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Nutritional interventions in older people with COVID-19: an overview of the evidence

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Abstract

Older people are a high-risk group for coronavirus disease 2019 (COVID-19) because of a range of factors including age-related changes in anatomical pulmonary and muscle function, decreased immunity and increased inflammation. These factors partly explain why older people with COVID-19 experience more severe symptoms and higher mortality than younger adults and are more likely to require nutritional support in intensive care. Furthermore, there is an association between suboptimal nutritional status and poorer recovery from COVID-19. Therefore, nutritional interventions are an important aspect of care for older people with COVID-19 and all members of the multidisciplinary team, not only dietitians, should be involved in assessing, treating and preventing nutritional deficiencies in older people with COVID-19. This literature review provides an overview of the evidence regarding the role of nutritional interventions in the treatment of, and recovery from, COVID-19 in older people.

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Keywords

Clinical, coronavirus disease 2019, COVID-19, diet, malnutrition, nutrition, nutritional status, nutritional supplements, nutritional support, obesity, older people, nutritional recovery

In early 2020, coronavirus disease 2019 (COVID-19) was declared a pandemic (World Health Organization 2020). Severe acute respiratory syndrome (SARS)-CoV-2 – the virus that causes COVID-19 – is mainly transmitted via respiratory droplets during close contact with a person who is infected, whether they are pre-symptomatic, symptomatic or asymptomatic (Gupta et al 2020). Commonly reported symptoms include fever, dry cough, fatigue, loss of taste and smell, respiratory distress, gastrointestinal

symptoms, dyspnoea (shortness of breath) and hypoxaemia (low levels of oxygen in the blood). More severe symptoms include acute respiratory distress syndrome, septic shock, refractory metabolic acidosis and cardiac issues (Chen et al 2020a, Gupta et al 2020, Li et al 2020).

The Centers for Disease Control and Prevention (2021) reported that 71.8% of deaths with confirmed or presumed COVID-19 in the US between occurred in people aged 65 years and over.

Older people are a high-risk group for COVID-19 partly because of age-related changes in anatomical pulmonary and muscle function, which lead to reduced lung reserves, weakened airway clearance and diminished defensive barrier function (Chen et al 2020b). Immunity decreases with age because of depleted levels of macrophages, natural killer cells, neutrophils, T-cell receptors and antibody-producing B-cells. In addition, in older people, there is an ongoing inflammatory process induced by increased levels of interleukin-6 (IL-6), interleukin-1 beta (IL-1 β) and tumour necrosis factor-alpha (TNF- α) (Chen et al 2020b). These factors partly explain why older people with COVID-19 experience more severe symptoms than younger people and are more likely to require nutritional support in intensive care (Chen et al 2020b).

In response to the pandemic, governments implemented measures such as shielding, lockdowns and social distancing. While these restrictions have had some effect in reducing transmission rates, in older people they may also have inadvertently led to malnutrition and sarcopenia (loss of muscle mass and strength) due to reduced physical activity and suboptimal nutritional intake because of limited access to shops, social isolation and loneliness (Welch et al 2020).

According to the European Society for Clinical Nutrition and Metabolism (ESPEN), people with COVID-19 who are under-nourished or over-nourished are at higher risk of severe disease and mortality (Barazzoni et al 2020). Before COVID-19, research showed that in Europe, the prevalence of malnutrition in older people was as high as 28% in hospitals, 17.5% in residential care and 8.5% in community settings (Leij-Halfwerk et al 2019, Dominguez et al 2021). A cross-sectional study in people with COVID-19 aged over 65 years in Wuhan, China, found that approximately 28% were at risk of malnutrition and 53% were malnourished (Li et al 2020). Another study found the risk of malnutrition in people with COVID-19 aged over 65 years hospitalised in a Wuhan hospital designated for patients with severe COVID-19 could be as high as 85% (Liu et al 2020). A study undertaken in the first 50 patients admitted to an Italian COVID-19 rehabilitation unit in spring 2020 found that 26% were at moderate risk and 45% at high risk of malnutrition (Brugliera et al 2020). In these studies, malnutrition was associated with suboptimal patient outcomes, so optimising the nutritional status of older people with COVID-19 may improve survival and recovery.

Aim

This literature review aimed to provide an overview of the evidence regarding the role of nutritional interventions in the treatment of, and recovery from, COVID-19 in older people.

