 (IBM, IL, USA), with results considered statistically significant at $p < 0.05$.

RESULTS

A total of 138 patients were enrolled in the study, with a mean age of 69.2 ± 10.9 years. The cohort comprised 59 (42.8 %) women and 79 (57.2 %) men. Cancer diagnoses were distributed across four primary sites: digestive tract (85 patients, 61.5 %), pancreas (17 patients, 12.3 %), head and neck (12 patients, 8.7 %), and other locations (24 patients, 17.5 %).

Anthropometric and biochemical variables

Weight loss in the 12 weeks prior to the start of nutritional treatment was 9.6 ± 3.5 kg compared to a variation of -0.3 ± 0.8 kg during treatment (p = 0.001); in percentage terms, the previous variation was -10.1 % compared to -0.2 % (p = 0.001) during nutritional treatment. At baseline, 43.7 % were classified as severe malnutrition with GLIM criteria, following the intervention, 33.7 % were reclassified as severe malnutrition status (p = 0.013). Table II outlines the changes in anthropometric and biochemical parameters following the nutritional intervention. No significant changes were detected in BMI, body weight and calf circumference. In contrast, handgrip strength revealed significant increases (1.7 ± 0.3 kg; p = 0.02). The only significant modification detected in the biochemical values was in total proteins levels (0.7 ± 0.2 g/dL; p = 0.01) and albumin levels (0.8 ± 0.2 g/dL; p = 0.03). The remaining biochemical parameters did not show statistically significant changes.

Table III shows the variables obtained by RF impedance and ultrasound. During this 12-week intervention, patients improved the levels of reactance (4.9 ± 0.1 ohm; p = 0.03), phase angle (0.3 ± 0.1°; p = 0.03), SMI (5.4 ± 0.1 kg/m^2; p = 0.01), ASM (3.2 ± 0.3 kg/m^2; p = 0.02) and ASMI (2.5 ± 0.3 kg/m^2; p = 0.01). Although all the ultrasound parameters increased, statistical significance was not reached. At the beginning of the study, 29.1 % of the patients presented sarcopenia according to the EWGSOP2 criteria, which decreased to 20.9 % after nutritional treatment (p = 0.01).

Dietary intake and tolerance

Table IV summarizes changes in dietary intake, assessed through a 3-day food diary, which included the two daily bricks of Atempero®. Following the nutritional intervention, significant increases were observed in energy intake (409.1 ± 22.1 cal/day; p = 0.02), carbohydrate intake (44.8 ± 10.1 g/day; p = 0.01), protein intake (21.0 ± 4.2 g/day; p = 0.02), total fat intake (7.3 ± 2.1 g/day; p =

0.02), and EPA+DHA intake (1539.4 ± 239.2 mg/day; $p = 0.001$). The macronutrient distribution as a percentage of total caloric intake remained stable after 12 weeks and physical activity, too.

The oral nutritional supplement (ONS) accounted for an average of 30.5 % of total caloric intake at 12 weeks, including 20.5 % of carbohydrate intake, 27.7 % of protein intake, and 24.2 % of fat intake. Compliance was robust, with all patients adhering to the protocol and consuming two servings of the supplement daily. The mean compliance rate was 83.4 % of the prescribed bricks over 12 weeks, corresponding to an average of 1.8 ± 0.3 bricks per day. Gastrointestinal tolerance was generally favourable, with nausea and vomiting reported in only 2 patients (1.3 %) and diarrhea in 6 patients (3.8 %) during the treatment period. No patients discontinued the intervention due to intolerance.

Quality of life

The overall EQ-5D index score did not demonstrate a significant improvement following 12 weeks of supplementation (0.83 ± 0.31 at baseline vs. 0.85 ± 0.13 post-intervention; $p = 0.28$). The test also has a visual scale that reported similar scores (60.6 ± 9.31 at baseline vs. 64.2 ± 8.1 post-intervention; $p = 0.31$). Analysis of the five EQ-5D dimensions showed a significant higher proportion of patients reporting "no problems" after the oral nutritional supplement (ONS) intervention, in mobility dimension**:** 80.7 % at baseline increased to 93.6 % at three months ($p = 0.03$) and usual activities: 82.2 % at baseline improved to 92.3 % at three months ($p = 0.04$). The remaining areas (pain or discomfort (77.0 % vs 73.1 %), anxiety or depression (67.9 % vs 61.5 %) and self-care (89.3 % vs 94.4 %) improve during dietary intervention but without reaching a significant level.

