Review Article

Costs of Malnutrition in Institutionalized and Community-Dwelling Older Adults: A Systematic Review

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A B S T R A C T

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Objectives: The aim of this study was to assess health economics evidence published to date on malnutrition costs in institutionalized or community-dwelling older adults.
Design: A systematic search of the literature published until December 2013 was performed using standard literature, international and national electronic databases, including MedLine/PubMed, Cochrane Library, ISI WOK, SCOPUS, MEDES, IBECS, and Google Scholar. Publications identified referred to the economic burden and use of medical resources associated with malnutrition (or risk of malnutrition) in institutionalized or community-dwelling older adults, written in either English or Spanish. Costs were updated to 2014 (€).
Results: A total of 9 studies of 46 initially retrieved met the preestablished criteria and were submitted to thorough scrutiny. All publications reviewed involved studies conducted in Europe, and the results regarding the contents of all the studies showed that total costs associated with malnutrition in institutionalized and community-dwelling older adults were considerably higher than those of well-nourished ones, mainly due to a higher use of health care resources (GP consultations, hospitalizations, health care monitoring, and treatments). Interventions to reduce the prevalence of malnutrition, such as the use of oral nutritional supplements, showed an important decrease in-hospital admissions and medical visits.
Conclusion: Malnutrition is associated with higher health care costs in institutionalized or community-dwelling older adults. The adoption of nutritional interventions, such as oral nutritional supplements, may have an important impact in reducing annual health care costs per patient.

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Undernutrition, defined as a deficiency of energy, protein, and other nutrients,[1] could be caused by changes in body metabolism due to acute or chronic diseases and/or interventions, which is known as disease-related malnutrition (DRM).[2] Unlike starvation-related malnutrition, diseases may interfere with the ingestion or absorption of nutrients, increasing energy requirements.[1]

DRM is a common problem among older adults,[3] and its prevalence changes significantly depending on the population studied, the methods used for nutritional screening or assessment, and health-related problems. Malnutrition, as assessed using the Mini Nutritional Assessment (MNA), was observed in an important percentage of the older population (16.6%) (95% confidence interval [95% CI] 0—62). Moreover, prevalence rates of malnutrition were higher in hospitalized (24.6%; 95% CI 5.2—50) and institutionalized older adults (20.8%; 95% CI 6—62) compared with those living in the community (6.9%; 95% CI 0—16.6).[4]

DRM adversely affects older adults in different settings, with potentially serious consequences at the physical and the psychosocial levels.[5] DRM has been closely related to frailty, as both are serious multifactorial conditions affecting the geriatric population. It is estimated that from 20% to 60% of frail older adults have DRM, defined as

unintended weight loss and/or an acute or chronic imbalance between intake and requirements.[1] A recent study including institutionalized Spanish older adults showed that frailty was significantly associated with incident disability and mortality (OR 3.3; 95% CI 1.7—6.6).[6] Like frailty, malnutrition was also shown to be related to higher morbidity rates leading to extended length of hospital stay (LOS), more frequent general practitioner (GP) visits, and intensive nursing care, thereby confirming previous results from several previous studies.[1,4,7—11] Moreover, a worsening of clinical outcomes associated with deterioration in the quality of life has been shown in institutionalized older adults at risk of malnutrition.[12,13]

Malnutrition is a tremendous burden of illness in aging populations and it has been demonstrated to lead to significant extra costs every year.[14,15] However, its economic impact on institutionalized and community-dwelling older adults has not been sufficiently explored. Previous studies have associated intake of oral nutritional supplements (ONS) with improved clinical outcomes and reduced health care costs among older patients.[16—18] Results from these studies support the proposal that routine ONS prescriptions could prevent weight loss, improve MNA scores, and reduce the length of hospitalizations in elderly populations.[19] Nevertheless, there is a lack of consistent published data to support this evidence; in addition, the information available regarding the economic impact of malnutrition in the nonhospitalized older adult population is scarce.

