State of the Art and Research Agenda for Malnutrition in the Elderly

Chairmen: Antonio Salvà (Barcelona, Spain) &
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This session reported on the results of the Nestlé Nutrition sponsored IAGG Task Force on Nutrition in older people. The objective of the task force was to review the state of the art in four different aspects of nutrition in older people and develop a consensus. The four topic areas are: epidemiology of nutrition and ageing; nutrition and frailty; nutrition assessment; and interventions to reduce undernutrition. The task force had a working session in November 2008 in Lausanne, Switzerland, with subsequent electronic communication and dialogue. The task force results were presented at this session and will also be published in the near future.

It was a pleasure for Nestlé Nutrition to be part of this important work and to collaborate with such outstanding experts who are passionately interested in improving nutritional care of older people and simultaneously investigating the science necessary to support appropriate clinical practice. This is a very important step towards increasing the visibility of the important role nutrition plays in older people and decreasing the alarming rate of malnutrition in older people, which is well known to have a direct correlation with morbidity and mortality.

Webinars of this session can be viewed at the Nestlé Nutrition Institute Website at: http://www.nestlenutrition-institute.org.

Epidemiology of nutrition and ageing

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Globally, the number of older people (≥60 years) is increasing steadily and, according to United Nations projections, it is expected to exceed that of younger individuals (≤14 years) by the year 2050.[1] Hence, nutrition should be given due attention for promoting the health and well being of this rapidly ageing population.

Benefits of a Mediterranean diet

Nutritional guidelines aim to steer people towards dietary quality. The Tufts nutritional guidelines – Modified MyPyramid for Older Adults – are designed specifically for older adults (≥70 years), taking into account their unique nutrient needs.[2] These guidelines incorporate several elements of the Mediterranean-style diet, which is well known for its significant health benefits. The Healthy Ageing: a Longitudinal study in Europe (HALE) showed that the combination of a Mediterranean diet and healthy lifestyle factors, such as physical activity, nonsmoking and moderate alcohol intake, was associated with a 65% decrease in 10-year all-cause mortality among individuals aged 70–90 years.[3] A recent meta-analysis further demonstrated that a two point increase in the adherence score for a Mediterranean diet was associated with a statistically significant 9% reduction in mortality.[4] However, the considerable beneficial effects of a Mediterranean diet go beyond all-cause mortality to influence cardiovascular mortality[4], Alzheimer's disease[5] and post-myocardial infarction mortality.[6]

Specific nutrient deficiencies in the elderly

Both vitamin D and vitamin B12 are predominantly derived from animal sources. However, deficiencies can occur when endogenous synthesis of vitamin D becomes insufficient or, in the case of vitamin B12, when malabsorption is present. In fact, vitamin D and vitamin B12 deficiencies are highly prevalent in the elderly. Among elderly people living in Europe, 40% reportedly have serum 25-hydroxyvitamin D (25[OH]D) levels <30 nmol/L[7] and 24% have plasma cobalamin levels <260 pmol/L and plasma methylmalonic acid (MMA) levels >0.32 µmol/L.[8] Hence, the Modified MyPyramid for older adults highlights the need for supplementation of these vitamins.

There is significant heterogeneity in current micronutrient recommendations across European countries, mainly because of differences in biochemical cut-off values.[9] The best biomarker for vitamin D status is serum 25(OH)D,[10] and vitamin B12 status is reflected in a combination of biomarkers, including MMA, cobalamin and homocysteine.[11]

While it is important to stress the role of individual nutrients, it should be noted that nutrients typically work together, rather than in isolation, and exert their effects on multiple tissues and organ systems.[12]

Vitamin D and vitamin B12 affect multiple outcomes

Clinical evidence shows supplementing older persons with vitamins D and B12 confers fracture risk reduction. The effect of vitamin D supplementation on reducing hip fracture risk is well established, as demonstrated by several meta-analyses.[13-15] A randomised controlled trial showed that vitamin B12 supplementation along with folate was effective in reducing the risk of hip fractures in elderly patients following stroke.[16]

The classical symptoms of vitamin B12 deficiency typically include pernicious anaemia and neurological impairment,[17] but growing evidence

supports its role in mental health and bone health. Similarly, vitamin D deficiency also leads to a spectrum of consequences affecting bone, muscle, brain and heart health.[18]

It is believed that ageing is a primary risk factor for increased susceptibility to diseases.[19] Future study of the epidemiology of nutrition in the elderly should focus on the impact that diet may have on combined health, functional and quality of life outcomes.

