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The effect of combined lifestyle intervention among long term care facilities: A systematic review

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ABSTRACT

The purpose of this research: Population aging is one of the most significant demographic phenomena of the 21st century. It has led to a growing number of older adults requiring long-term care (LTC), which poses significant challenges for healthcare systems worldwide. Lifestyle medicine is a promising strategy for improving health outcomes and quality of life among institutionalised older adults. Principal results: This systematic review aimed to evaluate the effects of combined lifestyle interventions, including physical exercise and nutrition, implemented in LTC facilities. Based on PRISMA guidelines, the PubMed and Scopus databases were searched up to December 2024. Studies including adults aged ≥65 years living in LTC facilities and receiving multidomain lifestyle interventions were selected. Out of 3,093 records, seven studies met the inclusion criteria. The interventions typically combined resistance, balance or multicomponent exercise programmes with nutritional supplementation or education and lasted from seven to 26 weeks. Most studies demonstrated improvements in physical functionality (e.g. gait speed, strength and balance), while results regarding quality of life were inconsistent. Nutritional status improved when protein- and energy-enriched supplements were included. Despite the overall positive findings, heterogeneity in study design, intervention duration and outcome assessment limits comparability. Major conclusion: While evidence suggests that combined lifestyle interventions are feasible and beneficial in long-term care (LTC) settings, further high-quality, standardised and long-term studies are needed to confirm their effectiveness and sustainability.

Introduction

Population aging is one of the most significant demographic phenomena of the 21st century, with profound implications for healthcare systems worldwide. According to the World Health Organization (WHO), the proportion of the global population aged over 60 is expected to nearly double, between 2015 and 2050.[1] In detail, as of January 1, 2023, more than one-fifth (21.3%) of the European population was aged 65 years or older (Eurostat-Population structure and ageing).[2] Life expectancy now averages 72.3 years worldwide and exceeds 80 years in countries with advanced healthcare systems.[3]

While increased longevity represents a public health success, it comes with a rise in the prevalence of chronic diseases among the elderly population, often exacerbated by sedentary lifestyles and medication dependency. This trend leads to a greater demand for long-term care (LTC) services.[4] Studies conducted in high-income countries highlight a wide variety of approaches to LTC, differing in the mix between formal and informal services, the extent of government involvement, and the overall scale of care provided.[5] This demographic shift presents significant challenges for healthcare providers and policymakers, requiring the adaptation of healthcare services to meet the evolving needs of the aging population. Socioeconomically, older adults face rising demands for social welfare, greater demand for institutional care, and changes in pension systems, all of which can strain financial resources and limit access to necessary support as they age.[6] However, the organization and financing of LTC are heterogeneous across countries. In many European countries, long-term care is primarily supported through public or mixed public–private systems.[7,8] In contrast, in the United States, LTC including assisted living, nursing homes, and Continuing Care

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Retirement Communities are largely financed through private resources and patient payments, with limited public coverage restricted mainly to means-tested programs such as Medicaid.[9]

Long term care facilities, already burdened by limited resources and decreasing public funding, struggle to provide optimal care. As a result, people residing in these facilities often experience a suboptimal quality of life, characterized by accelerated functional and cognitive decline.[10] As underlined by the European Commission, LTC for elder subjects should be structured under a person-centered approach and focused on the prevention of health deterioration, rather than simply providing supportive care.[11] Lifestyle medicine focused on a holistic approach to patient care through evidence-based lifestyle interventions. Unlike conventional medicine, lifestyle medicine aims not only to manage chronic conditions but also to prevent complications, particularly in LTC settings, while promoting health equity through cost-effective strategies.[12] Despite its rapid global growth, the field still faces significant barriers, including limited awareness and education, institutional resistance, lack of integration into traditional healthcare systems, insufficient resources and time, and cultural or socioeconomic challenges.[13]

Lifestyle medicine provides a valuable approach to addressing these challenges by emphasising the prevention and treatment, through evidence-based lifestyle interventions, such as a healthy diet and regular physical activity.[14] By promoting healthy diet and correct life styles, lifestyle medicine can help older adults to maintain their physical and cognitive functions, to prevent or delay the onset of chronic diseases, and to reduce the strain on healthcare systems.[15] Furthermore, adopting lifestyle medicine strategies can significantly reduce health-related costs and support the transition to more sustainable healthcare models.[16,17] A recent study published in The Lancet Public Health[18] confirms that adopting a healthy lifestyle is associated with a significantly reduced risk of developing chronic diseases as well as lower overall mortality. This translates not only into longer life expectancy but also a greater number of years lived in good health, free from the impact of these disabling conditions.