With this purpose in mind, we conducted a systematic review of the literature to identify and synthesize the available evidence related to malnutrition costs or use of resources in institutionalized and community-dwelling older adults. Likewise, we sought to investigate the effect of therapeutic interventions in the optimization of nutrition and associated costs in this population.

Methods

A systematic literature search regarding malnutrition costs or the resources use in institutionalized or community-dwelling older adults was performed. All publications until December 2013 were included. International (MedLine/PubMed, Cochrane Library, ISI Web of Knowledge [ISI WOK], SCOPUS) and national electronic databases (*Medicina en Español* [MEDES], *Índice Bibliográfico Español en Ciencias de la Salud* [IBECS]) were used, including Google Scholar. The English search terms used are summarized in Table 1, and it was expanded with an additional search using Spanish terms (Supplementary Table 1).

Selected publications included original articles, reviews, and congress proceedings in English or Spanish, related to the economic burden and/or use of medical resources associated with malnutrition (or risk of malnutrition) and/or the impact of preventive or therapeutic interventions aimed at improving the nutritional status of institutionalized or community-dwelling older adults. The review excluded economic evaluations of specific drugs, letters to the editor, editorials, experts' opinions, case studies, studies related to hospital admissions for acute events, and publications without a health economics component or analysis. No geographic or time limitations were applied for the literature review.

An initial comprehensive search was performed using the search terms strategy described in Table 1 and followed by an abstract/title review focused on the exclusion of studies that either did not provide any information that was relevant to the review or were duplicates. After the first article selection, a second review was conducted in the selected articles to fully apply the inclusion/exclusion criteria by full-text reading.

The publication selection was performed by 2 independent researchers and discrepancies were solved by consensus. All cost

Table 1
Search Terms and Search Strategy

| #	Search Terms: Malnutrition
1	Undernutrition
2	Undernourished
3	Risk of undernutrition
4	Malnutrition
5	Malnourished
6	Risk of malnutrition
7	Disease-related malnutrition
8	Nutritional risk
9	Nutritional deficiency
10	Nutritional deficiencies
11	#01 OR #02 OR #03 OR #04 OR #05 OR #06 OR #07 OR #08 OR #09 OR #10
#	**Search Terms: Institutionalized or Community-Dwelling Older Adults**
12	Nursing home
13	Nursing homes
14	Retirement home
15	Retirement homes
16	Rest home
17	Rest homes
18	Geriatric
19	Geriatrics
20	Hospice
21	Long term care hospital
22	Institutionalized
23	Institutionalization
24	Institutionalisation
25	#12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24
26	Aged
27	Aging
28	Older adult
29	Older adults
30	Older people
31	Elder
32	Elderly
33	#26 OR #27 OR #28 OR #29 OR #30 OR #31 OR #32
34	#25 AND #33
#	**Search Terms: Cost-of-illness and Economic Evaluation**
35	"Economics"[Mesh]
36	"Economics, Nursing"[Mesh]
37	"Economics, Medical"[Mesh]
38	"Economics, Hospital"Mesh]
39	"Economics, Pharmaceutical"[Mesh]
40	"Drug Costs"[Mesh]
41	"Employer Health Costs"[Mesh]
42	"Hospital Costs"[Mesh]
43	"Direct Service Costs"[Mesh]
44	"Health Care Costs"[Mesh]
45	"Cost-Benefit Analysis"[Mesh]
46	"Cost Savings"[Mesh]
47	"Cost Sharing"[Mesh]
48	"Cost of Illness"[Mesh]
49	"Costs and Cost Analysis"[Mesh]
50	economic*
51	cost
52	costs
53	costly
54	costing
55	price
56	prices
57	pricing
58	pharmacoeconomic*
59	resources use
60	resources utilization
61	health resources
62	#35 OR #36 OR #37 OR #38 OR #39 OR #40 OR #41 OR #42 OR #43 OR #44 OR #45 OR #46 OR #47 OR #48 OR #49 OR #50 OR #51 OR #52 OR #53 OR #54 OR #55 OR #56 OR #57 OR #58 OR #59 OR #60 OR #61
63	#50 OR #51 #52 OR #53 OR #54 OR #55 OR #56 OR #57 OR #58 OR #59 OR #60 OR #61
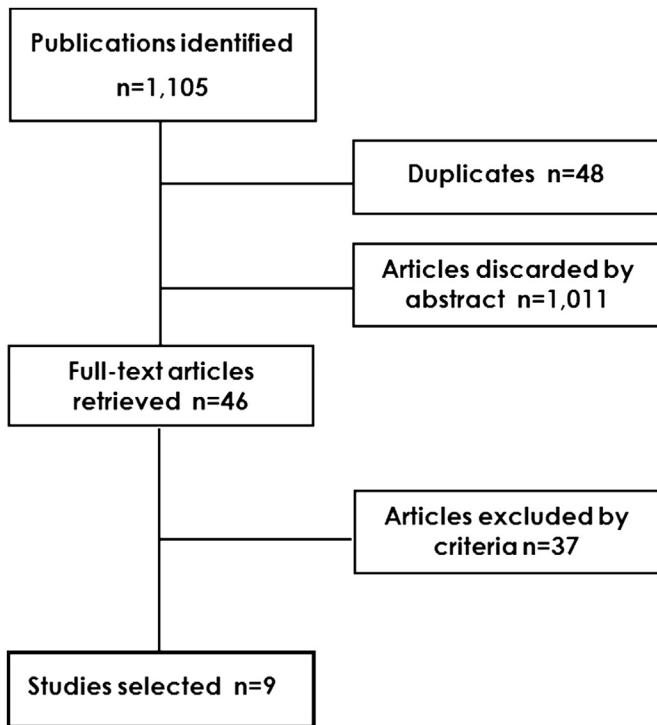
Fig. 1. Literature search.