Conclusions

Specific nutrient deficiencies, including vitamin D and B12 deficiencies, are highly prevalent in the elderly and can lead to a spectrum of adverse health consequences. This warrants nutritional supplementation. Given that micronutrients act in concert with each other, the focus should be on the role of overall nutrition and not just specific nutrients. Diet plays an important role in promoting healthy ageing. This is demonstrated by the significant health benefits observed in those following a Mediterranean-style diet.

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Nutrition and Frailty

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What is frailty?

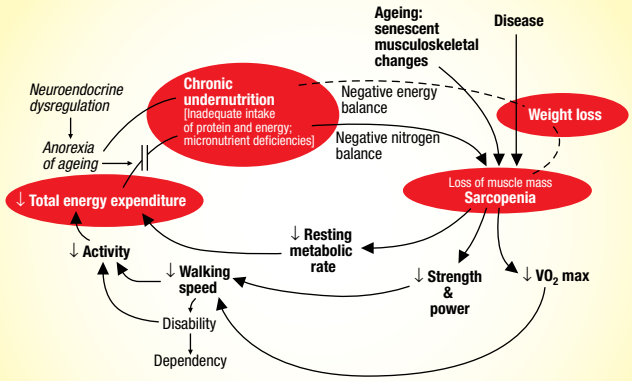
Researchers have long debated the definition for the term 'frailty'. Frailty is generally believed to be a condition of decreased reserve and resistance to stressors, resulting from cumulative declines across multiple physiological systems, and causing vulnerability to adverse outcomes, including mortality, disability, institutionalisation and falls.[1] A standardised definition for frailty was developed and validated in a study using data from the Cardiovascular Health Study (CHS).[1] According to this definition, frailty is defined by the presence of three or more of the following criteria and pre-frailty by one or two of the criteria:

- Unintentional weight loss
- Weakness (grip strength)
- Poor endurance (exhaustion)
- Slowness (walking time)
- Low physical activity

Pathophysiology of frailty

A theoretical model has been proposed depicting the strong relationship between nutrition and physical dysfunction and frailty (Figure 1).[1] This hypothesised cycle shows how chronic undernutrition contributes to physical dysfunction through weight loss, and in particular, loss of muscle mass (sarcopenia). In turn, this decrease in physical performance aggravates malnutrition through a reduction in physical activity.

Figure 1. Hypothesised cycle of frailty[1]



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Malnutrition, with its inadequate intake of protein, energy and micronutrients, leads to the different aspects of the frailty syndrome, including unintentional weight loss – an essential component of frailty. All of the components of the CHS frailty criteria contribute to disability in the elderly.

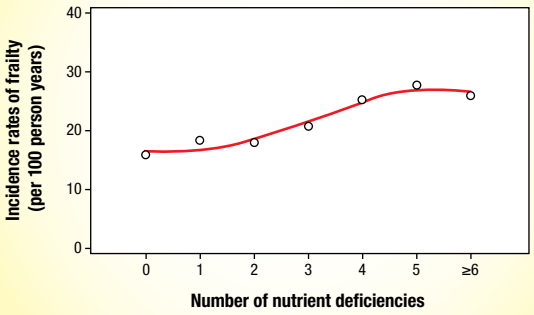
Frailty is a dynamic process, characterised by transitions between states (frail, pre-frail and non-frail) over time.[2] A prospective study was conducted in 754 community-living elderly persons (≥70 years) to determine transition rates between frailty states over 18-month intervals. Overall, transitions to states of greater frailty were more common (up to 43.3%), but transitions to states of lesser frailty were also observed (up to 23.0%).[2] This suggests that frailty is reversible and prevention is possible. Nutrition and physical activity are two important modifiable factors that may prevent frailty.

