Short communication

# The prevalence of malnutrition according to the new ESPEN definition in four diverse populations

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## ARTICLE INFO

## SUMMARY

*Background & aims:* Consensus on the definition of malnutrition has not yet been reached. Recently, The European Society for Clinical Nutrition and Metabolism (ESPEN) proposed a consensus definition of malnutrition. The aim of the present study was to describe the prevalence of malnutrition according to the ESPEN definition in four diverse populations.
*Methods:* In total, 349 acutely ill middle-aged patients, 135 geriatric outpatients, 306 healthy old individuals and 179 healthy young individuals were included in the study. Subjects were screened for risk of malnutrition using the SNAQ. The ESPEN definition of malnutrition, i.e. low BMI ($< 18.5$ kg/m$^2$) or a combination of unintentional weight loss and low FFMI or low BMI was applied to all subjects.
*Results:* Screening identified 0, 0.5, 10 and 30% of the healthy young, the healthy old, the geriatric outpatients and the acutely ill middle-aged patients as being at risk of malnutrition. The prevalence of malnutrition ranged from 0% in the healthy young, 0.5% in healthy old individuals, 6% in the geriatric outpatients to 14% in the acutely ill middle-aged patients. Prevalence of low FFMI was observed in all four populations (14–33%), but concurred less frequently with weight loss (0–13%).
*Conclusions:* Using the ESPEN definition, 0%–14% malnutrition was found in the diverse populations. Further work is needed to fully address the validity of a two-step approach, including risk assessment as an initial step in screening and defining malnutrition. Furthermore, assessing the predictive validity of the ESPEN definition is needed.

## 1. Introduction

Malnutrition is an increasingly recognized problem that is associated with morbidity, mortality and increased costs of care. To enhance early recognition and treatment of malnutrition, an easy and widely accepted definition of malnutrition is necessary. Such a definition should be easily applicable for all health care professionals and in all health care settings. Furthermore, the

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definition of malnutrition should be widely accepted to be able to compare prevalence rates among health care settings and countries and to improve communication among health care providers and politicians worldwide.

International consensus on the definition of malnutrition has not yet been reached. Recently, the European Society for Clinical Nutrition and Metabolism (ESPEN) proposed a new consensus definition [1]. The diagnosis of malnutrition is considered a two-step process. Before diagnosis, it is mandatory to fulfil criteria for being "at risk" of malnutrition by any validated risk screening tool. Those who are identified as being at risk proceed in the diagnostic process that includes two options: the first diagnostic option requires a body mass index (BMI) $< 18.5$ kg/m$^2$, following the recommendation by the World Health Organization [2]. The second option encompasses unintentional weight loss ($> 10\%$ independent of time or $> 5\%$ in the last three months), always combined with either a low BMI ($< 20$ kg/m$^2$ if $< 70$ years old or $< 22$ kg/m$^2$ if $\geq 70$ years old) or a low fat free mass index (FFMI; $< 15$ kg/m$^2$ for women and $< 17$ kg/m$^2$ for men).

As the new ESPEN consensus definition of malnutrition has been released only recently, validation studies have not yet been published. The aim of the present study was to describe the prevalence rates of malnutrition according to the newly proposed ESPEN consensus definition of malnutrition in four diverse populations, including acutely ill middle-aged patients, geriatric outpatients, healthy old individuals and healthy young individuals. This study provides a first overview of the applicability of the newly proposed consensus definitions of malnutrition in various target populations.

## 2. Methods

Within the four populations, individuals were screened for being 'at risk of malnutrition', applying the SNAQ screening tool [3]. As recent studies have shown that the validity of SNAQ is low in outpatients [4], the recently released ESPEN consensus definition of malnutrition (see Fact box 1) was applied to all subjects in the populations, dependent as well as independent of the SNAQ screening results. Only individuals for whom all data on screening and diagnostic criteria were complete were included in the analysis.

### 2.1. Population 1: acutely ill, middle-aged patients

This population consisted of 349 patients ($57.6 \pm 17.7$ years) who were admitted to wards of general internal medicine, gastroenterology, dermatology, rheumatology or nephrology or to wards of general surgery and surgical oncology. Data were collected from April 2002 to October 2002 and from February 2003 to June 2003 at the VU University Medical Center, Amsterdam, the Netherlands [3].