results were converted to Euros and updated to 2014 values to facilitate the comparison of findings among publications; for this purpose, we used the CCEMG-EPPI-Centre Cost Converter tool.[20]

Results

A total of 1105 titles of publications were identified, of which 1059 were excluded, as they were duplicates or did not contain any relevant information. After full-text reading and application of the inclusion/exclusion criteria, 9 of the 46 retrieved publications were included in the present review (Figure 1).

All the studies reviewed included European populations (3 of 9 were conducted in the Netherlands, 3 in United Kingdom, 1 in Ireland, 1 in Sweden, and 1 in France).

Despite the heterogeneity of the publications selected in terms of subjects, methodology, and national health system features, they were grouped according to the main purpose of the economic evaluation. The first group included studies that aimed to evaluate direct costs associated with malnutrition (Table 2), whereas the second group was made up of publications that estimated the impact of health care interventions on malnutrition costs (Table 3).

Direct Costs Associated With Malnutrition

Four publications were aimed at estimating the total or additional direct medical costs of malnutrition or DRM in institutionalized and community-dwelling older adults, taking into account health care resources such as nutritional screening, medical visits, monitoring, treatment, hospital admissions, or in-hospital LOS.

Three of the 4 studies had a cost-of-illness design: 2 of them were conducted in the Netherlands and 1 in Ireland, whereas the remaining publication was based on retrospective cohorts and was performed in the United Kingdom.

Freijer et al[21] aimed to calculate the total additional costs of DRM in the Netherlands in 2011. For this purpose, they conducted a cost-of-illness study focused on direct health care costs related to the use of care (prevention, diagnostics, therapy, rehabilitation, care of disease) in hospitals, nursing homes, residential homes, and home care settings, categorizing by diagnosis group, age, and gender. An "own-design" formula was developed to estimate the expenses related to DRM, based on total disease costs and prevalence of DRM, and introducing weight factors for hospital and nonhospital settings. As a result, the total additional costs of managing patients with DRM were approximately 4 times higher for patients of at least 60 years of age (€1.5 billion/$1.67 billion) compared with adult patients (>18 to <60 years old) (€500 million/$555 million). Of the €1.5billion ($1.67 billion) attributed to older adults, €438 million ($486 million) (0.5% of the Dutch national health expenditure) were related to additional costs of malnutrition in nursing and residential home settings. These costs were explained by an increase in in-hospital LOS in malnourished patients.

