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Supportive interventions for enhancing dietary intake in malnourished or nutritionally at-risk adults (Review)

Baldwin C, Kimber KL, Gibbs M, Weekes CE

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[Intervention Review]

Supportive interventions for enhancing dietary intake in malnourished or nutritionally at-risk adults

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ABSTRACT

Background

Supportive interventions such as serving meals in a dining room environment or the use of assistants to feed patients are frequently recommended for the management of nutritionally vulnerable groups. Such interventions are included in many policy and guideline documents and have implications for staff time but may incur additional costs, yet there appears to be a lack of evidence for their efficacy.

Objectives

To assess the effects of supportive interventions for enhancing dietary intake in malnourished or nutritionally at-risk adults.

Search methods

We identified publications from comprehensive searches of the Cochrane Library, MEDLINE, Embase, AMED, British Nursing Index, CINAHL, SCOPUS, ISI Web of Science databases, scrutiny of the reference lists of included trials and related systematic reviews and handsearching the abstracts of relevant meetings. The date of the last search for all databases was 31 March 2013. Additional searches of CENTRAL, MEDLINE, ClinicalTrials.gov and WHO ICTRP were undertaken to September 2016. The date of the last search for these databases was 14 September 2016.

Selection criteria

Randomised controlled trials of supportive interventions given with the aim of enhancing dietary intake in nutritionally vulnerable adults compared with usual care.

Data collection and analysis

Three review authors and for the final search, the editor, selected trials from titles and abstracts and independently assessed eligibility of selected trials. Two review authors independently extracted data and assessed risk of bias, as well as evaluating overall quality of the evidence utilising the GRADE instrument, and then agreed as they entered data into the review. The likelihood of clinical heterogeneity amongst trials was judged to be high as trials were in populations with widely different clinical backgrounds, conducted in different healthcare settings and despite some grouping of similar interventions, involved interventions that varied considerably. We were only able, therefore, to conduct meta-analyses for the outcome measures, 'all-cause mortality', 'hospitalisation' and 'nutritional status (weight change)'.

Main results

Forty-one trials (10,681 participants) met the inclusion criteria. Trials were grouped according to similar interventions (changes to organisation of nutritional care (N = 13; 3456 participants), changes to the feeding environment (N = 5; 351 participants), modification of meal profile or pattern (N = 12; 649 participants), additional supplementation of meals (N = 10; 6022 participants) and home meal delivery systems (N = 1; 203 participants). Follow-up ranged from 'duration of hospital stay' to 12 months.

The overall quality of evidence was moderate to very low, with the majority of trials judged to be at an unclear risk of bias in several risk of bias domains. The risk ratio (RR) for all-cause mortality was 0.78 (95% confidence interval (CI) 0.66 to 0.92); P = 0.004; 12 trials; 6683 participants; moderate-quality evidence. This translates into 26 (95% CI 9 to 41) fewer cases of death per 1000 participants in favour of supportive interventions. The RR for number of participants with any medical complication ranged from 1.42 in favour of control compared with 0.59 in favour of supportive interventions (very low-quality evidence). Only five trials (4451 participants) investigated health-related quality of life showing no substantial differences between intervention and comparator groups. Information on patient satisfaction was unreliable. The effects of supportive interventions versus comparators on hospitalisation showed a mean difference (MD) of -0.5 days (95% CI -2.6 to 1.6); P = 0.65; 5 trials; 667 participants; very low-quality evidence. Only three of 41 included trials (4108 participants; very low-quality evidence) reported on adverse events, describing intolerance to the supplement (diarrhoea, vomiting; 5/34 participants) and discontinuation of oral nutritional supplements because of refusal or dislike of taste (567/2017 participants). Meta-analysis across 17 trials with adequate data on weight change revealed an overall improvement in weight in favour of supportive interventions versus control: MD 0.6 kg (95% CI 0.21 to 1.02); 2024 participants; moderate-quality evidence. A total of 27 trials investigated nutritional intake with a majority of trials not finding marked differences in energy intake between intervention and comparator groups. Only three trials (1152 participants) reported some data on economic costs but did not use accepted health economic methods (very low-quality evidence).

Authors' conclusions

There is evidence of moderate to very low quality to suggest that supportive interventions to improve nutritional care results in minimal weight gain. Most of the evidence for the lower risk of all-cause mortality for supportive interventions comes from hospital-based trials and more research is needed to confirm this effect. There is very low-quality evidence regarding adverse effects; therefore whilst some of these interventions are advocated at a national level clinicians should recognise the lack of clear evidence to support their role. This review highlights the importance of assessing patient-important outcomes in future research.

PLAIN LANGUAGE SUMMARY

Supportive interventions for improving dietary intake in nutritionally vulnerable groups

Review question

Are supportive interventions for improving dietary intake in nutritionally vulnerable groups (malnourished or nutritionally at-risk individuals) effective?

Background

Serving meals in a dining room, or the use of assistance to help feed people in need and other similar methods are often recommended to help especially sick and elderly people who have lost or are likely to lose weight (nutritionally vulnerable groups). Such supportive interventions are implemented in the health care in many countries but their effects are not well investigated.

Study characteristics

We included 41 randomised controlled studies (clinical studies where people are randomly put into one of two or more treatment groups) with a total of 10,681 people in our review. There were five different interventions which we call 'supportive interventions': changes to the organisation of nutritional care (13 studies, 3456 people), changes to the feeding environment (5 studies, 351 people), modification of the meal profile or pattern (12 studies, 649 people), additional supplementation of meals (10 studies, 6022 people) and home meal delivery systems (1 study, 203 people). Monitoring participants over time (follow-up) ranged from 'duration of hospital stay' to 12 months. The comparator groups received 'usual' care. More than half of all participants took part in studies investigating the additional supplementation of meals (for example a protein-energy oral nutritional supplement in addition to the usual diet).

Key results

It is possible that supportive interventions for enhancing dietary intake in nutritionally vulnerable groups reduce death from any cause (approximately 23 fewer cases of death per 1000 participants in favour of supportive interventions). However, this has to be confirmed by more evidence from high-quality randomised controlled studies. The number of participants experiencing any medical complication did not differ substantially between the supportive interventions and the comparator groups. The same was found for health-related quality of life (which is physical, mental, emotional and social health attributed to health), patient satisfaction, nutritional or energy intake and days spent in hospital. Economic costs were not well investigated.