### 2.2. Population 2: geriatric outpatients

This population consisted of 135 geriatric outpatients ($80.8 \pm 7.3$ years) who were referred to the geriatric outpatient clinic of the Bronovo Hospital, the Hague, the Netherlands, for a comprehensive geriatric assessment due to mobility problems between March 2011 and January 2012 [5].

### 2.3. Population 3 and 4: healthy old individuals and healthy young individuals

The European MYOAGE study consisted of old and young healthy individuals who were physically active. Individuals in the MYOAGE study were recruited from five different sites across Europe, including Manchester, UK; Paris, France; Leiden, the Netherlands; Jyväskylä, Finland and Tartu, Estonia. Data was collected between 2010 and 2013 [6].

Old and young healthy individuals from the MYOAGE study were analysed separately; included were 306 healthy old individuals ($74.4 \pm 3.3$ years) and 179 healthy young individuals ($23.4 \pm 2.9$ years).

Individuals in all four populations were screened with the SNAQ, with $\geq 3$ points indicating high risk of malnutrition [3]. The diagnosis of malnutrition according to the ESPEN definition was assessed by self-reported unintentional weight loss and by measured weight and height, used for the calculation of BMI. FFMI was derived differently across the populations. The derived values of FFM were divided by height$^2$ to obtain FFMI. In the acutely ill middle-aged population, FFMI was assessed using Xitron 4000B multiple frequency Bioelectrical Impedance Spectroscopy, using its 50 KHz frequency and the Geneva equations [7]. In the geriatric outpatients, fat free mass FFMI was assessed using a direct segmental multi-frequency Bioelectrical Impedance Analyser (InBody 720, Biospace Co., Ltd, Seoul, Korea). In both old and young healthy individuals, FFMI was assessed using dual-energy x-ray absorptiometry (UK: Lunar Prodigy Advance, version EnCore 10.50.086; France: Lunar Prodigy, version EnCore 12.30; Netherlands: Ho logic QDR 4500, version 12.4; Estonia: Lunar Prodigy Advanced, version EnCore 10.51.006; Finland: Lunar Prodigy, version EnCore 9.30).

## 3. Results

Screening with SNAQ ($\geq 3$ points) identified 105 (30%) acutely ill middle-aged patients, 14 (10%) geriatric outpatients, 1 (0.5%) healthy old individual and none of the healthy young individuals as being at risk of malnutrition.

Assessment according to the new ESPEN definition respectively, with or without initial screening with SNAQ criteria, yielded 49(14%) and 54(15%) malnourished acutely ill, middle-aged patients, 8(6%) and 10(7%) malnourished geriatric outpatients, 0 and 3(1%) malnourished healthy old and 0 and 14(8%) malnourished healthy young.

Table 1 describes the prevalence data for each population. Furthermore, it shows the outcome for the individual diagnostic criteria of the definition. For example; in the acutely ill middle-aged population (n = 349, malnutrition rate of 15%) 116 individuals had a FFMI below the proposed cut-off points; 44(13%) of these 116 individuals were defined as malnourished based on the combination of low FFMI and unintentional weight loss.

Figure 1A and B displays the overlap of the new ESPEN consensus definition of malnutrition and its individual diagnostic

**Fact box**
**Two alternative ways to diagnose malnutrition**. Before diagnosis of malnutrition is considered it is mandatory to fulfil criteria for being "at risk" of malnutrition by any validated risk screening tool.

Option 1:

• BMI < 18.5 kg/m2

Option 2:

• Weight loss (unintentional) > 10% indefinite of time, or > 5% over the last 3 months combined with either
• BMI < 20 kg/m2 if < 70 years of age, or < 22 kg/m2 if ≥ 70 years of age or
• FFMI < 15 and 17 kg/m2 in women and men, respectively.

**Table 1**
Prevalence rates of malnutrition according to the new ESPEN consensus definition and to its individual diagnostic criteria in four populations.

