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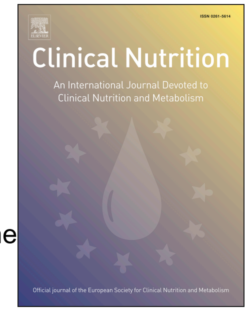

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ESPEN Guideline on Clinical Nutrition and Hydration in Geriatrics

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Abstract

Background: Malnutrition and dehydration are widespread in older people, and obesity is an increasing problem. In clinical practice, it is often unclear which strategies are suitable and effective in counteracting these key health threats.

Aim: To provide evidence-based recommendations for clinical nutrition and hydration in older persons in order to prevent and/or treat malnutrition and dehydration. Further, to address whether weight-reducing interventions are appropriate for overweight or obese older persons.

Methods: This guideline was developed according to the standard operating procedure for ESPEN guidelines and consensus papers. A systematic literature search for systematic reviews and primary studies was performed based on 33 clinical questions in PICO format. Existing evidence was graded according to the SIGN grading system. Recommendations were developed and agreed in a multistage consensus process.

Results: We provide eighty-two evidence-based recommendations for nutritional care in older persons, covering four main topics: Basic questions and general principles, recommendations for older persons with malnutrition or at risk of malnutrition, recommendations for older patients with specific diseases, and recommendations to prevent, identify and treat dehydration. Overall, we recommend that all older persons shall routinely be screened for malnutrition in order to identify an existing risk early. Oral nutrition can be supported by nursing interventions, education, nutritional counselling, food modification and oral nutritional supplements. Enteral nutrition should be initiated if oral, and parenteral if enteral nutrition is insufficient or impossible and the general prognosis is altogether favorable. Dietary restrictions should generally be avoided, and weight-reducing diets shall only be considered in obese older persons with weight-related health problems and combined with physical exercise. All older persons should be considered to be at risk of low-intake dehydration and encouraged to consume adequate amounts of drinks. Generally, interventions shall be individualized, comprehensive and part of a multimodal and multidisciplinary team approach.

Conclusion: A range of effective interventions is available to support adequate nutrition and hydration in older persons in order to maintain or improve nutritional status and improve clinical course and quality of life. These interventions should be implemented in clinical practice and routinely used.

Keywords: Guideline, recommendations, geriatrics, nutritional care, malnutrition, dehydration

Abbreviations: ADL, activities of daily living; EN, enteral nutrition; MoW, meals on wheels; ONS, oral nutritional supplements, PICO, population of interest, interventions, comparisons, outcomes; PN, parenteral nutrition; RCT, randomized controlled trial; SLR, systematic literature review.

Introduction

Particularities of older persons

An older person is usually defined as a person aged 65 years or older. A geriatric patient is not specifically age-defined but rather characterized by a high degree of frailty and multiple active diseases which becomes more common in the age group above 80 years (1). As a consequence of acute and/or chronic disease in combination with age-related degenerative changes, limitations in physical, mental and/or social functions occur. The ability to perform the basic activities of daily living independently is jeopardized or lost. The person is in increased need of rehabilitative, physical, psychological and social care and requires a holistic approach to avoid partial or complete loss of independence (1).

It is the main aim of geriatric medicine to optimize functional status of the older person and, thus, to ensure greatest possible autonomy and best possible quality of life (1). A reduced adaptive and regenerative capacity, however, and thus, reduced capacity for rehabilitation is characteristic of older patients, making it more difficult to return the patient to an unrestricted or to his/her previous condition.

One of the most meaningful geriatric syndromes is sarcopenia, characterized by a disproportionate loss of muscle mass and strength that is accompanied by a decline in physical activity, functionality and performance. An excessive loss of muscle mass and strength results in physical impairment, frailty, disability and dependence from others. Sarcopenia also impairs the metabolic adaptation to stress and disease (2). Despite large overlap with sarcopenia, frailty represents a distinct clinical syndrome, characterized by an increased vulnerability to stress as a consequence of cumulative decline in many physiological systems during aging. Frailty is associated with an increased risk of adverse health outcomes and estimated to affect about 25 % of persons aged 85 years or older (3, 4).

Nutritional challenges in older persons

Nutrition is an important modulator of health and well-being in older persons. Inadequate nutrition contributes to the progression of many diseases, and is also regarded as one important contributing factor in the complex etiology of sarcopenia and frailty (2, 3, 5).

Due to many factors, nutritional intake is often compromised in older persons and the risk of ***malnutrition*** is increased. Anorexia of aging is crucial in this context. Particularly in case of acute and chronic illness nutritional problems are widespread, and a reduced dietary intake in combination with effects of catabolic disease rapidly leads to malnutrition (5, 6). A close relation between malnutrition and poor outcome, e.g. increased rates of infections and pressure ulcers, increased length of hospital stay, increased duration of convalescence after acute illness as well as increased mortality, is well documented also in older persons (6). Regarding the definition of malnutrition we refer to the ESPEN consensus (7) and terminology (8). Within this framework, for older persons the presence of either a striking unintended loss of body mass (> 5 % in six months or > 10 % beyond six months) or a markedly reduced body mass (i.e. BMI <20 kg/m²) or muscle mass should be regarded as serious signs of malnutrition needing clarification of the underlying causes. For the diagnosis of malnutrition the recent global consensus approach (GLIM) advocates the combination of at least one phenotype criterion (i.e. non-volitional weight loss, low BMI or reduced muscle mass) and one etiology criterion (i.e. reduced food intake/malabsorption or severe disease with inflammation (9). Older persons are at risk of malnutrition if oral intake is markedly reduced (e.g. below 50 % of requirements for more than three days) or if risk factors, which either may reduce dietary intake or increase requirements (e.g. acute disease, neuropsychological problems, immobility, chewing problems, swallowing problems), are present. The prevalence of malnutrition generally increases with deteriorating functional and health status. Reported prevalence rates greatly depend on the definition used, but are generally below 10 % in independently living older persons and increase up to two thirds of older patients in acute care and rehabilitation hospitals (10, 11).

Besides malnutrition, older persons are at increased risk of ***dehydration*** for various reasons with serious health consequences (12, 13). Prevalence rates are also low in community-dwelling older persons but increase to more than one third in more frail and vulnerable older adults and in those in need of care (14).

On the other hand, like in the general population, ***obesity*** with its well-known negative health consequences is an increasing problem also in older people, currently affecting between 18 and 30 % of the worldwide population aged 65 years and older (15, 16).

Thus, supporting adequate nutrition including adequate amounts of food and fluid to prevent and treat malnutrition and dehydration as well as obesity is an important public health concern.

Ethical aspects regarding nutritional interventions in older persons

Oral nutrition does not only provide nutrients, but has significant psychological and social functions, enables sensation of taste and flavor and is an important mediator of pleasure and well-being. Therefore, oral options of nutrition should always be the first choice, also in situations where nutritional interventions, i.e. assisted feeding, are difficult, time-consuming and demanding due to advanced morbidity and slow responses.

In all cases, respecting the patient´s will and preferences is of utmost priority.

For further details regarding ethical aspects of nutritional interventions we refer to the ESPEN Guideline on ethical aspects of artificial nutrition and hydration (17).

Aims

The present guideline aims to provide evidence-based recommendations for clinical nutrition and hydration in older persons in order to prevent and/or treat malnutrition and dehydration as far as possible. Furthermore, the question if weight-reducing interventions are appropriate for overweight or obese older persons is addressed.

The aim of clinical nutrition in older persons is first and foremost to provide adequate amounts of energy, protein, micronutrients and fluid in order to meet nutritional requirements and thus to maintain or improve nutritional status. Thereby, maintenance or improvement of function, activity, capacity for rehabilitation and quality of life, support of independence and a reduction of morbidity and mortality is intended. These therapeutic aims do not generally differ from those in younger patients except in emphasis. While reducing morbidity and mortality is a priority in younger patients, in geriatric patients maintenance or improvement of function and quality of life is often the most important aim.

This guideline is intended to be used by all health care providers involved in geriatric care, e.g. medical doctors, nursing staff, nutrition professionals and therapists but also welfare workers and informal caregivers. Geriatric care takes place in different health care settings, i.e. acute care, rehabilitation and long-term care institutions but also in ambulatory settings and private households. Unless otherwise stated, the recommendations of this guideline apply to all settings since no fundamental differences in nutritional therapy are known.

Methods

The present guideline was developed according to the standard operating procedure for ESPEN guidelines and consensus papers (18). It is based on the German guideline “Clinical Nutrition in Geriatrics” (19) which was further developed and extended by a group of 13 experts (eight geriatricians and five nutrition scientists/dietitians) from nine European countries, who are all the authors of this guideline.

PICO questions

Based on the standard operating procedures for ESPEN guidelines and consensus papers, the first step of the guideline development was the formulation of so-called PICO questions which address specific **p**atient groups or **p**roblems, **i**nterventions, **c**ompare different therapies and are **o**utcome-related (18).

The development of PICO questions was guided by the question which interventions are effective to treat malnutrition in older persons and to prevent malnutrition in older persons at risk of malnutrition. In an initial two-day meeting of the guideline working group in April 2016, the PICO questions were created as described in ***Table 1***. We further aimed to clarify if older persons with specific common geriatric health problems (i.e. hip fracture and orthopedic surgery, delirium, depression, pressure ulcers) benefit from specific nutritional interventions and if older persons with diabetes mellitus, overweight or obesity should be advised to follow a specific diet. Besides malnutrition the topic of dehydration turned out to be of significant interest. Moreover, three basic questions regarding energy and nutrient requirements and general principles of nutritional care were found to be important and were added without systematic literature search.

In total, 33 PICO questions were created, which were finally split into four main chapters – “Basic questions and general principles”, “Recommendations for older persons with malnutrition or at risk of malnutrition”, “Recommendations for older patients with specific diseases”, and “Recommendations to prevent, identify and treat dehydration”. Fourteen tandems of one responsible person and one supporting person were formed each working on one of 14 subchapters of these guideline topics and related PICO questions. These persons were responsible for identification of relevant papers (based on lists of potentially relevant articles derived from the literature search), evaluation, quality assessment and assignment of evidence level for relevant papers (using SIGN checklists) and generation of a first draft of recommendations. They also prepared the supporting text explaining and substantiating the recommendations.

In a second two-day meeting in April 2017, recommendations were discussed and agreement achieved within the working group. 83 recommendations were formulated.

Table 1. Definition of population, interventions, comparators and outcomes (PICO)

Population
- Mean age 65+ years
- With malnutrition or at risk of malnutrition
- In all health care and social care settings
    - o community, outpatient, home-care
    - o nursing home, care homes, long-term care
    - o acute-care hospital, rehabilitation incl. orthogeriatrics
- In all functional and health conditions with or without specific health problems

Interventions
- Supportive interventions (improvement of meal ambience, nursing interventions)
- Dietary counselling
- Dietary modifications: additional snacks, finger food, fortification, texture-modification
- Oral nutritional supplements (ONS, standard products, specific modified products)
- Enteral nutrition (EN) / tube feeding
- Parenteral Nutrition (PN) incl. (subcutaneous) fluid
- Combined interventions, e.g.
    - dietetic and nursing actions
    - nutritional intervention and exercise
- Individualized, comprehensive, multidisciplinary, multidimensional approaches

Comparison
- Standard care
- Placebo

- Other nutritional interventions (e.g. EN vs. ONS)

Outcomes

- Adverse events
- Energy and/or nutrient intake
- Nutritional status (anthropometric, biochemical parameters, body composition)
- Clinical course (complications, morbidity, length of hospital stay)
- Functional course
  - physical (e.g. activities of daily living, mobility, physical performance, frailty)
  - mental (e.g. cognition, memory, mood)
- Quality of life, well-being
- Nursing home admission, hospital admissions
- Caregiver burden
- Health care costs, cost-effectiveness
- Survival

Literature search

To answer the PICO questions, a comprehensive literature search was performed on 4th July 2016 as described in ***Table 2*** to identify suitable systematic reviews and primary studies.

A detailed search strategy was developed combining keywords for older persons (e.g. aged, older persons, geriatric), health care settings (e.g. nursing home, long-term care, rehabilitation), (risk of) malnutrition/dehydration or overweight/obesity with a wide range of interventions (e.g. dietary counselling, nutrition education, meal ambience, food fortification, texture modification, dietary supplement, nutritional support, enteral nutrition, parenteral nutrition, fluid therapy, multicomponent intervention). The detailed search strategy is available from the authors on request.

After removal of duplicates, 6000 hits remained whose titles and abstracts were screened in duplicate by five group member tandems using the following predefined inclusion criteria:

- Paper is written in English
- Paper is a controlled trial (RCT) or a systematic review
- Paper exclusively or mainly about older adults aged at least 65 years

- Older adults have some form of malnutrition or dehydration, or are at specific risk of malnutrition or dehydration (including patients with typical geriatric conditions, e.g. femoral fracture, dementia, heart failure, delirium, depression, COPD, but excluding studies focusing on other medical disciplines, e.g. oncology, nephrology, neurology, major surgery, where separate guidelines exist) OR the paper reports effects of weight loss interventions in overweight/obese older persons.
- Effect of a nutritional or fluid intervention, effect of a change, of a specific intake or status, or the effect of an intervention or factor that may improve nutrition or hydration is studied.

Since the focus of the present guideline is on general (i.e. protein-energy) malnutrition, single or combined micronutrient interventions were excluded. Also pharmacological interventions were not considered. Relevant conference abstracts and study design papers were included, but only if no related full paper was in the list, to have the possibility to look for meanwhile published full papers.

Based on this screening process, lists of potential systematic literature reviews (SLRs), RCTs and other trials of interest were created by each reviewer, sorted by main topics (malnutrition, dehydration, specific patient groups). DV acted as a third reviewer in case of disagreement and combined all parts to three final lists of potentially relevant SLRs, RCTs and other trials.

Additional references from studies cited in guidelines, SLRs or (R)CTs were also included, if they did not appear in the original list. After 3rd July 2016, relevant new articles were considered.

Table 2. Criteria for systematic search for literature – databases, filters and keywords

Publication date	From 1st January 2000 – 3rd July 2016
Language	English

Databases	Medline/PubMed (NIH), EMBASE (Ovid), Cochrane library
Filters	1. randomized controlled trial.pt. (421924) 2. controlled clinical trial.pt. (91079) 3. randomized.ab. (352126) 4. placebo.ab. (171702) 5. drug therapy.fs. (1876752) 6. randomly.ab. (252510) 7. trial.ab. (364041) 8. groups.ab. (1573781) 9. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 10. exp meta-analysis/ (67756) 11. (systematic* adj2 review*).ti,ab. (89972) 12. (meta-anal* or metaanal*).ti,ab. 13. 10 or 11 or 12 14. 9 or 13 15. exp animals/ not humans.sh. 16. 14 not 15 (3351618) 17. exp Aged/ 18. adolescent/ or middle aged/ or young adult/ or exp child/ or exp infant/ 19. 18 not 17 20. 16 not 19
Publication type	systematic review or randomized controlled trial
Search format	(([aged] AND [malnutrition or dehydration]) OR [hip fracture or cognitive frailty]) AND [RCT or SR in older humans filters] AND [dietary or fluid or nutritional support]

Literature grading and grades of recommendation

For grading the literature, the grading system of the Scottish Intercollegiate Guidelines Network (SIGN) was used (20). The allocation of studies to the different levels of evidence is shown in ***Table 3***.

Table 3. Levels of evidence

1++	High quality meta-analyses, systematic reviews of RCTs, or RCTs with a very low risk of bias
1+	Well-conducted meta-analyses, systematic reviews, or RCTs with a low risk of bias
1-	Meta-analyses, systematic reviews, or RCTs with a high risk of bias
2++	High quality systematic reviews of case control or cohort or studies. High quality case control or cohort studies with a very low risk of confounding or bias and a high probability that the relationship is causal
2+	Well-conducted case control or cohort studies with a low risk of confounding or bias and a moderate probability that the relationship is causal
2-	Case control or cohort studies with a high risk of confounding or bias and a significant risk that the relationship is not causal
3	Non-analytic studies, e.g. case reports, case series
4	Expert opinion

According to the Scottish Intercollegiate Guidelines Network (SIGN) grading system. Source: SIGN 50: A guideline developer's handbook. Quick reference guide October 2014 (20)

According to the levels of evidence assigned, the grades of recommendation were decided (***Table 4***). In some cases, a downgrading was necessary e. g. due to poor quality of primary studies included in a systematic review. These cases are described in the commentary accompanying the recommendations. The wording of the recommendations reflects the grade of recommendation, i.e. level A is indicated by “shall”, level B by “should” and level 0 by “can” or “may”. The good practice point (GPP) is based on experts’ opinions due to the lack of studies; here, the wording can be chosen deliberately.

Table 4. Grades of recommendation (18)

A	At least one meta-analysis, systematic review, or RCT rated as 1++, and directly applicable to the target population; or a body of evidence consisting principally of studies rated as 1+, directly applicable to the target population, and demonstrating overall consistency of results
B	A body of evidence including studies rated as 2++, directly applicable to the target population; or A body of evidence including studies rated as 2+, directly applicable to the target population and demonstrating overall consistency of results; or and demonstrating overall consistency of results; or Extrapolated evidence from studies rated as 1++ or 1+
0	Evidence level 3 or 4; or Extrapolated evidence from studies rated as 2++ or 2+
GPP	Good practice points/expert consensus: Recommended best practice based on the clinical experience of the guideline development group

If applicable, the recommendations were assigned to the outcome models according to Koller et al. 2013 (21), see ***Table 5***.

Supportive of the recommendations, the working group developed commentaries to the recommendations where the background and basis of the recommendations are explained.

Table 5. Outcome models in clinical studies

Endpoints with implications for evaluating trials in clinical nutrition	***Examples***

Biomedical endpoint (BM)	e.g. improvement of body weight, body composition, morbidity, mortality
Patient-centered/-reported endpoint (PC)	e.g. validated quality-of-life score
Health economic endpoint (HE)	e.g. QALYs or budget savings
Decision-making endpoint (DM)	e.g. clinical parameters or biomarkers that allow to make a clinically relevant decision such as transfer from ICU to a normal ward or nutritional support yes/no
Integration of classical and patient-reported endpoint (IE)	The combination of BM and PC, e.g. complex scores such as the Frailty Index

Adapted from Koller et al. (21)

Consensus process

Between 16th June 2017 and 23rd July 2017, an online voting on the recommendation was performed on the guideline-services.com platform. All ESPEN members were invited to agree or disagree with the recommendations and to comment on. A first draft of the guideline was also made available to the participants on that occasion. 65 recommendations reached an agreement >90 %, 17 recommendations reached an agreement of >75 – 90 % and only one recommendation an agreement ≤ 75 %. Those recommendations with an agreement higher than 90 %, which means a strong consensus (***Table 6***) were directly passed, all others were revised according to the comments and voted on again during a consensus conference which took place during the ESPEN congress 2017 in The Hague on 11th September 2017. Apart from three recommendations, all recommendations received an agreement higher than 90 %. During the consensus conference, it was agreed after discussion to omit three of the original recommendations and to split two recommendations into two separate ones respectively. Therefore, the guideline consists of 82 recommendations.

To support the recommendations and the assigned grades of recommendation, the ESPEN guideline office created evidence tables of relevant meta-analyses, systematic reviews and (R)CTs. These evidence tables are available online as supplemental material to this guideline.

Table 6. Classification of the strength of consensus

Strong consensus	Agreement of > 90% of the participants
Consensus	Agreement of > 75 - 90% of the participants
Majority agreement	Agreement of > 50 - 75 % of the participants
No consensus	Agreement of < 50 % of the participants

According to the AWMF methodology (22)

Outline of the guidelines

I. Basic questions and general principles (without systematic literature search)

II. Recommendations for older persons with malnutrition or at risk of malnutrition

- Supportive interventions
- Nutritional counselling
- Food modification
- Oral nutritional supplements
- Enteral and parenteral nutrition
- Exercise

III. Recommendations for older patients with specific diseases

- Hip fracture and orthopedic surgery
- Delirium
- Depression
- Pressure ulcers
- Overweight and obesity
- Diabetes mellitus

IV. Recommendations to prevent, identify and treat dehydration in older persons

- 1. Low-intake dehydration
- 2. Volume depletion

I. Basic questions and general principles (without systematic literature search)

I.1 How much energy and nutrients should be offered/delivered to older persons?

Recommendation 1

> Guiding value for energy intake in older persons is 30 kcal per kg body weight and day; this value should be individually adjusted with regard to nutritional status, physical activity level, disease status and tolerance. (BM)
>
> Grade of recommendation B – strong consensus (97 % agreement)

Commentary

With increasing age, resting energy expenditure (REE) is generally decreasing, mainly due to decreasing fat-free body mass. In healthy and sick older persons measurements of REE resulted in about 20 kcal/kg body weight (BW) and day (23-25). Based on usual physical activity levels (PAL) between 1.2 and 1.8, total energy expenditure (TEE) amounts to 24 to 36 kcal/kg. Due to their strong relation to fat-free mass, basal energy requirements are also influenced by gender and by nutritional status; in fact REE/kg BW is higher for men than for women and increases with decreasing body mass index (BMI). For older persons with underweight (BMI ≤21 kg/m²) energy requirements between 32 and 38 kcal/kg are assumed (25). In sick older people energy requirements may, on the one hand, be reduced due to reduced physical activity, and on the other hand be increased due to disease effects (e.g. inflammation, fever, drug effects). Minimal requirements of ill older persons are estimated to be between 27 and 30 kcal/kg (25).

Based on these figures, about 30 kcal/kg BW are suggested as a rough estimate and general orientation for energy requirements in older persons. This guiding value needs individual adjustment regarding all relevant factors, i.e. gender nutritional status, physical activity and clinical condition. In addition, the aim of nutritional support (e.g. weight maintenance or increase), and acceptance and tolerance of the nutritional intervention need to be considered.

Because of great heterogeneity and large individual variation of energy requirements, even in healthy older persons (26, 27), adequacy of energy intake needs to be controlled by close monitoring of body weight (taking water retention or losses into account), and intake adapted accordingly. It should be kept in mind that spontaneous oral energy intake of acutely hospitalized older patients is usually low and does not cover requirements.

<u>Recommendation 2</u>

> Protein intake in older persons should be at least 1 g protein per kg body weight and day. The amount should be individually adjusted with regard to nutritional status, physical activity level, disease status and tolerance. (BM)
>
> Grade of recommendation B – strong consensus (100 % agreement)

Commentary

The traditional recommendation for protein intake 0.8 g/kg body weight and day for adults of all ages (28, 29) is currently under discussion for older persons, based on growing evidence from experimental and epidemiological research that older people might need higher amounts of protein for optimal preservation of lean body mass, body functions and health. Daily amounts of 1.0 - 1.2 g/kg body weight have been suggested for healthy older persons by several expert groups (30-32). In case of illness, protein requirements may even be further increased, e.g. due to inflammation (including inflamm-aging), infections and wounds, however, to which extent is difficult to assess. Very little is known about the protein needs of frail and ill older persons, and scientific evidence, e.g. from intervention trials, is presently insufficient to derive concrete figures. Daily amounts of 1.2 - 1.5 g/kg have been suggested for older persons with acute or chronic illness (30, 31) and up to 2.0 g/kg body weight and day in case of severe illness, injury or malnutrition (30).

Until more evidence is available, an intake of at least 1.0 g/kg should be ensured in all older persons, particularly in those at risk of malnutrition, e.g. frail and multimorbid persons, whose intake is often far below this amount (33-35). Increased requirements, e.g. for muscle growth with strength training, for tissue regeneration in malnutrition or wound healing or for increased metabolic demands in case of critical illness, should be met by appropriately increased intake.

It is important to bear in mind that an insufficient intake of energy increases protein requirement. Thus, regarding protein status it is important to ensure not only adequate intake of protein but also appropriate intake of energy.

Recommendation 3

> For EN, fiber-containing products should be used. (BM)
>
> Grade of recommendation B – strong consensus (91 % agreement)

Commentary

Older patients often suffer from gastrointestinal problems including constipation and diarrhea. Since dietary fiber may contribute to the normalization of bowel functions, and intake is usually low in geriatric patients, the importance of an adequate intake of dietary fiber is emphasized. Daily amounts of 25 g are considered adequate for normal laxation in adults of ages (36) and can be regarded as guiding value also for older patients.

Also for EN, there is no reason to omit dietary fiber as long as bowel function is not compromised. Conversely, fiber-containing products for EN have been shown to contribute to normal bowel function (37-43) and are, thus, generally recommended. In addition, enterally nourished patients should not be deprived of the well-known beneficial metabolic effects of dietary fiber.

Recommendation 4

> Provided that there is no specific deficiency, micronutrients should be delivered according to the recommendation for healthy older persons.
>
> Grade of recommendation GPP – strong consensus (91 % agreement)

Commentary

Dietary recommendations for micronutrients for older persons do not differ from those for younger adults, however, our knowledge about requirements in very old, frail or ill persons is poor. Due to an increasing prevalence of gastrointestinal diseases, which are accompanied by reduced nutrient bioavailability (e.g. atrophic gastritis and impaired vitamin B_{12}, calcium and iron absorption), older persons are at increased risk of micronutrient deficiencies, which should be corrected by supplementation. Provided that there is no specific deficiency, micronutrients should be delivered according to the recommendation of the European Food Safety Authority (EFSA) or corresponding national nutrition societies for healthy older persons (44).

I.2. How should nutritional care be organized in older persons?

Recommendation 5

> All older persons – independent of specific diagnosis and including also overweight and obese persons – shall routinely be screened for malnutrition with a validated tool in order to identify those with (risk of) malnutrition.
>
> Grade of recommendation GPP – strong consensus (100 % agreement)

Recommendation 6

> A positive malnutrition screening shall be followed by systematic assessment, individualized intervention, monitoring and corresponding adjustment of interventions.

Grade of recommendation GPP – strong consensus (100 % agreement)

Commentary to recommendations 5 and 6

The process of nutritional care for older persons consists of several steps which are based on systematic screening for malnutrition. If there are any indicators of nutritional risk, a detailed assessment should follow to substantiate the diagnosis of malnutrition and as a basis for the definition of individual treatment goals and the development of a comprehensive nutritional care plan. Interventions need to be implemented, checked for their effectiveness and adjusted if necessary until treatment goals are achieved (***Figure 1***).

Screening: Independent of specific diagnosis and also in overweight and obese persons, malnutrition and its risk should be systematically and routinely screened at admission to a geriatric institution using a validated tool and thereafter in regular intervals, depending on the patient´s condition (e.g. every three months in long-term care residents in stable condition, at least once a year in general practice) in order to identify affected individuals early. The only screening tool developed and validated for older persons is the short-form of the Mini Nutritional Assessment (MNA) (45, 46). In addition to standard screening parameters (BMI, weight loss, reduced intake, disease) (47) it includes two important geriatric syndromes that regularly contribute to the development of malnutrition – immobility and neuropsychological problems – and thus, besides malnutrition also considers an existing risk of malnutrition. If BMI is not obtainable, calf circumference can be used instead. The MNA short-form can be completed in a few minutes and be applied in all geriatric settings (11).

Assessment: In individuals who are identified as malnourished or at risk of malnutrition by screening, a comprehensive nutritional assessment should follow, providing information on kind and severity of malnutrition and its underlying causes as well as on individual preferences (regarding food and beverages as well as enteral and PN) and resources (e.g. chewing and swallowing ability, eating dependence, gastrointestinal function, severity of disease, general prognosis) for nutritional therapy. Dietary intake monitoring (e.g. by plate diagrams) is recommended for several days in order to estimate the amount of food and fluid consumed (48) and relate dietary intake to individual requirements (see recommendation 1).

Nutritional intervention: Based on the screening and assessment results, individual goals regarding dietary intake and body weight / BMI should be defined, and an individual nutrition care plan developed and implemented in an interdisciplinary team approach. All aspects of the patient – physical and mental/psychic, social, clinical as well as ethical – should be considered, and all options used to ensure an adequate dietary intake. Dietetic, nursing and medical actions should be implemented in a coordinated manner (see recommendation 8).

Monitoring: The intervention process needs to be monitored, and reassessments should be performed in regular intervals, e.g. after several days, in order to check if goals are achieved. If this is not the case, goals and interventions have to be modified and adjusted according to experienced problems and the new situation. In case of EN or PN criteria for termination of the therapy have to be defined, e.g. if the goals are not achieved in a given time period or nutritional situation improved markedely (see recommendation 30). In the hospital setting, it is important to initiate adequate nutritional care after discharge at home and to ensure the continuation of the nutritional strategy started in hospital (see recommendation 25).

Since nutritional therapy may require various persons and professions (e.g. medical specialists, nurses, therapists), all interventions should be coordinated and agreed with all parties involved (see recommendation 9). As a matter of course, also intensive communication with the patient and his or her family should take place during the whole process, in order to learn and consider wishes and expectations of the person concerned. For implementation in daily routines, these general recommendations have to be concretized and adapted to the local conditions of each institution. Standard protocols for nutritional screening, assessment and therapy have to be developed and consistently put into practice (see recommendation 7). Several guidelines for nutritional management of older persons have been developed in recent years (49-53), mainly for the long-term care setting (50-52), which are overall in line with the present recommendations.

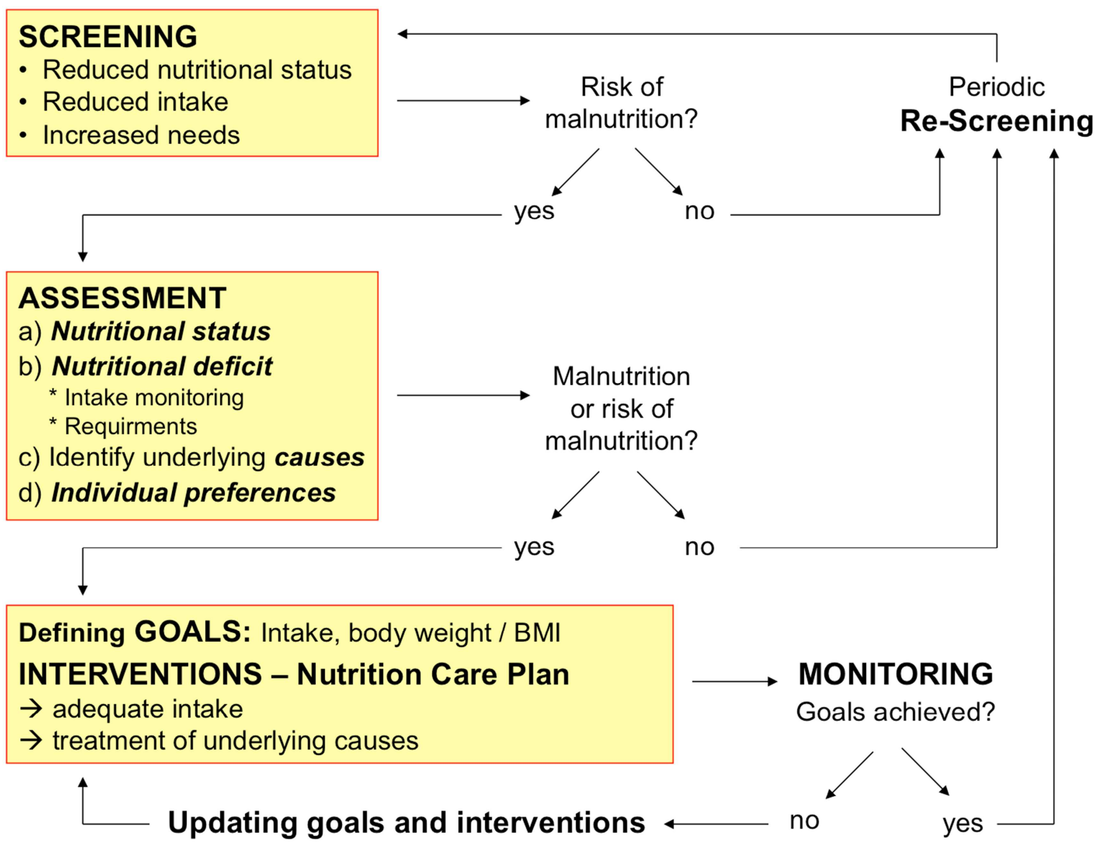

Figure 1: Process of nutritional care for older persons. Modified from (19).

Recommendation 7

In institutional settings, standard operating procedures for nutritional and hydration care shall be established and responsibilities well regulated.
Grade of recommendation GPP – strong consensus (100 % agreement)

Commentary

Based on the recommendations in this guideline, local policies and procedures for nutritional care – including standard operating procedures for regular screening for malnutrition – should be established. In order to assure implementation in every day practice, nutritional strategies should be supported by the head of the institution, and responsibilities well-regulated. Desirably, each geriatric institution should constitute a multidisciplinary team, including a (registered) dietitian, a nurse specialized in nutrition, a medical doctor, housekeeping personnel and representative from all other professions involved in nutritional care in this institution, which develops, implements and supervises local procedures for nutritional care. In geriatric acute care settings, a dietitian should be part of the geriatric team and participate in regular team conferences, ensuring the integration of nutritional interventions in the overall therapeutic concept.

In geriatric acute care and rehabilitation hospital units, nutritional assessment and implementation of a nutritional care plan has been shown to improve energy and protein intake, serum proteins and health-related quality of life of the patients (54). Implementation of a screening and treatment protocol at a geriatric hospital unit including regular team meetings improved body weight and hospital-acquired infections compared to standard care (55). Multidisciplinary nutritional care concepts including regular team meetings increased dietary intake and improved quality of life in hip fracture patients (56), and improved nutritional status, wellbeing and quality of mealtimes in demented nursing home residents (57).

As malnutrition is highly prevalent in older persons, especially if institutionalized, geriatric institutions should provide a defined care plan and adequate resources to screen for malnutrition and identify persons with or at risk of malnutrition as well as to prevent and treat malnutrition. Special attention should be drawn to the interface management, as important information concerning the nutritional situation is frequently lost in the situation of patients' transition to another healthcare sector.

I.3 How should nutritional care be performed in older persons?

<u>Recommendation 8</u>

Nutritional and hydration care for older persons shall be individualized and comprehensive in order to ensure adequate nutritional intake, maintain or improve nutritional status and improve clinical course and quality of life. (BM, PC)

Grade of recommendation A – strong consensus (100 % agreement)

Commentary

Nutritional problems are multifaceted and differ between individuals. Moreover, older persons are heterogeneous regarding health status, prognosis, physiological resources, nutritional needs, preferences, and individual goals. In this light it seems reasonable to adapt nutritional interventions individually. The systematic literature search identified five RCTs providing evidence for comprehensive individualized nutritional interventions in older persons with malnutrition or at risk of malnutrition (58-62). All studies were performed in the hospital setting, studies from the nursing home setting are lacking.

Three RCTs of low to acceptable quality investigated the effects of comprehensive individualized nutritional interventions in older hospitalized patients at nutritional risk with various diagnoses (58, 59) or after acute stroke (60). The studies reported positive effects on energy and protein intake (58, 59), body weight (59, 60), complications, antibiotic use, readmissions (59) and functional measures (59, 60). Additionally, all three studies showed benefits with respect to quality of life in the group receiving individual nutritional care compared to the group with usual care (58-60). No effect was found regarding length of hospital stay (59, 60). In a further RCT of acceptable quality (61), the effect of additional individual nutritional support by dietetic assistants was investigated in older hospitalized patients with hip fracture. The study reported increased energy intake and decreased mortality in the trauma unit and within four months after discharge in the intervention group compared to the group with standard care. The study did not show intervention effects on body weight, grip strength, complications and length of hospital stay. Feldblum et al. (62) extended an individualized nutritional intervention in older internal medical patients to six months after hospitalization and showed an improved MNA score and reduced mortality in the intervention compared to the control group. However, no intervention effects on energy or protein intake, body weight, and functional measures were observed.

Recommendation 9

> Nutritional interventions for older persons should be part of a multimodal and multidisciplinary team intervention in order to support adequate dietary intake, maintain or increase body weight and improve functional and clinical outcome. (BM)
>
> Grade of recommendation B – strong consensus (100 % agreement)

Commentary

Nutritional care comprises different approaches including e.g. dietary counseling, meal enrichment, offering snacks, provision of oral nutritional supplements (ONS), EN or PN (see recommendations 18 to 36), which can complement each other with respect to their effects on dietary intake and nutritional status. Moreover, nutritional care goes beyond pure nutritional interventions, also covering mealtime assistance (see recommendation 12), the adaption of environmental factors (see recommendations 13, and 14) and the elimination of underlying causes (see recommendation 10), turning it into a multidisciplinary action requiring collaboration of dietitians, nurses, kitchen and housekeeping personnel, medical doctors, therapists, family members and of course the patient himself.

The systematic search identified four RCTs with several sub-studies of low to acceptable quality focusing on multimodal and multidisciplinary interventions (combining more than two intervention strategies) in older persons with malnutrition or at risk of malnutrition (63-72). Neelemaat et al. (63) performed a RCT combining different components of nutritional care like energy- and protein-enrichment of diet, provision of ONS as well as calcium and vitamin D supplements, and telephone counseling in older patients from hospital admission up to three month after discharge and reported positive effects on energy and protein intake, vitamin D serum levels and the incidence of falls. In addition cost-effectiveness of the intervention was shown (64). No effects were found regarding body weight, fat free mass, handgrip strength as well as 1- and 4-year mortality (63, 65). Beck et al. (66, 67) conducted a multi-facet intervention in nursing home residents consisting of home-made nutritional supplements, oral care and group exercise resulting in improved protein intake, body weight, physical performance and social activity. The study showed no significant effect on energy intake. In an 11-week cluster RCT with older malnourished people receiving home care or living in nursing homes (68, 69) a multidisciplinary intervention with nutritional support, physio- and occupational therapy was implemented, showing positive effects on quality of life, ability to stand up from a chair and oral care. Moreover, the intervention was cost-effective (69). The RCT, however, did not find differences in body weight, handgrip strength, falls, institutionalization rates and mortality between the intervention and the control group (68, 69). A RCT in older patients with hip fracture reported beneficial results of a comprehensive rehabilitation program including nutritional intervention on length of hospital stay, activities of daily living and mobility after twelve months (70) as well as on in-hospital falls and fall-related injuries (71). A sub-study including only patients with complete MNA at baseline and 4-months follow-up showed significantly fewer days of delirium, less new pressure ulcers and reduced length of hospital stay in the intervention group than in the control group. BMI and MNA, however, remained unchanged (72) (see also recommendation 46).

These studies illustrate the complexity of the situation and underline the importance of a comprehensive treatment approach in older patients. Consequently, clinical nutrition interventions shall be part of a multimodal and multidisciplinary geriatric team intervention. Because of partly inconsistent results, the evidence grade was reduced from A to B.

<u>Recommendation 10</u>

Potential causes of malnutrition and dehydration shall be identified and eliminated as far as possible.

Grade of recommendation GPP – strong consensus (95 % agreement)

Commentary

Potential causes of poor intake and/or poor nutritional status in older persons are manifold and should be explored systematically, e.g. by check-lists and subsequent assessment and diagnostic clarification. Swallowing evaluation, dental examination, oral and general health assessment and check-up of medications for potential side effects impeding adequate nutrition (e.g. by causing anorexia, xerostomia, dysgeusia, gastrointestinal disorders or somnolence), for example, may uncover eating obstacles and provide starting points for adequate interventions. In institutionalized older people, eating and feeding problems are widespread and should also be identified, e.g. by informal observation during meals, and eliminated as far as possible by appropriate remedial actions (73). Potential causes of malnutrition in older persons and according interventions are shown in ***Table 7***.

Table 7: Potential causes of malnutrition and reasonable interventions

Potential cause	Potential interventions
Chewing problems	• oral care • dental treatment • texture modified diet, if adequate
Swallowing problems (dysphagia)	• professional swallowing evaluation • swallowing training • texture-modified diet, according to swallowing evaluation
Impaired upper extremity function	• physiotherapy, occupational therapy • adequate help with eating and drinking (e.g. cutting food, hand-feeding) • provision of adequate eating and drinking aids • finger foods • shopping / cooking aid, meals on wheels
Restricted mobility, immobility	• physiotherapy • resistance training • group exercise • shopping / cooking aid, meals on wheels
Cognitive impairment	• supervision of meals • adequate meal assistance (e.g. verbal prompting, help with eating) • shopping / cooking aid, meals on wheels • family style meals in institutions
Depressive mood, depression	• adequate medical treatment

	• eating and drinking with others / shared meals • pleasant meal ambience / eating environment • group activities, occupational therapy
Loneliness, social isolation	• eating and drinking with others / shared meals • group activities
Poverty	• social programs
Acute disease, (chronic) pain	• adequate medical treatment
Adverse effects of medications (e.g. xerostomia, apathy)	• check medication for potential side effects • reduce dose of medication • replace or stop medications
Restricted diets	• revision and liberalization of dietary restrictions

Recommendation 11

> Dietary restrictions that may limit dietary intake are potentially harmful and should be avoided.
>
> Grade of recommendation GPP – strong consensus (91 % agreement)

Commentary

Dietary restrictions are one potential cause of malnutrition since they may limit food choice and eating pleasure and thus bear the risk of limiting dietary intake. As recently reviewed by Darmon et al. (74), restrictive diets furthermore seem to be less effective with increasing age, albeit data about their effects in older persons are rare. In one study, ambulatory patients older than 75 years following a low salt, low cholesterol or diabetic diet for 11 ± 6 years were found to be at increased risk of malnutrition compared to age- and gender-machted controls (75). In a position statement, the American Dietetic Association concludes that liberalization of diet prescriptions for older adults in long-term care may enhance nutritional status and quality of life (76). Due to the risk of malnutrition, future studies about the effects of restrichtive diets in old age are unlikely, and itis good clinical practice to liberalize dietary restrictions in older persons in order to reduce the risk of malnutrition and related loss of fat-free mass and functional decline.

II. Recommendations for older persons with malnutrition or at risk of malnutrition

Supportive interventions

II.1 Should older persons with malnutrition or at risk of malnutrition be offered mealtime assistance?

<u>Recommendation 12</u>

Older persons with malnutrition or at risk of malnutrition and with eating dependency in institutions (A) as well as at home (GPP) shall be offered mealtime assistance in order to support adequate dietary intake. (BM)
Grade of recommendation A / GPP – strong consensus (100 % agreement)

Commentary

Many older persons are restricted in their ability to eat and drink independently due to functional and cognitive limitations. Support may be needed ranging from adequate positioning at a table and verbal prompting to direct physical assistance to bring foods and fluids into the mouth.

The literature search identified three SLRs which were considered relevant to the key question and all rated as high quality (77-79). The SLR by Tassone et al. (79) examined the effects of mealtime assistance provided to hospitalized patients (≥65 years) by nurses, trained staff or volunteers. Outcomes assessed were nutritional status including anthropometric measures and energy and protein intake. A total of five studies were included. Two of the studies reported on the participants' nutritional status prior to the intervention, with a number of those in the intervention group being malnourished or at-risk of malnourishment. Four of the five (including one RCT) could be combined for meta-analysis. Assistance provided at mealtimes in these studies included setting up meal trays, positioning patients in a comfortable position, opening food and beverages, removing lids, feeding patients, encouraging intake and providing social support at the mealtime. Overall, mealtime assistance significantly improved daily energy and protein intake. The two SLRs by Abdelhamid et al. (78) and Abbott et al. (77) dealt with several interventions including eating and drinking assistance provided to old people in institutions. Outcomes in general were those related to nutrition or fluid intake. Nutritional status is not reported for any of the studies, but the overall aim was to improve, maintain or facilitate dietary intake, suggesting that participants were at risk of or already malnourished. Abbott et al. (77) included six feeding assistance studies. Two RCTs (80, 81) and three pre-post comparisons (82-84) assessed the effects of positive reinforcement, correct positioning and feeding assistance, and all described positive effects on dietary intake. Marginal, non-significant improvements in food intake were also reported from a pre-post trial of reminiscence therapy during mealtimes in a very small study including seven residents with dementia (85). Abdelhamid et al. (78) focused on institutionalized persons with dementia and described six studies, where feeding assistance was mainly part of complex interventions to support food and drink intake, which made it difficult to conclude which part of the intervention was responsible for the observed effects.

No intervention studies have been performed among old people in home-care where malnutrition and risk of malnutrition are also prevalent. Nevertheless, it is reasonable to assume that eating-dependent older persons living in private households may also benefit from mealtime assistance.

II.2 Should food intake in older persons with malnutrition or at risk of malnutrition be supported by a home-like, pleasant dining environment?

<u>Recommendation 13</u>

In institutional settings, food intake of older persons with malnutrition or at risk of malnutrition shall be supported by a home-like, pleasant dining environment in order to support adequate dietary intake and maintain quality of life. (BM, PC)

Grade of recommendation A – strong consensus (100 % agreement)

Commentary

Environmental factors play an important role for the atmosphere during mealtimes, among them eating location, furniture and meal companions, ambient sounds, odors, temperature and lighting, food accessibility, portion size and presentation of the food (86, 87). These factors are known to be important determinants of food intake and can be modified in order to support adequate dietary intake in persons with eating difficulties.

Literature search identified two relevant SLRs to be included (77, 88), both of high quality. The SLR by Abbott et al. (77) examined the effectiveness of mealtime interventions for older persons living in residential care. Outcomes assessed were either those directly related to food intake or those related to nutritional or functional status. Data on dietary satisfaction and quality of life, where measured, were also outcomes of interest. A total of 11 studies assessed the effect of dining environment alteration and three of these were RCTs. In these three studies participants were older than 65 years and living in residential homes and hence with malnutrition or at risk of malnutrition. All three assessed the effect of enhancing the ambience of the dining room environment along with the introduction of family style meals and greater staff assistance. Meta-analysis results were in favor of the intervention regarding body weight (all three RCTs) and energy intake (two RCTs) but not significant. One of the studies (89) reached individual significance. Findings from the non-randomized studies were also mixed, but the authors conclude that positive findings prevail. Two of the RCTs also assessed the effects on quality of life and both found maintenance of reported quality of life in contrast to a significant decrease in residents dining in their usual conditions. The SLR by Bunn et al. (88) focused on interventions to indirectly promote dietary intake in persons with dementia across all settings and levels of care including a wide range of different outcomes. Nutritional status is not reported for any of the studies but the overall aim was to improve, maintain or facilitate food/drink intake, suggesting that participants were at risk of or already malnourished. Seventeen studies (no RCTs) were found reporting effects of changes to aspects of the dining environment or food service, but interventions were very heterogeneous and partly included multiple components, and a high risk of bias was reported for all studies. The authors conclude that family style meals and soothing mealtime music are promising interventions, among others, to support eating and drinking in persons with dementia (88).

II.3 Should older persons with malnutrition or at risk of malnutrition be encouraged to share their mealtimes with others?

<u>Recommendation 14</u>

Older persons with malnutrition or at risk of malnutrition should be encouraged to share their mealtimes with others in order to stimulate dietary intake and improve quality of life.
Grade of recommendation GPP – strong consensus (100 % agreement)

Commentary

Eating is a social act, and eating in company is known to stimulate dietary intake, also in older persons (86, 90). Older persons living alone and also nursing home residents however often miss company and conversation during mealtimes. In an observational study in 50 older home health service receivers a significantly higher intake of energy in persons who had others present during meals was observed compared to those who ate alone (91). Higher energy intakes were also observed in older hospitalized patients attending a dining room compared to those eating by their bedside (92). The stimulating effect of eating company seems to be dependent on the number of persons present at a meal as well as on the relationship between these persons: The more people are present, and the better known these persons are the more food is eaten (86). People in general are more relaxed and comfortable with familiar persons. As a consequence they stay longer at the table and continue to eat which may result in an increased dietary intake. Furthermore, a direct behavioral effect is assumed that people adapt their intake to the eating behavior of their companions (86). This effect might especially be helpful in older persons with cognitive impairment who are digressing and forgetting to eat and may be stimulated by other persons serving as a model.

Literature search identified a systematic review of high quality about the effectiveness of interventions to support dietary intake in persons with dementia (78), including mealtime interventions with a strong focus on the social elements of eating and drinking. No RCTs but four non-randomized trials (all among people above 65 years of age) were identified, assessing the effect of e.g. shared mealtimes with staff or implementation of a breakfast club on various outcome parameters. Although these studies were small and of low quality, they provided consistent suggestion of improvements in aspects of quality of life. In one of these studies the effect on body weight is reported with a significant increase after three months compared to the control group (93). It is however stressed that in case of specific problems and desires, individual approaches are needed, e.g. some older people may be agitated during meals causing disturbances in the dining room. Some older persons may find it disturbing to eat when they have to eat with other people with inferior hygiene and eating habits. On the other hand persons with severe eating problems may struggle to behave in accordance with their own standards, and it has been suggested that the lack of eating competences leads to small portions to decrease exposure to failures in the presence of others (94). As for all other interventions, here also decisions shall always be individualized according to the persons needs and preferences.

II.4 Should home-dwelling older persons with malnutrition or at risk of malnutrition be offered specific meals on wheels?

Recommendation 15

> Meals on wheels offered to home-dwelling older persons with malnutrition or at risk of malnutrition should be energy-dense and/or include additional meals to support adequate dietary intake. (BM)
>
> Grade of recommendation B – strong consensus (97 % agreement)

Commentary

Home-delivered meals, also called meals on wheels (MoW), are a valuable option for older persons living in private households who are unable to shop and prepare their meals by themselves. Purchase of this service may enable older persons to remain living in their own homes and contribute to adequate dietary intake of these persons. It might be especially helpful in situations of transition from institutional settings to the private household where patients are in a recovery phase and limited in their activities. Quality and effectiveness of home-delivered meals depend on many factors, and several studies suggest that nutritional intake of MoW consumers is below recommended levels (95). A recent review about home-delivered meals admits that the effects of this service are difficult to evaluate (96), but it seems reasonable to assume that persons who are otherwise unable to obtain regular meals may benefit from this support. The question however arises if home-delivered meals should meet specific requirements for persons with malnutrition or at risk of malnutrition.

Literature search identified two SLRs considered relevant to the PICO question (97, 98). Baldwin et al. (97) examined supportive interventions for enhancing dietary intake in malnourished or nutritionally at-risk adults in a recent Cochrane review and included two RCTs about the effects of specifically modified home-delivered meals (99, 100). Campbell et al. (98) focused on home-delivered meal programs, but this SLR was rated to be of low quality. Among 80 studies included, the same two RCTs comparing specific modes of MoW were identified which are used here to answer the PICO question. The RCT from Silver et al. (100) found that enhancing the energy density of food items regularly served in a home-delivered meals program increased lunch and 24-hour energy and nutrient intakes in a 1-day intervention. Although mean BMI was approximately 24 kg/m^2, almost half of the participants had lost at least 5 lb. during the prior six months. In the study by Kretser et al. (99) participants received either the traditional MoW program of five hot meals per week (providing 33 % of RDA), or the restorative, comprehensive new MoW program of three meals and two snacks per day, seven days a week for six months (providing 100 % of RDA). Almost all participants were malnourished or at risk of malnutrition according to MNA. The new MoW group gained significantly more weight than the traditional MoW group (99).

Because of presently limited evidence regarding specific modes of home-delivered meals grade of recommendation was downgraded to B.

II.5 Should older persons with malnutrition or at risk of malnutrition be offered nutritional education as part of a comprehensive intervention concept?

<u>Recommendation 16</u>

Older persons with malnutrition or at risk of malnutrition should be offered nutritional information and education as part of a comprehensive intervention concept in order to improve awareness of and knowledge about nutritional problems and thus promote adequate dietary intake. (BM)
Grade of recommendation B – strong consensus (94 % agreement)

Commentary

According to the Council of Europe (101) the majority of patients are not aware of the importance of a good nutritional status to secure a proper medical treatment. For example few patients are aware of the fact that a weight loss in relation to disease will increase their risk of complications. Therefore the Council of Europe recommends that the topic of patient information and education should receive high priority in educational themes at all levels (101). However, the focus of this report was not specifically on older patients.

Literature search identified two SLRs on this topic to be included (88, 102), one (88) was rated as high quality and the other (102) as acceptable. Young et al. (102) reviewed the evidence regarding effectiveness of nutritional education or advice on physical function, emotional health, quality of life, nutritional indices, anthropometric indicators, mortality, service use and costs of care in people over 65 years of age living at home. The main focus of the education was on healthy life style, and the intervention was mainly provided by nurses and in some cases dieticians. Five studies (of 23) had nutritional education as the sole constituent of the program, whilst the rest included it as part of a more complex intervention. There was very limited information about the nutritional status of the participants but few were probably malnourished or at risk of malnutrition. Based on the results presented in the SLR it is not possible to make any specific conclusions about this group. The SLR by Bunn et al. (88) included interventions with an educational and/or awareness component for persons with dementia and/or their formal or informal care-givers. The overall effect on nutritional status in the three RCTs included was very limited.

Despite presently poor scientific evidence we recommend to improve nutritional awareness and knowledge of older persons with malnutrition or at risk of malnutrition by information and education as one of several strategies to support adequate dietary intake. If care-givers are involved in nutritional matters, e.g. in case of cognitive impairment, they should also be addressed (see recommendation 17). For quality assurance reasons, it is desirable that nutritional information and education is given by a nutritional expert, e.g. a dietician.

II.6 Should food intake in older persons with malnutrition or at risk of malnutrition be supported by education of their caregivers?

<u>Recommendation 17</u>

> Health care professionals as well as informal caregivers should be offered nutritional education in order to ensure awareness of and basic knowledge on nutritional problems and

thus promote adequate dietary intake of older persons with malnutrition or at risk of malnutrition. (BM)

Grade of recommendation B – strong consensus (95 % agreement)

Commentary

One of the barriers to proper nutritional support in hospitals highlighted by the Council of Europe was lack of sufficient education with regard to nutrition among all staff groups, and it was concluded that a general improvement in the educational level of all staff groups is needed (101).

Literature search identified three relevant SLRs (77, 88, 103), two (77, 88) of high and one (103) of average quality. In the SLR by Abbott et al. (77), six studies examined the effectiveness of staff training in residential care regarding either food intake or nutritional status. The only RCT found no effect on dietary intake of residents with dementia in spite of increased knowledge. Positive effects were reported in two controlled trials on body weight and in two pre-post studies on dietary intake. The SLR by Bunn et al. (88) addressed the effectiveness of a range of interventions including education or training for people with dementia and/or their formal or informal care-givers. Nutritional status was not reported in any of the studies but the overall aim to support dietary intake suggests that participants were at risk of malnutrition or already malnourished. The SLR found 15 studies including six RCTs, all with high or unclear risk of bias. Study designs and results were heterogeneous with overall no definitive evidence on effectiveness or lack of effectiveness. Altogether, education and support for formal and informal care-givers was rated as promising intervention. The SLR by Marshall et al. (103) examined if informal carers and community care workers are effective in managing malnutrition in older adults living in the community regarding a range of outcomes. Based on eleven studies (including six RCTs) using varying types of interventions the SLR concluded that interventions targeted at identifying, preventing and/or treating malnutrition were able to improve or prevent decline in nutritional and functional status without increasing informal carer burden.

Despite presently poor scientific evidence we recommend to improve nutritional awareness and knowledge of formal as well as informal caregivers by nutritional education as one of several strategies to support adequate dietary intake of older persons with malnutrition or at risk of malnutrition. For quality assurance reasons, it is desirable that nutritional information and education is given by a nutritional expert, e.g. a dietician.

Nutritional counselling

II.7 Should older persons with malnutrition or at risk of malnutrition be offered individualized nutritional counselling?

Recommendation 18

> Older persons with malnutrition or at risk of malnutrition and/or their caregivers should be offered individualized nutritional counselling in order to support adequate dietary intake and improve or maintain nutritional status. (BM)
>
> Grade of recommendation B – strong consensus (100 % agreement)

Recommendation 19

> Individualized nutritional counselling should be offered by a qualified dietician to these persons and/or their caregivers, should consist of several (at least 2) individual sessions that may be combined with group sessions, telephone contacts and written advice and should be maintained over a longer period of time.
>
> Grade of recommendation GPP – strong consensus (97 % agreement)

Commentary to recommendations 18 and 19

Nutritional counselling by a health care professional is regarded as the first line of nutrition therapy. It is a supportive process consisting of repeated personal talks and discussions with the patient with the aim to develop a sound understanding of nutritional topics and support favorable health-promoting eating habits (104, 105). Individual counselling should be performed by trained nutrition professionals (registered/accredited dieticians or nutritionists) and may be combined with educative group sessions, written advice and/or telephone contacts and all other forms of nutritional therapy.

Literature search identified one guideline (53) and a SLR (106) which were considered relevant to the key question. The identified Danish guideline was developed by means of the GRADE approach and the quality was rated high. The SLR by Munk et al. (106) was conducted according to the methods of the Cochrane Collaboration and the level of quality was assigned as being high. The Danish guideline (DHMA) (53) comprised two PICOs relevant for the present guideline. Assessed outcomes for both PICOs were intake of energy and protein, weight (end of treatment and longest follow-up), mobility, muscle strength, activities of daily living, quality of life, and gastro-intestinal disturbances. The first PICO question addressed was: Should geriatric patients with loss of weight and function be offered individualized dietary counselling or standard nutritional support (brief general dietary advice or standard ONS prescription)? Four studies, published in seven papers, were identified that could answer this question (107-113), all were judged to be of low quality. Only one of the studies used individual nutritional counselling as stand-alone intervention, and the four studies were very heterogeneous regarding participants/setting as well as modes of dietary counselling. The narrative summation and meta-analysis did not find any significant effects, but calculated pooled estimates showed a trend in favor of the individualized dietary counselling for most outcomes considered. Therefore, a weak recommendation for this approach is given in the Danish guideline ("Individual dietary counselling may be considered ...") (53).

The second PICO question addressed in the Danish guideline was: Should geriatric patients with loss of weight and function be offered a short period (≤12 weeks), or a longer period (more than twelve weeks) of nutritional counselling? As no studies were found that could answer this question, DHMA made a good practice point in favor of the longer intervention period (53).

The SLR by Munk et al. (106) aimed to evaluate the evidence for an effect of individualized dietary counselling in nutritionally at risk older patients after discharge from an acute hospital. Outcomes assessed were energy and protein intake, nutritional status, physical function, quality of life, hospital readmissions and mortality. Four RCTs were included, which all were rated to be of high risk of bias, mainly because of lack of blinding and high drop-out rates (62-64, 107, 114, 115). In one of these studies, caregivers were involved as far as possible (114). The intervention schemes varied, consisting of no or one counselling sessions during hospital stay and three to six sessions after discharge (conducted as home visits or by telephone) over 8-16 weeks. Two studies included additional standardized prescription of ONS and vitamins (63, 64, 107, 115), in the other two studies ONS could be part of the individual care plan resulting from counselling (62, 114). The meta-analysis found positive effects on body weight, energy and protein intake but no effect on hand grip strength or mortality compared to brief dietary advice or nothing at all. Due to lack of data, conclusions with regard to quality of life and hospital admissions were not possible.

Due to the limited quality of the original studies, restriction to hospital discharge in some of the studies and only rare involvement of caregivers, the recommendation was downgraded to B. In order to be effective, the counselling should consist of several sessions over a longer period of time (at least eight weeks).

Food modification

II.8 Should older persons with malnutrition or at risk of malnutrition be offered food-based fortification?

<u>Recommendation 20</u>

Older persons with malnutrition or at risk of malnutrition should be offered fortified food in order to support adequate dietary intake. (BM)
Grade of recommendation B – strong consensus (100 % agreement)

Commentary

Food fortification (or dietary enrichment) by using natural foods (e.g. oil, cream, butter, eggs) or specific nutrient preparations (e.g. maltodextrin, protein powder) can increase energy and protein density of meals and beverages and thus enable an increased intake by eating similar amounts of food.