Only three studies reported on side effects, describing intolerance to the nutritional supplement (such as diarrhoea or vomiting in 5 of 34 participants) and discontinuation of oral nutritional supplements because of refusal or dislike of taste (567 of 2017 participants).

After analysing 15 studies in 1945 participants we found a beneficial effect of supportive interventions compared with comparators on weight: on average people in the supportive interventions groups increased their weight 0.6 kg more than people in the comparator groups.

This evidence is up to date as of September 2016.

Quality of evidence

The overall quality of evidence ranged between moderate to very low, mainly because for most of our outcomes there was only a small number of studies and participants to achieve reliable information, or because risk of bias made results uncertain. However, if some randomised controlled studies with low risk of bias for our patient-important outcomes and a good number of participants were performed, this review could quickly provide good guidance for better health care.

Summary of findings for the main comparison. Supportive interventions for enhancing dietary intake versus comparators in malnourished or nutritionally at-risk adults

Supportive interventions compared with usual care for malnourished or nutritionally at-risk adults

Population: malnourished or nutritionally at-risk adults
Settings: residential care (21 trials), hospital (15 trials), outpatients (5 trials)
Intervention: supportive interventions for enhancing dietary intake (changes to the organisation of nutritional care, changes to the feeding environment, modification of meal profile or pattern, additional supplementation of meals, congregate and home meal delivery systems)
Comparison: usual care

Outcomes	Illustrative comparative risks* (95% CI)		Relative effect (95% CI)	No of participants (trials)	Quality of the evidence (GRADE)	Comments
	Usual care	Supportive interventions				
All-cause mortality Follow-up: duration of hospital stay to 12 months	**133 per 1000**	**107 per 1000** (92 to 124)	**RR 0.78** (0.66 to 0.92)	6683 (12)	⊕⊕⊕⊖ **moderate**[a]	-
Morbidity/complications (number of participants with any medical complication) Follow-up: duration of hospital stay to 6 months	See comment	See comment	See comment	4015 (5)	⊕⊖⊖⊖ **very low**[b]	No summary effect size calculated because of high inconsistency; RR ranged from 0.59 in favour of supportive interventions to 1.42 in favour of usual care
Health-related quality of life and patient satisfaction Follow-up: duration of hospital stay to 12 months	See comment	See comment	See comment	4451 (5)	⊕⊕⊖⊖ **low**[c]	5/41 trials investigated health-related quality of life using different instruments in participants from a wide range of different clinical backgrounds; overall we noted no substantial differences between intervention and comparator groups 2/41 trials investigated patient satisfaction by means of an unvalidated questionnaire

Hospitalisation and institutionalisation (days) Follow-up: 8 days to 4 months	The mean hospitalisation ranged across control groups from 10 days to 40 days	The mean hospitalisation in the intervention groups was **0.5 days shorter** (2.6 days shorter to 1.6 days longer)	-	667 (5)	⊕⊝⊝⊝ **very low**[d]	3/5 trials with data on hospitalisation were in the group of trials of 'Changes to the organisation of nutritional care'
Adverse events Follow-up: 8 days to 6 months	See comment	See comment	See comment	4108 (3)	⊕⊝⊝⊝ **very low**[e]	Only 3/41 trials reported on adverse events (all evaluating the impact of supplementation of meals with oral nutritional supplements); 1 trial reported intolerance to the supplement (diarrhoea, vomiting) in 3/34 (15%) of participants. In another large trial 565/2017 (28%) of stroke patients stopped taking the oral nutritional supplements because of refusal or dislike of taste
Nutritional status (weight change in kg) Follow-up: 8 days to 12 months	The mean weight change ranged across control groups from -3.0 kg to +0.3 kg	The mean weight change in the intervention groups was +**0.6 kg higher** (0.2 kg to 1.0 kg higher)	-	2024 (17)	⊕⊕⊕⊝ **moderate**[f]	-
Economic costs Follow-up: duration of hospital stay to 12 months	See comment	See comment	See comment	1152 (3)	⊕⊝⊝⊝ **very low**[g]	3/41 trials evaluated and 2/41 trials reported some data on economic costs; none of the trials used accepted health economic methods and the reported data on both costs and effectiveness were generally poor

*The basis for the **assumed risk** (e.g. the median control group risk across trials) is provided in footnotes. The **corresponding risk** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).
CI: confidence interval; **RR:** risk ratio

GRADE Working Group grades of evidence
High quality: Further research is very unlikely to change our confidence in the estimate of effect.
Moderate quality: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
Low quality: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
Very low quality: We are very uncertain about the estimate.

*[a]Assumed risk was derived from the event rates in the comparator groups (usual care)

[a]Downgraded by one level because of risk of bias in several risk of bias domains
[b]Downgraded by three levels because of risk of bias in several risk of bias domains, serious inconsistency and imprecision
[c]Downgraded by two levels because of risk of bias in several risk of bias domains, indirectness and few trials investigating health-related quality of life in substantially diverse trial populations
[d]Downgraded by three levels because of risk of performance bias and serious imprecision
[e]Downgraded by three levels because of risk of bias in several risk of bias domains, imprecision and general substandard reporting of adverse events in included trials
[f]Downgraded by one level because of imprecision
[g]Downgraded by three levels because of risk of bias in several risk of bias domains, imprecision and few trials investigating economic costs with poor reporting, not using accepted health economic methods

BACKGROUND

Malnutrition in patients admitted to hospital was initially recognised in the 1970s (Butterworth 1974 ; McWhirter 1994). In recent years, malnutrition in the community has also been reported (Elia 2009). Whether in the hospital or the community, malnutrition is associated with poor clinical outcome, decreased health-related quality of life and increased mortality (Kubrak 2007; Norman 2008; Stratton 2003).