However, this knowledge base is almost referred to the general older population. Although it has been pointed out that lifestyle medicine interventions could be beneficial also for older people living in LTC facilities,[10] this population present differences in terms of needs, capabilities, and available resources.[19,20] Despite it is widely recognized that physical activity or adequate nutrition are effective interventions for improving the quality of life in frail, institutionalized older adults,[21,22] most of the studies focuses on single-component interventions. In contrast, an approach in line with lifestyle medicine principles (i.e., combining different interventions and strategies) has been found effective also for this population in improving various aspects of health.[10] These interventions have been shown to enhance body composition, cognitive function,[23] mobility,[24] and quality of life[25] among older adults living in community settings. However, evidence-based studies evaluating the effectiveness of such approaches in LTC settings are limited. An additional limitation of studies on LTC is the insufficient analysis of the characteristics and components of the interventions themselves. Specifically, there is a lack of clarity regarding the scales and tools employed to measure the effectiveness of the interventions, as well as the specific features of the intervention components.[10]

To the best of the authors' knowledge, no systematic review has yet summarized the evidence on lifestyle medicine interventions that combine physical activity and a healthy diet in long-term care settings. To address this gap, through the analysis of existing literature, we conducted a systematic review aimed at providing a comprehensive overview of the characteristics of combined interventions and the outcomes measured, with a particular focus on the tools and scales used. Our systematic review tries to answer to the following research questions: What is the effectiveness of combined nutrition-physical exercise (I; Intervention) interventions for older subjects living in long term care facilities (P; population) in improving quality of life and functionality (O; outcome).

Materials and Methods

Search strategy

We conducted a systematic review of literature according to the Recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement (PRISMA).[26] The search was performed on PubMed, Embase and Scopus databases on 30/12/2024. The review protocol is registered on PROSPERO (ID CRD42023389235). The full search strings are available in the Supplementary Material. We included studies published in English or Italian describing programs including at least physical exercise and nutritional intervention. Furthermore, we considered only interventions performed on people aged 65 years and older living in long-term care facilities. Moreover, we included published peer-reviewed original research studies, quasi-experimental study, RCT, observational, and qualitative studies while we excluded secondary research (e.g., reviews), as well as opinion papers. Our PICO criteria were as follow: Population older people (namely, people aged 65 years or older) living in long-term care or nursing home facilities, Intervention/Exposure: lifestyle medicine intervention combining (at least) one nutritional and one physical exercise interventions, Comparison: care-as-usual, placebo, or another intervention, Outcome: Improvements in quality of life and functionality (e.g., autonomy) in subjects exposed to the intervention.

Data extraction, analysis, and synthesis

Extracted information was entered on a Microsoft Excel database; two researchers (GO, QF) independently screened the articles to assess studies' eligibility for inclusion starting from titles and abstracts. In the second stage, two reviewers (A.C. and B.T) independently reviewed full texts of studies, excluding records not relevant to our research question, and then they extracted the data. Inconsistencies were resolved after a discussion involving the whole research team. In case of disagreements, a third reviewer (A.M.) cast the deciding vote. Gathered information was organized, and subsequently analyzed. The following data was extracted: author, year of publication, study design, county of the study, sample characteristics (includes, age, gender, and number of participants), type of exercise and nutrition intervention, outcomes and main results.

Given the heterogeneity of study designs (quantitative, qualitative, and mixed-methods), a narrative synthesis approach was used. We summarized the qualitative findings in both table and narrative texts, complemented by a description to illustrate key observations. Where available, quantitative data (such as means, ranges, and percentages) were also reported. Data from qualitative studies were extracted using predefined categories based on key themes and categories that aligned with our research question. If necessary we contacted investigators and relevant study authors, seeking information about unpublished or incomplete studies.

Quality appraisal

The quality appraisal was performed using the Joanna Briggs Institute (JBI) Critical Appraisal Checklists[27] based on different study designs. The JBI checklist score was as follows: "Yes" with 1 point, "No" and "Unclear" with 0 points. Decisions regarding methodological quality of the studies included were made, independently, by two reviewers, and any disagreement was resolved by research team discussion. The sum of the points was classified as the percentage of the

items present, considering the recommendations of the authors Camp and Legge.[28] Thus, a score lower than 70% was classified as low quality, between 70 and 79% of the checklist criteria was classified as medium high quality, between 80 and 90% was assigned high quality, and a score greater than 90% of the criteria was classified as excellent quality.

Results

A total of 3093 records were retrieved. After duplicates removal, 2937 titles and abstracts were screened, and 2740 excluded. Therefore, 197 full-texts were assessed, and a total of 7 studies were included in our review.[10,21,29–33] The PRISMA flowchart is shown in Fig. 1. Details of the included studies are available in Table 1.