DISCUSSION

Our study highlights that ambulatory patient's supplementation with an immunoenhanced oral nutritional supplement (ONS) over 12 weeks improves serum visceral protein levels, nutritional status, sarcopenia and some dimensions of quality of life (QoL).

Malnutrition and immunosuppression are significant challenges in patients with cancer. Existing evidence indicates that enteral nutrition enriched with omega-3 fatty acids, arginine, and other immunonutrients can reduce postoperative complications (22).

However, most research focuses on total tube feeding, with limited data on ambulatory cancer patients using this type of ONS (15-17). As our study, real-world evidence studies, which capture data from routine clinical practice rather than controlled settings, provide valuable insights into treatment outcomes and patient with cancer care (23). These designs without a placebo arm, as opposed to randomized clinical trials, are more pragmatic, especially in patient populations with problems in dietary adherence, such as cancer patients.

Our findings indicate that immunoenhanced ONS increased serum protein concentrations and promoting significant body weight stabilization, stopping the previous weight loss that was present before the supplementation. Our results are consistent with studies in pancreatic cancer patients, where omega-3 fatty acids intake of approximately 2 g/day was linked to body weight maintenance and lean mass gain (24). In our study, patients consumed an average of 1.8 g of EPA+DHA per day. Similarly, research on head and neck cancer patients demonstrated improved protein levels without significant body weight changes with omega-3-enriched supplementation (25). Additionally, patients in our study achieved significant increases in caloric and macronutrient intake, accompanied by high compliance rates of ONS intake in this real-world setting. This contrasts with some clinical trials where immunoenhanced ONS did not significantly enhance intake, often due to appetite suppression caused by concurrent treatments like

chemotherapy (26). However, data in the literature are contradictory, including those involving radiotherapy, have reported increased intake during ONS interventions (10).

In our study, the reduction of patients diagnosed with sarcopenia (19) was striking, in relation to the increase in muscle mass detected by impedance measurement, and the increase in strength by dynamometry, without relevant findings with the ultrasound of the rectus femoris muscle. Omega 3 supplementation might produce benefit for muscle mass and strength through different mechanisms such as; anabolic effect on muscle protein, anti-catabolic effect on muscle protein, modulation of mitochondrial functioning, motor and neuroprotective neuron excitability properties and decrease of insulin resistance (27,28). While the proposed benefits of omega-3 PUFA supplementation in managing sarcopenia are encouraging, evidence from randomized controlled trials (RCTs) remains inconsistent (29). This variability may be attributed to two key factors. First, the effectiveness of fish oil supplements in addressing sarcopenia appears to depend on the dosage used, with different doses in clinical trials (29). Second, the inclusion of a placebo in study designs may influence outcomes due to the potential placebo effect commonly observed in nutritional clinical trials. In our work it is also necessary to take into account that the immunogenic formula had, in addition to omega 3, other immunonutrients, such as arginine and nucleotides. Arginine is a non-essential amino acid that becomes essential in stress situations. It is an important amino acid for immune cells, and a precursor of nitric oxide and hydroxyproline, playing a relevant role in repair processes (30). Nucleotides are compounds derived from pyrimidine or purine. These molecules intervene in the immune system, tissue differentiation and growth (31), too. Both molecules may play a relevant role in muscle health (30,31).

Finally, the improvement in some dimensions of quality of life (mobility and usual activities), found in our study, may be related to this increase in muscle mass and its functionality. Quality of life is a

multidimensional construct influenced by physical and psychological factors, closely tied to nutritional status (32). High adherence to ONS likely played a key role in these outcomes, as compliance is critical to achieving therapeutic benefits. Conversely, better health status and QoL may enhance patient motivation for continued adherence, creating a reinforcing positive cycle.

This study has several limitations. First, the intervention was relatively short (12 weeks), and the patient population was heterogeneous in terms of cancer locations. Second, the lack of a control group prevents definitive attribution of observed benefits solely to the inmmunoenhanced ONS. Additionally, nutritional intake was assessed using subjective 3-day dietary records, which may introduce reporting bias. Despite these limitations, this study demonstrates the efficacy, tolerability, and high compliance of inmmunoenhanced ONS in improving sarcopenia, QoL and nutritional parameters, supporting its applicability in routine clinical practice. Finally, the use of different techniques to determine muscle mass, such as calf circumference, raw electrical data from BIA, muscle mass data from BIA, and ultrasound of the rectus femoris muscle, allows us to have objective data on this improvement in sarcopenia and also to show how some techniques are not able to detect the improvement in muscle mass in these patients.

