

# MaNuEL Toolbox

Clinical practice and policy  
recommendations from the  
MaNuEL Knowledge Hub

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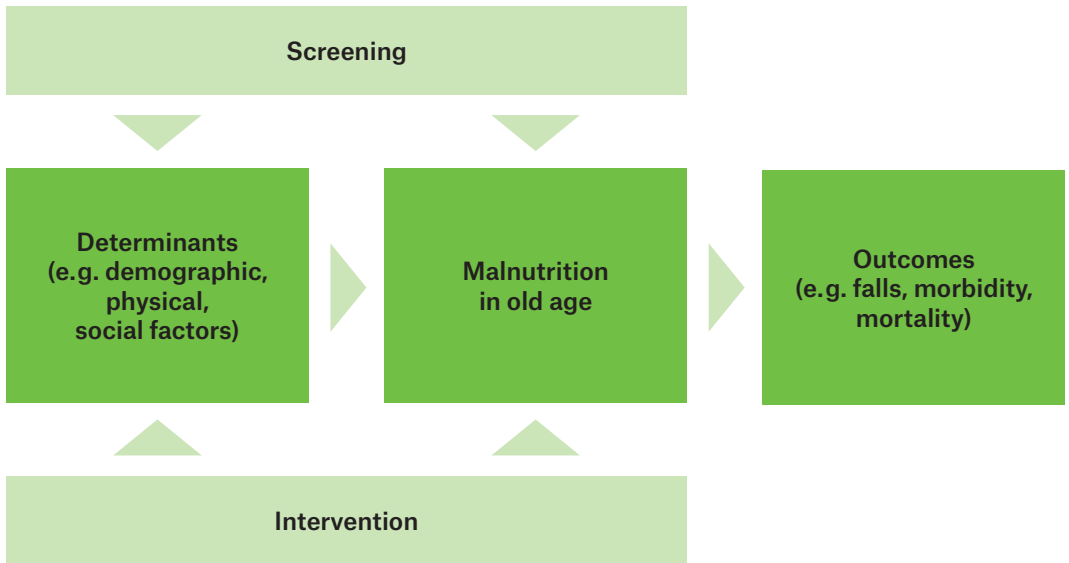
# Introduction

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## What is MaNuEL?

In the **MaNuEL** Knowledge Hub, scientists with complementary expertise from 22 institutions in seven countries have worked together for two years to summarize and improve the current scientific knowledge about different aspects of malnutrition in older persons – namely prevalence, screening, etiology/determinants, interventions, policy and education.

## MaNuEL Knowledge Hub concept



One main objective of **MaNuEL** was to harmonize methods and strengthen evidence-based practice.

## What is the MaNuEL Toolbox?

Practice-oriented recommendations were derived – based on **MaNuEL** Knowledge Hub results in the context of what was known before. These recommendations aim to support health care professionals in everyday clinical practice and also policy makers in order to enable finally that older people with malnutrition or at risk of malnutrition will benefit from research results.

The derived recommendations are now summarized in the present TOOLBOX, which intends to provide support to facilitate identification, prevention and treatment of malnutrition in older persons across health care settings.

### What is malnutrition?

Protein-energy malnutrition is defined as a state of energy and protein deficiency which is associated with functional impairment and a worse outcome from illness as well as being specifically reversible by nutritional support. Despite intensive discussions among experts in recent years, a uniform and generally accepted operationalization of malnutrition was lacking for a long time, resulting in varying definitions and criteria used to diagnose malnutrition.

In the **MaNuEL** Knowledge Hub, partners agreed at its start to use the following two aspects to identify malnutrition, based on the ESPEN terminology and consensus framework:

- a striking unintended loss of body mass (weight loss),  
or
- a markedly low body mass index (BMI)


In parallel to the **MaNuEL** Knowledge Hub, representatives of the major global clinical nutrition societies worked together on a harmonized definition of malnutrition and quite recently reached consensus on how to diagnose malnutrition in adults of all ages in clinical settings on a global scale.<sup>1</sup>

### Is malnutrition a problem in older persons?

Malnutrition is widespread among older people and associated with severe health and functional problems, accompanied by reduced quality of life for the individual as well as increased health care costs for societies. It is thus an important public health concern to avoid malnutrition as much as possible and implement effective strategies to tackle this problem. The work conducted in **MaNuEL** contributes to this aim.

1 Cederholm T, Jensen GL, Correia MITD et al. GLIM criteria for the diagnosis of malnutrition – A consensus report from the global clinical nutrition community. Clin Nutr. 2018 Sep 3. pii: S0261-5614(18)31344-X. doi: 10.1016/j.clnu.2018.08.002. [Epub ahead of print].