Literature search identified two SLRs (116, 117) which were both considered relevant and rated of acceptable quality. The SLR by Trabal & Farran-Codina (117) examined the effects of dietary enrichment with conventional foods on energy and protein intake, nutritional and functional status, and episodes of infection. Nine studies (including three RCTs and four cluster RCTs) were included, four performed in nursing homes, four in hospitals and one at home, with a mean age of participants between 67 and 91 years. Nutritional status was specified in only two studies where participants were described as malnourished or at risk of malnutrition. In all studies meals were enriched with energy, in five studies in combination with protein. Three studies included snacks in the intervention in addition to the enriched meals. In seven out of nine studies using energy enrichment a significant increase in energy intake was observed and in three out of five studies using protein enrichment a significant increase in protein intake was observed. Reporting on other outcomes was scarce and the quality of studies was described as heterogeneous, e.g. the amount of enrichment was often not clearly reported (117).

Morilla-Herrera et al. (116) also examined the effectiveness of food-based fortification by means of macronutrients in older people in a SLR. They included seven studies (all RCTs) with a mean age of participants above 65 years either using additional foods and snacks or increasing energy and nutrient density of the meals. Participants were frail community-dwelling or institutionalized and may thus be regarded as malnourished or at risk of malnutrition. Meta-analysis of four RCTs resulted in significant increases of energy and of protein intake. Due to heterogeneity of the studies, small numbers of participants and poor quality of some studies, the authors concluded that further high quality studies are required to provide reliable evidence (116).

Literature about food fortification with micronutrients was recently summarized in a scoping review for residential care (118) but evidence is presently insufficient to derive specific recommendations in this regard.

II.9 Should older persons with malnutrition or at risk of malnutrition be offered additional snacks, and/or finger food?

Recommendation 21

> Older persons with malnutrition or at risk of malnutrition should be offered additional snacks, and/or finger food, in order to facilitate dietary intake.
>
> Grade of recommendation GPP – strong consensus (100 % agreement)

Commentary

Dietitians and other healthcare professionals traditionally use a number of dietary strategies to improve the energy and nutrient intake of older adults with malnutrition or at risk of malnutrition including the use of snacks between meals or finger foods, the latter in particular for persons who have difficulties using cutlery and remaining at the table for the entire duration of a meal.

Literature search identified four SLRs that included studies offering additional snacks and/or finger foods (78, 88, 116, 117). The SLRs from Abdelhamid et al. (78) and from Bunn et al. (88), both focusing on people with dementia, were rated to be of high quality. Morilla-Herrera et al. (116) and Trabal & Farran-Codina (117) examined the effects of food fortification and included some studies which offered additional snacks along with food fortification strategies. The quality of both SLRs was rated as acceptable. Effects of snacks were however not analyzed separately and thus no specific conclusions were possible in this regard. In combination with food fortification positive effects on intake are described (116, 117) (see recommendation 20). Abdelhamid et al. (78) describe two non-randomized trials examining the use of finger foods. One evaluated six months of a finger food menu for twelve cognitively impaired residents with poor dietary intake and limited use of cutlery, finding weight-loss stopped in ten out of twelve participants and eating independence improved (though no numbers or statistical analysis were provided) (119). The other assessed effects of increased finger food provision on weight and food consumption of 43 care center residents with Alzheimer´s disease (120). The number of finger food offered could only be slightly increased. The proportion of food eaten also slightly increased but no effect on body weight was observed. Bunn et al. (88) also included the above mentioned study from Jean et al. (119) about finger foods in their SLR. In addition one study offering finger food (121) and one study offering additional snacks (122) as part of comprehensive mealtime interventions are described where the effects of finger foods and snacks however cannot be separated from the other intervention components. One study using a glass-door refrigerator filled with snacks accessible at all times and additional time for meals reported an increased BMI after twelve weeks in 40 inpatients with dementia (123). Based on this before-after study, constantly accessible snacks and additional time for meals are described as promising intervention needing high-quality reassessment (88). In an additional relevant trial in older long-term-care residents at risk of malnutrition, the offering of three snacks between main meals and before bed resulted in an increase in energy intake by about 30 % after three and after six weeks (124).

Due to little expense and no risk of harm we recommend additional snacks and/or finger food despite presently very limited scientific evidence.

II.10 Should older persons with malnutrition or at risk of malnutrition be offered texture-modified food?

Recommendation 22

Older persons with malnutrition or at risk of malnutrition and signs of oropharyngeal dysphagia and/or chewing problems shall be offered texture-modified, enriched foods as a compensatory strategy to support adequate dietary intake.

Grade of recommendation GPP – strong consensus (100 % agreement)

Commentary

Chewing and swallowing problems limit the ability to eat food of normal texture and thus increase the risk of malnutrition. Both problems are widespread in older persons. Texture-modified foods intend to compensate for these functional limitations and hence support an adequate dietary intake. Texture-modification can also make the swallowing process slower and thereby safer (125, 126). Nevertheless, insufficient dietary intake is described in older persons with dysphagia receiving texture-modified diets (33-35, 127).

Literature search identified one guideline giving evidence-based recommendations for the use of texture-modified diets for adults with oropharyngeal dysphagia (128), which was recently updated (129) and considered relevant to the key question. The guideline was developed as recommended by the Danish Centre for Clinical Guidelines. The quality of the update was assigned as high. In the underlying systematic search no literature assessing the effects of texture-modified food was found, and it was concluded that it is 'good clinical practice' to offer modified foods as a compensatory strategy to facilitate the intake of foods.

At present, also no studies about the effects of enrichment of texture-modified diets are available, but based on positive effects of enrichment of regular texture diets (see recommendation 20) it is assumed that enrichment can have similar effects in texture-modified diets for patients with chewing and/or swallowing problems. As texture-modified diets are usually accompanied by reduced food and fluid intake, nutritional intake should be closely monitored. For more detailed recommendations for patients with dysphagia we refer to the ESPEN Guideline Clinical Nutrition in Neurology (130).

Oral Nutritional Supplements

II.11 Should older persons with malnutrition or at risk of malnutrition be offered oral nutritional supplements?

ONS are energy and nutrient dense products designed to increase dietary intake when diet alone is insufficient to meet daily nutritional requirements. There are a wide range of ONS styles (milk, juice, yoghurt, savory), formats (liquid, powder, pudding, pre-thickened), volumes, types (high protein, fiber containing), energy densities (one to three kcal/ml) and flavors available to suit a wide range of needs and requirements. ONS are classified “high protein” when they provide > 20 % of energy from protein and “high energy” when they provide > 1.5 kcal/ml or gram.

<u>Recommendation 23</u>

> Older persons with malnutrition or at risk of malnutrition with chronic conditions shall be offered ONS when dietary counselling and food fortification are not sufficient to increase dietary intake and reach nutritional goals.
>
> Grade of recommendation GPP – strong consensus (100 % agreement)

<u>Recommendation 24</u>

> Hospitalized older persons with malnutrition or at risk of malnutrition shall be offered ONS, in order to improve dietary intake and body weight, and to lower the risk of complications and readmission. (BM)
>
> Grade of recommendation A – strong consensus (100 % agreement)

<u>Recommendation 25</u>

> After discharge from the hospital, older persons with malnutrition or at risk of malnutrition shall be offered ONS in order to improve dietary intake and body weight, and to lower the risk of functional decline. (BM)

Grade of recommendation A – strong consensus (100 % agreement)

Recommendation 26

Oral nutritional supplements offered to an older person with malnutrition or at risk of malnutrition, shall provide at least 400 kcal/day including 30 g or more of protein/day. (BM)

Grade of recommendation A – strong consensus (97 % agreement)

Recommendation 27

When offered to an older person with malnutrition or at risk of malnutrition, ONS shall be continued for at least one month. Efficacy and expected benefit of ONS shall be assessed once a month.

Grade of recommendation GPP – strong consensus (100 % agreement)

Recommendation 28

When offered to an older person with malnutrition or at risk of malnutrition, compliance in ONS consumption shall be regularly assessed. Type, flavor, texture and time of consumption shall be adapted to the patient's taste and eating capacities.

Grade of recommendation GPP – strong consensus (100 % agreement)

Commentary to recommedations 23 - 28

Dietary counselling (see recommendations 18 and 19), food fortification (see recommendation 20), additional snacks (see recommendation 21) and ONS are options to increase daily dietary intake by the oral route. However, only a very small number of studies have compared the effectiveness of ONS to that of “normal food” support strategies in older persons. In older persons living at home, requiring community services and at elevated risk of malnutrition, weight gain was greater and the number of falls was lower in the “ONS provided by a dietician group” than in the “dietician visit only” group (131). In older residents of long term care, energy intake was increased by 30 % with snack foods and by 50 % with

ONS (124). In older malnourished care home subjects, ONS resulted in a higher energy and protein intake and better quality of life than dietary counselling (132). However, dietary counselling and food modifications may be better accepted for long duration, and are cheaper, so we suggest that in chronic clinical situations such as observed in the community or in nursing homes, they may be proposed first, and that ONS be proposed when dietary counselling and food fortification are not sufficient to reach nutritional goals. It is important to mention, however, that these different options to support adequate intake should not be seen as mutually exclusive, but as complementing each other.

Systematic literature search found six high quality SLRs including up to 62 randomized or quasi-randomized clinical trials which have assessed the efficacy of ONS versus usual care in older persons (97, 133-139).

Milne and colleagues undertook systematic reviews restricted to older patients (mean age of population > 65 years) receiving protein and energy supplementation, usually in the form of sip feeds, versus usual care, first in 2002 (31 trials), with an update in 2005 (49 trials) and lastly in 2009 (62 trials) (135-137). Although studies took place in a variety of settings, most participants were hospitalized in-patients with acute conditions. Studies showed a benefit of supplementation on nutritional intake and on percentage weight change. Meta-analysis in 2002 and 2005 showed a significantly reduced total mortality in supplemented compared with control groups; this was not observed in 2009. Subgroup analyses regarding mortality were consistently statistically significant when limited to trials with participants who were defined as malnourished and when 400 kcal or more was provided per day by ONS. Subgroup analyses limited to participants who were at least 75 years old, when supplementation was continued for 35 days or more, and when participants were unwell produced contradictory results regarding mortality risk. In all three reviews, the risk of complications by the end of follow-up in supplemented groups was not statistically significantly different from that in the control groups. No statistically significant effect of supplementation was reported for hand grip strength, and it was not possible to combine trials for meta-analyses of other functional outcome parameters.

The systematic review from Cawood et al. (139) involved 36 RCTs using high protein ONS (>20% energy from protein) of any consistency (ready-made liquid, powder, puddings) for any duration. Population study groups had a mean age of 74 years (83 % of trials were performed in patients >65 years). Studies with participants in any nutritional status (well-nourished and malnourished) and from any setting were included. Compared to usual care, high protein ONS demonstrated a range of effects across settings and patient groups including reduced risk of complications, reduced risk of readmissions to hospital, improved grip strength, increased intake of protein and energy with little reduction in normal food intake and improvements in body weight. There was inadequate information to compare high protein ONS to standard ONS (<20% energy from protein). There was no overall significant effect on mortality and length of stay in the hospital. High protein ONS that provided > 400 kcal/day (16 trials) contained in mean 29 % of protein (20 – 40 %). Thus, we recommend that ONS shall provide at least 400 kcal with 30 % of the energy as protein, corresponding to 30 g of protein.

The meta-analysis from Stratton et al. (138) focused on the impact of ONS on hospital (re)admissions and showed significant reductions with ONS vs. routine care using data from six RCTs of which five were performed in older persons. In the five RCTs that recorded specifically readmissions after hospital discharge, the reduction of readmissions was also significant.

The SLR and meta-analysis from Baldwin et al. (97) included 41 trials addressing different interventions in adults to support dietary intake. In the ten trials that focused on supplementation of meals, nine used energy-protein ONS, one used a fat emulsion. Eight studies included exclusively older persons; one other study included malnourished hospitalized patients (70 ± 13 yrs.) and the last study included 4,023 stroke patients (71 ± 12 yrs.) of which only 8 % were malnourished. It is important to note that studies with individually adapted ONS were excluded. Overall results show no effect on mortality, length of hospital stay or readmissions. There was no subgroup analysis. It is possible that the large number of well-nourished stroke patients had a strong impact on the overall negative results.

The SLR and meta-analysis from Bally et al. (133) included 22 trials focusing on nutritional support in malnourished medical inpatients. Nutritional support was mostly ONS, but the authors also considered mixed interventions, oral glucose supplement with vitamins, unspecified clinical nutrition plans, or nutritional care from health care assistants and snacks. Fifteen trials were performed in older patients, eleven with ONS alone, two with ONS included in mixed interventions and two with other nutritional support plans. The authors underline the high heterogeneity of the trials. Results show a positive significant effect of nutritional support on energy and protein intake and body weight. Non-elective readmissions were significantly decreased by the intervention. There was no effect on mortality, hospital acquired infections, Barthel index or length of stay in the hospital. There was no subgroup analysis based on age or disease. This meta-analysis mostly reinforces previous results from Cawood et al. (139) and Stratton et al. (138), strongly suggesting that nutritional support decreases readmissions in hospitalized patients, including older patients, with malnutrition or risk of malnutrition.

Interesting data come from hospital post-discharge RCTs. A systematic review (134), including six trials with hospitalized older patients who were malnourished or at risk of malnutrition found evidence for increased dietary intake and body weight after discharge with oral nutritional supplements (ONS). In pooled analyses, no significant effects were found with respect to mortality or readmission risk. Two studies found a positive effect on functional outcomes (hand grip (140) and activities of daily living (141)). Two other RCTs (not included in this systematic review) studied the effects of a combined dietary counselling and ONS intervention after hospital discharge and reported prevention of weight loss and improved ADL functions (107) and decreased functional limitations (64, 115). Thus, individual RCTs suggest that nutritional interventions may support improvement of functional status post-discharge.

In a recent large multicenter RCT, which was not included in the previous SLRs, the effects of a high-protein ONS containing beta-hydroxy-beta-methylbutyrate were examined in 652 malnourished older hospitalized patients (142). No significant between-group differences were observed for 90-day readmission rate, but 90-day mortality was significantly lower with the ONS relative to placebo, which is different to the results reported above and certainly needs further investigations.

Regarding length of time of the intervention, subgroup analysis in the meta-analyses from Milne et al. both 2002 and 2005 showed a consistently statistically significant impact of ONS on mortality when supplementation was continued for 35 days or more compared to less than 35 days (135, 136). This effect was no longer observed in the updated review in 2009 (137), and this issue was not addressed in other SLRs. However, it is important to note that in the 2009 update, the duration of the nutritional intervention was ≥ 35 days in 70% of the trials. Furthermore, older malnourished patients need a higher energy supply than younger adults to gain weight, and the increase in body weight and fat free mass in response to equal energy supply is slower in older patient (143). Thus, nutritional interventions are likely to need time to be effective on nutritional status and other clinical outcomes. So, we recommend to consume ONS for at least one month.

The frequency of reported nutritional assessment in clinical trials is usually limited to the baseline and final assessments, and information on more often and continued monitoring of the nutritional situation is lacking. There was however consensus among the experts that nutritional status (body weight), appetite and clinical situation should be assessed at least once a month, when ONS are offered to older persons, to monitor the effects and expected benefits of the intervention as a basis to decide on continuation or cessation of the therapy.

To achieve beneficial effects, compliance is crucial. Compliance with ONS is usually reported to be good in clinical trials. In 46 clinical trials in mostly older participants across healthcare settings (mean age 74 years), overall compliance was 78 %, better in the community (81 %) than in the hospital (67 %) (144). Compliance was higher in older than in younger patients. A close correlation between the amount of energy from ONS prescribed and the amount consumed was reported. There was also a significant positive correlation between compliance and total energy intake (energy intake from food plus ONS energy intake), showing that ONS consumption has little effect on usual food intake.

In order to support compliance, offered products shall be adapted to the patient's wishes and needs. In particular, swallowing disorders may require texture adaptation of ONS. Because there is a risk that patients get tired in consuming the same ONS day after day, compliance shall be regularly assessed. A varied offer and options for change are proposed to enhance consumption of the products.

Enteral and parenteral nutrition

II.12 Should enteral tube feeding be offered to older persons with malnutrition or at risk of malnutrition?

Recommendation 29

> Older persons with reasonable prognosis shall be offered EN if oral intake is expected to be impossible for more than three days or expected to be below half of energy requirements for more than one week, despite interventions to ensure adequate oral intake, in order to meet nutritional requirements and maintain or improve nutritional status.
>
> Grade of recommendation GPP – strong consensus (100 % agreement)

Commentary

The effect of EN is generally not well studied. Rigorous prospective RCTs comparing EN with no feeding are not feasible for ethical reasons. All we know about EN therefore mainly comes from observational trials. EN is frequently commenced late, after substantial weight loss has already developed, which is in the stage of severe malnutrition (145, 146) and which hampers an effective nutritional therapy (147). In general, the survival after insertion of a percutaneous endoscopic gastrostomy (PEG) in geriatric patients is poor. A meta-analysis demonstrated a survival of 81% after one month, 56% after six month and of 38% after one year (148). However, survival very much depends on the indication and selection of patients (149-154). Several studies demonstrate some improvement of nutritional state after initiation of EN in older patients (146, 147, 155-160). Nevertheless, the effect on functionality, mortality and quality of life remains unclear (161-172).

Recommendation 30

The expected benefits and potential risks of EN shall be evaluated individually and reassessed regularly and when the clinical condition changes.
Grade of recommendation GPP – strong consensus (100 % agreement)

Commentary

Several studies have determined some risk factors for early mortality after PEG insertion, to help the decision-making process and to avoid futile PEG placements (149-153, 166, 173-176). These risk factors comprise dementia, urinary tract infection, previous aspiration, diabetes, hypalbuminemia, acute illness, hospitalization, bedsores, higher age, nil-by-mouth, poor nutritional state, low BMI and the number of comorbidities. Nevertheless, these factors can hardly lead the decision-making in an individual case. One would assume that geriatric patients in a very poor general state who undergo PEG placement would have a higher risk of early mortality after PEG placement, but a geriatric data base analysis revealed that none of the parameters of geriatric assessment emerged as a risk factor of hospital mortality after PEG insertion (154). Thus, each patient must be evaluated individually with regards to the following questions:

1. Is EN likely to improve or maintain the quality of life of this patient?
2. Is EN likely to improve or maintain the functionality of this patient?
3. Is EN likely to prolong survival in this patient?
4. Is prolongation of life desirable from the patient’s perspective?
5. Are the risks of feeding tube insertion and EN lower than the expected benefit?

In general, complication rates of EN are reported to be low (177), but under real-life conditions, the complication rate of both nasogastric tube feeding and PEG feeding may be substantial (153, 178). In this regard, it may be advisable to regularly assess mortality after PEG insertion in the individual hospital or department. If the mortality is higher than above mentioned (148), patient selection and technical aspects should be questioned.

In general, the condition of patients on EN may change very quickly. That is why the indication and the expected benefits of EN should be reassessed on a regular basis. If the patient’s ability for oral feeding improved substantially, or conversely an advantage of EN is no longer expected, EN should be discontinued. In situations where the effect of EN is difficult to anticipate, a treatment trial over a predefined period and with achievable and documented goals may be advisable (17). Especially in patients with severe dementia, the risk-benefit ratio of EN is unfavorable and EN is generally not recommended. In this situation, we refer to the specific dementia guidelines of ESPEN (179).

<u>Recommendation 31</u>

> Older persons with low nutritional intake in the terminal phase of illness shall be offered comfort feeding instead of EN.
>
> Grade of recommendation GPP – consensus (88 % agreement)

Commentary

EN is in principle a life-prolonging procedure. If the prolongation of life is no longer a desirable goal, the patients’ quality of life should be considered exclusively. This is regularly the case in the palliative situation. In this situation, the patient should be offered whatever he or she likes to eat and drink orally, in the amount he or she likes to consume. This approach is mostly described by the term comfort feeding (180). In this situation, covering a patient’s nutritional requirements is entirely irrelevant (17).

<u>Recommendation 32</u>

> If EN is indicated, it shall be started without delay.
>
> Grade of recommendation GPP – strong consensus (96 % agreement)

Commentary

Some studies show that a substantial weight loss has frequently occurred before the initiation of EN, i.e. on average 11.4 kg in the study by Loser et al. (145, 153). As weight loss and poor nutritional state are risk factors for mortality in general and particularly poor survival after PEG insertion (174), weight loss prior to initiation of EN should be avoided as far as possible. In addition, in the FOOD trial, which was performed in patients with dysphagic stroke, early EN was associated with an absolute reduction in risk of death of 5.8% (p=0.09) (181). Although this result was not statistically significant, this trend is an additional argument for early initiation of EN, in the absence of evidence from other randomized trials. Therefore, EN, if indicated, should start without relevant delay.

<u>Recommendation 33</u>

> Older patients who require EN presumably for less than four weeks should receive a nasogastric tube.
>
> Grade of recommendation GPP – strong consensus (100 % agreement)

Commentary

If there is an indication for EN, it must be decided which type of EN is adequate for the individual patient. From a practical point of view, it would be inadequate to undertake an invasive procedure like a PEG placement for a patient who will presumably need EN for only a few days. It is also assumed that EN sometimes may be continued longer as would be necessary once a PEG tube has been inserted. In a systematic review that compared nasogastric tube feeding with PEG feeding in older patients with non-stroke dysphagia, a pooled analysis of nine studies involving 847 patients demonstrated no significant differences in the risk of pneumonia and overall complications (182). Within this review, meta-analysis was not possible for mortality and nutritional outcomes, but three studies suggested improved mortality outcomes with PEG feeding while two out of three studies reported PEG feeding to be better from a nutritional perspective. Within the FOOD trial, which prospectively compared early versus delayed EN as well as PEG feeding with nasogastric feeding in dysphagic stroke patients, PEG feeding was associated with an increased risk of death or poor outcome of 7.8% (p=0.05) (181). These data do not support a policy of early initiation of PEG feeding in dysphagic stroke patients. However, sufficient data in patients without dysphagia are not available. The recommended time frame of four weeks is thus somehow arbitrary and is meant as advice from the experts' perspective.

<u>Recommendation 34</u>

> Older patients expected to require EN for more than four weeks or who do not want or tolerate a nasogastric tube should receive a percutaneous gastrostomy / PEG.
>
> Grade of recommendation GPP – strong consensus (96 % agreement)

Commentary

In addition to what has been recommended before, a gastrostomy should be undertaken in patients with reasonable prognosis who presumably require EN for a longer period. As mentioned in the commentary to recommendation 33, the time frame of four weeks is somehow arbitrary and mainly aims to prevent a too early gastrostomy. On the other hand, a nasogastric feeding-tube that is well tolerated, may be utilized for more than four weeks.

In geriatric patients, nasogastric tubes are frequently not well tolerated, but are also often not fixed adequately. In general, frequent dislodgement of nasogastric tubes is associated with poor EN, which is a concern when using nasogastric tubes. However, this should never lead to any physical or chemical restraints in order to avoid manual or accidental dislodgement. If a nasogastric tube is dislodged despite adequate skin fixation, a nasal loop may be an alternative. Two studies about nasal loops in tube fed stroke patients demonstrated that nasal loops are safe, well tolerated and effective in delivering full EN (183-185). A RCT observed an increase of 17% mean volume of fluid and tube feed given in the nasal loop group, without any differences in outcome after three months (185). As a practical alternative to nasal loops, a PEG may be placed in those patients with frequent tube dislodgement who presumably require EN for more than a few days.

Recommendation 35

Tube fed older patients shall be encouraged to maintain oral intake as far as safely possible.
Grade of recommendation GPP – strong consensus (100 % agreement)

Commentary

Most patients on EN are able to consume some amount of food and drinks orally. In case of dysphagia, the texture of food and drinks that can be swallowed safely has to be determined by a dysphagia specialist. Oral intake of the safe texture should be encouraged as far as safely possible, because oral intake is associated with sensory input and training of swallowing, increased quality of life and enhances the cleaning of the oropharynx. It has to be kept in mind that even patients with dysphagia and nil-by-mouth have to swallow more than 500 ml of saliva per day which alone is a risk factor for aspiration pneumonia. Aspiration pneumonia is suggested to be mainly caused by the bacterial content of aspirated saliva and not by the saliva itself, or a minimal oral intake (186, 187). However, the ability to have safe oral intake has to be decided individually, depending on the degree of dysphagia, the presence or absence of protective cough reflex and the cough force. For details please see ESPEN Guideline Clinical Nutrition in Neurology (130).

II.13 Should older persons with malnutrition or at risk of malnutrition be offered parenteral nutrition?

Recommendation 36

> Older persons with reasonable prognosis (expected benefit) shall be offered PN if oral and enteral intake are expected to be impossible for more than three days or expected to be below half of energy requirements for more than one week, in order to meet nutritional requirements and maintain or improve nutritional status.
>
> Grade of recommendation GGP – strong consensus (100 % agreement)

Commentary

PN is a safe and effective therapeutic procedure, which is used for delivery of all macronutrients and micronutrients into the organism via central or peripheral vein. It is always indicated and may allow adequate nutrition in patients who need nutrition support and who cannot meet their nutritional requirements via the enteral route (when EN is contraindicated or poorly tolerated). Age per se is not a reason to exclude patients from PN. Several studies have documented that PN is a feasible and successful method of nutritional support also in older people (147, 188-190), not only in hospital but also at home (191). It is however only rarely indicated as oral and enteral interventions are generally the first choice for nutritional support (190). When indicated, PN should to be initiated immediately due to the risk of loss of independence in older patients and because even short-term starvation in the acutely ill older person leads to loss of lean body mass which can be critical especially in older patients. Indication criteria for PN are the same as in middle-aged subject: older patients facing a period of starvation of more than three days when oral nutrition or EN is impossible, and when oral or EN has been or is likely to be insufficient for more than 7–10 days.

II.14 How should enteral and parenteral nutrition be performed in older patients?

Recommendation 37

EN and PN and hydration shall be considered as medical treatments rather than as basic care, and therefore should only be used if there is a realistic chance of improvement or maintenance of the patient´s condition and quality of life.

Grade of recommendation GPP – strong consensus (96 % agreement)

Commentary

Any kind of medical treatment is contraindicated when it is obvious that it cannot be help for the patient. EN and PN are medical treatments because they require the insertion of a feeding tube or intravenous cannulation and a physician's prescription. The most important reason for commencement of EN or PN or hydration should be anticipated beneficial effects of such treatment for the individual person. If EN, PN or hydration are initiated, the effect of such treatment should be controlled. Clinical improvement as well as prevention of further clinical deterioration can both be relevant goals for an individual patient. Conversely, as for any other medical treatment, EN and PN should not be initiated or are contraindicated in situations when no benefits for the patient are expected. Especially in patients where death is imminent, e.g. within the next four weeks, or in patients with incurable disease, which cannot be improved by any treatment including nutritional support (e.g. advanced dementia, terminal phase of malignant cancer disease) the patient´s comfort is the highest priority (17).

Prospective studies on the effect of EN or PN in patient patients with moderate or advanced dementia are lacking. Therefore, any use of EN, parenteral hydration or nutritional support should be in accord with other palliative treatments. Cessation of EN, PN and parenteral rehydration is possible when these treatments do not lead to anticipated goals. Cultural background, economical resources, social facilities as well as ethical and religious motivations may play a substantial role in determining the nutritional treatment and its outcome in very old, frail and chronically ill patients

<u>Recommendation 38</u>

> Older patients should *not* receive pharmacological sedation or physical restraints to make EN or PN or hydration possible.
>
> Grade of recommendation GPP – strong consensus (100 % agreement)

Commentary

The goal of nutritional support is to improve or at least maintain nutritional status of the patient, which should be connected with increased or maintained lean body and especially muscle mass. It was shown and it is obvious that immobilization of the subject leads to loss of fat free mass and notably skeletal muscle mass, in particular in older persons (192). The loss of physical activity is a logical consequence of pharmacological sedation or physical restraints; consequently, it usually leads to muscle mass loss. As maintenance or gain of body weight and muscle mass are the central goals of nutritional support, immobilization and sedation counteract planned goals of nutritional support. In addition, sedation and physical restraints may also lead to cognitive deterioration and should therefore be avoided. It has to be mentioned, however, that in rare exceptions, such as hyperactive delirium, it may be advantageous for the patient to use drugs with sedative effects or even physical restraints for a very limited period of time in order to prevent the patient from self-injury.

<u>Recommendation 39</u>

> In older patients with malnutrition, EN and PN shall start early; it shall be gradually increased during the first three days in order to avoid the refeeding syndrome.
>
> Grade of recommendation GPP – strong consensus (100 % agreement)

<u>Recommendation 40</u>

> During the first three days of EN and PN therapy in malnourished older persons, special attention shall be drawn to blood levels of phosphate, magnesium, potassium and thiamine which shall be supplemented even in case of mild deficiency.
>
> Grade of recommendation GPP – strong consensus (100 % agreement)

Commentary to recommendations 39 and 40

Refeeding syndrome (RFS) is a condition of potential risk in malnourished patients with electrolyte disturbances leading to clinical deterioration. Consequences include volume overload, redistribution of phosphate, potassium and magnesium, hypophosphatemia, muscle weakness, anemia and finally organ failure. Possible cardiac sudden death is described in up to 20%.

Criteria to identify RFS vary from reduced phosphate or any electrolyte serum concentration, the coexistence of electrolyte disturbances and clinical symptoms (e.g. peripheral edema, acute circulatory fluid overload, disturbance to organ function) (193). A standardized definition is unfortunately lacking, and current knowledge about the syndrome is altogether limited. Only two observational studies were performed in older populations (194, 195). Kagansky et al. (194) reported significantly more weight loss, lower albumin levels, glucose-containing infusions and food supplements in older patients who developed at least one episode of hypophosphatemia (serum phosphate $\leq$ 0.77 mmol/L), which was detected on average on day 10.9 ± 21.5 of hospitalization. Hypophosphatemia was also associated with an increased length of hospital stay and mortality rate, which was however no longer significant in a multivariate analysis (194). Lubart et al. (195) evaluated 40 frail older patients with prolonged feeding problems before the insertion of a nasogastric tube. A high mortality rate was observed which was mainly related to infectous complications, but in the light of a considerable number of patients with hypophosphatemia the authors suggested the RFS as a contributing factor to mortality (195).

Known risk factors for the RFS are a reduced BMI, significant unintended weight loss, no nutritional intake for several days, low plasma concentrations of magnesium, potassium or phosphate before feeding and a medical history of drug or alcohol abuse (196), and it has recently been observed that these risk factors are very common in older hospitalized patients (197). A large overlap between the risk of malnutrition according to common screening tools and the risk of RFS was observed in the same patient group (198), suggesting that in older persons with malnutrition or at risk of malnutrition a risk of RFS should generally be taken into consideration.

Particular attention has to be paid within the first 72 hours of nutritional support, which should generally be started early but increased slowly, accompanied by close monitoring of clinical signs and serum levels of phosphate, magnesium, potassium and thiamine. Further studies would be particularly useful in older patients, given also the high prevalence of kidney dysfunction in this specific population.

Exercise interventions

II.15 Should older persons with malnutrition or at risk of malnutrition in addition to nutritional interventions be offered exercise interventions?

Recommendation 41

> In addition to nutritional interventions, older persons with malnutrition or at risk of malnutrition should be encouraged to be physically active and to exercise in order to maintain or improve muscle mass and function. (BM)
>
> Grade of recommendation GPP – strong consensus (100 % agreement)

Commentary

In older people weight loss occurs at the expense of muscle mass (199) and is associated with impaired physical function (200). Muscle disuse and periods of bed rest can further exacerbate the degradation of muscle mass and strength (192).

The systematic search identified no RCT comparing a combined exercise and nutrition intervention with a singular nutritional intervention in older people with malnutrition or at risk of malnutrition using a two factorial design. Seven RCTs of low to acceptable quality were found using a four factorial design with an exercise group and a control group in addition to the two aforementioned intervention groups in older persons with malnutrition or at risk of malnutrition (108, 109, 113, 201-205). Most of these RCTs showed neither a beneficial effect of the combined nor of the singular nutritional intervention on body composition, strength and functional outcomes. Only Rydwik et al. (108) reported improved muscle strength in the combined intervention group compared to the nutrition group, while other functional and nutritional measures did not differ. The type of nutritional intervention varied distinctly between studies limiting their comparability. Possible reasons for failing might be insufficient adjustment of interventions to individual nutritional needs and small sample sizes which were partially not based on a-priori power calculation.

Despite poor evidence from RCTs, older persons with malnutrition or at risk of malnutrition should be encouraged to be physically active and to exercise in addition to nutritional treatment, as the older muscle is still able to react on anabolic stimuli of exercise training and consequently the decline in muscle function is at least partly reversible by adequate exercise interventions (206-208). Before starting the exercise intervention, health status and physical performance level of the patient need to be evaluated to exclude contraindications for exercise training and to identify the appropriate training type, intensity and starting level (209).

Recommendation 42

> During periods of exercise interventions, adequate amounts of energy and protein should be provided to older persons with malnutrition or at risk of malnutrition in order to maintain body weight and to maintain or improve muscle mass. (BM)
>
> Grade of recommendation B – strong consensus (100 % agreement)

Commentary

Exercise increases energy expenditure. In times of insufficient energy intake and energy stores, amino acids retained in the muscles, are used for energy production (210). To avoid (further) weight loss and to maintain muscle mass in older people with malnutrition or at risk of malnutrition a positive or at least zero energy balance is of particular importance during periods of exercise interventions. As energy needs may vary considerably between individuals, they need to be estimated before the start of an intervention (see recommendation 1). Adequate amounts of protein are at least as important to avoid muscle atrophy and to stimulate muscle protein synthesis (210) (see recommendation 2).

The systematic search found five RCTs of low to high quality comparing combined exercise and nutrition interventions to singular exercise interventions in older people with malnutrition or at risk of malnutrition (109, 204, 211-213). In older COPD patients, greater improvements in body weight were reported in those receiving an energy and protein containing supplement in combination with low intensity exercise training compared to the exercise alone group after twelve weeks of intervention (211). In older rehabilitation patients with reduced muscle mass, adding a protein and vitamin D enriched supplement to a multicomponent exercise training showed more beneficial effects on body weight, MNA score and muscle mass than the training alone (212). In another RCT from the same setting positive effects of a combined nutrition and exercise intervention were found regarding arm and calf circumferences as surrogates for muscle mass, but not for MNA score (213). A RCT in older malnourished patients with lower limb fracture reported lower weight loss in the group receiving an oral nutritional supplement in combination with resistance training compared to the resistance training group (204). One study in malnourished community-dwelling older adults failed to show any effect of individual nutritional advice and physical training (109). However, in this study independent of the interventions, participants who needed to increase their energy intake by ≥ 20% to reach their energy requirements but failed this goal lost weight and fat free mass during the intervention period whereas no changes were observed in those reaching this goal (109).

Alltogether, these studies support the need of adequate amounts of energy and protein during periods of exercise interventions.

III. Recommendations for older persons with specific diseases

III.1 Should older patients after hip fracture and orthopedic surgery be offered nutritional support?

Older persons suffering from a hip fracture and undergoing orthopedic surgery are generally at risk of malnutrition due to the acute trauma and surgery-associated anorexia and immobility. Voluntary oral intake in the postoperative phase is often markedly below requirements (61, 214-217). As a consequence, rapid deterioration of nutritional status and impairment of recovery and rehabilitation are common (56, 214, 218, 219).

The literature search found two systematic reviews that were relevant to the PICO question and examined different types of nutritional support as sole intervention (220, 221), one Cochrane review of high (220) and the other of acceptable quality (221). Three additional RCTs were identified (published in eleven articles of acceptable quality) testing the effects of multicomponent interventions including nutrition for hip fracture patients (70-72, 218, 222-228).

<u>Recommendation 43</u>

Older patients with hip fracture shall be offered oral nutritional supplements postoperatively in order to improve dietary intake and reduce the risk of complications. (BM)
Grade of recommendation A – strong consensus (100 % agreement)

A recent high-quality Cochrane review and meta-analysis included 41 randomized trials on different types of nutritional therapy involving 3,881 patients with a hip fracture (mean ages around 80 years) (220). The methodological quality of all included trials was judged to be low to very low, leading to a low to very low overall grading of the quality of evidence across all intervention types and outcomes (220). 18 trials (16 RCTs and two quasi-randomized trials) provided standard ONS to hip fracture patients, of which five specifically targeted patients that were malnourished. Four additional RCTs tested ONS with high protein content (>20 % energy from protein). Sample sizes were mostly small (between 10 and 171 participants). All interventions were started preoperatively or within the first postoperative week and continued for at least one month up to six months. The use of ONS mostly lead to a significant increase in energy and nutrient intake. Adverse side effects were not increased (6 RCTs). Meta-analysis showed no effect of supplementation via standard (15 RCTs) or high-protein (4 RCTs) ONS on mortality risk. Combined analysis of eleven trials using standard ONS indicated a reduced risk of postoperative complications (RR 0.71 (95% CI 0.59-0.86), whereas for high-protein ONS (2 RCTs) no such effect was found (220). The second meta-analysis (221) included a subset of ten of these RCTs (regardless whether they used standard or high-protein ONS) with a total of 986 patients and came to the same conclusions regarding mortality and complications. Regarding other outcomes (nutritional status, function, readmissions, length of hospital stay and quality of life), the great variety of variables and assessment methods used impeded any combined analysis.

Based on these results, we recommend to offer ONS to geriatric hip fracture patients, regardless of their nutritional state. To date, there is not sufficient evidence that special ONS (e.g. high in protein) have additional beneficial effects for these patients. ONS shall always be offered in combination with other interventions to increase oral intake (e.g. fortified foods) as part of a multidisciplinary approach (see recommendation 46).

<u>Recommendation 44</u>

> Supplementary overnight tube feeding shall NOT be offered to older patients with hip fracture unless there is an indication for EN for other reasons.
>
> Grade of recommendation GPP – strong consensus (100 % agreement)

The Cochrane analysis from Avenell et al. (220) found three RCTs and one quasi-randomized trial that tested the effects of supplementary overnight EN alone and one additional RCT that tested overnight tube feeding followed by ONS. Sample sizes were small (between 18 and 140 participants), the interventions were always started within five days from surgery and usually continued until discharge or until oral intake was sufficient. Supplementary overnight EN was overall poorly tolerated. Regarding mortality and complication risk, the meta-analysis of EN only studies as well as the RCT using tube feeding followed by ONS showed no evidence of an effect. Effects on nutritional status, length of hospital stay and functional status were inconsistent (220). Due to high patient burden, poor tolerance and lack of clear beneficial effects, a negative recommendation is given..

<u>Recommendation 45</u>

> In older patients with hip fracture, postoperative ONS may be combined with perioperative PN in order to improve nutritional intake and reduce the risk of complications. (BM)
>
> Grade of recommendation 0 – consensus (83 % agreement)

Regarding the effects of PN, Avenell et al. (220) included one RCT of low quality that evaluated three days of perioperative peripheral PN followed by seven days of ONS compared with standard care in 80 patients with a fractured hip (216, 229). This short-time combined intervention increased total fluid and energy intake to near optimal levels during hospital stay. Risk of complications within four months was significantly reduced (RR 0.21 (99% CI 0.08–0.59), while mortality risk, length of hospital stay and the proportion of participants who were discharged to their own homes were unaffected (216).

Based on this positive result, and bearing the risk of complications associated with PN in mind, it may be considered to offer supplementary PN during the acute perioperative period, combined with ONS and early oral food intake postoperatively, in order to increase nutritional intake and reduce the risk of complications. As presently only one trial of low quality is available, the grade of evidence was reduced to “0”.

<u>Recommendation 46</u>

> Nutritional interventions in geriatric patients after hip fracture and orthopedic surgery shall be part of an individually tailored, multidimensional and multidisciplinary team intervention in

order to ensure adequate dietary intake, improve clinical outcomes and maintain quality of life. (BM, PC)

Grade of recommendation A - strong consensus (100 % agreement)

Multicomponent interventions including nutritional measures were examined in three RCTs in hip fracture patients in comparison to usual care. In one trial, performed in Sweden, the intervention included geriatric assessment and subsequent rehabilitation, staff education, teamwork, individual care planning and active prevention, detection and treatment of postoperative complications during hospitalization (70-72, 222). Nutritional interventions consisted of nutritional status and dietary intake registration, provision of protein-enriched meals and additional protein drinks. The authors reported reduced length of hospital stay, improved independence in activities of daily living (ADL) and mobility after twelve months (71) as well as reduced in-hospital falls and fall-related injuries (70). The same intervention resulted in a subgroup of 157 patients with complete MNA at baseline and 4-months follow-up in significantly fewer days of delirium, fewer pressure ulcers and reduced length of hospital stay, despite no improvement in BMI and MNA (72). In another study in Taiwan a comprehensive, interdisciplinary in-hospital care concept was followed by discharge planning and a home-based rehabilitation program with consultations for six months post-hospital (218, 223-226, 228). Nutritional interventions consisted of periodic nutritional assessments and, in case of (risk of) malnutrition, further intervention by a dietitian, geriatric nurse and geriatrician (223, 226). Patients in the comprehensive care group had a three times higher likelihood of recovering to complete independence in basic activities of daily living (ADL) until six months follow up (223). These effects faded until twelve months follow up (223), but improved self-care ability and decreased emergency department visits were reported up to two years after hip-fracture surgery (228). Moreover, better health-related quality of life (224) and a lower risk of malnutrition (223) after six and twelve months were observed. Participants who were malnourished or at risk of malnutrition at discharge had a greater chance of recovering to a well-nourished state after six and twelve months (218, 225). In this subgroup, improvements in functional independence and balance occurred mainly in those who improved in nutritional status (225). Finally, in the third trial, multifactorial, targeted geriatric treatments including nutritional interventions in combination with high-intensity resistance training for twelve months, resulted in reduced mortality, nursing home admissions and ADL dependency compared with usual care (227).

These studies illustrate the importance of a holistic view and comprehensive treatment approach in orthogeriatric patients. Nutritional interventions should be continued after hospitalization, as effects were seen as long as nutritional care was provided.

In the field of supportive interventions, the effects of additional support by dietetic assistants during hospitalization were tested in one RCT of low quality, also considered in the Cochrane review of Avenell et al. (220), including 318 patients in an acute trauma unit, which were helped to get preferred foods and ONS and helped with eating (61). This intervention improved energy intake (mostly from ONS) and reduced the risk of mortality (RR 0.57 (95% CI 0.34–0.95) compared to conventional care, but did not affect complication risk and length of hospital stay. Because of no perceived risk of harm, assistance with food provision and intake is recommended for geriatric patients after hip fracture and surgery in the same way as for geriatric patients in general (see recommendation. 12).

III.2 Should older patients with delirium or at risk of delirium be offered nutritional support?

Recommendation 47

All older patients hospitalized to have urgent surgery shall receive a multi-component non-pharmacological intervention that includes hydration and nutrition management in order to prevent delirium. (BM)

Grade of recommendation A – strong consensus (100 % agreement)

Recommendation 48

All older patients admitted to a medical ward and at moderate to high risk of delirium shall receive a multi-component non-pharmacological intervention that includes hydration and nutrition management in order to prevent delirium. (BM)

Grade of recommendation A – strong consensus (95 % agreement)

Commentary to recommendations 47 and 48

Delirium is common in older people, especially when admitted to the hospital for acute medical or surgical care. Dehydration is a common precipitating factor and malnutrition a common contributing factor to delirium (230, 231).

Several systematic reviews on non-pharmacological approaches to prevent and treat delirium in older patients have been published recently (230, 232, 233). Abraha et al. (232) reviewed any non-pharmacological intervention aiming to prevent or treat delirium in older patients in any setting. They found that multicomponent non-pharmacological interventions significantly reduced the incidence of delirium in surgical wards (all except one study included participants in need of urgent surgery) and in medical wards (only in those at moderate or high risk of delirium). The evidence did not support the efficacy of any intervention in treating established delirium. Nutrition intervention was part of many non-pharmacological interventions, but no trials on nutrition as single-component intervention to prevent or treat delirium were identified. Other evidence-based recommendations support our recommendations on delirium (232). A more recent Cochrane review focusing on hospitalized non-ICU patients reached similar conclusions: multi-component interventions reduced the incidence of delirium compared to usual care in medical and surgical settings (233). Furthermore, this review calls attention to the subgroup of patients with pre-existing dementia, where the effect of multi-component interventions remains uncertain. An additional Cochrane review addressed the prevention of delirium in people living in nursing homes. A single, small, low quality trial showed no significant effect of hydration on the incidence of delirium. No trial that included any other nutrition intervention was identified (230).

In summary, nutrition and hydration interventions have only shown efficacy in the prevention of delirium when they are part of multidisciplinary interventions (10 of 19 trials on multidisciplinary interventions included at least one nutrition/hydration intervention). However, interventions used are heterogeneous (***Table 8***) and no evidence-based recommendations but common sense is needed to decide how to include nutrition and hydration in local programs.

Table 8. Nutrition and hydration in multi-component interventions to prevent delirium.

Trial*	Population	Intervention
Bjorkelund (2010)	Hip fracture	Intravenous fluid supplementation in the ambulance or immediately after admittance Extra oral multi-nutrient drinks daily post-operatively
Caplan (2006)	Geriatric ward	Hydration assistance, encouraging patients to drink, providing water close by and personal help when needed Feeding assistance that involved meal set up and feeding
Chen (2011)	Common elective abdominal surgical procedures	Daily oral care involving tooth brushing Nutrition screening Diet education Feeding assistance if needed
Harari (2007)	Elective surgical patients (65+ years)	Patient education on good nutrition Nutrition review and intervention by geriatric team
Inouye (1999)	General-medicine service (70+ years)	Early recognition of dehydration and volume repletion
Lundstrom (2007)	Hip fracture	Staff education Recording of food and liquid intake Protein enriched meals (at least 4 days) Nutritional and protein drinks twice daily during hospital stay Consultation with dietician as needed
Marcantonio (2001)	Hip fracture	Treatment of fluid overload or dehydration Proper use of dentures Proper positioning for meals Assistance for meals as needed Supplements: 1-3 cans depending on oral intake NG tube if unable to take food orally
Pitkala (2006)	General-medicine service (70+ years)	Comprehensive geriatric assessment and treatment including nutrition as an item Nutritional supplements for those at risk of malnutrition or malnourished

Vidán (2009)	Geriatric acute care unit	In presence of dehydration (urea:creatinine ratio >40), four glasses of water a day (prescribed and scheduled like a drug) were given In presence of malnutrition, daily intake register and nutritional supplements were introduced
Wong (2005)	Hip fracture	Maintenance of fluid and electrolyte balance Use of dentures Positioning Dietician review and intervention

* For full reference of these articles please refer to Abraha et al. (232).

Recommendation 49

> Hospitalized older patients with present delirium shall be screened for dehydration and malnutrition as potential causes or consequences of delirium.
>
> Grade of recommendation GPP – strong consensus (95 % agreement)

Commentary

Delirium is common in older people, especially when admitted to the hospital for acute medical or surgical care. Dehydration is a common precipitating factor and malnutrition a common contributing factor to delirium (230, 231). Guidelines on delirium management recommend checking nutrition and hydration in delirious patients in order to correct existing problems (for example, see (234-236).

III.3 Should older patients with depression be offered nutritional support?

Recommendation 50

> Depressed older patients shall be screened for malnutrition.
>
> Grade of recommendation GPP – strong consensus (100 % agreement)

Recommendation 51

Older patients with depression might NOT routinely receive nutritional interventions unless they are malnourished or at risk of malnutrition (BM)

Grade of recommendation 0 – strong consensus (100 % agreement)

Commentary to recommendations 50 and 51

Depression is a common cause of nutritional problems in old age. Having a significant weight loss or weight gain (>5%) or a change in appetite is one of the nine specific symptoms that define a major depressive disorder (237). Thus, detection of nutritional problems is part of the assessment of depression. On the other hand, depression is included in the differential diagnosis of the etiology of malnutrition, especially in older patients, and is included in the comprehensive geriatric assessment. The association between depressed mood and malnutrition is well established (238, 239).

However, data on the impact of nutrition interventions on the outcomes of depression in older subjects are lacking. Two trials have considered the effect of nutrition intervention on depressive symptoms in older hospitalized patients. A first RCT studied the effect of a high energy (995 kcal/day) ONS used for six weeks in 225 hospitalized patients (roughly, one third had depressive symptoms assessed with the 15-item Geriatric Depression Scale (GDS), baseline nutritional status not described) (240). GDS was significantly better in the intervention compared to the control group at six months, but not at six weeks. A second RCT explored an individualized nutritional intervention in 259 hospitalized older patients and found no changes in GDS scores at six months (62), the number of those with depression is not stated. All these trials used GDS (a validated depression screening instrument that measures depressive symptoms) as main outcome measure, but minimum clinically significant difference has not been defined for GDS. No trial has used the cure of depression as outcome measure for nutritional interventions in older persons. When depressed patients are malnourished or at risk, recommendations for these conditions made elsewhere in this guideline will apply.

III.4 Should older patients with or at risk of pressure ulcers be offered nutritional support?

Recommendation 52

> Nutritional interventions should be offered to older patients at risk of pressure ulcers in order to prevent the development of pressure ulcers. (BM)
>
> Grade of recommendation B – strong consensus (100 % agreement)

Recommendation 53

> Nutritional interventions should be offered to malnourished older patients with pressure ulcers to improve healing. (BM)
>
> Grade of recommendation B – strong consensus (100 % agreement)

Commentary to recommendations 52 and 53

The incidence and prevalence of pressure ulcers (PUs) vary widely according to the definition and stage of ulcer, patient population, care setting, and preventive interventions used among others. It has been reported that PUs prevalence in European hospitals ranges from 8 to 23 %, while in nursing homes about 11% of residents have a PU stage two or higher on admission, and among ulcer-free residents staying in the nursing home, 14 to 33 % develop a new PU (241). Possible important outcomes related to PUs treatment were defined by ONTOP Evidence Group which identified rates of complete wound healing as the most critical, and reduction of pain, time to complete wound healing, reduction of wound size, length of hospital stay, admission to nursing homes, lower incidence of infections or use of antibiotic therapy, nursing time spent in wound care, in-hospital mortality, costs of hospital admission, hospital readmissions in a given time after discharge as important outcomes (241).

Two SLRs (242, 243) and two overviews of SLRs (241, 244) were identified and considered relevant. Their quality was rated as moderate to high. The quality of studies included in these reviews was rated as low. One additional RCT published later was also considered (245). The quality of this RCT was rated as moderate. The meta-analysis by Stratton et al. (242) of four RCTs showed that the supplementation with ONS (high protein) in patients with no PUs at baseline resulted in a significantly lower incidence of PUs when compared to standard care. Addition of a RCT on EN in the meta-analysis produced similar results. Evidence form RCTs comparing the effect of ONS or EN versus routine care on the healing of existing pressure ulcers was insufficient to be compared and to allow meta-analysis. More recently, Lozano-Montoya et al. (244) evaluated the effects of non-pharmacological interventions for PU prevention, including nutritional interventions. Based on the same four RCTs meta-analyzed by Stratton et al. (242) the authors concluded that “nutrition intervention during acute hospital admission may slightly reduce the incidence of PUs at 2-4 weeks in patients at risk of developing PUs”. The quality of evidence was however rated as very low. Vélez-Díaz-Pallarés et al. (241) focused on treatment of existing PUs and identified eight studies (seven RCTs) evaluating the effects of nutritional interventions. All studies failed to show any effect, but again the overall quality of studies included was rated low to very low. Langer and Fink (243) identified eleven trials that compared the effects of mixed nutritional supplements with standard hospital diet, meta-analysis of eight of these trials found borderline significance for an effect on PU development (OR 0.96; 95% CI 0.73-1.00). Regarding healing, 14 trials were found which were very heterogeneous regarding type of nutritional supplements, participants, comparisons and outcomes, and meta-analysis was not appropriate. No clear evidence of an effect was found in any of the individual studies (243).

Benefits of nutritional interventions may depend on nutritional status and concomitant relevant health problems causing the (risk of) pressure ulcers. Unfortunately, the majority of trials considered did not distinguish between malnourished and non-malnourished patients. Cereda et al. (245) restricted their randomized, controlled and blinded study to 200 malnourished persons with PUs (stage II, III and IV) in long term and home care services and showed that supplementation with an oral nutritional formula enriched with arginine, zinc, and antioxidants improved PU healing compared to an isocaloric isonitrogenous formula (greater and more frequent reduction in PU area). Although the experimental formula was more expensive, it proved to be cost-effective (246).

In case of malnutrition, there is a clear need of nutritional interventions, and an early screening of malnutrition should be performed at hospital and nursing home admission independent of the presence of PUs, as described elsewhere in this guideline. Thus, also in malnourished older patients with pressure ulcer nutritional interventions are indicated; in these patients they may support healing of PUs. As only one RCT is presently documenting these benefits, the grade of recommendation is downgraded to B. The need of high quality studies in this specific topic is emphasized.

III.5 Should older persons with overweight or obesity be offered specific nutritional interventions or advised to follow a specific diet to reduce body weight?

Independent of age, the WHO defines overweight as BMI 25 - < 30 kg/m^2 and obesity as BMI ≥ 30 kg/m^2 (247). Due to changes in body composition during aging and a reduction of body height, the validity of the BMI as a measure of overweight and obesity is reduced in older people (248-250). Moreover, there is increasing evidence that in terms of mortality, cardiovascular and metabolic risk and even in terms of function, the distribution of body fat may be more important than the amount per se (249, 250). To date no consensus on how to assess obesity-related health risk in older adults has been reached and the role of BMI, overweight and obesity remains highly controversial.

The systematic literature search resulted in no suitable SLRs to answer the PICO questions, but several guidelines (250-254) and position statements (255, 256) on overweight and obesity treatment giving specific recommendations for older adults were identified. Twelve RCTs were found testing dietary interventions aimed at weight loss in overweight and obese older persons against a combination of the same dietary intervention with an exercise intervention (257-268).

Recommendation 54

> In overweight older persons weight-reducing diets shall be avoided in order to prevent loss of muscle mass and accompanying functional decline.
>
> Grade of recommendation GPP – strong consensus (95 % agreement)

Experts generally agree that there is usually no need for overweight older people to lose weight (250-252, 255, 256) as meta-analyses indicate that mortality risk of healthy older people is lowest in the overweight range (269-271). Further, weight loss, whether intentional or not, enhances the age-related loss of muscle mass, and consequently increases the risk of sarcopenia, frailty, functional decline, fractures and malnutrition (252, 272, 273). Moreover, the common weight regain after a weight-reducing diet is predominantly a regain in fat mass and not in lean mass (273). Thus, repeated phases of weight loss and regain, called “weight cycling”, might contribute to the development of sarcopenic obesity (the presence of reduced muscle mass together with excess fat mass) (273). Therefore, and to avoid a progress to obesity, maintaining a stable body weight is considered desirable for overweight older adults (16). A combination of a balanced, nutrient-rich diet providing adequate amounts of energy and protein, and physical activity, if possible even exercise, is a sound strategy to keep weight stable and to prevent obesity (274).

Recommendation 55

> In obese older persons with weight-related health problems, weight-reducing diets shall only be considered after careful and individual weighing of benefits and risks.
>
> Grade of recommendation GPP – strong consensus (100 % agreement)

Obesity, especially severe obesity (BMI ≥ 35 kg/m^2), increases metabolic and cardiovascular risk as well as the risk of mobility limitations and frailty in older persons (248, 255, 256), particularly when marked muscle loss has already occurred (273). Current expert recommendations regarding weight reduction in older people primarily refer to cases of obesity that are associated with comorbidities and obesity-related adverse health effects

(252, 255, 256, 272). In these cases, positive effects of intended weight loss on orthopedic problems, cardiovascular and metabolic risk, insulin sensitivity, chronic inflammation and functional limitations have been reported, partly in combination with physical exercise (16, 248-250, 252, 255). On the other hand, as weight loss in older persons may have harmful effects due to the loss of lean mass (see commentary to recommendation 54), the decision for or against weight reduction shall always be taken at the individual level. It should be based on a careful weighing of possible risks and benefits of the intervention considering functional resources, metabolic risk, comorbidities, patients' perspective and priorities, and estimated effects on his or her quality of life (249, 250). If decision is made against weight reduction, it is advisable to aim at weight stability and avoidance of further aggravation of obesity (16).

Recommendation 56

> If weight reduction is considered in obese older persons, energy restriction shall be only moderate in order to achieve a slow weight reduction and preserve muscle mass.
>
> Grade of recommendation GPP – strong consensus (95 % agreement)

If weight reduction is considered to be beneficial, it has to be approached with great care (250, 251). Interventions working in young adults cannot simply be extrapolated to older populations with low muscle mass and frailty (272). To avoid loss of muscle mass and to achieve a slow weight reduction in older persons, the dietary intervention should consist of a balanced diet as generally recommended for older adults, with a maximally moderate caloric restriction (~500 kcal/d less than estimated needs and maintaining a minimum intake of 1000-1200 kcal/d) targeting a weight loss of 0.25-1 kg/week (~5-10 % of initial body weight after six months or more) and assuring a protein intake of at least 1 g/kg BW/d and an appropriate intake of micronutrients (252, 254, 255). Strict dietary regimens, like diets with very low energy intake (<1000 kcal/day), are strongly discouraged in the older population due to the risk of developing malnutrition and promoting functional decline (75, 255, 273).

Recommendation 57

> If weight reduction is considered in obese older persons, dietary interventions shall be combined with physical exercise whenever possible in order to preserve muscle mass. (BM)
>
> Grade of recommendation A – strong consensus (100 % agreement)

As it is of utmost importance for obese older persons to avoid loss of muscle mass while losing their excess fat mass, dietary interventions shall be combined with structured, supervised physical exercise whenever possible, in addition to an increase in everyday physical activity. Twelve RCTs are available that compared the effects of a dietary weight loss intervention alone to a combination of the same dietary intervention with an exercise intervention in older persons. Three of these studies were restricted to obese persons (258, 260, 261), the others included mixed samples of obese and overweight older persons. The studies were not always based on an a-priori power calculation, and six studies had less than 40 participants (259-261, 264-266). In ten of these twelve trials, a weight-reducing diet alone resulted in the desired weight loss, which consisted of fat mass but also of lean mass (259-261, 263-268). The combination of a weight-reducing diet with exercise training had comparable if not greater effects than the singular weight-reducing diets regarding the reduction of body weight and fat mass, while often preserving lean mass better than diet alone (258-260, 264-266, 268). Moreover, for several strength and physical performance measures, greater improvements were observed in the combined groups than in the diet only groups (257-260, 262-266, 268). In these studies, the weight-reducing diets consisted of a balanced diet with a daily energy deficit of 300-1000 kcal, aiming at a weight loss of 5-10 % of initial body weight and/or 0.25-1 kg per week (257-268). One study used partial meal replacement to achieve the weight loss goal (263), and most studies provided weekly or bi-monthly dietician-led educational sessions (individual and/or group) on nutrition and on achieving behavioral and lifestyle changes (257-259, 261, 262, 266, 268). Exercise training was conducted 2-5 times per week and a single session lasted 45-90 minutes. Most studies used a combination of flexible, endurance and resistance training (257, 258, 260, 261, 263).

In two studies, participants performed solely aerobic endurance training (264, 268), in one trial exercise consisted mainly of walking (267), in three trials of moderate to high intensity resistance training (259, 265, 266), and one study compared aerobic and resistance training, showing comparable results (262). Before starting an exercise intervention, health status and physical performance level of the patient need to be evaluated to exclude contraindications for exercise training and to identify the optimal starting level and exercise type in order to ensure a safe and successful training (209, 275).

It should also be considered that the participants of the above mentioned RCTs were mostly "young-old" (60-70 years) with marginal disease burden and few functional limitations, not representing a typical geriatric population. As very old and frail persons are more vulnerable to any kind of stress, decisions for or against weight loss require particular care in this population subgroup (see commentary to Recommendation 55). Also, interventions to reduce body weight in very old, functionally impaired and multimorbid persons need to be conducted with particular caution and close monitoring (16, 251). Presently, RCTs on possible benefits and harms of weight loss in more vulnerable groups of obese older individuals, e.g. in nursing homes or hospitals, are lacking and are required in future since an increasing number of obese older patients is found in these settings, and obesity contributes to their dependence, complicates care procedures and therefore impacts their quality of life (16, 276).

III.6 Should older patients with diabetes mellitus be offered specific nutritional interventions or advised to follow a specific diet?