In conclusion, the use of an inmmunoenhanced ONS in ambulatory patients with cancer, evaluated within a real-world context, yields substantial improvements in nutritional status, sarcopenia and QoL. Further research is warranted to explore the impact of this type of ONS across diverse cancer populations, focusing on both nutritional and QoL outcomes.

REFERENCES

1. McGough C, Baldwin C, Frost G, Andreyev HJN. Role of nutritional intervention in patients treated with radiotherapy for

pelvic malignancy. Br J Cancer 2004;90:2278-87. DOI: 10.1038/sj.bjc.6601868

2. Correia MI, Waitzberg DL. The impact of malnutrition on morbidity, mortality, length of hospital stay and costs evaluated through a multivariate model analysis. Clin Nutr 2003;22:235-9. DOI: 10.1016/s0261-5614(02)00215-7
3. Naber THJ, Schermer T, Bree A, Nusteling K, Eggink L, Kruimel JW, et al. Prevalence of malnutrition in nonsurgical hospitalized patients and its association with disease complications. Am J Clin Nutr 1997;66:1232-9. DOI: 10.1093/ajcn/66.5.1232
4. Schattner M, Shike M. Nutrition support of the patient with cancer. In: Shils ME, et al. (eds). Modern nutrition in health and disease. 10th ed. Philadelphia: Lippincott Williams & Wilkins; 2005. *p*. 1290-313.
5. Wang CC, Liu HC, Lin WL, Wu LM, Guo HR, Huang SC, et al. Osteosarcopenia in patients with cancer: A systematic review and meta-analysis. Medicine (Baltimore) 2024;103(45):e40476. DOI: 10.1097/MD.0000000000040476
6. Evans MJ, Morley JE, Argilés J, Bales C, Baracos V, Guttridge D, et al. Cachexia: a new definition. Clin Nutr 2008;27:793-9. DOI: 10.1016/j.clnu.2008.06.013
7. Barber MD, Ross JA, Fearon KC. Cancer cachexia. Surg Oncol 1999;8:133-41. DOI: 10.1016/s0960-7404(99)00045-6
8. Dupertuis YM, Meguid MM, Pichard C. Advancing from immunonutrition to a pharmaconutrition: a gigantic challenge. Curr Opin Clin Nutr Metab Care 2009;12(4):398-403. DOI: 10.1097/MCO.0b013e32832c4ce1
9. Kreymann KG. Early nutrition support in critical care: a European perspective. Curr Opin Clin Nutr Metab Care 2008;11:156-9. DOI: 10.1097/MCO.0b013e3282f44c41
10. Ravasco P, Monteiro-Grillo I, Marques Vidal P, Camilo ME. Dietary counseling improves patient outcomes: a prospective, randomized, controlled trial in colorectal cancer patients

undergoing radiotherapy. J Clin Oncol 2005;23:1431-8. DOI: 10.1200/JCO.2005.02.054

11. Izaola O, Primo D, López JJ, Torres B, Gómez Hoyos E, de Luis DA. Estudio en vida real de un suplemento oral enriquecido con ácidos grasos ω-3 en pacientes ambulatorios oncológicos: efecto sobre la calidad de vida y los parámetros nutricionales [Real-world study in oncological outpatients of an oral supplement enriched with ω-3 fatty acids - effect on quality of life and nutritional parameters]. Nutr Hosp 2021;38:1132-7. DOI: 10.20960/nh.03514
12. Arends J, Bachmann P, Baracos V, Barthelemy N, Bertz H, Bozzetti F, et al. ESPEN guidelines on nutrition in cancer patients. Clin Nutr 2017;36(1):11-48. DOI: 10.1016/j.clnu.2016.07.015
13. Weimann A, Braga M, Carli F, Higashiguchi T, Hübner M, Klek S, et al. ESPEN guideline: Clinical nutrition in surgery. Clin Nutr 2017;36(3):623-50. DOI: 10.1016/j.clnu.2017.02.013
14. Stratton RJ, Elia M. Encouraging appropriate, evidence based use of oral nutritional supplement. Proc Nutr Soc 2010;69:477-87. DOI: 10.1017/S0029665110001977
15. de Luis DA, de la Fuente B, Izaola O, Martin T, Cuellar L, Terroba MC. Clinical effects of a hypercaloric and hyperproteic oral suplemment enhanced with W3 fatty acids and dietary fiber in postsurgical ambulatory head and neck cancer patients. Nutr Hosp 2014;31:759-63. DOI: 10.3305/nh.2015.31.2.8481
16. de Luis DA, Izaola O, Cuellar L, Terroba MC, Ventosa M, Martin T, et al. Clinical effects of a w3 enhanced powdered nutritional formula in postsurgical ambulatory head and neck cancer patients. Nutr Hosp 2013;28:1463-7. DOI: 10.3305/nh.2013.28.5.6662
17. de Luis DA, Izaola O, Aller R, González-Sagrado M, Cuellar L, Terroba MC, et al. Influence of a W3 fatty acids oral enhanced formula in clinical and biochemical parameters of head and

neck cancer ambulatory patients. An Med Interna 2008;25:275-8.