Of the included studies, four were randomized controlled trials[10,29–31] and three adopted a quasi-experimental design.[21,32,33] Six studies were conducted in Europe (two in Spain and one in Portugal, Austria, Sweden, Poland, respectively) and one in South Korea. Two studies included participants from assisted living residences belonging to both the public or the private sector.[21,32] One study was conducted in low-intensity care facilities, such as a residential home in South Korea[33] and five senior residences spread across Vienna's metropolitan area, Austria.[30] The last study investigated the population residing in nursing homes in Poland.[29] Interventions lasted from seven to 26 weeks, and were described as generally well tolerated by participants. Interventions' components are shown in Table 2.

Participants

Study samples ranged from 54 to 101 subjects, with a median of 91. Two studies restricted their sample to frail or pre-frail individuals aged 70 years and older, capable of performing the up and go test in less than 50 seconds or capable of walking for at least 50m.[21,32] All the participants were also selected depending on their ability to perform any degree of physical exercise voluntarily and or to be mentally and physically able to participate in the lifestyle intervention program.[21,32] Intervention populations also included a residential home hosting cognitively aware elderly women aged 65 years and older, and a nursing home with overweight patients aged 60-95 years old.[30,33]

Physical exercise

The total frequency of physical activity across studies ranged from two up to seven times per week. The mean session duration was 45 minutes. The type of the physical activity implemented in the included studies was structured exercises session and included resistance training,[30] balance and flexibility programs,[21] multicomponent exercise,[10,32] and dance.[33] One study only specified the type of exercise (i.e., sit to stand exercises), despite it did not disclose the exercise frequency.[31] In the study conducted by Zak et[29] all three different exercise modalities were compared: structured exercise sessions, standard exercise and progressive resistance exercise. In the majority of the included studies the exercise session was managed by a professional. Franzke et al involved a sport scientist while[10,21,29] and Grönstedt et al.[31] involved a physiotherapist. The dance intervention conducted by Kim et al. involved an expert in this discipline. Finally,[32] mentioned a supervised exercises plan without specifying the professionist involved.

Nutritional intervention

Nutritional interventions ranged from dietary awareness and education initiative[33] to oral supplementation with liquid preparation of macronutrients or calorie-dense beverages.[21,29–32]

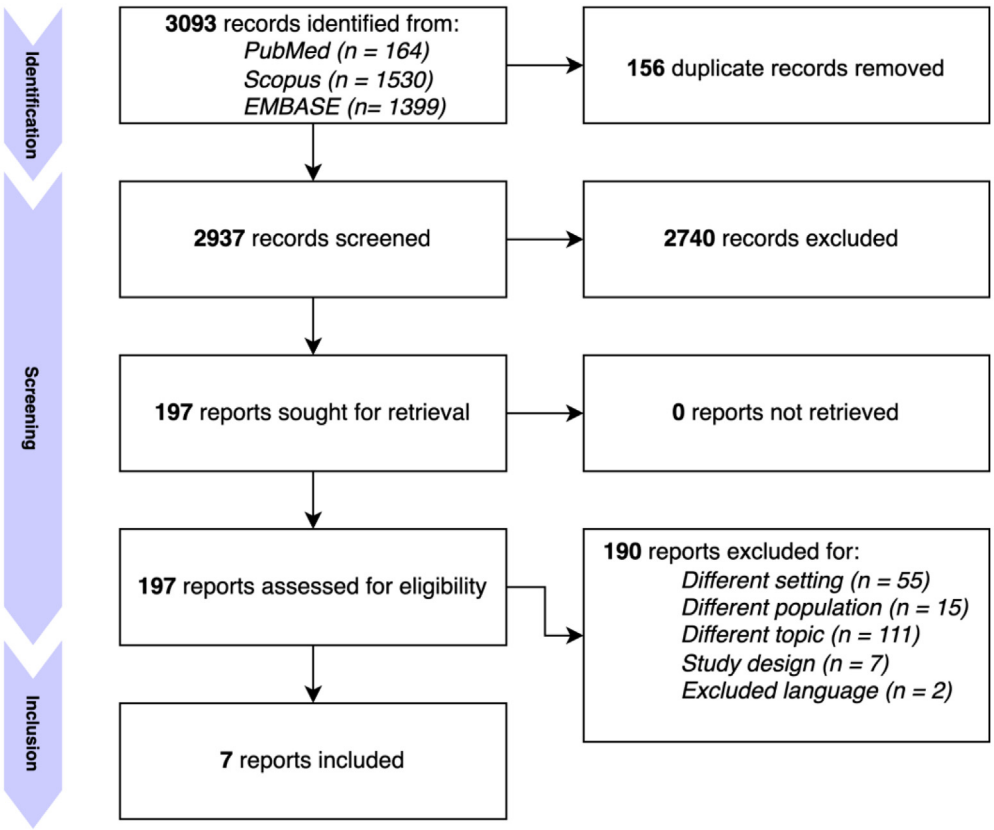

Fig. 1. PRISMA Flowchart.

Table 1
Characteristics of the included studies.