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 Related **MaNuEL** publication:  
• Visser M, Volkert D, Corish C, Geisler C, de Groot LC, Cruz-Jentoft AJ, Lohrmann C, O'Connor EM, Schindler K, de van der Schueren MA on behalf of the **MaNuEL** consortium. **Tackling the increasing problem of malnutrition in older persons: The Malnutrition in the Elderly (MaNuEL) Knowledge Hub**. Nutr Bull 2017; 42: 178-186. doi: 10.1111/nbu.12268

# The Prevalence of Malnutrition

Reported malnutrition prevalence varies widely between different countries, across health-care settings and even within health-care settings. The use of different diagnostic criteria has hindered accurate estimation of the prevalence of malnutrition risk in older adults in Europe.

## In the MaNuEL Knowledge Hub,

the prevalence of malnutrition was calculated based on 15 national and cross-country European studies and from New Zealand including in total 5,956 persons and using several uniform definitions.

## Ranges of malnutrition prevalence (%) in four healthcare settings using six different diagnostic criteria:

| Setting (number of study samples) | Low BMI general BMI <20 kg/m <sup>2</sup> | Low BMI age specific BMI <20 if age ≥65 to <70 BMI <22 if age ≥70 years | Weight loss >3 kg in the past 3 months or >5 kg in the past 6 months | Severe decrease in food intake in the past 6 months | BMI <20 and weight loss and severe decrease in food intake | BMI <20 or weight loss or severe decrease in food intake |
|-----------------------------------|---|---|--|---|--|--|
| Community (7)                     | 0–4 %                                     | 1–13.5 %  | 2–10.5 %   | 0–10 %  | 0–1 %  | 6–16 %   |
| Geriatric day hospital (2)        | 2–9 %                                     | 6–18 %  | 6–13 %   | 1.5–12 %  | 1.5–2 %  | 13–16 %  |
| Nursing home (3)                  | 4–18 %                                    | 8–34 %  | 4–8 %  | 1.5–8 %   | 0 %  | 10–27 %  |
| Acute hospital (3)                | 4.5–9 %                                   | 11–19 %   | 5–14 %   | 3–34 %  | 0.5–3 %  | 14–40 %  |

## Main findings

- Prevalence of malnutrition varies widely between study samples even when using the same definition in the same health-care setting. This variation may be explained by differences in functional and/or health status between the study samples.
- Prevalence doubles when using the age-specific cut-off for low BMI compared to the general cut-off of BMI <20 kg/m<sup>2</sup>.
- Prevalence is highest when combining three criteria by OR and lowest when combining them by AND.

## Recommendations

- Be aware of the diagnostic criteria used when interpreting prevalence rates of malnutrition.
- As each single criterion indicates at least a risk of malnutrition, preferably use the OR combination for an individual patient, look at each criterion separately and try to identify underlying causes.
- Future standardization of the diagnostic criteria is strongly recommended.

## Related MaNuEL publication:

- Wolters M, Volkert D, Streicher M, Kiesswetter E, Torbahn G, O'Connor EM, O'Keeffe M, Kelly M, O'Herlihy E, O'Toole PW, Timmons S, O'Shea E, Kearney P, van Zwiienen-Pot J, Visser M, Maitre I, Van Wymelbeke V, Sulmont-Rossé C, Nagel G, Flechtner-Mors M, Goisser S, Teh R, Hebestreit A, on behalf of the **MaNuEL** consortium. **Prevalence of malnutrition using harmonized definitions in older adults from different settings – a MaNuEL study.** (under revision).

# Screening for Malnutrition

Worldwide, 48 malnutrition screening tools are being used in older adults, of which 34 have been validated in 119 studies for use in this population group.

In the **MaNuEL Knowledge Hub**,

a scoring system was developed (Figure) and applied to evaluate the 34 tools in order to identify tools that are both valid and practicable for older persons.