The study by Meijers et al[22] is an economic evaluation that aimed to determine the implications of malnutrition in nursing homes in the Netherlands by integrating different approaches, including a questionnaire designed by the researchers themselves that was answered by a total of 22 dieticians from 110 nursing home organizations, with a

Table 2
Description of Reviewed Studies on Direct Costs Associated With Malnutrition

Author	Year	Country	Design	Objective	Population	Nutritional Status Assessment Method
Freijer et al[21]	2013	The Netherlands	Cost of illness	To calculate the total additional costs of DRM	2 groups of patients: (>60 years) and (>18 to <60 years) Community (home) or institutionalized	ESPEN Guidelines: Body mass index (BMI) < 18.5 (≤20 for patients ≥65 years)
Meijers et al[22]	2012	The Netherlands	Cost of illness	To determine the economic implications of malnutrition in nursing homes	n = 60,000 patients living in nursing homes in the Netherlands (mean age 80 years). Institutionalized	ESPEN Guidelines: BMI ≤20, unintentional weight loss (≥6 kg in the past 6 months or ≥3 kg in the past month)
Rice et al[23]	2012	Ireland	Cost of illness	To establish the annual public expenditure arising from the health and social care of patients with DRM	All adults receiving hospital care as inpatients, outpatients, community (assistance at home) or institutionalized elderly patients.	MUST screening tool (low risk = 0, medium risk = 1, high-risk malnutrition ≥2) on the basis of BMI, weight loss and acute disease
Guest et al[24]	2011	UK	Observational, retrospective cohort study	To examine the resource and cost implications associated with malnutrition	2 groups of patients: malnourished (n = 1000; mean age 63.2 years) and nonmalnourished (n = 996; mean age 64 years) Community (home) or institutionalized	BMI <18.5

Table 3
Description of Reviewed Studies on the Impact of Health Care Interventions on Malnutrition Costs

Author	Year	Country	Design	Objective	Population	Nutritional Status Assessment Method	Intervention
Freijer et al[25]	2013	The Netherlands	Economic evaluation	To assess the economic impact on the national health care budget of using ONS, for the treatment of DRM	Elderly patients (≥65 years) Community (assistance at home) or institutionalized	Dutch National Prevalence Measurement of Care Problems (LPZ)	Comparison of the use of ONS versus "no use" of ONS due to DRM in elderly patients aged 65 years and older in the community settings
Lorefält et al[26]	2011	Sweden	Observational, prospective, cohort study	To study the effect of individualized meals on nutritional status and to compare the results with a control group, as well as to estimate direct health care costs for both groups	Two groups of patients: intervention (n = 42; mean age 83.1 years) and control (n = 67; mean age 85.6 years) Institutionalized	MNA®	A multifaceted intervention based on a 3-month educational program including nutritional care
Kilonzo et al[27]	2007	UK	Economic evaluation	To assess the relative efficiency of multivitamin and multimineral supplementation compared with no supplementation	Two groups of patients: supplement (n = 456; mean age 72 years) and placebo (n = 454; mean age 71 years) Community (home) or institutionalized	Scottish Collaborative Group Food Frequency Questionnaire	Participants were randomized to 1 tablet daily of either a multivitamin and multimineral supplement or matching placebo, and were followed for 12 months
Edington et al[28]	2004	UK	Randomized, open-label clinical trial	To determine whether nutritional supplementation after discharge from hospital improved nutritional status and functional outcomes, or reduced health care costs	Two groups of patients: treatment (n = 51; mean age 76.8 years) and control (n = 49; mean age 79.3 years) Community (home)	BMI <20 or BMI ≥20 but documented evidence of weight loss of ≥10% in the 6 months or ≥5% in the 3 months before the study	Elderly malnourished patients were randomized to 8 weeks of supplementation or no supplementation after discharge and followed for 24 weeks
Arnaud-Battandier et al[29]	2004	France	Observational, prospective cohort study	To assess the cost of malnutrition and related comorbidities and to determine the impact of nutritional support practice on these outcomes	Two groups of patients: group 1 (n = 185; mean age 85.2 years) and group 2 (n = 193; mean age 85 years) Community (home or institutionalized)	MNA	Two groups of physicians were selected: group 1 with rare, and group 2 with frequent prescription of oral nutritional supplements

