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Accepted for publication in Food Quality and Preference

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<https://doi.org/10.1016/j.foodqual.2026.106147>

Understanding “resistance” to using oral nutritional supplements in older adults.

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## Abstract

Malnutrition in older adults is increasingly common, driven by ageing and loss of appetite. Its treatment is typically guided by a “food first” approach (adding energy-dense ingredients to food), followed by oral nutritional supplements (ONS: liquids/semi-solids that support energy intake with macro- and micro-nutrients) if food-first is not successful. These strategies, however, are often resisted by older adults. Therefore, this study examined healthy adults’ (n=454, M<sub>age</sub>= 47, female=230) views on using food-first and ONS to prevent and treat malnutrition. Willingness to consume was assessed using visual analogue scales. Participants reported preferences for personal use and recommending for others, reporting on both approaches for prevention and treatment. Fear of eating novel foods, food choice motives and attitudes toward taking both methods were also assessed, along with open-ended responses to scenarios in which the participant made treatment suggestions for a loved-one with loss of appetite. We found that participants were more willing to consume food-first than ONS both to prevent and treat malnutrition, with older adults much less willing to consume either method to prevent malnutrition than to treat it. This was supported by content analysis illustrating that food-first is perceived as “natural”, with ONS as “medicinal”. Specific attitudes relating to “not seeing the point” or “valuing the benefits” of each method were the strongest predictors of willingness to consume, decreasing and increasing willingness respectively. However, food choice motives and food neophobia were not significant predictors. These findings indicate a preference for food-first over ONS and clear age differences in attitudes toward taking each nutrition method. These findings suggest that ONS should be framed in terms of supporting health and nutritional status, rather than as a medicine for treating malnutrition, with appropriate emphasis on their benefits and necessity.

Keywords: Malnutrition; older adults; oral nutritional supplements; food-first; fortification.

## Introduction

Unintended weight loss, malnutrition and risk of malnutrition are commonly observed in older adults (Dent et al., 2023). In the UK, the Malnutrition Task Force (MTF) has estimated that one in ten people aged 65 and above are currently malnourished or at risk of malnutrition (MTF, 2021). Amongst older adults admitted to hospital, this prevalence increases to three in ten people (MTF, 2023). Both UK government and charity sector guidance from the National Health Service (NHS) and Age UK (Age UK, 2023) for example, advocate prevention and treatment of malnutrition through a “food first” approach in order to improve intake while preserving normal eating, choice, enjoyment and social mealtime routines (Dunne, 2007). This approach is favoured by dietitians in the UK as evidenced by the British Dietetic Association (BDA, 2021) whose guidance provides suggestions on how to achieve both prevention and treatment of malnutrition using nutrient and energy dense foods. For example, food fortification can be achieved by adding energy-dense ingredients such as butter, cream, cheese, and milk powder to foods typically consumed by older adults in the UK. This study assessed healthy adult’s views of using food first approaches and oral nutritional supplements to prevent and treat malnutrition.

The “food first” approach is supported by the idea that to prevent or treat malnutrition in older adults’, who are not meeting energy and nutrient requirements, foods must be fortified with additional energy, protein and nutrients. The approach promotes consumption of a well-balanced diet, eating little and often, and including more high protein foods as well as nutrient dense and high energy (full fat) foods into the diets of older adults (Dunne, 2007). According to the European Society for Clinical Nutrition and Metabolism (ESPEN), those with, or those at risk of malnutrition in the community should be offered fortified foods to ensure adequate dietary intake (Volkert et al., 2022). Furthermore, they advise that oral nutritional supplements (ONS) should be offered “when dietary counselling and food fortification are not sufficient to increase dietary intake and reach nutritional goals” (Volkert et al., 2022 pg 967). In a systematic review of 10 studies which had evaluated the effects of food fortification on energy, protein intake and body weight, most studies showed a significant increase in energy intake, half showed an increase in protein intake and three out of ten demonstrated an increase in body weight (Douglas et al., 2017). These studies indicate the potential benefits of food fortification, especially for increasing energy intake, but the lack of consistency across outcomes suggests that nutrient and body weight improvements were not met by food fortification alone.

Whilst food first is an appealing and accessible approach, using already familiar and liked foods and boosting nutrient, protein and energy intake, the use of ONS is advised to treat malnutrition when fortification has not succeeded. However, loss of appetite is common in older adults and for some this leads to malnutrition (Nieuwenhuizen et al., 2010). Therefore, for

those who are experiencing loss of appetite, whatever the cause, adopting a food first approach to malnutrition may be impractical. Essentially encouraging older adults to eat more protein sources (which enhance satiety; Morell & Fiszman, 2017) and to boost the energy content of existing dietary choices could be challenging to those with low appetites. Therefore, in such cases the use of ONS may be recommended (Stratton, 2025).

Oral nutritional supplements (ONS) include liquids, semi-solid or powder products that provide a convenient method to support energy intake with a mix of macronutrients (protein, fat and carbohydrate) and a range of micronutrients (vitamins, minerals and trace elements) (BDA, 2021). These products are usually prescribed as two servings or bottles per day for one to three months (Malnutrition Pathway, 2021). ONS have been shown to be effective in the prevention and treatment of malnutrition (Stratton, 2025). Health benefits are dependent on compliance, but a systematic review of the evidence showed that compliance to ONS was variable (Hubbard et al., 2012). For example, within clinical trials compliance to consuming ONS is significantly higher (79%) for randomised controlled trials (RCTs) where intake is supervised, compared to 61% compliance reported from surveys in the community (Hubbard et al., 2012).

In a recent review of mixed methods studies which included patients across different diagnostic categories, it was found that providing ONS as a “medicine” achieved optimal success (Liljeberg et al 2025). Improvements included increased nutritional quality of the overall diet, improved energy intake, weight gain, and a reduction in the risk of hospitalisation. However, these positive outcomes were dependent upon patients’ ability to consume fixed amounts of ONS over a long period of time, with nutritional monitoring of intake by support staff.

Where adherence (as defined by the World Health Organization) has been measured, barriers to adherence include the medical needs of the patient, therapeutic practices used by health care providers, and social and economic barriers, including the costs of ONS (Liljeberg et al 2025). Adherence has been linked to patient characteristics such as reported side effects of taking ONS, perceived poor taste and low palatability of ONS and the extended duration recommended for ONS (ibid.). In contrast, facilitators to ONS intake involved switching to relatively small volumes, treating ONS as “medicines” with specific times of the day for ingestion, which is then monitored. Supplements which were ready-made and perceived as palatable also facilitated intake (Liljeberg et al 2025).

Few qualitative studies have been conducted with those who are taking ONS. One such study conducted in Sweden revealed that ONS occupy an ambiguous space “between foods and medicines” (Liljeberg et al., 2022). This is an important finding since conceptualising ONS either as a food, or as a medicine may then influence subsequent adherence. For example, Liljeberg et al (2022) found from their interviews with users that usage of the ONS depended on the patient’s own priorities such as perceiving the need for additional nutrients, the imperative to

increase body weight, and to facilitate disease recovery. In contrast, a means-end chain analysis with 40 ONS users in the Netherlands revealed that most considered the supplements as a food (den Uijl et al. 2015). In this study, usage was facilitated by a relevant health professional, representing an authority figure meeting a health need. Community based users reported that their motivation to extend independence encouraged them to take ONS, whereas care home users indicated that ONS were taken to support improvements in quality of life, such as having more energy to take part in activities (den Uijl et al, 2015). Thus, compliance with ONS might depend on the users' priorities, motivations and perceived benefits of taking the supplements.