18. Cederholm T, Jensen GL, Correia MITD, Gonzalez MC, Fukushima R, Higashiguchi T, et al. GLIM Criteria for the Diagnosis of Malnutrition—A Consensus Report from the Global Clinical Nutrition Community. Clin Nutr 2019;38:1-9. DOI: 10.1016/j.clnu.2018.08.002
19. Cruz-Jentoft AJ, Bahat G, Bauer J, Boirie Y, Bruyère O, Cederholm T, et al. Sarcopenia: Revised European Consensus on Definition and Diagnosis. Age Ageing 2019;48:16-31. DOI: 10.1093/ageing/afz046
20. Balestroni G, Bertolotti G. L'EuroQol-5D (EQ-5D): uno strumento per la misura della qualità della vita [EuroQol-5D (EQ-5D): an instrument for measuring quality of life]. Monaldi Arch Chest Dis 2012;78:155-9. DOI: 10.4081/monaldi.2012.121
21. Mataix J, Mañas M. Tablas de composición de alimentos españoles. Ed: University of Granada; 2003.
22. Stableforth WD, Thomas S, Lewis SJ. A systematic review of the tole of immunonutrition in patients undergoing surgery for head and neck cancer. Int J Oral Maxillofac Surg 2009;38:103-10. DOI: 10.1016/j.ijom.2008.12.008
23. Pedrazzoli P, Caccialanza R, Cotogni P, Degli Esposti L, Perrone V, Sangiorgi D, et al. The Advantages of Clinical Nutrition Use in Oncologic Patients in Italy: Real World Insights. Healthcare (Basel) 2020;8:125. DOI: 10.3390/healthcare8020125
24. Wigmore SJ, Ross JA, Falconer JS. The effect of polyunsaturated fatty acids. Nutrition 1996;12(suppl):27-30. DOI: 10.1016/j.endoen.2015.08.003
25. Izaola O, de Luis DA, Cuellar L, Terroba MC, Ventosa M, Martin T, et al. Influence of an immuno-enhanced formula in postsurgical ambulatory patients with head and neck cancer. Nutr Hosp 2010;25:793-6.

26. Poulsen GM, Pedersen LL, Østerlind K, Bæksgaard L, Andersen JR. Randomized trial of the effects of individual nutritional counseling in cancer patients. Clin Nutr 2014;33:749-53. DOI: 10.1016/j.clnu.2013.10.019
27. Yoshino J, Smith GI, Kelly SC, Julliand S, Reeds DN, Mittendorfer B. Effect of dietary *n*-3 PUFA supplementation on the muscle transcriptome in older adults. Physiol Rep 2016;4(11):e12785. DOI: 10.14814/phy2.12785
28. Lim SN, Huang W, Hall JC, Ward RE, Priestley JV, Michael-Titus AT. The acute administration of eicosapentaenoic acid is neuroprotective after spinal cord compression injury in rats. Prostaglandins Leukot Ess Fat Acids 2010;83:193-201. DOI: 10.1016/j.plefa.2010.08.003
29. Tseng PT, Zeng BY, Zeng BS, Liao YC, Stubbs B, Kuo JS, et al. Omega-3 polyunsaturated fatty acids in sarcopenia management: A network meta-analysis of randomized controlled trials. Ageing Res Rev 2023;90:102014. DOI: 10.1016/j.arr.2023.102014
30. Gerlach AT, Murphy C. An update on nutrition support in the critically ill. J Pharm Pract 2011;24:70-7. DOI: 10.1177/0897190010388142
31. Osland E, Hossain MB, Khan S, Memon MA. Effect of timing of pharmaconutrition (immunonutrition) administration on outcomes of elective surgery for gastrointestinal malignancies: a systematic review and meta-analysis. JPEN J Parenter Enter Nutr 2014;38:53-69. DOI: 10.1177/0148607112474825
32. Hernández-Galiot A, Goñi I. Quality of life and risk of malnutrition in a home-dwelling population over 75 years old. Nutrition 2017;35:81-6. DOI: 10.1016/j.nut.2016.10.013