Methods

The databases Scopus, ScienceDirect and PubMed were searched between August 2020 and October 2020 for relevant studies published since 2003 for articles not related to COVID-19. Studies were included if they focused on:

- » Older people receiving nutritional interventions via the oral, enteral or parenteral route.
- » Nutritional interventions in older people in inpatient and outpatient and community settings.
- » Outcomes of nutritional interventions in older people with COVID-19.

Studies were excluded if they did not involve nutritional interventions; if their focus was on the prevention of malnutrition rather than on its treatment; or if their focus was on food insecurity, socioeconomic factors or behaviour change.

Published COVID-19 guidance and the websites of professional bodies such as the European Federation of the Associations of Dietitians and the British Dietetic Association were searched to source further relevant studies. Overall, 114 articles were identified. They were screened based on their title and abstract and 42 articles were included in the final review. Studies were included if they met the inclusion criteria focusing on nutritional intervention in older adults with COVID-19.

Findings

Five themes were identified from the analysis of the literature:

- » Identifying the risk of malnutrition in older people.
- » Obesity and COVID-19 in older people.
- » Proteins and calories intake.
- » Vitamins and minerals intake.
- » Omega-3 fatty acids intake.

Identifying the risk of malnutrition in older people

The COVID-19 pandemic has placed additional demands on healthcare teams and dietetic services, with an increased use of nutritional assessments in inpatient and outpatient settings, as well as the use of telephone and/or web-based interventions to monitor the nutritional needs of older people recovering from COVID-19, with the use of apps such as the Remote Malnutrition Application for Primary Practice (www.rmapnutrition.com/en) (Krzniarić et al 2020).

Older people are at increased risk of malnutrition due to age-related factors, comorbidities such as diabetes mellitus and respiratory (i.e. emphysema, COPD, severe acute respiratory syndrome-related coronavirus SARS-Covid-19) and gastrointestinal symptoms (Diarrhoea, nausea, vomiting in some cases ileus and bowel ischemia). Malnutrition and risk of malnutrition are often underdiagnosed in older people in hospital and in the community (Wolters et al 2019). A quarter of patients at risk of malnutrition do not receive nutritional support or advice, despite having been in routine contact with healthcare professionals (Orrevall et al 2009, Fávoro-Moreira et al 2016, Dominguez et al 2021). Malnutrition and risk of malnutrition have been associated with longer hospital stays, increased hospital expenses, suboptimal appetite and greater weight loss than well-nourished older patients (Liu et al 2020).

Malnutrition is identified in clinical practice using validated screening tools such as the Nutritional Risk Screening 2002 (NRS-2002) (Kondrup et al 2003), Malnutrition Universal Screening Tool (MUST) (Stratton et al 2006) and Mini Nutritional Assessment short form (MNA-SF) (Kaiser et al 2009) (Liu et al 2020). Guidance from the ESPEN on nutrition in patients with COVID-19 recommends that all members of the multidisciplinary team should be involved in the prevention, diagnosis and treatment of malnutrition (Barazzoni et al 2020). The guidance recommends regular nutritional screening of all patients with COVID-19 (Barazzoni et al 2020). The US Academy of Nutrition and Dietetics recommends that malnutrition care during the COVID-19 pandemic should include early referral to a dietitian so that patients at risk of or with malnutrition receive detailed nutritional care for preventing or treating nutritional status-related disorders such as malnutrition, sarcopenia, frailty and micronutrient deficiencies (Handu et al 2021).

Box 1 shows a practical approach to nutritional screening in older people with COVID-19.

Box 1. Practical approach to nutritional screening in older people with COVID-19

- » Undertake regular nutritional screening, in the clinical setting and in the recovery phase, as part of routine clinical care during hospital inpatient and outpatient episodes, in patients' homes and in the community
- » Use a validated screening tool such as the Nutritional Risk Screening 2002 (NRS-2002) (Kondrup et al 2003), Malnutrition Universal Screening Tool (MUST) (Stratton et al 2006) and Mini Nutritional Assessment short form (MNA-SF) (Kaiser et al 2009)
- » Diagnose malnutrition using a two-step-approach:
 - Step 1: initial screening to identify at-risk patients, using a validated screening tool
 - Step 2: nutritional assessment to diagnose and grade the severity of malnutrition using the Global Leaders in Malnutrition (GLIM) criteria (Cederholm et al 2019)
- » Refer patients at risk of or with malnutrition to a dietitian early for detailed nutritional care