There are many, complex causes of malnutrition among older adults (Nieuwenhuizen et al., 2010). These causes are related to physical, psychological and wider social consequences of ageing, which can co-exist in an individual (Volkert et al., 2019). Among these is loss of appetite (anorexia) which contributes to reduced energy intake exacerbated by underlying physiological consequences of ageing (Roy et al., 2016), notably alterations to appetite regulatory hormones which may relate to diminished ability of the gut to sense nutrients (Dagbasi et al., 2024). The effects of inflammation and presence of other disease states also play a key role in the development of appetite decline (Dent et al., 2023), alongside psychological determinants such as low mood (Wijnhoven et al 2024). Wider social factors are also important to consider in the context of malnutrition, particularly the impact of social isolation and loneliness in relation to appetite decline, as well as inability to access and afford food which all contribute to reduced energy intake and nutrient deficiencies (Cruz-Jentoft and Volkert, 2025).

Most studies in this field have been conducted with individuals who are already at risk of malnutrition or who have a diagnosis of malnutrition. However, it is important to explore the perception and experiences of ONS with healthy older adults too as, in time, they and/or those they care for may be encouraged to consume ONS, and their preconceived opinions will likely influence their future behaviours. A small-scale, qualitative study conducted in the UK found that older adults generally resist taking medicines and would specifically resist taking ONS as a possible solution to malnutrition (Hetherington et al., 2024). Older adults in these focus groups identified ONS as “artificial” with the potential to displace intake of regular foods. Another theme which was identified was the idea that supplements were associated with “disgust”- through both their perceived poor taste and their association with end-of-life care. Whilst resistance to taking medicines among older adults is well documented (Barnett, 2014), resistance to taking supplements among healthy older adults is less well understood. It is not clear whether resistance is linked to medicines in general, or to supplementation specifically. Within the context of healthy older adults with some experience of either taking ONS or providing them to others during illness, barriers to accepting ONS were varied (Hetherington et al., 2024). In turn, “resistance” to ONS may be influenced by an already negative view of

supplements as “manufactured”, medicinal (therefore burdensome rather than nutritional) and beneficial.

Older adults may differ from young adults in their evaluation of ONS as “artificial”, unfamiliar, and as displacing real foods. It may be that older adults have less experience of functional foods and supplements to promote health. For example, the market share in the UK of protein supplements, functional drinks and added protein foods in 2023 was more than 7 billion GBP (10 billion USD) with predicted ongoing increased sales (<https://global-angle.com/functional-food-market-in-united-kingdom/>). The market for these products is largely driven by health conscious consumers who are mainly female (66%) and aged between 34 and 45 years (<https://www.grandviewresearch.com>). Consumers of functional foods and drinks purchase a range of products to support gut health, body building and weight management, and for them their experience is likely to be more health maintenance and enhancement than preventing malnutrition. Therefore, resistance to ONS may be, in part, a cohort effect affected by negative associations (e.g. end-of-life care). In parallel with the increase in sales and interest in functional foods and drinks, so too have negative connotations with processing, and specifically ultra processing with potential stigmatizing effects (Lockyear et al., 2023). Since ONS (like nutritional supplements or breastmilk substitutes) would be categorized as a Nova Category 4 (ultra processed) food (UPF), this may drive resistance among some consumers. The idea of restricting UPFs has been considered by the World Health Organisation and other agencies, indeed limiting UPFs is now part of nutritional guidance in Brazil and Chile (references). Similarly, nutrient powders added to foods to fortify foods would also be labelled as UPFs, and these may also be avoided.

On the one hand, it is possible that barriers to ONS will decline with increased familiarity of supplements and fortified products, since young adults may link their use with health promotion and positive nutritional claims. For example, in the UK it is estimated that one in four adults regularly consume protein shakes, and around 40% of 25 to 34-year-olds take supplemented energy drinks ([YouGov, 2025](#)). On the other hand, considering ONS and supplements used to fortify familiar foods as UPFs may produce another barrier to these options since processing level affects consumer decisions (Rouse et al., 2025). It is not known whether healthy consumers, across age ranges, share negative connotations of ONS and food first (fortification) approaches, nor whether individual differences such as fear of trying new foods (neophobia) or food choice motivations (e.g. health over naturalness) might influence their attitudes towards using these potential solutions to preventing and treating malnutrition.

Beyond any perceived barriers to taking ONS or to boosting the energy and nutrient content of familiar foods is the common experience of low appetite among older adults (Cox, 2022; Cox et al 2020 r; Cox et al, 2025). Clearly those who have frank anorexia (loss of interest in eating) or

who have early satiety (being interested in eating but feeling full after a small amount of food) may differ in how they would respond to ONS compared to food fortification. For example, Cox et al (2021) concluded from their qualitative research with older adults (with appetite loss) that some would favour making foods more appealing to stimulate interest in eating, whilst others might prefer to reduce portion sizes of food to adapt to their small appetite. It follows that willingness to accept ONS compared to fortified foods will depend on how appetite is experienced (Cox et al., 2025). Similarly, individual characteristics such as different food choice motivations (e.g. favouring convenience over health) and fear of consuming unfamiliar foods (neophobia) must be considered when investigating potential barriers to ONS consumption.

The present study was conducted to assess the views of healthy adults regarding nutritional supplements and food first approaches for preventing and treating malnutrition. The study was designed to explore willingness to consume supplements and fortified foods<sup>1</sup> (as defined by the BDA) across a wide range of ages. Specific hypotheses were developed and registered ([OSF registration](#)) to compare older and younger adults on their own willingness to consume ONS and to use a food first approach to prevent and treat malnutrition, and whether they would recommend these approaches to others. Also, whether ONS would be favoured over food first approaches given their convenience and similarity with existing functional foods/drinks in the marketplace, and if treating ONS more like a medicine than a food might influence willingness to consume these products. Finally, willingness to consume was explored in the context of individual differences (low appetite, food neophobia, food choice motivations).

In summary the following predictions were made: a) that participants would be more willing to take, and to recommend to others, ONS than food first approaches; b) that younger participants would be more willing to take (and to recommend to others) ONS to prevent and treat malnutrition than older participants; and c) that participants would favour treating ONS like a medicine with a prescribed time for taking compared to free choice.

## Methods

### Ethics approval

Ethical approval was granted by the Loughborough University Ethics Review Sub-Committee (approval number: 2023-13002-13535; amended and approved 02/05/2024). Participants gave written, informed consent before completing the online survey.

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<sup>1</sup> For this paper, food fortification refers to the BDA definition of fortifying everyday food items with extra energy and protein (e.g., adding cheese, butter, skimmed milk powder, or cream to meals) to make them more "nutrient-dense" without significantly increasing portion sizes.

## Participants

Purposive sampling was achieved using Prolific (<https://prolific.com/>) to obtain a representative sample of healthy adults aged 18 and over. The aim was to recruit equally across age groups and to exclude anyone with conditions which could influence responses to ONS and food fortification. Therefore, exclusion criteria included: anyone under 18, those with a current eating disorder, illness/disease that affects eating/drinking or ongoing food restrictions for allergy, intolerance or avoidance of animal products (since food first and ONS involve the dairy food group). Participants were informed that the online survey should take no longer than 20 minutes, and that they would be paid *pro rata* for this time commitment (£11.48 per hour). Payment was processed through Prolific.

## Materials and Procedure

The survey was hosted online using the platform Qualtrics (<https://www.qualtrics.com>). Following the participant information sheet, written consent was obtained. Attention checks were included to detect and then reject potential bots (Liem, 2025). Additionally, the long code, personal ID from Prolific was required for payment as an additional bot check.

The subsequent survey consisted of 5 sections:

**Section 1** collected general demographic information, such as age, gender, ethnicity, education level, household income, geographical location, weight, height, weight change over the last 6 months and dietary restrictions and patterns such as veganism.