## 3 equally weighted domains: max. 45 points

| 1. Validation   | 2. Parameters  | 3. Practicability   |
|---|--|---|
| <p><b>Validated in the elderly</b><br/>Yes/No</p> <p><b>Type of Validity</b><br/>- Construct<br/>- Criterion<br/>- Predictive</p> <p><b>Validated Against</b><br/>- MNA, SGA or<br/>- clinical assessment</p> <p><b>Validation Results</b><br/>- Se, Sp, k-values etc.</p> <p><b>Amount of validation studies</b></p> | <p>Some are more suitable for an elderly population/ are more practical measures than others</p> <p><b>Lower Score e.g.</b><br/>- Albumin<br/>- Calf Circumference</p> <p><b>Higher Score e.g.</b><br/>- Recent weight loss<br/>- Reduced appetite</p> <p><b>Adjustments for the Elderly</b></p> | <p><b>Time</b><br/>0-3 min<br/>4-6 min<br/>7-10 min</p> <p><b>Cost/access</b><br/>- Free<br/>- Not Free</p> <p><b>Used By</b><br/>- Nutritionally trained staff only<br/>- All staff</p> <p><b>Languages</b><br/>- English only<br/>- English plus other EU languages</p> |
| Max. 15 points  | Max. 15 points   | Max. 15 points  |

## Main findings

The following tools scored highest in our **MaNuEL** study

- Community setting: DETERMINE your health checklist
- Hospital setting: MNA-SF or the Malnutrition Screening Tool (MST)
- Long-term care setting: Short Nutritional Assessment Questionnaire<sup>RC</sup> (SNAQ<sup>RC</sup>)
- Rehabilitation setting: Nutritional Form for the Elderly (NUFFE)

## Recommendations

- Always use a malnutrition screening tool that has been validated in older persons and in your health-care setting (i.e. community, hospital, long-term care, rehabilitation).
- Find out whether the malnutrition screening tool you are currently using, is validated for older persons and for your health-care setting (see **MaNuEL** publication below).

## Related **MaNuEL** publications:

- Power L, Mullally D, Gibney ER, Clarke M, Visser M, Volkert D, Bardon L, de van der Schueren MAE, Corish CA, on behalf of the **MaNuEL** Consortium. **A review of the validity of malnutrition screening tools used in older adults in community and healthcare settings - A MaNuEL study.** Clin Nutr ESPEN 2018;24:1-13.
- Power L, de van der Schueren MAE, Leij-Halfwerk S, Bauer J, Gibney E, Clarke M, Visser M, Volkert D, Bardon L, Corish CA, on behalf of the **MaNuEL** Consortium. **Creation of a scoring system to rate malnutrition screening tools used in older adults in community and healthcare settings - a MaNuEL study.** Clin Nutr 2018 [Epub ahead of print].

# Determinants of Malnutrition in Aged Persons – The DoMAP Model

Many factors are involved in the development of malnutrition – so called “determinants” – which are important to know for effective prevention and treatment.

## In the MaNuEL Knowledge Hub,

the DoMAP model was developed to illustrate the multitude of potential causes of malnutrition and their relation to malnutrition.

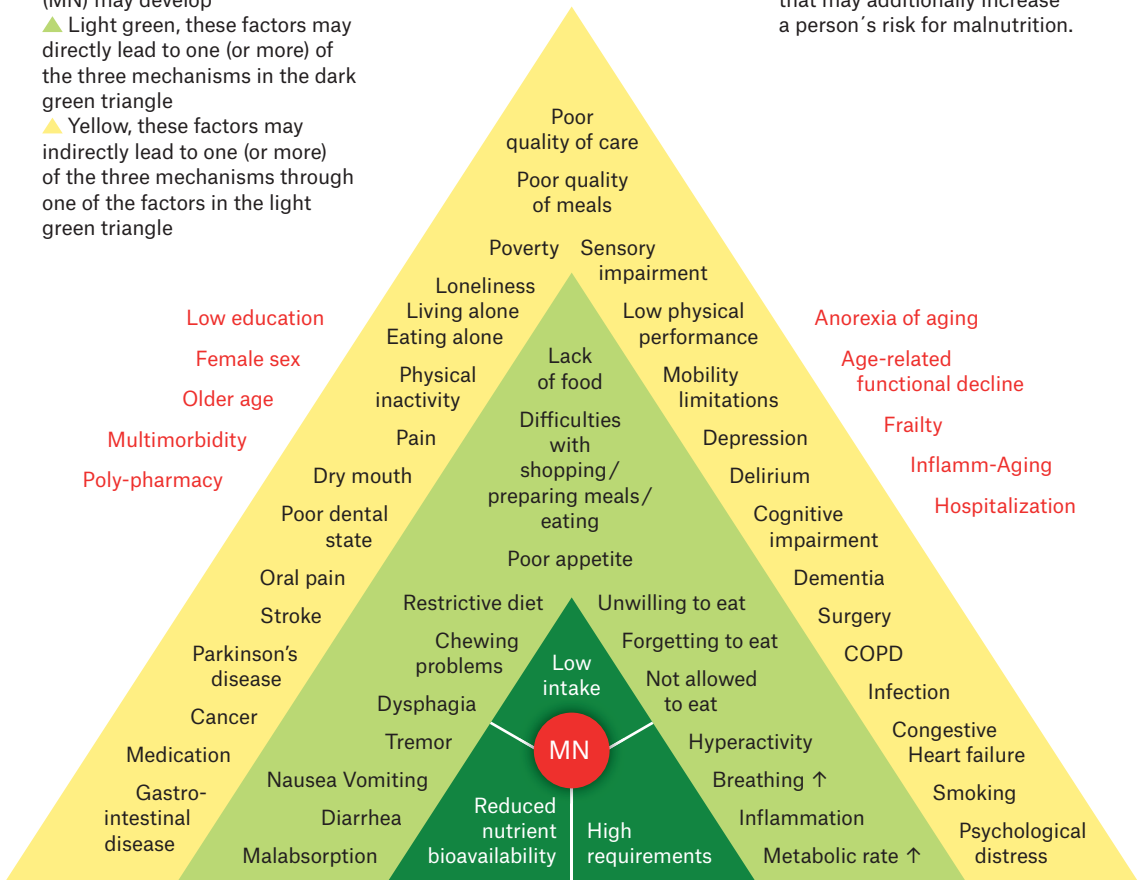
### Three DoMAP levels were defined:

▲ Dark green, these are the three central mechanisms how malnutrition (MN) may develop

▲ Light green, these factors may directly lead to one (or more) of the three mechanisms in the dark green triangle

▲ Yellow, these factors may indirectly lead to one (or more) of the factors in the light green triangle

● Red, the factors in red are considered general background variables and age-related changes that may additionally increase a person’s risk for malnutrition.



## Recommendations

- Check which factors are present in your individual patient.
- Identify factors which may be the cause of malnutrition or increase the risk of malnutrition in your individual patient.
- Think about options to remove the respective factors or provide remedy.

### Related MaNuEL publications:

- Volkert D, Kiesswetter E, Visser M et al. on behalf of the MaNuEL Consortium. **Etiology of malnutrition in older persons – a model of determinants.** (in preparation).

# How to Identify Determinants of Malnutrition

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Despite sound reasons to assume relations between many nutrition-related factors and the development of malnutrition, scientific evidence is fragmentary.

## In the **MaNuEL** Knowledge Hub,

a systematic approach was used to examine the existing evidence regarding potentially modifiable determinants of malnutrition in older adults, across all settings, using information from published prospective studies.

In addition, a multicohort meta-analysis of 6 community-based longitudinal datasets from **MaNuEL** partners was performed using a uniform definition of malnutrition and 23 harmonized potential determinants.

## Main findings

- In published studies, different sets of determinants, different assessment methods for determinants, different definitions of incident malnutrition and different statistical approaches are used – which impedes drawing sound conclusions. Results are partly conflicting, and no studies were considered to be of ‘high quality’.
- The systematic review found consistent evidence of moderate quality that difficulty feeding one-self, poor self-reported health, poor physical function, and hospitalization are determinants of malnutrition.
- The harmonized meta-analysis identified older age, marital status, limitations of walking, limitations of climbing stairs, and hospitalization as determinants of incident malnutrition.
- Thus, physical impairment and hospitalization emerged as relevant determinants in both **MaNuEL** studies – the literature review and in the meta-analyses.

## Recommendations

- Assess determinants as comprehensive as possible. As malnutrition is a multifactorial problem the analysis of single factors is of limited benefit.
- Be aware of a potential malnutrition risk in your individual patient – especially in case of functional impairment and hospitalization.
- Use validated tools for the assessment of determinants.

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## Related **MaNuEL** publications:

- O’Keeffe M, Kelly M, O’Herlihy E, O’Toole PW, Kearney PM, Timmons S, O’Shea S, Stanton C, Hickson M, Rolland Y, Sulmont Rossé C, Issanchou S, Maitre I, Stelmach M, Nagel G, Flechtner-Mors M, Wolters M, Hebestreit A, De Groot LP, van de Rest O, The R, Peyron M.A., Dardevet D, Papet I, Schindler K, Streicher M, Torbahn G, Kiesswetter E, Visser M, Volkert D, O’Connor EM on behalf of the **MaNuEL** consortium. **Potentially modifiable Determinants of Malnutrition in Older Adults: A Systematic Review.** (submitted).
- Streicher M, van Zwiene-Pot J, Bardon L, Nagel G, Teh R, Meisinger C, Colombo M, Torbahn G, Kiesswetter E, Flechtner-Mors M, Denkinger M, Rothenbacher D, Thorand B, Ladwig K-H, Corish CA, Clarke M, Kerse N, Muru-Lanning M, Gibney ER, O’Connor EM, Visser M, Volkert D on behalf of the **MaNuEL** consortium. **Determinants of incident malnutrition in community-dwelling older adults – a MaNuEL multicohort meta-analysis.** *J Am Geriatr Soc* 2018 [Epub ahead of print].