| | Acutely ill, middle-aged patients N = 349 | | Geriatric outpatients N = 135 | | Healthy old individuals N = 306 | | Healthy young individuals N = 179 | |
|---|---|---|---|---|---|---|---|---|
| Screened at risk of malnutrition according to SNAQ ≥ 3 points | 105 | 30% | 14 | 10% | 1 | 0.5% | 0 | 0% |
| **Malnourished according to ESPEN definition (n, %)** | | | | | | | | |
| **Whole population** | 54 | 15% | 10 | 7% | 3 | 1% | 14 | 8% |
| **In "at risk"-patients according to SNAQ** | 49 | 14% | 8 | 6% | 1 | 0.5% | 0 | 0% |
| BMI < 18.5 kg/m$^2$ | 21 | 6% | 3 | 1% | 3 | 1% | 13 | 7% |
| Unintentional WL> 10% indefinite of time, WL > 5% past 3 months | 88 | 25% | 17 | 13% | 2 | 1% | 4 | 2% |
| *Unintentional WL + low BMI/low FFMI according to ESPEN definition* | *46* | *13%* | *9* | *7%* | *0* | *0%* | *1* | *1%* |
| BMI < 20 kg/m$^2$ (< 70 years) or < 22 kg/m$^2$ (≥70 years) | 72 | 21% | 28 | 21% | 39 | 13% | 29 | 16% |
| *Low BMI + unintentional WL according to ESPEN definition* | *30* | *9%* | *9* | *7%* | *0* | *0%* | *1* | *1%* |
| FFMI < 15 kg/m2 (F) or < 17 kg/m2 (M) | 116 | 33% | 34 | 25% | 42 | 14% | 43 | 24% |
| *Low FFMI + unintentional WL according to ESPEN definition* | *44* | *13%* | *8* | *6%* | *0* | *0%* | *1* | *1%* |

Data are presented as n, %; SNAQ = short nutritional assessment questionnaire, BMI = body mass index, WL = weight loss, FFMI = fat free mass index, F = female, M = male. Data in bold provides the prevalence rates of malnutrition according to the ESPEN definition, both dependent and independent of initial SNAQ screening results. Data in italis indicate the combined finding of unintentional weight loss with either low BMI or low FFMI.

criteria in the acutely ill middle-aged population and in the geriatric outpatient population. Overlap figures are not displayed for the healthy old individuals and healthy young individuals due to low numbers of malnourished cases. In the healthy old individuals low BMI and low FFMI never occurred in combination with unintentional weight loss.

## 4. Discussion

This study is the first to provide insight into the applicability of the new ESPEN consensus definition of malnutrition. The different criteria that compose the new ESPEN consensus definition of malnutrition were represented in the four populations in various ways, as expected due to the diversity among the populations.

The first diagnostic option of the new ESPEN consensus definition of malnutrition consists of BMI < 18.5 kg/m$^2$. Subjects defined as malnourished based exclusively on low BMI were mostly observed in acutely ill middle-aged patients, likely reflecting acute weight loss triggered by the disease. In contrast, in both geriatric outpatients and healthy old individuals, a BMI < 18.5 kg/m$^2$ was rare (1% in each population), which is in line with other studies that report a higher BMI in older populations [9].

The second diagnostic option of the new ESPEN consensus definition of malnutrition consists of a combination of unintentional weight loss and either low BMI or low FFMI. In the acutely ill middle-aged population, 25% of all patients had unintentionally lost weight. This finding is in line with expectations, as unintentional weight loss is a frequently described phenomenon accompanying acute disease. Fifteen percent of the population was defined as malnourished according to the new ESPEN consensus definition, indicating that in 10% of the cases, unintentional weight loss did not occur in combination with a low BMI or a low FFMI. We believe that the infrequent concurrence of unintentional weight loss with low BMI (30 out of 54 malnourished acutely ill patients) or low FFMI (44 out of 54 malnourished acutely ill patients) is due to the relatively high average BMI within these populations, or to the fact that the weight loss triggered by the acute disease had not yet been translated into significant loss of body weight and/or fat mass. This finding may justify the measurement of FFMI as an alternative for the diagnosis of malnutrition.

In the geriatric outpatient population the combination of unintentional weight loss and low BMI (< 22 kg/m$^2$ if ≥ 70 years old), found in 9 out of 10 malnourished outpatients, overlapped reasonably well with the combination of unintentional weight loss and low FFMI, found in 8 out of 10 malnourished outpatients.

Expressed alternatively, approximately 20% of the subjects within each population showed both a low BMI and a low FFMI, yet were not diagnosed as malnourished because they had not reported unintentional weight loss. Thus, the mandatory criterion of unintentional weight loss had a strong influence when determining malnutrition prevalence rates. Weight loss reflects the dynamic part of becoming malnourished, next to the more static parameters of body composition. Since unintentional weight loss was a self-reported, rather than an empirically determined parameter, proper diagnosis of malnutrition is potentially limited by its inaccurate registration. Criteria should be defined to measure, monitor and record weight changes over time.