(Adapted from Barazzoni et al 2020, Liu et al 2020, Handu et al 2021)

Obesity and COVID-19 in older people

Obesity, which refers to an excessive accumulation of visceral, omental, intra-abdominal and ectopic fat, is a risk factor for cardiovascular disease and diabetes. Obesity is also a prognostic factor of compromised immunity, illness severity and mortality in older people with COVID-19 (Nikolich-Zugich et al 2020, Onder et al 2020, Watanabe et al 2020). Ageing is associated with physiological changes which can lead to an accumulation of excessive adipose (fatty) tissue that is often accompanied by sarcopenia. Sarcopenia, in turn, can lead to diminished functional capacity, frailty and other comorbidities (Azzolino et al 2020). The Strength,

Assistance with walking, Rise from a chair, Climb stairs and Falls (SARC-F) questionnaire (Malmstrom and Morley 2013) is recommended for identifying the risk of sarcopenia in older people, independent of body weight.

Ageing is associated with a gradual weakening of immune function – known as immunosenescence – that negatively affects the body's innate and adaptive immune responses and contributes to inflammation and immunodeficiency (Fulop et al 2018, Nikolich-Zugich et al 2020). Nutritional deficiencies negatively affect the maturation, differentiation and function of lymphocytes and the activity of natural killer cells – two types of cells that play an important role in the immune system. Older people's susceptibility to viral infections such as COVID-19 is compounded by a process of chronic low-grade inflammation that develops with age – known as inflammaging – which is partially driven by an increased production of cytokines by adipose tissue (Fulop et al 2018, Lighter et al 2020). Obesity and age-related immune dysfunction and chronic inflammation may partly explain why older people are more likely than younger people to develop severe symptoms of COVID-19 (Mueller et al 2020).

Sarcopenic obesity is characterised by excess adipose tissue and loss of muscle mass and strength. Sarcopenia in older people is related to the increased production of proinflammatory cytokines (Cesari et al 2005), the amount of muscle mass being inversely proportional to the plasma concentrations of IL-6 and TNF- α , which increase with age. Excessive adiposity stimulates the secretion of pro-inflammatory cytokines in skeletal muscle and promotes low-grade systemic inflammation, resulting in a cycle that promotes the development of sarcopenic obesity. Azzolino et al (2020) found that this inflammatory state, along with compromised respiratory function, was a factor in the severity of COVID-19 in patients of any age range with obesity. However, older people with obesity have lower cardiorespiratory and metabolic reserves available to combat COVID-19 (Sattar et al 2020).

Ryan and Caplice (2020) found that patients with obesity exhibit low-grade systemic inflammation and increased susceptibility to infection and high viral load. Obesity can also contribute to a potentially fatal immune reaction known as hypercytokinaemia (or 'cytokine storm'), which is characterised by hyper-inflammation. Hypercytokinaemia is associated with an excessive immune response, oxidative stress, endothelial dysfunction, altered microbiome and increased interferon gamma (IFN- γ) production (Voss and Dhurandhar 2017, Goossens et al 2020). In patients with COVID-19, hypercytokinaemia adds to the strain on the body's metabolism (Ye et al 2020).

Kassir (2020) highlighted that because obesity has been shown to increase vulnerability to infections, it may be a risk factor for COVID-19-related mortality. Two meta-analyses showed that obesity-related complications and abdominal obesity were risk factors significantly associated with the severity of COVID-19 (Földi et al 2021, Yang et al 2021). In a study of 268 patients with COVID-19 in a third-level hospital in Italy, two-thirds were older people, half of whom were overweight or obese. Diabetes, respiratory conditions and cardiovascular disease each affected at least 20% of patients. A higher body mass index (BMI) was associated higher levels of C-reactive protein (an indicator of inflammation), more frequent admission to the intensive care unit (ICU) and a more invasive modality of oxygen therapy than a lower BMI (Pironi et al 2021). Invasive mechanical ventilation in patients with COVID-19 treated in the ICU has been reported to be seven times more likely in patients with a BMI over 35 compared with those with a BMI below 35 (Simonnet et al 2020).