# Effective Nutritional Interventions

Scientific literature shows mixed results on the effects of nutritional interventions, but did not always specifically target older persons who are actually malnourished or at risk of malnutrition.

## In the MaNuEL Knowledge Hub,

- we performed a literature study on the effects of non-pharmacological interventions in older patients with well-defined malnutrition using relevant outcomes agreed by a broad panel of experts;
- we performed a statistical analysis of pooled individual participant data from nine randomized controlled clinical trials regarding the effects of nutritional interventions in older persons at risk of malnutrition.

## Main findings

| Intervention   | Outcomes  | Effect  | Recommendation  |
|--|---|---|---|
| <b>Literature study</b>  |   |   |   |
| Oral nutritional supplementation (ONS) compared to usual care (UC) | Nutritional status (body weight, BMI, MNA score, fat-free mass);<br>Functional status (Timed up-and-go, strength);<br>Quality of life and mortality | No effects were found   | <b>MaNuEL</b> results do not allow drawing any recommendation as the quality of the evidence was very low |
| Individualised dietary counselling (IDC) plus ONS compared to UC   | Nutritional status (body weight, BMI, MNA score);<br>Functional status (handgrip strength);<br>Quality of life and mortality                        | Positive effects were found, in a single study, for hand grip strength, QoL and mortality |   |
| <b>Pooled statistical analyses</b>                                 |   |   |   |
| IDC plus ONS compared to UC  | Meaningful increase in body weight;<br>Meaningful increase in energy intake   | Positive effects were found   | Combination of IDC plus ONS is effective in increasing energy intake and body weight                      |
| IDC and/or ONS compared to UC                                      | Meaningful increase in handgrip strength;<br>Mortality during intervention or up to 6 months  | No effects were found   | <b>MaNuEL</b> results do not allow drawing any recommendation   |


The evidence from the literature was of very low quality due to the risk of bias and the small sample size of the individual studies. Therefore, no recommendation can be derived from our results.

The evidence from the pooled statistical analyses suggests that the combination of individualized dietary counselling (IDC) plus oral nutritional supplements (ONS) improves energy intake and body weight in older malnourished persons or those at high risk. However, no benefit of nutritional interventions on handgrip strength or mortality was observed.

### Recommendations

- Use ONS in combination with dietary counselling whenever possible – as part of a comprehensive, individualized intervention approach.
- Also consider the just recently published evidence-based ESPEN guidelines on clinical nutrition and hydration in geriatrics to support your intervention decisions.<sup>2</sup>

2 Volkert D, Beck AM, Cederholm T et al. ESPEN guideline on clinical nutrition and hydration in geriatrics. *Clin Nutr* 2018. pii: S0261-5614(18)30210-3. doi: 10.1016/j.clnu.2018.05.024. [Epub ahead of print].

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-  Related **MaNuEL** publications:
- Correa-Pérez A, Lozano-Montoya I, Volkert D, Visser M, Cruz-Jentoft AJ. **Relevant outcomes for nutrition interventions to treat and prevent malnutrition in older people: a collaborative senator-ontop and MaNuEL Delphi study.** *Eur Geriatr Med* 2018;9:243–248.
  - Correa-Pérez A, Abraha I, Cherubini A, Collinson A, Dardevet D, de Groot L, de van der Schueren M, Hebestreit A, Hickson M, Jaramillo-Hidalgo J, Lozano-Montoya I, O'Mahony D, Soiza R, Visser M, Volkert D, Wolters M, Cruz-Jentoft AJ. **Efficacy of non-pharmacological interventions to treat malnutrition in older persons: A systematic review and meta-analysis.** The SENATOR project ONTOP series and **MaNuEL** Knowledge Hub project. (submitted).
  - Reinders I, van der Zwielen-Pot JJ, de Groot CPGM, Beck AM, Feldblum I, Jobse I, Neelemaat F, de van der Schueren MAE, Shahar DR, Smeets ETHC, Tieland M, Wijnhoven HAH, Volkert D, Visser M. **Effectiveness of nutritional interventions in older adults at risk of malnutrition across different health care settings: a pooled analysis of individual participant data from nine randomized controlled trials.** *Clin Nutr* 2018 [Epub ahead of print].
  - van der Zwielen-Pot JJ, Reinders I, de Groot CPGM, Beck AM, Feldblum I, Jobse I, Neelemaat F, de van der Schueren MAE, Shahar DR, Smeets ETHC, Tieland M, Wijnhoven HAH, Volkert D, Visser M. **The effect of nutritional intervention in older adults at risk of malnutrition on handgrip strength and mortality: results of a pooled analysis of individual participant data from 9 RCTs.** (in preparation).