Study	Study design	Country	Sample size (N)	Participants' characteristics (mean age, % females)	Duration (weeks)
[21]	QE	Spain	91	85.6±5.6, 70.3%	12
[32]	QE	Portugal	35	EG1 (N=8): 80±6.1, N/A EG2 (N=7): 86.7±4, N/A EG3 (N=7): 84.2±5.8, N/A CG (N=13): 83.1±5.4, N/A	16
[10]	RCT	Italy	54	EG (N=27): 84.9± 7.9, 81.5 CG (N=27): 83.26± 9.10, 63.0	13
[30]	RCT	Austria	97	Age 83.0±6.1, Female 86.6% RTG:35, Age 82.8±5.7 RTSG:29, Age 82.5±7.5 CTG:33, Age 83.5±5.4	26
[31]	RCT	Sweden	120	EG (N= 52): 85.8±5.0, 65.0 CG (N=50): 85.9±5.4, 58.0	12
[33]	QE	South Korea	64	N:64, Age 76.4±6.2, Female 100%	10
[29]	RCT	Poland	91	N:80 G1:19, Age 78.1±7.6, 84% Female G2:21, Age 79.2±9.2, 81/ Female G3:19, Age 78.3±6.8, 74% female G4:21, Age 81.1±6.4. 81% female	7

QE: quasi-experimental; RCT: randomized controlled trial; EG: experimental group; CG: control group.

Only the study conducted by Conti et al.[10] structured a supervised nutritional program with specific grams of each macronutrients during meals. To ensure a controlled food intake, both participants and their families were asked to avoid any food supplementation. In addition, as a routine procedure of the facility, relatives are asked to report to healthcare workers any additional food brought from outside, and the workers must report such events in the individual patient report.

Interventions that focused on dietary supplementation by using nutritional drinks all ranged between 300-600 kCal[21,29–31] per day distributed across different macronutrients categories. Most of these liquid supplements had a composition that included proteins, carbohydrates, polyunsaturated fatty acids, and fibers in different but somewhat similar proportions, as well as different micronutrients including vitamins and minerals. Only Cado-Silva et al. study explored the administration of exclusively branched-chain aminoacids (BCAAs) associated with physical exercise, specifically a mixture composed of L-leucine, L-isoleucine, and L-valine in the proportion of 2:1:1. 200mL was administered to each subject before exercise.[32] Only one study did not actively supplemented the diet of the participants but implemented a nutritional education with food diaries, portion control, teaching participants about food labels and calories, meal planning, increasing intake of fruits, vegetables, and water while decreasing consumption of calorie dense foods.[33]

Among the included studies, only Kim et al.[33] involved a dietician and Caldo-Silva et al designed the nutritional intervention with a nutritionist; the other study did not mention a specific supervision for the nutritional intervention.

Measured outcomes

Measured outcomes are shown in Table 3. Among the seven included studies, six considered physical functionality outcomes.[10,21,29–32] In terms of physical performance assessment, most studies employed standardized and validated tools. The 30-Second Chair Stand Test[34] was used to evaluate lower body strength and endurance,[31] while the Short Physical Performance Battery (SPPB)[35] served as a multidimensional measure of functional capacity, capturing balance, gait speed, and repeated chair stands.[21] Fitness assessments scale, although not always fully detailed, were employed to track improvements in muscle strength and general physical capacity.[29,30] Only Caldo-Silva et al.[32] evaluated enhancement in muscle strength, with no clear information of specific functional tests. Two studies were focused on quality of life[21,31] using EUROQOL questionnaire).[36] Grönstedt et al. reported no significant changes after the combined intervention while Abizanda et al. reported a general improvement in the points of the EUROQOL.[21,31] Finally, three studies considered other outcomes. The nutritional status was assessed through the Mini-Nutritional Assessment – Short Form (MNA-SF)[37] which revealed significant improvements following intervention.[21,31] Additionally, body weight gains and improvements in vitamin D status were documented as positive outcomes linked to nutritional supplementation[29,30]

Risk of bias

Table 4 summarises the quality of the included studies assessed using appropriate JBI checklists, while the complete quality appraisal is available in the Supplementary Materials. Four out of five RCT were scored as excellent quality, with only one study[31] scored as medium quality. Indeed, despite the Authors publishing separately an extensive and detailed study protocol,[38] the allocation concealment procedure was not extensively described. Moreover, outcome assessors were not blinded, and the performed statistical analyses were not adjusted considering the cluster-based design. All of the three quasi-experimental studies were scored as high quality. Specifically, two of them did not have a control group[21,33] and one[32] did not measure all the outcomes in a reliable way, as frailty, dietary assessment, and cognitive levels were self-reported by participants.