Various studies have found that the amount of visceral adipose tissue was elevated in patients being treated for COVID-19 in the ICU, as were the patients' age, severity of interstitial pneumonia, levels of inflammatory biomarkers (Battisti et al 2020), abdominal fat and waist circumference (Watanabe et al 2020, Földi et al 2021). Visceral adiposity or a high amount of intramuscular fat can independently predict the risk of critical illness in COVID-19 (Földi et al 2021, Yang et al 2021).

Proteins and calories intake

In older people with comorbidities, malnutrition and malnutrition risk need to be identified early (Cederholm et al 2019, Barazzoni et al 2020) and a food-first approach with dietary counselling should be used to optimise nutritional status. When that approach is not sufficient to meet the patient's nutrition needs, oral supplements should be considered in line with local policy (Volkert et al 2019).

In patients with COVID-19 treated in the ICU who are not mechanically ventilated, dietitians should work with the other members of the multidisciplinary team to ensure adequate protein and calorie intake (Handu et al 2021). The ESPEN guidance on nutrition in patients with COVID-19 recommends a daily protein intake of up to 1.5g/kg – or between 20% and 25% of the total daily calorie count – for older people who have a chronic illness. For non-ventilated patients, the ESPEN recommends a person-centred approach and referral to a dietitian for a detailed dietary assessment and tailored advice (Barazzoni et al 2020). In older people with polymorbidity whose nutrition needs cannot be met by oral nutrition, enteral nutrition needs to be considered. In non-intubated patients

in whom the enteral route presents challenges, peripheral parenteral nutrition may be considered. In ventilated or intubated patients, enteral nutrition should start with nasogastric tube feeding. Considering the high prevalence of swallowing disorders in older people after extubation, special attention must be paid to meet the nutritional needs of this particular patient group (Barazzoni et al 2020).

Box 2 shows a practical approach to nutritional support in older people with COVID-19.

Box 2. Practical approach to nutritional support in older people with COVID-19

- » The daily protein and calorie intakes for older people (and for people of any age) at risk of malnutrition should be >1 g/kg of protein and 27-30 kcal/kg
- » Non-ventilated patients in whom dietary counselling and a food-first approach are not sufficient to meet nutrition needs should receive oral nutritional supplements. Oral nutritional supplements should provide at least 400kcal and 30g of protein per day and be given for at least one month
- » In ventilated patients or intubated patients, enteral nutrition should start with nasogastric tube feeding
- » In non-intubated patients in whom the enteral route presents challenges, peripheral parenteral nutrition may be considered
- » In patients with high gastric intolerance and/or high risk of aspiration, prokinetics may be considered in addition to nasogastric feeding or post-pyloric feeding

COVID-19 = coronavirus disease 2019
(Adapted from Volkert et al 2019, Barazzoni et al 2020)

Vitamins and minerals intake

Micronutrients such as vitamins C, D and E, selenium and zinc have been associated with an improved immune response due to their cytokine-calming and antioxidant properties (Calder et al. 2020). However, research on their use in older people with COVID-19 is limited and inconclusive.

Vitamin D is required for the regulation of calcium and phosphorous levels and is synthesised in the skin when the skin is exposed to ultraviolet B radiation from sunlight. A review by the National Institute for Health and Care Excellence (NICE) found no evidence of benefits of using vitamin D in adults with COVID-19, but some studies have shown an association between lower levels of vitamin D levels and the subsequent development of COVID-19 (NICE 2020). The prevalence of vitamin D deficiency is higher in older people than in younger adults and higher in older people living in institutions compared with those living in the community (Marcos-Pérez et al 2020). This is attributable to factors such as longer time spent indoors, lower dermal synthesis of pre-vitamin D, inadequate vitamin D intake and decreased kidney function (Marcos-Pérez et al 2020). During the COVID-19 pandemic, the advice to shield and stay indoors may have compounded the risk of vitamin D deficiency in older people. The Scientific Advisory Committee on Nutrition (2016) recommends a daily reference nutrient intake for vitamin D of 10 micrograms (400IU) for everyone aged 4 years and above (NICE 2020). Further investigation of the potential benefits of vitamin D in COVID-19 is required.

Vitamins A, B6, B12, C, D and E and the trace elements selenium, zinc, iron, magnesium and copper have been discussed as positive modulators of the immune system (Moghaddam et al 2020). Selenium for example, which is essential for immune function, has been shown to be present at lower levels in older patients with COVID-19 compared to survivors (Moghaddam et al 2020). Consuming a balanced diet or taking selenium supplements can improve selenium levels but have not been substantiated in the context of COVID-19 (Moghaddam et al 2020).

