Malnutrition and frailty

Antonio Cherubini
Geriatria ed Accettazione geriatrica d’urgenza
IRCCS-INRCA, Ancona, Italy
What is malnutrition?

Malnutrition is a state of nutrition in which a deficiency, excess or imbalance of energy, protein, and other nutrients causes measurable adverse effects on tissue and body form (body shape, size, and composition), body function and clinical outcomes.

Stratton RJ 2003
Malnutrition

OVERnutrition: 45-75 years

UNDERnutrition: >75 years
Malnutrition across different settings
Results based on the MNA®
Factors contributing to undernutrition
Aging

- ↓ smell
- ↓ taste
- lack of teeth
- ↓ secretion of saliva
- ↓ gastric acid secretion
- ↓ production of digestive enzymes
- loss of absorption capacity of the bowel
- slower progression of food in the bowel
- impaired regulation of food intake
- anorexia

Chapman IM, 2004
Factors contributing to undernutrition

• Intrinsic factors
  - Oral problems (mouth ulcers, oral candida, ill fitting false teeth)
  - Gastrointestinal (esophagitis, esophageal stricture, achalasia, peptic ulcer disease, atrophic gastritis, constipation, colitis, malabsorption)
  - Neurological (dementia, Parkinson disease, cerebrovascular disease, depression)
  - Endocrinological (thyrotoxicosis, hypothyroidism, hypoadrenalism, hyperparathyroidism)
  - Other diseases (cardiac failure, chronic obstructive airways disease, renal failure; inflammatory arthropathies, infections, malignancies)
  - Psychological (alcoholism, bereavement)
Factors contributing to undernutrition in older people

• **Extrinsic factors**
  - **Social factors** (poverty, lack of transport, inability to shop, inability to prepare and cook meals, inability to feed, social isolation, lack of social support, caregiver issues)
  - **Medications**
    • Nausea/vomiting: antibiotics, opiates, digoxin, theophylline, NSAIDs
    • Anorexia: antibiotics, digoxin
    • Hypogeusia: metronidazole, calcium channel blockers, ACE inhibitors, metformin
    • Early satiety: anticholinergic drugs, sympathomimetic agents
    • Reduced feeding ability: sedatives, opiates, psychotropic agents
    • Dysphagia: potassium supplements, NSAIDs, biphosphonates, prednisolone
    • Constipation: opiates, iron supplements, diuretics
    • Diarrhea: laxatives, antibiotics
    • Hypermetabolism: thyroxin, ephedrine
Polypharmacy and nutritional status in elderly people

...the probability of nutritional problems as a consequence of drugs is highest in elderly people suffering from several diseases. Drug treatment may contribute to poor nutritional status by causing loss of appetite, gastrointestinal problems, and other alterations in body function. Some recently published studies add evidence on possible association between increasing number of drugs and malnutrition. In addition, there are available studies that have shown deficits in the intake of specific macronutrients and micronutrients (e.g. fiber, glucose, and specific vitamins) for older subjects who take a high number of drugs in use.

Jyrkka J et al, Curr Opin Clin Nutr Metab Care 2012
Multifactoriality of undernutrition in an elderly patient compared with an adult patient

Resnick and Marcantonio, 1997, modified
Consequences of malnutrition

- ↑ Morbidity
- ↓ Wound healing
- ↑ Infections
- ↑ Complications
- ↓ Convalescence
- ↑ Length of hospital stay

↓ Quality of life

↑ Disability

↑ Costs

↑ Mortality
Malnutrition and cognitive decline

...available data suggest that, besides single nutrients (e.g. vit E, vit D, n-3 pufa), dietary patterns, e.g. diets rich in fruits, vegetables, other plant-derived products, sea products rich in n-3 PUFA and with lower intakes of meat, highly saturated fat and added refined sugar could be protective against cognitive decline but with some remaining inconsistency due in part to methodological limitations.

The role of nutrition in modulating Alzheimer disease (AD) remains uncertain. Persons ingesting a Mediterranean-type diet and diets rich in antioxidants appear to be less likely to develop AD. ... Combination formulas appear to have small effects on cognition. Based on this review, a Mediterranean diet and/or a combination supplement appear to be the most beneficial approaches to slowing the progression of AD.
Approach to undernutrition in older subjects
Screening