Malnutrition is both a cause and consequence of ill health (Lean 2008) and its aetiology is complex. It predisposes to illness but is also a consequence of illness (NCCAC 2006), creating a vicious, self-perpetuating cycle of malnutrition and infection (Scrimshaw 2003). People who are undernourished on admission to hospital, who do not receive adequate nutritional care, experience decline in their nutritional status (McWhirter 1994). While in hospital, the reasons for further poor intakes and subsequent weight loss may include temporary starvation for medical procedures, difficulty in feeding, lack of nursing supervision during mealtimes, depression, unpalatable foods and disease- or drug-induced anorexia (Kelly 2000; Lennard-Jones 1992). At home, in addition to the effects of illness and its management, sub-optimal nutritional status may be due to practical challenges, such as lack of transport, difficulties in grocery shopping, or difficulties utilising cooking facilities, resulting in diets of poor nutritional quality. Social and psychological issues also have a significant impact. The factors that contribute to malnutrition in hospital and community patients have been described extensively elsewhere (Lennard-Jones 1992; NCCAC 2006).

Nutrition intervention and treatment of malnutrition has been recommended in clinical guidelines from many countries based on associations between improved dietary intake and nutritional status, health-related quality of life and functional outcomes (Mueller 2011; NCCAC 2006). Therefore, it is recommended that at the first sign of malnutrition or risk of malnutrition, a full nutritional assessment and appropriate nutritional intervention should follow (Mueller 2011; NCCAC 2006). As the causes of malnutrition are multifactorial, the interventions designed to treat malnutrition are likely to be complex. This merits an understanding of the multidimensional causes of malnutrition and the complex support strategies needed across a range of healthcare services from the strategic policy level down to the individual feeding of a patient (Weekes 2009).

Description of the condition

Despite the absence of universally accepted diagnostic criteria, a widely quoted definition describes malnutrition as the nutritional state in which an energy, protein or nutrient deficiency, excess or imbalance leads to adverse effects on body or tissue form (body shape, size and composition) and function, as well as clinical outcome (Elia 2003). The recently convened International Guideline Consensus Committee categorised malnutrition as, "starvation-related malnutrition" in cases of chronic starvation in the absence of inflammation, "chronic disease-related malnutrition" where there is chronic but mild-to-moderate inflammation and, "acute disease or injury-related malnutrition" where there is acute severe inflammation (Jensen 2010). While this provides a useful aetiological classification of malnutrition and recognises the effect of illness on nutritional status, there remain no clear criteria for how each category might be identified in practice. Nutrition screening is often used to detect risk factors known to be associated with nutritional complications (McMahon 2000) such as recent, unintentional weight loss; inadequate food intake; disease-related anorexia; low body weight, body mass index (BMI) or lean body mass; in order to decide whether a full nutritional assessment is indicated (Elia 2003). Nutrition screening tools commonly employ a standard pro forma to determine nutritional risk. The included parameters are intended to determine whether an individual is nutritionally at risk on the basis of a score, which determines the course of action (Green 2006; Jones 2002). Many tools suggest suitable action plans that may involve nutritional intervention. Nutritional assessment is a more comprehensive investigation including anthropometric measurements, biochemical tests, clinical examination and dietary intake monitoring, used to determine whether an individual is malnourished or likely to become malnourished (at risk of malnutrition) (Corish 2000a; McMahon 2000). Nutritional assessment is usually followed by appropriate nutritional intervention (Corish 2000a; McMahon 2000).

The absence of clear and universally accepted criteria for the diagnosis of malnutrition further complicates the interpretation of prevalence data and intervention trials. Major classic and more recent trials that assessed the prevalence of malnutrition in hospitals have estimated a prevalence of between 11% and 50% depending on the criteria used (Bistrian 1974; Corish 2000a; Corish 2000b; Edington 2000; Hill 1977; Kelly 2000; McWhirter 1994; Naber 1997). The variation in reports of prevalence result largely from differences in the definitions used to identify malnutrition across trials. In 2008, the nutrition screening week carried out by the British Association for Parenteral and Enteral Nutrition (BAPEN), which uses a standardised tool to assess nutritional risk status, demonstrated that malnutrition was present in nearly a third of people admitted to hospital, in just over a third of people admitted to care homes and in a fifth of people admitted to mental health units (Elia 2009). Furthermore, it has been estimated that at any given time over three million people in the UK are thought to be malnourished or at risk of malnutrition with the vast majority of these (93%) living at home (Elia 2009). In Australia, a survey that used a different nutrition screening tool to screen 3122 participants in the acute hospital setting, revealed that 41% of participants were "at risk" of malnutrition, with an overall prevalence of malnutrition of 32% (Agarwal 2011).

The clinical consequences of malnutrition are believed to include reduced muscle strength; failure of the respiratory, thermoregulatory, pancreatic, gastrointestinal, mental, endocrine, and cardiovascular systems; as well as impaired wound healing and poor clinical outcomes from surgical procedures or illness (Allison 2000; Corish 2000a; Lennard-Jones 1992). Wounds that heal more slowly become much more vulnerable to infection. Immune function is impaired, compounding constraints on the body from other disease states, constituting a much reduced resistance to infection (Corish 2000a). Respiratory muscle wasting may also predispose to infections if patients are unable to cough and expectorate effectively (Lennard-Jones 1992). Pressure sores may develop as mobility is reduced (Lennard-Jones 1992) and as the body becomes thinner and wasted. Arguably, the effects of malnutrition on the musculoskeletal system extend beyond the gain or loss of lean body tissue, but may incur metabolic changes in cellular electrolytes including calcium accumulation, which may prevent optimal muscle function (Jeejeebhoy 1986). Furthermore,

excretory systems may fail to regulate body sodium-water balance efficiently and may result in excess fluid retention and oedema (Allison 2000), which has reportedly been detected in 17% of malnourished people admitted to hospital (Weekes 1999). As disease further impinges on appetite (Allison 2000), malnutrition will progress and the clinical implications aforementioned will occur much more quickly in ill people than in healthy individuals (Corish 2000a).