**Section 2** of the survey included questionnaires to assess fear of eating novel foods and food choice motives. For this, the Food Neophobia Scale (Pliner and Hobden, 1992) and the Food Choice Questionnaire (Steptoe et al., 1995) were used. This was to enable an assessment of the influence, if any, of wariness around new foods in predicting willingness to use ONS or fortified foods in the survey; and to measure food choice motivations as predictors of main outcomes. The FCQ has nine subscales of which six (health, convenience, sensory appeal, natural content, weight control, familiarity) are directly relevant to how ONS and fortified foods might be regarded. For example, if a primary motivator in food choice decisions is familiarity, then this might affect willingness to consume ONS more than fortified foods.

Section 2 also assessed familiarity of using different supplements and functional food products. Participants were given a definition of ONS from the British Dietetic Association (BDA, 2021), as follows “oral nutritional supplements (**ONS**) are a type of oral nutritional support that can help people who are unable to get enough nutrients from food alone. ONS can be in the form of powders, semi-solids, or liquids”. Then the frequency with which items which might have been consumed was measured on a Likert scale from 1 (never tried) to 5 (consume every day). High

protein shakes, bars, shots, powders, supplements; fortified juices; sports/exercise drinks; meal replacements and high-energy powders were included as examples of ONS. An open-ended question (Q16) asked if they had used any of the above items to then provide their reasons for doing so.

Next, a definition of food fortification or enrichment was provided from the Malnutrition Task Force ([MTF 2024](#)) as follows: “food fortification or enrichment is the process of adding ingredients to increase the energy content of food without changing the portion size. This can be used for people with reduced appetites. Food fortification can also refer to the practice of adding vitamins and minerals to commonly consumed foods to increase their nutritional value”.

Examples of food fortification from the BDA were given and using a Likert scale from 1 (never used) to 5 (use these every day) participants indicated frequency of usage. These included adding butter, cream, cheese to boost energy and protein to foods; sprinkling micronutrient powders onto foods; including powdered greens and superfoods onto meals; and using multivitamin pills, gummies or sachets to increase the nutritional value of the overall diet. This was followed by another attention check question.

### **Section 3**

In this section willingness to consume and to recommend to others both ONS and food fortification was assessed using visual analogue scales (VAS) from 0 to 100. Questions were formed in the following ways – Indicate on the scale how willing you would be to consume ONS (or fortified foods) to prevent (and separately to treat) malnutrition for yourself. These questions were then repeated to recommend these for options for others (e.g. Indicate on the scale how willing you would be to recommend that others consume fortified foods [or ONS] to prevent [and separately to treat] malnutrition).

To assess attitudes towards taking ONS, 4 questions were adapted from the Behavioural Regulation in Exercise Questionnaire (Adapted-BREQ; Mullan et al., 1997) as follows: “I don’t see the point in taking ONS”; “I would take ONS because other people say I should”; “I value the benefits of taking ONS”; “I would consider taking ONS but not if they have side effects, e.g. displace intake of other foods”. These statements were scored from 0 to 4 with 0 (not true for me), 2 (sometimes true for me), and 4 (very true for me).

### **Section 4**

This section invited participants to address the extent to which they endorsed statements about supplementation and fortification based on the main barriers to consuming ONS identified by Hetherington et al (2024). Participants were asked to choose only one of the six statements to best represent their views of ONS from the following: I most associate ONS with

a) end of life care; b) medicines and would resist taking them; c) providing essential energy and nutrients much like protein shakes; d) the ageing process and dependency; e) necessity rather than pleasure; f) manufactured supplements rather than food.

These themes on ONS were then adapted for food fortification as follows: I most associate food fortification with a) end of life care; b) dietetic advice to add energy using high fat ingredients and would resist doing this; c) providing essential energy and nutrients, adding familiar ingredients to real foods; d) the ageing process and dependency; e) necessity rather than pleasure; f) real food rather than manufactured fortified ingredients.

Next participants were asked to identify the best ways of taking ONS (at prescribed times of the day or at a time that suited best) and fortified foods (with ingredients added to specific meals or taken as between meal snacks) if they had been prescribed ONS or food fortification for a particular illness. Each of the four options used a slider VAS to indicate preference from 0 = least preferred option, 50 = neutral, to 100 = most preferred option

## **Section 5**

This section included a series of scenarios referring more specifically to preferences for the self and for others on the use of ONS or food fortification. Responses to the scenarios were made on a sliding VAS from 0 to 100, with 0 representing the least preferred option, 50 being neutral and 100 representing the most preferred option. The first set of scenarios were set out with a focus on the self - "If you were prescribed ONS, or food fortification for a particular illness, to what extent would you prefer to do the following: a) to take the ONS at a prescribed time each day (e.g., with breakfast/lunch daily); b) to take the ONS at any time of the day you wished to; c) to fortify within main meals e.g. adding butter, cream, milk powder to cereals at breakfast, or to soups/desserts at lunch/dinner; d) to fortify the diet with additional between-meal snacks such as biscuits, crackers with cheese, toast with peanut butter.

This was followed by a single scenario focusing on a relative with the opportunity to respond to the question with a detailed explanation: "You have a loved one who is in their late 70s, and they are not fond of taking medication. They have recently begun to lose their appetite." a) what measures might you suggest to help them? b) would you recommend taking prescribed ONS or would you favour food fortification and why?

In this way two methods of assessing ONS versus food fortification were used; one focusing on what participants would do for themselves and what they would suggest for another person, in this case for a relative aged over 70 years.

Experience of low appetite was also measured using a clinical instrument – the ALIAS questionnaire (Cox, N personal communication). We had two further pre-registered predictions

based on self-reported low appetite, trialling the ALIAS, however results from this preliminary investigation of the tool are not included here due to poor construct validity. Finally, participants were thanked for their time, given a de-brief statement to remind them of the purpose of the study and to request their input of their Prolific Code for payment.

## **Data analysis**

Linear regressions were conducted, with subjective ratings of “willingness to consume” as the dependent variable and age, condition (treat vs prevent), nutrition method (ONS vs food first), and who for (to take themselves vs recommending for others) entered as predictor variables. Additionally, responses to the Food Neophobia measure, the Food Choice Questionnaire and the Adapted-BREQ subscales were explored within the model to examine predictive effects on ratings of willingness to consume. Interactions were also tested and explored within this model. To account for repeated measurements, cluster robust standard errors were used.

Paired t-tests were used to compare preferences for ONS vs food fortification and to examine preferences for taking ONS at a prescribed time vs. having freedom with when to take it.

For content analysis of the large number of entries in response to open-ended questions, text segments were coded for frequency of responses (e.g. familiarity with using supplements or fortification; preferences for ONS or a food first approach and why). The contents of each written text response were analysed for patterns and common themes. This was done using both simple frequency counts within and across age groups and by clustering similar answers with assistance from the AI platform DeepSeek (DeepSeek-AI, 2026). Prompts used for content analyses were specific to the open-ended questions e.g. Q16 for previous usage of supplementation and fortification methods; and for Q27 response to the scenario for recommending ONS or food first to a relative with appetite loss.

## **Results**

### **Section 1 – Demographics**

In total, 502 volunteers indicated an interest in participating in the study. Of these, 476 provided consent and then passed the initial attention checks, however, 22 were removed for inadequate completion of the survey (less than 80% of survey answered). Of the 454 participants who provided usable data, the age range was from 18 to 87 years, the median age was 47 years, with a mean of  $46.7 \pm 16$  yr. To compare older and younger adults on their

responses, participants were split into four age groups using the median and quartiles for age distribution (see Table 1).

The gender distribution was closely matched, however, most participants identified as white (85%) and more than half had a bachelor's degree or graduate/professional qualification. In terms of representativeness of the UK population, according to the UK 2021 Census (Office of National Statistics, 2022) most citizens identify as white (81.7%), with ethnic minorities making up around 18% of the population. The median age in the UK is 40 years and more than 34% hold level 4 schooling or a higher degree (18.2% have no formal education) and mean income after tax is £41,900. Approximately 84% of the UK population reside in England, 8% in Scotland, 5% in Wales and 3% in Northern Ireland. According to these national census data, compared to the UK population the current sample has a higher median age, higher than average education level, but a comparable household income and similar geographical residential distribution.