As the new definition suggests that unintentional weight loss should be combined with either a low BMI or a low FFMI to fulfil the criteria for malnutrition, this also suggests that a low BMI and a low FFMI could be used interchangeably. Although in geriatric outpatients, malnutrition based on low BMI or on low FFMI was equivalent, the correspondence in the acutely ill patients was lower, probably because recent weight loss had not yet been translated into significant loss of fat free mass. Larger numbers of patients are required to determine the correlation between BMI and FFMI in different populations. A low BMI and a low FFMI are preferably used complementary. Obese patients, for example, may experience substantial weight loss but still have a high BMI. Also geriatric patients may have a high BMI but a low FFMI. Based on the screening outcome or a clinical suspicion it is advisable to assess FFMI, in addition to BMI, to diagnose a proportionally high loss of fat free mass in order to define malnutrition.

Low FFMI was prevalent (14–33%) in all populations. This high occurrence may be explained by the chosen cut-off points in the ESPEN consensus definition. The cut-off point of FFMI below 15 kg/m$^2$ for women represents the 50th percentile, according to Schutz's reference tables [10]. For men, a cut-off point of FFMI below 17 kg/m$^2$ represents the 10th percentile, which may be a more relevant cut-off to apply. This raises the question whether the cut-off point

**A: Acutely ill middle-aged patients N = 349**

Of the 54 malnourished patients (new ESPEN diagnostic criteria):

| | | |
|---|---|---|
| ——— | BMI < 18.5 kg/m$^2$ | N=21 |
| – – – · | Unintentional weight loss + low BMI <20 kg/m$^2$ (<70 years) or <22 kg/m$^2$ (≥70 years) | N=30 |
| ·········· | Unintentional weight loss + low FFMI <15 kg/m$^2$ (females) or <17 kg/m$^2$ (males) | N=44 |
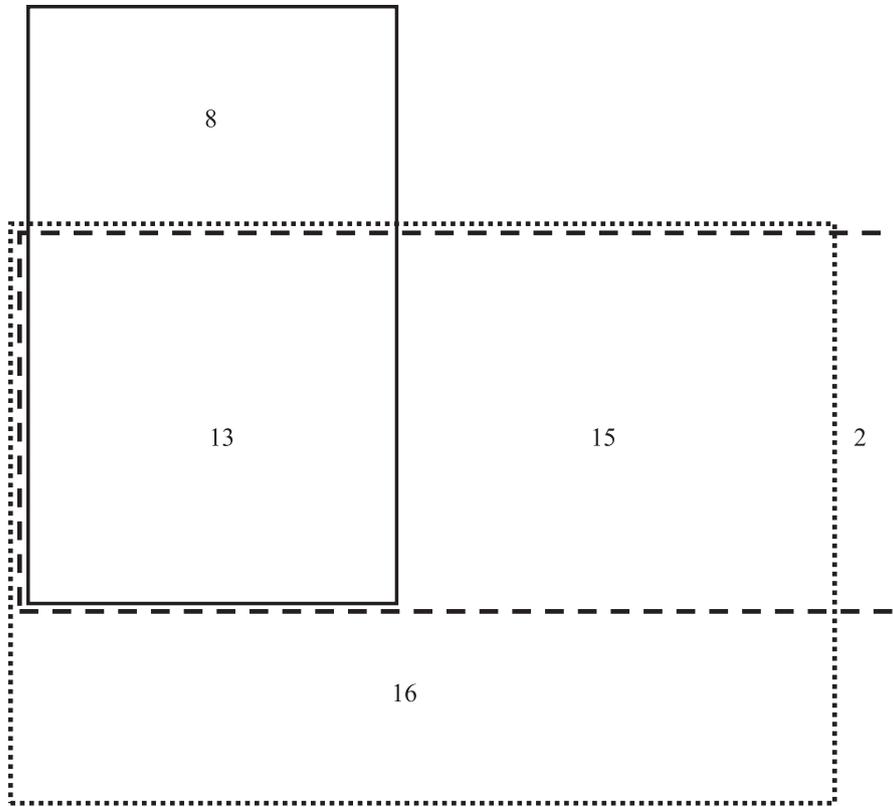


**B: Geriatric outpatients N = 135**

Of the 10 malnourished outpatients (new ESPEN diagnostic criteria):