Discussion

The present systematic review identified seven studies evaluating combined physical activity and nutrition interventions in LTC settings.[10,21,29–33] The findings of this systematic review highlight that nutritional interventions, when combined with physical activity programs, have the potential to provide significant benefits for institutionalized older adults. Specifically, the available evidence showed a positive effect primarily on physical function parameters, such as increased limb strength and mobility. However, the effects on quality of life are less consistent, with conflicting results among the included studies.

The improvement in physical outcomes are in line with consolidated evidence on older populations in community settings, where

Table 2
Characteristics of interventions.

Study	Physical exercise intervention	Nutritional intervention
[21]	**Type:**ActiPlan exercises program focused on balance, flexibility and strength **Frequency:** 5 days/week **Professionist:** Physiotherapist and Nurses	**Type:** Daily intake of 2 bottles of 200 mL. Each bottle contains 300 kcal, 20 g protein, 24.2 g carbohydrate, 13 g fat (poly-unsaturated fatty acids 18.5%; u6/u3 $^{1}/_{4}$ 2.8:1), 3 g fiber (30% inulin, 70% fructooligosaccharides), 500 IU vitamin D, and 480 mg calcium
[32]	**Type:** Multicomponent exercise. The exercise protocol respected the guidelines of exercise prescription for older persons and the guidelines of exercise periodization by the American College of Sports Medicine Exercise was supervised **Frequency:** twice a week	**Type:** The BCAAs power mixture was composed of L-leucine (Leu), L-isoleucine (Ile), and L-valine (Val) in the proportion of 2:1:1. 200mL before exercise. **Professionist:** Nutritionist
[10]	**Type:**Exercise sessions were structured in requiring moderate-to-high effort to subjects (level 7−8/ 10 on a visual analog scale). Each session was designed to burn about 190 Kcals, calculated on an average weight of 60 kg. **Frequency:** bi-weekly 45-minutes groups **Professionist:** physiotherapist	**Type:** The diet offered four different meals (breakfast, lunch, afternoon snack, and dinner), and was designed to provide at least 30 g of proteins with high content of leucine. Daily calcium intake was managed to reach the minimum quantity suggested by the recommended daily intake levels and phytate- and oxalate-rich food (e.g., spinach) were limited, to increase intestinal calcium absorption.
[30]	**Type** **Resistance training:** Ten exercises for the main muscle groups arms). One training session started with 10 min of warm-up, continued with 30−40 min of strength training and ended with a 10 minute cool-down. In the initial phase (4 weeks) one set of 15 repetitions was performed in order to learn the correct form of each exercise. From the fifth week on the intensity and volume has progressively been increased from two sets of light exercises to two sets of heavy resistance. If the participants could easily perform two sets of 15 repetitions they were told to either take more. **Frequency:** two weekly session **Professionist:** sport scientist	**Type:**Liquid supplement every morning, and after each training session. 20.7 g protein (56 energy (En)%, 19.7 g whey protein, 3 g leucine, N10 g essential amino acids) 9.3 g carbohydrates (25 En%, 0.8 BE) 3.0 g fat (18 En%), 1.2 g roughage (2 En%) 800 IU (20 μg) of vitamin D, 250 mg calcium, vitamins C, E, B6 and B12, folic acid and magnesium (1 portion FortiFit, Nutricia).
[31]	**Type** Sito-to-stand exercises 12 weeks repeatedly for 1−10 times at each session depending on the participant's ability, at least four times per day. **Professionist:** physiotherapist, occupational therapist and nurse **Frequency: 7** days a week **Duration:** 7 weeks	**Type** Oral supplementation (600kcal, 46g protein, 2 bottles/die) The participants will also be offered an oral protein-rich supplement (125 ml, 18 g protein which is 24% of Recommended Dietary Intake, 300 kcal) twice a day (between breakfast and lunch and in the afternoon) during 12 weeks (7 days/week).
[33]	**Type** Korean dance low intencity exercise. warm-up exercise (5 min), main dance movements (30 min), and a cool-down exercise (10 min). The movements provide aerobic exercise with a target heart rate of 50% of the maximum, and the entire 45-min routine involved 1500−2000 movement steps requiring 80−100 kcal of energy for an average-sized individual. **Frequency** 4 times per weekx **Professionists** Exercise leaders were trained research assistants who were taught the Korean dance movements by a Korean dance expert prior to the commence-ment of the study.	**Type** Nutrition education classes **Professionist:** dietitian with teaching experience
[29]	**Type** **Structured exercise sessions** 45 minutes sessions: 5 min. general warm-up exercises of the upper and lower limbs and the trunk (initially in an recumbent position, and in a sitting down position on a chair afterwards), 20 min. of func-tionally-oriented exercises (FOE), 20 min. long standard exercises (SE), or progressive resistance exercises (PRE), depending on a specific group allocation. Every session was then rounded off with a series of simple breathing and relaxation exercises. All exercise interventions were pursued at the subjects' actual place of residence and individually supervised by a physi-otherapist to ensure full (100%) compliance with the study regimen. **Standard exercises (SE)** 10 simple exercises (implemented in an upright sitting position on a standardised chair), followed by another series pursued on a pedal exerciser, designed to activate the lower limbs (duration: ca.10 min. with three 30 sec. intervals). **Progressive resistance exercises (PRE)** four series of proper resistance exercises pursued with the aid of a standardised elastic resistive exercise band. 3 × 10 stretches of a band per each discrete muscle group spaced out with 1 min long rest periods. **Frequency:** 5 days a week **Duration:** 7 weeks **Professionist:** physiotherapist	**Type:** The nutritional supplement − a 200 ml liquid supplying 300 kcal in the form of carbohydrate (49%), lipids (35%) and protein (16%) mixture was designed to augment individual caloric intake by ca. 20%, as well as top up their recommended daily allowances of vitamins and minerals (by ca. 25%). Compliance was assured by the trained nursing stuff **Professionist:** Nurses