**Table 1.** A summary of participants' age, gender, ethnicity, education level, household income and geographical location

|                            | <b>N (454)</b>                | <b>%</b> |
|----------------------------|-------------------------------|----------|
| <b>Age (18 – 87 years)</b> | Mean $\pm$ SD = 46.7 $\pm$ 16 |          |
| 18-33                      | 119                           | 26.2     |
| 34-47                      | 111                           | 24.4     |
| 48-59                      | 105                           | 23.1     |
| 60+                        | 118                           | 26.0     |
| Missing                    | 1                             | 0.2      |
| <b>Gender</b>              |                               |          |
| Female                     | 230                           | 50.7     |
| Male                       | 221                           | 48.7     |
| Non-binary                 | 3                             | 0.6      |
| <b>Ethnicity</b>           |                               |          |
| Arab                       | 5                             | 1.1      |
| Asian                      | 34                            | 7.5      |
| Black                      | 17                            | 3.7      |
| Mixed race                 | 9                             | 2.0      |
| White                      | 387                           | 85.2     |
| Prefer not to say          | 2                             | 0.4      |
| <b>Education level</b>     |                               |          |
| Some secondary             | 7                             | 1.5      |
| Completed secondary school | 85                            | 17.7     |
| Vocational or similar      | 81                            | 17.8     |
| Some University, no degree | 42                            | 9.3      |

|                               |     |      |
|-------------------------------|-----|------|
| University bachelor's degree  | 161 | 35.5 |
| Graduate, professional degree | 78  | 17.2 |
| <b>Household income</b>       |     |      |
| <£20,000                      | 65  | 14.3 |
| £20k - £39,999                | 161 | 35.5 |
| £40k - £59,999                | 103 | 22.7 |
| £60k - £99,999                | 101 | 22.3 |
| >100k                         | 22  | 4.9  |
| Prefer not to say             | 2   | 0.4  |
| <b>Geographical location</b>  |     |      |
| Scotland                      | 41  | 9.0  |
| Northeast England             | 33  | 7.3  |
| Northwest England             | 98  | 21.6 |
| Midlands England              | 51  | 11.2 |
| Southeast England             | 137 | 30.2 |
| Southwest England             | 54  | 11.9 |
| Wales, Northern Ireland       | 30  | 6.6  |
| Prefer not to say             | 10  | 2.2  |

## Section 2 - Familiarity with supplementation and fortification strategies

According to the data on frequency of using either supplementation or fortification, most participants reported greater familiarity with supplementation rather than fortification, except for the specific cases of taking multivitamin pills or adding butter to foods. For example, consuming protein shakes to supplement protein intake and sports drinks to replenish electrolytes had been tried more often than powders to boost energy intake. However, age group differences were observed for most of these methods (see Figure 1). Younger adults were more likely to have tried supplements than older adults and were more likely to use these than older adults. Fortifying foods was a less familiar approach to both younger and older adults than using supplementation.



**Figure 1.** Participant familiarity with different ONS (A) and Food Fortification (B) methods.

## Section 2 Content analysis – reasons reported for taking supplements or fortifying foods in the diet

Of 315 participants who provided an answer to why they used supplements and fortified foods/drinks, almost half (48.9%) reported using protein-based products (shakes, bars, powders, yoghurts), making it the most common product type used. Next, sports/exercise drinks were reportedly used by 41%. The use of meal replacements was much less frequently

mentioned by participants at 19.8%, as were energy drinks (15.3%) and fortified juices (13.7%) The least mentioned item was oral nutritional supplements (such as Fortisip®-type products) by 5.3% of the sample, primarily in older adults for medical recovery.

Of the participants who gave an answer to the open-ended question on usage, self-reported motivation to take these products differed by age group. For example, consumption of protein supplements was most frequently reported by younger adults, and their motivation was most often driven by going to the gym, to build muscle mass and for fitness; sports drinks were consumed to replace electrolytes and again most often mentioned by younger adults. Older adults (aged 50 yr +) mentioned using supplements in response to illness and described these as aids to recovery.

An overall shift in focus by age group was noted in the qualitative data on use of functional foods/drinks based on ways to enhance health in younger adults and on medical need in older adults. Thus, younger adults linked the use of functional products to improve health, fitness and body composition whereas among older adults the use of these products related to medical need such as having a low appetite, recovery from surgery or illness.

### **Section 3 - Willingness to consume and to recommend ONS and food first approaches by age**

Overall, ratings of willingness to consume ONS or to use food fortification were relatively high with clear differences between older adults (60 plus) and others. Participants reported that they were more willing to take food fortification (M=65.7, SD=30) than ONS (M=62.7, SD=30) to prevent malnutrition,  $t(450)=-4.07$ ,  $p < 0.001$ . Similarly, participants were also more willing to take food fortification (M=70.4, SD=30) than ONS (M=68.7, SD=31) to treat malnutrition,  $t(447)=-2.99$ ,  $p = 0.003$ .

The prediction that younger participants would be more willing to take (and to recommend to others) ONS to prevent and treat malnutrition than older participants was only partially supported. In the context of taking ONS to prevent malnutrition for themselves, older participants were less willing to take ONS than younger participants ( $\beta = -0.26$ ,  $p = \mathbf{0.004}$ ). However, this age effect was not observed for willingness to consume ONS to treat malnutrition ( $\beta = -0.16$ ,  $p = 0.086$ ) (**Figure 2**).