> "Frailty may be reversible and prevention possible"

Micronutrient deficiencies and frailty

Micronutrient deficiencies are common among the elderly and increase the risk of becoming frail. The association between micronutrient deficiencies and incident frailty was assessed in 463 initially non-frail women (≥65 years) from the Women's Health and Aging Study I.[3] The incidence of frailty increased with higher number of deficiencies (hazard ratio [HR] 1.10; 95% CI 1.01–1.20) (Figure 2).[3] Furthermore, deficiencies in individual micronutrients – carotenoids (HR 1.39; 95% CI 1.01–1.92), α-tocopherol (HR 1.39; 95% CI 1.02–1.92) and 25-hydroxyvitamin D (HR 1.34; 95% CI 0.94–1.90) – were also associated with an increased risk of becoming frail.[3] These findings highlight the important role that antioxidants and vitamin D play in preventing the onset of frailty.

Figure 2. Micronutrient deficiencies increase the risk of frailty[3]



The beneficial role of antioxidants

The clinical association between antioxidants and frailty is corroborated by other studies that have demonstrated a clear relationship between antioxidants and physical performance in older persons:

- A low serum concentration of vitamin E (<24.9 µmol/L) is associated with subsequent decline in physical function[4]
- Lower total plasma carotenoid levels (<1.37 µmol/L) increase the risk of decline in skeletal muscle strength over time[5]
- Low fruit and vegetable intakes (rich sources of antioxidants) are inversely associated with impaired lower extremity limitations and disability[6]

Ageing and age-related disorders are believed to result from oxidative damage to DNA, lipids and proteins by free radicals and reactive oxygen species generated during cell metabolism.[7] This oxidative stress can be decreased by the scavenging action of antioxidants. However, to date, intervention studies using antioxidant supplementation have not been very convincing.[8]

The beneficial role of vitamin D

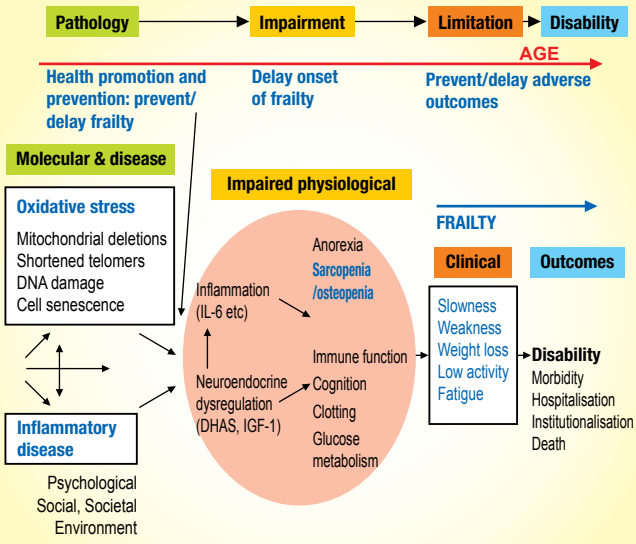
Besides its well-known effects on bone health and fracture prevention, vitamin D has also been shown to play a vital role in maintaining functionality in older people:

- Vitamin D supplementation (>400 IU/day) vs calcium or placebo reduces the risk of falls among ambulatory or institutionalised older individuals[9]
- Vitamin D insufficiency (<50 nmol/L) is associated with frailty in men[10]
- Low serum vitamin D concentrations (<40 nmol/L) are associated with worse musculoskeletal function in the lower extremities (eg, increased walking time) than higher concentrations (40–94 nmol/L)[11]
- Persons with low (<25 nmol/L) serum vitamin D levels are more likely to experience sarcopenia (based on grip strength and muscle mass) than those with high (>50 nmol/L) levels[12]

Several mechanisms have been proposed for the possible impact of vitamin D on functionality and frailty. The binding of vitamin D to vitamin D receptors in the muscle leads to replication of muscle fibres (muscle synthesis).[13] In addition, vitamin D increases calcium intake of muscle fibres, thereby stimulating muscle contraction.[14] Another hypothesised mechanism suggests that vitamin D may affect muscle function through its immunomodulatory effects.[15]

Figure 3 gives an overview of the complex interactions that take place among multiple molecular, physiological and clinical pathways leading to frailty in old age.[16,17]

Figure 3. Potential causal pathway to frailty[16,17]



IL-6, interleukin 6; DHAS, dehydroepiandrosterone sulfate; IGF-1, insulin-like growth factor-1

Gaps in knowledge and future directions

The IAGG taskforce identified the need for epidemiological studies to better understand the mechanisms and pathways involved in the association between nutrition and frailty. The suggested issues were:

- Midlife vs late life exposure to nutrients

- Dietary patterns (vs single nutrient) and their effect on function
- Interactions among different nutrients as well as interactions between nutrients and different pathophysiological processes of ageing, such as inflammation
- Interaction/confounding between diet and other lifestyle factors, such as physical activity
- Impact of one nutrient on multiple outcomes that tend to cluster (eg, vitamin D on muscle, bone, and cognition)
- Identify levels of inadequacy
- Longitudinal studies on dose-response effects to help support causation

The task force also recognised the need to design good intervention studies. Randomised controlled trials should:

- Mimic 'real world' situations (we don't eat single nutrients)
- Have stringent selection criteria for participants
- Determine appropriate primary outcomes (eg, disability and function)
- Have relatively long follow-up, given that chronic processes are slow
- Focus on specific areas, such as sarcopenia
- Include multifactorial intervention design (eg, nutritional supplementation and exercise)

Good behavioural intervention studies are also needed to detect compliance problems. Finally, larger intervention trials at the public health level could help change epidemiological trends.

Conclusions

Frailty is highly prevalent in old age, and its clinical presentation includes multiple components such as unintentional weight loss, weakness, exhaustion, slowness and low physical activity. It is hypothesised that there is a strong correlation between malnutrition and frailty in the elderly. Clinical data suggest that deficiencies in micronutrients, such as antioxidants and vitamin D, may increase the risk of frailty and disability, and supplementation may be beneficial in minimising or preventing adverse outcomes. Future epidemiological and intervention studies should be designed to enable a better understanding of the association between nutrition and frailty.

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Nutritional Assessment

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Predictors of mortality in the elderly

Ageing is associated with changes in body composition and, more importantly, changes in functionality. The Health, Aging and Body Composition (Health ABC) study conducted in 2,292 elderly people (70–79 years) demonstrated that muscle strength, but not muscle mass, was highly correlated with mortality.[1] For quadriceps strength, the crude hazard ratio for mortality in men was 1.51 (95% CI 1.28–1.79) and 1.65 (95% CI 1.19–2.30) for women. Since muscle strength is linked to functionality, it is important to include functional parameters when screening for malnutrition in the elderly.

Furthermore, body mass index (BMI) alone does not predict malnutrition and functional decline in the elderly, although it may be a good indicator of mortality risk. A recent prospective study of 200 elderly nursing home residents (mean age 84 years) showed that there were nearly equal numbers of persons with a BMI <20 and a BMI >35 (Bauer J, et al. In preparation). Upon 1-year follow-up, mortality was high in the BMI <20 group, while none died in the BMI >35 group (Kaiser R, et al. In preparation). Although a higher BMI predicts a higher chance of survival, there are drawbacks to using BMI; it gives no information on body composition (sarcopenia) and is less sensitive to change than weight measurements.

Serum albumin is also a good prognostic parameter for mortality in the elderly, but does not predict malnutrition. In one study, serum albumin was evaluated in 135 geriatric patients (>70 years) at time of hospital admission. The mortality rate was 38.6% in patients with serum albumin values <3.3 g/dL compared with 14.1% in those with albumin values ≥3.3 g/dL ($p<0.005$).[2]

Assessment of (mal)nutrition in the elderly

Assessment of nutritional status in the elderly starts with screening followed by proper assessment. If required, it is important to initiate intervention and follow up with further monitoring to adapt therapy. Hence, nutritional assessment for malnutrition should not be a one-time occurrence but an ongoing process during nutritional therapy.

The easiest method for assessing nutritional status is the change in weight over time. Despite the availability of effective assessment tools, weight measurements remain extremely important. For institutionalised individuals, it is also important to document the daily consumption of food and calories, for example, with pie charts. This will help determine the gaps in nutritional intake where supplementation may be needed.

Assessment Tools

There are five commonly used nutritional assessment tools:

- SGA (Subjective Global Assessment)
- MUST (Malnutrition Universal Screening Tool)
- SNAQ (Simplified Nutritional Appetite Questionnaire)
- NRS 2002 (Nutritional Risk Screening 2002)
- MNA® (Mini Nutritional Assessment)

When comparing prevalence data, it is crucial to determine what cut-points of BMI were used for malnutrition, since cut-points vary among different assessment tools: NRS 2002, BMI <20.5; MUST, BMI <20; and MNA®, BMI <23.