In addition to the clinical and social consequences, the economic impact of malnutrition is considerable. The increasing costs have become an economic burden for healthcare systems in many countries. Recent data from the UK suggest that malnutrition costs in excess of GBP 7.3 billion each year (EURO 8.74 billion/ year - December 2011 conversion) (DOH 2007; Russell 2007). Poor clinical outcomes, such as extended hospital stays, increased medical complications, reduced health-related quality of life and slow disease recovery, all contribute to rising hospital and home care costs (Gallagher 1996; Russell 2007; Stratton 2003). Malnourished patients stay in hospital for longer, are three times more likely to develop complications during surgery and have a higher mortality than adequately nourished patients (DOH 2007). Furthermore, those considered at risk of malnutrition are much more likely to require home healthcare services after discharge from hospital than those considered not at risk (Chima 1997). Malnutrition in the community has also been shown to increase the need for healthcare resources such as general practitioner (GP) visits, hospital admissions and new prescriptions, in addition to contributing to an increased risk of mortality (Martyn 1998). Therefore, if healthcare economics is considered, an undernourished patient imposes a greater economic burden on health services than a patient whose nutritional status is well maintained (Lennard-Jones 1992).

Description of the intervention

This review seeks to determine whether effective clinical management of malnutrition in both hospital and community settings requires more than just the provision of nutrients, dietary advice, or a combination, and whether additional strategies to support these existing approaches to ensure overall nutritional care is optimal, is worthy of consideration. The specific types of interventions considered are listed in Table 1. Related interventions include the sole use of oral nutritional supplements, dietary counselling or strategies, or a combination to manage malnutrition.

Guidelines exist for the identification, regular monitoring and initiation of nutritional support in individuals who may be malnourished or at nutritional risk. These include UK clinical guidelines for nutritional screening and support in adults (NCCAC 2006), Essence of Care benchmarks for food and nutrition from the UK Department of Health (DOH 2003), and the American Society for Parenteral and Enteral Nutrition (ASPEN) guidelines on nutrition screening, assessment and intervention in adults (Mueller 2011).

The strategies most frequently used to treat malnutrition in individuals requiring nutritional support aim to increase energy and nutrient intake by means of the following.

- Dietary counselling – provision of nutritional advice to increase nutrient intake, requiring an individual to understand and act upon instructions given. This approach may include providing advice on food fortification, to increase the energy density of foods without increasing quantity, or dietary fortification, to increase the energy density of the diet by adding extra snacks or drinks between meals.
- Oral nutritional supplements – available in either liquid or solid forms. These usually provide a mixture of macro- and micronutrients and may be nutritionally complete in a specified volume and are often available in the form of commercial supplement products.
- Artificial nutrition support - includes enteral tube feeds and parenteral nutrition that are used when oral intake is not possible.

The efficacy of nutritional support interventions has been the subject of much previous research but so far has focused primarily on the use of oral nutritional supplements, which may be applicable to only a minority of people (Weekes 2009). There are more than 20 systematic reviews in the literature of oral nutritional supplement-based interventions in the management of malnutrition (Stratton 2007). The findings are variable with some reviews showing clinical and nutritional benefits (Stratton 2007). However, these findings are by no means consistent and the patient groups most likely to benefit from this type of intervention remain to be characterised (Stratton 2007). Despite this, there has been a consistent trend to use oral nutritional supplements in clinical practice but the high cost implications of this approach, especially in the community as recently highlighted in a UK report (LPP 2009), makes the consideration of alternative approaches worthwhile. There has been an increased focus on the routine provision of food and drink as part of nutritional care since the 10 key characteristics of good nutritional care in hospital were published (COE 2003). Forty-five trials have examined the role of food-based interventions with or without oral nutritional supplements in the management of poor dietary intake (Baldwin 2011). The findings suggested that although dietary counselling may result in improvements in weight, body composition and muscle function, trials were heterogeneous and of variable quality with no evidence of benefit on mortality (Baldwin 2011). These trials have concentrated on interventions that rely on the patient receiving and acting on instructions to enhance their nutritional intake (i.e. dietary counselling). Despite the body of clinical evidence supporting the appropriate use of oral nutritional supplements and previous research around dietary counselling, whether additional supportive interventions are clinically effective in the management of malnutrition or the risk of malnutrition, remains unknown.

The Council of Europe and the UK Department of Health highlighted the importance of overall nutritional care including, among other supportive initiatives: mandatory nutritional screening, adequate provision of food and drink, oral supplements, modified diets, assistance with feeding and changes to the dining environment (COE 2003; DOH 2007). Such interventions have been incorporated into guidelines and healthcare policies and aim to improve nutritional intake by modifying aspects of food provision (e.g. the use of protected mealtimes, red tray initiatives (to identify those requiring mealtime assistance) and feeding assistance) or by adjusting the portion size and nutrient content of foods and enhancing the flavour, however, evidence of benefit of such initiatives is lacking.

Adverse effects of the intervention

The possible adverse effects of the supportive nutritional care interventions considered in this review may include but are not limited to the following events: provision of incorrect nutritional supplement, provision of incorrect between-meal snacks, gastrointestinal effects due to intolerance of supplements/extra snacks/drinks (e.g. bloating, vomiting or diarrhoea), potential accidents occurring as a result of the intervention such as a patient falling on the way to a dining area in a change of dining environment intervention, inappropriate moving and handling by untrained staff trying to obtain a weight or height measure, inappropriate screening or intervention (e.g. during end of life).

How the intervention might work

As recommended in the PRISMA statement (Liberati 2009), a conceptual framework highlighting the participants, interventions, comparisons, outcomes and trial design (PICOS) considered for this review, is illustrated (Figure 1).

Figure 1.