Table I. Nutritional composition of Atempero®, each brick 200 ml

		100 ml
Energy	kcal	163
	kJ	675
Protein	g	9.0
Carbohidrates	g	19.1
Sugars	g	13.6
Fats	g	5.30
Saturate	g	1.2
Monounsaturate	g	2.3
Polyunsaturate	g	1.6
EPA + DHA	mg	399
L-arginine	g	1.0
Nucleotides	mg	200
Fiber	g	0.27

Nutricion Hospitalaria

Table II. Clasical anthropometric parameters and biochemical values

Parameters	**Basal**	**12 weeks**	***p***
Body weight (kg)	62.9 ± 3.1	61.8 ± 1.3	0.15
BMI (kg/m^2)	23.4 ± 1.3	23.2 ± 1.4	0.28
Calf circumference (cm)	32.7 ± 4.1	32.6 ± 3.2	0.19
Handgrip strength (kg)	23.1 ± 4.0	24.8 ± 3.1	0.02
Glucose (mg/dl)	98.2 ± 11.1	95.5 ± 9.3	0.37
Creatinin (mg/dl)	0.7 ± 0.2	0.8 ± 0.4	0.32
Sodium (mEq/L)	137.6 ± 3.2	139.1 ± 4.0	0.21
Potassium (mEq/L)	4.2 ± 0.4	4.3 ± 0.1	0.36
Total proteins (g/dl)	6.1 ± 0.4	6.8 ± 0.2*	0.01
Prealbumin (mg/dl)	21.7 ± 3.2	22.5 ± 3.1	0.19
Transferrin (mg/dl)	227.9 ± 34.1	234.6 ± 27.2*	0.12
Albumin (g/dl)	3.4 ± 0.3	4.2 ± 0.4*	0.03
C-reactive protein (mg/dl)	13.7 ± 3.3	12.4 ± 5.4	0.48

Table III. Bioimpedance and rectus femoris ultrasound parameters

Parameters	**BASAL**	**12 weeks**	***p***
Resistance (ohm)	576.2 ± 96.1	570.8 ± 81.3	0.25
Reactance (ohm)	48.0 ± 2.3	52.7 ± 1.4*	0.03
Phase angle (°)	4.7 ± 0.3	5.0 ± 0.2*	0.03
SM (kg)	20.2 ± 4.0	23.6 ± 1.2	0.06
SMI (kg/m^2)	8.8 ± 3.1	14.2 ± 2.3*	0.01
ASM (kg)	8.9 ± 3.0	13.1 ± 2.4*	0.02
ASMI (kg/m^2)	11.4 ± 3.2	13.9 ± 4.0*	0.01
Fat mass (kg)	16.9 ± 2.1	16.0 ± 3.0	0.41
RFC (cm)	8.4 ± 1.4	8.6 ± 1.1	0.36
RFA (cm^2)	3.2 ± 0.2	3.3 ± 0.3	0.38
RFAI (cm^2/m^2)	1.2 ± 0.4	1.3 ± 0.3	0.21
X-RF (cm)	0.70 ± 0.1	0.71 ± 0.2	0.22
Y-RF (cm)	1.07 ± 0.2	1.08 ± 0.3	0.43

SM: skeletal muscle mass; SMI: skeletal muscle mass index; ASM: appendicular skeletal muscle mass; ASMI: appendicular skeletal muscle mass index; RFC: rectus femoris circumference; RFA: rectus femoris area; RFAI: rectus femoris area index. *$p < 0.05$.

Table IV. Dietary intake with diet and ONS

Parameters	**BASAL**	**12 weeks**	***p***
Calories (cal/day)	1496.7 ± 413.9	1838.4 ± 412.1*	0.02
Carbohydrates (g/day)	160.2 ± 39.0	204.5 ± 42.3*	0.01
% Carbohydrates in TCV	44.1 %	45.4 %	0.53
Proteins (g/day)	65.6 ± 14.1	86.5 ± 13.2*	0.02
% Proteins in TCV	17.7 %	20.3 %	0.21
Fats (g/day)	61.1 ± 10.1	68.4 ± 5.2*	0.02
% Fats in TCV	38.2 %	35.3 %	0.38
Fiber (g/day)	13.1 ± 4.2	16.7 ± 5.0	0.40
EPA + DHA (mg/day)	240.4 ± 28.1	1789.7 ± 99.6	0.001
Minutes exercise per day	54.8 ± 8.1	61.3 ± 6.6	0.31

TCV: total caloric value. *$p < 0.05$.

Nutrición Hospitalaria