# Future Intervention Studies – the Minimum Data Set

Results of multiple nutritional intervention trials (RCTs) can be combined in meta-analysis to obtain the highest level of scientific evidence. In addition, pooling of individual participant data from multiple RCTs allows innovative research with increased statistical power. The heterogeneity of variables included in current and previous RCTs presently hampers this research.

## In the MaNuEL Knowledge Hub,

we conducted a pilot survey for proposing a Minimum Data Set (MDS) of variables to include in future RCTs to characterize study participants at baseline, and a MDS of relevant outcome variables to include. An extension of the survey among non-MaNuEL experts is currently under way.

## Top 10\* of MDS variables to be assessed in future RCTs (setting specific) based on a pilot survey among MaNuEL experts

|                                 | Community                         | Hospital                          | Institution                       |
|---------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|
| <b>Baseline characteristics</b> |                                   |                                   |                                   |
| 1                               | Body weight                       | Body weight                       | Body weight                       |
| 2                               | Age                               | Malnutrition screening tool items | Current appetite                  |
| 3                               | Current appetite                  | Age                               | Malnutrition screening tool items |
| 4                               | Malnutrition screening tool items | Current appetite                  | Age                               |
| 5                               | Body height                       | Weight loss in past 3 months      | Weight loss in past 3 months      |
| 6                               | Current energy intake             | Current energy intake             | Current energy intake             |
| 7                               | Living alone                      | Body height                       | Body height                       |
| 8                               | Weight loss in past 3 months      | Appetite in the past month        | Current protein intake            |
| 9                               | ADL / IADL                        | Current protein intake            | Difficulty eating                 |
| 10                              | Cognitive functioning             | Pain when chewing                 | ADL                               |
| <b>Outcome variables</b>        |                                   |                                   |                                   |
| 1                               | Quality of life                   | Mortality                         | Body weight                       |
| 2                               | Current protein intake            | Quality of life                   | Quality of life                   |
| 3                               | Body weight                       | Body weight                       | Current protein intake            |
| 4                               | Current energy intake             | Current protein intake            | Mortality                         |
| 5                               | Falls                             | Current energy intake             | Current energy intake             |
| 6                               | Skeletal muscle mass              | Treatment complications           | Falls                             |
| 7                               | Gait speed                        | Length of stay                    | Fat mass / fat-free mass          |
| 8                               | Fat mass / fat-free mass          | Fat mass / fat-free mass          | ADL                               |
| 9                               | Physical activity                 | Falls                             | Self-rated health                 |
| 10                              | Cognitive functioning             | Re-admission                      | Cognitive functioning             |

\* Highest mean score on a scale from 1 (not relevant) to 10 (very relevant)

## Recommendations

- When conducting a RCT in older malnourished persons or those at high risk, assess nutritional status, appetite and dietary intake for a comprehensive baseline characterization and monitor these variables during treatment.
- When conducting a RCT in older malnourished persons or those at high risk, also consider person-centered outcomes such as quality of life and physical functioning.
- Obtain specific informed consent from your participants to allow the collected data to be used to address future research questions.
- Store all your original collected data in your dataset (e.g. keep the information of single items of your malnutrition screening tool in your dataset and not only the total score).
- Share your coded individual participant data with other researchers to allow meta-analyses and pooled statistical analyses.

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 Related **MaNuEL** publication:

- Visser M, Volkert D et al. **Towards a Minimum Data Set for nutritional intervention studies in malnourished older persons or those at high risk.** (in preparation).