total of 9855 patients. The study focuses on the additional time and resources spent on carrying out activities in nursing home patients who are either at risk of malnutrition or already malnourished. Results were extrapolated to the total nursing home population living in the Netherlands. The main analysis included general costs of malnutrition screening, weight measurements, and costs of meals. As a result, additional costs of managing malnutrition in Dutch nursing homes were estimated at €255million ($283 million), and were related to extra efforts in nutritional screening, monitoring, and treatment.

Using a cost-of-illness approach, Rice et al[23] studied the costs likely to be associated with the health and social care of patients with DRM in Ireland, using a methodology that had been developed previously. This method consisted of searching official sources, such as publications and national official data sets (Department of Health and Children, the Health Service Executive, and the Economic and Social Research Institute) for different health care settings, and included long-term care for older adults and those receiving home care. Annual public health and social care costs associated with malnourished adult patients in Ireland were estimated at more than €1.4 billion ($1.55 billion), €689.14million ($764.95 million) being attributed to institutionalized older adults with DRM (6% of the health care budget in Ireland in 2007).

Finally, an observational retrospective evaluation performed by Guest et al[24] was reviewed. This study assessed the effect of malnutrition on clinical outcomes and the use of health care resources following the initial diagnosis by a GP in the United Kingdom. The population studied comprised 1000 randomly selected individuals who had initially been diagnosed with malnutrition, with the addition of a group of 996 controls. Patients' outcomes and resource use were quantified for both malnourished and nonmalnourished individuals for a period of 6 months. As a result, the malnourished group used significantly more resources than nonmalnourished individuals. The cost per patient during the 6 months after diagnosis was estimated at €2119 ($2352) compared with €906 ($1006) in well-nourished patients. This difference was explained by a more frequent use of health care resources in patients with malnutrition (medical consultations, hospital admissions, and in-hospital LOS).

Impact of Health Care Interventions on Malnutrition Costs

Five selected studies evaluated the impact of different preventive or therapeutic interventions on malnutrition costs, which basically consisted of the introduction of ONS or the implementation of educational programs about nutrition care.

Two of these publications have an economic evaluation design and were conducted in the Netherlands and United Kingdom; another 2 were based on prospective cohorts of patients and were performed in Sweden and France. Finally, a randomized open-label clinical trial carried out in United Kingdom was included in the systematic review.

The study by Freijer et al[25] aimed to calculate the budget impact of using ONS in community-dwelling older adults (older than 65 years) with DRM in the Netherlands. For this purpose, they conducted a health economics analysis using clinical trials and published literature. A univariate sensitivity analysis was performed. According to their assessment, treating DRM in community-dwelling older adults through ONS reduced the annual total costs of DRM from €246.64 ($273.77) to €235.02 ($260.87) million (cost savings of €11.62/$12.90 million). The additional costs of ONS were balanced due to a reduction in rehospitalization in DRM patients. Sensitivity analysis results showed that the use of ONS consistently reduced the costs of care.

Lorefält et al[26] examined 109 participants in an observational prospective cohort study, including an intervention group (n = 42) and a control group (n = 67) from 3 residential homes in Sweden. The purpose of the study was to evaluate the effect of individualized meals on nutritional status among institutionalized older people. The intervention design was based on an educational nutrition care program, including both theoretical and practical issues. The MNA test was performed to evaluate the nutritional status among residents at baseline and after 3 months. In the intervention group, both an improvement in nutritional status and an increase in body weight were observed. Estimated annual direct costs per patient and costs of primary care were higher in the intervention group (individualized meals €830/$921 vs €760/$844) and nutritional education (€652/$724 vs €402/$446), compared with the control group 1 year after the intervention. Hospital care expenditure accounted for €0 in the intervention group, whereas in the control group it was €81 ($90).