<u>Recommendation 58</u>

Older patients with diabetes mellitus shall routinely be screened for malnutrition with a validated tool in order to identify those with (risk of) malnutrition.
Grade of recommendation GPP – strong consensus (95 % agreement)

Recommendation 59

> In older patients with diabetes mellitus restrictive diets shall be avoided in order to prevent malnutrition and accompanying functional decline.
>
> Grade of recommendation GPP – strong consensus (100 % agreement)

Recommendation 60

> Malnutrition and risk of malnutrition in older patients with diabetes mellitus shall be managed according to the recommendations for malnourished older persons without diabetes mellitus.
>
> Grade of recommendation GPP – strong consensus (100 % agreement)

Commentary to recommendations 58 - 60

Our review of the literature disclosed no studies on the prevention or treatment of malnutrition specifically in older persons with diabetes. Based on the few studies on the prevalence of malutrition in older diabetics it follows that the prevalence of (risk of) malnutrition in older diabetics is as high or even higher than in their non-diabetic counterparts (277-279). This risk is most likely related to the functional dependence and multimorbidity in these older diabetics. In order to identify those diabetics with (risk of) malnutrition we recommend to screen routinely for malnutrition (see part on screening and assessment of this guideline).

To decrease the risk of malnutrition developing in older persons with diabetes we recommend to avoid restrictive diets. These diets have limited benefits and can lead to nutrient deficiencies (74, 280). A balanced diet of about 30 kcal/kg body weight/d providing 50-55 % of the total energy contribution by carbohydrates, rich in fiber (25-30 g/d) and which favors mono- and polyunsaturated fatty-acids is proposed as recommended for the general older population. In case of obesity in older diabetic patients we refer to the respective recommendations provided elsewhere in this guideline (see recommendations 55 - 57).

In case of malnutrition in an older person with diabetes mellitus we recommend to follow the same guidelines as for non-diabetic older adults. The use of oral nutritional supplements or use of tube feeding can result in a rise of the glucose levels. However, prevention and treatment of malnutrition with its probable negative short-term outcomes are regarded more important than possible long-term complications of hyperglycemia.

IV. Recommendations to identify, treat and prevent dehydration in older persons

Dehydration relates to a shortage of water (fluid) in our bodies. This can be due to insufficient drinking (low-intake dehydration) or excess losses (through bleeding, vomiting, diarrhea etc., called volume depletion), or a combination of both types (combined dehydration) (281-284). ***Low-intake dehydration*** is a shortage of pure water leading to loss of both intracellular and extracellular fluid and to raised osmolality in both compartments (intracellular and extracellular). ***Volume depletion*** is due to excess losses of fluid and salts (especially sodium and sometimes other components); extracellular fluid is lost primarily, not intracellular fluid, and serum osmolality will be normal or low. Literature search identified ten SLRs (78, 88, 285-292) and four RCTs (281, 293-295) relevant to answer the PICO question.

Low-intake dehydration

IV.1 How much should older persons drink each day?

<u>Recommendation 61</u>

> Older women should be offered at least 1.6 L of drinks each day, while older men should be offered at least 2.0 L of drinks each day unless there is a clinical condition that requires different approach. (BM)
>
> Grade of recommendation B – strong consensus (96 % agreement)

Commentary

Daily water intake is required to compensate daily losses by respiration, exudation, urine and feces. An individual's minimum fluid requirement is 'the amount of water that equals losses and prevents adverse effects of insufficient water' (295). We take fluid from drinks and foods, but drinks or beverages account for 70 to 80 % of fluid consumed (296).

Recommendations for adequate fluid intakes in older adults are often based on small studies in young adults and studies in other mammals (297) so actual volumes suggested tend to depend on the assumptions made. The European Food Safety Authority (EFSA) reviewed the literature and recommended an Adequate Intake (AI) of 2.0 L/day for women and 2.5 L/day for men of all ages (from a combination of drinking water, beverages and food) (286). Assuming 80 % of these fluid needs to come from drinks then women would require 1.6 L/d of drinks, and men 2.0 L/d. Minimal drinks recommendations in women vary from 1.0 L/d in the Nordic countries to 2.2 L/d in the USA, while in men the range is 1.0 to 3.0 L/d of drinks or beverages (298-302). Other countries use vaguer units, such as “6-8 cups/glasses a day” (303). Given this variation, use of the EFSA fluid recommendation of 2 L/d for women and 2.5 L/d for men from all sources, or 1.6 L/d and 2.0 L/d respectively from drinks alone would seem appropriately cautious in older adults. Individual fluid needs are related to energy consumption, water losses and kidney function, so larger people may require more fluid. The EFSA recommendations apply to “conditions of moderate environmental temperature and moderate physical activity levels” so needs may be higher in extreme temperatures (e.g. summer heat) or at times of greater physical activity. Excessive losses due to, fever, diarrhea, vomiting or severe hemorrhage must also be balanced by additional intake. On the other hand, specific clinical situations, namely heart and renal failure, may need a restriction of fluid intake.

IV.2 What should older persons drink each day?

<u>Recommendation 62</u>

A range of appropriate (i.e. hydrating) drinks should be offered to older people according to their preferences. (BM)

Grade of recommendation B – strong consensus (100 % agreement)

Commentary

Drinks providing fluid with a hydrating effect on our bodies include water, sparkling water, flavored water, hot or cold tea, coffee, milk and milky drinks, fruit juices, soups, sports or soft drinks and smoothies (294). There is a common myth, which should be dispelled, that in order to be hydrated we need to drink plain water – this is not the case. Beer and lager are hydrating and may also be appropriate for some older adults (not needing to restrict alcohol for medical or social reasons). Drinks should be chosen according to the preferences of the older person, as well as the drinks' fluid and nutritional content – so that milky drinks, fruit juices and smoothies, high calorie drinks and fortified drinks all have particular benefits in specific circumstances. Despite worries about "dehydrating" effects of caffeine and alcohol there is good evidence that coffee does not cause dehydration (293, 294), and nor do alcoholic drinks of up to 4 % alcohol (294). The effect of alcoholic drinks with greater than 4 % alcoholic content on hydration status is not yet clear, and clinical studies are lacking (further research is needed). Research on which drinks are hydrating was carried out in younger adults (293, 294); similar research does not appear to have been carried out in older adults. However, there is little reason to believe that these findings would not apply to older adults.

In the UK coffee intake and alcoholic drinks each make up around 10 % of drinks intake in free-living older adults, so are important fluid sources (304). Twenty percent of UK care home residents reported that their favorite drink was coffee, and 50 % drank coffee at some point each day (305, 306). If continence is a concern then decaffeinated drinks (such as coffee, tea and soft drinks) may be tried, but are not necessary unless found helpful (307, 308).

There is good evidence from two RCTs that the hydration potential for most non-alcoholic drinks, such as hot or iced tea, coffee, fruit juice, sparkling water, carbonated beverages/soda, and also lager, are very similar to those of water (293, 294). Although this research was in younger adults it suggests that variety, offering a range of drinks, and the drinks preferred by older adults, will be both hydrating and more enjoyable than always drinking water.

IV.3 Which older persons are at risk of low-intake dehydration?

Recommendation 63

> All older persons should be considered to be at risk of low-intake dehydration and encouraged to consume adequate amounts of drinks. (BM)
>
> Grade of recommendation GPP – strong consensus (100% agreement)

Commentary

A non-systematic review of studies reporting serum osmolality in older adults suggests that low-intake dehydration is common in this group (309). Levels of dehydration (signified by serum or plasma osmolality >300 mOsm/kg) were low (0 to 15 %, mean 7 %) in older adults living at home in Japan (310), the US (311, 312) and Sweden (313). Three US (314-316) and one UK (14) study of more frail and vulnerable older adults living in residential or long-term care suggested that up to 38 % (mean 19 %) were dehydrated. The risk of dehydration was higher again in older adults admitted to hospital (4 to 58 %, mean 36 %) in the UK (317-321), Sweden (reported in Hooper (287)) and Austria (322). Reduced fluid intake in more vulnerable older adults was confirmed in a study measuring daily water turnover rates (using deuterium oxide tracer) in older adults living in residential care (median 1.5 L/d, range 0.91-2.94), 27 % less than in independently living older adults (323). The causes of low-intake dehydration in older adults appear to be varied and inter-related, and have been examined in several non-systematic reviews (12, 13, 324).

A wide range of age-related physiological changes increase dehydration risk (12, 324). Aging appears to blunt two key physiological (and protective) responses to drinking too little, thirst and primary urine concentration by the kidney (14, 325-328). In addition our total body water is reduced as we get older so we have a smaller fluid reserve, and many older adults use medications such as diuretics and laxatives which increase fluid losses (122, 329-332). While in some populations age is a risk factor for dehydration, in frail and vulnerable older adults it appears that degree of frailty and vulnerability (as assessed by functional status and cognition) are more relevant indictors (13, 14, 315).

Besides physiological changes, a range of other risk factors increase vulnerability to dehydration with age. Memory problems may cause older adults to forget to drink and forget that they haven't drunk (not being prompted to drink by thirst) (12-14, 315). Many older adults choose to reduce their drinks intake voluntarily, and because they don't feel thirsty as a result, assume they are still drinking enough for their health. Reasons for reducing fluid intake often revolve around continence (and fear of incontinence) and issues about getting to the toilet (13, 333, 334). Furthermore, drinking with others is an important part of social interaction, and social contact is a key trigger for drinking – but as social isolation becomes more common, drinking routines are lost and drinks intake is reduced (335). Physical access to drinks can also be an issue (13, 323, 336), as can swallowing problems and dysphagia. Thus, older adults are at high risk of dehydration due to drinking insufficient amounts of fluids and should be encouraged to consume adequate amounts of drinks.

IV.4 Should older persons be screened for low-intake dehydration?

<u>Recommendation 64</u>

> All older persons should be screened for low-intake dehydration when they contact the healthcare system, if clinical condition changes unexpectedly, and periodically when malnourished or at risk of malnutrition.
>
> Grade of recommendation GPP – strong consensus (100 % agreement)

Commentary

As described above (recommendation 63), low intake dehydration is common in older adults. There is some evidence that older adults with low-intake dehydration have poorer outcomes than those who are well-hydrated (322). High quality cohort studies which have adjusted for key confounding factors have consistently found that older adults with raised serum osmolality (>300 mOsm/kg or equivalent) have an increased risk of mortality (337-339) and one showed an associated doubling in risk of 4-year disability (338).

Two systematic reviews (285, 340) have assessed RCTs and uncontrolled trials aiming to increase fluid intake in older adults. Unfortunately most trials assessed fluid intake hydration status and health outcomes poorly, so success in increasing fluid intake is unclear. Nevertheless, regarding the severe consequences of dehydration, we recommend to screen for low-intake dehydration to identify dehydration early allowing for timely interventions to normalize hydration status and prevent poor outcomes. This might be of particular importance in situations of increased risk of dehydration e.g. in case of acute deterioration of health or poor food intake.

IV.5 How should low-intake dehydration be identified in older persons?

Recommendation 65

> Directly measured serum or plasma osmolality should be used to identify low-intake dehydration in older adults.
>
> Grade of recommendation GPP – strong consensus (95 % agreement)

Commentary

When we take in too little fluid (drink too little) the fluid within and around our cells becomes more concentrated, raising the osmolality of serum and plasma (281-284). The raised osmolality is the key physiological trigger of protection mechanisms (such as thirst and increased concentration of urine by the kidney). In older adults renal function is often poor so that renal parameters no longer accurately signal low-intake dehydration (12, 334, 341). Clinical judgement is also highly fallible in older adults (342). For these reasons, the US Panel on Dietary Reference Intakes for Electrolytes and Water stated ''The primary indicator of hydration status is plasma or serum osmolality'' (300). This statement sets the reference standard for dehydration in older adults. It is based on physiology and biochemistry and has been well agreed by hydration experts for many decades (282-284). In contrast, extracellular water loss (volume depletion) due to diarrhea, vomiting or renal sodium loss is connected with normal or low plasma osmolality.

Recommendation 66

An action threshold of directly measured serum osmolality >300 mOsm/kg should be used to identify low-intake dehydration in older adults. (DM)
Grade of recommendation B – strong consensus (94 % agreement)

Commentary

Threshold values of serum osmolality have been assessed in varied ways, but Cheuvront et al. (281) appear to have developed these most rigorously. They assessed the range of plasma osmolality in hydrated younger adults, then in the same persons who had been dehydrated, identifying the cut-off that best separated the two states. Their suggested threshold is that serum or plasma osmolality >300 mOsm/kg is classified as dehydrated. This cut-off value concurs with observations from cohort studies assessing effects of raised serum osmolality in older people (317, 337-339).

Serum osmolality is the sum of concentrations of osmotically active components especially of sodium, chloride, bicarbonate, potassium glucose, and urea. Interpretation of raised serum osmolality (>300 mOsm/kg) as sign of dehydration depends on checking that serum glucose, and to some extent urea are within normal range; if not these should be normalized by adequate treatment. In low-intake dehydration it is common that despite raised serum osmolality none of the major components (sodium, potassium, urea or glucose) is raised out of the normal range – but general fluid concentration leads to small rises within the normal range in all these components (Hooper unpublished).

Recommendation 67

Where directly measured osmolality is not available then the osmolarity equation (osmolarity = 1.86 × (Na+ + K+) + 1.15 × glucose + urea + 14 (all measured in mmol/L) with an action threshold of >295 mmol/L) should be used to screen for low-intake dehydration in older persons. (DM)
Grade of recommendation B – strong consensus (94 % agreement)

Commentary

Work with a set of European cohorts of older adults has suggested that most existing serum osmolarity equations are not diagnostically accurate to calculate serum osmolality in older adults (341, 343). However, one equation (osmolarity = 1.86 × (Na+ + K+) + 1.15 × glucose + urea + 14 (all measured in mmol/L)) usefully predicted serum osmolality in people aged ≥65 years with and without diabetes, poor renal function, dehydration, in men and women, in the community, in residential care and in hospital, with a range of ages, health, cognitive and functional status (341, 343). Given costs and prevalence of dehydration in older people, a cut point of 295 mOsm/L will identify most adults with low-intake dehydration (sensitivity 85 %, specificity 59 %) and should trigger advice and support with drinking and fluid intake. A directly measured serum osmolality test a few days later will identify older adults in need of more intensive support, intervention and/or follow up. This equation has also been found to be useful in younger adults (344).

Note on terms: osmola**l**ity is directly measured osmolality, measured using freezing point depression, while osmola**r**ity aims to approximate osmolality and is an estimate based on an equation of several components. The terms are often used incorrectly.

Recommendation 68

Simple signs and tests commonly used to assess low-intake dehydration such as skin turgor, mouth dryness, weight change, urine color or specific gravity, shall NOT be used to assess hydration status in older adults. (DM)

Grade of recommendation A – consensus (83 % agreement)

Recommendation 69

Bioelectrical impedance shall NOT be used to assess hydration status in older adults as it has not been shown to be usefully diagnostic. (DM)

Grade of recommendation A – strong consensus (100 % agreement)

Commentary to recommendations 68 and 69

A Cochrane systematic review of diagnostic accuracy of simple signs and tests for dehydration in older adults (aged at least 65 years old) has pooled diagnostic data from studies assessing many single clinical signs and tests against serum osmolality, osmolarity or weight change (287). It found that none was consistently useful in indicating hydration status in older adults (287). The signs have either not been shown to be usefully diagnostic or have been shown not to be usefully diagnostic. These findings have been confirmed by more recent diagnostic accuracy studies in older adults (319, 345-347). The Cochrane review also found no evidence of the utility of bioelectrical impedance in assessment of hydration status in older adults in four included studies (287).

Recommendation 70

Older persons and their informal carers may use appropriate tools to assess fluid intake, but should also ask healthcare providers for assessment of serum osmolality periodically.

Grade of recommendation GPP – strong consensus (94 % agreement)

Commentary

Unfortunately, assessment of fluid intake is often highly inaccurate in older adults. A recent study in residential care compared staff-completed drinks intake assessment with direct observation over 24 hours for 22 older adults, finding a very low correlation (r=0.122) (305). The low correlation appeared to be due to many drinks being omitted from the staff assessments, as well as recording of drinks given rather than drinks consumed. On average staff assessments were 700 ml/d lower than direct observation would suggest. This poor ability to assess drinks intake in residential and nursing care facilities has been reported numerous times (348-351). Measurement of serum osmolality is the method of choice (see recommendations 65 and 66).

There is little evidence of the accuracy of assessment of fluid intake by informal carers, but it may be better than for care staff as informal carers may be more aware of the full drinks intake of the older adult. We have evidence that when older adults record their own drinks intake it is more accurate than that assessed by care staff (352). Older adults and their informal carers may like to use a tool like the Drinks Diary (which explicitly assesses amount consumed, rather than amount provided (352)) to record fluid intake, but we suggest that they also ask their health care providers to check serum or plasma osmolality. Within health and social care settings fluid intake or fluid balance should only be assessed in specialist medical units with specifically trained personnel.

IV.6 How should older persons be treated for low-intake dehydration?

Recommendation 71

> Older adults with measured serum or plasma osmolality >300 mOsm/kg (or calculated osmolarity >295 mmol/L) who appear well should be encouraged to increase their fluid intake in the form of drinks preferred by the older adult.
>
> Grade of recommendation GPP – strong consensus (100 % agreement)

Commentary

Treatment for low-intake dehydration involves administration of hypotonic fluids (282-284), which will help correct the fluid deficit while diluting down the raised osmolality. In mild dehydration older persons should be encouraged to drink more fluid, which can be in the form of drinks preferred by the older person, such as hot or iced tea, coffee, fruit juice, sparkling water, carbonated beverages/soda, lager or water (293, 294). Oral rehydration therapy (which aims to replace electrolytes lost in volume depletion by diarrhea or vomiting) and sports drinks are NOT indicated. Hydration status should be reassessed regularly until corrected, then monitored periodically alongside excellent support for drinking.

<u>Recommendation 72</u>

> For older adults with measured serum or plasma osmolality >300 mOsm/kg (or calculated osmolarity >295 mmol/L) who appear unwell, subcutaneous or intravenous fluids shall be offered in parallel with encouraging oral fluid intake. (BM)
>
> Grade of recommendation A – strong consensus (95 % agreement)

<u>Recommendation 73</u>

> For older adults with measured serum or plasma osmolality >300 mOsm/kg (or calculated osmolarity >295 mmol/L) and unable to drink, intravenous fluids shall be considered. (BM)
>
> Grade of recommendation A – strong consensus (95 % agreement)

Commentary to recommendations 72 and 73

Several systematic reviews of moderate quality have reviewed the evidence comparing subcutaneous and intravenous fluid administration in older adults (291-292) or more generally (289, 290), and guidelines for older adults have been produced (329, 353). The earlier systematic review assessing evidence for hypodermoclysis in older people searched until 1996 and included 13 studies, mainly case reports, which reported on 668 patients receiving electrolyte-containing, electrolyte-free or hypertonic solutions (291), suggesting that

23 patients (3.4 %) experienced adverse effects, but noted that electrolyte-containing solutions resulted in fewer and less severe side effects than electrolyte-free or hypertonic.

The later systematic review re-analyzed the earlier review and included two small later RCTs and a cohort study (292). The first RCT randomized 96 patients with signs of mild to moderate dehydration in German geriatric wards to subcutaneous or intravenous infusion of half-normal saline-glucose 5 % (354). Thirteen (27%) allocated to subcutaneous changed to intravenous, eleven due to a need for intravenous drugs and two because of poor absorption, while 17 (35 %) allocated to intravenous were switched to subcutaneous administration (eight due to intravenous puncture being difficult to achieve). There were no differences between groups in median duration of hospital stay, duration of infusion, patient discomfort or nurses' assessment of feasibility, but doctors rated subcutaneous infusions as significantly more feasible, and more fluid was delivered to patients receiving intravenous therapy. The second RCT randomized cognitively impaired patients admitted to a UK acute geriatric unit with mild dehydration or poor oral intake to subcutaneous or intravenous 0.9 % saline, 0.45 % saline or 5 % dextrose (355). Re-siting of the infusion was required in four patients (13 %) of the subcutaneous and seven (23 %) of the intravenous group, and one of the intravenous group was switched to subcutaneous because of access difficulties. Groups were similar in terms of amount of fluid delivered, serum creatinine and urea. Agitation related to the fluid provision was noted for 80 % of those on intravenous and 37 % on subcutaneous fluids (p=0.0007). The only complications noted were local edema in two receiving subcutaneous fluids. Overall, the review suggested that the evidence suggests that "appropriate volumes of subcutaneous dextrose infusions (in the form of half-normal saline-glucose 5 %, 40 g/L dextrose and 30 mmol/L NaCl, or 5 % dextrose solution and 4 g/L NaCl, or two-thirds 5 % glucose and one-third normal saline) can be used effectively for the treatment of dehydration, with similar rates of adverse effects to intravenous infusion" (292).

A systematic data review suggests that financial costs of subcutaneous rehydration are probably lower than intravenous, but the systematic review is methodologically poor and the evidence base it collates is of low quality – better designed studies are needed (289).

When dehydration is severe and greater fluid volumes are needed or intravenous access is required for administration of medications or nutrition, then administration of intravenous fluid is the method of choice (356, 357). Parenteral hydration should however always be considered as a medical treatment rather than as basic care, and its benefits and risks should be carefully balanced (see Chapter "Parenteral Nutrition").

IV.7 What interventions may help to support older persons to drink well and prevent low-intake dehydration?

Recommendation 74

> To prevent dehydration in older persons living in residential care, institutions should implement multicomponent strategies across their institutions for all residents. (BM)
>
> Grade of recommendation B – strong consensus (100 % agreement)

Recommendation 75

> These strategies should include high availability of drinks, varied choice of drinks, frequent offering of drinks, staff awareness of the need for adequate fluid intake, staff support for drinking and staff support in taking older adults to the toilet quickly and when they need it. (BM)
>
> Grade of recommendation B – strong consensus (100 % agreement)

Recommendation 76

> Strategies to support adequate fluid intake should be developed including older persons themselves, staff, management and policymakers.
>
> Grade of recommendation B – strong consensus (100 % agreement)

Recommendation 77

> Care plans for older adults in institutions should record individual preferences for drinks, how and when they are served, as well as continence support, to promote drinking. Assessment of individual barriers and promoters of drinking should lead to plans for supporting drinking specific to each older person.
>
> Grade of recommendation GPP – strong consensus (100 % agreement)

<u>Recommendation 78</u>

> At a regulatory level, the strategy of mandatory monitoring and reporting by institutions of hydration risks in individual residents and patients should be considered. (BM)
>
> Grade of recommendation GPP – strong consensus (100 % agreement)

<u>Recommendation 79</u>

> Older adults who show signs of dysphagia should be assessed, treated and followed up by an experienced speech and language therapist. Their nutrition and hydration status should be carefully monitored in consultation with the speech and language therapist and a dietician.
>
> Grade of recommendation GPP – strong consensus (94 % agreement)

Commentary to recommendations 74 - 79

No interventions to support adequate drinks intake have been clearly shown to prevent or treat low-intake dehydration in older adults. A recent systematic review assessed the effectiveness of interventions and environmental factors to increase drinking and/or reduce dehydration in older adults living in residential care, including randomized trials, non-randomized intervention studies and cohort studies (285). The review identified 19 intervention and four observational studies from seven countries but suggested that overall the studies were at high risk of bias. The evidence suggests that multicomponent interventions (including increased staff awareness, assistance with drinking, support using the toilet and a greater variety of drinks on offer) may be effective (285). It was also suggested that introduction of the US Resident Assessment Instrument (which requires mandatory monitoring and reporting of hydration risks) reduced dehydration in older adults (285, 295). A small single study implied that high contrast red cups were helpful in supporting drinking in nine men with dementia (285). Large cohort studies in the US and Canada suggested different relationships between care home ownership and dehydration – in Canada for-profit ownership was associated with increased hospital admissions for dehydration while in the US dehydration prevalence did not differ between for-profit and not-for-profit homes (285). No clear relationships were observed between staffing levels and dehydration prevalence (285, 358, 359). The review suggested that multiple strategies including involvement and input from older adults, staff, management and policymakers will be needed to address problems with drinking in residential care.

A pair of systematic reviews assessed effectiveness of interventions to support food and drink intake in people with mild cognitive impairment or dementia, which included cohorts of older adults not labelled as having dementia but where a cognitive assessment showed that on average cognitive impairment was present (88, 340), as it is in most care home populations. Included studies were small and fluid intake and hydration status were poorly assessed. No further strategies for supporting fluid intake were identified within these reviews, but a key suggestion from assessments of nutrition more generally was that studies with a strong social element, where socializing around food and drink was supported, tended to improve quality of life, nutritional status and fluid intake (340).

Observational data have suggested that the number of drinks offered to older adults in residential care is strongly positively associated with fluid intake (13, 305). We found limited information on increasing fluid intake in hospital or community settings.

Patients with dysphagia are at specific high risk of dehydration and fluid intake has been reported to be low, especially when thickened fluids are used to make swallowing safer (360). A partner ESPEN guideline recommends that stroke patients receiving thickened fluids should have their fluid balance monitored by trained professionals (130). A high quality systematic review, though not specific to older adults, has suggested that use of chin down swallowing and thin fluids should be the first choice of therapy in chronic dysphagia (128). A small short term RCT in older adults with severe cognitive impairment suggested that cervical spine manipulation may increase dysphagia limit for those with swallowing problems, but effects on hydration were not assessed (361).

A recent systematic review and guidelines reports RCTs showing that in people following stroke thickened fluids alongside access to free water (not other drinks) compared to thickened liquids alone was effective at protecting against aspiration and increasing fluid intake. Use of pre-thickened drinks rather than drinks thickened with powder at point of use were also better at supporting fluid intake post-stroke (130).

Volume depletion

IV.8 How should volume depletion be identified?

Recommendation 80

> In older adults, volume depletion following excessive blood loss should be assessed using postural pulse change from lying to standing (≥30 beats per minute) or severe postural dizziness resulting in inability to stand.
>
> Grade of recommendation B – strong consensus (100 % agreement)

Recommendation 81

> In older adults, volume depletion following fluid and salt loss with vomiting or diarrhea should be assessed by checking a set of signs. A person with at least four of the following seven signs is likely to have moderate to severe volume depletion: confusion, non-fluent speech, extremity weakness, dry mucous membranes, dry tongue, furrowed tongue, sunken eyes.
>
> Grade of recommendation B – strong consensus (95 % agreement)

Commentary to recommendations 80 and 81

Volume depletion (reduced volume of extracellular fluids only, due to loss of fluids and electrolytes, also called salt loss or extracellular dehydration) occurs without raised serum or plasma osmolality, and following medical conditions resulting in excessive losses of fluid and electrolytes, such as bleeding, vomiting and diarrhea (281-284).

The clearest signs following excessive blood loss are a large postural pulse change (≥30 beats per minute) or severe postural dizziness leading to lack of ability to stand (288), which are 97 % sensitive and 98 % specific when blood loss is at least 630 mL, but much less sensitive at lower levels of blood loss. However, these results were found in younger adults not taking beta-blockers, so sensitivity and specificity may vary in older persons. The authors report that postural hypotension has little additional predictive value.

Signs following fluid and salt loss with vomiting or diarrhea are less clear. A systematic review of signs associated with volume depletion after vomiting or diarrhea suggests that no signs are individually very useful, but that a person having at least four of the following seven signs is likely to have moderate to severe volume depletion: confusion, non-fluent speech, extremity weakness, dry mucous membranes, dry tongue, furrowed tongue, sunken eyes, However, the authors suggested that this form of diagnosis needs further assessment (288). Decreased venous filling (empty veins) and low blood pressure may also be good signs of hypovolemia.

IV.9 How should volume depletion be treated?

<u>Recommendation 82</u>

> Older adults with mild/moderate/severe volume depletion should receive isotonic fluids orally, nasogastrically, subcutaneously or intravenously. (BM)
>
> Grade of recommendation B – strong consensus (95 % agreement)

Commentary

Treatment for volume depletion aims to replace lost water and electrolytes and involves administration of isotonic fluids (284, 356).

NICE conducted a set of systematic reviews to assess the best protocol for assessment and management of fluid and electrolyte status in hospitalized patients (356), including older adults. Their evidence base was updated in 2017. Their resultant guidance and flowchart suggests that where a patient is hypovolaemic and needs fluid resuscitation then this should occur immediately. Where fluid resuscitation is not needed then assessment of patients' likely fluid and electrolyte needs should be met orally or enterally where possible, but if not feasible then intravenous fluid should be considered. Where electrolyte levels are low this would suggest replacement with isotonic fluids (fluids with sodium, potassium and glucose concentrations similar to those within the body) such as oral rehydration therapy. Isotonic or slightly hypotonic fluids are ideal (284). NICE provide a set of interrelated algorithms for assessment, fluid resuscitation, routine intravenous maintenance and replacement and redistribution of fluid and electrolytes.

Conflict of interest

The expert members of the working group were accredited by the ESPEN Guidelines Group, the ESPEN Education and Clinical Practice Committee, and the ESPEN executive. All expert members have declared their individual conflicts of interest according to the rules of the International Committee of Medical Journal Editors (ICMJE). If potential conflicts were indicated, they were reviewed by the ESPEN guideline officers and, in cases of doubts, by the ESPEN executive. None of the expert panel had to be excluded from the working group or from co-authorship because of serious conflicts. The conflict of interest forms are stored at the ESPEN guideline office and can be reviewed by ESPEN members with legitimate interest upon request to the ESPEN executive.

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Authors´ contribution

All authors were involved in the development of the PICO questions and development of the literature search strategy, read and approved the final manuscript. DV was responsible for writing the introduction and the methods section (in close cooperation with the guideline office), for I.1 and I.2 (#1-7), #10 and 11. She supervised the guideline process, organised the group meetings, put all parts together and critically read and commented all parts of the manuscript. AMB was responsible for II.1 – II.10 (#12-22). ACJ was responsible for III.2 (#47-49) and III.3 (#50-51) and supported III.1 (#43-46) and III.4 (#52-53). SG was responsible for III.1 (#43-46) and supported II.7 (#18,19) and III.5 (#54-57). LH organized and performed the literature search and organized the literature selection process. She was responsible for chapter IV. (#61-82). EK was responsible for #8 and 9, II.15 (#41,42) and III.5 (#54-57). MM was responsible for III.4 (#52,53) and for #39 and 40. ARS was responsible for II.11 (#23-28). LS was responsible for (#36-38). DvA was responsible for III.6 (#58-60). RW was responsible for II.12 (#29-35). CCS and TC supported the whole guideline process and critically commented the manuscript. SCB supervised the guideline process and critically commented formal and methodological aspects of the manuscript.

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I Basic questions and general principles (without systematic literature search)

I.1 How much energy and nutrients should be offered/delivered to older persons?

<u>Recommendation 1</u>

Guiding value for energy intake in older persons is 30 kcal per kg body weight and day and should be individually adjusted with regard to nutritional status, physical activity level, disease status and tolerance. (BM)

Grade of recommendation B – strong consensus (97 % agreement)

1.	**Alix E, Berrut G, Bore M, Bouthier-Quintard F, Buia JM, Chlala A, et al. Energy requirements in hospitalized elderly people. Journal of the American Geriatrics Society. 2007;55(7):1085-9.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Cohort study 2+	***Countries:*** France ***Centers:*** General Hospital, Le Mans; University Hospital, Angers; St Nicolas Hospital, Angers ***Setting:*** acute or rehabilitation care unit ***Funding Sources:*** Chiesi SA ***Dropout rates:*** 0% ***Study limitations:*** a phase of hypermetabolism during the first 5 to 7 days after admission may have been missed	**Total no. Patients:** 90 **Inclusion criteria:** men and women aged 65 and older and hospitalized in an acute or rehabilitation care unit **Exclusion criteria:** low MMSE score (<19)	n/a
Notes	**Author's Conclusion:** The mean REE of the geriatric patients studied was 18.8 kcal/kg per day, whereas energy intake was just sufficient to cover minimal requirements. Thus, hospitalized elderly patients are likely to benefit from higher calorie intake.		
Outcome measures/results	Patients' energy intake and resting EE (REE) were measured over a 3-day period. Blood samples were taken to determine C-reactive protein (CRP), creatinine, and albumin		Energy intake was higher than REE by a factor of 1.29, but it was lower than the energy requirement. Energy intake, adjusted for differences in body weight, was independent of sex, highest in those who were

	concentrations and to check renal function.	malnourished (defined as a body mass index (BMI) <21), and lowest in patients who scored poorly on the Mini-Mental State Examination. Energy intake and REE were independent of plasma CRP, creatinine, and albumin concentrations, as well as the initial diagnosis. REE was similar in men and women, at 18.8 kcal/kg per day. REE was 21.4 kcal/kg per day in patients with a BMI of 21 or less and 18.4 kcal/kg per day in those with a BMI greater than 21 kg/m2. The Harris-Benedict equation accurately predicted mean REE.

2.	**Gaillard C, Alix E, Salle A, Berrut G, Ritz P. Energy requirements in frail elderly people: a review of the literature. Clinical nutrition (Edinburgh, Scotland). 2007;26(1):16-24.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Review 1-	***Countries:*** France ***Centers:*** Angers, Le Mans ***Setting:*** n/a ***Funding Sources:*** n/a ***Dropout rates:*** n/a ***Study limitations:*** n/a	**Total no. Patients:** 2450 **Inclusion criteria:** (1) studies in which subjects had a minimal mean age of 60 yr. or more with all being at least 55 yr. of age, (2) those in which indirect calorimetry was performed while subjects were at rest and while fasting. **Exclusion criteria:** Studies that included patients on specific diets, mechanically ventilated, cancer or burns patients or patients with thyroid problems, Studies that did not mention the mean body weight of the studied group	n/a
Notes	**Author's Conclusion:** REE, which can be used in conjunction with PAL to calculate energy requirements, is approximately 20 kcal/kg/d in sick elderly people. This figure is not increased when compared to their healthy elderly counterparts. REE appears no longer affected by		

	gender over the age of 60 yr. and minimal energy requirements can be set between 20x1.36 and 20x1.51, i.e. between 27 and 30 kcal/kg/d in sick elderly people. Requirements are higher in underweight people (34–38 kcal/kg/d). Further studies are needed in very elderly and sick people, taking their specific pathology into consideration.	
Outcome measures/results	• REE using indirect calorimetry • Body composition using dual energy X-ray absorptiometry, DLW, BIA, underwater weighing or body density • Total energy expenditure (TEE) and Energy Intake (EI) using DLW technique • Dietary records	(1) REE, when adjusted for differences in both body weight and fat-free mass (FFM), is similar in healthy and in sick elderly people being 20 and 28 kcal/kg of FFM per day, respectively, (2) their nutritional status influences their energy requirements given that weight-adjusted REE increases in line with a decrease in BMI, (3) total energy expenditure is lower in sick elderly people given that their physical activity level, i.e. the ratio of total energy expenditure to REE, is reduced during disease averaging at 1.36, (4) energy intake (EI) being only 1.23_REE is insufficient to cover energy requirements in sick elderly patients, whereas the EI of healthy elderly people appears sufficient to cover requirements, and finally, (5) gender ceases to be a determinant of REE in people aged 60 yr. or over, with the Harris & Benedict equation capable of accurately predicting mean REE in this population, whether healthy or sick.

3.	**Gaillard C, Alix E, Salle A, Berrut G, Ritz P. A practical approach to estimate resting energy expenditure in frail elderly people. The journal of nutrition, health & aging. 2008;12(4):277-80.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Retrospective cohort study 2++	***Countries:*** France ***Centers:*** Pôle de médicine interne et maladies métaboliques, Angers; Service de Gériatrie, Le Mans ***Setting:*** University hospital of Angers ***Funding Sources:*** Chiesi SA ***Dropout rates:*** n/a	**Total no. Patients:** 187 **Inclusion criteria:** men and women above 55 yrs. of age and hospitalized in a short-stay or rehabilitation care units **Exclusion criteria:** n/a	n/a

	Study limitations: n/a		
Notes	**Author's Conclusion:** A simple formula using a factor multiplying body weight, i.e. 22 kcal/kg/d in under-weight and 19kcal/kg/d in normal weight sick elderly was accurate to predicting REE and bias was not influenced by the level of REE. This model included half of the group in the range of ±10% of the difference between predicted REE and measured REE, but the confidence interval of the bias was ±400kcal/d. Conversely, the Harris and Benedict and WHO formulae did accurately predict REE.		
Outcome measures/results	• Height and weight, BMI • REE measured by indirect calorimetry		The present study shows that the Fredrix et al. equation gave an accurate prediction of REE without significant bias along the whole range of REE. It also shows that under-weight sick elderly patients (BMI≤ 21 kg/m²) had a greater weight-adjusted REE than their normal weight counterparts.

Recommendation 2

Protein intake in older persons should be at least 1 g protein per kg body weight and day. The amount should be individually adjusted with regard to nutritional status, physical activity level, disease status and tolerance. (BM)

Grade of recommendation B – strong consensus (100 % agreement)

4.	**Bauer J, Biolo G, Cederholm T, Cesari M, Cruz-Jentoft AJ, Morley JE, et al. Evidence-based recommendations for optimal dietary protein intake in older people: a position paper from the PROT-AGE Study Group. Journal of the American Medical Directors Association. 2013;14(8):542-59.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Position paper 1+	***Countries:*** n/a ***Centers:*** n/a ***Setting:*** n/a ***Funding Sources:*** Nestlé Nutrition ***Dropout rates:*** n/a ***Study limitations:*** n/a	**Total no. Patients:** n/a **Inclusion criteria:** n/a **Exclusion criteria:** n/a	n/a
Notes	**Author's Conclusion:** Guidelines for dietary protein intake have traditionally advised similar intake for all adults, regardless of age or sex: 0.8 grams of protein per kilogram of body weight each day (g/kg BW/d). The one-size-fits-all protein recommendation does not consider age-related changes in metabolism, immunity, hormone levels, or progressing frailty.		
Relevant recommendations/ statements	• To maintain physical function, older people need more dietary protein than do younger people; older people should consume an average daily intake at least in the range of 1.0 to 1.2 g/kg BW/d. • The amount of additional dietary protein or supplemental protein needed depends on the disease, its severity, the patient's nutritional status prior to disease, as well as the disease impact on the patient's nutritional status. • Most older adults who have an acute or chronic disease need even more dietary protein (i.e., 1.2–1.5 g/kg BW/d); people with severe illness or injury or with marked malnutrition may need as much as 2.0 g/kg BW/d. • Older people with severe kidney disease who are not on dialysis (i.e., estimated GFR < 30 mL/min/1.73m^2) are an exception to the high-protein rule; these individuals need to limit protein intake. • Protein quality, timing of intake, and amino acid supplementation may be considered so as to achieve the greatest benefits from protein intake, but further studies are needed to make explicit recommendations. • In combination with increased protein intake, exercise is recommended at individualized levels that are safe and tolerated.		

5.	**Deutz NE, Bauer JM, Barazzoni R, Biolo G, Boirie Y, Bosy-Westphal A, et al. Protein intake and exercise for optimal muscle function with aging: recommendations from the ESPEN Expert Group. Clinical nutrition (Edinburgh, Scotland). 2014;33(6):929-36.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Recommendations 2++	***Countries:*** n/a ***Centers:*** n/a ***Setting:*** n/a ***Funding Sources*** n/a ***Dropout rates:*** n/a ***Study limitations:*** n/a	**Total no. Patients:** n/a **Inclusion criteria:** n/a **Exclusion criteria:** n/a	n/a
Notes	**Author's Conclusion:** In order to help prevent or delay adverse consequences, we encourage increased intake of dietary protein for older adults (>65 years) compared to younger adults, and continued participation in routine exercise or physical activities. At the same time, it is important for older people to balance total energy intake with total body energy demands a rationale for consuming protein as a higher proportion of daily energy intake.		
Relevant recommendations/ statements	• for healthy older people, the diet should provide at least 1.0-1.2 g protein/kg body weight/day, • for older people who are malnourished or at risk of malnutrition because they have acute or chronic illness, the diet should provide 1.2-1.5 g protein/kg body weight/day, with even higher intake for individuals • with severe illness or injury, • daily physical activity or exercise (resistance training, aerobic exercise) • should be undertaken by all older people, for as long as possible.		

6.	**Rizzoli R, Stevenson JC, Bauer JM, van Loon LJ, Walrand S, Kanis JA, et al. The role of dietary protein and vitamin D in maintaining musculoskeletal health in postmenopausal women: a consensus statement from the European Society for Clinical and Economic Aspects of Osteoporosis and Osteoarthritis (ESCEO). Maturitas. 2014;79(1):122-32.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Consensus statement 2+	***Countries:*** n/a ***Centers:*** n/a ***Setting:*** n/a	**Total no. Patients:** n/a **Inclusion criteria:** n/a	n/a

	Funding Sources: Danone S.A. ***Dropout rates:*** n/a ***Study limitations:***	**Exclusion criteria:** n/a	
Notes	**Author's Conclusion:** The European Society for Clinical and Economic Aspects of Osteoporosis and Osteoarthritis (ESCEO) recommends optimal dietary protein intake of 1.0–1.2 g/kg body weight/d with at least 20–25 g of high-quality protein at each main meal, with adequate vitamin D intake at 800 IU/d to maintain serum 25-hydroxyvitamin D levels >50 nmol/L as well as calcium intake of 1000 mg/d, alongside regular physical activity/exercise 3–5times/week combined with protein intake in close proximity to exercise, in postmenopausal women for prevention of age-related deterioration of musculoskeletal health.		
Relevant recommendations/ statements	• Food intake and physical activity are key anabolic stimuli for muscle protein synthesis. Exercise can enhance muscle protein synthesis irrespective of age. • The ingestion of protein and amino acids stimulates muscle protein synthesis; however, the anabolic sensitivity of skeletal muscle tissue to protein intake is reduced with ageing, leading to the concept of anabolic resistance. • Different protein sources may vary in their capacity to stimulate the rate of postprandial muscle protein synthesis. Leucine is a key anabolic amino acid that exerts a dose response effect on muscle protein synthesis, and is demonstrated to increase rates of postprandial muscle protein synthesis in elderly men. • Dietary proteins have a direct effect on key regulatory proteins and growth factors involved in muscle and bone growth. For example, aromatic amino acids (prevalent in dairy protein) lead to increased IGF-I resulting in greater muscle mass and strength. • Low dietary intake of protein (below the recommended daily allowance level of 0.8 g/kg/BW/d) in elderly women is associated with a reduction in plasma IGF-I levels and skeletal muscle fiber atrophy. The least muscle loss was seen in the elderly (aged 70–79 years) consuming protein at 1.1 g/kg/BW/d or 18% of total energy intake. • The distribution of protein intake over the day may be important, and it is proposed that 20–25 g of dietary protein per meal is required to allow an appropriate stimulation of post-prandial muscle protein synthesis over a 24-h period. • Dietary protein may positively impact bone health by increasing calcium absorption, suppressing parathyroid hormone, and increasing production of IGF-I, a potent bone anabolism stimulator. • A positive association between protein intake and BMD, bone mineral content, and a reduction in bone resorption markers has been demonstrated in a meta-analysis. • There is no evidence to support the theory that high protein intake (of animal origin) leads to increased bone resorption, bone loss and osteoporosis.		

Recommendation 3

For enteral nutrition fiber-containing products should be used. (BM)

Grade of recommendation B – strong consensus (91 % agreement)

<table>
<tr><td>7.</td><td colspan="4">Bass DJ, Forman LP, Abrams SE, Hsueh AM. The effect of dietary fiber in tube-fed elderly patients. Journal of gerontological nursing. 1996;22(10):37-44.</td></tr>
<tr><td>Study Type/
Evidence Level</td><td>Study details/limitations</td><td colspan="2">Patient characteristics</td><td>Interventions</td></tr>
<tr><td>Recording study
2+</td><td>Countries: Texas
Centers: Acute care medical center
Setting: 10-bed continuing care facility
Funding Sources: n/a
Dropout rates: 0 %
Study limitations: The retrospective method used relies on the accuracy of recording stool passage, commonly done by certified nursing assistants. Primary and secondary diagnoses, particularly among the elderly, usually chronically ill, population were not evaluated.</td><td colspan="2">Total no. Patients: n = 50
Inclusion criteria: Tube feeding for at least 3 weeks
Exclusion criteria: No exclusions were made based on medical diagnosis.</td><td>Group 1 received fiber containing formula (FCF) (n = 35).
Group 2 received fiber free formula (FFF) (n = 15).</td></tr>
<tr><td>Notes</td><td colspan="4">Author’s Conclusion: Fiber containing formula was found to decrease the number of liquid/loose stools and increase the number of formed stools when compared to fiber-free formula. The correlation statistics indicate that people with lower serum albumin concentrations tended to have more liquid/loose stools.</td></tr>
<tr><td>Outcome measures/results</td><td colspan="2">Primary Outcome: Effect of dietary fiber on the incidence of diarrhea

Secondary outcomes:
Serum albumin
Correlation of age, serum albumin and antibiotic use with the number of liquid/loose or formed stools</td><td colspan="2">In patients receiving FCF serum albumin was 2.77 g/dL; in those receiving FFF it was 2.73 g/dL. There was no significant difference found.
Each member of the FCF group had a mean of 3.0 liquid/loose stools during the study period, while those receiving FFF had a mean of 12.9 (p<0.014). Those patients on FCF averaged 49.6 formed stools in 3 weeks, while those receiving FFF only averaged 19.5 (p<0.001).
Age and antibiotic use was not significantly correlated with the number of liquid/loose or formed stools. Serum albumin had a weak significant negative correlation with “liquid/loose stool experienced.”</td></tr>
</table>

8.	Grant LP, Wanger LI, Neill KM. Fiber-fortified feedings in immobile patients. Clinical nursing research. 1994;3(2):166-72.		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1-	***Countries:*** USA ***Centers:*** n/a ***Setting:*** veterans' long-term care setting ***Funding Sources:*** Ross Laboratories ***Dropout rates:*** 0% ***Study limitations:*** small sample size (pilot study)	**Total no. Patients:** 7 **Inclusion criteria:** male, tube-fed, immobile patients with no organic cause for constipation **Exclusion criteria:** body temperature above 100 degrees Fahrenheit for more than 24 hours	• Intervention Group: fiber-fortified feedings for seven weeks • Control Group: usual enteral feeding
Notes	**Author's Conclusion:** Results indicate that fiber-fortified feedings should be added gradually to immobile, tube-fed patients´ diets under close supervision.		
Outcome measures/results	Weight, bowel habits, Water intake		Patients who receive the fiber-fortified enteral feedings had more stools and better consistency of stools than did those patients who did not receive the fiber- fortified formula.

9.	Homann HH, Kemen M, Fuessenich C, Senkal M, Zumtobel V. Reduction in diarrhea incidence by soluble fiber in patients receiving total or supplemental enteral nutrition. JPEN Journal of parenteral and enteral nutrition. 1994;18(6):486-90.		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** Germany ***Centers:*** Department of Surgery, Ruhr University, Bochum ***Setting:*** n/a ***Funding Sources:*** n/a ***Dropout rates:*** 0% ***Study limitations:*** n/a	**Total no. Patients:** 100 **Inclusion criteria:** surgical and medical patients **Exclusion criteria:** insulin-dependent diabetes, assisted ventilation, septic complications, medication with effects on	• Standard Diet: Nutrodrip Standard (a ready-to-use liquid formula) • Supplement Diet: same diet supplemented with 20 g of soluble fiber, containing partially hydrolyzed guarm gum (Sunfiber), per liter

		gastrointestinal function, the use of antibiotics (expect for a single dose of cephalosporin) or a history of gastrointestinal disorder	
Notes	**Author's Conclusion:** Enteral feeding with a formula supplemented with partially hydrolyzed guar gum reduces the incidence of diarrhea in patients receiving total enteral nutrition as well as in those receiving enteral supplementation, regardless of the cause of diarrhea. The increased hydrogen production and the significantly higher rate of flatulence are likely to result from fermentation of the soluble fiber in the colon, with concomitant production of short-chain fatty acids, which leads to increased absorption of short-chain fatty acids, sodium, and water by the colonocytes. This effect, together with the observed cholecystokinin-mediated decrease in colonic transit time with partially hydrolyzed guar gum, may explain the reduction in the incidence of diarrhea in this study.		
Outcome measures/results	Gastrointestinal side effects such as constipation, flatulence, vomiting and bowel movements. Diarrhea was defined as more than three liquid stools within 12 hours.		The patients receiving total enteral nutrition with soluble fiber had decreased diarrhea but increased flatulence. In none of these patients did enteral feeding have to be discontinued because of gastrointestinal side effects, whereas in four patients who were on a standard diet, enteral feeding had to be interrupted because of diarrhea ($p < .05$). Similar observations were made in patients receiving enteral supplementation. In both groups, the incidence of diarrhea decreased significantly with the soluble fiber diet compared with the standard diet (6 vs 15, $p < .05$).

10.	**Nakao M, Ogura Y, Satake S, Ito I, Iguchi A, Takagi K, et al. Usefulness of soluble dietary fiber for the treatment of diarrhea during enteral nutrition in elderly patients. Nutrition (Burbank, Los Angeles County, Calif). 2002;18(1):35-9.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Intervention study 1-	***Countries:*** *Japan* ***Centers:*** *Nagoya University Hospital Geriatrics Department* ***Setting:*** *bed-ridden* ***Funding Sources:*** *n/a*	**Total no. Patients:** n=20 (w=10; m=10) **Inclusion criteria:** bed-ridden for a prolonged period due to cerebral infarction or cerebral hemorrhaging, demonstrated loose stool or diarrhea **Exclusion criteria:** organic	1) Soluble dietary fiber (SDF)-Group (n=20) Initial dose: 7g of galactomannans (25g package per day) Gradually increase at 1-wk intervals (+25g package/wk.) After 4 weeks: maximum of four packages (100g, 28g of galactomannan) After 4 wk., the administration was discontinued for 2 wk. to confirm the effects of SDF

	Dropout rates: *n/a* ***Study limitations:*** *n/a; low number of patients, no control group*	disorders of the digestive tract	
Notes	• Not controlled, no randomization, no blinding **Author's Conclusion:** The administration of SDF is useful for controlling spontaneous, favorable bowel movement by improving symptoms of small intestinal mucosal atrophy and normalizing the intestinal flora.		
Outcome measures/results	• Administration SDF with the use of a continuous pump (60 mL/h; transnasal gastric tube) • Fecal cultures were prepared to rule out bacterial diarrhea • Determination of DAO activity: serum biochemical parameters, blood collection Blood collection after overnight fast: before administration of fiber and at 1,2,3 and 4 wk. after administration; and 1 and 2 wk. after discontinuation • Water content of feces: times like DAO activity • Fecal features and frequency of bowel movements: classification – normal, loose, sludgy, watery stool • Investigation of intestinal flora: number of colony forming units (CFU/g) • Fecal pH and SCFA levels • Nutritional parameters: body weight, serum total protein, prealbumin, transferring, retinol-binding protein, total cholesterol, triacylglycerol, serum oligodynamic trace minerals through blood collections		• After administration of SDF: ▪ Serum diamine oxidase activity increased ($p<0.001$) ▪ Water content of feces decreased between 2 and 4 wk. after administration ($p<0.05$ and $p<0.01$) ▪ Frequency of daily bowel movements also decreased ($p<0.05$) ▪ Fecal features improved (watery stool to sludge or loose stool); normal stool was observed 3 wk. after fiber administration ▪ Fecal pH decreased 4 wk. after administration of fiber ($p<0.05$) ▪ Total level of short-chain fatty acids increased 4 wk. after administration ($p<0.05$) ▪ Fecal level of each and total SCFA increased after 3 and 4 wk. after administration (both $p<0.05$) ▪ Intestinal flora: no significant changes in total number of bacteria or number of anaerobic bacteria Number of aerobic bacteria decreased 4 wk. after administration ($p<0.05$) ▪ No significant changes in various nutritional indices ▪ Nutritional parameters: no significant differences • After 2 wk. discontinuation: ▪ Decrease in DAO activity compared to 4 wk. after administration ($p<0.001$) ▪ Water content increased 2 wk. after discontinuation compared to 4wk after administration ($p<0.05$)

		▪ Fecal features deteriorate to loose, sludge or watery stool ▪ Frequency of bowel movements increased vs. 4 wk. after administration ($p<0.05$) ▪ Number of aerobic bacteria increased compared to 4 wk. after administration ($p<0.05$)

11.	**Shankardass K, Chuchmach S, Chelswick K, Stefanovich C, Spurr S, Brooks J, et al. Bowel function of long-term tube-fed patients consuming formulae with and without dietary fiber. JPEN Journal of parenteral and enteral nutrition. 1990;14(5):508-12.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1-	***Countries:*** Canada ***Centers:*** multicenter (n=4) ***Setting:*** hospitalized chronic care tube-fed patients ***Funding Sources:*** n/a ***Dropout rates:*** 15.16% ***Study limitations:*** mean transit time evaluation: only half of the study population contributed to this analysis (because of difficulties with study procedure); low number of patients	**Total no. Patients:** n=33 **Inclusion criteria:** receiving liquid formula diet as their nutritional source for at least 1 month prior to study enrollment, requirement of this mode of feeding for another 6 months **Exclusion criteria:** any known gastrointestinal disease, any chronic disease known to interfere with gastrointestinal function or to cause gastrointestinal symptoms, unstable cardiac condition, uncontrolled epilepsy, medications known to affect bowel function (other than laxatives)	Effects of 2 enteral formulae: 1) 12.8 g of dietary fiber per 1000 kcal (Enrich) 2) Fiber-free (Ensure) ➔ 6 week periods: 2 weeks adaption, 4 week study period (all patients 6 weeks A and 6 weeks B) Group A: Enrich followed by Ensure; Group B: Ensure followed by Enrich ➔ Energy and nutrient composition almost identical
Notes	• Age range: 23 to 87 years; n=21 were comatose; n=7 tube fed, because of impaired ability to swallow; n=7 nasogastric tube • Randomized, double-blind crossover study • Energy intake adjusted as needed in order to maintain constant body weight; intake of formula and water, frequency and dosage of medications were recorded daily		

	Author's Conclusion: These results suggest that the addition of dietary fiber to enteral formulae improves gastrointestinal tolerance and bowel function, and reduces laxative use in long-term enterally fed patients.	
Outcome measures/results	• Bowel function Stool frequency Fecal weight (diapers pre- and reweighed) Laxative use Gastrointestinal tolerance (presence/absence of constipation, diarrhea, vomiting, distension →recorded daily during 4 week study period • Body weight (weekly); height • Demographic data + history of illness • Blood sample (after 8h fasting): total protein, serum albumin	• Mean weight group A (65.8 kg) vs. group B (59.4 kg) sig. different (p=0.02); body weight of each group did not change sig. from one period to the next • No difference between total daily energy requirements of the 2 groups at baseline; no other differences between groups • Reporting rates of consumption were not significantly different in the 2 groups • No significant period or sequence effect for any parameter • Mean daily number of stools + mean daily fecal wet weight were not significantly different between Enrich-fed- and Ensure-fed-groups • Ensure-fed patients required more laxatives (7.8 ±1.1 laxatives per period) than Enrich-fed patients(5.2 ± 1.0 per period; p=0.02) Fewer glycerine suppositories (p=0.02), MOM (p=0.03), MOM+cascara (p=0.03) used by Enrich-fed patients compared to Ensure; no differences in the use of Dulcolax suppositories or fleet enema • 26 reports of diarrhea in Ensure-fed groups vs. 6 in Enrich-fed group (p=0.006); rates of constipation, vomiting, distension no sig. differences • Transit times lower in Enrich-fed patients compared with Ensure-fed patients (p=0.02) • Bowel function improved 57.1% of patients receiving Enrich compared to 14.3% of Ensure-fed patients (p=0.005)

<table>
<tr><th>12.</th><th colspan="3">Zarling EJ, Edison T, Berger S, Leya J, DeMeo M. Effect of dietary oat and soy fiber on bowel function and clinical tolerance in a tube feeding dependent population. Journal of the American College of Nutrition. 1994;13(6):565-8.</th></tr>
<tr><th>Study Type/ Evidence Level</th><th>Study details/limitations</th><th>Patient characteristics</th><th>Interventions</th></tr>
<tr><td>RCT

1-</td><td>Countries: USA

Centers: Extended Care Facility Hines VA Hospital, Maywood, IL
Setting: chronic care facility

Funding Sources: supported by a grant from Bristol-Myers Inc., Mead Johnson Nutritional Division
Dropout rates: none
Study limitations: Low number of patients, special group of patients</td><td>Total no. Patients: n=10 (all males)
Inclusion criteria: medically stable, recovering from stroke which occurred a minimum of 6 months earlier, well-established gastrostomy tube in place (used as sole source of nutrition for a minimum of 6 months
Exclusion criteria: history of gastric, small bowel or colon restriction, history of unstable cardiac, pulmonary, renal disease; malabsorption, diarrhea, inflammatory bowel disease, current treatment for active peptic ulcer disease or pneumonia, concurrent participation in any other experimental protocol</td><td>Effect of 28.8 g/day of 50% soy and 50% oat fiber combination
1) Isocal HN
2) Ultracal
➔ Identical in composition; except Ultracal contains 14.4 g/L of fiber
➔ 2x 10 days study period, between periods: washout phase of 3 days
➔ Group A Isocal HN followed by Ultracal; Group B Ultracal followed by Isocal HN</td></tr>
<tr><td>Notes</td><td colspan="3">• Randomized; mean age 67.5 ± 7 years (range 52-76)
• Fecal dye markers used to identify appropriate collection times
• While study was in progress: no subject consumed or was fed any food products other than the study material provided
• Each subject received: 2000 kcal/day (84 g of fat, 84 g of protein)
Author's Conclusion: We conclude that the addition of a combination of soy and oat fiber to tube feeding material is well tolerated, and promotes regular bowel movements without altering the rate of gastric emptying or intestinal transit time.</td></tr>
<tr><td>Outcome measures/results</td><td colspan="2">• History and physical examination: ensure absence of active medical problems</td><td>• Fiber increased
number of bowel movements per day (0.9 ± 0.4 vs. 0.5 ± 0.2; p<0.05)</td></tr>
</table>

	• Recording of symptomatic tolerance intestinal transit time (calculated from the time between initial appearance of each of fecal dye markers (brilliant blue dye) Assessment of fecal ▪ frequency ▪ weight ▪ moisture ▪ caloric content ▪ fat ▪ nitrogen • At start and finish of each treatment arm: Blood values collected (albumin, cholesterol, hemoglobin) • Radioscintigraphic measurements of: gastric emptying, gastroesophageal reflux, pulmonary aspiration	fecal weights (57 ± 31 vs. 32 ± 25 g/day; p<0.05) fecal nitrogen output (110 ± 65 vs. 75 ± 74 mg/day; p<0.05) fecal energy (141 ± 73 vs. 76 ± 62 kcal/day; p<0.05) • Fiber no effect on Fecal moisture Gastric emptying Intestinal transit time Total amount of fat passed the intestine • Albumin, Cholesterol, hemoglobin were not significantly different between baseline and end of the treatments • No patient, in either arm of the study had any esophageal reflux, pulmonary aspiration

I.3 How should nutritional care be performed in older persons?