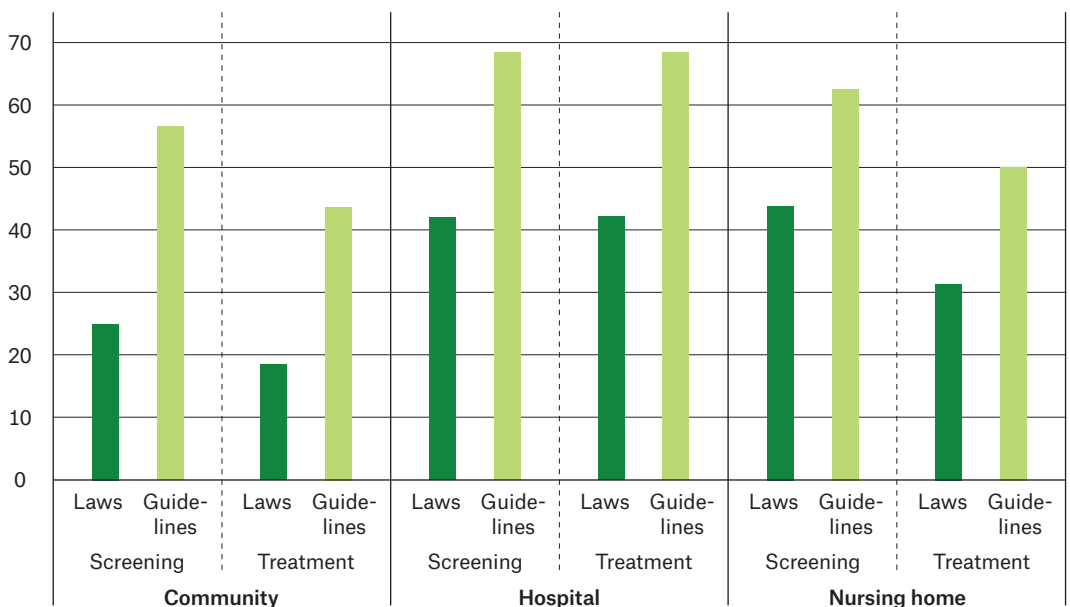
# Policy Measures

Policies and current practice for screening and treatment of malnutrition in older persons vary widely across Europe. National regulations can create an environment that favors early detection of malnutrition and subsequent treatment.

## In the MaNuEL Knowledge Hub,

a web-based survey was conducted among 19 countries (out of 31, response rate 61.3%) to provide an overview on present national policies across Europe with regard to the detection and management of malnutrition in older persons.

## Proportion of countries with existing laws and guidelines providing recommendations on screening and treatment of malnutrition in older persons by health-care setting (%)



(Community and nursing home: n=16, hospital n=19 countries; lacking information from 0-4 countries)

## Recommendations

- More effort is needed to implement binding norms for early detection and treatment of malnutrition in older persons.
- More effort is needed, that prevention, detection and management of malnutrition is obligatorily included in medical treatment and should not depend on individual caregivers knowledge and engagement.
- National health system policies on quality management in hospitals and nursing homes should include implementation of screening for malnutrition, nutritional treatment and monitoring standards.

📖 Related MaNuEL publication:

- Ranzenberger-Haider T, Schindler K et al. on behalf of the MaNuEL Consortium. **Policies and current practice on screening and treatment of malnutrition in older adults across Europe.** (in preparation).

# Education of Health Professionals

The lack of knowledge of health care professionals is one main barrier to implementing adequate nutritional interventions in older persons. Until now, it is not known to which extent European nurses and medical doctors are exposed to the topic of malnutrition in older adults during their education.

## In the MaNuEL Knowledge Hub,

an online survey was conducted to gain information about the curriculum content on malnutrition in basic study programs for nurses and medical doctors.

## Proportion of nursing and medical education institutions teaching specific topics with respect to malnutrition in older adults (%)

| Topic                                     | Nursing education institutions<br>(n=131 institutions from<br>26 countries) | Medical education institutions<br>(n=26 institutions from<br>12 countries) |
|---|---|--|
| Malnutrition screening                    | 70.8  | 35.0   |
| Consequences of malnutrition              | 68.7  | 46.2   |
| Causes of malnutrition                    | 67.2  | 50.0   |
| Assessment of malnutrition                | 59.5  | 50.0   |
| Oral nutritional supplements              | 53.4  | 38.5   |
| Application of enteral nutrition          | 53.4  | 34.6   |
| Application of parenteral nutrition       | 51.1  | 20.8   |
| Calculation of nutritional requirements   | 43.6  | 42.3   |
| Responsibilities of various professions   | 35.1  | 30.8   |
| Multidisciplinary nutrition support teams | 28.2  | 30.8   |

## Recommendations

- The topic of malnutrition in older adults needs to be included in the curriculum of nurses and physicians.
- The topics of multidisciplinary cooperation and evidence-based interventions should also be included in the curricula.
- Healthcare professionals should receive training on screening for malnutrition.
- Teachers with expertise in nutrition education, such as registered dietitians, should preferably be involved in the education.
- Health professionals should be encouraged to follow additional courses (e.g. MOOC) to educate themselves on the topic of malnutrition in older persons.