Assessment

Intervention

Monitoring
SCREENING
Malnutrition screening tools in older subjects

- Mini Nutritional Assessment (MNA)
- Mini-Nutritional Assessment–Short Form (MNA-SF)
- Malnutrition Universal Screening Tool (MUST)
- Subjective global assessment (SGA)
- Nutritional Risk Screening 2002 (NRS)
- Short nutritional assessment questionnaire (SNAQ©)
- Simplified Nutritional Appetite Questionnaire (SNAQ)
- Malnutrition Screening Tool (MST)
- Rapid Screen
- Nutritional Form for the Elderly
<table>
<thead>
<tr>
<th>Screening Tool</th>
<th>Reference</th>
<th>Focused population/settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>MNA</td>
<td>Guigoz et al</td>
<td>Older adults/all settings</td>
</tr>
<tr>
<td>MNA-SF</td>
<td>Rubenstein et al</td>
<td>Older adults/all settings</td>
</tr>
<tr>
<td>US-SNAQ</td>
<td>Wilson et al</td>
<td>Adults and older adults, long-term care and community</td>
</tr>
<tr>
<td>Dutch-SNAQ</td>
<td>Kruizenga et al</td>
<td>Adults/hospital, outpatients, community and rehabilitation</td>
</tr>
<tr>
<td>MUST</td>
<td>Elia</td>
<td>Adults/all settings</td>
</tr>
<tr>
<td>NRS 2002</td>
<td>Kondrup et al</td>
<td>Adults/hospital</td>
</tr>
<tr>
<td>SGA</td>
<td>Detsky et al</td>
<td>Adults/hospital</td>
</tr>
<tr>
<td>GNRI</td>
<td>Bouilliance et al</td>
<td>Older adults/all settings</td>
</tr>
<tr>
<td>DETERMINE</td>
<td>While et al</td>
<td>Older adults/community, hospital and long-term care</td>
</tr>
</tbody>
</table>


Bauer JM et al, Curr Op Clin Nutr Meta Care 2010
# Mini Nutritional Assessment (MNA®)

## Screening

**A** Has food intake declined over the past 3 months due to loss of appetite, digestive problems, chewing or swallowing difficulties?
- 0 = severe decrease in food intake
- 1 = moderate decrease in food intake
- 2 = no decrease in food intake

**B** Weight loss during the last 3 months
- 0 = weight loss greater than 3 kg (6.6 lbs)
- 1 = does not know
- 2 = weight loss between 1 and 3 kg (2.2 and 6.6 lbs)
- 3 = no weight loss

**C** Mobility
- 0 = bed or chair bound
- 1 = able to get out of bed / chair but does not go out
- 2 = goes out

**D** Has suffered psychological stress or acute disease in the past 3 months?
- 0 = yes
- 2 = no

**E** Neuropsychological problems
- 0 = severe dementia or depression
- 1 = mild dementia
- 2 = no psychological problems

**F1** Body Mass Index (BMI) (weight in kg) / (height in m²)
- 0 = BMI less than 19
- 1 = BMI 19 to less than 21
- 2 = BMI 21 to less than 23
- 3 = BMI 23 or greater

IF BMI IS NOT AVAILABLE, REPLACE QUESTION F1 WITH QUESTION F2. DO NOT ANSWER QUESTION F2 IF QUESTION F1 IS ALREADY COMPLETED.

**F2** Calf or leg circumference (CC) in cm
- 0 = CC less than 31
- 3 = CC 31 or greater

## Screening score (max. 14 points)

- 12-14 points: Normal nutritional status
- 8-11 points: At risk of malnutrition
- 0-7 points: Malnourished

For a more in-depth assessment, complete the full MNA® which is available at [www.mna-elderly.com](http://www.mna-elderly.com).
**Malnutrition Universal Screening Tool**

**Step 1**
BMI score

- BMI Kg/m² Score
  - > 20 (>30 Obese) = 0
  - 18.5-20 = 1
  - <18.5 = 2

**Step 2**
Weight loss score

- Unplanned weight loss in past 3-6 months
  - <5 = 0
  - 5-10 = 1
  - > 10 = 2

**Step 3**
Acute disease effect score

- If patient is acutely ill and there has been or is likely to be no nutritional intake for > 5 days
  - Score 2

**Step 4**
Overall risk of malnutrition

Add Scores together to calculate overall risk of malnutrition
- Score 0 = Low Risk
- Score 1 = Medium Risk
- Score 2 or more = High risk
ASSESSMENT
Assessment

1. History, in particular weight loss
2. Physical examination
3. Anthropometry and body composition
4. Assessment of nutrient intake (diary, FFQ)
5. Blood parameters (albumin, transferrin, pre-albumin, retinol binding protein, cholesterol, specific micronutrients)
Types of malnutrition

- Protein-energy (PEM)
- Micronutrients (vitamins and minerals)
TREATMENT
PEM management