multidimensional interventions have demonstrated significant benefits on mobility, body composition, and reduced risk of frailty.[22,39] Multidomain exercise prescriptions can enhance the functional strength of older individuals, contributing to fall prevention and increased independence.[40] Overall, the experimental groups showed statistically significant improvements in these tests compared to control groups, suggesting that structured, progressive resistance training is effective in mitigating functional decline in older adults.[6]

Although different tests were used among the included studies, physical functionality improved in all of them. This confirms that exercise has tangible and measurable effects on physical function in the elderly, with the delivering characteristics (i.e., supervised and

Table 3
Measured outcomes.

Study	Physical functionality outcomes	Quality of life outcomes	Other measured outcomes
[21]	Daily adherence to physical exercise and ONS. Excellent adherence higher than 80% good adherence higher than 60%. Mean improvement in SPPB at week 6 was 0.8 points, and in SF-LLFDI 3.1 points. There was no significant improvement in function at week 12, mean values were higher at that point than at baseline	**Quality of life** Improvement inquality of life measured with the EQ5DVAS by 6% (95% confidence interval (CI) 3%e10%) at week 6, and by 5% (95% CI 0%e10%) at week 12.	**Diet** Improvement in their nutritional status (weight gain, BMI increase, and higher MNA-SF scores at 6- and 12-week follow up). igher in participants with more frailty criteria, lower functional level, lower vitamin D levels, and poorer nutritional status.
[32]	Improvement of cognitive profile and muscle strength-related albumin levels, reduction in the TNF-α levels were found particularly in ME plus BCAAs group. No significant variations were observed over time for TNF-α/IL-10 ratio or MPO activity. The study showed that MIP triggered slight alterations in the inflammatory and physical function of the frail older participants,	N/A	N/A
[10]	EG showed a significant improvement in the total scores of all the measured scales. A significant improvement was observed for the functional dimension of the Bartel Index and for both Tinetti scale dimensions (walk and balance). None of the participants reported adverse effects.	N/A	N/A
[30]	**Fitness test** The participants of the RT and the RTS groups demonstrated signifi-cant improvements in the chair rise and the 6 minute walking tests (chair rise: RT: +23%, p = 0.002, RTS: +24%, p = 0.001; 6 minute walking: RT: +13%, p = 0.021, RTS +11%, p = 0.015). The CT group did not improve in functional parameters and none of the three groups improved significantly at the handgrip strength test.	N/A	**Vitamin D** status changed significantly only in the RTS group (plasma B12: +130%, p = 0.006; red blood cell folate: +43%, p = 0.018) after six months. nly in the RTS group, a significant negative correlation between the six month change of the B12 plasma level and the MN frequency was observed (RTS: r = −0.584, p = 0.009; RT: r = 0.081, p = 0.715; CT: r = −0.259, p = 0.284), which indicates decreased chromosomal damage with increased B12 plasma status
[31]	**Fitness test** The 30-second Chair Stand Test (30sCST) no significant differences between groups Berg Balance Scale (BBS) no significant differences between groups Body weight increased by approximately 2 kg in the EG, which was significantly different from the CG. Fat mass and Fat free mass increased significantly within the EG at follow-up, and the participants in the High adherence EG significantly improved THE Fat mass and Fat free mass compared to the CG.	**Quality of Life** No statistically significant differences for the self-reported EQ5D-5L between groups	**Diet** Mini-Nutritional Assessment-Short Form (MNA-SF) No significant difference between the EG and the CG in MNA-SF baseline to follow-up, but there was a significant improvement among the participants in the high adherence EG group compared with the CG. There were no differences in blood chemistry between or within groups at baseline or at follow-up
[33]		N/A	**Blood sample** Vitamin C, thiamin, and iron improved significantly by the interventions. Calcium was not improved. Patterns of nutrient intake were significantly lower than the baseline data for most nutri-ents and for energy intake; even those nutrients for which intake improved after the intervention program had decreased to baseline levels The mean INQ of values calculated for weeks 10 and 24 were significantly higher than the baseline data. The mean INQ of week 24 was also significantly higher than that calculated for week 10 (t = −9.63, p < .001). Dietary behaviors of the program participants were significantly better after the program than before it. Dietary behaviors were improved during the first 10 weeks after the intervention, but declined to baseline levels up to week 24. Lipid profiling Significantly increased after the intervention, in particular mean LDL-C, HDL-C, and ratio of LDL-C to HDL-C scores, and the atherogenic index were significantly improved after the intervention.
[29]	**Muscle strengh** Progressive resistance exercise (PRE) regimen is clearly instrumental in appreciably improving individual muscle strength, irrespective of nutritional supplementation, at least in the volume actually offered to the present study subjects. **Individual mobility Tinetti scale** improvements in Group III which pursued the regimen combining SE with nutritional supplementation, although, admittedly, appreciable gains in individual muscle strength (Group I) clearly did not appear to trans-late directly into perceptible improvement in individual mobility. **6 minute walking test** In the standard exercise (SE) regimen statistically significant improvement was noted with regard to the distance covered by over 35 metres on completion of a 7- week study, whereas in the groups following progressive resistance exercise (PRE) regimen muscle strength in both legs reached statistically significant improvement by 3.5 − 6.6 N/m over the same period.	N/A	**Body weight** The tandard exercise (SE) regimen (Group III), as well as received nutritional sup-plement were found to have appreciably gained in body weight by ca. 1.72 kg on average over 7 weeks (p = 0.01), whereas no such gains were observed in the group pursu-ing the progressive resistance exercise (PRE) regimen(Group I); the difference possibly attributable to the per-ceptibly less strenuous character of the former regimen.