### Related MaNuEL publications:

- Eglseer D, Halfens RJG, Schüssler S, Visser M, Volkert D, Lohrmann C 2018. **Is the topic of malnutrition in older adults addressed in the European nursing curricula? A MaNuEL study.** Nurse Education Today, 68: 13– 18.
- Eglseer D, Visser M, Volkert D, Lohrmann C. **Nutrition education on malnutrition in older adults in European medical schools: Need for improvement?** (In preparation) **Massive open online course (MOOC)** (in process): <https://imoox.at/mooc/local/courseintro/views/startpage.php?id=31>

## MaNuEL partner institutions

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**Austria**  
Medical University Vienna (MUV)  
Medical University Graz (MUG)

**France**  
Champmaillot Centre Geriatric  
Research Unit-Dijon (CHU)  
French National Institute for  
Agronomic Research Paris  
(INRA)  
School of Agricultural Studies  
Angers (ESA)  
Gerontopole of Toulouse (CHU)

**Germany**  
German Institute for Human  
Nutrition Potsdam (DIfE)  
Friedrich-Schiller-University  
Jena (FSU)

Ulm University (UUI)M)  
Leibniz Institute for Prevention  
Research and Epidemiology –  
BIPS (BIPS)  
Christian-Albrechts University  
Kiel (CAU)  
Friedrich-Alexander-Universität  
Erlangen-Nürnberg (FAU)

**Ireland**  
University College Dublin (UCD-1)  
Institute of Food and Health  
Dublin (UCD-2)  
University of Limerick, Department  
of Biological Science (UL)  
Alimentary Pharmabiotic Centre –  
Microbiome Institute Cork  
(UCC)

**New Zealand**  
University of Auckland (UoA)

**Spain**  
Instituto Ramón y Cajal de  
Investigación Sanitaria Madrid  
(IRYCIS)

**The Netherlands**  
Vrije Universiteit Amsterdam (VU)  
VU University Medical Center  
(VUmc)  
Wageningen University Research  
Centre (WUR)  
HAN University of Applied  
Sciences (HAN)  
Dutch Malnutrition Steering  
Group (DMSG)

## MaNuEL funding organizations

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**Austria**  
Federal Ministry of Science,  
Research and Economy (BMWFW)

**France**  
The National Institute for  
Agricultural Research (INRA)

**Germany**  
Federal Ministry of Food and  
Agriculture (BMEL) represented  
by Federal Office for Agriculture  
and Food (BLE)

**Ireland**  
Department of Agriculture,  
Food & the Marine (DAFM) and  
the Health Research Board (HRB)

**The Netherlands**  
The Netherlands Organisation for  
Health Research and Development  
(ZonMw)

**Spain**  
National Institute of Health Carlos  
III (ISCIII) and the SENATOR trial  
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### MaNuEL Coordinators on behalf of the whole MaNuEL Consortium

Prof. Dr. Marjolein Visser  
Professor of Healthy Aging

Department of Health Sciences,  
Vrije Universiteit Amsterdam  
De Boelelaan 1085  
1081 HV Amsterdam  
The Netherlands

E-Mail: [m.visser@vu.nl](mailto:m.visser@vu.nl)

Prof. Dr. Dorothee Volkert  
Professor for Clinical Nutrition  
in the Elderly

Institute for Biomedicine of Aging  
Friedrich-Alexander-Universität  
Erlangen-Nürnberg  
Kobergerstraße 60  
90408 Nürnberg  
Germany

E-Mail: [dorothee.volkert@fau.de](mailto:dorothee.volkert@fau.de)

Presentations of **MaNuEL**  
Knowledge Hub results are  
available online at:  
[https://av-media.vu.nl/VUMedia/  
Play/8bb85270414043d6aa  
746f494cbb3ef91d](https://av-media.vu.nl/VUMedia/Play/8bb85270414043d6aa746f494cbb3ef91d)

More information about the  
**MaNuEL** Knowledge Hub  
can be found at:  
[www.healthydietforhealthylife.eu/  
index.php/joint-actions/  
malnutrition](http://www.healthydietforhealthylife.eu/index.php/joint-actions/malnutrition)