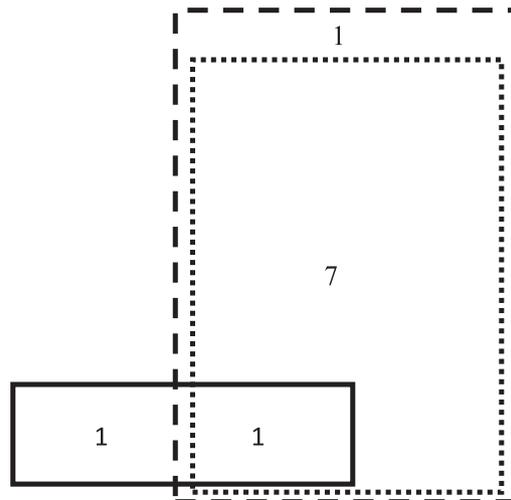| | | |
|---|---|---|
| ——— | BMI < 18.5 kg/m$^2$ | N=2 |
| – – – | Unintentional weight loss + low BMI <20 kg/m$^2$ (<70 years) or <22 kg/m$^2$ (≥70 years) | N=9 |
| ·········· | Unintentional weight loss + low FFMI <15 kg/m$^2$ (females) or <17 kg/m$^2$ (males) | N=8 |



**Fig. 1.** A and B: The overlap of the new ESPEN consensus definition of malnutrition and its individual diagnostic criteria in acutely ill middle-aged patients and geriatric outpatients.

for women should be amended, for example to 14 kg/m$^2$, which represents the 10th percentile for women [10]. When this cut-off was applied for the women in the present study populations the prevalence rates of malnutrition decreased from 15% to 13% in the acutely ill middle-aged patients, but did not change in the other three populations.

Of the acutely ill middle-aged patients with a low BMI ($< 20$ kg/m$^2$ ($< 70$ years) or $< 22$ kg/m$^2$ ($> 70$ years)), approximately half were defined as malnourished as they also displayed the second diagnostic option: unintentional weight loss. In the geriatric outpatient population a low BMI occurred in 28 (21%) of the subjects, of whom 9 (7%) also displayed unintentional weight loss. This may suggest that the cut-off point for weight loss in this population is probable (too) conservative, which may result in underdiagnosis of malnutrition. In the healthy old individuals, 39 (13%) had a low BMI but none was defined as malnourished since no one reported concurrent unintentional weight loss.

A final remark concerns the two-step approach: screening with a validated screening tool is the first required step in the diagnosis of malnutrition. In this study the SNAQ screening tool was applied in all four populations. However, recent research has shown that the SNAQ is less valid for outpatients [4]. For that reason, we have chosen to present the outcome of the diagnostic procedure both with and without preceding SNAQ screening.

This study also sheds new light on the value of different screening tools. By using SNAQ in the young healthy individuals we identified 0% at risk of malnutrition, thus negating the need for further diagnosis. If, for example, MUST [8] had been used, 13 healthy individuals (7%) would have been selected by screening and been diagnosed as malnourished, which would most likely be false, as they were all selected for their excellent health. They were probably 'healthy and slim' or very athletic. Under regular circumstances young healthy individuals would probably not be subjected to screening and assessment for malnutrition. Moreover, clinical judgement would discard athletic slim subjects as being malnourished.

The validity of the various screening tools may need to be reassessed, once the new ESPEN definition has been confirmed in more studies, and acknowledged as the golden standard.

## 5. Conclusions and suggestions for further research

This first study on the applicability of the new ESPEN consensus definition shows, as expected, that prevalence rates largely depend on the characteristics of the population studied. Future studies should further validate the suggested ESPEN consensus definition of malnutrition in other clinical and ethnic settings and analyse the predictive value for relevant clinical outcomes. The result of this study does not justify any urgent changes of the recently suggested diagnostic criteria, but should be seen as a first step towards insight in the clinical relevance of the new ESPEN consensus definition of malnutrition. These are some suggestions for further studies:

- to study the importance of the relative contribution of unintentional weight loss versus low BMI or low FFMI in the new ESPEN consensus definition of malnutrition
- to study the optimal cut-off points for FFMI (both absolute cut-off points and age- and sex-specific percentiles), also in relation to their predictive value for outcome
- to study whether a low BMI and a low FFMI are interchangeable for defining malnutrition within and among populations
- to evaluate the validity of risk assessment by different validated screening tools preceding the diagnosis of malnutrition by the ESPEN consensus definition

In future analyses, we will report on the association between the new ESPEN consensus definition of malnutrition, its individual diagnostic criteria and clinically relevant outcome measures such as functionality and survival.

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