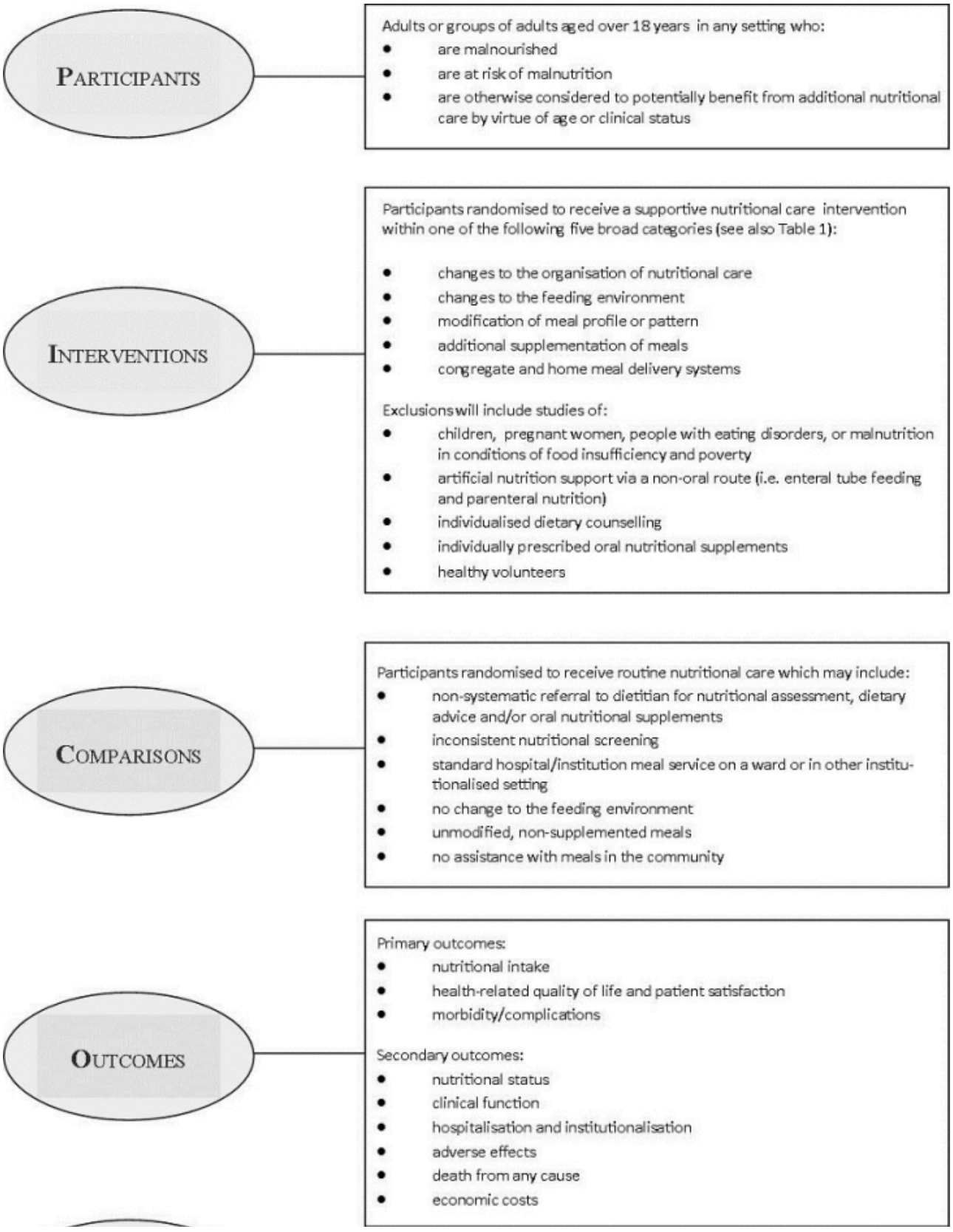


Figure 1. (Continued)

The treatment of malnutrition aims to reverse its effects, including the physical and functional impairments, and the provision of appropriate nutritional care may involve several approaches. The factors that influence our experiences with food are complex and nutritional care interventions aimed at the management of malnutrition or nutritional risk may need to address more than the provision of energy (calories). The biological and symbolic dimensions of food are inseparable and a socio-anthropological perspective suggests an intimate yet dynamic relationship between consumption of food and perceptions of self (Lupton 1996). The meaning of food extends beyond its mere nutritive value as it can have a tremendous impact on a person's sense of independence, self-esteem, well-being and health-related quality of life, especially in elderly people (Donini 2003). Indeed, experiences with food have important implications for the emotional and psychological well-being of an individual that sit within a traditional, cultural, socioeconomic and religious context and ultimately determines our food preferences (Donini 2003; Khan 1981; Lupton 1996). In severe illness, coping mechanisms, sense of body image, value of social networks and support, and personal symbolism may all be affected and food may take on new meaning (McQuestion 2011). Overall, this represents a challenge to health professionals and merits a deeper understanding of what really impacts on our experiences with food. Taking this into account, interventions that enhance the food experiences of malnourished individuals or those at risk of malnutrition by supporting their ability to take the intervention, thereby improving compliance, should theoretically result in greater dietary intakes and improved outcomes. Furthermore, the benefits of such interventions may extend beyond the conventional clinical, nutritional or functional outcomes and could conceivably also improve patient-satisfaction and perceived health-related quality of life. Indeed, following improvements in nutritional intake there may also be psychological and social benefits in individuals who are malnourished or at risk of malnutrition (NCCAC 2006). To summarise the mode of action, supportive nutritional care interventions should theoretically increase intake of micro- and macro-nutrients and, in turn, improve the nutritional status and clinical function of nutritionally at-risk individuals. By this, mortality, morbidity and hospitalisation are expected to be lowered. Considering the beneficial effects on physical health and the symbolic dimensions of food, health-related quality of life should also improve.

Why it is important to do this review

A Cochrane systematic review of protein and energy supplementation in individuals over 65 years at risk from malnutrition contains 62 trials with a total of 10,187 randomised participants and the authors concluded that supplementation led to small but consistent weight gain in older people, and reductions in mortality in those who were undernourished (Milne 2009). There was no evidence of benefit to complications, functional status or length of hospital stay (Milne 2009). Interventions considered focused primarily on dietary supplementation with commercial sip feeds, milk-based supplements and via the fortification of normal food sources (Milne 2009), rather than the array of supportive nutritional care interventions of interest to this review. In addition, the review included both randomised and quasi-randomised trials (e.g. allocation by alternation, day of week, date of birth) (Milne 2009). It is acknowledged that the complex nature of the interventions in this area may result in trials that lack robust design and their inclusion may best represent the body of evidence available. However, meaningful conclusions may be more difficult to decipher, and therefore this systematic review of purely randomised controlled trials will better highlight the research needs and knowledge gaps in this area. Furthermore, a wider range of interventions and trials including adults of all ages have been considered in this review.