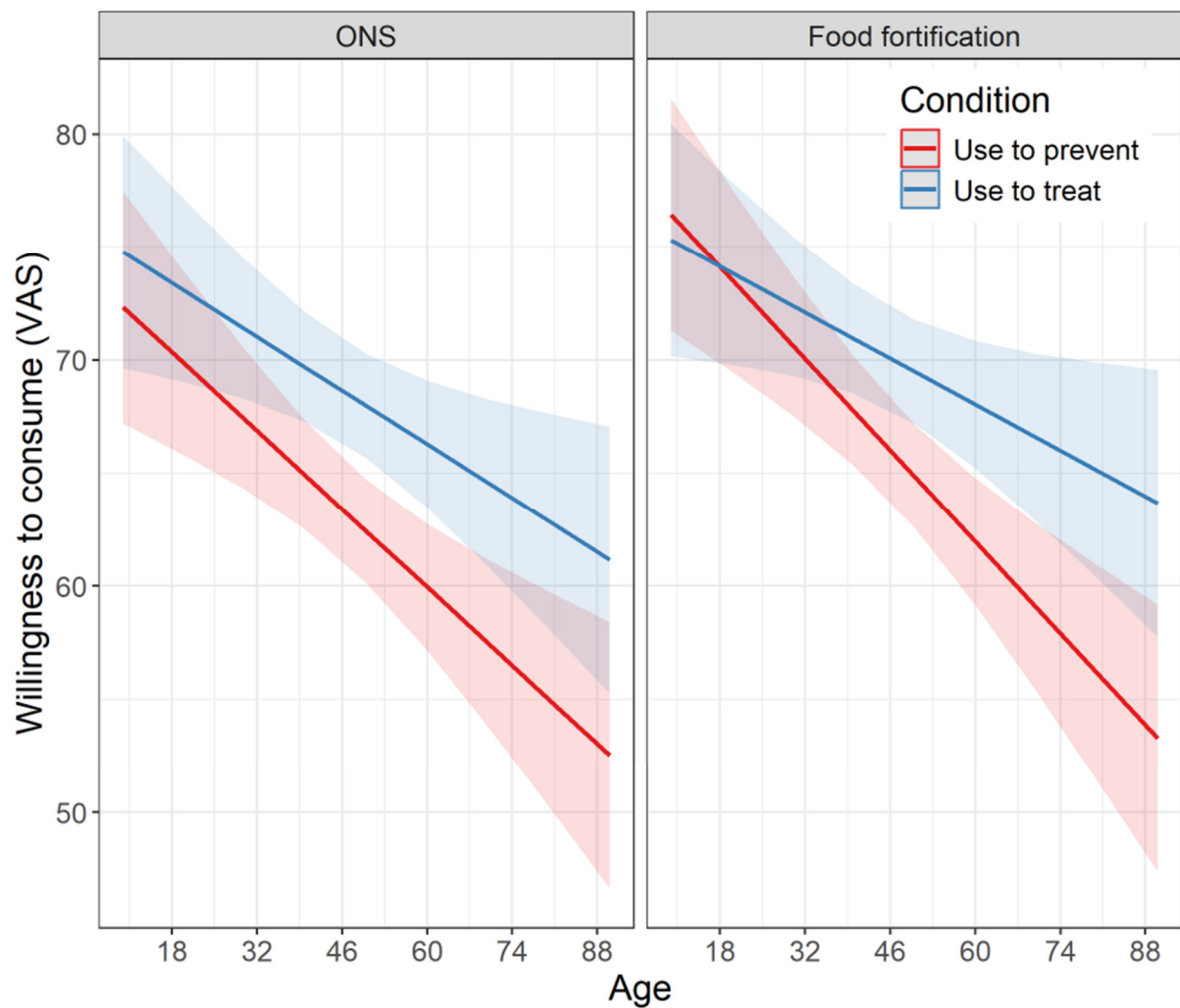


**Figure 2.** Relationship between age and willingness to consume ONS or Food fortification to either prevent or treat malnutrition.

Older participants were less willing than younger participants to recommend that others take ONS to *prevent* malnutrition ( $\beta = -0.23$ ,  $p = \mathbf{0.011}$ ), but again this age effect was not present when recommending others take ONS to *treat* malnutrition ( $\beta = -0.18$ ,  $p = 0.052$ ).

These results suggest that younger and older adults in this sample were both willing to take and to recommend ONS as a treatment for malnutrition, but only younger adults were more willing to take (for themselves) and to recommend ONS for others to *prevent* malnutrition. This partially supported the hypothesis that younger adults are both more familiar with and more willing to use ONS than older adults, but specifically in preventing malnutrition.

### Section 3 - Predictors of willingness to consume ONS and food first approaches to prevent and treat malnutrition

To predict willingness to consume ONS and fortified foods, a hierarchical regression was conducted with core factors (age, gender, education, familiarity, treat vs prevent, ONS vs food first, and for whom [self vs others]) input into step 1, and exploratory factors (FCQ, Food Neophobia, Adapted-BREQ) input into step 2. We found that participants had higher willingness to consume food first than to consume ONS, thus not supporting hypothesis a. Participants were also more willing to take either nutrition method if it was used to *treat* malnutrition, rather than *prevent* it, yet participants were less willing to recommend either nutrition method for others compared to consuming either method for themselves. Gender ( $b=3.68$ ,  $p = 0.14$ ), education level ( $b=-0.4$ ,  $p = 0.76$ ) and interactions were also tested but none were of added value to the overall model fit (**Table 2**, Block 1).

The exploratory analysis (**Table 2**, Block 2) explained 36% more variance (41% variance overall) in willingness to consume ONS vs food first compared with Block 1. The adapted-BREQ questions, indicating attitudes towards nutrition methods, were strong predictors of willingness to consume. Amotivation (“I don’t see the point in consuming ONS or fortified foods”) was negatively associated with willingness to consume, whereas external regulation (“others say I should consume ONS or fortified foods”) and identified regulation (“I value the benefits of ONS or fortified foods”) were both positively associated with willingness to consume. Food neophobia and FCQ subscales, including choosing food for health, did not add to the model.

Finally, in Block 2 age and nutrition method were no longer significant predictors of willingness to consume. This suggests that attitudes towards ONS and food fortification FF were much stronger predictors of willingness to consume either nutrition method than the nutrition method itself, whether the methods were used to treat or prevent malnutrition, and whether people were taking themselves or recommending them to others.

**Table 2.** Primary and exploratory regression analyses examining predictors of willingness to consume ONS and food fortification.

| <i>Predictors</i>                                  | <b>Willingness to consume</b>     |              |                  |                                       |               |                  |
|----------------------------------------------------|-----------------------------------|--------------|------------------|---------------------------------------|---------------|------------------|
|                                                    | <b>Block 1 (primary analysis)</b> |              |                  | <b>Block 2 (exploratory analysis)</b> |               |                  |
|                                                    | <i>Estimates<br/>(std. error)</i> | <i>CI</i>    | <i>p-value</i>   | <i>Estimates<br/>(std. error)</i>     | <i>CI</i>     | <i>p-value</i>   |
| (Intercept)                                        | 48.57 (6.0)                       | 36.82, 30.32 | <b>&lt;0.001</b> | 38.7 (6.73)                           | 25.52, 51.89  | <b>&lt;0.001</b> |
| Age                                                | -0.09 (0.08)                      | -0.25, 0.07  | 0.269            | 0.00 (0.06)                           | -0.11, 0.12   | 0.950            |
| Familiarity with ONS/Food fortification            | 2.03 (0.35)                       | 1.35, 2.72   | <b>&lt;0.001</b> | -0.30 (0.26)                          | -0.8, 0.2     | 0.240            |
| Condition [Use to treat vs Use to prevent]         | 4.72 (0.66)                       | 3.42, 6.02   | <b>&lt;0.001</b> | 4.67 (0.65)                           | 3.39, 5.95    | <b>&lt;0.001</b> |
| nutrition method [Food first vs ONS]               | 13.6 (2.05)                       | 9.57, 17.63  | <b>&lt;0.001</b> | -0.84 (1.57)                          | -3.92, 2.24   | 0.594            |
| Who for [Recommend for others vs to take for self] | -9.29 (0.97)                      | -11.19, -7.4 | <b>&lt;0.001</b> | -9.33 (0.97)                          | -11.24, -7.43 | <b>&lt;0.001</b> |
| <i>FCQ health</i>                                  |                                   |              |                  | 1.27 (1.47)                           | -1.62, 4.16   | 0.390            |
| <i>Adapted BREQ amotivation score<sup>a</sup></i>  |                                   |              |                  | -5.95 (0.89)                          | -7.69, -4.2   | <b>&lt;0.001</b> |

|                                                             |                                           |                                              |
|-------------------------------------------------------------|-------------------------------------------|----------------------------------------------|
| <i>Adapted BREQ external regulation score<sup>b</sup></i>   |                                           | 3.83 (0.75)    2.35, 5.31 <b>&lt;0.001</b>   |
| <i>Adapted BREQ identified regulation score<sup>c</sup></i> |                                           | 10.14 (1.07)    8.04, 12.24 <b>&lt;0.001</b> |
| Observations                                                | 3591                                      | 3556                                         |
| R <sup>2</sup> / R <sup>2</sup> adjusted                    | 0.075 / 0.074                             | 0.408 / 0.407                                |
| F                                                           | 58.22(5, 3585), <i>p</i> <b>&lt;0.001</b> | 271.8(9, 3546), <i>p</i> <b>&lt;0.001</b>    |

<sup>a</sup>Amotivation: “I don’t see the point in consuming ONS or fortified foods”

<sup>b</sup>External regulation: “others say I should consume ONS or fortified foods”

<sup>c</sup>Identified regulation: “I value the benefits of ONS or fortified foods”

## Section 4 – How ONS and food first approaches are viewed by age group

When given six specific views derived from qualitative research on ONS, participants in the current study most often endorsed the view that ONS were associated with “providing essential energy and nutrients much like protein shakes”. The two views least often endorsed were “I most associate ONS with medicines and would resist taking them” and “I most associate ONS with end-of-life care” (**Figure 3**). Around one third of older adults endorsed the view - “I most associate ONS with necessity rather than pleasure” and 25% endorsed the view that ONS are manufactured supplements not real food.