The publication by Kilonzo et al[27] aimed to assess the relative efficiency of multivitamin and multimineral supplementation compared with no supplementation from the perspective of the UK National Health Service. For this purpose, a cost-utility analysis was undertaken, using a double-blind placebo-controlled trial in which 910 participants older than 65 years were recruited and randomized to either placebo (n = 454) or multivitamin and multimineral supplementation (n = 456), and followed for 12 months. Use of health care resources and costs were higher among a group of patients receiving nutritional supplements (€114, SD €197) ($127, SD $219) compared with a placebo group (€95, SD €181) ($105, SD $201); however, those differences were not statistically significant. Sensitivity analysis confirmed the base-case results.

A randomized multicenter open-label clinical trial was conducted by Edington et al[28] in the United Kingdom to determine whether nutritional supplementation after hospital discharge improved nutritional status and functional outcomes, or reduced health care costs. The study included 100 individuals older than 65 years, discharged from hospital with a documented weight loss of 10% or more of their usual body weight in the 6 months before inclusion or 5% or more in the 3 months before inclusion. Patients randomized to the intervention group (n = 51) were supplemented with 600 to 1000 kcal per day during the first 8 weeks of the study and those randomized to the control group received no additional caloric intake (n = 49). Both groups were followed for 24 weeks. Nutritional status improved significantly from baseline to week 24 in the intervention group (P < .05). Although there were no significant differences in nutritional status between groups at week 24, a statistically significant difference was observed in cost savings between the intervention group (€-452) ($−502) and the control group (€−3,736/$−4,147; P = .034). The number of hospital admissions decreased significantly in both groups (intervention, P = .034; control, P = .0015).

The study by Arnaud-Battandier et al[29] aimed to assess the cost of malnutrition and related comorbidities among elderly patients living in the community in France, and to estimate the impact of nutritional support practice on these outcomes, using an observational prospective cohort of 402 patients older than 70 with evidence of malnutrition, with a 12-month follow-up period. The study compared patients from 2 groups of physicians, selected according to their usual clinical practice: group 1 with infrequent and group 2 with frequent prescription of ONS. Nutritional status at baseline was determined using the MNA tool. Main outcome measures were nutritional status, malnutrition-related comorbidities, and medical care use (prescribed supplementation products, GP visits, nursing care, physiotherapist visits, specialist visits, examinations, and hospital admissions). The main result observed was that MNA scores were significantly higher in group 2 when compared with group 1. Although costs associated with ONS were €548 ($608) higher in the frequent prescription group, the costs of health care use were lower, mainly due to a decrease in hospital admissions (€1631 vs €2203) ($1810 vs $2445) and medical visits (€299 vs €462) ($332 vs $513).

Discussion

According to this systematic review of the literature, only a select number of studies have addressed the direct medical costs of malnutrition and/or DRM in institutionalized and community-dwelling older adults, as well as the economic impact of specific preventive or therapeutic interventions on malnutrition costs in this population. Although there are important methodological differences between the selected publications, which might hamper robust comparisons among studies, the information obtained allowed us to appraise the economic impact associated with malnutrition. In the present review, malnutrition resulted in a major health care burden across different European countries, and constituted a serious problem for public health systems. In general, malnutrition was related to aging and chronic diseases; as a result, institutionalized older patients were particularly susceptible to suffer DRM.

Expenses related to the management of institutionalized and community-dwelling older patients with DRM represented an important percentage of the health care budget in each country. For instance, it was estimated at €438 million in the Netherlands[22] (0.5% of the Dutch national health expenditure) and €689 million ($765 million) in Ireland[23] (6% of the Irish health care budget). In addition, costs of managing patients at risk of malnutrition were less than those for malnourished patients (€2000/$2220 less per patient and year)[22] and even lower for nonmalnourished individuals.[24] This difference was explained mainly by a higher use of health care resources in patients with malnutrition (medical consultations, hospital admissions, and LOSs). On the other hand, additional costs associated with patients with DRM were approximately 4 times higher for older patients (€1.5 billion) (1.67 billion), compared with the younger patients (€500 million) ($555 million).[21] This difference might be partially explained by the fact that an older age is associated with an overall increase in disease prevalence.