<u>Recommendation 8</u>

Nutritional and hydration care for older persons shall be individualized and comprehensive in order to ensure adequate nutritional intake, maintain or improve nutritional status and improve clinical course and quality of life (BM, PC)

Grade of recommendation A – strong consensus (100 % agreement)

13.	**Duncan DG, Beck SJ, Hood K, Johansen A. Using dietetic assistants to improve the outcome of hip fracture: a randomised controlled trial of nutritional support in an acute trauma ward. Age and ageing. 2006;35(2):148-53.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** UK ***Centers:*** n/a ***Setting:*** 38 bedded acute trauma ward in a teaching hospital ***Funding Sources:*** Women´s Royal Voluntary Service (WRVS), British Dietetic Association (BDA), Shire Pharmaceuticals, Wales Office of Research and Development (WORD) ***Dropout rates:*** 16.8% ***Study limitations:*** trial was originally designed to look at LOS (length of stay)	**Total no. Patients:** 363 **Inclusion criteria:** women over the age of 65 presenting to a single trauma ward with acute nonpathological hip fracture **Exclusion criteria:** pathological fracture, old fracture, ‚nil by mouth'	• Control group: conventional pattern of nurse- and dietitian-led care, normally provided on the trauma unit • Intervention: additional personal attention of the Das (dietetic assistants)
Notes	Assessments were based on the protocol of the Standardized Audit of Hip Fractures in Europe (SAHFE) **Author's Conclusion:** dietetic or nutrition assistants are being introduced in units across the UK. This, the largest ever study of nutritional support after hip fracture, shows that their employment significantly reduced patients´ risk of dying in the acute trauma unit; an effect that persisted at 4 month follow-up.		
Outcome	• Primary outcome measures: postoperative mortality		DA-supported participants were less likely to die in the acute ward (4.1

measures/results	in the acute trauma unit • Secondary outcome measure: postoperative mortality at 4 months after fracture, length of stay, energy intake and nutritional status	versus 10.1%, P=0.048). This effect was still apparent at 4 month follow-up (13.1 versus 22.9%, P= 0.036). DA-supported subjects had significantly better mean daily energy intake (1,105 kcal versus 756 kcal/24h, 95% CI 259-440 kcal/24h, P<0.001), significantly smaller reduction in mid-arm circumference during their inpatient stay (0.39 cm, P=0.002) and no significantly favorable results for other anthropometric and laboratory measurements.

14.	**Feldblum I, German L, Castel H, Harman-Boehm I, Shahar DR. Individualized nutritional intervention during and after hospitalization: the nutrition intervention study clinical trial. Journal of the American Geriatrics Society. 2011;59(1):10-7.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** Israel ***Centers:*** Soroka University Medical Center ***Setting:*** 1000-bed university-affiliated acute-care hospital ***Funding Sources:*** n/a ***Dropout rates:*** 25.8% ***Study limitations:*** differences in dropout rate across the study groups (11.5% intervention vs	**Total no. Patients:** 259 **Inclusion criteria:** age 65 and older who were admitted to one of four internal medicine departments; The screening process was performed using two methods: 1. The short form of the MNA, 2. Weight loss of more than 10% during 6 months; people with a MNA-sf score <10 or those who had lost more than 10% of their weight during 6 months were invited to participate. **Exclusion criteria:** current diagnosis of cancer, cognitive impairment, an inability to be interviewed, language difficulties, or an unwillingness to provide informed consent	• Group 1 (intervention group) received individualized nutritional treatment from a dietitian in the hospital and three home visits after discharge. • Group 2 received one meeting with a dietitian in the hospital. • Group 3 received standard care. →Groups 2 and 3 were combined into a single group that served as the control group in the analysis.

	32% control); strict exclusion criteria, for example individuals with dementia were not included, results cannot be directly generalized to the entire elderly population		
Notes	**Author's Conclusion:** Lower mortality and moderate improvement in nutritional status were found in patients receiving individualized nutritional treatment during and after acute hospitalization.		
Outcome measures/results	Mortality, health status, nutritional outcomes, blood tests, cognition, emotional, and functional parameters		After 6 months, rise in Mini Nutritional Assessment score, adjusted for education and hospitalization ward, was significantly higher in the intervention group than in the control groups (3.01 ± 2.65 vs 1.81 ± 2.97, *P*=.004) mainly on the subjective assessment part (0.34 ± 0.86 vs. −0.04 ± 0.87, *P*=.004). The only laboratory parameter for which a difference was observed between the groups was albumin; 9.7% of the intervention group had serum albumin levels of less than 3.5 g/dL, versus 22.9% of the control group (*P*=.03). Mortality was significantly lower in the intervention group (3.8%) than in the control group (11.6%, *P*=.046).

15.	**Ha L, Hauge T, Spenning AB, Iversen PO. Individual, nutritional support prevents undernutrition, increases muscle strength and improves QoL among elderly at nutritional risk hospitalized for acute stroke: a randomized, controlled trial. Clinical nutrition (Edinburgh, Scotland). 2010;29(5):567-73.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** Norway ***Centers:*** Østfold Hospital Trust ***Setting:*** medical acute care ward ***Funding Sources:*** ***Dropout rates:*** 85.28%	**Total no. Patients:** 842 **Inclusion criteria:** age >65 years, ischemic stroke, cerebral hemorrhage **Exclusion criteria:** stroke diagnosis could not be	• Intervention: nutritional treatment, the main treatment goal in the intervention group was to maintain or improve nutritional status using established oral energy- and protein rich feedings or enteral tube feeding according to individual intake and needs. Resting energy requirements were estimated with gender and age group specific equations from the WHO, 18 and total energy need was calculated from an appropriate physical activity level

	Study limitations: • the nutritional intervention procedure was performed in patients at the same ward as the control patients, by the same multidisciplinary team • dietary recording was not routinely used in stroke patients at the ward before the trial started, and hence there were control patients who otherwise would not have their dietary intake recorded • post-hoc analysis of the secondary outcomes data in the control group without dietary recording was not included due to the small number of patients which would bias the	confirmed, critical illness, severe dementia, planned discharge within 24h	factor (ranging from 1.25 to 1.40). • Control: routine care with use of oral sip feedings or tube feeding at the discretion of the attending physician. There were no pre-existing procedures neither for nutritional assessments, monitoring dietary intake or treating undernutrition.

	results.		
Notes	**Author's Conclusion:** Individualized, nutritional treatment strategy can prevent clinically significant weight loss and improve QoL in elderly acute stroke patients at nutritional risk.		
Outcome measures/results	Primary outcome measure was the percentage of patients with weight loss ≥5%. Secondary outcomes measures were quality of life (QoL), handgrip strength and length of hospital stay.		At follow-up, 20.7% of the intervention group (n = 58) lost ≥5% weight compared with 36.4% in the control group (n = 66) (P = 0.055). The intervention group had a significantly higher increase in QoL score (P = 0.009) and in handgrip strength (P = 0.002). There was no difference in length of hospital stay.

16.	**Rufenacht U, Ruhlin M, Wegmann M, Imoberdorf R, Ballmer PE. Nutritional counseling improves quality of life and nutrient intake in hospitalized undernourished patients. Nutrition (Burbank, Los Angeles County, Calif). 2010;26(1):53-60.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** Switzerland ***Centers:*** Kantonsspital Winterthur ***Setting:*** n/a ***Funding Sources:*** Independent Research Fund of the Department of Internal Medicine of Kantonsspital Winterthur, Federation of the Swiss Medical Nutrition Industry ***Dropout rates:*** 32% ***Study limitations:*** potential confounding factor for the increased energy and protein intakes may be the spontaneously	**Total no. Patients:** 53 **Inclusion criteria:** LOS >10 d, unintended loss of body weight >5% of usual weight over the previous 2 mo., and loss of appetite **Exclusion criteria:** terminal illness, existing enteral or parenteral nutrition, ongoing nutritional counseling or interventions, e.g. intake of ONSs, impaired cognition, and incapability to give consent	• Nutritional therapy group: individual nutritional counseling and interventions, including oral nutritional supplements if appropriate, by a dietitian • Oral nutritional supplement group: oral nutritional supplements in addition to hospital meals without further instruction or counseling

	favorable course of the disease		
Notes	**Author's Conclusion:** Both interventions caused a significant increase in energy and protein intakes and quality of life. In the NT group every patient received an efficacious individualized intervention. In contrast, the 7 of 18 patients in the ONS group who did not consume ONS had no intervention at all. Therefore, undernourished patients should be counseled individually by a dietitian.		
Outcome measures/results	• Primary endpoint: increase in energy and protein intakes, and improvement of QoL • Secondary endpoints: maintenance of body weight, and better nutritional status		Energy and protein intakes increased between baseline and time point 1 in both groups (P=0.001). The NT group (n=18) met the energy requirements at time point 1 by 107% and of protein by 94%, the ONS group (n=18) by 90% and 88%, respectively. Hospital meals alone did not cover the requirements. From baseline to time point 1, quality of life increased in both groups. Quality of life increased further in the NT group from time point 1 to time point 2 (P=0.016), but not in the ONS group.

17.	**Starke J, Schneider H, Alteheld B, Stehle P, Meier R. Short-term individual nutritional care as part of routine clinical setting improves outcome and quality of life in malnourished medical patients. Clinical nutrition (Edinburgh, Scotland). 2011;30(2):194-201.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1++	***Countries:*** Switzerland ***Centers:*** Kantonsspital Liestal ***Setting:*** general medical ward ***Funding Sources:*** Exchange Organisation StudEx/ Switzerland and the German Academic Exchange Service(DAAD)/Germany, Nestlé Nutrition ***Dropout rates:*** 1.19% ***Study limitations:*** morbidity, LOS, quality of	**Total no. Patients:** 134 **Inclusion criteria:** NRS score >3 **Exclusion criteria:** no informed consent, terminal condition, expected stay <5d, previous participation in this study, patient in starvation, on parenteral nutrition, and/ or being on dialysis	• Intervention group: individualized nutritional support for maximum 28 days, including a detailed nutritional assessment, individual food supply, fortification of meals with maltodextrin, rapeseed oil, cram and/or protein powder, in-between snacks and oral nutritional supplements • Control group: standard hospital care including the prescription of oral nutritional supplements and nutritional therapy prescribed by the physician independently of this study

	life or mortality are often influenced by other factors than nutrition alone		
Notes	**Author's Conclusion:** Malnourished patients profit from nutrition support regarding nutrition status and quality of life. They have fewer complications, need fewer antibiotics and are less often re-hospitalized.		
Outcome measures/results	• Primary endpoints: average daily energy and protein intake • Secondary endpoints: changes in body weight during hospitalization, number of complications, number of antibiotic therapies due to infectious complications, length of hospital stay, quality of life (SF-36), hospital readmission (after 6 months), mortality, compliance with oral nutrition standard supplement consumption and plasma concentrations of 25-OH-D3, ascorbic acid and glutathione		Nutrition interventions led to higher intakes (mean [standard deviation]) in energy (1553 [341] kcal vs. 1115 [381] kcal, $p < 0.001$) and protein (65.4 [16.4] g vs. 43.9 [17.2] g, $p < 0.001$). Intervention patients ($n = 66$) kept their body weight in comparison to control patients ($n = 66$; 0.0 [2.9] kg vs. -1.4 [3.2] kg, $p = 0.008$). Positive effects on plasma ascorbic acid level (46.7 [26.7] µmol/l vs. 34.1 [24.2] µmol/l, $p = 0.010$), SF-36 function summary scale (37 [11] % vs. 32 [9] %, $p = 0.030$), number of complications (4/66 vs. 13/66, $p = 0.035$), antibiotic therapies (1/66 vs. 8/66, $p = 0.033$) and readmissions (17/64 vs. 28/61, $p = 0.027$) were recorded.

Recommendation 9

Nutritional interventions for older persons should be part of a multimodal and multidisciplinary team intervention in order to support adequate dietary intake, maintain or increase body weight and improve functional and clinical outcome (BM)

Grade of recommendation B – strong consensus (100 % agreement)

18.	**Beck AM, Damkjaer K, Beyer N. Multifaceted nutritional intervention among nursing-home residents has a positive influence on nutrition and function. Nutrition (Burbank, Los Angeles County, Calif). 2008;24(11-12):1073-80.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** Denmark ***Centers:*** n/a ***Setting:*** home-care or nursing home setting ***Funding Sources:*** Health Insurance Foundation and the Velux Foundation ***Dropout rates:*** 2% ***Study limitations:*** • The nurses who assessed the residents´ performance and the physiotherapist who tested handgrip strength and functional fitness were blinded to the	**Total no. Patients:** 246 **Inclusion criteria:** elderly people (65+ years of age) receiving home-care or living in the two nursing homes with staff caregivers, able to complete the planned tests **Exclusion criteria:** patients who were not able or willing to give informed consent	• Intervention group: new model for multidisciplinary nutrition support during the 11 wk. study, individual treatment of the potentially modifiable nutritional risk factors identified by the EVS

	treatment allocation and visited the nursing homes only during assessments. • Recruitment of nursing homes, which had shown a continuous interest in nutritional aspects before the study.		
Notes	**Author's Conclusion:** It is possible to improve nutrition and function in elderly nursing-home residents by means of a multifaceted intervention consisting of chocolate, homemade supplements, group exercise, and oral care.		
Outcome measures/results	Quality of life by means of EuroQol-5D-3L, physical performance by means of a 30-second chair-stand, nutritional status by means of weight and hand-grip strength, oral care by means of RAI-NH, RAI-HC and observation, fall incidents, hospital admissions, rehabilitation stay, moving to nursing homes and mortality		A total of 121 subjects (61%) accepted the invitation and 62 were randomized to the intervention group. Six of these dropped out during the 11 wk. At the 4-mo follow-up there were 15 deaths in the intervention group and 8 in the control group. The nutrition and exercise were well tolerated. After 11 wk. the change in percentage of weight ($P = 0.005$), percentage of body mass index ($P = 0.003$), energy intake ($P = 0.084$), protein intake ($P = 0.012$), and Berg's Balance Scale ($P = 0.004$) was higher in the intervention group than in the control group. In addition, the percentage of subjects whose functional tests improved was higher in the intervention group. Both groups lost the same percentage of weight after the intervention ($P = 0.908$). The total percentage of weight loss from baseline to follow-up was higher in the control group ($P = 0.019$). Oral care was not well accepted and the prevalence of plaque did not change.

19.	Beck AM, Damkjaer K, Sorbye LW. Physical and social functional abilities seem to be maintained by a multifaceted randomized controlled nutritional intervention among old (>65 years) Danish nursing home residents. Archives of gerontology and geriatrics. 2010;50(3):351-5.		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** Denmark ***Centers:*** Copenhagen and surrounding municipalities ***Setting:*** three home-care areas, two nursing homes ***Funding Sources:*** Health Insurance Foundation, VELUX FOUNDATION ***Dropout rates:*** 5% ***Study limitations:*** • recruitment of nursing homes which had formerly shown a continuous interest in nutritional aspects • the sample size, which was estimated based on % BMI and therefore might have been too small	**Total no. Patients:** 119 **Inclusion criteria:** nursing home residents aged 65 years and older who could be weighed, were non-terminal, non-hospitalized , and living in one of seven nursing homes in Denmark **Exclusion criteria:** n/a	• Intervention: nutrition (chocolate, homemade oral supplements), group exercise (moderate intensity) and oral care
Notes	**Author's Conclusion:** It seems possible to maintain social and (physical) functional abilities in old nursing home residents by means of a		

	multifaceted intervention consisting of chocolate, homemade oral supplements, group exercise and oral care.	
Outcome measures/results	Weight, BMI, energy and protein intake, and functional abilities (ADL, cognitive performance, and social engagement)	After 11 weeks the change in % weight (1.3 vs. -0.6%, p=0.005), %BMI (0.4 vs. -0.2%, p=0.003), energy intake (0.7 vs. -0.3 MJ/day, p=0.084) and protein intake (5 vs. -2g/day, p=0.012) was higher in the intervention group than in the control group. Also after 11 weeks, social and physical function had decreased in the control group but was unchanged in the intervention group. The difference between groups was significant in relation to social engagement (p=0.009). After the end of the intervention both groups had lost weight and physical function. Cognitive performance did not change, at any time.

20.	**Beck AM, Keiding H, Christensen AG, Hansen BS, Damsbo-Svendsen S, Møller TKS. Multidisciplinary nutritional support for undernutrition in older adults in nursing home and home-care is cost-effective. Journal of Nursing and Care. 2015;1(1).**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** Denmark ***Centers:*** Frederiksberg ***Setting:*** three home-care areas, two nursing homes ***Funding Sources:*** Danish National Board of Social Service ***Dropout rates:*** 5% ***Study limitations:*** difficult to compare to other studies (use of EQ-5D-3L)	**Total no. Patients:** 246 **Inclusion criteria:** Elderly people (65 + years of age) receiving home-care or living in the two nursing homes with an EVS (2 points according to EVS) made by the nursing staff caregivers and, according to the staff caregivers, able to complete the planned tests **Exclusion criteria:** People who were not able to complete the planned tests according to the staff caregivers	The intervention group received nutritional support consisting of: 1. Individual dietary counselling by a dietician including advice on the use of prescribed ONS 2. 30-45 minutes of resistance type exercise by a physiotherapist two times per week, either in groups in one of the participating nursing homes or alone in the participants own home in combination with the intake of 150 mL ONS providing an average of 1010 kJ and 14.4 g of protein per 100 mL 3. Dysphagia assessment and treatment, including texture modification of food and drinks, by an occupational therapist, as needed.

Notes	**Author's Conclusion:** Multidisciplinary nutritional support in older adults in nursing home and home-care identified with EVS is cost-effective since the cost effectiveness ratio compares reasonably well to other interventions found worthwhile in the Danish healthcare sector.	
Outcome measures/results	• Primary outcome parameters: quality of life (by means of Euroquol-5D-3L) • Secondary outcome parameters: physical performance (30-second chair stand), nutritional status (weight, and hand-grip strength), oral care, fall incidents, hospital admissions, rehabilitation stay, moving to nursing homes and mortality	A difference was seen after 11 weeks in quality of life (0.758 (±0.222) vs. 0.534 (±0.355), p=0.001). Even though a small gain in weight was observed in the intervention group there was no difference in change in weight. The effect on quality of life, measured in terms of Quality-Adjusted Life Year (QALY) gain relatively to the control group, gave a cost-effectiveness ratio of DKK 46,000 per QALY gained which compares reasonably well to other interventions found worthwhile the Danish healthcare sector.

21.	**Beck AM, Christensen AG, Hansen BS, Damsbo-Svendsen S, Moller TK. Multidisciplinary nutritional support for undernutrition in nursing home and home-care: A cluster randomized controlled trial. Nutrition (Burbank, Los Angeles County, Calif). 2016;32(2):199-205.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** Denmark ***Centers:*** Frederiksberg ***Setting:*** two nursing homes ***Funding Sources:*** Danish National Board of Social Service ***Dropout rates:*** 6.9% ***Study limitations:*** • Participants who	**Total no. Patients:** 246 **Inclusion criteria:** Elderly people (65 + years of age) receiving home-care or living in the two nursing homes with an EVS (2 points according to EVS) made by the nursing staff caregivers and, according to the staff caregivers, able to complete the planned tests **Exclusion criteria:** People who were not able or willing to give informed consent	The nutrition coordinators were present in both the control and the intervention group. Also, in both groups', standard interventions from physiotherapist, registered dietitian, occupational therapist, and care dentistry was requested through the municipality's normal assessment, and referral system was maintained. • Intervention group: In addition to the educated nutrition coordinator, the participants assigned to the intervention group strategy received the new model for multidisciplinary nutrition support during the 11 wk. study. Focus was on individual treatment of the potentially modifiable nutritional risk factors identified by the EVS, by involving physiotherapist, registered dietitian, and occupational therapist, as relevant according to the EVS and independent of the municipality's ordinary assessment and referral system. The intervention group received nutritional support consisting of: 4. Individual dietary counselling by a dietician including advice on

	scored 2 points in EVS were included, instead of using the Mini Nutritional Assessment (MNA), which might limit the comparability with other studies. • The participants included had to be able to complete the planned tests and to give informed consent. The criteria might have excluded demented and functionally impaired persons, and hence reduce the reliability of the findings.		the use of prescribed ONS 5. 30-45 minutes of resistance type exercise by a physiotherapist two times per week, either in groups in one of the participating nursing homes or alone in the participants own home in combination with the intake of 150 mL ONS providing an average of 1010 kJ and 14.4 g of protein per 100 mL 6. Dysphagia assessment and treatment, including texture modification of food and drinks, by an occupational therapist, as needed.
Notes	**Author's Conclusion:** Multidisciplinary nutritional support in older adults in nursing home and home-care could have a positive effect on quality of life, muscle strength, and oral care.		
Outcome measures/results	• Primary outcome parameter: Quality of life by means of EuroQol-5D-3L (EQ-5D-3L) • Secondary outcome parameters: Physical performance by means of 30-second chair-stand, Nutritional status by means of weight and hand-grip		Respectively, 55 (46 from 2 home-care clusters) and 40 (18 from 1 home-care cluster) were identified with the EVS and comprised the intervention and control group. A difference after 11 wk. in quality of life (0.758 [0.222] versus 0.534 [0.355], P = 0.001), 30-seconds chair stand (47% versus 17% improved, P = 0.005) and oral care (1.1 [0.3] versus 1.3 [0.5], P = 0.021)

	strength, Oral care by means of RAI-NH, RAI-HC and observation, Fall incidents, hospital admissions, rehabilitation stay, moving to nursing homes, and mortality	was observed. There was an almost significant difference in mortality (2% versus 13%, P = 0.079).

22.	**Neelemaat F, Lips P, Bosmans JE, Thijs A, Seidell JC, van Bokhorst-de van der Schueren MA. Short-term oral nutritional intervention with protein and vitamin D decreases falls in malnourished older adults. Journal of the American Geriatrics Society. 2012;60(4):691-9.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** Netherlands ***Centers:*** n/a ***Setting:*** From hospital admission until 3 months after discharge. ***Funding Sources:*** The Netherlands Organisation for Health Research and Development (ZonMw) ***Dropout rates:*** 28.6 % ***Study limitations:*** not blinded, a 2-week dietary history was used to assess participants' nutritional intake, loss to follow-up was 30%	**Total no. Patients:** 210 **Inclusion criteria:** Malnourished older adults (≥ 60) newly admitted to an acute hospital **Exclusion criteria:** dementia	Participants were randomized to receive nutritional intervention (energy- and protein-enriched diet, oral nutritional supplements, calcium-vitamin D supplement, and telephone counseling by a dietitian) for 3 months after discharge or usual care.
Notes	**Author's Conclusion:** A short-term nutritional intervention consisting of oral nutritional supplements and calcium and vitamin D supplementation and supported by dietetic counseling in malnourished older adults decreases the number of patients who fall and fall incidents.		
Outcome measures/results	Fat-Free Mass and Hand Grip Strength, Physical Activities, Functional Limitations and Physical Performance, Fall Incidents		Three months after discharge, 10 participants (10%) in the intervention group had fallen at least once, compared with 24 (23%) in the control group (hazard ratio = 0.41, 95% confidence interval (CI) = 0.19-0.86). There were 57 fall incidents (16 in the intervention group; 41 in the

		control group). A significantly higher intake of energy (280 kcal, 95% CI = 37-524 kcal) and protein (11 g, 95% CI = 1-25 g) and significantly higher serum 25-hydroxyvitamin D levels (10.9 nmol/L, 95% CI = 2.9-18.9 nmol/L) were found in participants in the intervention group than in controls.

23.	**Neelemaat F, Bosmans JE, Thijs A, Seidell JC, van Bokhorst-de van der Schueren MA. Oral nutritional support in malnourished elderly decreases functional limitations with no extra costs. Clinical nutrition (Edinburgh, Scotland). 2012;31(2):183-90.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** Netherlands ***Centers:*** n/a ***Setting:*** From hospital admission until 3 months after discharge. ***Funding Sources:*** The Netherlands Organisation for Health Research and Development (ZonMw) ***Dropout rates:*** 28.57% ***Study limitations:*** • The follow-up period was three months only • The study was powered to detect differences in functionality, but underpowered to	**Total no. Patients:** 210 **Inclusion criteria:** hospital admitted malnourished (BMI ≤20 and/ or ≥5% unintentional weight loss in the previous month and/ or ≥10% unintentional weight loss in the previous six months) elderly (≥ 60 y) patients **Exclusion criteria:** Patients were excluded when they suffered from senile dementia, could not understand the Dutch language or were not able or willing to give informed consent.	• Intervention group: Patients in the intervention group received nutritional supplementation (energy and protein enriched diet, oral nutritional support, calcium-vitamin D supplement, telephone counselling by a dietician) until three months after discharge from hospital. • Control group: Patients in the control group received usual care (control).

	detect cost differences		
Notes	**Author's Conclusion:** A multi-component nutritional intervention to malnourished elderly patients for three months after hospital discharge leads to significant improvement in functional limitations and is neutral in costs. A follow-up of three months is probably too short to detect changes in QALYs or physical activities.		
Outcome measures/results	• Primary outcomes : Quality Adjusted Life Years (QALYs) • Secondary outcomes: physical activities and functional limitations.		210 patients were included, 105 in each group. After three months, no statistically significant differences in quality of life and physical activities were observed between groups. Functional limitations decreased significantly more in the intervention group (mean difference -0.72, 95% CI-1.15; -0.28). There were no differences in costs between groups. Cost-effectiveness for QALYs and physical activities could not be demonstrated. For functional limitations we found a 0.95 probability that the intervention is cost-effective in comparison with usual care for ceiling ratios > €6500.

24.	**Olofsson B, Stenvall M, Lundstrom M, Svensson O, Gustafson Y. Malnutrition in hip fracture patients: an intervention study. Journal of clinical nursing. 2007;16(11):2027-38.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** Sweden ***Centers:*** Umea University Hospital ***Setting:*** orthopedic department ***Funding Sources:*** Borgerskapet in Umea Research Foundation, the Dementia Fund, the ‚Vardal Foundation' ***Dropout rates:*** 21.1% ***Study limitations:*** • MNA has not	**Total no. Patients:** 199 **Inclusion criteria:** patients aged 70 years and above with femoral neck fracture **Exclusion criteria:** severe rheumatoid arthritis, severe hip osteoarthritis, severe renal failure, metastatic fracture and patients who were bedridden before their injury	• **Intervention group:** The staffing ratio was 1·07 nurses or aids per bed. Patients in the intervention group were admitted to a geriatric ward specializing in geriatric orthopedic patients. A nutritional journal was established for each patient and the patient's intake of food and liquid was registered in this journal for the first four postoperative days. Protein-enriched meals were served during the first four postoperative days and longer if necessary. All the patients in the intervention group also received two nutritional and protein drinks daily during their whole hospitalization period. The environment surrounding the meal was adjusted. • **Control group:** The staffing ratio at the orthopedic ward was 1·01 nurses or aids per bed. The control group received their

	generally been used to detect changes in nutritional status in relation to different variables over time, as it is used in the present study • Study sample is rather small • The assessment for MNA was not made on more than one occasion soon after admission and then the questions referred to the prefracture conditions		postoperative care in the orthopedic department in accordance with conventional postoperative care routines.
Notes	**Author's Conclusion:** Malnutrition was common among older people with hip fractures admitted to hospital. The nutritional intervention might have contributed to the patients suffering fewer days with delirium, fewer decubitus ulcers and shorter hospitalization but did not improve the long-term nutritional status, at least not in women.		
Outcome measures/results	Nutritional status (MNA), cognitive status (MMSE), delirium (OBS Scale), Depression (GDS-15)		Malnutrition was common and low MNA scores were associated with postoperative complications such as delirium and decubitus ulcers. There were significantly fewer days of delirium in the intervention group, seven patients in the intervention group developed decubitus ulcers vs. 14 patients in the control group and the total length of hospitalization was shorter. There were no detectable significant improvements regarding nutritional parameters between the intervention and the control group at the four-month follow-up but men improved their mean BMI, body weight and MNA scores in both the intervention and the control groups while

		women deteriorated in both groups.

25.	Stenvall M, Olofsson B, Lundstrom M, Englund U, Borssen B, Svensson O, et al. A multidisciplinary, multifactorial intervention program reduces postoperative falls and injuries after femoral neck fracture. Osteoporosis international: a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA. 2007;18(2):167-75.		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** Sweden ***Centers:*** Umea University Hospital ***Setting:*** orthopedic and geriatric departments ***Funding Sources:*** Vardal Foundation, the Joint Committee of the Northern Health Region of Sweden ***Dropout rates:*** 0% ***Study limitations:*** some falls could have been missed, the fall registration could not be blinded regarding group allocation, small study sample size	**Total no. Patients:** 199 **Inclusion criteria:** patients with femoral neck fracture aged ≥70 years **Exclusion criteria:** severe rheumatoid arthritis, severe hip osteoarthritis, or pathological fracture	• Intervention group: Active prevention, detection and treatment of postoperative complications such as falls, delirium, pain and decubitus ulcers was systematically implemented daily during the hospitalization. The staffing at the intervention ward were 1.07 nurses/aides per bed. • Control group: conventional postoperative routines, the staffing at the orthopedic unit was 1.01 nurses/aides per bed and 1.07 for the geriatric control ward
Notes	**Author's Conclusion:** A team applying comprehensive geriatric assessment and rehabilitation, including prevention, detection, and treatment of fall risk factors, can successfully prevent inpatient falls and injuries, even in patients with dementia.		
Outcome measures/results	Complications during hospitalization, including falls, length of stay, morbidity, and mortality.		Twelve patients fell 18 times in the intervention group compared with 26 patients suffering 60 falls in the control group. Only one patient with dementia fell in the intervention group compared with 11 in the control group. The crude postoperative fall incidence rate was 6.29/1,000 days in the intervention group vs 16.28/1,000 days in the control group. The

		incidence rate ratio was 0.38 [95% confidence interval (CI): 0.20 – 0.76, *p* = 0.006] for the total sample and 0.07 (95% CI: 0.01–0.57, *p*=0.013) among patients with dementia. There were no new fractures in the intervention group but four in the control group.

26.	**Stenvall M, Olofsson B, Nyberg L, Lundstrom M, Gustafson Y. Improved performance in activities of daily living and mobility after a multidisciplinary postoperative rehabilitation in older people with femoral neck fracture: a randomized controlled trial with 1-year follow-up. Journal of rehabilitation medicine. 2007;39(3):232-8.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** Sweden ***Centers:*** Umea University Hospital ***Setting:*** orthopedic and geriatric departments ***Funding Sources:*** Vardal Foundation, the Joint Committee of the Northern Health Region of Sweden ***Dropout rates:*** 0% ***Study limitations:*** • the outpatient rehabilitation after discharge was not as standardized as during in-hospital stay • the assessors were not blinded concerning group	**Total no. Patients:** 199 **Inclusion criteria:** patients with femoral neck fracture, aged >or= 70 years **Exclusion criteria:** severe rheumatoid arthritis, severe hip osteoarthritis, or pathological fracture	The intervention consisted of staff education, individualized care planning and rehabilitation, active prevention, detection and treatment of postoperative complications. The staff worked in teams to apply comprehensive geriatric assessment, management and rehabilitation. A geriatric team assessed those in the intervention group 4 months postoperatively, in order to detect and treat any complications. The control group followed conventional postoperative routines.

	allocation during the home visit and therefore bias cannot be excluded • no figures for cost effectiveness		
Notes	**Author's Conclusion:** A multidisciplinary postoperative intervention program enhances activities of daily living performance and mobility after hip fracture, from both a short-term and long-term perspective.		
Outcome measures/results	primary outcomes: living conditions, walking ability and activities of daily living performance on discharge, 4 and 12 months postoperatively		Despite shorter hospitalization, significantly more people from the intervention group had regained independence in personal activities of daily living performance at the 4- and 12-month follow-ups; odds ratios (95% confidence interval (CI)) 2.51 (1.00-6.30) and 3.49 (1.31-9.23), respectively. More patients in the intervention group had also regained the ability to walk independently indoors without walking aids by the end of the study period, odds ratio (95% confidence interval) 3.01 (1.18-7.61).

II Recommendations for older persons with malnutrition or at risk of malnutrition

II.1 Should older persons with malnutrition or at risk of malnutrition be offered mealtime assistance?

<u>Recommendation 12</u>

Older persons with malnutrition or at risk of malnutrition and with eating dependency in institutions (A) as well as at home (GPP) shall be offered mealtime assistance in order to support adequate dietary intake (BM)

Grade of recommendation A / GPP – strong consensus (100 % agreement)

27.	**Abbott RA, Whear R, Thompson-Coon J, Ukoumunne OC, Rogers M, Bethel A, et al. Effectiveness of mealtime interventions on nutritional outcomes for the elderly living in residential care: a systematic review and meta-analysis. Ageing research reviews. 2013;12(4):967-81.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Systematic review 1++	***Countries:*** United States, Sweden, Holland, Canada, UK, Finland, France, Taiwan ***Centers:*** n/a ***Setting:*** n/a ***Funding Sources:*** National Institute for Health Research through Peninsula CLAHRC	**Total no. Studies:** n=37 **Inclusion criteria:** (cluster) RCTs, non-RCTs, Studies with before and after designs, time-series studies, case-control studies, intervention in residential, nursing homes/care homes, Residents aged 65 years +, interventions had to be provided directly or indirectly, Nutrition education/training specific to mealtime care, report at least one nutritional outcome **Exclusion criteria:** case studies, not enough information for replication or quality appraisal, studies in hospital or palliative	Mealtime interventions → 5 categories 1) changes to food service (for ex.: presentation, color-contrast, portions, finger food) 2) food improvement (for ex.: adding sauce, flavor) 3) dining environment alteration (including: food service, staff assistance sometimes components of improving dining environment with the aim of making the dining room **more ´home-like´ =** decoration, self-service, ambience) 4) staff training (for ex.: feeding skills) 5) feeding assistance (for ex.: reinforcement, correct positioning)

	Dropout rates: 99.39% (total 6028 → full text 95 → 37 included) ***Study limitations:*** inadequate reporting in over a half of the articles → Data quality, Meta-analyses limited, limited number of RCTs, categories may not fully accounted for all components of interventions/big variation in interventions	care setting, individual´s home within the community, studies that included residents with specific eating difficulties (dysphagia), Interventions with oral nutritional supplementation or assessed fortification of food with protein or energy	
Notes	• **S**earch strategy: developed by specialist, combination of MeSH terms and free text terms • Bias: risk of bias assessed using a checklist (randomization RCT, blinded, reporting of compliance, outcomes, power calculation, validity, reliability) → none of the studies met all criteria • Used random-effects model for meta-analyses (weightings:size, heterogeneity) • Studies involved: published between 1981 and 2012 • Overall quality of the included studies was low (due to range of designs, measurements, etc.) **Author's Conclusion:** The need to improve the nutrition of the elderly living in residential long term care is well recognized. This review found some evidence that simple intervention around various aspects of mealtime practices and the mealtime environment can result in favorable nutritional outcomes.		
Outcome measures/results	• Nutritional outcome: direct→ **food intake** (energy, macronutrient, percentage);**body weight/weight status** MNA, BMI, body composition, biochemical indices, functional status • Mealtime intervention: aim to improve mealtime routine, experience, environment • Intervention directly/indirectly: assistance, encouragement, stimulating environment, increased access to food, more choice/appealing foods • Other nutritional outcomes: Diet satisfaction, time		• Food improvement: low/inconsistent effects • Food services: Most of the interventions showed positive effects on caloric intake (increased) → real food snacks; except for reducing portion size to increase appetite. This was the only one residents consumed less food. Biochemical indices were inconsistent between the studies that measured them • Dining environment: mixed findings, individual significance (Nijs et al.). Low/no effects on body weight/consumption, biochemical indices; MNA in some intervention group improved vs. control • Staff training: low or mixed effect

	spent eating, fluid intake	• Feeding assistance: one to one feeding assistance improves consumption

28.	**Abdelhamid A, Bunn D, Copley M, Cowap V, Dickinson A, Gray L, et al. Effectiveness of interventions to directly support food and drink intake in people with dementia: systematic review and meta-analysis. BMC geriatrics. 2016;16:26.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Systematic review and meta-analysis 1++	***Countries:*** Europe, North America, Brazil, Taiwan, New Zealand ***Centers:*** n/a ***Setting:*** most institution or hospital setting, 4 day centers/community, 1 unclear setting ***Funding Sources* :**National Institute for Health research, Collaboration for Leadership in Applied Health Research&Care, National Insitute of Health Research Fellowship programme ***Dropout rates:*** n/a	**Total no. Studies:** n=43 **Inclusion criteria:** RCT and non-RCT: ≥3 adults with any type/stage of dementia or mild cognitive impairment or MMSE score plus one standard deviation ≤26, ≥5 days, interventions: aimed modify food and/or drink, provide food- or drink-based supplements, assist with eating/drinking/manage swallowing problems, and see “outcomes” **Exclusion criteria:** n/a	Direct intervention: - Oral supplements - Food/drink modification - Swallowing problems management - Eating assistance - Social support

	Study limitations: some studies might have been missed due to poor indexing and abstracts omitting to identify participants as having dementia or cognitive impairment; transferability interventions for people with swallowing problems without dementia to people with dementia; lack of data in the studies (for ex. Nutritional status); interventions might be stage- or problem-specific; no definite evidence on effectiveness of one or more interventions		
Notes	• Data and quality characteristics were extracted independently by two reviewers/Methodological quality was assessed using Cochrane risk of bias tool: study was at low risk of bias when it was at low risk of both selection bias and detection bias • Studies were grouped by type of intervention, study design → many studies underpowered → unable to suggest statistically significant benefits or harms **Author's Conclusion:** We found no definitive evidence on effectiveness, or lack of effectiveness, of specific interventions but studies were small and short term. People with cognitive impairment and their carers have to tackle eating problems despite this lack of evidence, so promising interventions are listed. The need remains for high quality trials tailored for people with cognitive impairment assessing robust outcomes.		
Outcome measures/results	• At least one of these outcomes: Nutrition or hydration status→quantity, quality or adequacy of food or fluid intake, ability to eat independently, swallow without aspirating, enjoyment of food or meaningful activity		• ONS intervention: some no effect on weight >12 weeks, some RCTs→ [MD] 0.72 kg, 95 % CI −1.02-2.45, 382 participants) but with high heterogeneity (I2 89 %); some had an effect on weight: RCTs 3-12 weeks →2.02 kg, 95 % CI 1.53-2.50, 344 participants, I2 0 %; effects on other anthropometric measures were mixed; MNA

	• Quality of life, functional, cognitive status, views or attitudes, cost effectiveness, resource use, mortality, health outcomes	improved; Quality of life, functional, cognitive status, mortality→ no effect • Food and drink modification: no significant/mixed effect; but finger food seems to be positive for improving energy intake/weight (+2.06 kg vs +0.32 kg, $p < 0.05$), no effect on MNA, cognition, mortality • Eating and drinking assistance: energy intake, cost effectiveness → no significant on weight, mixed effects on energy intake • Social support: low effects on weight and BMI (weight: 1.3% vs. -0.6%, p=0.005; BMI: 0.4 % vs. -0.2 %, p = 0.003). Energy intake (0.7 vs.-0.3 MJ/day, p = 0.084), functional and cognitive status did not alter; Family-style meals showed improvements for example on satisfaction/enjoyment, weight, autonomy • Swallowing problems: reformed foods/thickened fluids vs standard → some found improvements, some not

29.	**Tassone EC, Tovey JA, Paciepnik JE, Keeton IM, Khoo AY, Van Veenendaal NG, et al. Should we implement mealtime assistance in the hospital setting? A systematic literature review with meta-analyses. Journal of clinical nursing. 2015;24(19-20):2710-21.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Systematic Review 1++	***Countries:*** USA, Australia, UK ***Centers:*** n/a ***Setting:*** hospital ***Funding Sources:*** no grants received for this research	**Total no. Studies:** n=5 **Inclusion criteria:** hospitalized patients ≥65 years, mealtime assistance by nurses/volunteers or trained staff, standard/usual care vs multiple interventions with mealtime assistance; Publications only in English **Exclusion criteria:** dysphagia**,** critically/terminally ill; studies in age-care nursing home facilities,	Specific feeding/mealtime assistance strategies carried out by volunteers, nursing staff or trained paid personal Compared to Standard/usual care practices

	Dropout rates: n/a ***Study limitations:*** heterogeneity of the studies included (designs, sample size, duration of intervention, data collection);absence of blinding in the included studies; observation +sampling bias possible; language bias (only English studies included)	mental health facilities, outpatient centers; Studies targeting nutritional status through enteral/parenteral nutrition, nutritional supplements (also vitamins/minerals), medication aiding in appetite stimulation; systematic reviews, conference abstracts, theses, non-peer reviewed articles, non-human research	
Notes	• Studies were examined for quality and risk of bias (by Academy of Nutrition and Dietetics Quality Checklist); Outcome data were combined narratively and by meta-analyses; no criteria for study design (PICOs format was used to develop the criteria for study inclusion) • Study designs: RCT, Case series, cross-over (2x), quasi-experimental • none of the included papers were rated below level III-2, indicating that the level of evidence for mealtime assistance was generally of good quality • Food intake: recorded by visual estimation (if not possible to weighed remaining food on the plate → observational bias possible) **Author's Conclusion:** The evidence identified suggests that mealtime assistance provided to hospitalized older patients (≥65 years) leads to a statistically significant increase in energy and protein intake. For many patients, this increase in both energy and protein intake will be clinically significant, reducing the gap between requirements and actual intake.		
Outcome measures/results	• Key outcome: Nutritional status including energy and protein intake, anthropometric measures: body mass index, triceps skinfold, mid-arm-(+ -muscle) circumference		Overall, mealtime assistance significantly improved daily energy intake, with a mean difference of 486.4 kJ (95% CI: 11.15, 961.66 kJ), p = 0.04. The mean difference in daily protein intake of 5.86 g (95% CI: 1.09, 10.63 g), p = 0.02, was also statistically significant. Mealtime assistance was generally not associated with significant differences in anthropometric variables, although a trend towards increased body weight was reported → no decreases in anthropometrical or nutritional outcomes were associated with mealtime assistance in any of the included studies

II.2 Should food intake in older persons with malnutrition or at risk of malnutrition be supported by a home-like, pleasant dining environment?

Recommendation 13

In institutional settings, food intake of older persons with malnutrition or at risk of malnutrition shall be supported by a home-like, pleasant dining environment in order to support adequate dietary intake and maintain quality of life (BM)

Grade of recommendation A – strong consensus (100 % agreement)

30.	**Abbott RA, Whear R, Thompson-Coon J, Ukoumunne OC, Rogers M, Bethel A, et al. Effectiveness of mealtime interventions on nutritional outcomes for the elderly living in residential care: a systematic review and meta-analysis. Ageing research reviews. 2013;12(4):967-81.**
	➔ **See number 27**

31.	**Bunn DK, Abdelhamid A, Copley M, Cowap V, Dickinson A, Howe A, et al. Effectiveness of interventions to indirectly support food and drink intake in people with dementia: Eating and Drinking Well IN dementiA (EDWINA) systematic review. BMC geriatrics. 2016;16:89.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Systematic Review 1++	***Countries:*** North America, Europe, Asia, New Zealand, South America ***Centers:*** n/a ***Setting:*** any setting(most institutional settings) ***Funding Sources:*** This article summarizes independent research	**Total no. Studies:** n=51 **Inclusion criteria:** RCT,CCTs→≥3 adults diagnosed any stage/type of dementia or mild cognitive impairment or MMSE score+standard deviation ≤26, ≥consecutive days; included interventions: see “interventions”; Included studies only with outcomes: see “outcomes” **Exclusion criteria:** case reports	Studies were grouped by type of Intervention 1. Dining environment and food service (any alteration (for ex. Noise, sensory adjustments, furniture,..) of the physical environment in which food/drink was taken) 2. Education/training of people with dementia or their care givers 3. behavioral intervention: alter behavior such as verbal prompting 4. exercise (any exercise component) 5. multicomponent intervention (>3 interventions, including at least 1 listed here) then grouped by study design

	funded in part by the National Institute for Health Research, Collaboration for Leadership in Applied Health Research & Care, East of England, and in part by the National Institute of Health Research Fellowship programme ***Dropout rates:*** n/a ***Study limitations:*** high risk of bias (small number of patients included in the studies+ low validity), effective interventions may be underpowered, shortage of potentially useful interventions/research, inability to pool outcome data (no meta-analysis possible → interventions too different)		
Notes	• Meta-analysis (statistical pooling) was not appropriate so data were tabulated and synthesized narratively; Methodological quality was assessed using Cochrane risk of bias tool; assessed also: funding bias, validity of dementia diagnosis, outcome measures and baseline comparability between groups • Intervention duration differed from 5 days to 1 year **Author's Conclusion:** We found no definitive evidence on effectiveness, or lack of effectiveness, of specific interventions but studies were small and short term. A variety of promising indirect interventions need to be tested in large, high-quality RCTs, and may be approaches that people with dementia and their formal or informal care-givers would wish to try.		
Outcome	• Primary outcomes:		• No clearly effective or clearly ineffective interventions

measures/results	- Nutrition or hydration status - Meaningful activity or enjoyment of food/drink - Quality of life • Secondary outcomes - Quantity, quality, adequacy of food/fluid intake • Other outcomes of interest: - Functional or cognitive status - Views, attitudes - Cost effectiveness - Resource use - Mortality, health outcomes	- Mixed results: some examples: Charras et al. shared mealtimes → weight increased (+5.64 kg, p>0.024), improved autonomy, longer meals; no effect on weight/BMI (Desai et al.) by comparing bulk service vs. pre-plated but increased intake of energy, protein, carbohydrate; education: (Riviere et al.)improved weight (1.4 kg, p<0.05) compared to usual care/(Hanson et al.) significant decrease in %weight loss compared to control; behavioral intervention → longer mealtimes (Van Ort et al.); exercise interventions no improve in nutritional status in any study • Promising interventions included: - eating meals with care-givers - family style meals - soothing mealtime music - constantly accessible snacks and longer mealtimes - education and support for formal and informal care-givers - spaced retrieval and Montessori activities - facilitated breakfast clubs (Santo Pietro et al., 1998, CCT) - multisensory exercise and multicomponent interventions

32.	**Nijs KA, de Graaf C, Kok FJ, van Staveren WA. Effect of family style mealtimes on quality of life, physical performance, and body weight of nursing home residents: cluster randomised controlled trial. BMJ (Clinical research ed). 2006;332(7551):1180-4.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Cluster RCT 1+	***Countries:*** Netherlands ***Centers:*** 5 Dutch nursing homes (located in different parts of the country) ***Setting:*** *n/a*	**Total no. Patients:** n=178 **Inclusion criteria:** medium sized nursing homes (175-275 beds) with general nursing home population (2 wards for residents with chronic somatic diseases, long term care or permanent	2 Groups (randomized): 1. Intervention Group: n=95 → took their meals family style 2. Control Group: n=83 → usual individual pre-plated service Interventions duration: 6 months Each of 5 nursing homes had 1 control and 1 intervention ward Meals offered the control and intervention group: similar weight, nutrient

	Funding Sources: Netherlands Organisation for Health Research and Development ***Dropout rates:*** 28% ***Study limitations:*** one package intervention → cannot say which part of the intervention had most effect; only representative for the Dutch population/situation	stay, similar for staff numbers, disciplines, education level of the careers, newness of infrastructure, location, residents activities **Exclusion criteria:** terminal phase of disease, total parenteral feeding, inability to give informed consent (due to physical/mental condition→ dementia)	content
Notes	• mean age = 77 years, representative population • Dutch nursing homes two types of care are available: psychogeriatric care for residents with dementia or chronic somatic care for patients with conditions such as stroke or Parkinson's disease. • Ten wards for residents with chronic somatic diseases were involved, had own dining area • To blind the allocation of the wards, we did not visit the wards nor have any contact with the staff or residents before allocation. • Randomization: The wards' name with the initial letter occurring first in the alphabet became the intervention ward. • Collected information: sex, age, length of stay, number of drugs, diseases, dietary supplements • Non-participating residents of the intervention groups were given the same meal services as participants; control and intervention group ate the meals in the dining room of the particular ward • Quality of life was assessed face-to-face through validated questionnaire + formula; physical performance assessed by validated nursing home physical performance test; energy intake: trained Dieticians, observation, weighing back **Author's Conclusion:** Family style mealtimes maintain quality of life, physical performance, and body weight of nursing home residents without dementia.		
Outcome measures/results	• main Outcome: Quality of life (safety, autonomy, physical, psychosocial functioning), gross+fine motor function, body weight		• significant difference in: - overall quality of life (6.1 units, 95% CI 2.1 to 10.3) - fine motor function (1.8 units, 0.6 to 3.0)

	• Nutritional status: MNA	→physical performance o stable in the intervention group o significant decline in control group - body weight (1.5 kg, 0.6 to 2.4) sig. different between groups; sig. decrease in the control group (-1.1,-1.9 to-0.2) - sig. increase of mean energy intake in the intervention group, sig. decrease in control group ➔ everything better in the intervention group • no statistically significant differences: - within the groups: sensory functioning, autonomy - gross motor function

II.4 Should home-dwelling older persons with malnutrition or at risk of malnutrition be offered specific meals-on-wheels?

<u>Recommendation 15</u>

Meals-on-wheels offered to home-dwelling older persons with malnutrition or at risk of malnutrition should be energy-dense and/or include additional meals to support adequate dietary intake (BM)

Grade of recommendation B – strong consensus (97 % agreement)

33.	**Kretser AJ, Voss T, Kerr WW, Cavadini C, Friedmann J. Effects of two models of nutritional intervention on homebound older adults at nutritional risk. Journal of the American Dietetic Association. 2003;103(3):329-36.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Intervention study/ controlled trial 1-	***Countries:*** n/a ***Centers:*** n/a ***Setting:*** Meals-on-Wheels → home of the participants ***Funding Sources:*** National Meals on Wheels Foundation, Millenium Healthcare Solutions, Mecklenberg Country Department of Social Services ***Dropout rates:*** 23.64% ***Study limitations:*** n/a	**Total no. Patients:** n= 203 (age-range= 60-90 years) **Inclusion criteria:** comprehensive home care assessment tool and MNA through same assessor→ Eligibility **Exclusion criteria:** MNA>22.5, self-report of terminal illness, medical conditions that precluded meals being adequate, significant food allergies, previous participation in home-delivered senior nutrition meals	2 Intervention Groups: 1)traditional MOW-Model (Meals-on-Wheels): 5 hot meals per week → 33% of DRI for those over 50 years (Daily Reference Intake) (n= 101) 2) restorative, comprehensive New MOW-program: 3 meals and 2 snacks per day, 7 days a week → 100% DRI for those over 50 years (n=102); daily phone call from older adult volunteers to provide a measure of safety and socialization Meal delivery: weekly
Notes	• 6 months prospective comparative study; 15 months period • Randomized: unserviced rural outlying area = new MOW model; few participants refused multiple meal model → were placed in traditional MOW; participants were not denied participation in either model if he/she could not contribute. • Assessments were conducted in the home of the participants • Recruitment: potential participants were drawn from current waiting lists, referrals made by hospital discharge planners, local		

<table>
<tr><td></td><td colspan="2">advertisement; then followed by telephone screening
• During each reassessment: New MOW participants → food satisfaction survey with specific questions to the food they consumed on that day or the day before. Additional questions: assistance in meal preparation, difficulty in opening meals, and suggestions for improving meals.
Author's Conclusion: Applicants for home meal delivery have varying nutrition needs. By addressing nutritional risk, interventions can be targeted to meet these needs. A new, restorative, comprehensive meal program improved nutritional status and decreased nutritional risk and can possibly impact independence and functionality. Our research indicates that a higher quality of life and the potential for delaying the loss of independence is within reach of the MOW program.</td></tr>
<tr><td>Outcome measures/results</td><td>• MNA: evaluate nutritional risk, status: baseline, after 3 and 6 months
• Evaluation of limitations in actions of daily living: through standardized functional impairment scales, ADL , IADL (scoring system → summary scores for all tasks: ADL range=0-6; IADL range= 0-7; change in functional status: ADL/IADL follow up – baseline)</td><td>• New MOW group:
▪ significant weight gain baseline to 3 months (2.78 lb. vs -1.46 lb., p=.0120) and 3 to 6 months (4.3 lb. vs -1.72 lb., p=0.0004) compared to traditional
• MNA:
▪ MNA improved faster in the New MOW group at 3 months (Improvement New MOW: at risk 86%, malnourished 96%)
▪ no significant difference in mean MNA between MOW groups
▪ 2/3 of participants moved from "at-risk" to "well-nourished" at 6 months in both models
▪ MNA significant lower in women than in men
• Greatest improvement in nutritional risk: first 3 months of treatment in both groups
• Functional change: more related to BMI, age than to intervention; malnourished participants of the New MOW with increase in BMI had less decline in functional status (especially at 6 months; IADL, p=0.0494)
• Malnourished participants in both groups took longer to affect positive change (between 3 to 6 months) vs participants "at risk"→ weight gain occurred earlier (within first 3 months, p=0.003)
• Drop-outs: Higher mortality rate among traditional MOW (n=9 vs n=3), loss of independence higher in traditional group, withdrawal of consent</td></tr>
</table>

34.	**Silver HJ, Dietrich MS, Castellanos VH. Increased energy density of the home-delivered lunch meal improves 24-hour nutrient intakes in older adults. Journal of the American Dietetic Association. 2008;108(12):2084-9.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1++	***Countries:*** Florida, USA ***Centers:*** n/a ***Setting:*** Regularly served home-delivered meal menu ***Funding Sources:*** Retirement Research Foundation, Chicago, IL ***Dropout rates:*** 13.47% ***Study limitations:*** short duration, findings discern whether greater preference for enhanced meal was directly related to fat content or energy density, kosher food items, recipe manipulations with items from local grocery stores	**Total no. Patients:** n=52 **Inclusion criteria:** subjects providing home delivered kosher lunch meals from Kramer Senior Services Agency, West Palm Beach, FL, ≥60 years **Exclusion criteria:** chewing, swallowing dysfunction, need for feeding assistance, eating disorder, depression, impaired functional status, dementia, BMI≥30 followed a medically restricted diet, liquid nutrition supplements, meal skipping, took orexigenic acids, smoked, alcoholic beverage daily >1	Regularly served home-delivered meal menu Crossover: 1)regular meal 2)enhanced meal →Type of food, portion size and appearance of the lunch was held constant →both: 225 g portion of Salisbury steak, 150 g portion of mashed potato (enhanced by adding eggs, nondairy kosher creamer for water) dish, 120 g portion of broccoli casserole (enhanced by adding almonds, mayonnaise), 24 g dinner roll 7 months period Regular or enhanced version during alternate test weeks; Test days separated by a 6-day washout period
Notes	• Recruitment: Screening by telephone; interest in participation: home visit by registered dietitian trained in subject recruitment, 24-hour diet recall methodology, anthropometry (height measurement through knee height, weight without shoes, heavy clothes) • Subjects were counseled to maintain their habitual lifestyle and physical activities during the study. • Subjects were compensated for participation with three $5 Publix gift certificates • Regular lunch meal: 1/3 of Recommended Dietary Allowance for energy (1,1 kcal/g)/ enhanced versions energy density was twice of the regular (2,2 kcal/g)+10g more protein; stable cook-chill food preparation system		

	• Pre-experiment pilot test with 9 adults: confirming study methods • Subjects were instructed how to warm the lunch meal, how to consume it in the same manner with usual home-delivered meal, how to place leftovers **Author's Conclusion:** Altering the energy density of regularly served menu items is an effective strategy to improve dietary intakes of free-living older adults.	
Outcome measures/results	• Interview: demographic data, usual dietary behavior, weight history • Telephone interviews, home visits during first week; second week: Test meals prepared • 24-hour diet recall for ad libitum food and beverage consumption (12:00 AM Monday to 12:00 AM Tuesday; standardized script) • Leftovers were weighed • Labels were showed to dietitians: portion size, ingredients	• High acceptance of test meals • Enhanced meal: ▪ Increased lunch energy intake by 86% (358.6±17,4 kcal; p<0.001) ▪ increased 24-hour energy intake by 453 kcal (from 1423.1±62.2 regular meal to 1876±78.3 kcal enhanced meal, p<0.001) ▪ consumption increased within the enhanced meal: potato dish: regular 83% vs enhanced 93%; Broccoli casserole: regular 64% vs enhanced 99% (p<0.001) ▪ key nutrients significantly more on enhanced meal day: protein, n-3 fatty acids, vitamin D/E/riboflavin/B6, niacin, calcium, magnesium, copper, selenium • not statistically different between meals : ▪ consumption of Salisbury steak and dinner roll ▪ grams of food consumed ▪ energy intakes during breakfast, dinner on regular and test meal days

II.5 Should older persons with malnutrition or at risk of malnutrition be offered nutritional education as part of a comprehensive intervention concept?

<u>Recommendation 16</u>

Older persons with malnutrition or at risk of malnutrition should be offered nutritional information and education as part of a comprehensive intervention concept in order to improve awareness of and knowledge about nutritional problems and thus promote adequate dietary intake.

Grade of recommendation B – strong consensus (94 % agreement)

35.	**Bunn DK, Abdelhamid A, Copley M, Cowap V, Dickinson A, Howe A, et al. Effectiveness of interventions to indirectly support food and drink intake in people with dementia: Eating and Drinking Well IN dementiA (EDWINA) systematic review. BMC geriatrics. 2016;16:89.**
	➔ **See number 31**

36.	**Young K, Bunn F, Trivedi D, Dickinson A. Nutritional education for community dwelling older people: a systematic review of randomised controlled trials. International journal of nursing studies. 2011;48(6):751-80.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Systematic Review of RCTs 1+	***Countries:*** United States, United Kingdom, Australia, Canada, Spain, Norway, Finland ***Centers:*** n/a ***Setting:*** community dwelling older people ***Funding Sources:*** supported by a grant from	**Total no. Studies:** n=23 (separate RCTs) Publications included n=35 **Inclusion criteria:** RCTs evaluating nutritional education or advice for people aged ≥65 years, living in their own homes, any type of nutritional intervention that contained dietary advice and education, and/or provision of information, studies limited to English languagepublications only **Exclusion criteria:** RCTs with participants living in residental	Classification of interventions: 1) Nutritional education only (n=5) 2) Complex interventions: including serveral interactive components (n=18) → individualized holistic care, healthy lifestyle advice, exercise advice, screening ➔ Interventions were all delivered by out-patient, hospital outreach or community staff

	Hertnet, The Hertfordshire Primary Care Research Network, UK ***Dropout rates:*** n/a ***Study limitations:*** high heterogenity, high risk of bias, methodological issues that could have bearing on the validity of the results, studies with complex interventions: difficult to isolate effectiveness of the nutritional aspect, complexity of measurements of dietary related outcomes,	or sheltered housing where food is provided, interventions relating to parenteral/enteral feeds, medications, prescription of sip/supplementary feeds	
Notes	• Assessment of risk of bias on 6 domains → many studies were at moderate or high risk of bias; methodological quality of studies was assessed using criteria based on those of the Cochrane Collaboration; Additional use of NICE (National Institute of Health and Clinical Excellence)criteria • Due to high heterogeneity results were not pooled but are reported narratively • From 23 studies all but one of the interventions were delivered by health care professionals; 10 delivered by nurses • Review was intended to inform nursing practice: review was interested in interventions that either were or had the potential to be, delivered by nurses • Studies varied in the format of intensities, strategies, populations(healthy, frails elderly, specific diseases) an aims **Author's Conclusion:** This review indicates that nutritional education or advice can positively affect physical function and diet, whilst complex interventions with nutritional education as a component, can reduce depression in people over 65 years who live at home. However, more research is needed to determine whether outcomes are influenced by types of intervention, morbidity, and socioeconomic circumstance of participants.		
Outcome measures/results	Measurements of: • Physical function • Emotional well being/mental health • Quality of life		• Nutritional education or advice can be used positively influence diet and improve physical function • Some biochemical markers can be positively affected by nutritional education (raising albumin, reducing sodium

	• Service use • Nutritional indices • Anthropometric measures: BMI, grip strength, biochemical indicators • Mortality	excretion); mixed results in influencing inflammatory biomarkers in patients with OA • Several studies indicated that complex interventions with nutritional education as a component, also reduce depression • Impact on weight change was inconclusive • No evidence of improvements in anxiety, quality of life, service use, costs of care or mortality, or that length of the intervention has an impact on effectiveness • Dietary fiber: none of the studies which measured dietary fiber found any evidence of effect • Mixed effects in cardiovascular studies on dietary fat intake; together the studies provide some evidence to suggest that nutritional educations can lead to change in fat intake • Energy intake: significant intervention effects (decrease in cardiovascular patients/increase in patients with chronic kidney disease) • General dietary improvements: intervention group reported more improvements to their diet than the control (n=2) • Interventions significantly decreased BMI (n=2) vs. no significant intervention effect (n=5) • Limited success in lowering cholesterol by nutritional education

II.6 Should food intake in older persons with malnutrition or at risk of malnutrition be supported by education of their caregivers?

Recommendation 17

Health care professionals as well as informal caregivers should be offered nutritional education in order to ensure awareness of and basic knowledge on nutritional problems and thus promote adequate dietary intake of older persons with malnutrition or at risk of malnutrition.