There is an urgent need to identify effective strategies for the management for malnourished people in hospitals and other health and social care settings. Not only has this been highlighted in reports from the Council of Europe (COE 2003) and within the UK by the Department of Health (DOH 2007), but also by professional bodies such as the Royal College of Nursing, the British Association for Parenteral and Enteral Nutrition (BAPEN) and patient-focused organisations such as Age UK (BAPEN 2009; RCON 2008). Numerous strategies aimed at influencing nutritional management and improving the provision of nutritional care in hospitals, care homes and other health and social care settings, have been adopted and incorporated into national policies and international guidelines. Additionally, in the UK, protected mealtimes and the use of red trays have been rolled out across the National Health Service very recently, and interventions applicable across a range of healthcare settings, such as the use of feeding assistance, adjusting the portion size and nutrient content of foods and enhancing food flavours, are increasingly being used. Such service developments have received widespread support by local and national organisations and government. There has been a consistent trend to recommend the implementation of policies designed to influence nutritional care and the environment in which nutrition is provided, without a synthesis of the evidence of potential benefits or harms of such interventions. Crucially, the incorporation of such initiatives into usual care has implications for the staffing and funding of healthcare as well as the potential need for additional training across services. As yet there has been no synthesis of evidence to support the potential benefits of their implementation. Furthermore, a supportive multidisciplinary team approach is necessary in the provision of adequate nutritional care (Jefferies 2011). Given the widespread prevalence of malnutrition and with so many at risk, the potential impact of this systematic review in terms of informing the nutritional management of

patients is considerable and therefore, the need for this review was paramount.

Two literature reviews examined various supportive nutritional care interventions (Silver 2009; Weekes 2009) but neither was systematic and both presented a narrative synthesis without meta-analysis. Furthermore, the review by Weekes and colleagues (Weekes 2009) included non-randomised trials and searched only electronic sources, while the review by Silver (Silver 2009) considered only trials in older adults. Despite their usefulness in presenting some of the available literature in this area, the true effect of supportive interventions to improve dietary intake by modifying the nutrient content of foods served or aspects of the food service system or environment remains unknown. Therefore, this review represents a first systematic attempt to bring together evidence on the impact of supportive interventions on nutritional, clinical, economic and patient-centred outcomes.

OBJECTIVES

To assess the effects of supportive interventions for enhancing dietary intake in malnourished or nutritionally at-risk adults.

METHODS

Criteria for considering studies for this review

Types of studies

We included randomised controlled clinical trials (RCTs).

Types of participants

Adults (aged over 18 years) who were malnourished, judged to be at nutritional risk or otherwise would potentially benefit from improved nutritional care. The population is therefore described as nutritionally vulnerable.

Diagnostic criteria (malnourished or nutritionally at-risk adults)

The term malnutrition used in this review refers to under-nutrition, considered to be the state of poor nutritional status as a result of inadequate nutrient intake or metabolic impairment as well as the state of increased nutritional risk and imminent malnutrition (Corish 2000a; Reilly 1995).

The Malnutrition Universal Screening Tool (MUST) published by BAPEN (Elia 2003), as well as clinical guidelines in the UK and Europe published by the European Society for Parenteral and Enteral Nutrition (ESPEN) (Volkert 2006) and the National Institute for Health and Care Excellence (NICE) (NCCAC 2006), allow identification of malnourished individuals and those at risk of malnutrition in clinical practice and may be used to classify trial participants. These criteria are:

Malnourished

NICE (NCCAC 2006)

- Body mass index (BMI) below 18.5 kg/m^2
- Unintentional weight loss greater than 10% within the last three to six months
- BMI below 20 kg/m^2 and unintentional weight loss greater than 5% within the last three to six months

ESPEN (Volkert 2006)

- 5% unintentional weight loss in last three months and BMI below 20 kg/m^2
- 10% unintentional weight loss in last six months and BMI below 20 kg/m^2

At risk of malnutrition

NICE (NCCAC 2006)

- Have eaten little or nothing for more than five days, are likely to eat little or nothing for the next five days or longer, or both
- Have a poor absorptive capacity, have high nutrient losses, have increased nutritional needs from causes such as catabolism, or a combination

ESPEN (Volkert 2006)

- Loss of appetite
- Reduced dietary intake
- Physical or psychological stress

MUST (Elia 2003)

- Current acute illness plus no (or likely to be no) nutritional intake for more than five days

In the absence of clear, internationally accepted diagnostic criteria for clinical malnutrition, in many instances a health professional's decision to initiate dietetic referral for nutritional assessment or a clinician's decision to commence nutritional intervention is based on subjective criteria and clinical judgement (McCarron 2010). It was assumed therefore, that participants recruited to intervention trials were judged by the researcher to be malnourished or at risk of malnutrition, or otherwise had the potential to benefit from improved nutritional care on the basis of their clinical background or age.

Types of interventions

Intervention

Interventions that aimed to enhance food intake by improving either the meal itself (e.g. food fortification), aspects of the mealtime environment (e.g. enhancement of the eating environment), aspects of meal delivery, supplementation of meals or indirect supportive strategies (e.g. training of staff or carers). The strategies anticipated prior to searching included the examples listed within the five categories shown in Table 1. However, we recognised that it may become necessary to create additional categories as necessary following searching.

A previous systematic review (Baldwin 2011) included trials of interventions based on dietary counselling that required a person to receive instruction on food modification, oral nutritional supplements or both and have the ability and willingness to act on the instructions in order to enhance their nutritional intake. Although this review is closely related to the previous review, we planned to exclude trials where dietary counselling or oral nutritional supplements, or both were offered on an individualised basis. This review only considered food-based or oral nutritional supplement interventions when they were provided as an institution-led intervention without the patient needing to understand and act on instructions to take the additional items (e.g. offering snacks or supplements routinely

to frail elderly people in an institutional setting, or the use of organisational structures to support the delivery of oral nutritional supplements). The inevitable overlap with reviews of oral nutritional supplements in the management of malnutrition is noted, but the inclusion of such trials in this review contributes to a more precise understanding of the benefits to be derived from these products.

Comparator

All interventions were compared with usual care.

Summary of specific exclusion criteria

We excluded the following intervention trials from this review.