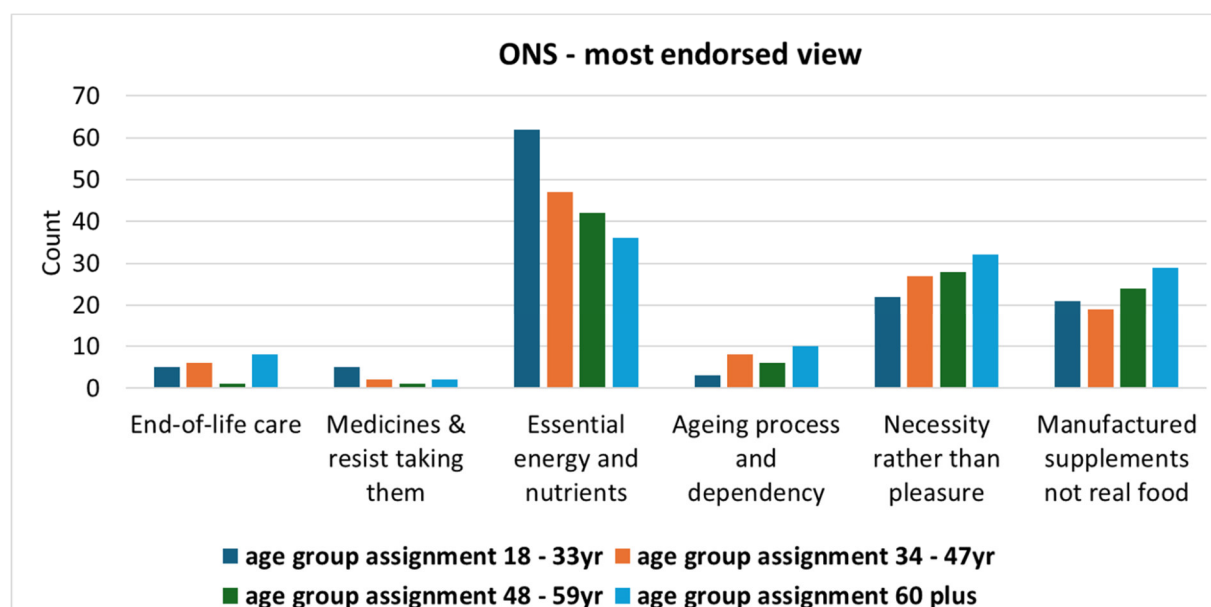


**Figure 3.** Frequency count by age group for most endorsed view of ONS by age group

For food fortification (**Figure 4**), most participants associated food fortification with the provision of essential nutrients and energy, by adding familiar ingredients to real foods. Both younger and older adults also endorsed food fortification as a necessity rather than a pleasure. Overall, these descriptive data diverge from the results of the earlier qualitative study, placing views of ONS as medicines to be resisted and associations with end-of-life care as the least endorsed of the choices available regarding ONS.

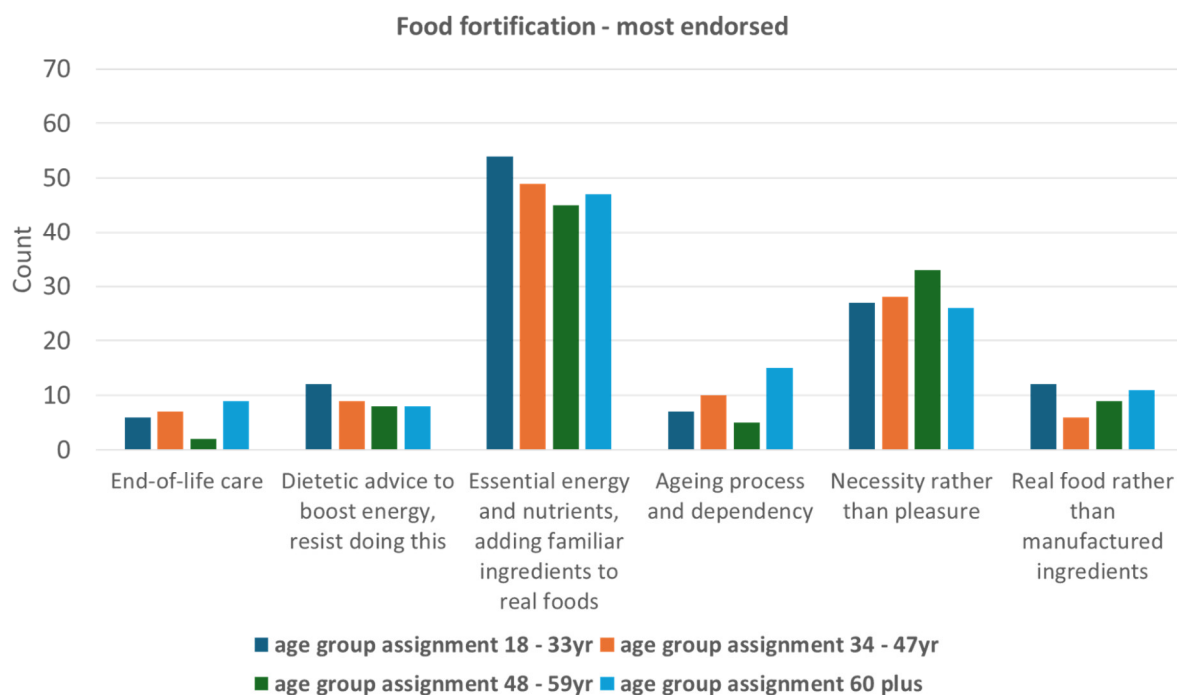


**Figure 4.** Frequency count by age group for most endorsed view of food fortification by age group

#### Section 4 - Using supplementation at a prescribed time of day and food first approaches? with meals or as snacks

To answer whether participants would prefer to take ONS like a “medicine” with a prescribed time or a flexible time, we compared VAS ratings of preference for each option. Participants reported their preference for taking ONS at a specified time rather than at flexible times, mean difference = -9.14,  $t(438) = -3.88$ ,  $p < 0.001$ , supporting the hypothesis. For food fortification, the question asked about boosting energy and nutrient content of foods either at main meals or between meals, as snacks. Participants reported their preference for using food fortification within meals rather than between meals (mean difference = -10.98,  $t(440) = -6.55$ ,  $p < 0.001$ ). However, there were interaction effects between age and when to take ONS ( $\beta = 0.31$  [SE=0.15],  $p = 0.036$ ) and between age and when to use food fortification ( $\beta = 0.21$  [SE=0.11],  $p = 0.049$ ). This suggests that whereas younger people did not “prefer” the option of taking ONS at flexible or prescribed times, older people did express a stronger preference for taking ONS at a **prescribed** time. Similarly, preference for food fortification within meals was high across all ages, whereas preference for taking energy dense snacks between meals was lower among older than younger participants (**Figure 5**).