Zinc has antioxidant and anti-inflammatory properties and could boost the immune response against viruses. Zinc deficiency compromises immune function in older people (Mossink et al 2020). Zinc may have a protective effect in patients with COVID-19 by reducing inflammation, improving mucociliary clearance in the lungs and preventing ventilator-induced lung injury. However, clinical and experimental studies are required before recommendations for clinical practice can be made (Skalny et al 2020).

Omega-3 fatty acids intake

Excessive acute inflammation has been related to lung diseases including acute respiratory distress syndrome, chronic obstructive pulmonary disease and COVID-19 (Sandhaus and Swick 2020). The omega-3 fatty acids eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) are found in seafood, especially oily fish. DHA and EPA are known to have anti-inflammatory, antithrombotic and immunoregulatory properties (Ruperto et al 2021). DHA, EPA and the omega-6 fatty acid arachidonic acid are available at sites of acute inflammation, where they are converted into bioactive pro-resolving mediators, which have a role in limiting acute responses and removing pathogens, dead cells and debris from areas of inflammation. Omega-3 fatty acids could have a role in

mitigating hypercytokinaemia and resolving inflammation in patients with active COVID-19 infection and in patients with documented omega-3 deficiency recovering from COVID-19. However, further research is needed before recommendations for clinical practice can be made (Rogero et al 2020).

Discussion

The literature on nutritional interventions and COVID-19 is rapidly expanding and it is expected that researchers will learn more about the effects of nutrition on treatment of and recovery from COVID-19.

COVID-19 is associated with an increased risk of malnutrition, possibly due to the effects of the loss of taste and smell on appetite, the gastrointestinal symptoms of COVID-19 and increased nutrient requirements due to inflammation and an upregulated immune response (Mueller et al 2020; Ye et al 2020; Pironi et al 2021). In older people who may already be malnourished, this may further increase the likelihood of negative outcomes. Maintaining an optimal nutritional status, including preventing overweight and obesity, will likely support older people to recover from COVID-19.

Guidance states the importance of an adequate protein and calorie intake to support positive outcomes in older people with COVID-19 (Barazzoni et al 2020, Handu et al 2021). Older people are at higher risk of malnutrition than younger people, so the need to improve their nutritional status is even more important. Similarly, to recovery from conditions other than COVID-19, a suboptimal nutritional status is closely associated with poorer recovery from COVID-19.

Early referral to a dietitian enables older people at risk of or with malnutrition to access specialist nutritional assessment and interventions. The early detection of malnutrition leads to timely nutritional interventions that will aid recovery from COVID-19. Nutritional screening provides a platform for triaging patients and providing prompt nutritional interventions to those who need them. While nutritional risk screening is mandatory in the hospital setting, it is only recommended in community settings (NICE 2017). Therefore, regular screening in community settings should be mandatory for all adults over 65 years old.

Micronutrients including vitamins C, D and E, selenium and zinc have been hypothesised to aid recovery from COVID-19 and reduce the severity of symptoms due to their role in supporting immune function, but evidence regarding the effectiveness of their use in older people with COVID-19 is yet to be demonstrated. Evidence is also needed to make recommendations regarding the use of omega-3 fatty acids in older people with COVID-19. However, these nutrients should already be part of a healthy balanced diet in older people regardless of COVID status (Volkert et al 2019).

Limitations

Covid -19 was a developing disease and therefore there was limited research published at the time of the review. Additionally, many studies did not focus on the older adult population or did not provide information on the ages of participants. The quality of the studies was poor with very few randomised controlled trials to date.

Conclusion

Older people with COVID-19 are likely to be at high risk of malnutrition and should be routinely screened for malnutrition and risk of malnutrition using a validated screening tool. Older people are at higher risk of experiencing severe symptoms of COVID-19 and higher mortality than other patient groups and a suboptimal nutritional status is associated with poorer recovery from COVID-19. Early interventions aimed at optimising the nutritional status of older people with COVID-19 are therefore essential. All members of the multidisciplinary team – including nurses, allied health professionals and doctors, not only dietitians – should be involved in assessing, treating and preventing nutritional deficiencies in older people with COVID-19.

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