Grade of recommendation B – strong consensus (95 % agreement)

37.	**Abbott RA, Whear R, Thompson-Coon J, Ukoumunne OC, Rogers M, Bethel A, et al. Effectiveness of mealtime interventions on nutritional outcomes for the elderly living in residential care: a systematic review and meta-analysis. Ageing research reviews. 2013;12(4):967-81.**
	➔ **See number 27**

38.	**Bunn DK, Abdelhamid A, Copley M, Cowap V, Dickinson A, Howe A, et al. Effectiveness of interventions to indirectly support food and drink intake in people with dementia: Eating and Drinking Well IN dementiA (EDWINA) systematic review. BMC geriatrics. 2016;16:89.**
	➔ **See number 31**

39. **Marshall S, Bauer J, Capra S, Isenring E. Are informal carers and community care workers effective in managing malnutrition in the older adult community? A systematic review of current evidence. The journal of nutrition, health & aging. 2013;17(8):645-51.**

Study Type/ Evidence Level	Study details/limitations	Patient characteristics	Interventions
Systematic Review 1+	***Countries:*** Australia ***Centers:***University of Queensland, Brisbane ***Setting:*** n/a	**Total no. Studies:** 9 **Inclusion criteria:** Intervention studies, Interventions were considered which were delivered to 1) informal carers: adults ≥18y who provide care for community-dwelling older adults, ≥65y, and have no professional caregiving education training or 2) Non-clinical community care workers:	Nutrition- related interventions delivered to informal carers or non-clinical care workers of community-dwelling older adults.

	Funding Sources: no funding ***Dropout rates:*** 0% ***Study limitations:*** n/a	paid workers who provide in-home care to community-dwelling older adults and have no health-related professional backround or education. Mean age of the study population ≥65y. Interventions delivered in an in-home community or outpatient setting. **Exclusion criteria:** studies where participants received enteral tube feeding, parenteral nutrition, hemodialysis, peritoneal dialysis or had diabetes, cardiovascular disease or cancer	
Notes	**Author's Conclusion:** Interventions targeted at identifying, preventing and/or treating malnutrition were able to improve or prevent decline in nutritional and functional status, without increasing informal carer burden. The findings of this review support the involvement of non-clinical community care workers and informal carers as part of the nutritional care team for community-dwelling older adults.		
Outcome measures/results	Nutritional and functional status were the most commonly reported primary outcomes.		Nine studies were eligible for inclusion. The strength and quality of the evidence was moderate (six studies with level II intervention evidence, five with positive quality). Types of interventions used were highly varied. The majority of interventions were delivered to informal carers (6 studies), with three of these studies also involving older adult care recipients. Five interventions were targeted at identifying, preventing and/or treating malnutrition specifically (two positive quality, three neutral quality, n=2368). As a result of these interventions, nutritional status improved or stabilized (two positive quality, two neutral quality, n=2333). No study reported an improvement in functional status but two successfully prevented further decline in their participants (two neutral quality, n=1097).

II.7 Should older persons with malnutrition or at risk of malnutrition be offered individualized nutritional counselling?

Recommendation 18

Older persons with malnutrition or at risk of malnutrition and/or their caregivers should be offered individualized nutritional counselling in order to support adequate dietary intake and maintain nutritional status (BM)

Grade of recommendation B – strong consensus (100 % agreement)

40.	**Munk T, Tolstrup U, Beck AM, Holst M, Rasmussen HH, Hovhannisyan K, et al. Individualised dietary counselling for nutritionally at-risk older patients following discharge from acute hospital to home: a systematic review and meta-analysis. Journal of human nutrition and dietetics : the official journal of the British Dietetic Association. 2016;29(2):196-208.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Systematic Review and meta-analysis 1++	***Countries:*** n/a ***Centers:*** n/a ***Setting:*** n/a ***Funding Sources:*** n/a ***Dropout rates:*** n/a ***Study limitations:*** small number of included studies, high risk of bias in the single studies, lack of statistical power in the single studies	**Total no. Studies:** n=4 **Inclusion criteria:** studies on patients > 60 years and assessed to be at nutritional risk, studies evaluating individualized dietary counselling after an acute hospital stay, RCT **Exclusion criteria:** patients suffering from chronic medical conditions requiring further hospital stays, artificial nutritional support, no individual counselling, multifactorial interventions	Different forms of individualized dietary counselling
Notes	**Author's Conclusion:** We found moderate-quality evidence that individualized dietary counselling provided by a registered dietitian improved weight, energy and protein intake in older nutritionally at-risk patients, although without clearly improving physical function. No effect was found on mortality. Because of a lack of data on hospital readmissions and quality of life, meta-analyses of these outcomes were not possible. Given the prevalence of undernutrition in older patients, the valid evaluation of the effect of nutritional interventions		

	on clinically relevant outcomes is a prerequisite. Therefore, consensus regarding which instruments to use to measure outcomes and the identification of minimal clinically relevant changes is needed.	
Outcome measures/results	Primary outcome: physical function Secondary outcomes: different parameters of nutritional status	There was no significant effect of the intervention on hand grip strength; weight increased significantly in intervention patients; the mini nutritional assessment (MNA) improved for dietary assessment and subjective assessment in intervention patients; there was no influence on mortality; no difference was detected regarding quality of life

II.8 Should older persons with malnutrition or at risk of malnutrition be offered food-based fortification?

<u>Recommendation 20</u>

Older persons with malnutrition or at risk of malnutrition should be offered fortified food in order to support adequate dietary intake. (BM)

Grade of recommendation B – strong consensus (100 % agreement)

41.	**Morilla-Herrera JC, Martin-Santos FJ, Caro-Bautista J, Saucedo-Figueredo C, Garcia-Mayor S, Morales-Asencio JM. Effectiveness of Food-Based Fortification in Older People. A Systematic Review and Meta-Analysis. The journal of nutrition, health & aging. 2016;20(2):178-84.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Systematic Review and Meta-Analysis 1+	***Countries:*** n/a ***Centers:*** n/a ***Setting:*** Hospitals, Community-dwelling, Institutions ***Funding Sources:*** Andalusian Council of Health ***Dropout rates:*** n/a ***Study limitations:*** poor methodological quality of the included studies, heterogeneity of the studies	**Total no. Studies:** n=7 **Inclusion criteria:** RCT, quasi-experimental, interrupted time series including a longitudinal analysis with at least 2 observations before and after intervention, elderly patients who are institutionalized, hospitalized, community-dwelling, age ≥65 **Exclusion criteria:** patients in clinical care, recovering from cancer treatment, Studies used oral nutritional supplementation, unpublished studies	Studies had to compare: 1)food-based fortifications with macronutrients Versus 2)alternatives
Notes	• PICO question: In older people, the use of food-based fortification with macronutrients against other alternatives, which effects produces on any nutritional parameter, such as weight gain, protein or calories intake, or non-nutritional outcomes such as food		

	consumption, functional status or quality of life. • Independent peer review was implemented; studies were evaluated with regard to: random sequence generation, allocation concealment, blinding, personnel and outcome assessment, basal homogeneity of groups, precision of results, presence of co-interventions, incomplete data reporting-intention to treat analysis **Author's Conclusion:** Food-based fortification yielded positive results in the total amount of ingested calories and protein. Despite the limited evidence, due to their simplicity, low cost, and positive results in protein and calories intake, simple dietary interventions based on the food-based fortification or densification with protein or energy of the standard diet could be considered in patients at risk of malnutrition.	
Outcome measures/results	• Comparison of the interventions for assessing their effectiveness on any nutritional parameter (weight gain, protein/calorie intake, anthropometric changes, biochemical markers, changes in nutritional status) or non-nutritional outcomes (food consumption, functional status, QoL)	• Food-based fortification within the studies: ▪ Enrichment: effective to achieve caloric increases (enriched breakfast, enriched foods and snacks) ▪ Densification: caloric increase in all of the studies, mixed results: protein increase vs no effect • Meta-analysis: ▪ Mean difference in favor of the enrichment group resulted in 200.22 Kcal/day [132.97, 267.48] p<0.00001.high heterogeneity (I2= 85%) ▪ Protein intake→differences: 7.01 g/day (1.42, 12.60), p<0.00001, although as previously, high heterogeneity (I2=98%); after sensitivity analysis: protein intake in favor of the experimental group (4.35 mg/day, 95% CI: 0.82 to 7.88) ▪ No meta-analysis: nutritional/functional status, QoL

42.	**Trabal J, Farran-Codina A. Effects of dietary enrichment with conventional foods on energy and protein intake in older adults: a systematic review. Nutrition reviews. 2015;73(9):624-33.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Systematic Review 1+	***Countries:*** n/a ***Centers:*** n/a ***Setting:*** community setting, Hospital, long-	**Total no. Studies:** n=9 **Inclusion criteria:** experimental, quasi-experimental, observational time series	Intervention: 1)standard diet versus 2)dietary-enrichment interventions with conventional foods and powered

	term care facilities ***Funding Sources:*** no external funding ***Dropout rates:*** n/a ***Study limitations:*** Heterogeneity: different designs, presentation of the result, lack of important outcome measures and wide variability in duration of the intervention between the studies, small number of included studies, 5 studies high risk of bias→ limits validity of the results	designs, participants age >65 years of any nutritional status, dietary-enrichment interventions with conventional foods and powered modules with aim to increase energy/protein density without significantly increasing final volume of the meals, community setting, Hospital, long-term care facilities **Exclusion criteria:** case series, case studies, published in other language than English, Spanish, Catalan, interventions with enriched dishes a la carte, use of nutritional supplements, vitamin/mineral supplements, homemade supplements, studies only evaluating micronutrient enrichment, abstracts from conference communications	modules →interventions: energy + protein enrichment (5 studies); enrichment of meals with energy dense food (4 studies); snacks included in 3 studies; powered modules along with conventional food (4 Studies)
Notes	• PICOS criteria; Risk of bias and study quality were assessed using the Academy of Nutrition and Dietetics' Quality Criteria Checklists for Primary Research • Nutritional status: not restricted to any specific method; Studies had to report on at least one measure of assessment aside from body weight; nutritional status of the individuals was not specified in most studies • Higher energy densities ranged from 198 kcal/day to 966 kcal/day; protein enrichment 22 g/day (1 study); duration of intervention varied from 2 days to 15 weeks • 4 studies were nonrandomized **Author's Conclusion:** The results suggest that dietary enrichment can improve energy intake in older adults. While dietary enrichment		

<table>
<tr><td></td><td colspan="2">seems to increase protein intake, there is not enough evidence of sufficient quality to confirm this observation or to determine whether dietary enrichment improves other outcomes assessed in this population. Additional large clinical trials with long-term interventions are needed to establish the effects of dietary enrichment in older people at risk of malnutrition.</td></tr>
<tr><td>Outcome measures/results</td><td>Main outcome: Changes in energy intake
Other Outcomes: nutrient intake(protein intake), nutritional status, body weight, functional status, episodes of infection</td><td>Energy intake:
Significant changes in total daily energy intake due to the enriched intervention (7 studies; 2 no sig. changes)
For example: most effective intervention - breakfast + lunch enrichment (18% increase; Castellanos et al.); crossover study 24 % (Silver et al.), 35% with snacks/50% without snacks (only enrichment in lunch and dinner) (Odlund Olin et al.) increase in energy intake between periods (p<0.001); Gall et al.: BMI<20 greatest increase in energy intake (32%)
Protein intake:
Significant changes (3 studies from 8 which reported protein intake) only due to energy enrichment! No specific protein enrichment in these studies
For example: 16%difference (Smoliner et al.), 10% increase (Silver et al.)
Nutritional status: MNA no differences between groups (Smoliner et al.), no between-group differences in BMI after intervention
Body weight: only 1 of 4 studies observed a significant increase in body weight of 3.4% (Odlund Olin et al.)
Functional status: no differences between groups (2 of 3 studies)
Episodes of infection: no significant changes (1 of 1 study)</td></tr>
</table>

II.11 Should older persons with malnutrition or at risk of malnutrition be offered oral nutritional supplements?

Recommendation 24

Hospitalized older persons with malnutrition or at risk of malnutrition shall be offered ONS, in order to improve dietary intake and body weight, and to lower the risk of complications and readmission (BM)

Grade of recommendation A – strong consensus (100 % agreement)

Recommendation 25

After discharge from the hospital, older persons with malnutrition or at risk of malnutrition shall be offered ONS in order to improve dietary intake and body weight, and to lower the risk of functional decline (BM)

Grade of recommendation A – strong consensus (100 % agreement)

Recommendation 26

Oral nutritional supplements offered to an older person with malnutrition or at risk of malnutrition, shall provide at least 400 kcal/day including 30 g or more of protein/day

Grade of recommendation A – strong consensus (97 % agreement)

43.	Baldwin C, Kimber KL, Gibbs M, Weekes CE. Supportive interventions for enhancing dietary intake in malnourished or nutritionally at-risk adults. The Cochrane database of systematic reviews. 2016;12:Cd009840.		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Systematic Review 1++	***Countries:*** UK ***Centers:*** Diabetes & Nutritional Sciences Division, School of Medicine, King's College London ***Setting:*** n/a ***Funding Sources:*** British Dietetic Association ***Dropout rates:*** n/a ***Study limitations:*** The overall quality of evidence ranged between moderate to very low, mainly because for most of the outcomes there was only a small number of studies and participants to achieve reliable information, or because risk of bias made results uncertain.	**Total no. Studies:** 41 **Inclusion criteria:** Randomized controlled trials of supportive interventions given with the aim of enhancing dietary intake in nutritionally vulnerable adults compared with usual care **Exclusion criteria:** n/a	There were five different interventions ('supportive interventions'): changes to the organization of nutritional care (13 studies, 3456 people), changes to the feeding environment (5 studies, 351 people), modification of the meal profile or pattern (12 studies, 649 people), additional supplementation of meals (10 studies, 6022 people) and home meal delivery systems (1 study, 203 people)
Notes	**Author's Conclusion:** There is evidence of moderate to very low quality to suggest that supportive interventions to improve nutritional care results in minimal weight gain. Most of the evidence for the lower risk of all-cause mortality for supportive interventions comes from hospital-based trials and more research is needed to confirm this effect. There is very low-quality evidence regarding adverse effects; therefore whilst some of these interventions are advocated at a national level clinicians should recognize the lack of clear evidence to support their role. This review highlights the importance of assessing patient-important outcomes in future research.		
Outcome	• **Primary Outcomes:** nutritional intake, health-related		Forty-one trials (10,681 participants) met the inclusion criteria. Trials were

measures/results	quality of life and patient satisfaction, morbidity/ complications • **Secondary Outcomes:** nutritional status, clinical function, hospitalization and institutionalization, adverse effects, death from any cause, economic costs	grouped according to similar interventions (changes to organization of nutritional care (N = 13; 3456 participants), changes to the feeding environment (N = 5; 351 participants), modification of meal profile or pattern (N = 12; 649 participants), additional supplementation of meals (N = 10; 6022 participants) and home meal delivery systems (N = 1; 203 participants). Follow-up ranged from 'duration of hospital stay' to 12 months. The overall quality of evidence was moderate to very low, with the majority of trials judged to be at an unclear risk of bias in several risk of bias domains. The risk ratio (RR) for all-cause mortality was 0.78 (95% confidence interval (CI) 0.66 to 0.92); P = 0.004; 12 trials; 6683 participants; moderate-quality evidence. This translates into 26 (95%CI 9 to 41) fewer cases of death per 1000 participants in favor of supportive interventions. The RR for number of participants with any medical complication ranged from 1.42 in favor of control compared with 0.59 in favor of supportive interventions (very low-quality evidence). Only five trials (4451 participants) investigated health-related quality of life showing no substantial differences between intervention and comparator groups. Information on patient satisfaction was unreliable. The effects of supportive interventions versus comparators on hospitalization showed a mean difference (MD) of -0.5 days (95% CI -2.6 to 1.6); P = 0.65; 5 trials; 667 participants; very low-quality evidence. Only three of 41 included trials (4108 participants; very low-quality evidence) reported on adverse events, describing intolerance to the supplement (diarrhea, vomiting; 5/34 participants) and discontinuation of oral nutritional supplements because of refusal or dislike of taste (567/ 2017 participants). Meta-analysis across 17 trials with adequate data on weight change revealed an overall improvement in weight in favor of supportive interventions versus control: MD 0.6 kg (95% CI 0.21 to 1.02); 2024 participants; moderate-quality evidence. A total of 27 trials investigated nutritional intake with a majority of trials not finding marked differences in energy intake between intervention and comparator groups. Only three trials (1152 participants) reported some data on economic costs but did not use accepted health economic methods (very low-quality evidence).

44.	**Beck AM, Holst M, Rasmussen HH. Oral nutritional support of older (65 years+) medical and surgical patients after discharge from hospital: systematic review and meta-analysis of randomized controlled trials. Clinical rehabilitation. 2013;27(1):19-27.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Systematic Review and Meta-Analysis 1-	***Countries:*** Europe, United States, China, Australia ***Centers:*** n/a ***Setting:*** discharge from hospital → rehabilitation care, patients own homes ***Funding Sources:*** no specific grant from any founding agency in the public, commercial or not-for-profit sectors ***Dropout rates:*** n/a ***Study limitations:*** poor quality with regard to blinding, limited number of studies, length of the included studies was relatively short, start intervention at discharge might be too late, high number of re-admission, low level of compliance, patients with single or multiple conditions might	**Total no. Studies:** n=6 **Inclusion criteria:** RCTs, minimum duration of intervention 1 week, surgical/medical patients, age ≥65 years, patients being discharged from hospital, dietary supplements **Exclusion criteria:** other language than English, publicized studies older than 5 years, lack of recovery and rehabilitation measures, start of intervention before discharge/unclear start of intervention, additional vitamin D and calcium only	Interventions: 1) standard care (for comparison) 2) Industrial oral nutritional supplements (iONS); home-made milk based supplements, fortification of normal food sources and dietary advice

	make a difference, only English studies included, lack of adequately performed RCTs		
Notes	• aim: improving the intake of protein and energy(normal oral route) • also observed: Confounding factors (compliance, adverse effects); results were double-checked with trials identified in the Cochrane reviews, Methodological quality was assessed as described in the Cochrane Handbook 1997 (No study passed all the methodological criteria, highest score:17); only one reviewer • Often outcome measurements were not in sufficient detail or format, to be included in a meta-analysis • Except for one study, the participants in the included trials underwent screening and were classified as actually being malnourished or at nutritional risk. **Author's Conclusion:** Although the evidence is limited, we suggest that oral nutritional support may be considered for older malnourished medical and surgical patients after discharge from hospital.		
Outcome measures/results	• Primary Outcomes: Re-admission and mortality • Secondary outcomes: energy and protein intake, Survival, Nutritional and functional status, Quality of life (QoL), morbidity		• all trials: positive effect on nutritional intake (energy) and/or nutritional status (weight) • compliance with nutritional intervention varied between 38% to 67% (compliance reported in only 3 studies); 2 studies side effects of the nutritional intervention were reported (gastrointestinal disturbances) • positive effect on functional outcomes (2 studies) • prevalence of re-admission: 56% in both intervention and control group • no significant effect on mortality (odds ratio 0.80 (95% confidence interval (CI) 0.46 to 1.39)) or re-admissions (odds ratio 1.07 (95% CI 0.71 to 1.61)) • no statistically significant heterogeneity was found

45.	Cawood AL, Elia M, Stratton RJ. Systematic review and meta-analysis of the effects of high protein oral nutritional supplements. Ageing research reviews. 2012;11(2):278-96.		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Systematic Review and Meta-Analysis 1+	***Countries:*** n/a ***Centers:*** n/a ***Setting:*** n/a ***Funding Sources:*** AC, RS employed by Nutricia, Advanced Medical Nutrition ***Dropout rates:*** n/a ***Study limitations:*** heterogeneity of the studies (duration, setting,..)	**Total no. Studies:** n=36 **Inclusion criteria:** Studies available as full papers, English language, only RCTs, subjects of any nutritional status, no restrictions on sample size/duration/year of publication/type of comparator/setting, using multi-nutrient high protein ONS of any consistency with at least 20% of energy provided from protein using or comparing with dietary counseling and/or standard diet/ONS, subjects ≥18 years **Exclusion criteria:** animal studies, developing world, pregnancy/lactation, sport studies, dietary counselling only, parental nutrition only, enteral tube feeding, ONS with <2 macronutrients, no macronutrients, <20% energy from protein, language other than English, abstract only, conference proceedings	Intervention could provide some or the entire daily requirement for energy + could be nutritional complete or incomplete 1) high protein ONS (>20% energy from protein) 2) comparator arm = control or standard ONS
Notes	• Studies had intervention and follow up periods ranging from as little as 2 weeks to a maximum of 1 year. The total number of patients studied in a single trial ranged from o 672 patients. High protein ONS had differing energy densities (0.75–3.85 kcal/ml)		

	and the percentage energy from protein ranged from 20–54%. • Populations studied: hip fractures, pressure ulcers, COPD, cancer, gastro-intestinal disease, range of clinical and acute illness • Heterogeneous group → sub group analysis (setting); Confounder noted in statistical analysis **Author's Conclusion:** There are clinical, nutritional and functional benefits resulting from high protein ONS use and the available evidence suggests little suppression of normal food intake, with the ONS being mostly additive to food intake. The systematic review and meta-analysis provides evidence that high protein supplements produce clinical benefits, with economic implications.	
Outcome measures/results	• clinical, health care use: complications, mortality, length of stay, readmission to hospital • functional: strength, QoL, activities of daily living (ADL), mobility • nutritional: intake, weight, appetite, body composition	• positive effects of the (high protein) ONS: ▪ reduced complications (odds ratio (OR) 0.68 (95%CI 0.55–0.83), $p < 0.001$, 10 RCT, n = 1830) → average of 19% absolute reduction in complications ▪ reduced readmission to hospital (OR 0.59 (95%CI 0.41–0.84), $p = 0.004$, 2 RCT, n = 546); ONS reduced overall readmission by 30% ▪ improved grip strength (1.76 kg (95%CI 0.36–3.17), $p < 0.014$, 4 RCT, n = 219) ▪ increased intake of protein and energy ($p<0.001$) ▪ improvements in weight ($p<0.001$); Meta-analysis (12RCT) high protein ONS significantly increased weight compared to control (1.7 kg (95% CI 0.8–2.7) $p < 0.001$, n = 1224, random effects model); duration has an great impact (increasing length → higher improvements through ONS) • inadequate information to compare standard ONS with high protein ONS • none of 15 RCTs reported significant differences in mortality between groups; Meta-analysis showed the same • length of stay: mixed effects (4 of 9 studies showed effects in favor of ONS group); meta-analysis (7 studies)high protein ONS reduced length of stay not sig. (ca. 10% reduction) • ADL mixed results: 5 studies no significant effect, 2 studies improvements in ADL in ONS group; Quality of life: Improvements, some significant in the ONS group; mobility: no sig. difference between groups • Body composition: 6 of 10 studies significant improvements with

		ONS

46.	**Milne AC, Potter J, Vivanti A, Avenell A. Protein and energy supplementation in elderly people at risk from malnutrition. The Cochrane database of systematic reviews. 2009(2):Cd003288.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Systematic Review 1++	***Countries:*** Europe, USA, Canada, Australia, Hong Kong ***Centers:*** n/a ***Setting:*** variety of settings, most participants (71%, 26 studies) were hospitalized in-patients with acute conditions; others: long-stay/care of elderly, care wards, nursing homes, at home in the community ***Funding Sources:*** n/a ***Dropout rates:*** n/a ***Study limitations:*** poor quality of the included trials(blinding, not without placebo), bias: analysis of outcomes on "intention-to-treat bias", often not reported: reasons for losses to follow-up, selective reporting	**Total no. Studies:** n=62 **Inclusion criteria:** RCTs, quasi-randomized CTs, oral protein and energy supplementation, minimum duration ≥2 weeks, age ≥ 65 years, mixed groups of patients (some recovering from cancer, some under clinical care, interventions: normal oral route **Exclusion criteria:** groups recovering from cancer treatment or clinical care, dietary advice alone, specially designed immunomodulatory supplements, supplements with specific amino acids, protein-only supplementation	Interventions with the aim of improving the intake of protein/Energy: 1) Interventions: ▪ Commercial sip feeds ▪ Milk based supplements ▪ Via the fortification of normal food sources 2) Usual practice (no supplement, alternative supplement with different amount of calories or protein, placebo (low energy drink)
Notes	• Duration varied from minimum 10 days to 18 months; minimum duration of intervention 1 week; number of participants varied from 10 to 4023		

	• Most included trials had poor quality; articles retrieved if there was some doubt about eligibility; all differences in data extraction/methodological quality were resolved by discussion with a third reviewer • Short term outcomes: up to 3 months; medium term outcomes: 3 to 6 months; long term outcomes: over 6 months • Subgroup analysis/investigations of heterogeneity: baseline nutritional status, health status, mean age, amount of kilocalories in supplement, duration of intervention (less than 35 days; 35 days or more); sensitivity Analyses **Author's Conclusion:** Supplementation produces a small but consistent weight gain in older people. Mortality may be reduced in older people who are undernourished. There may also be a beneficial effect on complications which needs to be confirmed. However, this updated review found no evidence of improvement in functional benefit or reduction in length of hospital stay with supplements. Additional data from large-scale multi-center trials are still required. Patients should have a variety of options for increasing intake.	
Outcome measures/results	• Primary Outcomes: ▪ All-cause mortality ▪ Morbidity, number complications ▪ Functional status (cognitive, muscle, mobility, ADL) • Secondary Outcomes ▪ QoL (validated scale) ▪ Length of hospital stay (hospital patients only) ▪ Number of primary care contacts (non-hospital participants only) ▪ Adverse effects of nutritional supplementation ▪ Level of care/support required ▪ Number of hospital/care (re)admissions ▪ Nutritional status (change anthropometry) ▪ Percentage change dietary intake ▪ Compliance with intervention ▪ Economic outcomes	• Nutritional status: ▪ Weight mean difference (WMD) for percentage weight change: benefit of supplementation 2.2% (95% CI 1.8 to2.5; 42 trails) ▪ AMC: benefit of supplementation of 1.2% ▪ Intake: different results or not clear in the studies • Mortality: No significant reduction in mortality between groups (RR 0.92, CI 0.81 to 1.04; 42 trails); Mortality results significant: limited to trails in which participants (N=2461) were defined as undernourished (RR 0.79, 95% CI 0.64 to 0.97); post-hoc subgroup analyses for mortality: statistically significant within patients with geriatric conditions most in hospital (n=2701, RR 0.78; 95%CI 0.62 to 0.98); no benefit within hip fracture. • Risk of complications was reduced (RR 0.86, 95% CI 0.75 to 0.99; 24 trails); risk of developing pressure ulcer in control group increased vs. intervention group (n=672, RR 0.57, 95%CI 1.03 to 2.38) • Functional benefit from supplementations (few trails); no evidence of improvement in cognitive function between groups • QoL: some studies reported improvements in the intervention group vs control group • length of hospital stay: no benefit from supplementation • Adverse effects: nausea or diarrhea, vomiting, fatigue, loss of appetite → gastro-intestinal discomfort → often lead to drop-out

		• Compliance: varied in the studies; often reported "taste-problems" • No reduction in health care costs with supplementation

47.	**McMurdo ME, Price RJ, Shields M, Potter J, Stott DJ. Should oral nutritional supplementation be given to undernourished older people upon hospital discharge? A controlled trial. Journal of the American Geriatrics Society. 2009;57(12):2239-45.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** Scotland, UK ***Centers:*** Tayside (Ninewells Hospital, Medicine for the Elderly wards at Royal Victoria Hospital, Dundee) and Glasgow (Glasgow Royal Infirmary Ligthburn Hospital and Stobhill Hospital) ***Setting:*** Community-based study ***Funding Sources:*** Health Services Research Committee, Chief Scientist Office, Department of Health, Scotland; Fresenius Kabi Ltd. Donated ONS and the control group supplement at no cost ***Dropout rates:*** 24.51% (n=62)	**Total no. Patients:** n=253 **Inclusion criteria:** community-dwelling, ≥70 years, admitted to hospital with an acute illness, BMI<24 kg/m², mid-arm muscle circumference below 10th centile or weight loss of 5% or more during the hospital stay **Exclusion criteria:** Barthel score>18, chronic liver disease, renal failure (serum creatinine >3.39 mg/dL), residence in a care home, cognitive impairment precluding informed consent, dysphagia, metastatic carcinoma or other terminal illness, acute inflammatory arthritis, stroke affecting both hands, major surgery within preceding month	1) Oral nutritional supplementation (600 kcal/d); IG; n=126 2) Control supplement (200 kcal/d); CG; n=127 →16 weeks

	Study limitations: both groups received additional calories, poor adherence		
Notes	• Mean age: 82 years • Blinded: both preparations were packaged in identical 200 mL plain white rectangular cartons and labeled using one of two randomization codes **Author's Conclusion:** Oral nutritional supplementation of undernourished older people upon hospital discharge did not reduce disability, despite improving handgrip strength and modestly increasing objectively measured physical activity levels. Lack of an effect of the nutritional supplement used in this study may have been due to low adherence, suggesting that different approaches to nutritional supplementation need to be tested in this population.		
Outcome measures/results	• Primary outcome: 20-point activity of daily living Barthel Index • Secondary outcomes: ▪ handgrip strength (muscle function) ▪ sit-to-stand test ▪ Euroquol (health-related Quality of Life) ▪ Body weight, BMI ▪ Physical activity ▪ Dietary intake: 3-day dietary record at baseline and during second half of the study ➔ Measurements at baseline (after discharge from hospital and before supplement was commenced) and 8 and 16 weeks ➔ Accelerometry-measured physical activity levels at baseline and 16 weeks ➔ Falls were recorded prospectively		• Similar baseline characteristics in each group, except for sex (higher proportion of females in IG) • no significant changes in Barthel score between IG and CG (adjusted mean difference = 0.28, 95% CI -0.28-0.84) • body weight increase in IG of 1.6 ± 4.2 kg and 0.8 ± 3.42 kg in CG; difference not significant; after adjusting for adherence to the supplement: mean difference 1.17 kg, 95% CI 0.07-2.27, p=0.04) • handgrip strength improved more in IG (adjusted mean difference= 1.48 kg, 95% CI 0.46-2.50; p=0.005) • IG exhibited modestly greater vector movement (overall activity) than CG (p=0.02) • No significant between-group differences in Sit-to-Stand test but showing a trend toward improvement in IG (mean change of -2.1 ±13.5 seconds vs. CG 0.6 ± 12,3 seconds, p=0.08) at 16 weeks • No significant between-group differences in health-related quality of life or falls • Adherence to nutritional supplement was 38.2% in IG and 50.0% in CG • Weight did not increase in IG as a whole; on treatment analysis adjusting for adherence → mean weight gain of 1.17 kg (95% CI 0.07-2.27, p=0.04) in IG than in CG • Accelerometry: (unadjusted) greater percentage change in vector movement in IG (2.87 ±4.40) vs. CG 0.93 ± 4.10, p=0.01); after

		correcting for sex: significantly more vector movement in IG than in CG (p=0.02); no between-group differences in time spent walking • Dietary intake: 23% (n=57) completed both of the 3-day dietary records; in this subgroup baseline mean energy intake was higher in CG (1573 kcal/d vs. 1365 kcal/d IG) and remained higher during second half (CG 1.643 kcal/d vs. 1439 kcal/d IG; p=0.04)

48.	**Woo J, Ho S, Mak Y, Law L, Cheung A. Nutritional status of elderly patients during recovery from chest infection and the role of nutritional supplementation assessed by a prospective randomized single-blind trial. Age and ageing. 1994;23(1):40-8.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** China, Hong Kong ***Centers:*** n/a ***Setting:*** after discharge from hospital ***Funding Sources:*** Sandoz Foundation for Gerontological Research, Earmarked Grant for Research from the University and Polytechnic Grant Committee, Hong Kong ***Dropout rates:*** n/a ***Study limitations:*** Screening tools may not be sensitive enough, no examination of the effect of ONS on short-term mortality (number of	**Total no. Patients:** n=81 **Inclusion criteria:** ≥65 years, chest infection, admitted to an acute medical ward **Exclusion criteria:** chronic disabled, demented patients, heart failure, renal/hepatic failure, stroke, malignancies, bedridden subjects who could not feed themselves	Nutritional supplementation 1) Supplement : 500 ml of Ensure liquid daily for 1 month after discharge (Intervention group, IG; n=40) 2) No supplement on discharge (Control group, CG; n=41)

	patients who died was too small within 6 months), low number of subjects (statistical significance), no uniform scales for assessment of well-being in the elderly, no dietary intake data before illness and during hospital stay for comparison		
Notes	• Patients recruited from only general district hospital serving one of the five geographical regions in Hong Kong • Patients were diagnosed to be suffering from chest infection if they had purulent sputum + increasing shortness of breath, pyrexia, elevated while cell count, with or without radiological changes on chest radiography • Compliance was checked during routine follow-up visits • All assessments except for dietary assessment were performed by an investigator blinded to the randomized grouping • Anthropometric indices were analyzed in men and women separately **Author's Conclusion:** Various measures of well-being and biochemical status of the water-soluble vitamins were better in the supplement group. We conclude that nutritional supplementation may have a role in helping elderly patients to recover from chest infections.		
Outcome measures/results	• Questionnaire ▪ Health status ▪ Mental status: part of the Clifton Assessment Procedure for the Elderly; Geriatric Depression Scale ▪ Functional status; Barthel index ▪ Well-being: questions on appetite, sleep problems, self-rated health, physical activity, number of days due to illness during past month, number of visits to doctors, number of times admitted to hospital, duration of stay in hospital, participation in household tasks, community activities, physical exercise, smoking, alcohol intake, life satisfaction • Anthropometric measurements		• No difference between groups at baseline • During 3 months recovery period patients in IG and CG reported improvement in appetite, life satisfaction, mental test score • During 2nd visit IG reported increased physical activity and during 3rd visit these subjects also reported fewer problems with sleeping ($p<0.05$) • 3rd visit functional ability of IG was better compared to CG • Both groups showed improvements in anthropometric indices during 3-month period; IG: improvements in more indices • CG only BMI and FFM showed improvements and the magnitude of increase was less than in IG (BMI 1.25 vs. 0.45; FFM 1.34 vs. 0.66; $p>0.05$) • Changes in women were less marked; only increase in TBF was observed in both groups, without difference between the groups • Baseline patients had lower plasma total protein, albumin,

	▪ Height, weight, BMI ▪ Mid-arm circumference ▪ Biceps/triceps skinfold thickness ▪ Total body fat (TBF), fat-free mass (FFM) according to Durnin and Womersley ➔ Assessments at baseline, 1, 2, 3 months • Biochemical nutritional status: blood test ▪ Complete blood picture: renal/liver function, total protein, albumin, prealbumin, thiamine, riboflavin, pyridoxine, plasma retinol, folic/ascorbic acids ➔ Assessment at baseline, 1 and 3 months • Dietary intake (24 h recall) ➔ Assessment at 1 and 3 months	prealbumin, retinol compared with values for healthy elderly living in the community • During 3 months after discharge IG and CG showed a rise in serum albumin, prealbumin, retinol, folic/ascorbic acids; IG also improved transketolase and aspartate transaminase status, had better glutathione reductase, folate and ascorbate status at 1 months compared with CG • Difference in folate continued to be observed at 3 months • Supplement was effective in providing extra calories, vitamins, minerals • During recovery IG and CG showed improvements in various measures of well- being and biochemical status • CG showed a lower level of functional ability after 3 months

Recommendation 42

During periods of exercise interventions, adequate amounts of energy and protein should be provided to older persons with malnutrition or at risk of malnutrition in order to maintain body weight and to maintain or improve muscle mass. (BM)

Grade of recommendation B – strong consensus (100 % agreement)

49.	**Lammes E, Rydwik E, Akner G. Effects of nutritional intervention and physical training on energy intake, resting metabolic rate and body composition in frail elderly. a randomised, controlled pilot study. The journal of nutrition, health & aging. 2012;16(2):162-7.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Open, randomized, controlled pilot treatment study 1-	***Countries:*** Sweden ***Centers:*** Elderly research centre in Solna (suburb of Stockholm) ***Setting:*** Community-based research center ***Funding Sources:*** Äldreforskning Nord Väst (local research centre for the elderly) ***Dropout rates:*** baseline: 3.13% (n=3); after 3 months follow-up: 17.71% After 9 months follow-up: 33.34% ***Study limitations:*** large clinical heterogeneity→ no standard power	**Total no. Patients:** n=96 **Inclusion criteria:** community-dwelling frail elderly people, >75 years, unintentional weight loss of ≥5% during the last year and/or BMI <20 kg/m², low physical activity level (≤grade 3 in Mattiasson-Nilo classification of physical activity) **Exclusion criteria:** age under 75, BMI > 30 kg/m², nonwalkers, recent cardiac problems requiring hospital care, hip fracture or surgery during the last 6 months, current cancer treatment, stroke within the last 2 years; <7 points of MMSE, institutionalized residents	4 treatment arms 1) Nutrition (n=25): Individual nutritional advice and group sessions on nutrition for the elderly; general physical training advice 2) Training (n=23): Physical training 2x 45 minutes per week for 3 months; general dietary advice 3) Combined nutritional und physical intervention (n=25): Individualized dietary counseling and group session education; specific physical training 4) Control group (n=23): General advice regarding diet and physical training ➔ Nutritional intervention: individual dietary counseling on the baseline food record data focusing on food choices and meal patterns; Energy needs: 1.4 x RMR (N/C Group); 1.5 x RMR (NT/T group)

	calculation possible, therefore: Pilot-study; no consensus regarding definition of frailty		
Notes	• Recruitment: questionnaires, advertisements in local newspapers, referrals from primary care and home service administration • N=437 were interested and who met inclusion criteria were contacted by telephone for screening • Randomization in open manner (study personal, statistician); no blinding • Assessments: baseline, 3 months (F1), 9Months (F2) **Author's Conclusion:** Individual nutrition counselling and physical exercise had no effect on energy intake, RmR or fat free mass in community-dwelling frail elderly people aged 75 and older. Interventions in frail elderly people should be targeted according to the needs of the individual patients. The issues of randomization, targeting and responders in are problematized and discussed.		
Outcome measures/results	• Energy intake (4-day food diary); home visit (nutritionist went through the record verifying details of food and amounts consumed); questions about: appetite, cooking, buying groceries, meal patterns) • MNA • Resting metabolic rate (indirect calorimetry; fasting) • Body composition: anthropometry (weight, height, skinfolds (4); body density + FM from sum of 4 skinfolds; FFM (Body weight- FM); Body composition (DXA) • Physical performance: pADL with Functional Independence Measure (FIM), iADL • Physical training: 60 minutes organized sessions 2x/week for 12 weeks (endurance, muscle strength, balance) → physiotherapist, trained instructor		• At baseline: 4 groups were comparable; except there were significantly more men in the training group compared to control group • Median MNA score just above "risk for malnutrition"; Majority was practically independent (pADL); large variation in iADL between individuals • Analysis within treatment groups: changes from baseline to F1 and F2 were very small • Training group: significant increase in RMR at 3 months; otherwise no differences between 4 groups • Correlation of 0.75 between FFM and RMR for all groups combined at each of the 3 assessments; Correlation energy intake for FFM and RMR varied between 0.27 and 0.49, with the lowest at F2; no correlation at an individual level for all 3 assessments • Mean energy intake: no differences at baseline between groups • Participants with low energy intake who increased it during the study ("responders"): statistically significantly lower BMI (21 vs. 24) and lower fat percentage (23 vs. 30) at baseline than "non-responders" • "non-responders": statistically significant decrease in body fat percentage at F1 and in Body weight, BMI, FFM at 9 months (F2)

50.	Miller MD, Crotty M, Whitehead C, Bannerman E, Daniels LA. Nutritional supplementation and resistance training in nutritionally at risk older adults following lower limb fracture: a randomized controlled trial. Clinical rehabilitation. 2006;20(4):311-23.		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1++	***Countries:*** Australia ***Centers:*** Flinders University Department of Rehabilitation and Aged Care, Repatriation General Hospital ***Setting:*** Teaching hospital ***Funding Sources:*** NHMRC Public Health Postgraduate Research Scholarship, Flinders University-Industry Collaborative Research Grant and Nutricia Australia Pty Ltd ***Dropout rates:*** 7% ***Study limitations:*** -relatively small sample size - The study interventions were not implemented until day 7 post injury and	**Total no. Patients:** 100 **Inclusion criteria:** All participants were recruited from the orthopedic wards of the Flinders Medical Centre, Adelaide, South Australia. Patients aged ≥70 years consecutively admitted to Flinders Medical Centre with a fall-related lower limb fracture between September 2000 and October 2002 were screened for inclusion in the study. **Exclusion criteria:** Patients were excluded who (1) did not reside within southern Adelaide, (2) were unable to comprehend instructions relating to positioning of the upper arm for eligibility assessment, (3) were unable to fully weight bear on the side of the injury for more than seven days post admission, (4) were not independently mobile prefracture, (5) were medically unstable > seven days post admission, (6) were suffering from cancer, chronic	Commenced seven days after injury. Consisted of daily multinutrient energy-dense oral supplement (6.3 kJ/mL) individually prescribed for six weeks (n =25), tri-weekly resistance training for 12 weeks (n = 25), combined treatment (n = 24) or attention control plus usual care and general nutrition and exercise advice (n = 26).

	there may have been significant declines or complications prior to commencing the interventions that impacted on the effectiveness of treatment. - There are possibly other unknown non-medical variables that may have impacted on outcomes of all participants.	renal failure, unstable angina or unstable diabetes or (7) were not classified as malnourished, (> 25th percentile for mid-arm circumference of a large representative sample of older Australians - 27.0 cm and 26.3 cm for males and females respectively).	
Notes	**Author's Conclusion:** Frail, undernourished older adults with a fall-related lower limb fracture experience clinically significant weight loss that is unable to be reversed with oral nutritional supplements. Those receiving a program of resistance training without concurrent nutrition support are at increased risk of weight loss compared with those who receive a combined nutrition and resistance training intervention. In this high-risk patient group it is possible to prevent further decline in nutritional status using oral nutritional supplements if strategies are implemented to ensure prescription is adequate to meet energy requirements and levels of adherence are high.		
Outcome measures/results	Weight change, quadriceps strength, gait speed, quality of life and health care utilization at completion of the 12-week intervention.		At 12 weeks, all groups lost weight: nutrition -6.2% (-8.4, - 4.0); resistance training -6.3% (-8.3, -4.3); nutrition and resistance training -4.7% (-7.4, -2.0); attention control - 5.2% (-9.0, - 1.5). Those receiving resistance training alone lost more weight than those receiving the combined treatment (P=0.029). Significant weight loss was prevented if supplement was consumed for at least 35 days. Groups were no different at 12 weeks for any other outcome.

51.	Rondanelli M, Klersy C, Terracol G, Talluri J, Maugeri R, Guido D, et al. Whey protein, amino acids, and vitamin D supplementation with physical activity increases fat-free mass and strength, functionality, and quality of life and decreases inflammation in sarcopenic elderly. The American journal of clinical nutrition. 2016;103(3):830-40.		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1++	***Countries:*** Italy ***Centers:*** University of Pavia ***Setting:*** geriatric physical medicine and rehabilitation division at the Santa Margherita Hospital in Pavia ***Funding Sources:*** Italian Ministry of the University and Research to the University of Pavia Department of Public Health ***Dropout rates:*** 0% ***Study limitations:*** no blood vitamin D concentrations were assessed , the effects of vitamin D supplementation separately from essential amino acid supplementation were assessed	**Total no. Patients:** 130 **Inclusion criteria:** no acute illness or severe liver, heart, or kidney dysfunction, stable body weight for 6 months, normal cognitive function or only mild cognitive disturbance as defined by a Mini-Mental State Examination >20 **Exclusion criteria:** anyone with evidence of heart disease, kidney or liver disease, or any other disease that might influence the results, altered glycometabolic control, thyroid disorders, other endocrinopathies or cancers and any patients treated with steroids and heparin or who had a total walking incapacity	A comprehensive physical fitness and muscle mass enhancement training program of moderate intensity was provided for all participants. The intervention treatment included an oral essential amino acid, whey protein, and vitamin D mixture. The control group was given a placebo (32 g) that consisted of an isocaloric amount of maltodextrin with the same flavor and appearance as the intervention product.
Notes	Investigators were blinded to the randomization table, the code assignments, and the procedure. A research dietitian, blinded to the		

	randomization schedule provided by the statistician, distributed the supplements to participants each day. **Author's Conclusion:** Supplementation with whey protein, essential amino acids, and vitamin D, in conjunction with age-appropriate exercise, not only boosts fat-free mass and strength but also enhances other aspects that contribute to well-being in sarcopenic elderly.	
Outcome measures/results	-primary endpoint: comparison of the increase in FFM or strength -secondary endpoint: comparison of anthropometric characteristics (RSMM, fat mass, gynoid and android fat, and waist circumference), muscle strength (handgrip), quality of life (SF-36 mental component summary and physical component summary), hormonal status (IGF-I, inflammation (CRP) and ADL	Compared with physical activity and placebo, supplementation plus physical activity increased fat-free mass (1.7-kg gain, $P < 0.001$), relative skeletal muscle mass ($P = 0.009$), android distribution of fat ($P = 0.021$), handgrip strength ($P = 0.001$), standardized summary scores for physical components ($P = 0.030$), activities of daily living ($P = 0.001$), mini nutritional assessment ($P = 0.003$), and insulin-like growth factor I ($P = 0.002$), and lowered C-reactive protein ($P = 0.038$).

52.	**Sugawara K, Takahashi H, Kashiwagura T, Yamada K, Yanagida S, Homma M, et al. Effect of anti-inflammatory supplementation with whey peptide and exercise therapy in patients with COPD. Respiratory medicine. 2012;106(11):1526-34.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** Japan ***Centers:*** Akita City General Hospital ***Setting:*** n/a ***Funding Sources:*** n/a ***Dropout rates:*** 13.89% ***Study limitations:*** The sample size and the time period were insufficient to	**Total no. Patients:** 36 **Inclusion criteria:** COPD patients with %IBW <110% and %FEV1 <80% who underwent low-intensity exercise therapy following the pulmonary rehabilitation (PR) program, and who met the diagnostic criteria of the COPD guidelines established by the American Thoracic Society (ATS) **Exclusion criteria:** Patients with a current cigarette smoking habit and complication of unstable heart disease, those for whom the medication was changed	**-Nutrition group**: active nutritional supplementation therapy with 200 kcal/pack of nutritional supplement twice a day in addition to normal meals and dietary instruction **-Control group:** normal meals alone with dietary instruction

	reach a definitive conclusion.	during the study period, those with severe disorders interfering with exercise including mental diseases and difficulty in oral ingestion of the nutritional supplement, and those in whom the condition was acutely aggravated after study initiation	
Notes	**Author's Conclusion:** Concomitant use of an anti-inflammatory nutritional supplement containing whey peptide, which exhibits an anti-inflammatory effect, with exercise therapy in stable elderly COPD patients with %IBW < 110% and %FEV1 < 80% may not only increase body weight but may also inhibit systemic inflammation and thus improve exercise tolerance and HRQOL.		
Outcome measures/results	Resting energy expenditure (REE); food intakes over 3 consecutive days in order to assess dietary intake; albumin (Alb), hemoglobin (Hb), and transferrin (Tf) were measured as nutrition indices, TNF-a, IL-6, IL-8, and high-sensitivity C-reactive protein (hsCRP) as inflammatory markers; mouth pressure was measured as respiratory muscle strength; weight-bearing index (WBI); maximum isometric extension and contraction of the quadriceps femoris muscle; corridor walk for 6 min according to the ATS guidelines; disease-specific HRQOL was measured using the Japanese version of the Chronic Respiratory Disease Questionnaire (CRQ)		In the nutritional support group, the body weight, %IBW, FM, energy intake, %AC, Alb, PImax, PEmax, 6MWD, WBI, emotional function, and CRQ total were significantly increased, and the levels of hsCRP, IL-6, IL-8, and TNF-a were reduced significantly, while no significant change was noted in any item of physiological evaluation or any biomarker in the control group.

53.	**Yoshimura Y, Uchida K, Jeong S, Yamaga M. Effects of Nutritional Supplements on Muscle Mass and Activities of Daily Living in Elderly Rehabilitation Patients with Decreased Muscle Mass: A Randomized Controlled Trial. The journal of nutrition, health & aging. 2016;20(2):185-91.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** Japan ***Centers:*** n/a ***Setting:*** A rehabilitation hospital in Kumanto	**Total no. Patients:** 39 **Inclusion criteria:** -aged 65 years or above - participating in ongoing	A combination of resistance training plus nutritional supplementation (**R/N group**) or resistance training alone (**R group**). The training and supplementation were conducted essentially from the patient's admission to discharge (2-6 months).

	Funding Sources: No specific grant from any funding agency in the public, commercial or not-for-profit sectors. ***Dropout rates:*** 7.7% ***Study limitations:*** - CC was used as an index of muscle mass, but this is not the gold standard for the accurate evaluation of sarcopenia -comorbidities, disabilities such as hemiparesis and other potential diversity of the subjects were not fully evaluated -this study was performed in the clinical hospital settings and there were only two groups; groups with resistance training with or without	convalescent rehabilitation training - with decreased skeletal muscle mass (calf circumference < 31 cm) (23-27) - receiving appropriate current nutritional management (the patient had adequate caloric intake according to requirements set by a registered dietitian) **Exclusion criteria:** - obesity or overweight (body mass index [BMI] > 25.0 kg/ m2) - presence of edema (based on the physical confirmation of the presence of palpable swelling, especially in lower limbs) - severe renal dysfunction (estimated glomerular filtration rate < 30 mL/min/1.73 m2) - dementia (Mini-Mental State Examination score < 23 (28))	

	nutritional intervention; Adding two patient groups to the study, a group without resistance training and a group with only nutritional intervention, could enhance the results -total energy and protein intake were not recorded; This would affect the changes in muscle mass over time		
Notes	**Author's Conclusion:** The results of this study suggest that nutritional intervention added to resistance training during convalescent rehabilitation may improve skeletal muscle mass and activities of daily living.		
Outcome measures/results	skeletal muscle mass (calf circumference [CC] as a primary outcome, and arm circumference [AC]), hand grip strength (HG), Mini-Nutritional Assessment-Short Form (MNA®-SF) score, serum albumin level (Alb), body mass index (BMI), and activities of daily living (ADL) as represented by the Barthel Index (BI) score		Significant treatment effects were seen for CC, AC, BI, Alb in the R/N group compared to the R group. A mean treatment effect of 3.2 (95%CI: 2.0-4.4) was seen in CC, 1.4 (95%CI: 0.8-2.1) was seen in AC, 11.2 (95%CI: 0.5-21.8) was seen in BI, 0.3 (95%CI: 0.1-0.5) was seen in Alb.

III Recommendations for older patients with specific diseases / main diagnoses

III.1 Should older patients after hip fracture and orthopedic surgery be offered nutritional support?

Recommendation 43

Older patients with hip fracture shall be offered oral nutritional supplements postoperatively in order to improve dietary intake and reduce the risk of complications. (BM)

Grade of recommendation A – strong consensus (100 % agreement)

54.	**Avenell A, Smith TO, Curtain JP, Mak JC, Myint PK. Nutritional supplementation for hip fracture aftercare in older people. The Cochrane database of systematic reviews. 2016;11:Cd001880.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Systematic Review 1++	***Countries:*** n/a ***Centers:*** n/a ***Setting:*** hospital, rehabilitation, any location after discharge from either of these facilities ***Funding Sources:*** National Institute for Health Research via Cochrane Infrastructure funding to the Cochrane Bone, Joint and Muscle Trauma Group ***Dropout rates:*** n/a	**Total no. Studies:** n=41 (3881 participants) **Inclusion criteria:** randomized, quasi-randomized controlled trials, nutritional interventions (started within the first months after hip fracture), patients >65 years, hip fracture, studies with mixed populations (orthopedic/other geriatric) only if separate data from hip fracture patients available **Exclusion criteria:** nutritional interventions that examined the secondary prevention of osteoporotic fractures after hip fracture, studies focused on mainly on younger patients, studies with patients with	Nutritional interventions aimed to improve the recovery from hip fracture by increasing energy intake, protein, vitamins/minerals, alone or in combination 1) Oral multinutrients feeds (non-protein energy, protein, vitamins, minerals; n=18 trials) 2) Enteral (Nasogastric) multinutrient feeding (n=4) 3) Tube feeding (n=1) 4) Combination of intravenous (parental) feeding and oral supplementation (n=1) 5) Increased protein intake (n=4); Comparison of different protein sources (n=1) 6) (Intravenous) Vitamin Supplementation (n=4); Comparison of different Vit. D sources (n=1); Iron suppl. Vs Control (n=3); Vit., mineral, amino acid vs. control (n=1); Isonitrogenous ornithine alpha-ketoglutarate versus peptide supplement (n=1); taurine vs. placebo (n=1) 7) Dietetic assistance (n=1)

	Study limitations: outcome data were limited, risk of bias →studies often methodologically flawed, Quality of evidence ranged from very low to low (GRADE Assessment), pooled mortality, complications, unfavorable outcome data irrespective of length of follow-up	multiple trauma/pathological fractures, trials published before 1980 with undefined geriatric population, mixed populations with fewer than 5 patients with hip fracture,	
Notes	• studies also included that could not be analyzed on a intention-to-treat basis, lack of blinding, use of placebo treatment • authors independently assessed risk of bias (Cochrane Risk of Bias tool) • RCT n=37; quasi-RCT n=4; sample size ranged from 10 to 318; Majority of participants were female **Author's Conclusion:** There is low-quality evidence that oral multinutrient supplements started before or soon after surgery may prevent complications within the first 12 months after hip fracture, but that they have no clear effect on mortality. There is very low-quality evidence that oral supplements may reduce 'unfavorable outcome' (death or complications) and that they do not result in an increased incidence of vomiting and diarrhea.		
Outcome measures/results	• Main Outcomes: ▪ All-cause mortality ▪ Morbidity ▪ Postoperative complications (wound infection, pressure sores, etc.) ▪ Unfavorable outcome (participants who died + number of survivors with complications) • Secondary outcomes: ▪ Length of hospital/rehabilitation unit stay ▪ Postoperative functional status (cognitive functioning, mobility, activities daily living) ▪ Level of care/extent of support required after discharge		• Oral multinutrient feeds little effect on mortality (risk ratio (RR) 0.81 favoring supplementation; 95% CI 0.49 to 1.32; 15 trials) Complications: evidence that the number of participants with complications may be reduced (RR 0.71, 95%CI 0.59 to 0.86; n=11) Lower numbers of unfavorable outcome due to oral supplement (RR 0.67, 95% CI 0.51 to 0.89; n=6) No increased incidence of vomiting/diarrhea due to oral supplementation (RR 0.99, 95% CI 0.47 to 2.05; n=6) Results Influence Interventions on length of hospital stay varies, but seems to be positive; functional status results different; QoL/fracture healing no difference between Groups • Nasogastric feeding (n=3): poorly tolerated; no effects on

	▪ Quality of life after discharge ▪ Fracture healing ▪ Adverse events (diarrhea) • Other outcomes ▪ Tolerance of/compliance with nutrition intervention ▪ Career burden and stress ▪ Economic outcomes	mortality/complications; no unfavorable outcome; no homogenous results for length of stay/ADL • Tube feeding (n=1): poorly tolerated; no effects on mortality/complications/length of stay/ADL • Combination (intravenous, oral; n=1): Intervention may reduce complications (significant reduction: RR 0.21, 99% CI 0.08 to 0.59); no difference between groups: length of stay • Increased protein intake (n=4): no clear effect on mortality/complications/adverse events; low contradictory evidence of a reduction in unfavorable outcomes (RR 0.78, 95% CI 0.65 to 0.95; n=2) • Intravenous vitamins (many versions): low/very low quality evidence of no clear effect on mortality/complications • Dietetic assistance: may reduce mortality, no clear effect on complications/length of stay

55.	**Liu M, Yang J, Yu X, Huang X, Vaidya S, Huang F, et al. The role of perioperative oral nutritional supplementation in elderly patients after hip surgery. Clinical interventions in aging. 2015;10:849-58.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Systematic Review 1+	***Countries:*** China ***Centers:*** n/a ***Setting:*** n/a ***Funding Sources:*** National Natural Sciences Foundation of China ***Dropout rates:*** n/a	**Total no. Patients:** 986 **Inclusion criteria:** 1. Target population: patients aged over 65 years who had hip fractures and undergone surgery 2. Intervention measure: perioperative ONS 3. Design type: RCT **Exclusion criteria:** 1. Patients with multiple systemic fractures or pathologic fractures	Perioperative ONS

	Study limitations: small number of available studies	2. Data without standard deviations 3. Participants with hip fractures who had undergone nonsurgical treatment	
Notes	Each of the ten included studies was an RCT and two of them were double blind. **Author's Conclusion:** Based on the evidence available, this meta-analysis is consistent with the hypothesis that perioperative ONS can help elderly patients recover after hip surgery and reduce complications.		
Outcome measures/results	1. Total protein, 2. Complications (including all infections, bed sores, cardiac disease, cognitive impairment, prolonged immobilization, thrombophlebitis, deep vein thrombosis, vomiting diarrhea, pressure ulcers, dysphasia, severe hyponatremia, anaphylaxis, pneumonedema, pulmonary embolism, and myocardial infarction), 3. Change in serum albumin levels (the difference in serum albumin levels before and after intervention, 4. Mortality		The combined trials showed that ONS had a positive effect on the serum total protein (P<0.00001) and led to a significantly decreased number of complications (P=0.0005). Furthermore, data from the infection subgroups showed significant decreases in wound infection (P=0.02), respiratory infection (P=0.04), and urinary tract infection (P=0.03). Clinical observation suggest that the intervention may improve the level of serum albumin, although the data did not reach statistical significance (P=0.48). Regarding mortality, there was no significant statistical difference between the intervention group and the control (P=0.93).

Recommendation 45

In older patients with hip fracture, postoperative oral nutritional supplements may be combined with perioperative parenteral nutrition in order to improve nutritional intake and reduce the risk of complications. (BM)

Grade of recommendation 0 – consensus (83 % agreement)

56.	**Eneroth M, Olsson UB, Thorngren KG. Insufficient fluid and energy intake in hospitalised patients with hip fracture. A prospective randomised study of 80 patients. Clinical nutrition (Edinburgh, Scotland). 2005;24(2):297-303.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** Sweden ***Centers:*** University Hospital in Lund Sweden, Department für Orthopaedics ***Setting:*** hospitalisation ***Funding Sources:*** supported by Medical Faculty of Lund University, County of Skane, Swedish National Board of Health and Welfare ***Dropout rates:*** 86% (n=590 eligiblepatients) ***Study limitations:*** generalitydue to selection of most healthy hip fractures patients, no	**Total no. Patients:** n=80 **Inclusion criteria:** >60 years, cervical/trochanteric hip fracture <24h old, admitted to Department of Orthopaedics, surgery had to be performed <48h from trauma, comparatively healthy patients (able to participate in a number of functional outcome measurements **Exclusion criteria:** multiple fractures, pathologic fractures, malignant disease, inflammatory joint disease, pain or functional impairment other than hip fracture which might hamper normal mobilization, dementia, depression, acute psychosis, known alcohol/medication abuse, epileptic seizures, insulin-treated diabetes mellitus, heart/kidney/liver insufficiency,	Intervention: 1) Control Group (n=40): ordinary hospital food and beverage 2) Intervention Group (n=40): ordinary hospital food and beverage + intravenous supplementary nutrition (1000 kcal/day, Vitimix) for 3 days, then followed by oral supplementary nutrition (400 kcal/day, Fortimel) for 7 days or until discharge

	golden standard to diagnose PEM (MNA seems best available tool), used recommendations in literature but there is still a great uncertainty about actual needs of the elderly	suspected acute myocardial infarction, hematemesis	
Notes	• Block randomisation by research nurse; All study cases were managed within the same unit in a non-blinded fashion • All tests and recordings were performed by the same person • Food: from hospital kitchen, known energy content; food/fluid intake: recorded daily in both groups on charts → staff observed all meals and noted the contents of the patient´s plate and beverages; water content of food was not included in fluid intake • Optimal dietary intake based on basal demand of 25 kcal/kg bodyweight/day; optimal fluid intake: 30 ml/kg bodyweight/day **Author's Conclusion:** Malnutrition is common even in a selection of healthy patients with hip fractures. During hospital stay the fluid and energy intake was considerably lower than that needed in the control group. Supplementary nutritional intake for ten days increased the total fluid and energy intake in the treatment group to near needed levels.		