SGA

As the name suggests, SGA is a ‘subjective’ measure and, therefore, would not be useful in an elderly population. An objective assessment would be more desirable.

MUST

The MUST test uses BMI <20 as its cut-point. However, this will exclude those patients who are at risk of developing malnutrition (BMI 20–24) and would potentially benefit from nutritional intervention.

SNAQ

The SNAQ is easy to use and predicts weight loss based on appetite. A SNAQ score ≤14 indicates significant risk of at least 5% weight loss within the next 6 months.[3]

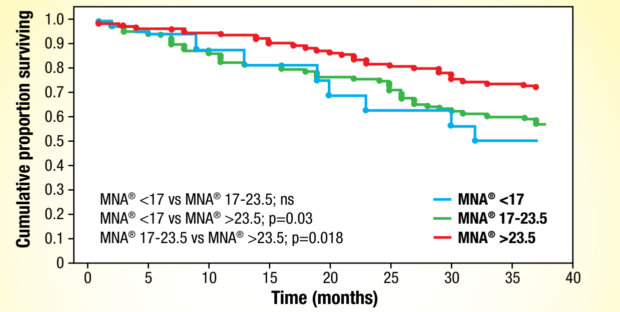
NRS 2002

NRS 2002 is a screening tool recommended by the ESPEN to identify patients in a hospital setting who are malnourished or at risk for malnourishment and who would benefit from improvement of their nutritional status.[4] The initial screening looks at BMI (<20.5), recent weight loss, recent decrease in dietary intake and severity of illness. If any of the screening questions screen positive, then a full test will be performed. The final screening assigns specific scores for impaired nutritional status and severity of disease.[4] The NRS 2002 is designed for the acute-care setting, but is not useful for the elderly because of the low BMI cut-point.

MNA®

The MNA® is the only nutritional assessment tool specifically developed for the elderly. This is reflected in the threshold for BMI for underweight (20 kg/m²), which is higher for the elderly than for younger people (18.5 kg/m²). The MNA® has two parts – a short form and a full form. It comprises 18 questions dealing with overall assessment of health, nutrition, anthropometry and subjective self-estimation. The total score for the full MNA® is 30 points. Based on the score, an individual will be assigned to one of three categories: well nourished (>23); at risk for malnutrition (17–23.5); and malnourished (<17).

Figure 4. MNA® and survival[5]



MNA®, Mini Nutritional Assessment

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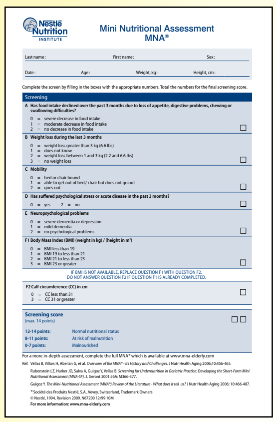
The MNA® is very useful in demonstrating a direct correlation between nutritional status and survival (frailty). In a 3-year follow-up study of 224 elderly persons living at home, nutritional status was assessed using the MNA® and mortality was evaluated. The 3-year mortality was 50% for those who were malnourished, 40% for those at risk of malnutrition, and 28% for the well-nourished group (p<0.05) (Figure 4).[5]

The MNA® was compared with the NRS 2002 in a study evaluating 121 geriatric hospital patients. Among patients assessed by the NRS 2002 to be at risk or malnourished, there was 85% concordance with the MNA®.[6] However, 37% of patients classified as ‘not at risk’ and ‘normal’ with the NRS 2002 screened as ‘at risk’ of malnourishment with the MNA®.[6] Hence, the MNA® is more sensitive than the NRS 2002 in the elderly even in the acute-care setting.

MNA®-short form (MNA®-SF)

The short form consists of six questions and can be completed in 2–3 minutes. In addition to appetite and weight loss, it incorporates other domains, such as functionality (mobility), depression and dementia, which are crucial for the elderly. The new revised MNA®-SF (Figure 5) allows calf

Figure 5. MNA®-SF[7]



1. Has appetite and food intake declined in the past 3 months?
2. Weight loss in past 3 months?
3. Mobility problems?
4. Acute illness or major stress in the past 3 months?
5. Dementia or depression?
6. Body mass index (BMI) (kg/m²) or calf circumference (CC)

MNA®-SF, Mini Nutritional Assessment-Short Form

circumference (CC) to be used as an alternative when BMI is not available.[7] Just like the classic MNA®-SF, the new MNA®-SF also classifies individuals as well nourished (12–14 points), at risk for malnutrition (8–11) and malnourished (0–7).