Table 4
Risk of bias assessment.

Study	Study design	Quality assessment tool	Overall quality
[21]	QE	JBI Checklist for QE	High
[32]	QE	JBI Checklist for QE	High
[10]	RCT	JBI Checklist for RCT	Excellent
[30]	RCT	JBI Checklist for RCT	Excellent
[31]	RCT	JBI Checklist for RCT	Medium
[33]	QE	JBI Checklist for QE	High
[29]	RCT	JBI Checklist for RCT	Excellent

QE: quasi experimental; RCT: randomized controlled trial.

structured sessions) more important than the specific intervention content.[41]

With regards to the nutritional component, the majority of the included studies adopted calorie and/or protein nutritional supplementation drinks, typically providing between 300 and 600 kcal per day, often enriched with fibers, polyunsaturated fatty acids, and essential micronutrients. This strategy showed a positive impact on nutritional status, with significant improvements in Mini Nutritional Assessment – Short Form (MNA-SF) scores and, in some cases, increases in body weight and muscle mass. These results are in line with a well-established body of evidence supporting the role of adequate protein intake in preventing sarcopenia and supporting functional outcomes in older adults.[42,43,44]

It is well known that sufficient protein intake, evenly distributed throughout the day, promotes muscle protein synthesis and enhances functional outcomes, especially when combined with resistance training. However, it is worth mentioning that only some of the studies included in this review provided detailed descriptions of the qualitative composition of the supplements or the level of personalization of the nutritional support. Moreover, the involvement of nutritional professionals in included studies is limited. Indeed, only two studies reported the direct engagement of dietitians or nutritionists in the design, delivery and monitoring of the interventions. Moreover, in most cases nutritional support was provided without adequate individualized assessment. This represents a significant limitation, considering that older adults in LTC facilities often present multiple comorbidities, dysphagia, reduced appetite, and metabolic alterations, all of which require individualized dietary planning to maximize safety and effectiveness.[10] Moreover, adhering to an oral supplementation routine is harder than following a diet.[45,46]

Particular attention should be given to sustainability and cost-effectiveness of the proposed interventions. In LTC settings, which are often characterized by limited resources, implementing nutritional strategies that are both effective and economically sustainable remains a key challenge.[10] In this regard, it is particularly concerning that none of the included studies performed an at least economic evaluation of the cost and benefits of the proposed interventions. As the scientific community has been stressed the growing importance of producing evidence that can be effectively translated in the real world, this aspect seems underexplored and should be considered in future studies. On the same line, the feasibility of intervention implementation has been discussed only in few of such studies, with only one adopting a study design which prioritized evidence emerging from real world practice.[10]