- Trials in children, pregnant women, people with eating disorders or malnutrition in conditions of food insufficiency and poverty. We have excluded these trials as malnutrition in such cases results from different aetiology, and the types of interventions and responses to such interventions also differ.
- Trials of artificial nutrition support via a non-oral route (i.e. enteral tube feeding and parenteral nutrition).
- Trials of individualised nutritional support including either dietary counselling (i.e. where the individual was required to understand and act upon specific nutritional advice, which is most likely to occur in the outpatient setting). In cases where dietary advice was provided in combination with a supportive intervention, we have only included the trial if it was possible to evaluate the impact of the supportive intervention separately.
- Trials of individually prescribed oral nutritional supplements.
- Trials in healthy volunteers.

Types of outcome measures

We recorded the following outcome measures as change from baseline to end of intervention unless otherwise stated.

Primary outcomes

- Nutritional intake (actual or percentage change in macro- and micronutrient intake)
- Health-related quality of life (evaluated by validated scores) and patient satisfaction
- Morbidity/complications (number of participants with medical complications)

Secondary outcomes

- Nutritional status (change in weight, body mass index (BMI), mid-upper arm circumference (MUAC), triceps skin-fold thickness (TSF) or as otherwise reported)
- Clinical function (change in clinical functional status (e.g. skeletal muscle strength), respiratory and cardiac function, cognitive and behavioural function, activities of daily living)
- Hospitalisation and institutionalisation
- Adverse events
- All-cause mortality
- Economic costs

Timing of outcome measurement

We extracted data on outcomes measured in each trial from baseline to the end of the intervention period. For trials with follow-up periods that extended beyond the end of the intervention, we also extracted data at the end of intervention to the point of final follow-up. From experience of a previous review of dietary advice with or without oral nutritional supplements for disease-related malnutrition in adults (Baldwin 2011) we anticipated that the length, intensity and type of intervention would vary considerably in this current review, given its wider scope. We did not, therefore, establish lengths of intervention and only grouped interventions by time point if a sufficient number of trials was identified to permit this.

Summary of findings

We have presented a 'Summary of findings' table to report the following outcomes, listed according to priority.

- All-cause mortality
- Morbidity/complications
- Health-related quality of life and patient satisfaction
- Hospitalisation and institutionalisation
- Adverse events
- Nutritional status
- Economic costs

Because of lack of data and substantial clinical and methodological heterogeneity we only performed meta-analyses on all-cause mortality, number of participants with complications and nutritional status (weight change).

Search methods for identification of studies

Electronic searches

We searched the following sources from inception of each database to the specified date and placed no restrictions on the language of publication.

- Cochrane Library (14 September 2016).
- Ovid Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily and Ovid MEDLINE(R) (1946 to 14 September 2016).
- Embase (to March 2013).
- AMED (to March 2013).
- British Nursing Index (to March 2013).
- CINAHL (to March 2013).
- SCOPUS (to May 2013).
- ISI Web of Science (to March 2013).
- ClinicalTrials.gov (14 September 2016).
- World Health Organization (WHO) ICTRP (International Clinical Trials Registry Platform - http://apps.who.int/trialsearch/) (14 September 2016)

During the first round of electronic searches, we searched databases for all trials published up until the end of October 2011. During the second round of electronic searches, we searched databases for trials published between November 2011 and the end of March 2013 (May 2013 for SCOPUS only). We used identical search strategies in both the first and second round of searches. We carried out a third round of electronic searches prior to publication, when we used a revised search strategy to search the Cochrane Library, Ovid MEDLINE, ClinicalTrials.gov and WHO ICTRP. We carried out revised searches of the Cochrane Libary and Ovid MEDLINE from 1

January 2013 to 14 September 2016. We searched ClinicalTrials.gov and the ICTRP from inception to 14 September 2016.

For detailed search strategies please see Appendix 1 and Appendix 2.

Searching other resources

We searched the references lists of included trials and (systematic) reviews, and meta-analyses to identify additional trials. We also searched the conference proceedings of relevant professional bodies and associations (British Dietetic Association, BAPEN and Royal College of Nursing) for the 10-year period 2001 to 2011.

Data collection and analysis

Selection of studies

In order to identify trials to be assessed further, two review authors (MG and CEW) independently scanned the abstract, title or both for every record retrieved according to the inclusion criteria for the first round of searches. For the second round of searches, MG and CB independently scanned the abstract, title or both for every record retrieved according to the inclusion criteria, as before. For the third round of searching, CB and Bernd Richter (The review group editor) scanned titles and abstracts. We obtained all potentially relevant articles as full text and the three review authors (MG, CB and CEW) independently assessed their eligibility using a standardised trial eligibility form. Where there were differences in opinion, we resolved them by discussion among the three authors and made a decision by consensus. If resolving disagreement was not possible, we added the article to those 'awaiting assessment' and contacted the trial authors for clarification. We marked trials where we had not reached a primary consensus and if we included them later on, we planned to subject them to a sensitivity analysis. We listed excluded trials in the 'Characteristics of excluded studies' table along with the reasons for their exclusion. We present an adapted PRISMA flow-diagram of trial selection (Liberati 2009).

Data extraction and management

For trials that fulfilled the inclusion criteria, two review authors (CB, CEW) abstracted relevant population and intervention characteristics using modified versions of standard data extraction sheets from the CMED Group which incorporated some adaptations from the data collection form used in a previous review by two of the review authors (Baldwin 2011). Data are reported as shown in Table 2; Table 3; Table 4; Table 5; Table 6; Table 7; Table 8; Table 9; Table 10; Table 11; Table 12; Table 13; Table 14; Table 15; Table 16; Table 17; Table 18; Table 19; Table 20; Table 21; Table 22; Table 23; Table 24; Table 25; Table 26 and Appendix 3; Appendix 4; Appendix 5; Appendix 6; Appendix 7; Appendix 8; Appendix 9; Appendix 10. The third review author acted as an arbiter in case of disagreement.

We sent an email request to authors of included trials to enquire whether they were willing to answer questions regarding their trials. Appendix 11 shows the results of this survey. Thereafter, we sought relevant missing information on the trial from the trial authors of the article, if required.