Conclusions

Poor nutritional status is highly prevalent in the elderly and is correlated with decreased functionality, and increased morbidity and mortality. Therefore, nutrition screening and evaluation is important in all elderly people to identify those who are malnourished or at risk for malnutrition, so that appropriate interventions can be initiated early. Weight loss is a very helpful parameter to diagnose malnutrition in the elderly. BMI is a good indicator of mortality risk, but gives no information on body composition. It is very important that the chosen assessment tool is appropriate for the particular setting and population being screened. MNA® is the only test designed for malnutrition screening and assessment in the elderly. The new MNA®-SF allows CC to be used as an alternative when BMI is not available.

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Interventions to prevent and treat malnutrition

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Age-related problems and nutrition

Malnutrition in the elderly often results from reduced food intake as a result of age-related physiological changes, such as a curbed appetite, early satiation, constipation, constricted senses (vision, smell and taste) and dementia. Changes in body composition or decrease in lean body mass results in reduced basal metabolic rate, which in turn reduces energy requirement.[1] Although energy requirements decline with age, the nutrient requirements remain the same, hence the need for nutrient-dense foods. According to the European Nutrition and Health Report 2004, the intakes of carbohydrates, dietary fibre and micronutrients, including vitamin D, folate, calcium and iodine, are in general below the recommended levels in elderly people.[2]

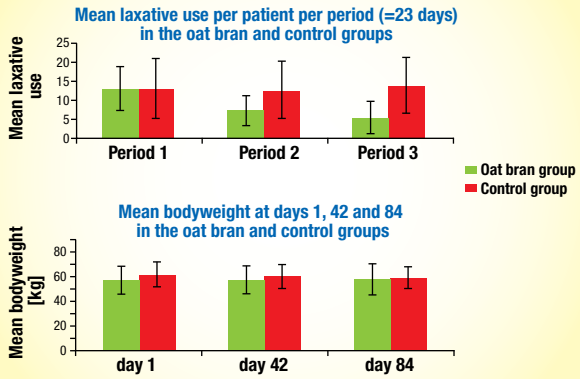
Apart from physiological changes, other factors that cause appetite loss in older people include a worse perceived health status and multiple drug intake.[1]

Examples of interventions

A combination of moderate exercise and oral nutrient supplements has been shown to be more effective than single interventions. A 12-week study conducted in 37 nursing home residents showed that 20–30 minutes of aqua running twice a week combined with a multivitamin drink resulted in better improvements in antioxidant status (vitamin E, vitamin C, α-tocopherol, γ-tocopherol and carotenoids) and respiratory measurements than individual interventions.[3]

In another 12-week study conducted in 30 nursing home residents (57–98 years) using laxatives regularly, patients who received oat bran in addition to standard oral diet used 59% less laxatives ($p<0.001$) and were also able to maintain their body weight throughout the study (Figure 6).[4] In contrast, patients who received no additional fibre had an 8% increase in laxative use ($p=0.128$) and experienced significant loss in body weight ($p<0.005$).[4]

Figure 6. Impact of fibre supplementation on laxative use and body weight[4]



The usefulness of these and other interventions for improving malnutrition in elderly people can be fully realised only when optimal nutritional routines are followed in institutions. A recent investigation among medical professionals in internal medicine and gastroenterology reported that there was much room for improvement with regard to attitudes, expertise and knowledge on nutrition.[5]

Conclusions

Age-related physiological changes have an impact on nutritional status. Appropriate interventional strategies should be implemented to correct current dietary inadequacies in the elderly.

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Nutrition screening

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Most validated tool for the elderly

- Sensitive and reliable
- Recommended by national and international organisations
- Supported by more than 400 published studies

Quick and easy to use

- Screen in less than 4 minutes
- Requires no special training

Identifies nutritional status

- Malnourished vs At risk vs Normally Nourished
- Facilitates early intervention
- Identifies at risk persons before weight loss occurs

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