Overall, the impact of combined lifestyle interventions on QoL among institutionalized older adults appears promising but remains inconclusive due to limited and heterogeneous evidence. Among the included studies, only two specifically assessed QoL using standardized tools, (i.e., the EUROQOL questionnaire), with heterogeneous results. Factors such as cognitive impairment, social isolation, and comorbidities may limit the extent to which improvements in physical or nutritional status translate into perceived well-being. Moreover, the lack of standardized and sensitive assessment tools for QoL in LTC populations reduces the comparability of findings across studies. The self-reported EQ5D-5L is widely used however may not fully capture relevant psychosocial domains, such as emotional well-being or social connectedness and it may not be the most appropriate method for older NH residents or for people with dementia[47] while the DEMQOL instrument has been developed that might be more sensitive to detect meaningful changes.[48]

Future studies should prioritize the integration of comprehensive and multidimensional QoL measures, alongside physical and nutritional outcomes, to better evaluate the holistic impact of combined interventions. Longer follow-up periods and personalized approaches that incorporate meaningful activities and social engagement may also enhance the effectiveness of lifestyle interventions in improving overall well-being. Future study should consider multicomponent intervention including also the cognitive engagement due to the fact that recent literature suggest that an effective combined intervention should utilize a combination form of cognitive, exercise, and nutritional interventions. The Finnish Geriatric Intervention Study to Prevent Cognitive Impairment and Disability (FINGER) included older adults at risk of cognitive decline, indicating that multidomain intervention could reduce the occurrence of cognitive impairment and cardiovascular events[49,50] and also the Frailty Intervention Trial (FIT) in Singapore evaluated a 6-month multidomain intervention significantly decreased the severity of frailty and sarcopenia in pre-frail and frail older adults.[51,52] Looking forward, there is a clear need to develop more standardized and personalized lifestyle medicine protocols that consider individual protein-energy requirements, clinical conditions, and patient preference.[1,53,54] Integrating systematic nutritional assessments with regular, multidisciplinary follow-up could improve adherence and amplify the benefits of combined interventions. Future studies should focus on the implementation of combined intervention as a preventive pathway[55] in a preventive context and not just in LCTs setting.

Limitations

Despite the promising results, there are several limitations in our review. Despite all the included studies, with the exception of one, were classified of high or excellent quality, the lack of detailed intervention components descriptions (i.e., exercise intensity/frequency and dietary supplements), complicates comparisons between trials. This highlights the need for more rigorous and standardised reporting in future research to improve the generalisability and replicability of findings.

It is important to state that due to the nature of the interventions it is very difficult, if not impossible, to make the participants blind about the group to which they are assigned. This leads to the inability to create blind operators and participants. In order to avoid an overall low/average grade we considered this criteria not applicable in this specific studies.

In addition, the heterogeneity of LTC populations - ranging from frail individuals to those with cognitive impairment - poses a challenge for researchers seeking to design interventions that can accommodate a wide range of physical and cognitive abilities. Many of the studies included in this review focused on frail or pre-frail individuals, but future research should explore the effectiveness of lifestyle medicine interventions in broader LTC populations, including those with severe cognitive decline or other comorbidities. Finally, the lack of long-term follow-up data is a significant gap in the current literature. While several studies have reported short-term improvements, there is limited evidence on the sustainability of these effects after the interventions have stopped. Longitudinal studies tracking the long-term benefits and potential risks of combined physical and nutritional interventions in long-term care settings are fundamental.

Conclusions

The present study highlighted the limited yet emerging evidence supporting the use of combined physical activity and nutritional interventions for older adults in LTC settings. Despite the heterogeneity of the available studies in terms of design, intervention components and outcome measures, the majority of interventions demonstrated positive effects, particularly with regard to physical function. These findings reinforce the importance of supervised exercise programmes as a key component of lifestyle interventions for institutionalised populations. However, the evidence regarding nutritional strategies remains inconsistent. Most interventions relied on oral nutritional supplements, which, while beneficial for improving nutritional status, raise questions about adherence, long-term feasibility and true impact on quality of life. Additionally, the limited involvement of nutrition professionals and the absence of personalised dietary planning in the included studies emphasise a significant shortcoming that must be addressed in future research. Overall, while the current evidence suggests that multimodal interventions are feasible and beneficial, more high-quality, well-designed randomised controlled trials with standardised protocols, individualised approaches and longer follow-up periods are needed.

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Declaration of generative AI use

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Data Availability Statement

Data is contained within the article or supplementary material.

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All the Authors declare that they have no conflicts of interest.

CRediT authorship contribution statement

Andrea Conti: Writing – original draft, Methodology, Investigation, Data curation, Conceptualization. **Martina Porretto:** Writing – review & editing, Data curation. **Alice Masini:** Writing – original draft, Supervision, Methodology, Investigation, Data curation. **Qudratullah Fikrat:** Writing – review & editing, Investigation. **Gaia Ogliari:** Writing – review & editing, Investigation. **Bruno Tamburini:** Investigation, Data curation. **Massimiliano Panella:** Writing – review & editing, Supervision, Project administration, Methodology, Conceptualization.

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Supplementary materials

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