- Presence of, or high risk for, protein-energy malnutrition
  - Would prevention or treatment of PEM improve prognosis or quality of life?
    - Yes, or possibly
    - No
      - Supportive care

- Can requirements be met with oral foods and supplements?
  - Yes, or possibly
  - No
    - Oral food and nutritional supplements
    - Functional GI Tract?
      - Yes
        - Enteral nutrition
      - No
        - Parenteral nutrition
Nutritional support

• Minimize dietary restrictions
• Enhance total intake
  - Frequent meals and snacks
  - Provide favourite foods
  - Oral Nutritional Supplements
  - Appetite stimulants (?)
• Anabolic agents (?)
• Enteral Nutrition
• Parenteral nutrition
Nutritional support

Considerations

- Degree of PEM
- Current intake relative to requirement
- Expected duration of inadequate nutrition
- Risk/benefit ratio
- Potential reversibility
- Patient/family preferences
MALNUTRITION AND FRAILTY
...a biologic syndrome of decreased reserve and resistance to stressors, resulting from cumulative declines across multiple physiologic systems, and causing vulnerability to adverse outcomes.
The route of frailty

Determinants and pathways → ‘Partial’ components/manifestations → Clinically observable syndrome → Adverse outcomes*

Robust/resilient ← Pre-frail ← Frail

* disability, morbidity, hospitalization, institutionalization, mortality

Sternberg et al, JAGS, 2011
The Cycle of Frailty

- Taste, smell
- Poor dentition
- Dementia
- Depression
- Illness
- Hospitalization

Neuroendocrine Dysregulation

- Anorexia of aging
- \( \downarrow \) Total Energy Expenditure

\[ \Downarrow \text{Activity} \]

- Disease eg, depression, dementia
- Acute illness
- Medication (eg, sedating)
- Stressful life events
- Fall

\[ \Downarrow \text{Walking Speed} \]

■ Resting Metabolic Rate

■ Disability

■ Immobilization

■ Falls & Injuries

■ Impaired balance

■ Impaired balance

■ Osteopenia

■ Weight loss

■ Catabolic state

■ Chronic inflammation/Cytokines

■ Disability Medications

■ Insulin sensitivity

■ Loss of muscle mass

Sarcopenia

■ VO\(_2\) max

Fried, Walstom, Ferrucci, 2009

Undernutrition [Inadequate intake of protein and energy; micronutrient deficiencies]
OBSERVATIONAL STUDIES
Low Nutrient Intake Is an Essential Component of Frailty in Older Persons

Methods: .. data from 802 persons aged 65 years or older participating to the InCHIANTI study. The European Prospective Investigation into Cancer and nutrition (EPIC) questionnaire was used to estimate the daily intake of energy and nutrients.

Results: Daily energy intake $\leq 21$ kcal/kg was significantly associated with frailty (odds ratio [OR]: 1.24; 95% CI: 1.02–1.5). After adjusting for energy intake, a low intake of protein; vitamins D, E, C, and folate; and having a low intake of more than three nutrients were significantly and independently related to frailty.

Bartali B et al, J Gerontol 2006
Nutritional Status According to the MNA and Frailty in Community Dwelling Older Persons: A Close Relationship

Methods: a cross-sectional study on 206 community-dwelling older adults, volunteers aged 75 years or older without cognitive, recruited in the region of Nürnberg, Germany.

Results: 15.1% of the participants were at risk of malnutrition, no participant was malnourished. 90% of those at risk of malnutrition were either pre-frail or frail. For the anthropometric, dietary, subjective and functional, but not for the general MNA subscore, frail participants scored significantly lower than pre-frail (p<0.01), and non-frail participants (p<0.01).

Conclusions: there is a close association between frailty syndrome and nutritional status in older persons.

Bollwein J et al, J Nutr Health Aging 2013
Dietary Quality Is Related to Frailty in Community-Dwelling Older Adults

**Methods:** In 192 community-dwelling older volunteers (>75 years), an interview-based food frequency questionnaire was used to assess nutritional data. A Mediterranean diet (MED) score (maximum 9 points) was used to evaluate dietary quality.

**Results:** The mean (SD) age of the participants was 83 years; 41.1% were prefrail and 15.1% were frail. The risk of being frail was significantly reduced in the highest quartile of the MED score (OR 0.26; 95% CI 0.07–0.98).

**Conclusions:** A healthy dietary pattern is associated with a lower risk of being frail.

*Bollwein J et al, J Gerontol 2013*
InCHIANTI

Principal Investigators: Luigi Ferrucci, Stefania Bandinelli
Age- and sex-adjusted levels of vitamin E according to frailty status

P = 0.015

P for trend = 0.015

P = 0.086

P = 0.142

Ble et al, J Gerontol 2006
Association of low Vitamin D Levels With the Frailty Syndrome in Men and Women

**Objective:** to estimate sex-specific associations of low 25(OH)D with frailty and to explore the role of PTH as a potential mediator in this association.