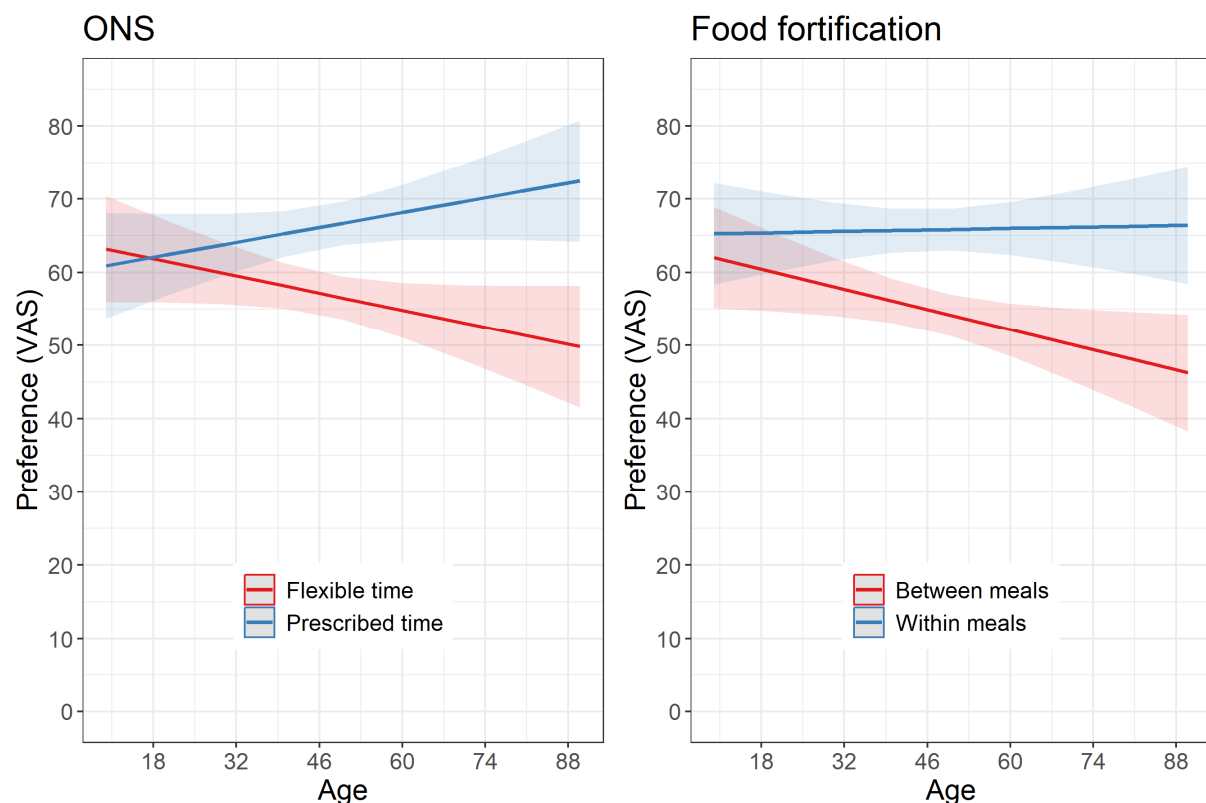


**Figure 5.** Associations between age and preference for taking ONS at flexible or prescribed times, and preference for taking food fortification within or between meals.

## Section 5 - Content analysis of responses to why nutrition methods were selected for self vs others

Overall, 445 participants provided an explanation in response to the question about why they might choose either of the methods for themselves and if this differed from what they would recommend for others. Generally, any differences between what participants were willing to take for themselves and what they recommended to others were based on the need for bodily autonomy and feeling that recommending to others required the appropriate qualifications. This snapshot was further explored in the next scenario where a specific case of recommending to an older relative was provided.

### Section 5 Content analysis scenario for older relative

Regarding the scenario for suggesting ONS or food fortification to a loved one with loss of appetite, 443 participants provided a response. The most common preferred action was food fortification rather than ONS. However, this response was moderated by severity of appetite loss. Participants reported that if appetite loss was considered severe, then ONS would be the

first choice, but if appetite loss was modest then food first was considered the most appropriate course of action.

The responses to the justification for suggesting ONS vs food fortification revealed a tension between the ideals expressed around the desire to consume natural food, to exert autonomy over the diet, and avoiding medicines against the practical realities of severe appetite loss, difficulty eating, and risk of malnutrition. Most respondents favoured **starting with food fortification** for its naturalness and acceptability, but many acknowledged that **ONS may be necessary** if appetite was very poor or if the person lived alone and could not prepare fortified meals.

For those who selected a food first approach, comments centred around benefits such as the naturalness of ingredients and that food is the best way to deliver nutrients, e.g. "Best way to get nutrients was from food"; "I tend to use natural ingredients"; "Not convinced additives are beneficial"; "A balanced diet is better" (than using supplements). Of those responding that they would take ONS, much of this was qualified by the need for proof and agency, e.g. "if recommended by a doctor" and "if medically necessary".

Respondents frequently positioned food fortification as "natural," "real food," "familiar," or "less like medication," while ONS was seen as "clinical," "manufactured," or "medicinal."

The responses to open-ended questions to explain willingness to consume for self and others revealed a more favourable attitude towards food fortification compared with using ONS.

## Discussion

In this study, an online survey was designed to examine healthy adults' views of taking oral nutritional supplements and food first approaches for preventing and treating malnutrition. Contrary to our first hypothesis, we found that participants overall were more willing to use a food fortification approach to prevent and treat malnutrition than using ONS. The second hypothesis was supported, as older adults were less willing to take ONS or food fortification to prevent malnutrition than younger adults. However, these age differences disappeared when examining willingness to consume ONS or food fortification to treat malnutrition. Thus, ONS were viewed as the more suitable option as a treatment for malnutrition by participants. Similar, albeit weaker, relationships were found when examining attitudes towards recommending others take ONS or food fortification to either prevent or treat malnutrition, as all participants were less willing to recommend to others than to use the nutrition method themselves. Older adults in particular reported preference for taking ONS at a prescribed time than at flexible times (supporting our third hypothesis), and for taking food fortification within meals rather than between meals. This finding supports previous qualitative research indicating a negative perception of snacking between meals by older adults (Cox et al., 2021), as well as

invoking a moral dimension of “treats” which may be tempting but considered unhealthy, and not for everyday consumption (Delaney and McCarthy, 2014).

Furthermore, we found that specific attitudes towards each nutrition method were the best predictors of willingness to consume them. Not seeing the point in taking the nutrition methods reduced willingness to consume, whereas valuing the benefits of the nutrition methods increased willingness to consume. Content analyses of familiarity with supplements and fortified products indicated a greater usage by younger than older adults, perhaps contributing to a more favourable response to these nutrition methods in prevention efforts; and an overall recognition that these products serve to enhance energy and nutrient intake. More positive attributions were reported by participants in response to food fortification compared to ONS, in part, due to perceived “naturalness” of food fortification compared with “medicinal” connotations of ONS. Overall, responses to the open-ended questions about why one or other method might be recommended to an older relative revealed a preference for food fortification over supplementation, but this was moderated by concerns about low appetite.

In contrast with our earlier qualitative research, ONS in the current study were most associated with nutritional benefits rather than with end-of-life care (Hetherington et al., 2024). This finding suggests that when older adults have had some experience of using ONS for themselves or for family members during illness, they associate supplements with medical care. Reviews on poor adherence to ONS when prescribed propose an interaction between product attributes (taste, smell, texture, form etc), personal characteristics (appetite, food preferences, attitudes, sensory decline) and contextual factors (e.g. lack of social support, timing of administration) (Lester et al., 2022). In the present study, most older adults had not taken supplements, and so their views may not be influenced by product characteristics or context whereas for those who had direct experience of ONS the negative associations were linked to perceived dislike of sensory attributes, and to the context of caring for a relative (Hetherington et al., 2024). Of those older adults who had taken ONS, this was to recuperate from illness. Younger adults had greater experience of supplements in a variety of forms to achieve health goals, including protein shakes for health and fitness and sports drinks for hydration and electrolytes. Resistance to taking ONS as reported in qualitative research may diminish as frequency of taking supplements for health maintenance becomes more common. On the other hand, this suggestion depends on the appropriate framing of ONS as having nutritional benefit to both maintain good health and to treat malnutrition.