Results of this review support the concept that prescribing nutritional oral supplements to ensure sufficient protein and energy intake might represent a beneficial strategy to improve the nutritional status in malnourished institutionalized and community-dwelling older adults. Accordingly, in the ONS intervention groups, significant improvements in nutritional status and anthropometric measurements were observed compared with controls, in a relatively short period of time.[26–28] In general, additional costs associated with ONS prescription and educational programs were offset by substantial cost savings from decreases in hospital admissions (€1631 vs €2203 per year) ($1810 vs $2445 per year),[29] and medical visits (€299 vs €462 per year) ($332 vs $513 per year).[29] Only studies with long-term interventions showed significant cost savings (€11.62/$12.90 million saved per year).[25] These results agree with a meta-analysis[30] demonstrating that the use of ONS in at-risk patients significantly reduces the rate of readmissions in hospitalized patients, mainly in those 65 years or older (6 randomized controlled trials, n = 834, effect size −0.18; 95% CI −0.31 to −0.04; P = .011), with important economic implications for the health care system.

However, the cost-effectiveness of the introduction of protein and energy supplements among institutionalized older adults is not altogether clear.[27] Some of the studies reviewed pointed out that a tailored educational program in nutrition,[26] or the intervention of a dietitian that has a "placebo effect"[28] might be enough to increase dietary intake and to improve body weight among older adults. Moreover, some studies evaluated the cost-effectiveness of nutritional supplementation from a societal perspective. Neelemaat et al[31] concluded that a nutritional intervention in malnourished in-patient adults older than 60 implemented for 3 months improves functional limitations with neutral costs. However, a 3-month follow-up was considered a short period of time to detect changes in quality-adjusted life years (QALYs). On the other hand, Norman et al[32]

showed that a 3-month intervention with ONS increases quality of life in post-hospital malnourished patients, and the interventions that were studied were cost-effective (ICER: €12,099/QALY) (ICER: $13,430/QALY).

According to the results reported, reducing the incidence of malnutrition with preventive strategies such as routine malnutrition screening in high-risk groups (older adults and chronic disease patients) should be a priority for health care systems. In addition, multifactorial interventions, including nutritional educational programs, the creation of multidisciplinary teams with dietitians, or the administration of ONS, should be implemented within the health care system.[33] Current publications prove that ONS reduces pathology-related and nutritional status—related complications, thus reducing medical costs and mortality. Furthermore, ONS is shown to be a safe therapeutic intervention with no important adverse effects, which improve patients' functionality and overall quality of life. However, more studies regarding the efficacy of ONS in malnourished older adult patients are needed.[34] Ideally, such studies should be carried out with longer follow-up periods, and assess quality of life and cost-effectiveness, as regards specific clinical situations, so as to aid health care professionals when it comes to making clinical decisions based on evidence and cost analyses.

Possible limitations of this review include the small number of articles identified that fulfill the preestablished inclusion criteria. Most of the studies reviewed had an observational and exploratory design. In addition to this, despite our comprehensive search, there may be relevant articles in languages other than English or Spanish or that are indexed in databases other than those searched, which we did not identify. On the other hand, as all the studies reviewed involved European populations, the review reflects the disease characteristics of patients in industrialized countries.

Conclusion

Our systematic review suggests that malnutrition and DRM are important burdens of illness, mainly because of their high prevalence associated with the aging population in Western societies, leading to increased morbidity and mortality, decreasing patients' quality of life, and resulting in increased health care and societal costs. For these reasons, even a small reduction in their prevalence or severity might have the potential to cause substantial savings for the health care system, as DRM is preventable or treatable with a nutritional intervention. Prescribing nutritional oral supplements to ensure sufficient protein and energy intake seems an efficient and beneficial strategy to improve the nutritional status in institutionalized and community-dwelling older adults. Nevertheless, more research is needed to generate evidence supporting the cost-effectiveness of these interventions.

Supplementary Data

Supplementary data related to this article can be found online at http://dx.doi.org/10.1016/j.jamda.2015.07.005.

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