**Methods:** 444 male and 561 female participants aged 65 years and older.

**Results:** independent of covariates, men with 25(OH)D <50 nmol/L had greater odds of frailty than those with 25(OH)D >50nmol/L (OR 4.94, CI 95%). In women the adjusted OR was 1.43. ORs for frailty changed little after controlling for PTH.

**Conclusions:** Vitamin D insufficiency was associated with frailty in men, but not in women and PTH could be to mediate the relationship between 25(OH)D and non-energy expenditure aspects of frailty.

*Shardell et al, J Gerontol, 2009*
Serum 25-Hydroxyvitamin D, Transitions Between Frailty States, and Mortality in Older Adults: The Invecchiare inChianti Study

Objective: to assess whether serum 25-hydroxyvitamin D (25(OH)D) concentrations relate to transitions between the states of robustness, prefrailty, and frailty and to mortality in older adults.

Results: Prefrail participants with 25(OH)D levels less than 20 ng/mL were 8.9% more likely to die, 3.0% more likely to become frail, and 7.7% less likely to become robust than prefrail participants with 25(OH)D levels of 20 ng/mL or more...prefrailty is an “at risk” state from which older adults with high 25 (OH)D levels are more likely to recover than to decline, but high 25(OH)D levels were not associated with recovery from frailty.

Shardell M et al, JAGS 2012
A higher adherence to a Mediterranean-style diet is inversely associated with the development of frailty in community-dwelling elderly men and women.

A longitudinal analyses using data from 690 community-living persons (≥65 y) who were randomly selected from a population registry in Tuscany, Italy. Adherence to a Mediterranean-style diet (scored 0-9, modeled categorically as ≤3, 4-5, and ≥6) was computed from the European Prospective Investigation into Cancer and nutrition FFQ previously validated in this cohort.

After a 6-y follow-up, higher adherence (score ≥6) to a Mediterranean-style diet was associated with lower odds of developing frailty [OR = 0.30 (95% CI: 0.14, 0.66)] compared with those with lower adherence (score ≤3).

Talegawkar SM, Ferrucci L et al, J Nutr 2012
EXPERIMENTAL STUDY
Protein supplementation improves physical performance in frail elderly people: a randomized, double-blind, placebo-controlled trial

Objective: to assess the impact of 24 weeks of dietary protein supplementation on muscle mass, strength, and physical performance in frail elderly people.

Design: A total of 65 frail elderly subjects were included and randomly allocated to either daily protein or placebo supplementation (15 g protein at breakfast and lunch).

Conclusion: Dietary protein supplementation improves physical performance, but does not increase skeletal muscle mass in frail elderly people.

Tieland M et al, J Am Med Dir Assoc 2012
Woman, 25 yrs

Woman, 80 yrs
Protein and energy supplementation in elderly people at risk from malnutrition

Objectives: to examine trials for improvement in nutritional status and clinical outcomes when extra protein and energy were provided, usually as commercial ‘sip-feeds’.

Main results: 62 trials with 10,187 randomised participants have been included. Maximum duration of intervention was 18 months. Most included trials had poor study quality. There was no significant reduction in mortality in the supplemented compared with control groups (RR 0.92, CI 0.81 to 1.04) …results were statistically significant when limited to trials in which participants (N= 2461) were defined as undernourished (RR 0.79, 95% CI 0.64 to 0.97). The risk of complications was reduced in 24 trials (RR 0.86, 95% CI 0.75 to 0.99). Few trials were able to suggest any functional benefit from supplementation. …length of stay also showed no statistically significant effect (-0.8 days, 95% CI -2.8 to 1.3).
Protein and energy supplementation in elderly people at risk from malnutrition

Authors’ conclusions: 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-centre trials are still required.

Milne AC et al, The Cochrane Collaboration 2009
Research needs

• Investigation of the mechanisms linking specific nutrients or dietary patterns to frailty

• Clinical trials using nutritional interventions to prevent and treat frailty in older subjects

• Clinical trials using multifactorial interventions integrating nutrition and other treatments, e.g. exercise, CGA, against frailty
Management needs

• Improving the level of knowledge of healthcare professionals concerning malnutrition and promoting multidisciplinary approach
• Improving the implementation of screening, assessment and treatment of malnutrition in all clinical settings
• Implementing multifactorial intervention to prevent and treat frail older subjects