For the present study, food neophobia was not an important predictor of willingness to consume ONS. Observations from qualitative studies linking ONS with negative affective responses such as disgust or dislike, may be specific to those who have had direct experience of these (Hetherington et al., 2024) and who describe them as “neither tasty nor disgusting”

(Liljeberg et al., 2022 pg 5). The present quantitative data indicates that ONS are generally seen as beneficial in providing essential energy and nutrients, this confirms the observation by Liljeberg et al (2022) that those taking ONS see them as a remedy for malnutrition, compensating for missed energy and nutrients but with no effect on “normal eating” (pg 4). Since food fortification involves “normal food” this may explain why this method was favoured over ONS except where low appetite was an issue.

This observation is important in recognising individual needs when treating malnutrition, which is embodied by Comprehensive Geriatric Assessment (CGA). It has been proposed that appetite decline in ageing should be considered as a geriatric syndrome (Cox et al., 2025). Since appetite loss precedes unintended weight loss leading to malnutrition, having a standard method of assessing anorexia of ageing will lead to a more person-centred approach to treating malnutrition (Cox et al., 2025). This approach takes account of underlying causes of appetite loss which in turn places individual preferences (food first vs ONS), eating capability (Laguna et al., 2016) and appetite capacity (Cox et al., 2020) at the forefront of treatment decisions (Pilotto et al., 2017).

Previous qualitative research with older adults suggests that ONS are often conceptualised as medicine, or as occupying an ambiguous space between food and medicine, intended to compensate for nutrients that are not eaten (Cox et al., 2021; Liljeberg et al., 2021). Our data align with this interpretation as participants reported greater willingness to consume ONS to treat, but not prevent, malnutrition. This suggests that, when framed in preventive terms, ONS may not be perceived as appropriate or necessary, whereas framing ONS as a treatment may legitimise their use in a way consistent with medication-taking behaviour. This perspective is also supported by this study’s data showing a preference for taking ONS at prescribed times of day, rather than with greater flexibility. This pattern of behaviour fits with typical medication-taking routines where a particular time and frequency of consumption is often required.

Viewing ONS as medicine may therefore constitute a barrier to preventive use. Older adults frequently express ambivalence toward preventive medicines, particularly with respect to their necessity, benefits, and long-term risks (Qadi et al., 2020). Although prevention is generally viewed as good for health, this is often accompanied by a desire to minimise medicine use, driven both by concerns about taking too many medications and social reasons to avoid being seen as a heavy or frequent medicine user (Eborall et al., 2011). In contrast, regular prescribed medicines are often taken despite being disliked because they are believed to be necessary (Bagge et al., 2013). These necessity beliefs may be central in shaping decisions about whether to consume ONS for malnutrition prevention.

Research from other areas of older adult health behaviour indicates that preventive action is often contingent on prior experience and perceived personal risk. For example, older adults may not engage in fall-prevention behaviours until they experience a fall and recognise

limitations in their balance, particularly when they hold a locus of control regarding modifying the risk (Ellmers et al., 2022). Similarly, higher perceived risk of COVID-19 has been associated with greater engagement in preventive behaviours (Lu et al., 2021). Applied to malnutrition, this suggests that individuals who have not experienced its consequences may underestimate both their susceptibility and their capacity to influence this outcome, particularly if reduced appetite is seen as inevitable (Cox et al., 2021) rather than preventable. Taken together, these findings suggest that when ONS are perceived as medicine, concerns about necessity, trust, perceived risk, and usefulness may limit their uptake as a preventive strategy. This is supported by findings in the current study that positive attitudes toward the benefits of ONS were associated with a higher willingness to consume them. However, framing ONS as a means of preventing malnutrition may be less effective than positioning them as supporting healthy functioning, as many younger adults are known to take ONS for this purpose.

Our findings show a preference for food fortification over ONS both for the prevention and treatment of malnutrition. This preference was evident even among younger adults, despite this group reporting greater familiarity with, and use of, ONS. One explanation is that ONS are commonly used by younger populations for general health promotion and maintenance (Bailey et al., 2013) rather than for addressing malnutrition. For example, supplements such as protein powders are typically consumed to increase muscle mass, promote regeneration or to regulate weight (Hartmann & Siegrist, 2016), and may not be associated either with the term “ONS” or with preventing malnutrition. This distinction raises an important issue, as it is not understood whether taking ONS or food fortification for improving health is extrapolated by consumers to preventing future malnutrition. Therefore, the perceived function of ONS may be context-dependent. For example, when nutritional supplements are associated with specific, goal-directed outcomes (e.g., muscle gain), they may be viewed positively. However, when framed as preventing malnutrition, they may be seen as less relevant or appropriate. In contrast, food fortification may be perceived as a more natural or intuitive approach to addressing malnutrition, as it aligns more closely with everyday eating practices. Increasing food intake and protein in particular to attain adequate nutrition can be done within a healthy, balanced diet. Whereas, specialist nutritional supplements may be associated with targeted functional benefits e.g. increasing muscle mass. This difference in perceived role may help to explain the stronger preference for food-first approaches observed in the current study, despite some familiarity with ONS.

A limitation of this study is that food-first and ONS were framed solely as approaches to preventing or treating malnutrition. It is possible that adults would not take either nutrition method to prevent malnutrition, yet at the same time may express stronger preferences for one or other method when framed in terms of maintaining or enhancing health. This is especially the case among younger adults and older adults without prior experience of malnutrition, or who do not perceive themselves to be at risk. As such, the framing used may not reflect participants’ current personal circumstances. However, a key strength of this study is

the inclusion of healthy adults across a broad age range, which provides insight into attitudes in the absence of direct experience of taking ONS and food-first. This allows for the examination of baseline perceptions of food-first approaches and ONS, unconfounded by prior use or clinical need, and is valuable for informing how these strategies are framed in public health and clinical communications. Future research could examine attitudes toward different types of ONS (e.g., protein shakes versus fortified drinks) and compare individuals with and without prior ONS experience to determine whether these perceptions generalise to products intended for malnutrition. Additionally, given that the older adult age group was mainly comprised of 60–70-year-olds (n=83/104 participants), future studies focusing on more specific age groups within the older adult population may provide greater insight into prevention and treatment attitudes across later stages of adulthood. Research is also needed to test whether alternative framing or targeted interventions can improve attitudes toward ONS, increase understanding of their benefits and therefore reduce “resistance” to ONS if necessary for treatment. These are important studies to undertake in order to ultimately inform clinical policy on optimising malnutrition treatment, as well as national public health approaches to embed the prevention of ageing-related frailty, illness and early mortality into every behaviours.

In conclusion, among a wide age range of healthy adults, self-reported willingness to consume ONS and food fortification was high. However, older adults were less willing to take ONS to *prevent* malnutrition but as willing as younger adults to use ONS to *treat* malnutrition. Younger adults had more experience of regular consumption of nutritional supplements, attributing this to enhancing health and fitness. Older adults were less experienced with consuming functional foods and drinks (supplements or fortified products) and tended to attribute their use to recovery from illness. Viewing ONS as medicine may then limit their use among older adults as a preventive measure, and self-reported willingness to consume ONS to treat malnutrition may depend on having experience of these products, whether direct or indirect. Given links made between functional foods and health benefits among young adults, resistance to taking ONS in the future may decrease if these are framed as having potential preventive and therapeutic benefits to tackle malnutrition.

Acknowledgements – Ms Abir Ajab is thanked for her help with data cleaning and describing the sample demographics. Funding is acknowledged from the Food4Years network pump priming follow-on award ([BB/W018349/1](#)) to Dr Chris McLeod, Dr Jason Thomas, and Professor Marion Hetherington “SPOONful: a Structured Prescription Of Oral Nutritional supplementation for community-dwelling older adults”.

Conflicts of Interest – Dr Chris McLeod works for the Department of Health and Social Care at the time of manuscript submission. Dr Natalie Cox receives funding from the National Institute

for Health and Care Research (NIHR). This paper represents the views of the authors and not of the NIHR, Department of Health and Social Care or the UK government. No other authors have any conflicts of interest to declare.

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