Outcome measures/results	• Mini mental test for exclusion of patients with dementia (score <6 excluded)
	• Care programs were the same within groups (intravenous infusions in pre-, per-, and postoperative phases, infection prophylaxis, full weight-bearing postoperatively)
	• Day 1: Nutritional status: Subjective Global Assessment (SGA), blood samples (serum protein, immunological test)
	• Day 3: Anthropometric measurements (AMC, TSF, BMI)
	→BMI<22 = underweight, serum albumin <36 g/l, serum transthyretin <0.18 g/l (females)/>0.20 g/l (males), total lymphocyte count <1.5 x 10^9/l = markers malnutrition
			• Mean age treatment group 84 years; control group 78 years (p=0.001), no difference: sex, pre-fracture living conditions, hip fracture type, time to surgery from trauma, signs of PEM; median stay: 13 days
			• 1/3 of the patients (of both groups): malnourished (abnormal nutritional parameters → strong indicators of PEM)
			• Fluid intake (p<0.0001); energy intake (p=0.003) days 1-10
			  ▪ Control group: 1300 ml; 916 kcal
			  ▪ Intervention group: 1856 ml; 1296 kcal
			  ▪ Fluid intake based on drink only (days 1-10) higher in treatment group (p=0.04; 1136 vs. 1017 ml)
			  ▪ Energy intake based on food and drink only (days 1-10) higher in control group (444 vs. 388 kcal, p=0.01)
			• Difference between actual and needed fluid (p<0.0001)and energy intake (p=0.0003) days 1-10
			  ▪ Control group: -739 ml by mean needed of 2039 ml; -783 kcal/day by mean needed of 1699 kcal
			  ▪ Intervention group: +27 ml by mean needed of 1829 ml; -

		228 kcal/day by mean needed of 1524 kcal →there seem to be small negative influence on appetite in treatment group (but is compensated by extra intake by the supplements)

57.	**Eneroth M, Olsson UB, Thorngren KG. Nutritional supplementation decreases hip fracture-related complications. Clinical orthopaedics and related research. 2006;451:212-7.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** Sweden ***Centers:*** Department of Orthopedics, Lund University Hospital ***Setting:*** n/a ***Funding Sources:*** 1 author received from the Medical Faculty of Lund University, the Country of Skane and Swedish National Board of Health and Welfare ***Dropout rates:*** 5% ***Study limitations:*** balanced protein/energy supplement → unknown whether effect was because of protein or increased balanced overall caloric/fluid intake, selection of most healthy	**Total no. Patients:** n=80 **Inclusion criteria:** cervical/trochanteric hip fractures treated by orthopedic department, >60 years, surgery less than 48 hours after trauma, no diseases or other fractures that might hamper normal mobilization **Exclusion criteria:** multiple fractures, pathologic fractures, malignant disease, inflammatory joint disease, pain, functional impairment other than hip fracture, substantial cognitive impairment, depression, acute psychosis, known alcohol/medication abuse, epileptic seizures, insulin-treated diabetes mellitus, heart, kidney, liver insufficiency, (suspected) acute myocardial infarct, hematemesis	1) Intervention group (n=40, IG): hospital food and beverages of known energy content + 1000 kcal daily intravenous supplement (Virtimix, peripheral veins,3 days), followed by 400 kcal oral nutritional supplements (Fortimel, 7 days) 2) Control Group (n=40; CG): hospital food and beverages of known energy content

	patients → generality?		
Notes	• Daily record of: fluid and energy intake during first 10 days of hospitalization and fracture-related complications up to 4 months • Mini-mental test → for exclusion of patients with cognitive impairment (score <6) • Research nurse: randomization (block-) • All patients treated in the same unit; all tests performed by the same nurse; all nurses and physicians were blinded to provided treatment and results; all clinical data were viewed by one UBO (unblinded) • meals observed by nurse, noted content of the patient´s plate and beverage; Proportion of each component of the meal and beverage consumed was calculated on charts on a daily basis • optimal dietary intake based on basal demand of 25 kcal(kg body weight/day; optimal fluid intake: 30 ml/kg body weight/day • definition of complications: clinical symptoms/signs, positive objective investigation; registered at days 3, 10, 30, 120 • poor compliance with oral supplement → no issue in this study, since all patients received oral nutritional supplementation while hospitalized, none had mental impairment **Author's Conclusion:** The comprehensive balanced nutrition supplement resulted in lower complication rates and mortality at 120 days postoperatively.		

Outcome measures/results	• Nutritional status: SGA
	• Anthropometric measurements: arm muscle circumference, triceps skinfold thickness, BMI
	• blood samples: Serum protein (albumin, transthyretin), total lymphocyte count
			• Median age: 78 years CG vs. 84 years IG; no differences in age, gender comorbidities, living conditions, hip fracture type, time to surgery to trauma; no perioperative differences in signs of PEM; mean stay: 12,5 days
			• SGA: 9% of patients abnormal values (indicating PEM); tree or more abnormal nutritional parameters (PEM) in 38% in the IG and 33% in the CG; 1-2 abnormal nutritional parameters in 60% IG and 58% CG
			1/3 of patients were PEM
			• Energy and fluid intake:
			  ▪ Energy: CG: 54% Energy vs. IG 85%
			  ▪ Fluid: CG 64% fluid of optimal intake vs. IG 101%
			  ▪ Average daily intake (kcal; ml)
			first 3 days: CG 665 kcal vs. IG 1468 kcal (p=0.001); CG 1704 ml vs. IG 2358 ml (p=0.04)
			Days 1-10: CG 916 kcal vs. IG 1296 kcal/day (P=0.003); CG 1300 ml vs. IG1856 ml (p=0.0001)
			• Hip-fracture complications: greater in control group (70%) vs. Intervention (15%; p<0.0001); within 30 days: 33 complications

		CG and 6 IG (p<0.0001); no difference of risk PEM-patients vs. no-PEM-patients • Cumulative number of infections greater in CG than in IG at days 10, 30, 120; for example: wound infection CG 12 vs. IG 2 patients within 30 days from surgery (p=0.006) • No differences: serum parameters (decrease both groups day 10; increase to higher levels day 30 • Overall mortality 1% (within 30 days); 5% within 4 months; 4 patients died in CG within 70 days

Recommendation 46

Nutritional interventions in geriatric patients after hip fracture and orthopedic surgery shall be part of an individually tailored, multidimensional and multidisciplinary team intervention in order to ensure adequate dietary intake, improve clinical outcomes and maintain quality of life. (BM, PC)

Grade of recommendation A – strong consensus (100 % agreement)

58.	**Lundström M, Olofsson B, Stenvall M, Karlsson S, Nyberg L, Englund U, et al. Postoperative delirium in old patients with femoral neck fracture: a randomized intervention study. Aging clinical and experimental research. 2007;19(3):178-86.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** Sweden ***Centers:*** University Hospital in Umeå ***Setting:*** n/a ***Funding Sources:*** Vardal Foundation, Joint Committee of the Northern Health Region of Sweden, JC Kempe Memorial Foundation, Foundation of the Medical Faculty, University of Umeå, County Council of Västerbotten ("Dagmar", "FoU" and "Äldre centrum Västerbotten") and Swedish Research Council, Grant K2005-27VX-15357-01A. ***Dropout rates:*** 0 % ***Study limitations:*** psychiatric symptoms and	**Total no. Patients:** n=199 **Inclusion criteria:** age ≥ 70 yrs.; femoral neck fracture **Exclusion criteria:** age under 70, severe rheumatoid arthritis, severe hip osteoarthritis, severe renal failure, pathological fracture, and patients who were bedridden before the fracture due to the operation methods that were planned to be used in the study.	Intervention: Special care in a geriatric ward, applying a comprehensive geriatric assessment including a multidisciplinary team, individual care planning, assessment of delirium, bowel/bladder function, sleep apnoea, decubitus ulcers, pain, saturation, body temperature, blood pressure, nutrition, as well as rehabilitation and secondary preventions of falls and fractures and osteoporosis prophylaxis. Control: Conventional care in the orthopedic department

	cognitive testing of patients was only carried out on one occasion during hospitalization		
Notes	**Author's Conclusion:** postoperative delirium can be successfully treated by a team applying comprehensive geriatric assessment, management and rehabilitation. It seems that successful intervention programs must include all aspects of good medical and nursing care, and the total effect of the multi-factorial intervention program is without doubt greater than the sum of its separate parts.		
Outcome measures/results	Primary outcome measures: number of days of postoperative delirium tested by Mini Mental State Examination (MMSE), Organic Brain Symptom Scale (OBS) and Geriatric Depression Scale (GDS-15). Secondary outcome measures: Secondary outcome measures were complications during hospitalization, length of stay, and in-hospital and one-year mortality.		The number of days with postoperative delirium among intervention patients were fewer (5.0±7.1 days. Intervention patients additionally had delirium postoperatively, seven days postoperatively and at the day of discharge. Intervention patients suffered from fewer complications, such as decubitus ulcers, urinary tract infections, nutritional complications, sleeping problems and falls, than controls. Total postoperative hospitalization was shorter in the intervention ward (28.0±17.9 days vs 38.0±40.6 days, p=0.028).

59.	**Olofsson B, Stenvall M, Lundstrom M, Svensson O, Gustafson Y. Malnutrition in hip fracture patients: an intervention study. Journal of clinical nursing. 2007;16(11):2027-38.**
	➔ **See number 24**

60.	**Stenvall M, Olofsson B, Lundstrom M, Englund U, Borssen B, Svensson O, et al. A multidisciplinary, multifactorial intervention program reduces postoperative falls and injuries after femoral neck fracture. Osteoporosis international: a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA. 2007;18(2):167-75.**
	➔ **See number 25**

61.	**Stenvall M, Olofsson B, Nyberg L, Lundstrom M, Gustafson Y. Improved performance in activities of daily living and mobility after a multidisciplinary postoperative rehabilitation in older people with femoral neck fracture: a randomized controlled trial with 1-year follow-up. Journal of rehabilitation medicine. 2007;39(3):232-8.**
	➔ **See number 26**

62.	Li HJ, Cheng HS, Liang J, Wu CC, Shyu YIL. Functional recovery of older people with hip fracture: does malnutrition make a difference? Journal of advanced nursing. 2013;69(8):1691-703.		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** Taiwan ***Centers:*** n/a ***Setting:*** trauma ward ***Funding Sources:*** Grant no. NHRI-EX92–9023PL from the National Health Research Institute in Taiwan ***Dropout rates:*** 25 % ***Study limitations:*** single-blinded design, large lost-tp-follow-up number, long time between data collection and data analysis	**Total no. Patients:** n=162 **Inclusion criteria:** 60 years or older; non-pathologic, accidental single-side hip fracture; hip arthroplasty or internal fixation; able to perform a full range of motion against gravity and against some (or full) resistance prior to the hip fracture; Chinese Barthel Index score >70 before the hip fracture; living in northern Taiwan **Exclusion criteria:**severe cognitive impairment; terminally ill	<u>Experimental group:</u> An interdisciplinary three-component community-based intervention program in-hospital and 3-month postdischarge rehabilitation was provided by geriatric nurses, a physical therapist, and a geriatrician. Geriatric Consultation: provision of a comprehensive geriatric assessment and medical supervision to detect potential medical and functional problems and to decrease delays before surgery Rehabilitation program: provision of early postoperative physical rehabilitation to facilitate mobility and plan for hospital discharge, with rehabilitation in the patient's usual environment (home visits). Discharge planning: conducted by a geriatric nurse <u>Control group:</u> Routine care from the hospital
Notes	Analysis of <u>four</u> groups: malnourished experimental, malnourished control, non-malnourished experimental, and the non-malnourished control group. **Author's Conclusion:** Healthcare providers should develop a nutritional assessment management system in their interdisciplinary intervention program to improve the functional recovery of older people with hip fracture.		

Outcome measures/results	Nutritional status (via Mini Nutritional Assessment, MNA); Physical function (via Chinese Barthel Index, CBI); Instrumental fuction (via the Chinese version of Lawton and Brody's instrumental activities of daily living, IADL)	The recovery rate of ADL and walking ability in the malnourished control group was the worst and the recovery rate in the non-malnourished experimental group was the best at 3, 6, and 12 months following hospital discharge. The recovery rate of ADL in the malnourished experimental group was higher than in the non-malnourished control group at 1 and 3 months postdischarge. At 6 and 12 months postdischarge, the recovery rate of ADL in the non-malnourished control group was higher than in the malnourished experimental group. The recovery rate of walking ability in the malnourished experimental group was higher than in the non-malnourished control group at 1, 3, and 6 months postdischarge. At month 12, the recovery rate of walking ability in the non-malnourished control group was higher than in the malnourished experimental group. The intervention is more effective on the performance of activities of daily living and recovery of walking ability in malnourished patients than in non-malnourished patients.

63.	**Shyu Y-IL, Liang J, Tseng M-Y, Li H-J, Wu C-C, Cheng H-S, et al. Comprehensive and subacute care interventions improve health-related quality of life for older patients after surgery for hip fracture: a randomised controlled trial. International journal of nursing studies. 2013;50(8):1013-24.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** Taiwan ***Centers:*** n/a ***Setting:*** n/a	**Total no. Patients:** n=299 **Inclusion criteria:** > 60 years; admitted to hospital for an accidental first-time, single-side, simple femoral neck fracture, intertrochanteric, or subtrochanteric hip fracture; receiving hip arthroplasty or internal fixation; ability to perform full range of motion against gravity and against some or full resistance of the	<u>Subacute care group (n= 101):</u> Comprehensive geriatric assessment and medical supervision, rehabilitation started on the first day after surgery and was continued at home, discharge planning <u>Comprehensive care group (n= 99):</u> Components of the interdisciplinary care model, as well as nutrition consultation, depression management, and fall prevention <u>Usual care group (n = 99):</u> Teaching of exercices by nurses during the first 2-3 days after surgery, physiotherapy usually starting on the third day after surgery, no home

	Funding Sources: National Health Research Institute, Taiwan (grant number: NHRI-EX98-9404PI). ***Dropout rates:*** 10 % ***Study limitations:*** single blinded study, sample section bias	unaffected limb as assessed by a research nurse; self-reported to have a prefracture Chinese Barthel Index (CBI) score >70; admission from a home setting, and; living in northern Taiwan. **Exclusion criteria:** severely cognitively impaired and completely unable to follow orders; inability to communicate; terminal illness; admission from a nursing home	rehsabilitation
Notes	**Author's Conclusion:** Both comprehensive care and subacute care programmes may improve health outcomes of elders with hip fracture.		
Outcome measures/results	Health-related quality of life by SF-36 (consisting of 36 items representing eight generic health concepts)		The comprehensive care group and subacute care group had significantly better physical functioning than the usual care group. The comprehensive care and subacute care groups had better role physical than the usual care group from 3 to 12 months following discharge. The comprehensive care group had better general health than the usual care group at 12 months following discharge.

64.	**Shyu Y-IL, Liang J, Tseng M-Y, Li H-J, Wu C-C, Cheng H-S, et al. Enhanced interdisciplinary care improves self-care ability and decreases emergency department visits for older Taiwanese patients over 2 years after hip-fracture surgery: A randomised controlled trial. International journal of nursing studies. 2016;56:54-62.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** Taiwan ***Centers:*** n/a ***Setting:*** n/a	**Total no. Patients:** n=299 **Inclusion criteria:** > 60 years; admitted to hospital for an accidental first-time, single-side, simple femoral neck fracture,	Interdisciplinary care group (n= 101): Comprehensive geriatric assessment and medical supervision, rehabilitation started on the first day after surgery and was continued at home, discharge planning

	Funding Sources: National Health Research Institute, Taiwan (grant number: NHRI-EX98-9404PI). ***Dropout rates:*** 10 % ***Study limitations:*** single blinded study, sample section bias	intertrochanteric, or subtrochanteric hip fracture; receiving hip arthroplasty or internal fixation; ability to perform full range of motion against gravity and against some or full resistance of the unaffected limb as assessed by a research nurse; self-reported to have a prefracture Chinese Barthel Index (CBI) score >70; admission from a home setting, and; living in northern Taiwan. **Exclusion criteria:** severely cognitively impaired and completely unable to follow orders; inability to communicate; terminal illness; admission from a nursing home	<u>Comprehensive care group (n= 99):</u> Components of the interdisciplinary care model, as well as nutrition consultation, depression management, and fall prevention <u>Usual care group (n = 99):</u> Teaching of exercices by nurses during the first 2-3 days after surgery, physiotherapy usually starting on the third day after surgery, no home rehsabilitation
Notes	**Author's Conclusion:** Our comprehensive care programme, which integrated interdisciplinary care components (geriatric hip-fracture assessment, rehabilitation and discharge-support) with interventions to manage nutrition, prevent falls, and manage depression, enhanced the self-care ability and decreased emergency department visits for older persons well beyond the first 12 months following hip-fracture surgery. These results reinforce the rationale for offering comprehensive care.		
Outcome measures/results	Self-care ability was measured in terms of performance of activities of daily living (ADLs) and instrumental ADLs (IADLs). ADL performance was assessed using the Chinese Barthel Index (CBI) and IADL performance was measured by the Chinese version of a measure for instrumental IADLs, data on health care use including hospital readmission		Relative to usual care, those who received comprehensive care had a higher mean CBI. The level of CBI and its rates of change did not differ between usual care and interdisciplinary care. Participants in the comprehensive care group were less likely than those in the usual care group to visit the emergency department during the 24 months after discharge. The three care groups did not differ significantly in hospital readmissions. The three groups did not differ in mortality during the 2-year follow-up.

65.	Shyu Y-IL, Liang J, Tseng M-Y, Li H-J, Wu C-C, Cheng H-S, et al. Comprehensive care improves health outcomes among elderly Taiwanese patients with hip fracture. Journals of Gerontology Series A: Biomedical Sciences and Medical Sciences. 2012;68(2):188-97.		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** Taiwan ***Centers:*** n/a ***Setting:*** n/a ***Funding Sources:*** National Health Research Institute, Taiwan (grant number: NHRI-EX98-9404PI). ***Dropout rates:*** 10 % ***Study limitations:*** single blinded study, sample section bias	**Total no. Patients:** n=299 **Inclusion criteria:** > 60 years; admitted to hospital for an accidental first-time, single-side, simple femoral neck fracture, intertrochanteric, or subtrochanteric hip fracture; receiving hip arthroplasty or internal fixation; ability to perform full range of motion against gravity and against some or full resistance of the unaffected limb as assessed by a research nurse; self-reported to have a prefracture Chinese Barthel Index (CBI) score >70; admission from a home setting, and; living in northern Taiwan. **Exclusion criteria:** severely cognitively impaired and completely unable to follow orders; inability to communicate; terminal illness; admission from a nursing home	<u>Interdisciplinary care group (n= 101):</u> Comprehensive geriatric assessment and medical supervision, rehabilitation started on the first day after surgery and was continued at home, discharge planning <u>Comprehensive care group (n= 99):</u> Components of the interdisciplinary care model, as well as nutrition consultation, depression management, and fall prevention <u>Usual care group (n = 99):</u> Teaching of exercices by nurses during the first 2-3 days after surgery, physiotherapy usually starting on the third day after surgery, no home rehsabilitation
Notes	**Author's Conclusion:** A comprehensive care program with nutrition consultation, depression management, and fall prevention along with interdisciplinary care components (geriatric hip-fracture assessment and rehabilitation and discharge support) appeared to be more		

	beneficial than only interdisciplinary care for older persons with hip fracture in Taiwan.	
Outcome measures/results	Self-care ability (CBI), depressive symptoms (Geriatric Depression Scale short form, GDS-s), nutritional status by Mini Nutritional Assessment (MNA), frequency and duration of exercises, occurrence of falls, visits to the hospital and emergency rooms	The comprehensive care group had 3.19 times greater likelihood than the usual care group of recovering complete independence in ADL. The probability of recovery in ADL independence increased more rapidly for both the comprehensive care and interdisciplinary care groups than for the usual care group during the first 6 mo. However, from 6 to 12 months, the ADL recovery rate gradually declined for the comprehensive care and interdisciplinary care groups, whereas the recovery rate of the usual care group was more stable. Risk of malnutrition was consistently lower for the comprehensive care group than for the interdisciplinary and usual care groups. The risk of depression was lower for the comprehensive care group. The three groups did not differ significantly in their trajectories for subsequent falls.

66.	**Tseng M-Y, Liang J, Shyu Y-IL, Wu C-C, Cheng H-S, Chen C-Y, et al. Effects of interventions on trajectories of health-related quality of life among older patients with hip fracture: a prospective randomized controlled trial. BMC musculoskeletal disorders. 2016;17(1):114.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** Taiwan ***Centers:*** medical center in northern Taiwan ***Setting:*** n/a	**Total no. Patients:** n = 281 **Inclusion criteria:** ≥ 60 years old; hospitalized for an accidental first time, single-side simple hip fracture and receiving hip arthroplasty or internal fixation; with a pre-fracture Chinese Barthel Index (CBI) score >70 at admission and able to perform full range of motion against gravity and against some or full resistance with the unaffected lim; living in northern Taiwan.	Three treatment care models: • Interdisciplinary care (n = 97) consisted of geriatric consultation, discharge planning, and 4 months of in-home rehabilitation. • Comprehensive care (n = 91) consisted of interdisciplinary care plus management of malnutrition and depressive symptoms, fall prevention, and 12 months of in-home rehabilitation. • Usual care (n = 93) included only in-hospital rehabilitation and occasional discharge planning, without geriatric consultation and in-home rehabilitation.

	Funding Sources: National Health Research Institutes, Taiwan, Healthy Aging Research Center, Chang Gung University, Chang Gung Medical Foundation ***Dropout rates:*** ***Study limitations:*** The generalizability of the findings are limited to older patients with hip fracture, but without severe cognitive impairment and relatively independent in pre-fracture performance of ADLs due to our sample inclusion criteria. The study was single blinded; only subjects and families were blinded to the interventions. HRQoL was not assessed at baseline, making it difficult to explore the intervention effects more completely. The sample size estimated might not support the current hypotheses.	**Exclusion criteria:** Severely cognitively impaired and completely unable to follow orders determined by a score <10 on the Chinese Mini-Mental State Examination; terminally ill	
Notes	**Author's Conclusion:** The interdisciplinary and comprehensive care models improved recovery from hip fracture by increasing subjects' odds for following a trajectory of good physical functioning after hospitalization.		
Outcome	• Mental and physical Health-related quality of life		We identified three quadratic PCS trajectories: poor PCS (n = 103, 36.6

measures/results	(HRQoL) were measured at 1, 3, 6, and 12 months after discharge by the physical component summary scale (PCS) and mental component summary scale (MCS), respectively, of the Medical Outcomes Study Short Form 36, Taiwan version. • Pre-fracture ADL performance was retrospectively assessed using the Chinese Barthel Index (CBI) before randomization and before hip-fracture surgery.	%), moderate PCS (n = 96, 34.2 %), and good PCS (n = 82, 29.2 %). In contrast, we found three linear MCS trajectories: poor MCS (n = 39, 13.9 %), moderate MCS (n = 84, 29.9 %), and good MCS (n = 158, 56.2 %). Subjects in the comprehensive care and interdisciplinary care groups were more likely to experience a good PCS trajectory (b = 0.99, odds ratio [OR] = 2.69, confidence interval [CI] = 7.24–1.00, p = 0.049, and b = 1.32, OR = 3.75, CI = 10.53–1.33, p = 0.012, respectively) than those who received usual care. However, neither care model improved MCS.

67.	**Singh NA, Quine S, Clemson LM, Williams EJ, Williamson DA, Stavrinos TM, et al. Effects of high-intensity progressive resistance training and targeted multidisciplinary treatment of frailty on mortality and nursing home admissions after hip fracture: a randomized controlled trial. Journal of the American Medical Directors Association. 2012;13(1):24-30.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1++	***Countries:*** Australia ***Centers:*** Exercise Health and Performance Research Group, Faculty of Health Sciences, University of Sydney ***Setting:*** Outpatient clinic ***Funding Sources:*** Australian National Health and Medical Research Council ***Dropout rates:*** 1.04% ***Study limitations:*** smaller than planned sample size owing to funding reductions and fewer than expected hip fractures in Australia during the	**Total no. Patients:** 124 **Inclusion criteria:** age older than 55 years and sufficient cognitive ability and English-language skills sufficient to understand the informed consent process **Exclusion criteria:** terminal illness, pathological fracture, no surgical repair, or geographical distance precluding participation	Twelve months of geriatrician-supervised high-intensity weight-lifting exercise and targeted treatment of balance, osteoporosis, nutrition, vitamin D/calcium, depression, cognition, vision, home safety, polypharmacy, hip protectors, self-efficacy, and social support.

	recruitment period, not possible to state which intervention components were responsible for beneficial outcomes, as the study was intentionally not designed to evaluate the individual effects of each treatment arm		
Notes	**Author's Conclusion:** The HIPFIT intervention reduced mortality, nursing home admissions, and ADL dependency compared with usual care.		
Outcome measures/results	Functional independence: mortality, nursing home admissions, basic and instrumental activities of daily living (ADLs/IADLs), and assistive device utilization.		Risk of death was reduced by 81% (age-adjusted OR [95% CI] = 0.19 [0.04-0.91]; P < .04) in the HIPFIT group (n = 4) compared with usual care controls (n = 8). Nursing home admissions were reduced by 84% (age-adjusted OR [95% CI] = 0.16 [0.04-0.64]; P < .01) in the experimental group (n = 5) compared with controls (n = 12). Basic ADLs declined less (P < .0001) and assistive device use was significantly lower at 12 months (P = .02) in the intervention group compared with controls. The targeted improvements in upper body strength, nutrition, depressive symptoms, vision, balance, cognition, self-efficacy, and habitual activity level were all related to ADL improvements (P < .0001-.02), and improvements in basic ADLs, vision, and walking endurance were associated with reduced nursing home use (P < .0001-.05).

III.2 Should older patients with delirium or at risk of delirium be offered nutritional support?

<u>Recommendation 47</u>

All older patients hospitalized to have urgent surgery shall receive a multi-component non-pharmacological intervention that includes hydration and nutrition management in order to prevent delirium. (BM)

Grade of recommendation A – strong consensus (100 % agreement)

<u>Recommendation 48</u>

All older patients admitted to a medical ward at moderate to high risk of delirium shall receive a multi-component non-pharmacological intervention that includes hydration and nutrition management in order to prevent delirium. (BM)

Grade of recommendation A – strong consensus (95 % agreement)

68.	**Abraha I, Trotta F, Rimland JM, Cruz-Jentoft A, Lozano-Montoya I, Soiza RL, et al. Efficacy of Non-Pharmacological Interventions to Prevent and Treat Delirium in Older Patients: A Systematic Overview. The SENATOR project ONTOP Series. PloS one. 2015;10(6):e0123090.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Systematic overview of systematic reviews 1-	***Countries:*** n/a ***Centers:*** n/a ***Setting:*** surgical setting, medical departments, hospitalized patients, post-acute care facilities ***Funding Sources:*** work is part of ONTOP project, a workpackage of a European Union funded	**Total no. studies:** n=24 systematic reviews with 31 primary studies **Inclusion criteria:** experimental comparative study (randomized/non-randomized) from the included systematic reviews/meta-analysis with non-pharmacological intervention for prevention or treatment delirium **Exclusion criteria:** other language than English, Italian or Spanish, primary study which were observational or before-	Non-pharmacological intervention to treat or prevent delirium - Multicomponent interventions - Single component intervention Earplugs, eye masks, educational stuff, multidisciplinary team, use of sitter, family support, ortho-geriatric consultation, pharmacological and non-pharmacological, supportive reorientation, thromboprophylaxis, anesthesia, analgesia, surgical fixation of fractures, nutritional status, mobilization, rehabilitation, daily proactive geriatrics consultation

	FP7 research named SENATOR; none of the included SRs sponsored by a company, 6 funded by a governmental institution or non-profit organization ***Dropout rates:*** n/a ***Study limitations:*** all studies suffered from performance bias (no blinding), heterogeneity of the studies, arbitrary age cut-off, lack of assessment of cost-effectiveness	after studies with historical controls	
Notes	• AMSTAR criteria: 12 reviews moderate quality, 3 high quality • Identification of important and critical outcomes; only results of critical outcomes presented • Assessment of risk of bias (included primary studies): using criteria from Cochrane Collaboration (low/high/unclear risk) • Quality of evidence assessed with GRADE (high/moderate/low/very low) based on judgements for the primary outcome • Heterogeneous reviews: in addition to intervention → some evaluated pathogenesis, role of sitters, diagnosis of delirium, etc.) • Categorization of the studies by design, provision of intervention, setting and risk of bias **Author's Conclusion:** In older patients multi-component non-pharmacological interventions as well as some single-components intervention were effective in preventing delirium but not to treat delirium.		
Outcome measures/results	• Delirium incidence (critical outcome) • Delirium improvement (Delirium treatment, delirium resolution/reduction in its severity; critical outcome) • Functional status (degree of functional autonomy; critical outcome)		• Multicomponent non-pharmacological interventions significantly reduced incidence of delirium in surgical wards by 29% (RR 0.71, 95% CI 0.59 to 0.86) Combining former results with single CCT (similar characteristics): results which remained statistically significant with no change in heterogeneity (RR 0.71, 95%CI 0.60 to 0.84) • No evidence supporting efficacy of the non-pharmacological interventions to prevent delirium in low risk populations (RR 1.75, 95% CI 0.50 to 6.10) • Single component intervention: staff education (RR 0.50, 95% CI 0.26 to 0.96), reorientation protocol in ICU (delirium sig. lower in

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		intervention group; RR 0.63, 95% CI 0.26 to 0.96), Geriatric Risk Assessment MedGuide software ((HR 0.42, 95%CI 0.14 to 4.00)) were effective in preventing delirium • Patients who developed delirium: no evidence of efficacy of multicomponent non-pharmacological interventions to treat delirium • Pooled data across studies with patients received orthopedic surgery: meta-analysis statistically significant result in favor of the multicomponent interventions (RR 0.57, 95% CI 0.39 to 0.85; p=0.25) • Functional status: n=2 studies, Barthel Index score; results not statistically significant • Post-acute care facilities: nursing facilities, better identification of delirium but ineffective at reducing delirium

69.	**National Clinical Guideline Centre. Delirium: prevention, diagnosis and management. London: National Institute for Health and Care Excellence. 2010.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Clinical guideline 1++	***Countries:*** n/a ***Centers:*** n/a ***Setting:*** n/a ***Funding Sources:*** National Institute for Health and Care Excellence ***Dropout rates:*** n/a ***Study limitations:*** n/a	**Total no. Patients:** n/a **Inclusion criteria:** n/a **Exclusion criteria:** n/a	n/a
Notes	**Author's Conclusion:** Treatment and care should take into account people's needs and preferences. People with delirium or at risk of delirium should have the opportunity to make informed decisions about their care and treatment, in partnership with their healthcare professionals.		
Relevant	• Ensure that people at risk of delirium are cared for by a team of healthcare professionals who are familiar to the person at risk.		

recommendations/ statements	Avoid moving people within and between wards or rooms unless absolutely necessary. • Give a tailored multicomponent intervention package: – Within 24 hours of admission, assess people at risk for clinical factors contributing to delirium. – Based on the results of this assessment, provide a multicomponent intervention tailored to the person's individual needs and care setting • The tailored multicomponent intervention package should be delivered by a multidisciplinary team trained and competent in delirium prevention.

70.	**Guy's and St Thomas NHS Foundation Trust. Clinical Guideline: The Prevention, Recognition and Management of Delirium in Adult In-Patients. Guy's and St Thomas NHS Foundation Trust. 2011.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Guideline 2+	***Countries:*** n/a ***Centers:*** n/a ***Setting:*** n/a ***Funding Sources:*** n/a ***Dropout rates:*** n/a ***Study limitations:*** n/a	**Total no. Patients:** n/a **Inclusion criteria:** n/a **Exclusion criteria:** n/a	n/a
Notes	**Author's Conclusion:** Management should be patient centered, giving patients the opportunity to make informed decisions about their health care and taking into account the individuals needs and wishes. Often patients with delirium lack capacity for some decisions. If this is the case, the code of practice detailed in Mental Capacity Act should be followed (see www.publicguardian.gov.uk or trust link http://gti/clinical/assurance/clinicalgovernance/mentalcapacityact/mentalcapacityact.aspx for more information). Good communication between members of the team caring for the patient is vital. Written communication should be clear and appropriately detailed. Family and carers should have the opportunity to be involved in treatment strategies.		
Relevant recommendations/ statements	Delirium Prevention: Preventing delirium is the most effective strategy for reducing its frequency and complications. Up to one third of cases have been shown to be preventable. Patients found to be at risk of delirium should be assessed for clinical factors that may contribute to delirium within 24 hours of admission. Following the multi-component do's and don'ts intervention package listed in table 5.1 (see original document) will provide a framework prevent delirium and interventions should be tailored suit individual's needs. Those highlighted in bold are specifically endorsed by NICE.		
71.	**Registered Nurses Association of Ontario (2004). Caregiving Strategies for Older Adults with Delirium, Dementia and Depression. Toronto, Canada:**		

Registered Nurses Association of Ontario. 2004.			
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Nursing Best Practice Guideline 1+	***Countries:*** n/a ***Centers:*** n/a ***Setting:*** n/a ***Funding Sources:*** Ministry of Health and Long-Term Care (MOHLTC) ***Dropout rates:*** n/a ***Study limitations:*** n/a	**Total no. Patients:** n/a **Inclusion criteria:** n/a **Exclusion criteria:** n/a	n/a
Notes	**Author's Conclusion:** Studies suggest that not all cases are preventable. Selected risk factors lend themselves to intervention to prevent delirium in clients who are at high risk. Prevention strategies often happen almost concurrently with screening and must address both the contributing factors as well as the presenting behavior.		
Relevant recommendations/ statements	Nurses should maintain a high index of suspicion for the prevention, early recognition and urgent treatment of delirium to support positive outcomes. Nurses should use the diagnostic criteria from the Diagnostic and Statistical Manual (DSM) IV-R to assess for delirium, and document mental status observations of hypoactive and hyperactive delirium. Nurses should initiate standardized screening methods to identify risk factors for delirium on initial and ongoing assessments. Nurses have a role in prevention of delirium and should target prevention efforts to the client's individual risk factors. In order to target the individual root causes of delirium, nurses working with other disciplines must select and record multi-component care strategies and implement them simultaneously to prevent delirium. Nurses must monitor, evaluate, and modify the multi-component intervention strategies on an ongoing basis to address the fluctuating course associated with delirium.		

III.3 Should older patients with depression be offered nutritional support?

<u>Recommendation 51</u>

Older patients with depression might NOT routinely receive nutritional interventions unless they are malnourished or at risk of malnutrition (BM)

Grade of recommendation 0 – strong consensus (100 % agreement)

72.	**Gariballa S, Forster S. Effects of dietary supplements on depressive symptoms in older patients: a randomised double-blind placebo-controlled trial. Clinical nutrition (Edinburgh, Scotland). 2007;26(5):545-51.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** n/a ***Centers:*** n/a (single-center) ***Setting:*** hospitalization at home after discharge ***Funding Sources:*** Health Foundation project grant ***Dropout rates:*** 49% (n=220); PG 46% (n=102); IG 52% (n=117) ***Study limitations:*** no exclusion possible that decrease in depressive symptoms as a result of ONS is a chance finding, follow-up assessments only carried out on a sub-sample, inclusion criteria represents a better-nourished group of patients	**Total no. Patients:** n=445; n=225 responded to follow-up **Inclusion criteria:** actually ill, ≥65 years, stable medical condition, able to swallow, able to sign written informed consent **Exclusion criteria:** severe medical or psychiatric illness, dementia (abbreviated metal test <6), malignancy, living in institution, already on supplements	1) Normal hospital diet + placebo (PG; n=222; after 6 months follow-up n=119): placebo was identical to supplement but contained no protein or micronutrients and minimum calorie content (60 kcal) 2) Normal hospital diet + 400 mL oral nutritional supplements (IG; n=223; after 6 months follow-up n=106): ONS=995 kcal, 100% of reference Nutrient Intakes for a healthy old person for vitamins and minerals ➔ Daily for 6 weeks (entirely in hospital or continued in the community for patients discharged earlier than 6 weeks

Notes	• Double blind, prospective, randomized, placebo-controlled single-center trail • Placebo and supplements and other commercially available food supplement were piloted in 15 volunteers (no packaging, all flavors tested for both • Non-responder to follow-up: significantly more female (p=0.016) and older (p=0.011) • Details of clinical and nutritional status assessments and blood sampling and analysis have been published previously **Author's Conclusion:** Oral nutritional supplementation of hospitalized acutely ill older patients led to a statistically significant benefit on depressive symptoms.	
Outcome measures/results	• Outcome measures 6 weeks and 5 months changes in: nutritional status depressive symptoms: geriatric depression questionnaire (GDS) cognitive state: abbreviated mental test questionnaire (AMT) • Dietary intakes: measured using validated food diary, left over supplements were measured	• No statistically significant differences between IG and PG at 6 months follow up: body weight, BMI, MUAC, TSF, transferring • Serum albumin: significant increase in IG • Significant increase in red-cell folate and plasma vitamin B12 concentrations (IG) and decrease in PG • Significant differences in symptoms of depression scores in the IG compared with PG at 6 months (p= 0.021 between group differences) • Effect of the supplement was seen in all patient groups including those with no symptoms of depression, mild depression and severe depression (p=0.007) • No difference in cognitive function scores at 6 months

73.	**Feldblum I, German L, Castel H, Harman-Boehm I, Shahar DR. Individualized nutritional intervention during and after hospitalization: the nutrition intervention study clinical trial. Journal of the American Geriatrics Society. 2011;59(1):10-7.**
	➔ **See number 14**

III.4 Should older patients with or at risk of pressure ulcers be offered nutritional support?

Recommendation 52

Nutritional interventions should be offered to older patients at risk of pressure ulcers in order to prevent the development of pressure ulcers.

Grade of recommendation B – strong consensus (100 % agreement)

Recommendation 53

Nutritional interventions should be offered to malnourished older patients with pressure ulcers to improve healing.

Grade of recommendation B – strong consensus (100 % agreement)

74.	**Lozano-Montoya I, Velez-Diaz-Pallares M, Abraha I, Cherubini A, Soiza RL, O'Mahony D, et al. Nonpharmacologic Interventions to Prevent Pressure Ulcers in Older Patients: An Overview of Systematic Reviews (The Software ENgine for the Assessment and optimization of drug and non-drug Therapy in Older peRsons [SENATOR] Definition of Optimal Evidence-Based Non-drug Therapies in Older People [ONTOP] Series). Journal of the American Medical Directors Association. 2016;17(4):370.e1-10.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Systematic Review 1+	***Countries:*** Spain ***Centers:*** n/a ***Setting:*** different care settings ***Funding Sources:*** the European Union Seventh Framework Program ***Dropout rates:*** n/a	**Total no. Studies:** 65 **Inclusion criteria:** The included SRs were examined to identify any experimental comparative study, either randomized or nonrandomized, that investigated any nonpharmacological interventions to prevent PUs in older patients (65 years of age or over). **Exclusion criteria:** Primary studies were excluded if they were observational studies or before-after (BA) studies with	Any nonpharmacological interventions to prevent PUs in older patients (65 years of age or over)

	Study limitations: Limitations of this study include the potential skipping of some primary studies (such as recently published primary studies that are not listed in systematic reviews and published trials on PU prevention that differ in their terminology), the omission of some original manuscripts from old journals (i.e., over 35 years ago, even when all attempts to get them from authors were made), the large heterogeneity of the trials for some interventions (precluding proper comparisons), the wide range of time of the listed studies (more than 30 years, with potential relevant changes in standards of care), and the inability to separate, in some trials, results specific for PUs from a minority of non- PUs.	historical controls. Conference proceedings or program abstracts were also excluded. Studies were also excluded when the mean age of participants was under 65 years, when they addressed patients with nonpressure-related ulcers (such as venous or diabetic foot ulcers), studies of ulcers because of immobilization in patients with neurologic disorders or spinal cord injury, or exclusively considered patients admitted in intensive care or palliative care units. Studies using individual vitamins or micronutrients were excluded, as these were considered a pharmacologic intervention.	
Notes	**Author's Conclusion:** In older patients at high risk to suffer PUs, high-technology and low- technology support surfaces can significantly reduce the incidence of PUs. Nutrition intervention may also have a role in preventing PUs in hospital settings. More evidence is needed to support other recommendations, which is specially lacking for repositioning.		

Outcome measures/results	Rates of incidence of new Pus was used as the outcome measure, as recommended by a panel of independent experts. Other important outcomes were only used occasionally as secondary outcomes in some trials, and some "hard" outcomes (mortality, readmissions, cost) were not considered.	One hundred ten SRs with 65 primary studies satisfied the inclusion criteria. The most frequent interventions explored in these trials were support surfaces (41 studies), repositioning (8), and nutrition interventions (5). High quality of evidence was not found for any intervention, mainly because of a high risk of bias and imprecision. There is moderate quality evidence to support the use of alternating pressure support mattresses over usual hospital mattresses in medical and surgical inpatients, low quality evidence to support constant low pressure devices and Australian medical sheepskin over usual mattresses, and very low quality evidence to support nutrition interventions in hospital settings. No recommendations on hydration, repositioning, standardized risk assessment, or multicomponent interventions can be done.

75.	**Velez-Diaz-Pallares M, Lozano-Montoya I, Abraha I, Cherubini A, Soiza RL, O'Mahony D, et al. Nonpharmacologic Interventions to Heal Pressure Ulcers in Older Patients: An Overview of Systematic Reviews (The SENATOR-ONTOP Series). Journal of the American Medical Directors Association. 2015;16(6):448-69.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Systematic Review 1+	***Countries:*** Spain, Italy, UK, Ireland ***Centers:*** Hospital Universitario Ramón y Cajal, Madrid; Italian National Research Center in Aging, Ancona; NHS Grampian, Aberdeen; University College Cork ***Setting:*** n/a ***Funding Sources:*** European Union Seventh Framework Program ***Dropout rates:*** 0%	**Total no. Studies:** 110 **Inclusion criteria:** randomized or nonrandomized studies, that investigated any nonpharmacologic intervention to treat PUs in older patients (65 or older) **Exclusion criteria:** observational studies, mean age of participants under 65 years, patients with nonpressure-related ulcers,	The most frequent interventions explored in the trials were support surfaces (13 Studies), nutrition (8), and electrotherapy (6).

	Study limitations: High or moderate quality of evidence was found in none of the interventions, mainly because of the very serious risk of bias of most studies and imprecision in the treatment effect.	studies of sacral ulcers attributable to immobilization in patients with neurologic disorders or spinal cord injury, studies considering usual PU treatment, biophysical agents, growth factors or surgery, studies considering exclusively patients admitted in intensive care or palliative care	
Notes	**Author's Conclusion:** In older patients with PUs, evidence to use any nonpharmacological therapy to increase the rates of wound healing is inconclusive, except for low quality evidence that supports the use of electrotherapy. This situation is especially alarming for interventions that are usually standard clinical practice (repositioning, support surfaces). Although there is some evidence in younger populations and other types of ulcers, studies in older populations with PUs using sound methodology are needed.		
Outcome measures/results	• Complete ulcer healing • Reduction of pain • Time to complete wound (ulcer) healing • Quality of life • Reduction of wound size • Length of hospital stay • Admission to care homes • Lower incidence of infections or use of antibiotic therapy • Nursing time used in wound care • In hospital mortality • Costs of hospital admission • Hospital readmission in a given time after discharge		One hundred ten SRs with 45 primary studies satisfied the inclusion criteria. The most frequent interventions explored in these trials were support surfaces (13 studies), nutrition (8), and electrotherapy (6). High or moderate quality of evidence was found in none of the interventions, mainly because of the very serious risk of bias of most studies and imprecision in the treatment effect. Evidence grade is very low or insufficient to support the use of any support surface, nutrition intervention, multicomponent interventions, repositioning or other adjunctive therapy (ultrasound, negative pressure, laser, electromagnetic, light, shock wave, hydrotherapy, radiofrequency, or vibration therapy) to increase the rates of PU healing in older patients. Electrotherapy showed some beneficial effect in the treatment of PUs, although the quality of evidence is low.

76.	**Langer G, Fink A. Nutritional interventions for preventing and treating pressure ulcers. The Cochrane database of systematic reviews. 2014(6):Cd003216.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Systematic Review 1++	***Countries:*** Germany ***Centers:*** University Halle-Wittenberg ***Setting:*** Fifteen of the 23 trials were carried out in hospitals, three in long-term care facilities, one study was conducted in the long-term care unit of a university hospital (Ek 1991). Two multicenter trials covered a range of settings, with long-term care units and hospital wards (ter Riet 1995; van Anholt 2010). The Delmi 1990 trial was carried out in an orthopedic ward, but some of the participants were transferred to a rehabilitation hospital. Chernoff 1990 did not mention the setting. ***Funding Sources:*** n/a ***Dropout rates:*** n/a ***Study limitations:*** Most of the studies included in the review were small and had	**Total no. Studies:** 23 RCTs **Inclusion criteria:** Randomized controlled trials (RCTs) of parallel or crossover design evaluating the effect of enteral and/or parenteral nutrition on the prevention and treatment of pressure ulcers by measuring the incidence of new ulcers, ulcer healing rates or changes in pressure ulcer severity. **Exclusion criteria:** not an RCT, pressure ulcers and other outcomes predefined for this review not measured	The interventions in the included trials can be summarized as special nutrient supplementation or mixed nutritional supplements.

	either an unclear, or high risk, of bias.		
Notes	**Author's Conclusion:** There is currently no clear evidence of a benefit associated with nutritional interventions for either the prevention or treatment of pressure ulcers. Further trials of high methodological quality are necessary.		
Outcome measures/results	**Primary outcomes:** • proportion of participants developing new (incident) pressure ulcers (for prevention studies) • time to complete healing (for treatment studies) **Secondary outcomes:** • acceptability of supplements • side effects • costs • rate of complete healing • rate in change of size of ulcer (absolute and relative) • health-related quality of life		We included 23 RCTs, many were small (between 9 and 4023 participants, median 88) and at high risk of bias. Eleven trials compared a combination of nutritional supplements, consisting of a minimum of energy and protein in different dosages, for the prevention of pressure ulcers. A meta-analysis of eight trials (6062 participants) that compared the effects of mixed nutritional supplements with standard hospital diet found no clear evidence of an effect of supplementation on pressure ulcer development (pooled RR 0.86; 95% CI 0.73 to 1.00; P value 0.05; I2 = 13%, random effects). This outcome is at unclear or high risk of bias. Fourteen trials evaluated the effects of nutritional supplements on the healing of existing pressure ulcers: seven trials examined mixed nutritional supplements, three the effects of proteins, two trials examined zinc, and two studies examined ascorbic acid. The included trials were heterogeneous with regard to participants, interventions, comparisons and outcomes and meta-analysis was not appropriate. There was no clear evidence of an improvement in pressure ulcer healing from the nutritional supplements evaluated in any of these individual studies.

77.	**Cereda E, Klersy C, Serioli M, Crespi A, D'Andrea F. A nutritional formula enriched with arginine, zinc, and antioxidants for the healing of pressure ulcers: a randomized trial. Annals of internal medicine. 2015;162(3):167-74.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** n/a ***Centers:*** Multicenter (n=7) ***Setting:*** long-term care and home care services	**Total no. Patients:** n=200 **Inclusion criteria:** malnourished patients with stage II,III and IV Pus, able to drink ONSs, provide written informed consent	1) Energy-dense protein-rich oral formula enriched with arginine, zinc, antioxidants (400mL/d; 500 kcal)+ 40g protein; n=101 2) Equal volume of isocaloric isonitrogenous formula; n=99 ➔ 8 weeks ➔ 2 bottles per day (400 mL)

	Funding Sources: Azienda Ospedaliera Universitaria Maggiore della Carità ***Dropout rates:*** experimental formula: 33.66 % (n=34; patients completed n=67) Control formula: 28.3% (n=29; patients completed n=71) ***Study limitations:*** participation restricted to malnourished patients, able to drink oral supplements, living in long-term care or receiving home care services	**Exclusion criteria:** poorly controlled diabetes (glycated hemoglobin level >7%), acute organ failure, chronic obstructive pulmonary disease, peripheral vascular disease, connective tissue disease, previous or current neoplastic disease, hemoglobin level less than 10 g/dL, obesity, current immunosuppressive therapy, infected wound, cellulitis, sepsis, osteomyelitis, any type of artificial nutrition	➔ At baseline and every 2 weeks: total daily energy and protein intake were assessed by the same trained dietitians
Notes	• Blinded; Patients with several PUs, the most severe was selected for investigation • Malnutrition was defined as a low BMI <20 kg/m² and <21 kg/m² for patients aged <65 and ≥65 years respectively, recent unintentional weight loss (≥10% in 3 months or ≥5% in 1 months), low serum albumin levels (<35 g/L and <30 g/L for patients aged <65 and ≥65 years), reduced food intake (<60% of estimated total daily energy requirements • Every patient received wound care according to evidence-based guideline • General dietary advice given to every patient receiving home care services; diet provided in long-term care institutions was tailored to individual requirements (Chewing, swallowing) • Daily protein requirements: 1.5 g/kg (exception patients BMI greater than 27 kg/m² → calculation with ideal body weight (BMI 23 kg/m²)) **Author's Conclusion:** Among malnourished patients with PU, 8 weeks of supplementation with an oral nutritional formula enriched with arginine, zinc, and antioxidants improved PU healing.		
Outcome measures/results	• primary end point: percentage of change in PU area at 8 weeks • secondary end points: complete healing, reduction in PU area 40% or greater, incidence of wound		• overall treatment was effective in improving PU healing ($p<0.001$ for both interventions) • Supplementation with enriched formula (mean reduction 60.9%; 95% CI, 54.3% to 67.5%) greater reduction in PU area than control

	infections, total number of dressings at 8 weeks, percentage of change in area at 4 weeks • other parameters: BMI, height, weight, REE (Harris-Benedict equation), adverse events	group (45.2%; CI, 38.4% to 52.0%)(adjusted mean difference, 18.7%; CI, 1.12 to 3.48, p=0.018 None of the covariates included in adjusted model had a significant effect on reduction in PU area • No difference in terms of the other secondary end points ▪ Greater proportion of the experimental formula group (16.9%, CI, 8.2% to 25.5%) had complete PU healing at 8 weeks than the control formula group (9.7%, CI, 2.1% to 17.3%), but the difference was not significant • Secondary analysis restricted to patients remaining in the study for 4 weeks: experimental formula showed a significant effect on the rate of complete healing (p=0.042) and the reduction in PU area at 4 weeks (p=0.003) • Proportion of patients who did not respond was similar between groups

78.	**Stratton RJ, Ek AC, Engfer M, Moore Z, Rigby P, Wolfe R, et al. Enteral nutritional support in prevention and treatment of pressure ulcers: a systematic review and meta-analysis. Ageing research reviews. 2005;4(3):422-50.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Systematic Review 1+	***Countries:*** UK, Sweden, Netherlands, Ireland, USA ***Centers:*** ***Setting:*** hospital or community	**Total no. Studies:** 15 **Inclusion criteria:** • Population: all adult human studies, nutritional status either well-nourished or malnourished, patients with pressure/ decubitus ulcers, or those at risk of developing them • Intervention: all studies	ONS and/ or ETF

	Funding Sources: Numico *Dropout rates:* n/a *Study limitations:* the quality of evidence available, including RCTs is generally poor	using ONS and/ or ETF, including those simultaneously using or comparing with dietary counselling and/or parenteral nutrition and/ or simultaneous standard diet • Main outcome measures: Pressure ulcer incidence, pressure ulcer healing, Quality of life, complications, mortality, dietary intake, nutritional status **Exclusion criteria:** • Population: animal studies • Intervention: dietary counselling only, parenteral nutrition only, interventions <2 macronutrients, interventions with no micronutrients	
Notes	**Author's Conclusion:** This systematic review shows enteral nutritional support, particularly high protein ONS, can significantly reduce the risk of developing pressure ulcers (by 25%). Although studies suggest ONS and ETF may improve healing of PU, further research to confirm this trend is required.		
Outcome measures/results	• **Primary outcome measures**: pressure ulcer incidence and pressure ulcer healing • **Secondary outcomes**: quality of life, complications, mortality, dietary intake and nutritional status		Meta-analysis showed that ONS (250-500 kcal, 2-26 weeks) were associated with a significantly lower incidence of pressure ulcer development in at-risk patients compared to routine care (odds ratio 0.75, 95% CI 0.62-0.89, 4 RCTs, n=1224, elderly, post-surgical, chronically

		hospitalized patients). Similar results were obtained when a combined meta-analysis of ONS (4 RCT) and ETF (1 RCT) trials was performed (OR 0.74, 95% CI 0.62-0.88, 5 RCTs, n=1325). Individual studies showed a trend towards improved healing of existing pressure ulcers with disease-specific (including high protein) versus standard formulas, although robust RCTs are required to confirm this. Although some studies indicate that total nutritional intake is improved, data on other outcome measures (quality of life) are lacking.

III.5 Should older persons with overweight or obesity be offered specific nutritional interventions or advised to follow a specific diet to reduce body weight?

Recommendation 57

If weight reduction is considered in obese older persons, dietary interventions shall be combined with physical exercise whenever possible in order to preserve muscle mass. (BM)

Grade of recommendation A – strong consensus (100 % agreement)

79.	**Amati F, Dube JJ, Shay C, Goodpaster BH. Separate and combined effects of exercise training and weight loss on exercise efficiency and substrate oxidation. Journal of applied physiology (Bethesda, Md : 1985). 2008;105(3):825-31.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Pilot study combined with a 3 arms randomized clinical trail 1+	***Countries:*** n/a ***Centers:*** n/a ***Setting:*** n/a ***Funding Sources:*** supported by American Diabetes Association clinical Research Award, National Institute on Aging, General Clinical Research Center, Obesity Nutrition Research Center ***Dropout rates:*** n/a ***Study limitations:*** no use of efficiency measures taking into account resting	**Total no. Patients:** n=64 (women=38; men=26) **Inclusion criteria:** no regular physical activity (>1 time/wk.), weight stable (±3kg) for at least 6 months before study **Exclusion criteria:** history of type 2 diabetes, coronary heart disease, peripheral vascular disease, uncontrolled hypertension, taking chronic medications affecting glucose homeostasis, screening testing anemia, clinical hypothyroidism, elevated liver enzymes	Separate or combined effects of exercise training and weight loss on metabolic efficiency, economy and fat oxidation during steady-state moderate submaximal exercise; duration of each intervention: 4 months 1) Weight loss; diet-induced (n=11; WL): goal →10% weight loss; caloric deficit of 500-1.000 kcal/day based on recent food records; low fat diet (<30% of calories from fat); weekly meeting of dietician: individual counseling, review of food records, weight monitoring 2) Exercise training (n=36; EX): moderate intensity supervised aerobic exercise regimen; 3-5 sessions per week (at least 3 sessions supervised in their facility); intensity and duration progressively adapted to reach 45 min and 75% of their peak aerobic capacity (walk (primary mode), bike, row) 3) Combination of both (n=17; WLEX): both described above

<table>
<tr><td></td><td>values, no true control group (variability of tests),cycle ergometry no typical activity of daily living, generalization?, improvements to efficiency due to biomechanical changes?</td><td></td><td></td></tr>
<tr><td>Notes</td><td colspan="3">Sedentary older (67±0.5 yr. old) overweight to obese (30.7±0.4 kg/m²) volunteers
All tests before and after intervention with the same absolute work rate: preintervention-postintervention research design; two groups with weight loss: maintained stable for 2 weeks before postintervention measurements
52 subjects: part of a 3 arms randomized clinical trial (16 week intervention: WL, EX or WLEX); 12 subjects part of Pilot study (EX without randomization)
2 days before tests: subjects instructed to avoid strenuous physical activity, eat at least 200g carbohydrates for 3 days before submaximal exercise test
assess the variation in the measurement tool and a possible learning effect, a subset of individuals (n _ 14) performed two tests before and two tests after the intervention
Author's Conclusion: From these findings, we conclude that exercise training, either alone or in combination with weight loss, increases both exercise efficiency and the utilization of fat during moderate physical activity in previously sedentary, obese older adults. Weight loss alone, however, significantly improves neither efficiency nor utilization of fat during exercise.</td></tr>
<tr><td>Outcome measures/results</td><td colspan="2">Energy expenditure (EE)
Gross efficiency (GE)
Economy (EC)
Proportion of energy expended from fat (EF %)
Anthropometric measurements (weight, height, BMI)
Blood analyses
Dual-energy X-ray absorptiometry (Lean body mass, fat mass)
Muscle biopsies
➔ Determined during 1-h submaximal cycle ergometry exercise before and after intervention
➔ 75% peak aerobic capacity (Vo2peak)</td><td>Submaximal exercise measurements at baseline similar among 3 groups
Differences between men and women (LBM, Vo2peak, EE) disappeared when expressed in relative units
All groups lost significant amount of weight; WL group lost more LBM than others (p<0.001)
Vo2peak increased (p<0.05) in EX/WLEX compared to WL
Cadence maintained constant throughout submaximal test in pre- and postintervention testing; Vo2 constant within each test
Significant decrease in EE (p=0.004) for WLEX group
EX and WLEX increased gross efficiency (EX:4.7±2.2%; p=0.78; WLEX: p=0.02) compared with WL; GE all groups together: less change LBM (R^2=0.19, p=0.02) and improved Vo2peak (R^2=0.11,</td></tr>
</table>

	➔ Intensity monitored by heart rate (HR), blood pressure, electrocardiogram (before, during, after); Vo2 via indirect calorimetry	p=0.008) were only sig. predictors of improvement in GE • EX increased economy (4.2±2.1%) • Addition WL to EX: greater increase in gross efficiency (9.0±3.3%) compared with WL alone (not EX alone) →effects remained after adjusting for changes in lean body mass • Proportion of energy derived from fat during moderate exercise increased with EX and WLEX (p=0.04); not with WL

80.	**Avila JJ, Gutierres JA, Sheehy ME, Lofgren IE, Delmonico MJ. Effect of moderate intensity resistance training during weight loss on body composition and physical performance in overweight older adults. European journal of applied physiology. 2010;109(3):517-25.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT (Pilot study) 1+	***Countries:*** n/a ***Centers:*** n/a ***Setting:*** community-based settings (senior centers) ***Funding Sources:*** College Environmental and Life Sciences Community Access to Research and Extension Services (CELS CARES) grant from the USDA and URI Foundation ***Dropout rates:*** 12.91% ***Study limitations:*** small sample size, physical activity and food	**Total no. Patients:** n=31 **Inclusion criteria:** overweight older adults, relatively healthy, age 60-75 years, weight stability for previous 3 months, BMI between 25.0 and 39.9 kg/m², free of significant cardiovascular metabolic or musculoskeletal disorders **Exclusion criteria:** recent engagement in a regular exercise program, taking prescribed medications for less than 3 weeks prior to start of the study, medications were scheduled to change during study	Impact of resistance training in overweight older adults undergoing weight loss 1) Dietary Approaches to stop hypertension for weight loss diet (DASH, n=12) = usual care control group 2) DASH + moderate intensity resistance training (DASH-RT, n=15) ➔ 10 weeks ➔ Dietary intervention: 30 min dietary education session each week for duration of the intervention ➔ Both groups: encouragement for 30 min of physical activity on most days of the week (180 min per week) ➔ Resistance training: 40 min of moderate intensity resistance training on 3 non-consecutive days each week for 10 weeks

	frequency questionnaire may be questionable for DASH group, too low weight loss for estimated energy balance, sample was found to be higher functioning→lack of observed differences in function changes may be due to changes in physical activity		
Notes	• BMI 31.7±3.6 kg/m², older age 67±4 years, randomized; inclusion criteria based on self-report • Fat and skeletal muscle cross-sectional areas (cm2), were analyzed using Medical Imaging and Processing and Visualization software (National Institutes of Health, Bethesda, MD) by a single, trained, blinded technician who analyzed all scans at the end of the study **Author's Conclusion:** This study shows that the combination of moderate intensity resistance training and weight loss can significantly improve body fat mass and mid-thigh composition, strength, and muscle quality in overweight and obese community-dwelling older adults who are at risk of future obesity-and sarcopenia-related disability, whereas a weight loss-only program did not seem to have these positive effect.		
Outcome measures/results	• Weight loss • Total body (air-displacement plethysmography) and mid-thigh composition (CT; Measurements of: fat and skeletal muscle, intermuscular adipose tissue, subcutaneous adipose tissue) • Muscle (power, quality →1-RM, leg press machine) and physical function (short physical performance battery (SPPB), progressive balance test, normal gait speed, timed 5-chair stand test, 400-m corridor walk test) • Questionnaires: Yale Physical Activity Survey, Fred Hutchinson Food Frequency Questionnaire		• No significant weight loss differences between DASH-RT and DASH groups (-3,6±0.8 vs. -2.0±0.9%, p=0.137) • Adherence to dietary intervention sessions: 85% DASH group; 98% DASH-RT group; adherence for resistance training was high in DASH-RT subjects (96%) • Daily caloric intake: sig. reduced in DASH group (-327±145 kcal, p=0.026), no sig. difference in DASH-RT group • DASH-RT than DASH ▪ greater reduction in body fat (-11.2 vs. -0.2%, p=0.005) ▪ greater changes in lean mass (+0.8±0.4 vs. -1.4±0.4 kg, p=0.002)→ no loss in DASH-RT ▪ greater changes in strength (+60±18 vs. -5±9 N, p=0.008) ▪ muscle quality sig. increase DASH-RT vs. DASH (+0.22±0.08 vs. +0.004±0.050 N/cm³, p=0.013)

		▪ favorable changes in mid-thigh composition variables (DASH lack of changes), except for intermuscular adipose tissue ▪ total thigh adipose tissue DASH-RT group sig. decline (-8,4% vs. -3,6% DASH, p=0.051) ▪ sig. decrease in low-density muscle DASH-RT vs. non-sig. change DASH (-15.6 vs. -5.7%, p=0.019) ▪ subcutaneous adipose tissue: DASH-RT sig. decline vs. DASH (-7.8 vs. -3.3%, p=0.063) • Both groups decreases in 400-m walk times (no differences between groups) • Moderate intensity resistance training during weight loss improves fat mass and thigh composition; weight loss only does not

81.	**Campbell WW, Haub MD, Wolfe RR, Ferrando AA, Sullivan DH, Apolzan JW, et al. Resistance training preserves fat-free mass without impacting changes in protein metabolism after weight loss in older women. Obesity (Silver Spring, Md). 2009;17(7):1332-9.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** n/a ***Centers:*** n/a ***Setting:*** during weeks 2, 3, 15, 16 = in-patient weeks in a metabolic research kitchen facility with overnight stay ***Funding Sources:*** supported by grants from National Institute for Health and General Clinical Research Center	**Total no. Patients:** n=20; n=16 completed **Inclusion criteria:** postmenopausal overweight women, 61-78 years, BMI 24-34 kg/m² **Exclusion criteria:** abnormal heart, liver, kidney, thyroid function, type 2 diabetes mellitus, smoking, hormone replacements, participation in a	Intervention: - Each women consumed 1.0 g protein/kg/day; 65% carbohydrate, 35% fat (Harris-Benedict equation of REE+EE - At baseline (weeks B1-B3) and post study (weeks RT12-RT13; RT=resistance training) energy intake matched each subject´s need - During weeks RT1-RT11: hypo energetic by 2,092 kJ(day (500 kcal/day); protein-free beverage 1) Intervention group (RT group; n=8): RT1-RT13 women performed RT 3 day/week 2) Control Group (SED group; n=8): remained sedentary ➔ 16 week controlled diet and exercise study (4 in-patient

	Dropout rates: 20% ***Study limitations:*** choice of time points, additional biopsies needed for better establishment of time course of steady state in PA/PP periods, lack of steady state → underestimation of PA/overestimation PP, FSRm	RT program within the past 12 months	weeks → all meals in their kitchen, 12 outpatient weeks) ➔ Outpatient weeks: laboratory each weekday morning to be weighed and eat breakfast, but otherwise encouraged to maintain daily living activities as much as possible at home ➔ Multivitamin-mineral tablet daily for every woman ➔ Water, decaffeinated tea/coffee ad libitum
Notes	• Age 68±1years, BMI 29±1 kg/m²; before starting the study each woman completed a medical evaluation (written medical history, physical examination, resting electrocardiogram, 75g OGTT, routine blood and urine • randomized **Author's Conclusion:** In summary, RT helps older women preserve FFM during body mass loss. The comparable whole-body nitrogen retentions, leucine kinetics, and FSRm between groups are consistent with the lack of differential protein–mineral mass change.		
Outcome measures/results	• maximum strength (one Rep-max): B1, RT1, RT7, RT13; RT group additionally: 3 days per week, training intensity 80% one-Rep max, 1-2 min rest between sets; before and after strength testing/resistance exercise: 5-10 min easy cycling+5-10 min stretching exercises • body composition: fasting weight, height, BMI, total body water, body fat (from body density), FFM, protein-mineral mass, skinfold thickness, body circumference • food, stool collections (4 days): B3, RT13; B3, RT7, RT11, RT13 24-h urine • Nitrogen analyses • Infusion procedures: B2, RT12; 8 hours (PA 4-h, PP4-h); leucine turnover, muscle samples		• RT did not influence the energy restriction–induced decrease in body mass (SED −5.8 ± 0.6 kg; RT −5.0 ± 0.2 kg) and fat mass (SED −4.1 ± 0.9 kg; RT −4.7 ± 0.5 kg) • Fat-free mass (FFM) and total body water decreased in SED (−1.6 ± 0.4 and −2.1 ± 0.5 kg) and were unchanged in RT (−0.3 ± 0.4 and −0.4 ± 0.7 kg) (group-by-time, $P \leq 0.05$ and $P = 0.07$, respectively) • Protein mineral mass did not change in either group (SED 0.4 ± 0.2 kg; RT 0.1 ± 0.4 kg) • Nitrogen balance: positive at baseline (2.2 ± 0.3 g N/day); unchanged post study • Muscle strength: no differences between groups at baseline; RT group 12-34% increase over time vs unchanged SED group ($p \leq 0.01$) • After body mass loss: Leucine turnover, oxidation ($p<0.0001$), synthesis ($p<0.05$) higher, breakdown lower ($p<0.0001$) in postprandial (PP) vs. post absorptive (PA); leucine turnover ($p<0.0001$), synthesis, breakdown decreased ($p<0.001$)

		• Leucine oxidation and balance unchanged at RT12 vs. baseline • PA and total FSRm (PA+PP) in vastus lateralis were higher after weight loss • RT did not influence protein metabolism responses

82.	Chomentowski P, Dube JJ, Amati F, Stefanovic-Racic M, Zhu S, Toledo FG, et al. Moderate exercise attenuates the loss of skeletal muscle mass that occurs with intentional caloric restriction-induced weight loss in older, overweight to obese adults. The journals of gerontology Series A, Biological sciences and medical sciences. 2009;64(5):575-80.		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1-	***Countries:*** USA, Pittsburgh metropolitan and surrounding areas ***Centers:*** n/a ***Setting:*** facilities of Division of Endocrinology and Metabolism, Department of Medicine, University of Pittsburgh School of Medicine ***Funding Sources:*** Support: from American Diabetes Association, Clinical Translation Research Center, Obesity and Nutritional Research Center ***Dropout rates:*** 17.24% (n=5); WL: 9.09% (n=1);	**Total no. Patients:** n=29 (13=m; 16=w) **Inclusion criteria:** 60-75 years, overweight to obese (BMI= 25.0-38.0 kg/m²), impaired glucose tolerance (IGT; 2-hour OGTT ≥140 mg/dL), impaired fasting glucose (IFG; fasting glucose ≥ 100 but ≤126 mg/dL), drug-naive type 2 diabetes mellitus (T2DM; fasting glucose ≥ 126 but ≤200 mg/d Land OGTT ≥200 mg/dL **Exclusion criteria:** clinically significant cardiovascular disease, resting systolic blood pressure >150 mmHg and diastolic blood pressure > 95 mmHg, smoker, not weight stable for 6 months, not sedentary (more than 2 d/week aerobic exercise)	1) diet-induced weight loss alone (WL; n=11): low fat, 500-1000 kcal/day caloric restriction → goal: 8-10% weight loss in total body weight 2) 1+exercise (WL/EX; n=18): WL intervention + progressive aerobic exercise, moderate-intensity walking (5 times/week, 45 min, heart rate range 65-75% of max. heart rate) → individualized program ➔ 4 months

	WL/EX: 22.22%(n=4) ***Study limitations:*** no control group, small number of participants, effects of weight loss/moderate exercise may differ between overweight and obese individuals, no test for changes of muscle function (muscle strength or power)		
Notes	• all participants diagnosed as having IGT/IFG were randomizes into one of the 2 groups (WL or WL/EX); all participants with T2DM were not randomized → enrolled into WL/EX group for ethical reasons • WL/EX group exercise: 3 sessions supervised in their facility; 2 unsupervised • Participants wore: polar heart rate monitor **Author's Conclusion:** Diet-induced weight loss significantly decreased muscle mass in older adults. However, the addition of moderate aerobic exercise to intentional weight loss attenuated the loss of muscle mass.		
Outcome measures/results	• Whole-body dual-energy x-ray absorptiometry (DXA): FM, FFM, appendicular lean mass • Tight computed tomography (CT), abdominal muscle cross-sectional area (CSA) • Percutaneous muscle biopsy (type 1+2 fibers) ➔ To assess changes in skeletal muscle at whole-body, regional and cellular level • Body weight (weekly)		• IGT and T2DM groups similar baseline characteristics and responses to WL/EX intervention • Both groups similar decreases in: ▪ bodyweight (WL -9.2% ± 1.0%; WL/EX -9.1 ± 1.0%; both p<0.001) ▪ Whole-body fat mass (WL -16.5%; WL/EX -20.7%), but decrease in whole-body fat mass in WL was significant (-4.3% ± 1.2%, p<0.05); not in WL/EX (-1.1 ± 1%) ▪ BMI • WL lost significantly more FFM (p=0.044)lower limb and trunk) than the WL/EX group • thigh muscle cross-sectional area by CT decreased in both groups with no statistically difference between groups: ▪ WL -5.2% ± 1.1% ▪ WL/EX -3.0% ± 1.0%

		• Type 1 muscle fiber area ▪ Significant decreased in WL (-19.2% ± 7.9%, p=0.01) ▪ remained unchanged in WL/EX (3.4 ± 7.5%) ▪ similar patterns observed in type 2 fibers (WL -16.6% ± 4.0%; WL/EX -0.2% ± 6.5%)

83.	**Dunstan DW, Daly RM, Owen N, Jolley D, De Courten M, Shaw J, et al. High-intensity resistance training improves glycemic control in older patients with type 2 diabetes. Diabetes care. 2002;25(10):1729-36.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1-	***Countries:*** Australia ***Centers:*** n/a ***Setting:*** n/a ***Funding Sources:*** grant from the Victorian Health Promotion Foundation, Rotary Club of Kew, Victoria, Australia and Soroptimist International, Brighton Division ***Dropout rates:*** 19% (n=7); RT/WL: 15.78% (n=3); WL: 23.52% (n=4) ***Study limitations:*** n/a; little study group	**Total no. Patients:** n=36 **Inclusion criteria:** sedentary, overweight (BMI >27 kg/m² and ≤40 kg/m²), with established (>6 months)treated (diet and/or medication Type 2 Diabetes mellitus, 60-80 years, HbA1c range 7-10%, not taking insulin, nonsmokers **Exclusion criteria:** history or physical findings: ischemic heart disease, systemic diseases, uncontrolled hypertension (>160/90 mmHg), advanced diabetic neuropathy or retinopathy, severe orthopedic, cardiovascular or respiratory conditions that would preclude participation in an exercise program, medical condition listed in the American College of Sports Medicine absolute	1) high-intensity progressive resistance training + moderate weight loss (RT/WL group; n=19) 2) moderate weight loss + control program (WL group; n=17) ➔ 4 week baseline period: healthy eating plan for moderate weight loss of 0.25 kg/week ➔ Exercise laboratory on 3 nonconsecutive days per week (individual resistance training first/second week: 50-60% 1-RM; goal: 75-80% of 1-RM) ➔ Control program: provide participative involvement but no elicit change in muscle strength or cardiovascular fitness

		contraindications	
Notes	• clinical and laboratory measurements assessed at 0, 3, 6 months • Recruitment from the clinics of the international Diabetes Institute and by a local media campaign; Screening by telephone (n=110) • Antidiabetic and antihypertensive medications were continued during study • 3 day food records during baseline,3 and 6 months; Compliance with healthy eating plan was assessed by interviews every 2 weeks with the dietitian and by completion of a weekly food checklist • No blinding of the subjects! **Author's Conclusion:** High-intensity progressive resistance training, in combination with moderate weight loss, was effective in improving glycemic control in older patients with type 2 diabetes. Additional benefits of improved muscular strength and LBM identify high-intensity resistance training as a feasible and effective component in the management program for older patients with type 2 diabetes.		
Outcome measures/results	• Anthropometry: Height, weight, waist circumference • Dual x-ray absorptiometry (DXA): Fat mass, LBM • Muscle strength: 1-RM • Habitual physical activity: 7-day questionnaire • Clinical and laboratory measurements: resting blood pressure (at least 24-h post exercise), blood samples: plasma glucose, serum insulin, lipids, lipoproteins, HbA1c (48-h post exercise), HOMA for insulin sensitivity		• No differences in baseline characteristics between groups • During 6 months period 4 subjects decreased their oral hyperglycemic medication dosage, 2 from each group increased their medication • Adherence to exercise sessions: high RT/WL: 88% (95% CI 81.7-94.1) WL: 85% (95% CI 77.9-92.4) • HbA1c ▪ fell significantly more in RT/WL group than in WL at 3 months (0.6 ± 0.7 vs.0.07± 0.8%, *P*<0.05) and 6 months (1.2 ± 1.0 vs. 0.4 ± 0.8%, *P*<0.05); ▪ no detectable changes in HbA1c in WL ▪ net difference between groups in mean HbA1c from baseline -0.5% (p<0.05) at 3 months, -0.8% (p<0.05) at 6 months • reductions after 6 months ▪ body weight (RT/WL 2.5 ±2.9 vs. WL 3.1 ± 2.1 kg) ▪ fat mass (RT/WL 2.4 ± 2.7 vs. WL 2.7 ± 2.5 kg) ▪ waist circumference ▪ no between group differences in net change from baseline • lean body mass (LBM) after 6 months (p<0.05)

		▪ increased in RT/WL (0.5 ± 1.1 kg) ▪ decreased in WL (0.4 ± 1.0 kg) • muscle strength ▪ no changes in WL ▪ RT/WL upper body strength 22.9% (p<0.01) at 3 months, 41.7% (p<0.01) at 6 months/lower body: 5.8% 3 months (p=0.06) and 28% at 6 months (p<0.01) • no between group differences for ▪ fasting glucose ▪ insulin ▪ serum lipids ▪ lipoproteins ▪ resting blood pressure

84.	**Frimel TN, Sinacore DR, Villareal DT. Exercise attenuates the weight-loss-induced reduction in muscle mass in frail obese older adults. Medicine and science in sports and exercise. 2008;40(7):1213-9.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** USA ***Centers:*** Washington University School of Medicine ***Setting:*** n/a	**Total no. Patients:** n=30 **Inclusion criteria:** older (≥ 65 years), obese (BMI ≥ 30 kg/m²) adults, sedentary (exercise ≤2 per week), stable medications, stable weight and 2 of three criteria for mild-moderate physical frailty (1)modified physical performance test (PPT) score between 18 and 32 (maximum score = 36); 2) peak aerobic power (V˙ O2peak) between 10 and 18 mL/kg*min; and 3)	Diet/behavioral therapy: 1) Diet group (DG; n=15): balanced diet; energy deficit 750 kcal/day; weight loss goal no more than 1.5% body weight loss per week; weekly group meetings with a study dietician; prohibition of exercise training program during the study 2) Diet or behavioral therapy + exercise (PRT; diet + exercise group; n=15): exercise= incorporated progressive resistance training; weekly group diet meets as DG ➔ 6 months, randomly assigned to one of the groups

	Funding Sources: National Institute of Health (General Clinical Research center and Clinical Nutrition Research Unit); T. Frimel supported by a fellowship from the Foundation for Physical Therapy ***Dropout rates:*** 9.09 % ***Study limitations:*** low number of participants, no control group, no examination of sex differences possible(small sample size)	self-reported difficulty and/or assistance with up to two instrumental activities of daily living and/or one basic activity of daily living **Exclusion criteria:** severe cardiopulmonary disease, diabetes mellitus, musculoskeletal or neuromuscular impairments, sensory or cognitive deficits, cancer diagnosis within last 5 yr., and use of corticosteroids, androgens, or estrogen-containing compounds within the last year	
Notes	• Participants who dropped out early (n=3) were excluded from the study • All assessments were performed by individuals blinded to group assignment at baseline and after 6 months of diet plus exercise therapy • All exercise testing sessions were medically supervised • all participants in the diet + exercise group were required to complete the 72 exercise sessions, compliance with the exercise program was 100% **Author's Conclusion:** Exercise added to diet reduces muscle mass loss during voluntary weight loss and increases muscle strength in frail obese older adults. Regular exercise that incorporates PRT should be used to attenuate muscle mass loss in frail obese older adults on weight-loss therapy.		
Outcome measures/results	• Body composition: dual-energy x-ray absorptiometry (DXA) • Muscle strength (1-rep max): hoist machines		• No difference between groups: physical frailty and VO2peak ($p>0.05$) • DG and diet + exercise groups similar decrease in weight (10.7 ± 4.5 vs. 9.7 ± 4.0 kg) and fat mass (6.8 ± 3.7 vs. 7.7 ± 2.9 kg)($p>0.05$)

	• Volume of upper extremity (UE) and lower extremity (LE): determines by multiplying average number of repetitions performed by average weight lifted during first three exercise sessions and during the last three exercise sessions	• Diet + exercise group lost less: fat free mass (FFM; 1.8 ± 1.5 vs. 3.5 ± 2.1 kg; p=0.02) LE lean mass (0.9 ± 0.8 vs.2.0 ± 0.9 kg; p=0.001) UE lean mass (0.1 ± 0.2 vs. 0.2 ± 0.2 kg; p=0.03) Than diet group • Diet + exercise group had greater increases in % of weight as FFM than diet group (7.9 ± 3.3 vs. 5.4 ± 3.7%; p=0.04) • Diet + exercise group increased UE and LE strength in response to exercise (17-43%); diet group maintained strength • Volume of UE and LE exercise correlated with amount of UE and LE lean mass (r= 0.64-0.84; p<0.05) • Volumes of weight lifts did not correlate strongly with the changes in lean mass for diet + exercise group • Weight loss alone did not result in a significant loss of lean mass at the UE in diet + exercise group (p=0.35 compared with baseline)

85.	**Kitzman DW, Brubaker P, Morgan T, Haykowsky M, Hundley G, Kraus WE, et al. Effect of Caloric Restriction or Aerobic Exercise Training on Peak Oxygen Consumption and Quality of Life in Obese Older Patients With Heart Failure With Preserved Ejection Fraction: A Randomized Clinical Trial. Jama. 2016;315(1):36-46.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1++	***Countries:*** USA ***Centers:*** Wake Forest University ***Setting:*** Urban academic medical center ***Funding Sources:*** National Institutes of Health ***Dropout rates:*** 8%	**Total no. Patients:** 100 **Inclusion criteria:** age ≥ 60 years; body mass index (BMI) ≥30kg/m2; symptoms and signs of HF defined by NHANES HF score ≥317 and/or the criteria of Rich et al.;18 LV ejection fraction ≥50% **Exclusion criteria:** LV segmental wall motion abnormalities; significant ischemic or valvular	20 weeks of Diet and/or Exercise; Attention Control consisted of telephone calls every 2 weeks.

	Study limitations: the data do not address safety and efficacy of Diet in patients with BMI <30 kg/m²	heart disease, pulmonary disease, anemia, or other disorder that could explain the patients' HF symptoms. Participants were clinically stable, had no significant change in cardiac medications for 4 weeks, and were not undergoing regular Exercise or Diet	
Notes	**Author's Conclusion:** Among obese older patients with clinically stable heart failure and preserved ejection fraction, caloric restriction diet or aerobic exercise training increased peak oxygen consumption, and the effects may be additive. Neither intervention had a significant effect on quality of life as measured by the Minnesota Living with Heart Failure Questionnaire.		
Outcome measures/results	Exercise capacity measured as peak oxygen consumption (VO2, ml/kg/min; primary outcome) and QOL measured by the Minnesota Living with HF Questionnaire (MLHF) total score (co-primary outcome; score range: 0–105, higher scores indicate worse HF-related QOL).		By main effects analysis, peak VO2 was increased significantly by both interventions: Exercise main effect 1.2 ml/kg/min (95%CI: 0.7, 1.7; p<0.001); Diet main effect 1.3 ml/kg/min (95%CI: 0.8, 1.8; p<0.001). The combination of Exercise + Diet was additive (complementary) for peak VO2 (joint effect 2.5 ml/kg/min). The change in MLHF total score was non-significant with Exercise (main effect −1 unit; 95%CI: −8.5; p=0.70) and with Diet (main effect −6 units; 95%CI: −12.1; p=0.078). The change in peak VO2 was positively correlated with the change in percent lean body mass (r=0.32; p=0.003) and the change in thigh muscle/intermuscular fat ratio (r=0.27; p=0.02). There were no study-related serious adverse events. Exercise attendance was 84±14%; Diet compliance was 99±1%. Body weight decreased by 7±1 kg (7%) in Diet, 4±1 kg (3%) in Exercise, 11±1 kg (10%) in Exercise + Diet, and 1±1 kg (1%) in Control.

86.	**Messier SP, Loeser RF, Miller GD, Morgan TM, Rejeski WJ, Sevick MA, et al. Exercise and dietary weight loss in overweight and obese older adults with knee osteoarthritis: the Arthritis, Diet, and Activity Promotion Trial. Arthritis and rheumatism. 2004;50(5):1501-10.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** USA ***Centers:*** Claude D. Pepper	**Total no. Patients:** 316 **Inclusion criteria:** age ≥60 years;	1. Exercise: 3 days/week exercise program prescribed to each participant randomized to either the exercise-only or the diet plus

	Older Americans Independence Center of Wake Forest University ***Setting:*** n/a ***Funding Sources:*** n/a ***Dropout rates:*** 20% ***Study limitations:*** n/a	calculated body mass index ≥28kg/m²; knee pain on most days of the month; sedentary activity pattern with <20 minutes of formal exercise once weekly for the past 6 months; self-reported difficulty in at least one of the following activities ascribed to knee pain: walking one-quarter of a mile, climbing stairs, bending, stooping, kneeling, shopping, house cleaning or other self-care activities, getting in and out of bed, standing up from a chair, lifting and carrying groceries, or getting in and out of the bathtub; radiographic evidence of grade I-III tibiofemoral or patellofemoral OA based on weight-bearing anteroposterior and sunrise view radiographs; and willingness to undergo testing and intervention procedures **Exclusion criteria:** serious medical condition that prevent safe participation in an exercise program, including symptomatic heart or vascular disease, severe hypertension, recent stroke, chronic obstructive, pulmonary disease, severe insulin-	exercise groups consisted of an aerobic phase, a resistance-training phase, a second aerobic phase and a cool-down phase. The first 4 months were facility based. After the first 4 months, participants who wished to exercise at home underwent a 2-month transition phase during which he or she alternated attendance between facility and the home. 2. Dietary intervention: based on principles from the group dynamics literature and social cognitive theory, divided into 3 phases: intense (months 1-4), transition (months 5-6), and maintenance (months7-18). -Intense phase: Behavior change was facilitated using self-regulatory skills, including self-monitoring, goal setting, and cognitive management. One introductory individual session was followed by 16 weekly sessions (3 group sessions and 1 individual session each month).Each group session included problem solving, the review of a specific topic, and tasting of several well-balanced, low- fat nutritious foods prepared with widely available ingredients. -Transition phase: sessions every other week for 8 weeks (3 group and 1 individual session). The goals for this phase included assisting participants who had not reached their weight loss goals in establishing new goals and maintaining preventing relapse in those who had reached their weight loss goals. -Maintenance phase: monthly meetings and phone contacts, alternated every 2 weeks, newsletters; goals included assisting participants who had reached their weight loss goals to maintain this weight loss and providing counseling for participants who had a difficult time losing weight and adhering to the intervention.

		dependent diabetes mellitus, psychiatric disease, renal disease, liver disease, active cancer other than skin cancer and anemia; a Mini-Mental State Examination score of <23; inability to walk without a cane or other assistive device; participation in another research study; reported alcohol consumption >14 drinks per week; ST segment depression of at least 2mm at an exercise level of 4 METS or less, hypotension or complex arrhythmias during a graded exercise test; inability to complete protocol, in the opinion of the clinical staff, because of frailty, illness or other reason	
Notes	**Author's Conclusion:** The combination of modest weight loss plus moderate exercise provides better overall improvements in self-reported measures of function and pain and in performance measures of mobility in older overweight and obese adults with knee OA compared with either intervention alone.		
Outcome measures/results	- **Primary outcome**: self-reported physical function as measured with the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) - **Secondary outcomes**: weight loss, 6-minute walk distance, stair-climb time, WOMAC pain and stiffness scores, and joint space width.		Of the 316 randomized participants, 252 (80%) completed the study. Adherence was as follows: for healthy lifestyle, 73%; for diet only, 72%; for exercise only, 60%; and for diet plus exercise, 64%. In the diet plus exercise group, significant improvements in self-reported physical function ($P < 0.05$), 6-minute walk distance ($P < 0.05$), stair-climb time ($P < 0.05$), and knee pain ($P < 0.05$) relative to the healthy lifestyle group were observed. In the exercise group, a significant improvement in the 6-minute walk distance ($P < 0.05$) was observed. The diet-only group was not significantly different from the healthy lifestyle group for any of the functional or mobility measures. The weight-loss groups lost significantly

		(P < 0.05) more body weight (for diet, 4.9%; for diet plus exercise, 5.7%) than did the healthy lifestyle group (1.2%). Finally, changes in joint space width were not different between the groups.

87.	**Messier SP, Mihalko SL, Legault C, Miller GD, Nicklas BJ, DeVita P, et al. Effects of intensive diet and exercise on knee joint loads, inflammation, and clinical outcomes among overweight and obese adults with knee osteoarthritis: the IDEA randomized clinical trial. Jama. 2013;310(12):1263-73.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** USA ***Centers:*** Wake Forest University ***Setting:*** n/a ***Funding Sources:*** National Institutes of Health (NIH), Merck Serono, Novartis, Abbott, Perceptive, Bioclinica ***Dropout rates:*** 12% ***Study limitations:*** it is unknown whether patients with more severe knee OA (Kellgren-Lawrence score of 4) and	**Total no. Patients:** 454 **Inclusion criteria:** Kellgren-Lawrence grade 2 or 3 (mild or moderate) radiographic tibiofermoral OA or tibiofemoral plus patellofemoral OA of one or both knees, pain most days due to knee OA, a BMI from 27 through 41, and sedentary lifestyle (<30 minutes per week of formal exercise for the past 6 months) **Exclusion criteria:** severe manifestations of coronary heart disease, Mini-Mental State score less than 70	Intensive diet-induced weight loss plus exercise, intensive diet-induced weight loss, or exercise.

	higher levels of pain would benefit from this long-term intervention; the musculoskeletal model used to calculate knee compressive forces has several limitations (e.g. several knee ligaments are not included)		
Notes	**Author's Conclusion:** Among overweight and obese adults with knee OA, after 18 months, participants in the diet + exercise and diet groups had more weight loss and greater reductions in IL-6 levels than those in the exercise group; those in the diet group had greater reductions in knee compressive force than those in the exercise group		
Outcome measures/results	Mechanistic primary outcomes: knee joint compressive force and plasma IL-6 levels; secondary clinical outcomes: self-reported pain (range, 0-20), function (range, 0-68), mobility, and health-related quality of life (range, 0-100).		Three hundred ninety-nine participants (88%) completed the study. Mean weight loss for diet + exercise participants was 10.6 kg (11.4%); for the diet group, 8.9 kg (9.5%); and for the exercise group, 1.8 kg (2.0%). After 18 months, knee compressive forces were lower in diet participants (mean, 2487 N; 95% CI, 2393 to 2581) compared with exercise participants (2687 N; 95% CI, 2590 to 2784, pairwise difference [Δ] (exercise vs diet) = 200 N; 95% CI, 55 to 345; P = .007). Concentrations of IL-6 were lower in diet + exercise (2.7 pg/mL; 95% CI, 2.5 to 3.0) and diet participants (2.7 pg/mL; 95% CI, 2.4 to 3.0) compared with exercise participants (3.1 pg/mL; 95% CI, 2.9 to 3.4; Δ(exercise vs diet + exercise) = 0.39 pg/mL; 95% CI, -0.03 to 0.81; P = .007; Δ(exercise vs diet)= 0.43 pg/mL; 95% CI, 0.01 to 0.85, P = .006). The diet + exercise group had less pain (3.6; 95% CI, 3.2 to 4.1) and better function (14.1; 95% CI, 12.6 to 15.6) than both the diet group (4.8; 95% CI, 4.3 to 5.2) and exercise group (4.7; 95% CI, 4.2 to 5.1, Δ(exercise vs diet + exercise) = 1.02; 95% CI, 0.33 to 1.71; P(pain) = .004; 18.4; 95% CI, 16.9 to 19.9; Δ(exercise vs diet + exercise), 4.29; 95% CI, 2.07 to 6.50; P(function)< .001). The diet + exercise group (44.7; 95% CI, 43.4 to 46.0) also had better physical health-related quality of life scores than the exercise group (41.9; 95% CI, 40.5 to 43.2; Δ (exercise vs diet + exercise) = -2.81; 95% CI, -4.76 to -0.86; P = .005).

88.	Rejeski WJ, Ambrosius WT, Burdette JH, Walkup MP, Marsh AP. Community Weight Loss to Combat Obesity and Disability in At-Risk Older Adults. The journals of gerontology Series A, Biological sciences and medical sciences. 2017;72(11):1547-53.		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** USA ***Centers:*** Wake Forest University ***Setting:*** n/a ***Funding Sources:*** National Institutes of Health/National Heart, Lung and Blood Institute; National Institutes on Aging ***Dropout rates:*** 22% ***Study limitations:*** study sample included persons both with CVD and Met Sand were not powered to examine potential differences between these two subgroups on the outcomes of interest; strength testing was restricted to knee extensor strength	**Total no. Patients:** 249 **Inclusion criteria:** age between 60 and 79 years, engaged in <60 min/wk. of moderately intense physical activity, BMI≥28 and <42, self-reported limitations with mobility, and had documented evidence of CVD or an ATP III diagnosis of MetS **Exclusion criteria:** severe heart disease, severe systematic disease, myocardial infarction or cardiovascular procedure in the past 3 months, a blood glucose ≥140mg/dl, diagnosis of Type I diabetes or insulin-dependent Type II diabetes, or severe psychiatric condition	Three interventions: weight loss alone (WL), weight loss + aerobic training (WL + AT), and weight loss + resistance training (WT + RT).

Notes	**Author's Conclusion:** At risk, older, overweight and obese adults can achieve clinically significant reductions in body weight with community-based weight loss programs. The change in percent weight loss and improvements in mobility are significantly enhanced when either RT or AT is combined with dietary WL.	
Outcome measures/results	Primary outcomes: 400-m walk time in seconds and knee extensor strength in Newton meters.	All groups lost weight from baseline: average baseline adjusted change of −6.1% (95% confidence interval [CI]: −7.5 to −4.7) for WL only, −8.6% (95% CI: −10.0 to −7.2) for WL + AT, and −9.7% (95% CI: −11.1 to −8.4) for WL + RT. Combined, the two physical activity + WL training groups had greater improvement in walk time than WL alone (mean difference 16.9 seconds [95% CI: 9.7 to 24.0], *p* < .0001). Baseline adjusted change in knee extensor strength was no greater with WL + RT than WL + AT (mean difference −3.6 Nm [95% CI: −7.5 to 0.3], *p* = .07).

89.	**Shah K, Stufflebam A, Hilton TN, Sinacore DR, Klein S, Villareal DT. Diet and exercise interventions reduce intrahepatic fat content and improve insulin sensitivity in obese older adults. Obesity (Silver Spring, Md). 2009;17(12):2162-8.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** USA ***Centers:*** Washington University School of Medicine ***Setting:*** n/a ***Funding Sources:*** National Center for Research Resource ***Dropout rates:*** 5% ***Study limitations:*** n/a	**Total no. Patients:** 18 **Inclusion criteria:** BMI ≥30 kg/m², age 65-82 years, sedentary lifestyle, stable body weight (±2kg) over the past year, and no changes in medications for at least 6 months before enrolling in the study **Exclusion criteria:** diabetes, current smoking history, anemia, severe cardiopulmonary disease, renal disease, visual, hearing, or cognitive impairments, history of malignant neoplasm, and recent use of corticosteroid or sex-steroid compounds agents	• **Diet therapy**: balanced diet to provide energy deficit of 500-1000 kcal/day from daily energy requirement, 30% of energy as fat, 50% as carbohydrate, and 20% as protein. Once 10% body weight was lost, total caloric intake was again adjusted to maintain a constant body weight and prevent further weight loss. On a weekly basis, the subjects met as a group for ~60 minutes with a dietitian. • **Diet and exercise training**: combination of diet and exercise training, dietary intervention identical to that of the Diet group, because of the calories burned during exercise, slightly higher caloric intake to achieve the same 10% weight loss, exercise-training program focused on improving endurance, strength, and balance, 90 min group sessions on three days each week

Notes	**Author's Conclusion:** Diet with or without exercise results in significant decreases in IHF content accompanied by considerable improvements in insulin sensitivity in obese older adults. The addition of exercise to diet therapy improves physical function and other obesity- and aging-related metabolic abnormalities.	
Outcome measures/results	• **Primary outcome**: IHF quantified by magnetic resonance spectroscopy (MRS) • **Secondary outcomes**: insulin sensitivity (assessed by oral glucose tolerance), body composition (assessed by dual-energy X-ray absorptiometry), physical function (VO_2 peak) and strength), glucose, lipids, and blood pressure (BP)	Body weight (D: -9 +/- 1%, D+E: -10 +/- 2%, both P < 0.05) and fat mass (D: -13 +/- 3%, D+E -16 +/- 3%, both P < 0.05) decreased in both groups but there was no difference between groups. IHF decreased to a similar extent in both groups (D: -46 +/- 11%, D+E: -45 +/- 8%, both P < 0.05), which was accompanied by comparable improvements in insulin sensitivity (D: 66 +/- 25%, D+E: 68 +/- 28%, both P < 0.05). The relative decreases in IHF correlated directly with relative increases in insulin sensitivity index (ISI) (r = -0.52; P < 0.05). Improvements in VO_2 peak, strength, plasma triglyceride (TG), and low-density lipoprotein-cholesterol concentration, and diastolic BP occurred in the D+E group (all P < 0.05) but not in the D group.

90.	**Villareal DT, Chode S, Parimi N, Sinacore DR, Hilton T, Armamento-Villareal R, et al. Weight loss, exercise, or both and physical function in obese older adults. The New England journal of medicine. 2011;364(13):1218-29.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1++	***Countries:*** USA ***Centers:*** Washington University School of Medicine, St. Louis, New Mexico Veterans Affairs Health Care System, University of New Mexico School of Medicine ***Setting:*** n/a ***Funding Sources:*** National Institutes of Health ***Dropout rates:*** 13%	**Total no. Patients:** 107 **Inclusion criteria:** 65 years of age or older, obese (BMI of 30 or more), sedentary lifestyle, stable body weight during the previous year, stable medications for 6 months before enrollment, mild-to-moderate frailty **Exclusion criteria:** severe cardiopulmonary disease, musculoskeletal or	• **Control group**: Participants assigned to the control group did not receive advice to change their diet or activity habits and were prohibited from participating in any weight-loss or exercise program. They were provided general information about a healthy diet during monthly visits with the staff. • **Diet group**: Participants assigned to the diet group were prescribed a balanced diet that provided an energy deficit of 500 to 750 kcal per day from their daily energy requirement. The diet contained approximately 1 g of high-quality protein per kilogram of body weight per day. Participants met weekly as a group with a dietitian for adjustments of their caloric intake and for behavioral

	Study limitations: study was not powered to determine potential differences in the outcomes between sexes, small sample size, most of the participants were women, white, well educated, and older (70±4 years of age)	neuromuscular impairments that preclude exercise training, visual, hearing or cognitive impairments, history of cancer, persons receiving drugs that affect bone health and metabolism, current smoking	therapy. The goal was to achieve a weight loss of approximately 10% of their baseline body weight at 6 months and to maintain that weight loss for an additional 6 months. • **Exercise group**: Participants in the exercise group were given information regarding a diet that would maintain their current weight and participated in three group exercise-training sessions per week. Each session was approximately 90 minutes in duration and consisted of aerobic exercises, resistance training, and exercises to improve flexibility and balance. • **Diet-exercise group**: Participation in both the weight-management and exercise programs.
Notes	**Author's Conclusion:** These findings suggest that a combination of weight loss and exercise provides greater improvement in physical function than either intervention alone.		
Outcome measures/results	• **Primary outcome:** change in score on the modified Physical Performance Test • **Secondary outcomes**: other measures of frailty, body composition, bone mineral density, specific physical functions, and quality of life.		A total of 93 participants (87%) completed the study. In the intention-to-treat analysis, the score on the Physical Performance Test, in which higher scores indicate better physical status, increased more in the diet-exercise group than in the diet group or the exercise group (increases from baseline of 21% vs. 12% and 15%, respectively); the scores in all three of those groups increased more than the scores in the control group (in which the score increased by 1%) ($P<0.001$ for the between-group differences). Moreover, the peak oxygen consumption improved more in the diet-exercise group than in the diet group or the exercise group (increases of 17% vs. 10% and 8%, respectively; $P<0.001$); the score on the Functional Status Questionnaire, in which higher scores indicate better physical function, increased more in the diet-exercise group than in the diet group (increase of 10% vs. 4%, $P<0.001$). Body weight decreased by 10% in the diet group and by 9% in the diet-exercise group, but did not decrease in the exercise group or the control group ($P<0.001$). Lean body mass and bone mineral density at the hip decreased less in the diet-exercise group than in the diet group (reductions of 3% and 1%, respectively, in the diet-exercise group vs. reductions of 5% and 3%, respectively, in the diet group; $P<0.05$ for both comparisons). Strength,

		balance, and gait improved consistently in the diet-exercise group ($P<0.05$ for all comparisons). Adverse events included a small number of exercise-associated musculoskeletal injuries.

IV Recommendations to identify, treat and prevent dehydration in older persons

IV.1 How much should older persons drink each day?

Recommendation 61

Older women should be offered at least 1.6 L of drinks each day, while older men should be offered at least 2.0 L of drinks each day unless there is a clinical condition that requires different approach. (BM)

Grade of recommendation B – strong consensus (96 % agreement)

91.	**EFSA Panel on Dietetic Products Nutrition and Allergies (NDA). Scientific Opinion on Dietary Reference Values for Water. EFSA journal. 2010;8(3):48.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Scientific Opinion 2+	***Countries:*** n/a ***Centers:*** n/a ***Setting:*** n/a ***Funding Sources:*** ***Dropout rates:*** n/a ***Study limitations:*** n/a	**Total no. Patients:** n/a **Inclusion criteria:** n/a **Exclusion criteria:** n/a	n/a
Notes	**Author's Conclusion:** The Panel concludes that available data for adults permit the definition of adequate intakes and that these adequate intakes should be based both on observed intakes and on considerations of achievable or desirable urine osmolarity. Adequate total water intakes for females would have to be 2.0 L/day and for males 2.5 L/day. The Panel defines the same adequate intakes for the elderly as for adults, because both renal concentrating capacity and thirst are decreasing with age. **Note:** Research suggests that ~80% of fluid intake is from drinks, ~20% from foods and metabolism, hence drinks recommendations are 80% of total water intakes.		
Relevant recommendations/ statements	Several studies show that elderly persons have lower total water intakes than younger adults, and that particularly women are at risk of too low intake. This has adverse effects on mental status and activities of daily life. Adequate intakes of water for the elderly, therefore, should not be based solely on observed intakes, but should take into account the decreases in renal concentrating capacity with age and the decrease in thirst sensitivity. The Panel has decided to follow the decision of the Institute of Medicine (United States) to set, therefore, the adequate total intake of water for elderly at the same level as for younger adults.		

IV.2 What should older persons drink each day?

Recommendation 62

A range of appropriate (i.e. hydrating) drinks should be offered to older people according to their preferences. (BM)

Grade of recommendation B – strong consensus (100 % agreement)

92.	**Maughan RJ, Watson P, Cordery PA, Walsh NP, Oliver SJ, Dolci A, et al. A randomized trial to assess the potential of different beverages to affect hydration status: development of a beverage hydration index. The American journal of clinical nutrition. 2016;103(3):717-23.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1++	***Countries:*** UK ***Centers:*** Loughborough, Bangor, Stirling ***Setting:*** n/a ***Funding Sources:*** European Hydration Institute ***Dropout rates:*** 15.3% ***Study limitations:*** the results of the study relate only to the acute effects of a large bolus of fluid over the subsequent 4h	**Total no. Patients:** 85 **Inclusion criteria:** male, healthy, physically active, between 18 and 35 **Exclusion criteria:** history of cardiovascular, renal, muscoskeletal, or metabolic disease, currently undertaking an energy-restricted diet and/ or exercise plan	Each participant consumed still water and 3 of the following drinks in a randomized, counter-balanced order: sparkling water, cola, diet cola, sports drink, oral rehydration solution, orange juice, Lager beer, hot black coffee, hot black tea, cold black tea, full-fat milk or skimmed milk. Participants ingested 1L of the assigned test drink over a period of 30 min (4 equal volumes administered 7.5 min apart).
Notes	**Author's Conclusion:** BHI (beverage hydration index) may be a useful measure to identify the short-term hydration potential of different beverages when ingested in a euhydrated state.		
Outcome measures/results	The main outcome measure was cumulative urine mass after ingestion of each drink (also expressed as a BHI for each beverage by dividing each individual´s cumulative urine mass after still water with cumulative urine mass for each other test drink consumed).		Total urine masses (mean ± SD) over 4 h were smaller than the still-water control (1337 ± 330 g) after an oral rehydration solution (ORS) (1038 ± 333 g, $P < 0.001$), full-fat milk (1052 ± 267 g, $P < 0.001$), and skimmed milk (1049 ± 334 g, $P < 0.001$). Cumulative urine output at 4 h after ingestion of cola, diet cola, hot tea, iced tea, coffee, lager, orange juice, sparkling water, and a sports drink were not different from the response to water ingestion. The mean BHI at 2 h was 1.54 ± 0.74 for the ORS, 1.50 ± 0.58 for

		full-fat milk, and 1.58 ± 0.60 for skimmed milk.

93.	Grandjean AC, Reimers KJ, Bannick KE, Haven MC. The effect of caffeinated, non-caffeinated, caloric and non-caloric beverages on hydration. Journal of the American College of Nutrition. 2000;19(5):591-600.		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
RCT 1+	***Countries:*** n/a ***Centers:*** n/a ***Setting:*** free-living ***Funding Sources:*** supported by a grant from Coca-Cola Company	**Total no. Patients:** n=18 **Inclusion criteria:** males, 19-39 years, normal stable weight, exercise less than four one-hour sessions per week, not participate in sports on a routine and competitive basis, willing to abstain from alcohol on specified days of the testing period, usual, average caffeine consumption (20-1000 mg/ day), normal gastrointestinal function, consume diet without extreme food, beverage or dietary supplement intakes, willing to abstain from supplements during the study, free of medications that might influence weight, fluid or electrolyte balance, free of any chronic illnesses, live, work in an environment of ambient temperature with no significant temperature or humidity variation, fairly routine schedule day to day (including nocturnal sleep patterns) **Exclusion criteria:** n/a	1) Water (TxA) 2) Water + caffeinated, carbonated cola (TxB) 3) Water + caffeinated, carbonated non-caloric cola (TxC) 4) Water + caffeinated carbonated cola, caffeinated, carbonated non-caloric cola and instant coffee (TxD) 5) Half water, half carbonated citrus, non caffeinated soft drink (TxE) ➔ A-D was counterbalanced and randomized ➔ E was not randomized, undertaken as an ancillary experiment by a subset of 10 volunteers after successful completion of Tx A-D ➔ Consummation of treatment beverages on Wednesdays (Tuesday and Wednesday of each week → subjects followed a prescribed diet) ➔ Laboratory each week: Wednesday and Thursday mornings ➔ 35 mL/kg body weight/day (water from foods of the study diet an 300 mL for metabolic water was subtracted) ➔ Diet: personalized one-day menu for each subject

	Dropout rates: n/a ***Study limitations:*** small sample size, ward setting would have added greater degree of control, biochemical variables used were not sensitive enough to mark small changes in hydration status		
Notes	• Clinical guidelines were used to determine fluid allowance for each subject; recruitment through flyers, advertisements and mailings distributed throughout the university medical center campus; screenings via telephone interview • Subjects were allowed to carry on with their usual activities that were consistent with the protocol • After post-treatment data collection on Thursday morning: subjects followed their usual dietary habits including their normal caffeine beverage consumption • Portable scale accurate: body weight 2x/day; home data booklets: record daily output information **Author's Conclusion:** This preliminary study found no significant differences in the effect of various combinations of beverages on hydration status of healthy adult males. Advising people to disregard caffeinated beverages as part of the daily fluid intake is not substantiated by the results of this study. The across-treatment weight loss observed, when combined with data on fluid-disease relationships, suggests that optimal fluid intake may be higher than common recommendations.		
Outcome measures/results	• Body weight: pre- and posttreatment fasted early-morning body weight • Urine assay : electrolytes, creatine, osmolality, specific gravity; Collection: pre, 24-hour, post each treatment • Blood assay: hemoglobin, hematocrit, electrolytes, osmolality, urea nitrogen, creatinine, protein ➔ Wednesday = treatment day ➔ Measurements before and after treatment ➔ Consumption of beverages in a 24-h period 6:00 a.m. to 10:00 p.m. (except for TxD: entire coffee between 6:00 and 10:00 a.m.		• Slightly body weight loss observed in all treatments (average of 0.30%) • No differences among treatments found for body weight changes or any of the biochemical assays ($p>0.05$) • Creatinine increased on all treatments except for an 8.9% decrease in 10 subjects of TxE • Urinary osmolality increased (pre to post) an average of 4.7% on TxA and 5.3% on TxD; decrease on TxB, C and E. • Urinary specific gravity remained unchanged for Tx A, B and C; increase 0.0001 on TxD • Mean caffeine intake: 114 mg/d ± 26 for both TxB and TxC 253 mg/d ± 59 mg/d for TxD vs. usual intake rage: 61 mg/d to 464 mg/d

IV.3 Which older persons are at risk of low-intake dehydration?

<u>Recommendation 63</u>

All older persons should be considered to be at risk of low-intake dehydration and encouraged to consume adequate amounts of drinks. (BM)

Grade of recommendation GPP– strong consensus (100% agreement)

94.	**Hooper L, Abdelhamid A, Ali A, Bunn DK, Jennings A, John WG, et al. Diagnostic accuracy of calculated serum osmolarity to predict dehydration in older people: adding value to pathology laboratory reports. BMJ open. 2015;5(10):e008846.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Diagnostic accuracy study 1+	***Countries:*** n/a ***Centers:*** n/a ***Setting:*** living in community, residential care, acute medical care, emergency room, hospitalized ***Funding Sources:*** NHS England, National Institute of Health Research Fellowship programme, European Union´s Seventh Framework Programme grant agreement no. 266486, medical training and clinical research (ALF) ***Dropout rates:*** n/a ***Study limitations:*** lack of incorporation of alcohol into the equations→ only assess effect of mild	**Total no. Patients:** n=595 (across 5 cohorts) **Inclusion criteria:** ≥65 years **Exclusion criteria:** age< 65 years, missing of any serum/plasma osmolality, serum sodium, potassium, urea, glucose measurements, presented values resulting from artefact or physiological extremes	5 cohorts: 1) Dietary Strategies for Healthy Ageing in Europe (NU-AGE, living in the community): RCT multicenter, of healthy, independent older people (without frailty, heart failure, serious chronic illness) responsible for their own shopping/cooking/meal choice and preparation, 65-79 years; Department of Clinical Biochemistry, Norfolk and Norwich University Hospital, Norfolk, UK; included in this Accuracy study n=236 from 271 2) Dehydration Recognition In our Elders (DRIE, living in residential care): ≥65 years, Norfolk or Suffolk (UK), variety of cognitive and/or functional impairment; exclusion: hearts failure, end-stage renal failure, terminal illness; Department of Clinical Biochemistry; included in this Accuracy analysis n=172 from 201 3) Fortes (admitted to acute medical care): ≥60 years, excluded: too unwell, begun medical treatment or rehydration already; Becton Dickinson, Oxford, UK; included in this Accuracy study n= 97 from 180 4) Sjöstrand (emergency room): ≥75 years, not critically ill; excluded: ACE inhibitors, diuretics, β-blockers, heart failure, under influence of alcohol; Karolinska ISO-certified laboratory; included in this Accuracy stud n=36 from 41 5) Pfortmueller cohorts (hospitalized with liver cirrhosis): retrospective analysis; Department of clinical Chemistry, Bern

	inebriation, only found modestly affected results, limited information of alcohol intake in any cohort		University Hospital; included in this Accuracy study n=54 from 312
Notes	• Reference standard for hydration status: Directly measured serum/plasma osmolality: current dehydration (serum osmolality >300 mOsm/kg), impending/current dehydration (≥295 mOsm/kg); hydrated (275 to <295 mOsm/kg) • Index test: 39 osmolarity equations calculated using serum indices from the same blood draw as directly measured osmolality • For clarity: written all equations using SI units; Direct osmolality measured in mOsm/kg; osmolarity in mOsm/L; serum sodium, potassium, urea, glucose in mmol/L **Author's Conclusion:** Some commonly used osmolarity equations work poorly, and should not be used. Given costs and prevalence of dehydration in older people we suggest use of the best formula by pathology laboratories using a cut point of 295 mOsm/L (sensitivity 85%, specificity 59%), to report dehydration risk opportunistically when serum glucose, urea and electrolytes are measured for other reasons in older adults.		

Outcome measures/results	• Assessment of osmolarity equations: directly measured osmolality, sodium, potassium, glucose and urea from a single blood draw for each participant
	  ▪ Ran equations with and without multiplication
	  ▪ Assessment of equivalence of each of the 39 calculated osmolarity equations to reference standard
	• Estimated-glomerular filtration rate (eGFI): calculated with the Modification of Diet in renal Disease formula, truncated at 90 to reflect clinical practice
			• Absolute bias varied from -37.6 mOsm (Fortes) to 31.8 mOsm (NU-AGE)
			• Predictive accuracy: 70-90% for most equations NU-AGE, DIRE, Sjöstand, lower in Fortes (40-50%) and Pfortmueller (30-50%)
			• 19% of 595 patients were dehydrated (osmolality > 300 mOsm/kg)
			• Of 39 osmolality equations, 5 showed reasonable agreement with directly measured osmolality and 3 had good predictive accuracy in subgroups with diabetes and poor renal function
			• Bland-Altman analysis (for the 5 equations): better agreement NU-AGE, DIRE, Fortes (formula 32); formula 32 second to 33 for Sjöstrand, not good for Pfortmueller
			• Differential bias (5 equations): difference was positively associated with direct measured osmolality, correlations less strong for equations 32,33
			• Diagnostic accuracy:
			  ▪ Combined data set: equations 32,33 similar diagnostic accuracy (ROC (AUC) 0.831 and 0.828; sensitivity ≥80%, specificity 67%
			  ▪ 2 equations characterized by narrower limits of

		agreement, low levels of differential bias and good diagnostic accuracy in receiver operating characteristic plots (areas under the curve >0.8) ▪ Overall diagnostic accuracy: slope of 0.85, is tangent to the equation 32 ROC curve at the cut point of 295 mOsm/L giving sensitivity of 84.5% and specificity of 58.9% • Best equation: osmolarity = 1.86x((Na+)+(K+))+1.15xglucose+urea+14 (all measured in mmol/L) • Useful in people aged ≥65 years with/without diabetes, poor renal function, dehydration, in men and women, with a range of aged, health, cognitive and functional status

95.	**El-Sharkawy AM, Watson P, Neal KR, Ljungqvist O, Maughan RJ, Sahota O, et al. Hydration and outcome in older patients admitted to hospital (The HOOP prospective cohort study). Age and ageing. 2015;44(6):943-7.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Prospective cohort study 2++	***Countries:*** UK ***Centers:*** UK teaching hospital, single-center study ***Setting:*** hospital ***Funding Sources:*** Grant from the European Hydration Institute; Authors: PW/RJM received funding from food and beverage industry, DNL received funding from Fresenius Kabi	**Total no. Patients:** n=200 **Inclusion criteria:** >65 years, admitted to hospital as an emergency **Exclusion criteria:** patients who were moribund, terminal illness, predicted life expectancy of <3 months, admission >12 h ago, refusal to participate	Prevalence of HD in hospitalized adults → assessment of impact of HD on short-term and long-term outcomes

	Dropout rates: n/a ***Study limitations:*** serum-osmolality does not necessarily represent overall 24-h fluid balance, HD may be a manifestation of disease severity		
Notes	• hyperosmolar dehydration (HD) defined as serum osmolality >300 mOsmol/kg • Repetition of the measurements 48 h after admission (participants who were still in hospital at that time); Participants who had been discharged were not reviewed • Follow-up: using hospital´s electronic records, participants were reviewed at 30 days, 90 days and 12 months after admission **Author's Conclusion:** HD is common in hospitalized older adults and is associated with poor outcome. Coordinated efforts are necessary to develop comprehensive hydration assessment tools to implement and monitor a real change in culture and attitude towards hydration in hospitalized older adults.		
Outcome measures/results	• Hard endpoint: mortality • Other endpoints: length of stay, discharge destination Measurements: • Charlson comorbidity index (CCI): medical notes, demographics, cause of hospital admission, co-morbidities • National early warning score (NWES) • Frailty: Canadian Study of Health and Aging (CSHA) clinical frailty scale • Malnutrition: Nutrition Risk Screening Tool (NRS) 2002 • Barthel activity of daily living index (ADL) • Cognitive function: mini mental state examination (MMSE), confusion assessment method (CAM) • Fluid intake: questions about consumption habit, average number of cups of beverages consumed		• 37%(n=69) of n=200 patients were dehydrated • Of the 37%(n=69) 61%(n=22) were still dehydrated after 48 h • 7% (n=14) died in hospital; 79% (n=11) of whom were dehydrated at admission (p=0.001) • 30-day mortality greater in those dehydrated at admission than those euhydrated (n=11 (16%) vs. n=5 (4%); p=0.001) • Cox regression analysis (age, gender, CCI, NEWS, CSHA, NRS): participants dehydrated at admission 6 times more likely to die in hospital than those euhydrated (HR 6.04 (1.64-22.25);p=0.007)

	• Blood samples: Serum osmolality, serum concentrations (sodium, potassium, urea, creatinine, eGFR, full blood count) • Urine sample		

96.	**Marra MV, Simmons SF, Shotwell MS, Hudson A, Hollingsworth EK, Long E, et al. Elevated Serum Osmolality and Total Water Deficit Indicate Impaired Hydration Status in Residents of Long-Term Care Facilities Regardless of Low or High Body Mass Index. Journal of the Academy of Nutrition and Dietetics. 2016;116(5):828-36.e2.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Cohort study 2+	***Countries:*** USA ***Centers:*** n/a ***Setting:*** long term care (LTC) settings ***Funding Sources:*** National Institutes on Aging; Agency for Healthcare Research and Quality R01; The National Center for Research Resources and The National Center for Advancing Translational Science ***Dropout rates:*** n/a ***Study limitations:***	**Total no. Patients:** 247 **Inclusion criteria:** being long-stay (not admitted for short-term rehabilitation), not being provided with enteral or parenteral nutrition, not receiving hospice care, and having a written order for daily caloric supplementation (between-meal snacks or oral nutrition supplements) **Exclusion criteria:** n/a	Between-meal snacks versus oral nutrition supplements

	-serum osmolality levels were not available for 46.6% of subjects -physical assessment of hydration status (e.g., skin turgor, sunken eyes or tongue dryness) was not performed, which might assist in defining dehydration or determining relationships between hydration status and total water intake -although the formulas used to determine adequacy of total water intake are frequently used in clinical practice, it is understood that there is limited evidence of their validity and reliability in the LTC population -the findings presented here may not be generalizable to all LTC residents because having a prescription for some form of caloric supplementation (between-meal snacks or ONS) was a requirement for study inclusion		
Notes	**Author's Conclusion:**		

	Dehydration and inadequate total water intake is prevalent in LTC residents across all BMI categories. Type of liquid beverages, type of ONS, and type of between-meal snacks are factors that could be targeted for nutrition interventions designed to prevent or reverse dehydration.	
Outcome measures/results	Hydration status was assessed by serum osmolality concentration and total water intakes were quantified by weighed food, beverage, water and oral nutrition supplement (ONS) intake.	Forty-nine (38.3%) subjects were dehydrated (>300 mOsm/kg) and another 39 (30.5%) had impending dehydration (295–300 mOsm/kg). The variance in serum osmolality was significantly accounted for by blood urea nitrogen level, mental status score, and having diabetes ($R2 = 0.46$, $P < 0.001$). Total water intake averaged 1147.2 ± 433.1 mL/d. Thus, 96–100% subjects did not meet estimated requirements, with a deficit range of 700–1800 mL/d. The variance in total water intake was significantly accounted for by type of liquid beverages (thin vs thick), type of ONS, total energy intake, total activities of daily living dependence, sex and BMI ($R2 = 0.56$, $P < 0.001$).

IV.5 How should low-intake dehydration be identified in older persons?

Recommendation 66

An action threshold of directly measured serum osmolality >300 mOsm/kg should be used to identify low-intake dehydration in older adults. (BM)

Grade of recommendation B – strong consensus (94 % agreement)

98.	**Cheuvront SN, Ely BR, Kenefick RW, Sawka MN. Biological variation and diagnostic accuracy of dehydration assessment markers. Am J Clin Nutr. 2010;92(3):565-73.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Cohort study 2++	***Countries:*** USA ***Centers:*** n/a ***Setting:*** n/a ***Funding Sources:*** n/a ***Dropout rates:*** 0 % ***Study limitations:*** n/a	**Total no. Patients:** n=18 **Inclusion criteria:** Healthy volunteers who passed the Army Physical Fitness Test within the previous six months **Exclusion criteria:** n/a	Phase I: Generation of an euhydrated state by consumption of approx.. 3.6 L of fluids; biological variations were studied. Phase II: The subjects were dehydrated by inducing sweating; dehydration markers were measured.
Notes	**Author's Conclusion:** Values that occur between euhydration and dehydration represent the typical human variation in homeostatic set points because of biology (1, 20) as well as social (ie, diet) and environmental (ie, exercise and climate) influences. Currently, the Posm provides the best potential measure for static dehydration assessment, whereas dynamic dehydration assessment is best accomplished by using P_{osm}, U_{sg}, and B_m. The use of ≥2 markers should provide added diagnostic confidence when serial measures are made.		
Outcome measures/results	Plasma volume and body fluid (urine and saliva) osmometry (P_{osm}, U_{osm} and S_{osm}); urine specific gravity (U_{sg}); urine color (U_{col}); body mass; percentage dehydration;		All dehydration markers displayed substantial individuality and one-half of the dehydration markers displayed marked heterogeneity of intraindividual variation. Decision levels for all dehydration markers were within one SD of the ROC criterion values, and most levels were nearly identical to the prospective group means after volunteers were dehydrated by 1.8–7.0% of body mass. However, only plasma osmolality (P_{osm}) showed statistical promise for use in the static dehydration assessment. A diagnostic decision level of 301 6 5 mmol/kg was proposed. Reference change values of 9 mmol/kg (P_{osm}), 0.010 [urine specific gravity (U_{sg})], and 2.5% change in body mass were also statistically valid for

		dynamic dehydration assessment at the 95% probability level.

99.	**Wachtel TJ, Tetu-Mouradjian LM, Goldman DL, Ellis SE, O'Sullivan PS. Hyperosmolarity and acidosis in diabetes mellitus: a three-year experience in Rhode Island. J Gen Intern Med. 1991;6(6):495-502.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Retrospective chart review 2+	***Countries:*** USA ***Centers:*** 15 community hospitals in Rhode Island ***Setting:*** n/a ***Funding Sources:*** n/a ***Dropout rates:*** n/a ***Study limitations:*** n/a	**Total no. Patients:** n = 613 **Inclusion criteria:** serum glucose > 300 mg/dL and a bicarbonate (HCO_3) < 15 mEq/L, or a serum glucose> 600 mg/dL; total serum osmolarity > 320 mOsm/L and a serum glucose > 600 mg/dL for being included as a case of diabetic hyperosmolar state (DHS); bicarbonate level 15 mEq/L and a serum glucose > 300 mg/dL to be included as a diabetic acidosis (DA) **Exclusion criteria:** n/a	n/a
Notes	**Author's Conclusion:** We conclude that 1) many patients experience mixed DA (diabetic ketoacidosis) and DHS rather than either condition alone, 2) both DA (diabetic ketoacidosis) and DHS occur in young and old diabetic persons, 3) infection is the most common predisposing factor for either condition, and 4) higher osmolarity, older age, and nursing home residence are associated with nonsurvival in DHS.		
Outcome measures/results	Three predisposing factors for DA or DHS, including 1) new onset of diabetes, 2) presence of an infection, and 3) compliance with treatment (all three as described by the attending physician in the medical record). If a subject had		Patients with DA alone were younger and patients with DHS alone were older. However, 28 (10%) of the 2 78 cases of DHS alone and 72 (36%) of the 200 cases of mixed DA and DHS occurred in patients under the age of 30. Eighteen cases (13%) of DA alone and 62 cases (31%) of mixed DA and

	more than one predisposing factor, only one was noted, with the following priority: new onset of diabetes, infection, and noncompliance; Biochemical values: serum glucose, blood urea nitrogen, sodium, potassium, chloride, bi- carbonate, and the presence of ketones in the blood or urine; information about level of consciousness on admission	DHS occurred in patients over the age of 60. The results were not substantially changed when effective osmolarity > 310 mOsm/L was used to define hyperosmolarity and when only cases with documented diabetic ketoacidosis were included. An infection was the most common precipitating factor of DA (30%), DHS (27%), and mixed cases (32%). Other corn- mort associated factors included noncompliance with treatment (20% for DA, 12% for DHS, and 22% for mixed cases) and previously undiagnosed diabetes (24% for DA, 18% for DHS, and 10% for mixed cases). Nursing home residents accounted for 0.7% of DA cases, 18% of DHS cases, and 4.5% of mixed cases. Mortality was 4% for DA, 12% for DHS, and 9% for mixed cases. The mortality for DHS is the lowest reported in the literature, continuing a downward trend that began in the 1970s. Nonsurvival was associated with older age, higher osmoiarity, and nursing home residence. Survival was associated with the presence of an infection.

100.	**Institute of Medicine. Panel on Dietary Reference Intakes for Electrolytes and Water. Dietary Reference Intakes for Water, Potassium, Sodium, Chloride, and Sulfate. Washington DC, USA: National Academies Press. 2004.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Book on dietary reference intakes n/a	***Countries:*** n/a ***Centers:*** n/a ***Setting:*** n/a ***Funding Sources:*** n/a ***Dropout rates:*** n/a ***Study limitations:*** n/a	**Total no. Patients:** n/a **Inclusion criteria:** n/a **Exclusion criteria:** n/a	n/a
Notes	**Author's Conclusion:** For water, plasma or serum osmolality is an acceptable indicator of hydration status; however, trials that rigorously control and test different levels of total water intake, rather than allowing *ad libitum* intakes, have not been performed.		
Relevant recommendations/	Plasma osmolality provides a marker of dehydration levels. Osmolality is closely controlled by homeostatic systems and is the primary physiological signal used to regulate water balance, resulting in changes in urine output and fluid consumption. Plasma osmolality rarely		

statements	varies beyond ± 2 percent and is controlled around a set-point of 280 to 290 mOsmol/kg; this set-point increases with aging and becomes more variable among people. The age-related impairments in renal-concentrating and sodiumconserving ability are associated with an increased incidence of volume depletion and hypernatremia in the elderly. Under normal physiological conditions, increased thirst and fluid intake are natural defense mechanisms against volume depletion and hypernatremia. A deficit in thirst and regulation of fluid intake in the elderly, however, may further contribute to the increased incidence of dehydration and hypernatremia. In a series of studies the osmotic threshold for thirst during hypertonic saline infusion has been found to be much higher in healthy elderly subjects than in their younger counterparts, with many apparently healthy elders not reporting thirst despite elevations of plasma osmolality to levels over 300 mOsmol/kg.

101.	**Bhalla A, Sankaralingam S, Dundas R, Swaminathan R, Wolfe CD, Rudd AG. Influence of raised plasma osmolality on clinical outcome after acute stroke. Stroke. 2000;31(9):2043-8.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Cohort study 2++	***Countries:*** UK ***Centers:*** n/a ***Setting:*** Hospital ***Funding Sources:*** Research and Development Cerebrovascular Disease Program, London, and the Stroke Association ***Dropout rates:*** n/a ***Study limitations:*** n/a	**Total no. Patients:** n = 167 **Inclusion criteria:** stroke onset accurately determinable; blood collection within 24 hours of stroke onset **Exclusion criteria:** n/a	n/a
Notes	**Author's Conclusion:** In this study we have demonstrated that high plasma osmolality levels in the acute phase of stroke are associated with excessive mortality rates. This may enable identification of stroke patients who may benefit from fluid replacement in a more systematic fashion. Further work is required to determine the scale of water homeostasis and stroke subtype. Fluid intervention trials are required to test the hypothesis that plasma osmolality levels after acute stroke are indicators of water balance and that improving plasma osmolality levels in the acute phase will also improve clinical outcome.		
Outcome	sociodemographic characteristics ; case severity;		Mean admission (300 mOsm/kg, SD 11.4), maximum (308.1 mOsm/kg, SD

measures/results	comorbidities; plasma osmolality, serum sodium, and urea within 24 h after stroke onset, after 1, 3 and 7 days after stroke; mortality	17.1), and AUC (298.3 mOsm/kg, SD 11.7) plasma osmolality were significantly higher in those who died compared with survivors (293.1 mOsm/kg [SD 8.2], 297.7 mOsm/kg [SD 8.7], and 291.7 mOsm/kg [SD 8.1], respectively; P,0.0001). Admission plasma osmolality .296 mOsm/kg was significantly associated with mortality (OR 2.4, 95% CI 1.0 to 5.9). In patients hydrated intravenously, there was no significant fall in plasma osmolality compared with patients hydrated orally (P50.68).

102.	**El-Sharkawy AM, Watson P, Neal KR, Ljungqvist O, Maughan RJ, Sahota O, et al. Hydration and outcome in older patients admitted to hospital (The HOOP prospective cohort study). Age and ageing. 2015;44(6):943-7.**
	➔ **See number 95**

103.	**Stookey JD, Purser JL, Pieper CF, Cohen HJ. Plasma hypertonicity: another marker of frailty? Journal of the American Geriatrics Society. 2004;52(8):1313-20.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Longitudinal study 2++	***Countries:*** USA ***Centers:*** Center for the Study of Aging and Human Development and Claude D. Pepper Older Americans Independence Center, Duke University Medical Center, Durham, North Carolina ***Setting:*** n/a ***Funding Sources:*** National Institute on Aging (NIA) ***Dropout rates:*** n/a ***Study limitations:*** blood samples were drawn at	**Total no. Patients:** 705 **Inclusion criteria:** Older adults (>or =70), who reported no disability and gave blood in the 1992 Duke Established Populations for Epidemiologic Studies of the Elderly survey **Exclusion criteria:** n/a	n/a

	the convenience of each subject, elevated plasma glucose levels observed in this study could reflect postprandial glucose levels as opposed to insulin-resistance		
Notes	**Author's Conclusion:** Plasma hypertonicity may be a marker of early frailty. It was prevalent in this sample of nondisabled community-dwelling older adults and predicted incident disability and mortality. Further research to identify its determinants and consequences may help inform interventions against frailty.		
Outcome measures/results	Plasma tonicity was estimated from plasma glucose, sodium, and potassium measures and used to classify subjects as normo- (285-294 mOsm/L) or hypertonic (> or =300 mOsm/L). Disability was defined as any impairment on the Rosow-Breslau, activity of daily living (ADL), and instrumental activity of daily living (IADL) scales. The relative risk (RR) of any new disability and relative hazard of death associated with hypertonicity were estimated using logistic regression models and Cox proportional hazards models, respectively.		Plasma hypertonicity (observed in 15% of subjects) was associated with increased risk of new Rosow-Breslau (RR=2.1, 95% confidence interval (CI) =1.2-3.6), IADL (RR=2.3, 95% CI=1.2-4.3), and ADL (RR=2.7 95% CI=1.3-5.6) disability by 1996 and mortality by 2000 (RR=1.4, 95% CI=1.0-1.9). Results were similar for the normoglycemic subgroup (ADL: RR=2.9, 95% CI=1.0-8.0; IADL: RR=2.5, 95% CI=1.0-6.3; Rosow-Breslau: RR=1.8, 95% CI=0.8-3.9; mortality: RR=1.5, 95% CI=0.9-2.3).

<u>**Recommendation 67**</u>

Where directly measured osmolality is not available then the osmolarity equation (osmolarity =1.86 × (Na+ + K+) + 1.15 × glucose + urea + 14 (all measured in mmol/L) with an action threshold of >295mmol/L) should be used to screen for low-intake dehydration in older persons. (BM)

Grade of recommendation B – strong consensus (94 % agreement)

104.	**Hooper L, Abdelhamid A, Ali A, Bunn DK, Jennings A, John WG, et al. Diagnostic accuracy of calculated serum osmolarity to predict dehydration in older people: adding value to pathology laboratory reports. BMJ open. 2015;5(10):e008846.**
	➔ **See number 94**

105.	**Heavens KR, Kenefick RW, Caruso EM, Spitz MG, Cheuvront SN. Validation of equations used to predict plasma osmolality in a healthy adult cohort. The American journal of clinical nutrition. 2014;100(5):1252-6.**

Study Type/ Evidence Level	Study details/limitations	Patient characteristics	Interventions
Cohort Study 2+	***Countries:*** USA ***Centers:*** US Army Research Institute of Environmental Medicine ***Setting:*** ordinary living conditions ***Funding Sources:*** supported by United States Army Medical Research and Materiel Command ***Dropout rates:*** none ***Study limitations:*** the correct identification of an osmole gap requires the absence of any such gap in a healthy cohort, only healthy cohort studied here	**Total no. Patients:** n=60 (42=m; 18 =w) **Inclusion criteria:** healthy, 19- 46 years **Exclusion criteria:** use of dietary supplements, any medication other than oral contraceptive	n/a „Our goal was to identify the most efficacious equations for use in a healthy population where unidentified osmoles would not contribute to an equation bias"
Notes	• Volunteers continued their ordinary food and fluid intakes and physical activity patterns • Before each visit: Study restrictions were limited to abstention from alcohol consumption for ≥24 h and food and fluid intakes for ≥90 min • Although an ~7% numerical discrepancy may exist between osmolality (mmol/kg) and osmolarity (mmol/L) because of a smaller molal water fraction, the rational suggestion to uniformly convert to molarity (18) or molality (19) units has not always produced consistent improvements in bias (16, 17) → for consistency all calculations referred to as providing osmolarity (mmol/L); direct measurements made on plasma: referred to as osmolality (mmol/kg) • For each equation, 163 cases were resampled • Shrinkage was assessed by using minimum threshold bootstrap R= 0.7; acceptable bootstrap models with the smallest original bias (<5 mmol) were further considered as optimal		

<table>
<tr><td></td><td colspan="2">Medium time between intraindividual blood samples was 2 days
Author's Conclusion: The use of bootstrap regression provides a unique insight for osmolality prediction equation performance from a very large theoretical population of healthy people. Of the original 36 equations evaluated, 5 equations appeared optimal for the prediction of osmolality when its direct measurement was not practical or an osmole gap was of interest. Note that 4 of 5 optimal equations were derived from a nonhealthy population.</td></tr>
<tr><td>Outcome measures/results</td><td>Plasma osmolality:
Was calculated by using 36 different equations
using freezing point depression by microosmometer
Osmolality calculated from biosensor measures of select analytes according to the dictates for each formula tested
Weight, height, blood samples
Plasma: sodium, potassium, calcium, magnesium, blood urea nitrogen, glucose, protein</td><td>No outliers were identified when applied robust liner regression to 36 plasma osmolality and plasma osmolarity
163 plasma samples; 36 equations considered for analysis, 11 equations met the prescreen variables for bootstrap regression analysis (were selected)
Of 11 equations considered, 8 met shrinkage and apparent model error thresholds, 5 equations were deemed optimal with an original model osmole gap <5 mmol (range 0.7 to -4.5 mmol)
These are the 5 optimal equations in young adults, and they include the optimal equation in older adults:
1.86 x (Na+ + K+) + 1.15 x Glucose + Urea + 14
2 x Na+ + BUN/2.8 + Glucose/18
2 x Na+ + BUN/3 + Glucose/20 + 8
2 x (Na+ + K+) + Glucose/18 +0.93 x 0.5 x BUN/2.8
2 x (Na+ + K+) + BUN/2.8 + Glucose/18
➔ There remains no consensus over which equation is the best</td></tr>
</table>

106.	Siervo M, Bunn D, Prado CM, Hooper L. Accuracy of prediction equations for serum osmolarity in frail older people with and without diabetes. The American journal of clinical nutrition. 2014;100(3):867-76.		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Cohort Study 2+	***Countries:*** UK ***Centers:*** Human Nutrition Research Centre, Institute for Ageing and Health ***Setting:*** 56 care homes	**Total no. Patients:** 186 **Inclusion criteria:** age ≥65 years, living in residential care in Norfolk and Suffolk	n/a

	Funding Sources: n/a ***Dropout rates:*** n/a ***Study limitations:*** specific to frail older people living in residential care	**Exclusion criteria:** renal failure, heart failure, in receipt of palliative care, illnesses that suggested they were unlikely to survive <3 months,	
Notes	**Author's Conclusion:** The assessment of a panel of equations for the prediction of serum osmolarity led to identification of one formula with a greater diagnostic performance. This equation may be used to predict hydration status in frail older people (as a first-stage screening) or to estimate hydration status in population studies.		
Outcome measures/results	Predictive equations, serum osmolarity, Na+, urea, creatinine, glucose, potassium, BMI, Barthel Index, MMSE score		A total of 186 people living in UK residential care took part in the Dehydration Recognition In our Elders study (66% women; mean ± SD age: 85.8 ± 7.9 y; with a range of cognitive and physical impairments) and were included in analyses. Forty-six percent of participants had impending or current dehydration (serum osmolality ≥295 mmol/kg). Participants with diabetes (n = 33; 18%) had higher glucose ($P < 0.001$) and serum osmolality ($P < 0.01$). Of 38 predictive equations used to calculate osmolarity, 4 equations showed reasonable agreement with measured osmolality. One [calculated osmolarity = $1.86 \times (Na^{+} + K^{+}) + 1.15 \times$ glucose + urea +14; all in mmol/L] was characterized by narrower limits of agreement and the capacity to predict serum osmolality within 2% in >80% of participants, regardless of diabetes or hydration status. The equation's sensitivity (79%) and specificity (89%) for impending dehydration (≥295 mmol/kg) and current dehydration (>300 mmol/kg) (69% and 93%, respectively) were reasonable.

Recommendation 68

Simple signs and tests commonly used to assess for dehydration such as skin turgor, mouth dryness, weight change, urine color or specific gravity, shall NOT be used to assess hydration status in older adults.

Grade of recommendation A – consensus (83 % agreement)

Recommendation 69

Bioelectrical impedance shall NOT be used to assess hydration status in older adults as it has not been shown to be usefully diagnostic.

Grade of recommendation A – strong consensus (100 % agreement)

107.	**Fortes MB, Owen JA, Raymond-Barker P, Bishop C, Elghenzai S, Oliver SJ, et al. Is this elderly patient dehydrated? Diagnostic accuracy of hydration assessment using physical signs, urine, and saliva markers. Journal of the American Medical Directors Association. 2015;16(3):221-8.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Prospective cross-sectional diagnostic accuracy Study 2++	***Countries:*** UK ***Centers:*** Gwynedd Hospital, Bangor, UK ***Setting:*** hospital acute medical care and emergency department ***Funding Sources:*** HydraDx Inc. ***Dropout rates:*** 26.7% ***Study limitations:*** 25µL of salvia sample for analysis meant that only 75% of the samples could be analyzed, nanotechnology	**Total no. Patients:** n=178 (85=m; 93=w) → after further exclusion: n=130 (59=m; 71=w) **Inclusion criteria:** any primary diagnosis, >60 years, admitted to acute medical care unit or emergency department **Exclusion criteria:** oral trauma, dental surgery within 14 days, swallowing problems, salivary gland tumors, were deemed too unwell by the medical staff to participate, assessed as not having capacity to consent, already begun any form of	Forms of dehydration: 1) Water-loss dehydration (n=27(21%)): Plasma osmolality > 295 mOsm/kg 2) Water-and-solute-loss dehydration (n=25(19%)): BUN: creatinine ratio ≥20, and normal plasma osmolality →forms of dehydration: n=52 3) Euhydration (n=78(60%)): Normal Plasma osmolality and BUN: creatinine ratio

	for assessment of salvia osmolality are under development, salvia: confounding effect possible!, unclear physiological mechanisms responsible for an increase in salvia osmolality during dehydration	medical treatment or rehydration therapy, renal disease, cardiac failure, reference test not available, abnormally low BUN:Cr (<10), syndrome of inappropriate antidiuretic hormone, glucocorticoid medication	
Notes	• hydration assessment within 30 min of admittance to hospital; reference standard to hydration: Plasma osmolality, blood urea nitrogen to creatinine ratio • all physical examinations and assessments of confidential medical information was carried out by the same clinical research fellow, who was blinded to the results of the reference standards and the salvia and urine index test results/salvia and urine samples: independent research assistant, who was blinded • separated comparison of dehydration forms to euhydrated control group • Salvia osmolality assessed in 98(75%) of participants; Urine color/Usg analyzed in 84 (65%) of the participants **Author's Conclusion:** With the exception of low systolic blood pressure, which could aid in the specific diagnosis of water-and-solute-loss dehydration, physical signs and urine markers show little utility to determine if an elderly patient is dehydrated. Saliva osmolality demonstrated superior diagnostic accuracy compared with physical signs and urine markers, and may have utility for the assessment of both water-loss and water-and-solute-loss dehydration in older individuals. It is particularly noteworthy that saliva osmolality was able to detect water-and-solute-loss dehydration, for which a measurement of plasma osmolality would have no diagnostic utility.		

Outcome measures/results	• Hydration assessment: 7 physical signs
	  ▪ Tachycardia >100 bpm
	  ▪ Low systolic blood pressure <100 mmHg
	  ▪ Dry mucous membrane
	  ▪ Axillary dryness
	  ▪ Poor skin turgor
	  ▪ Sunken eyes
	  ▪ Long capillary refill time >2 seconds
	• Urine color, urine specific gravity (Usg)
	• Salvia flow rate, salvia osmolality
	• Plasma osmolarity
			• Participants with water-loss dehydration: elevated plasma osmolality
			Participants with water-and-solute-loss dehydration: elevated BUN:Cr
			Compared with euhydrated control
			• No discrimination between dehydration and euhydration: Urine color, Usg, SFR (AUCroc range 0.49-0.57, all p>0.05)
			• All physical signs: poor sensitivity (0-44%) for detecting either form of dehydration; better in detecting euhydration (Specificity 60-99%)
			• Salvia osmolality greater in groups with dehydration than euhydrated control (p<0.001)

	• Blood urea nitrogen to creatinine ratio	• Low systolic blood pressure: potential utility for aiding the diagnosis of water-and-solute-loss dehydration (OR= 14.7) • Salvia osmolality: moderate diagnostic accuracy (area under the receiver operating characteristic curve = 0.76; p<0.01) to distinguish both dehydration types →water-loss dehydration: 70% sensitivity, 68% specificity, OR= 5.0; 95% CI 1.7-15.1 →water-and-solute-loss-dehydration: 78% sensitivity, 72% specificity, OR= 8.9; 95% CI 2.5-30.7 Salvia osmolality cut-off that provided the optimum balance between sensitivity and specificity: 95, 97 and 94 mOsm/kg for water-loss only, water-and-solute-loss only, and both forms of dehydration combined

108.	**Hooper L, Abdelhamid A, Attreed NJ, Campbell WW, Channell AM, Chassagne P, et al. Clinical symptoms, signs and tests for identification of impending and current water-loss dehydration in older people. The Cochrane database of systematic reviews. 2015(4):Cd009647.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Systematic Review 1++	***Countries:*** n/a ***Centers:*** n/a ***Setting:*** hospitalized, living in community or institution	**Total no. Studies:** n=212 (full-text records assessed) n= 24 (included) n= 21 (included in meta-analysis) **Inclusion criteria:** diagnostic**,** cohort, cross-sectional studies obtained in full text, assessed independently in duplicate, disagreements resolved by a third author, collected data on at least one reference standard, at least one index test, in at least 10 people aged ≥65 years who were hospitalized, living in the	• 3 studies included with published diagnostic accuracy data • Further 21 provided datasets that were analyzed • Assessment of 67 tests for diagnostic accuracy of water-loss dehydration (primary target) and current dehydration (secondary target)

	Funding Sources: n/a for Cochrane review; stated for every study included in this review ***Dropout rates:*** n/a ***Study limitations:*** heterogeneity in the reference standards accepted, equivalence of different levels of cut-offs for the different reference standards, combining index tests that may have been carried out differently in different studies/different equipment, insufficient published data to confidently pre-set three appropriate cut-offs for continuous index tests, lacking power to combine tests/develop combined diagnostic test	community, in institutions, in a developed country, may have had chronic or acute illnesses (stroke, fracture, diabetes, infection) requesting original dataset → creation of 2 x 2 tables; studies only included where proportion of those under 65 years was less than 10% **Exclusion criteria:** studies with more than 10% of participants having one or more of the following: kidney failure, cardiac failure, had not recently been prepared for surgery/undergo surgery, age <65 years in mixed populations	

<table>
<tr><td>Notes</td><td colspan="2">• Diagnostic accuracy of each test was assessed against best available reference standard for water-loss dehydration: serum/plasma osmolality cut-off ≥ 295 mOsm/kg, serum osmolarity or weight change; impeding (serum osmolality 295-300 mOsm/kg) or current (serum osmolality >300 mOsm/kg) dehydration → having water-loss dehydration, contrasted with being euhydrated (serum osmolality 275 to <295 mOsm/kg
• Each index test: data presented in forest plots of sensitivity (minimum of a useful test: 60%) and specificity (minimum 75%)
• Index tests for dehydration: dry axilla and other markers of transepidermal water loss, dry mucous membrane, dry or furrowed tongue, extended capillary refill time, measures of skin blood flow, etc.
• Body mass (weight) change: impeding dehydration reduction of 3% to 5% of body weight within 7 days or less/ or increase of 3% to 5% of body weight within 7 days as an indication that a person was dehydrated before rehydration; current dehydration: changes more than 5% of body weight; weight change over a period less than 7 days was not multiplied up to 7 day equivalent
• Heterogeneity due to different cut-off values for each index test were examined by comparing results of the bivariate random-effects meta-analyses at each cut-off point
• Risk of bias: low risk n=6, high risk n=13, unclear risk n=5
Author's Conclusion: There is limited evidence of the diagnostic utility of any individual clinical symptom, sign or test or combination of tests to indicate water-loss dehydration in older people. Individual tests should not be used in this population to indicate dehydration; they miss a high proportion of people with dehydration, and wrongly label those who are adequately hydrated. Promising tests identified by this review need to be further assessed, as do new methods in development. Combining several tests may improve diagnostic accuracy.</td></tr>
<tr><td>Outcome measures/results</td><td>• Primary target: water-loss dehydration (including impending or current water-loss dehydration)
• Body mass (weight) change: included where at baseline weight was measured and re-weighing occurred within 7 days
• Secondary targets:
1. To assess the effect of different cut-offs of index test results assessed using continuous data on sensitivity and specificity in diagnosis of water-loss dehydration.
2. To identify clinical symptoms, signs and tests that may be used in screening for water-loss dehydration in older people.
3. To identify clinical symptoms, signs and tests that are not useful in screening for water-loss dehydration in older people.
4. To assess clinical symptoms, signs and tests of current</td><td>• 3 tests showed any ability to diagnose water-loss dehydration (both impeding and current) as stand-alone tests:
▪ expressing fatigue (sensitivity 0.71 (95% CI 0.29 to 0.96), specificity 0.75 (95% CI 0.63 to 0.85), in one study with 71 participants, but two additional studies had lower sensitivity);
▪ missing drinks between meals (sensitivity 1.00 (95% CI 0.59 to 1.00), specificity 0.77 (95% CI 0.64 to 0.86), in one study with 71 participants)
▪ BIA resistance at 50 kHz (sensitivities 1.00 (95% CI 0.48 to 1.00) and 0.71 (95% CI 0.44 to 0.90) and specificities of 1.00 (95% CI 0.69 to 1.00) and 0.80 (95% CI 0.28 to 0.99) in 15 and 22 people respectively for two studies, but with sensitivities of 0.54 (95% CI 0.25 to 0.81) and 0.69 (95% CI 0.56 to 0.79) and specificities of 0.50 (95% CI 0.16 to 0.84)</td></tr>
</table>

	dehydration (including all those with serum osmolality > 300 mOsm/kg). 5. To assess clinical symptoms, signs and tests of impending dehydration (including all those with serum osmolality 295 to 300 mOsm/kg). 6. To directly compare promising index tests (sensitivity ≥ 0.60 and specificity ≥ 0.75) where two or more are measured in a single study (direct comparison). 7. To carry out an exploratory analysis to assess the value of combining the best three index tests where the three tests each have some predictive ability of their own, and individual studies include participants who had all three tests.	and 0.19 (95% CI 0.17 to 0.21) in 21 and 1947 people respectively in two other studies) ▪ In post-hoc ROC plots drinks intake, urine osmolality and axillial moisture also showed limited diagnostic accuracy • Combining two tests so that an individual both missed some drinks between meals and expressed fatigue was sensitive at 0.71 (95% CI 0.29 to 0.96) and specific at 0.92 (95% CI 0.83 to 0.97) • No test was consistently useful in more than one study and in diagnosing current water-loss dehydration

109.	**Hooper L, Bunn DK, Abdelhamid A, Gillings R, Jennings A, Maas K, et al. Water-loss (intracellular) dehydration assessed using urinary tests: how well do they work? Diagnostic accuracy in older people. The American journal of clinical nutrition. 2016;104(1):121-31.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Diagnostic Accuracy study/cohort study 2++	***Countries:*** UK ***Centers:*** n/a ***Setting:*** living in long-term care or in the community ***Funding Sources:*** NHS England, National Institute for Health Research fellowship programme, European Union´s Seventh Framework Program ***Dropout rates:*** n/a	**Total no. Patients:** n=313 **Inclusion criteria:** ≥65years NEW-AGE: free from frailty and current or recent chronic diseases, free living, able and willing to provide informed consent **Exclusion criteria:** DRIE: renal/heart failure, receiving palliative care, unlikely to survive ≥3 months, too anxious or unwell to be approached, care home manager who reported that the resident did not wish to	2 prospective cohort studies included: (cross-sectional) 1) DIRE (Dehydration Recognition in our Elders; living in long-term care): women: 67%; mean age: 86 y; n = 162 Aim: quantify the diagnostic accuracy of clinical and physical signs of water-loss dehydration in frail older people ≥65 years, living in residential care, nursing homes, specialist dementia care, mixed homes in Norfolk/Suffolk, UK Laboratory for blood samples: Norfolk/Norwich University Hospital 2) NU-AGE (Dietary Strategies for Healthy Aging in Europe; living in the community): women: 64%; mean age: 70 y; n = 151 RCT, multicenter (n=5); Norfolk, UK Aim: assess the effects of a year's dietary intervention based on recommendations, specifically developed for the elderly, on markers of inflammation and a series of related health outcomes

	Study limitations: no reproducibility of assessments of the 2 studies, urine color may be altered (food, medication, medical condition),different urine collection in the 2 cohorts, older people with different characteristics in the 2 cohorts	participate, if sample was not obtained at the second attempt	including cognitive function, physical ability, bone mineral density, body composition, and cardiovascular markers age 65-79 Laboratory: Norwich Clinical Research Trials Unit (CRTU)
Notes	• Minimum useful diagnostic accuracy was set at sensitivity and specificity ≥ 70%, or receiver operating characteristic plot area under the curve ≥0.70 • Classification dehydration: normally hydrated (serum osmolality 275 to <295 mOsm/kg), having impending dehydration (295–300 mOsm/kg), or current dehydration (>300 mOsm/kg) • DIRE study: researchers were blinded to each other's readings • Reproducibility of the assessment of urine color, pH and protein was low for both studies • The interrater reliability was high for most urinary tests with exceptions being urinary color, pH, and protein. Protein readings were all either negative or trace, and we had already decided, as raters, that negative and trace readings could not be distinguished • Urine collection was different: 24-h samples taken over the day before the blood sample and frozen; and urine samples taken from 30 min before to 120 min after phlebotomy and analyzed fresh **Author's Conclusion:** Although USG, urine color, and urinary osmolality have been widely advocated for screening for dehydration in older adults, we show, in the largest study to date to our knowledge, that their diagnostic accuracy is too low to be useful, and these measures should not be used to indicate hydration status in older people (either alone or as part of a wider tranche of tests). There is a need to develop simple, inexpensive, and noninvasive tools for the assessment of dehydration in older people.		
Outcome measures/results	• Reference standard: serum osmolality • index test included: ▪ USG (Urine specific gravity) ▪ urine color ▪ urine osmolality ▪ urine cloudiness ▪ additional dipstick measures		• DRIE participants more limited cognitive and functional abilities that did NU-AGE participants (MMSE: NEW-AGE 28.4 ± 1.5 vs. DIRI 21.8 ± 5.7) • Functional NEW-AGE participants also more able • Mean BMI higher in NEW-AGE (26.8 ± 4.0) vs. DRIE 25.6 ± 5.6) • 19% of DIRE and 22% of NU-AGE participants were dehydrated (serum osmolality >300 mOsm/kg)

	▪ ability to provide a urine sample ▪ volume of a random urine sample • Functional status: Barthel Index (DRIE); Katz´s Activities of daily living scale (NEW-AGE) • Cognitive status: Mini-Mental State Examination (MMSE) (DRIE; NEW-AGE)	• impeding dehydration : NEW-AGE 41% vs. DRIE 27% • normally hydrated: NEW-AGE 37% vs. DRIE5 54% • None of the urinary measures had an ROC (AUC) >0.7 in diagnosis of current dehydration or impeding and current dehydration • None of the potential tests at any cutoff and for either current or impeding dehydration had both sensitivity and specificity ≥70% • Neither USG nor any other potential urinary tests were usefully diagnostic for water-loss dehydration

IV.6 How should older persons be treated for low-intake dehydration?

Recommendation 72

For older adults with measured serum or plasma osmolality >300 mOsm/kg (or calculated osmolarity >295 mmol/L) who appear unwell, subcutaneous or intravenous fluids shall be offered in parallel with encouraging oral fluid intake.

Grade of recommendation A – strong consensus (95 % agreement)

Recommendation 73

For older adults with measured serum or plasma osmolality >300 mOsm/kg (or calculated osmolarity >295 mmol/L) and unable to drink, intravenous fluids shall be considered.

Grade of recommendation A – strong consensus (95 % agreement)

110.	**Sobotka L, Schneider SM, Berner YN, Cederholm T, Krznaric Z, Shenkin A, et al. ESPEN Guidelines on Parenteral Nutrition: geriatrics. Clinical nutrition (Edinburgh, Scotland). 2009;28(4):461-6.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Guideline 2+	***Countries:*** n/a ***Centers:*** n/a ***Setting:*** n/a ***Funding Sources:*** n/a. ***Dropout rates:*** n/a ***Study limitations:*** n/a	**Total no. Patients:** n/a **Inclusion criteria:** n/a **Exclusion criteria:** n/a	n/a
Notes	**Author's Conclusion:** PN is a safe and effective therapeutic procedure and age per se is not a reason to exclude patients from this treatment. The use of PN should always be balanced against a realistic chance of improvement in the general condition of the patient. Lower glucose tolerance, electrolyte and micronutrient deficiencies and lower fluid tolerance should be assumed in older patients treated by PN. Parenteral nutrition can be administered either via peripheral or central veins. Subcutaneous administration is also a possible solution for basic hydration of moderately dehydrated subjects. In the terminal, demented or dying patient the use of PN or hydration should only be given in accordance with other palliative treatments.		
Relevant recommendations/	Peripheral or central venous access for fluid and electrolyte replacement is mandatory in emergencies and in situations where strict fluid balance is required. The subcutaneous route is possible for fluid administration in order to correct mild to moderate dehydration but not		

statements	to meet other nutrient requirements. PN and parenteral hydration should be considered as medical treatments rather than as basic care. Both require intravenous cannulation and a physician's prescription. Their use should therefore be balanced against a realistic chance of improvement in the general condition.

111.	**Rochon PA, Gill SS, Litner J, Fischbach M, Goodison AJ, Gordon M. A systematic review of the evidence for hypodermoclysis to treat dehydration in older people. The journals of gerontology Series A, Biological sciences and medical sciences. 1997;52(3):M169-76.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Systematic Review 1+	***Countries:*** Canada ***Centers:*** University of Toronto ***Setting:*** n/a ***Funding Sources:*** The Max and Roslyn Gordon Summer Scholarship ***Dropout rates:*** n/a ***Study limitations:*** Only two RCTs were included in the review, and these provided limited evidence of benefit for the intervention.	**Total no. Studies:** 13 **Inclusion criteria:** English-language articles involving hypodermoclysis (defined as the subcutaneous infusion of fluids) that contained original patient data on adults receiving fluids for the purpose of rehydration **Exclusion criteria:** n/a	Hypodermoclysis using three types of fluid, specifically electrolyte-containing solution, nonelectrolyte solutions and hypertonic solutions. The type of fluid infused was unspecified in 3 case reports, whilst in 2 randomized controlled trials (RCTs), the control groups received intravenous infusions.
Notes	**Author's Conclusion:** Hypodermoclysis can be used to most safely provide fluids when electrolyte-containing fluids are administered. Hypodermoclysis may have fallen into disuse because of reports of severe adverse reactions related to infusions of electrolyte-free or hypertonic solutions that would likely be considered inappropriate today. Whether or not hyaluronidase is required to promote subcutaneous fluid absorption remains unresolved. Limited evidence suggests that potassium chloride may, with caution, be safely added to subcutaneous infusions. The majority of the available studies evaluating hypodermoclysis are of poor quality. Because of the tremendous potential benefits of administering fluid subcutaneously, there is a need for good quality studies to evaluate the efficacy of		

	hypodermoclysis.	
Outcome measures/results	Efficacy and adverse effects of administration of fluid by hypodermoclysis	Eighteen articles met the inclusion criteria. Since we hypothesized that adverse effects associated with hypodermoclysis may have been related largely to the use of nonelectrolyte or hypertonic solutions, the studies were evaluated according to the type of fluid administered. Six hundred and eighty-five patients were described in 13 studies evaluating the efficacy and toxicity of subcutaneously administered fluid. Four studies evaluated hypodermoclysis using electrolyte-containing solutions in 25 patients. Two of these were randomized control trials (RCT) that compared hypodermoclysis to intravenous therapy. Both reported similar absorption of fluids. In the single RCT that evaluated adverse effects, 4 of 17 patients receiving hypodermoclysis reported minor side effects similar to those reported with intravenous therapy. Adverse effects were more severe when electrolyte-free or hypertonic solutions were evaluated. Of the 639 patients who may have received electrolyte-free solutions, 16 patients (2.5%) reported adverse effects, 8 of which were severe. Both patients reported to have received hypertonic solutions noted adverse effects, one of which was severe. The use of hyaluronidase to facilitate absorption was evaluated in 74 patients. These studies suggest that hyaluronidase improves the speed of fluid absorption but may not change the patient's comfort level. A single case report of 350 subcutaneous infusions in 67 patients investigated the administration of up to 34 mmol/L of potassium chloride (KCl) by hypodermoclysis. The only adverse reaction observed was discomfort at the infusion site.

112.	**Turner T, Cassano AM. Subcutaneous dextrose for rehydration of elderly patients--an evidence-based review. BMC geriatrics. 2004;4:2.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Systematic Review 1+	***Countries:*** Australia ***Centers:*** Centre for Clinical Effectiveness, Monash Institute of Health Services	**Total no. Studies:** 4 **Inclusion criteria:** articles published in English in the last 10 years, primary studies or	Subcutaneous infusion of dextrose solutions

	Research, Monash Medical Centre, Clayton, Victoria; Rehabilitation and Aged Care Services, Kingston Centre, Cheltenham, Victoria ***Setting:*** n/a ***Funding Sources*** n/a ***Dropout rates:*** n/a ***Study limitations:*** the evidence in this area is limited and the studies appraised each have methodological flaws that limit the strength of the conclusions that can be drawn	systematic reviews of primary studies providing evidence as to the effectiveness and safety of subcutaneous infusion of dextrose solutions for rehydration of elderly patients **Exclusion criteria:** n/a	
Notes	**Author's Conclusion:** The four studies appraised all provide evidence that appropriate volumes of subcutaneous dextrose infusions (in the form of half-normal saline-glucose 5%, 40 g/L dextrose and 30 mmol/L NaCl, or 5% dextrose solution and 4 g/L NaCl, or two-thirds 5% glucose and one-third normal saline) can be used effectively for the treatment of dehydration, with similar rates of adverse effects to intravenous infusion. The evidence in this area is limited, and larger randomized controlled trials using validated outcome measures would be useful to confirm these results.		
Outcome measures/results	Effectiveness and safety of subcutaneous infusion of rehydration with subcutaneous 5% dextrose solutions compared with intravenous 5% dextrose solutions		From our search we identified 15 potentially relevant articles. We obtained the full text of these articles to determine their relevance. After application of the inclusion criteria, four articles remained for appraisal including one systematic review, two randomized controlled trials and one cohort study.

113.	**Remington R, Hultman T. Hypodermoclysis to treat dehydration: a review of the evidence. Journal of the American Geriatrics Society. 2007;55(12):2051-5.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**

Systematic Review 1++	***Countries:*** USA ***Centers:*** Department of Nursing, School of Health and Environment, University of Massachusetts at Lowell ***Setting:*** n/a ***Funding Sources:*** no financial arrangements with any organization or company ***Dropout rates:*** n/a ***Study limitations:*** small sample size and the use of nonstandardized evaluation methods in the studies	**Total no. Studies:** 8 **Inclusion criteria:** articles written in English and reporting of a research study of HDS for rehydration; focus of the research was on adult humans; articles published between 1996 and 2006 **Exclusion criteria:** studies that dealt mainly with subcutaneous administration of medications or the use of HDC to control symptoms or conditions other than dehydration or to relieve severe dehydration	n/a
Notes	**Author's Conclusion:** This review has provided recent evidence that HDC remains a safe feasible alternative to IV hydration, and there is current evidence that HDC is as efficient as IV rehydration, thus potentially reducing the frequency of acute hospitalization and expense of treatment for mild to moderate dehydration.		
Outcome measures/results	Safety, Efficacy and Feasibility		A total of eight studies (two RCTs and six cohort studies) were identified and appraised. Although RCTs generally provide the most reliable evidence, cohort studies were reviewed because of the paucity of research related to HDC for rehydration during the review period. Studies were examined using a coding sheet developed for this review. Data entered onto the coding sheet included country of origin, methodological design, study samples, intervention, and outcome measures. -**HDC Versus IV:** • *Safety*: the safety profile of HDC was found to be comparable with that of IV administration, and HDC was found to be a safe alternative to IV administration for rehydrating older adults. • *Efficacy*: both methods of hydration were shown to be equally

		effective; more subjects improved generally and clinically with IV than with HDC, although the difference was not statistically significant (81% IV, 57% HDC, p=0.19). Improvement in laboratory indicators of dehydration was similar in both groups. There was no significant difference in the duration of the site of the infusion. • *Feasibility*: nurses rated the feasibility of HDC and IV the same, whereas physicians rated HDC significantly better. **-HDC Alone**: • *Safety*: local complications of HDC were reported in 11% to 16% of patients (including local inflammation, pain, swelling, bruising, edema, extravasation, and bleeding). There were no occurrences of systemic side effects or sepsis associated with HDC in these studies. • *Efficacy*: the condition of a majority of patients improved or stayed the same with HDC. • *Feasibility and Cost:* more cannula were required to maintain IV hydration than HDC, and the cost for IV supplies was approximately 4 times greater than for HDC.

IV.7 What interventions may help to support older persons to drink well and prevent low-intake dehydration?

Recommendation 74

To prevent dehydration in older persons living in residential care, institutions should implement multicomponent strategies across their institutions for all residents. (BM)

Grade of recommendation B – strong consensus (100 % agreement)

Recommendation 75

These strategies should include high availability of drinks, varied choice of drinks, frequent offering of drinks, staff awareness of the need for adequate fluid intake, staff support for drinking and staff support in taking older adults to the toilet quickly and when they need it. (BM)

Grade of recommendation B – strong consensus (100 % agreement)

Recommendation 76

Strategies to support adequate fluid intake should be developed including older persons themselves, staff, management and policymakers.

Grade of recommendation B – strong consensus (100 % agreement)

114.	Bunn D, Jimoh F, Wilsher SH, Hooper L. Increasing fluid intake and reducing dehydration risk in older people living in long-term care: a systematic review. Journal of the American Medical Directors Association. 2015;16(2):101-13.		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Systematic Review 1++	***Countries:*** Canada, US, UK, Ireland, Germany, Japan, Taiwan ***Centers:*** n/a ***Setting:*** long-term care facilities, US for-profit and not-for-profit home, nursing homes ***Funding Sources:*** National Institute for Health Research (NIHR; Program LH), Sponsor: Sue Steel, Contracts Manager, Research and Enterprise Hub ***Dropout rates:*** n/a ***Study limitations:*** high risk of bias (selection, attrition) , lack of valid outcome measures of fluid intake and dehydration, many definitions of “fluids“, different methods of assessing fluid intake, varying periods of time over which fluid intake was measured	**Total no. Studies:** n=23 (Intervention n=19, observational studies n=4) **Inclusion criteria:** Intervention and observational studies, increasing fluid intake and/or reduce dehydration risk, older people (≥65 years) living in long-term care facilities who can drink orally **Exclusion criteria:** n/a	Many different intervention designs/possibilities 1) Multicomponent strategies: greater choice and availability of beverages, increased staff awareness, increased staff assistance with drinking and toileting, etc. 2) Implementation of the US Resident Assessment Instrument 3) Different colors of tableware 4) Drinks prethickened vs drinks thickened at bedside 5) Increased choices of drinks

<table>
<tr><td>Notes</td><td colspan="2">No blinding of residents or staff in any study; Blinding of outcome (n=2); Fluid intake assessments judged high risk if they were conducted for part of the day or method of a ascertainment was not considered to be accurate; dehydration status (n=4): high risk if not validated against serum osmolarity; combination fluid intake and dehydration status (n=6);
Author's Conclusion: A wide range of interventions and exposures were identified, but the efficacy of many strategies remains unproven due to the high risk of bias present in many studies. Adequate research support has been recognized as a key challenge in developing high-quality research in nursing homes, but this is what is required to improve fluid intake and hydration status in older care home residents.</td></tr>
<tr><td>Outcome measures/results</td><td>Assessment of fluid intake (International Classification of Disease Ninth Revision (ICD-9, n=1), fluid intake over 24-hours (n=1), serum osmolarity (n=2), fluid intake only (n=8), observation, weighed)
Dehydration status (n=4) (urine specific gravity, urine color, dry eyes and mouth, RAI-MDS definitions, BIA (Total Body Water (TBW), Total body Resistance (TBR))</td><td>Multicomponent strategies: positive effect
Implementation of the US Resident Assessment Instrument (RAI-MDS): reduced dehydration prevalence from 3% to 1% (p=0.01)
High-contrast red cups: positive effect on men with Alzheimer disease
Supplementing mildly dehydrated residents with oral hydration solution over 5 days: positive effect
No clear effects: Modifications to the dining environment, advice to residents, presentation of beverages, mode of delivery
Canada for-profit ownership: increased hospital admission for dehydration
No difference in dehydration prevalence between US for-profit and not-for-profit homes or staffing levels
No changes in fluid intake due to color of tableware (Dunne et al.)
No differences in fluid intake prethickened vs. thickened at bedside
Changes in environment: Risk of dehydration unaltered (RR 0.36; 95%CI 0.06-2.04, p=0.25); lower fluid intake for participants in the dining room vs. bedroom (OR 0.18; 95% CI 0.06-0.63), no affection by number of residents, presence of family members or noise level
No evidence that staff grade or number of staffing hours had an effect on residents´ dehydration level</td></tr>
</table>

Recommendation 78

At a regulatory level, the strategy of mandatory monitoring and reporting by institutions of hydration risks in individual residents and patients should be considered. (BM)

Grade of recommendation B – strong consensus (100 % agreement)

115.	**Fries BE, Hawes C, Morris JN, Phillips CD, Mor V, Park PS. Effect of the National Resident Assessment Instrument (RAI) on selected health conditions and problems. Journal of the American Geriatrics Society. 1997;45(8):994-1001.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Quasi-experimental, pre-/post-design 2-	***Countries:*** n/a ***Centers:*** n/a ***Setting:*** Nursing homes ***Funding Sources:*** Health Standards and Quality Bureau of the Health care Financing Administration ***Dropout rates:*** 5.23% ***Study limitations:*** sample limited to those who could manifest each such change between baseline and follow-up, methodology strengthened if had gold standard determinations of medical conditions , limited nursing home	**Total no. Patients:** n=2128 (residents); second cohort n=2088; Nursing homes: n=268 before RAI-Implementation; n=254 of the same nursing homes after Implementation **Inclusion criteria:** residents of nursing homes, minimum bed size of 25 **Exclusion criteria:** n/a	Cluster Sample within 10 states, 2 rounds 1) First round 1990: states chosen on four criteria: - Geographic location - Reimbursement methodology (case-mix, non-case-mix) - High/low Medicaid reimbursement level - High/low staffing levels 2) Second round 1993: same facilities, same protocol, new sample pf residents ➔ Assessments at baseline and follow-up (improvement/decline computed as changes between baseline and follow-up) and outcome contrast between 1990 and 1993

	resources (caused by recent reforms),unable to document completely the causal link between RAI implementation and outcomes, no direct attributions to RAI of manifested changes in outcomes		
Notes	• 24 facilities in each MSA (standard metropolitan area), 3 rural facilities recruited from each state; each facility 8-16 residents • Elimination of patients who could not decline (because they had the condition or were at the lowest level already at baseline) from analysis of improvement; regardless to condition at baseline: residents who left to home, hospital, death were classified as exiting • Resident assessment protocol (RAP): every domain-except for pain and stasis ulcer- have their own RAP; MDS (mini Data Set): all are represented by single items, except for dental status and malnutrition **Author's Conclusion:** Several outcomes for nursing home residents improved after implementation of the RAI. Of the four conditions for which there are significant declines in prevalence or outcome changes, three are specifically addressed in the care planning guidelines incorporated the RAI system (all except stasis ulcer, although there is a RAP for decubitus ulcer). Pain, the only other condition with a significant result - an increase in baseline prevalence - also has no RAP. Although the changes might be ascribed otherwise, they support the premise that the RAI has directly contributed to improved outcomes for nursing home residents.		
Outcome measures/results	Outcome variables: • Dehydration • Falls • Decubitus • Vision problems (4-level scale) • Stasis ulcer • Pain • Dental status • Malnutrition (poor nutrition: BMI<20) Independent Variables: • Primary: post-RAI cohort – tested significant outcome differences before and after RAI implementation • Covariates: cognitive performance (CPS),		• No significant differences in the two cohorts in the rate of exit • Ulcer had significantly lower prevalence after the implementation of the RAI (1993) compared with 1990. • Pain declined in the post implementation rate of improvement • Not significantly from zero: seven from eight conditions exhibited decline; summary score for the eight decline coefficients is -6.62 ($p<0.0001$) • Six from eight conditions showed reduced improvement rates for post-RAI cohort; 2 were significant results for decline (improvement rates sig. reduced): malnutrition and vision • Increase from pre- to post-RAI: percentage of residents with falls increased insignificantly • RUG-III/MDS case-mix index changed 1.7% (from 0.89 to 0.91,

	functionality (MDS ADL), case-mix intensity (RUG-III/MDS), baseline condition • Mortality	p=0.20) between the two cohorts • Dehydration: 60 participants (3% of total) at baseline in pre-RAI sample; 22 participants (1%) in post-RAI wave • Baseline comparisons: fewer residents in post-RAI cohort with malnutrition (BMI<20); improvements→ 6.5% pre-RAI vs. 5.0% post-RAI) • Remaining malnourished: 18.4 pre-RAI vs. 19.6% post-RAI • Adequate baseline BMI: greater percentage 6 months later remained nourished in post-RAI cohort (50.2 pre-RAI vs. 53.9% post-RAI) and fewer declined (5.3% pre-RAI vs. 6.6% post-RAI) • Good outcomes: 59.5% pre-RAI residents – increase in post-RAI to 61.6% ➔ Although the rate of improvement was reduced in the post-RAI cohort, its effect was more than compensated by the reduced rate of decline for the larger segment of the population (those with adequate BMI). ➔ Although vision declined (both rounds) from baseline to follow-up, decline lower in post-RAI cohort

Recommendation 79

Older adults who show signs of dysphagia should be assessed, treated and followed up by an experienced speech and language therapist. Their nutrition and hydration status should be carefully monitored in consultation with the speech and language therapist and a dietician.

Grade of recommendation B – strong consensus (94 % agreement)

IV.8 How should volume depletion be identified?

Recommendation 80

In older adults, volume depletion following excessive blood loss should be assessed using postural pulse change from lying to standing (≥30 beats per minute) or severe postural dizziness resulting in inability to stand.

Grade of recommendation A – strong consensus (100 % agreement)

Recommendation 81

In older adults, volume depletion following fluid and salt loss with vomiting or diarrhea should be assessed by checking a set of signs. A person with at least four of the following seven signs is likely to have moderate to severe volume depletion: confusion, non-fluent speech, extremity weakness, dry mucous membranes, dry tongue, furrowed tongue, sunken eyes.

Grade of recommendation B – strong consensus (95 % agreement)

116. McGee S, Abernethy WB, 3rd, Simel DL. The rational clinical examination. Is this patient hypovolemic? Jama. 1999;281(11):1022-9.			
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Systematic Review 1-	***Countries:*** USA ***Centers:*** n/a ***Setting:*** n/a	**Total no. Studies:** 14 **Inclusion criteria:** articles from January 1966 to November 1997 in the MEDLINE database, English language, humans 16 years or older	n/a

	Funding Sources: n/a ***Dropout rates:*** n/a ***Study limitations:*** n/a	**Exclusion criteria:** n/a	
Notes	**Author's Conclusion:** A large postural pulse change (> or =30 beats/min) or severe postural dizziness is required to clinically diagnose hypovolemia due to blood loss, although these findings are often absent after moderate amounts of blood loss. In patients with vomiting, diarrhea, or decreased oral intake, few findings have proven utility, and clinicians should measure serum electrolytes, serum blood urea nitrogen, and creatinine levels when diagnostic certainty is required.		
Outcome measures/results	n/a		When clinicians evaluate adults with suspected blood loss, the most helpful physical findings are either severe postural dizziness (preventing measurement of upright vital signs) or a postural pulse increment of 30 beats/min or more. The presence of either finding has a sensitivity for moderate blood loss of only 22% (95% confidence interval [CI], 6%-48%) but a much greater sensitivity for large blood loss of 97% (95% CI, 91%-100%); the corresponding specificity is 98% (95% CI, 97%-99%). Supine hypotension and tachycardia are frequently absent, even after up to 1150 mL of blood loss (sensitivity, 33%; 95% CI, 21%-47%, for supine hypotension). The finding of mild postural dizziness has no proven value. In patients with vomiting, diarrhea, or decreased oral intake, the presence of a dry axilla supports the diagnosis of hypovolemia (positive likelihood ratio, 2.8; 95% CI, 1.4-5.4), and moist mucous membranes and a tongue without furrows argue against it (negative likelihood ratio, 0.3; 95% CI, 0.1-0.6 for both findings). In adults, the capillary refill time and poor skin turgor have no proven diagnostic value.

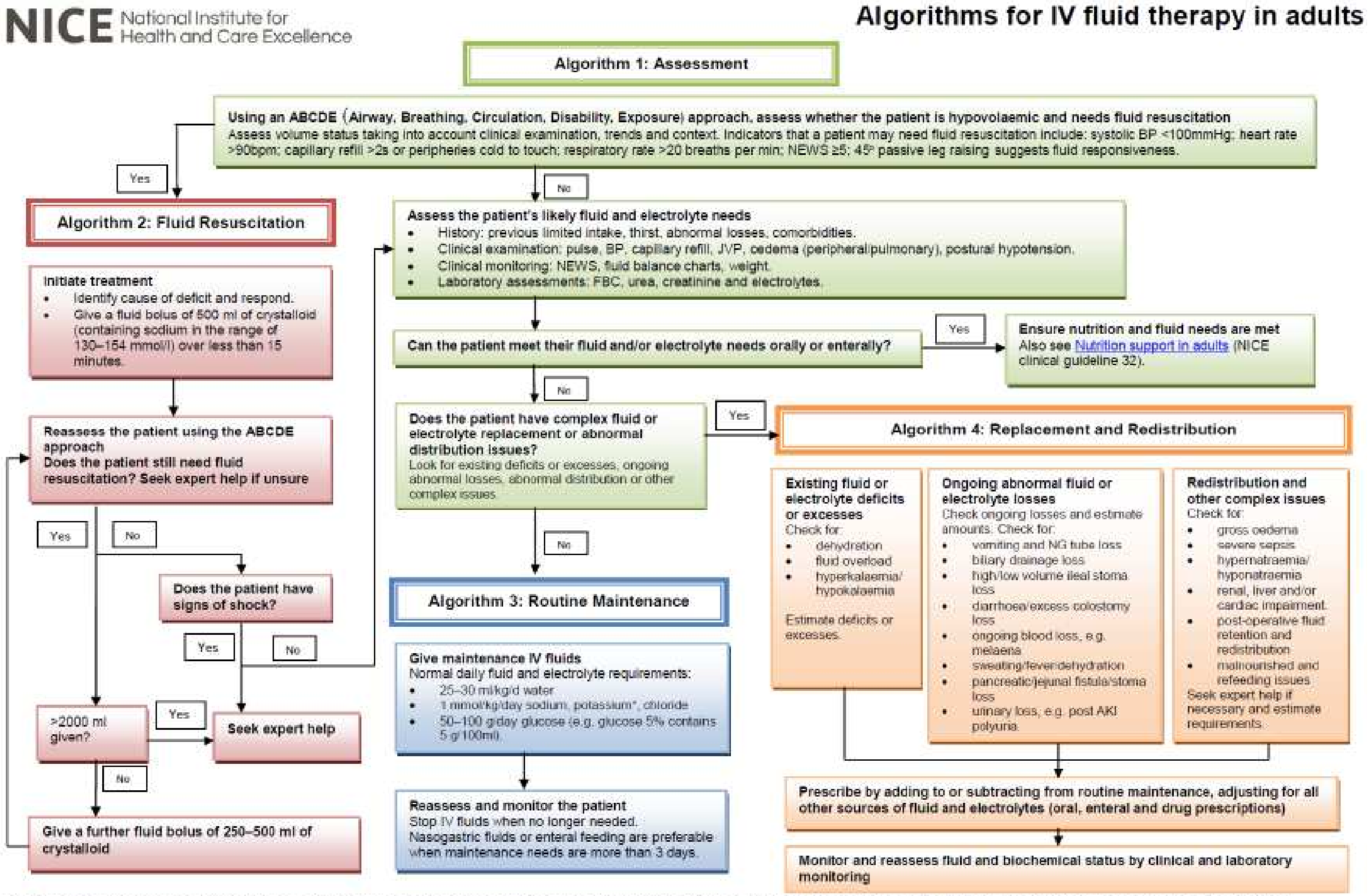
IV.9 How should volume depletion be treated?

Recommendation 82

Older adults with mild/moderate/severe volume depletion should receive isotonic fluids orally, nasogastrically, subcutaneously or intravenously. (BM)

Grade of recommendation B – strong consensus (95 % agreement)

117.	**National Clinical Guideline Centre. Intravenous fluid therapy - Intravenous fluid therapy in adults in hospital. London: National Institute for Health and Care Excellence. 2013.**		
Study Type/ Evidence Level	**Study details/limitations**	**Patient characteristics**	**Interventions**
Clinical guideline 1+	***Countries:*** n/a ***Centers:*** n/a ***Setting:*** n/a ***Funding Sources:*** National Institute for Health and Care Excellence ***Dropout rates:*** n/a ***Study limitations:*** n/a	**Total no. Patients:** n/a **Inclusion criteria:** n/a **Exclusion criteria:** n/a	n/a
Notes	**Author's Conclusion:** Assess and manage patients' fluid and electrolyte needs as part of every ward review. Provide intravenous (IV) fluid therapy only for patients whose needs cannot be met by oral or enteral routes, and stop as soon as possible.		
Relevant recommendations/ statements	Offer IV fluid therapy as part of a protocol (see Algorithms for IV fluid therapy): • Assess patients' fluid and electrolyte needs following Algorithm 1: Assessment. • If patients need IV fluids for fluid resuscitation, follow Algorithm 2: Fluid resuscitation. • If patients need IV fluids for routine maintenance, follow Algorithm 3: Routine maintenance. • If patients need IV fluids to address existing deficits or excesses, ongoing abnormal losses or abnormal fluid distribution, follow Algorithm 4: Replacement and redistribution. When prescribing IV fluids and electrolytes, take into account all other sources of fluid and electrolyte intake, including any oral or enteral intake, and intake from drugs, IV nutrition, blood and blood products. Patients have a valuable contribution to make to their fluid balance. If a patient needs IV fluids, explain the decision, and discuss the signs and symptoms they need to look out for if their fluid balance needs adjusting. If possible or when asked, provide written information (for example, NICE's Information for the public), and involve the patient's family members or carers (as appropriate).		



*Weight-based potassium prescriptions should be rounded to the nearest common fluids available (for example, a 67 kg person should have fluids containing 20 mmol and 40 mmol of potassium in a 24-hour period).

Potassium should not be added to intravenous fluid bags as this is dangerous.

'Intravenous fluid therapy in adults in hospital', NICE clinical guideline 174 (December 2013. Last update December 2016)