Dealing with duplicate publications

In the case of duplicate publications and companion papers of a primary trial, we have tried to maximise yield of information by inclusion of and simultaneous evaluation of all available data.

Assessment of risk of bias in included studies

Two review authors (CB and CEW) assessed each trial independently. We resolved possible disagreements by discussion amongst the three authors and made a judgement based on consensus.

We assessed risk of bias using the Cochrane tool for assessing risk of bias (Higgins 2011a; Higgins 2011b). We used the following risk of bias criteria.

- Random sequence generation (selection bias)
- Allocation concealment (selection bias)
- Blinding (performance bias and detection bias), separated for blinding of participants and personnel and blinding of outcome assessment
- Incomplete outcome data (attrition bias)
- Selective reporting (reporting bias)
- Other bias

We assessed risk of bias for each component of each trial as 'low risk', 'high risk' or 'unclear risk' as described in the Cochrane Handbook for Systematic Reviews of Interventions (Higgins 2011a).

Measures of treatment effect

We expressed dichotomous data as risk ratios (RRs) with 95% confidence intervals (CIs) and continuous data as mean differences (MDs) with 95% CIs.

Unit of analysis issues

We planned to take into account the level at which randomisation occurred, such as cross-over trials, cluster-randomised trials and multiple observations for the same outcome. For cross-over trials data had to be available from baseline to the end of phase 1 of the cross-over trial to be included in meta-analyses. The cross-over design as such was not feasible for our research question because of anticipated substantial carryover effects.

We could not recalculate data taking into account the design effect for cluster-RCTs because we did not have reliable information about intracluster correlation coefficients for our substantial heterogeneous populations in the included trials. Therefore, we did not establish meta-analyses by using both parallel and cluster-RCTs but excluded the cluster-RCTs from all meta-analyses.

Dealing with missing data

Where feasible, we obtained relevant missing data from study authors. We investigated attrition rates, for example number of dropouts, losses to follow-up and withdrawals, and critically appraised issues of missing data and imputation methods (e.g. last-observation-carried-forward (LOCF)).

Assessment of heterogeneity

In the event of substantial clinical, methodological or statistical heterogeneity, we did not report trial results as the pooled effect estimate in a meta-analysis. We identified heterogeneity (inconsistency) through visual inspection of the forest plots and by using a standard Chi^2 test with a significance level of $\alpha = 0.1$. In view of the low power of this test, we also considered the I^2 statistic, which quantifies inconsistency across trials to assess the impact of heterogeneity on the meta-analysis (Higgins 2002; Higgins 2003);

where an I^2 statistic of 75% or more indicates a considerable level of heterogeneity (Deeks 2011).

When we found heterogeneity, we attempted to determine possible reasons for it by examining individual trial and subgroup characteristics.

Assessment of reporting biases

If we included 10 trials or more investigating a particular outcome and intervention, we planned to use funnel plots to assess small study effects. Several explanations can be offered for the asymmetry of a funnel plot, including true heterogeneity of effect with respect to trial size, poor methodological design (and hence bias of small trials) and publication bias. Therefore we interpreted results carefully (Sterne 2011).

Data synthesis

Prior to undertaking any data synthesis, two authors (CB, CEW) considered the clinical heterogeneity of the trials. The likelihood of clinical heterogeneity amongst trials was judged to be high in many cases, as trials were in populations with widely different clinical backgrounds, conducted in different healthcare settings, and despite some grouping of similar interventions, involved interventions that varied considerably. We undertook data synthesis, therefore, for some outcome measures only, by means of a random-effects model.

Quality of evidence

We presented the overall quality of the evidence for each outcome according to the GRADE approach, which takes into account issues not only related to internal validity (risk of bias, inconsistency, imprecision, publication bias) but also to external validity such as directness of results. We presented a summary of the evidence in Summary of findings for the main comparison. This provides key information about the best estimate of the magnitude of the effect, in relative terms and absolute differences, for each relevant comparison of alternative management strategies, numbers of participants and trials addressing each important outcome and the rating of the overall confidence in effect estimates for each outcome. We created the 'Summary of findings' table based on the methods described in the Cochrane Handbook for Systematic Reviews of Interventions (Schünemann 2011) by means of the Review Manager (RevMan) table editor (RevMan 2014). We included the Appendix 11 'Checklist to aid consistency and reproducibility of GRADE assessments' (Meader 2014) to help with standardisation of the 'Summary of findings' tables. We presented the results for the outcomes as described in the Types of outcome measures section. If meta-analysis was not possible, we presented results in a narrative format in the 'Summary of findings' table. We justified all decisions to downgrade the quality of trials using footnotes, and we made comments to aid the reader's understanding of the review where necessary.

Subgroup analysis and investigation of heterogeneity

We undertook the following subgroup analysis.

- Intervention category (e.g. changes to the organisation of nutritional care, changes to the feeding environment, modification of meal profile or pattern, additional supplementation of meals, congregate and home meal delivery systems)

Insufficient data were available to undertake the following subgroup analyses.

- Intervention format (e.g. interventions given to individuals or groups of individuals)
- Baseline nutritional status (e.g. judged to be malnourished or at risk of malnutrition)
- Mean age of participants (e.g. below 65 years and 65 years or over)
- Intervention setting (e.g. home, hospital, long-term care facility, other community setting)
- Intervention duration (e.g. short term (less than 3 months), medium term (3 to 6 months) or long term (above 6 months))
- Intensity of intervention (e.g. number of visits/consults; considerations will be given to a post hoc analysis if sufficient data are available, as the intensity of intervention is very likely to differ according to care setting)
- Effects beyond the cessation of intervention (e.g. maintenance of weight gain, continued improvements in health-related quality of life)
- Change in outcome versus no change in outcome for nutritional status and intake

Sensitivity analysis

We planned to perform sensitivity analyses to explore the influence of the following factors (when applicable) on effect sizes by restricting the analysis to the following.

- Published trials
- Taking into account risk of bias, as specified in the Assessment of risk of bias in included studies section
- Very long or large trials to establish the extent to which they dominate the results
- Trials using the following filters: diagnostic criteria, imputation, language of publication, source of funding (industry versus other), or country

We also planned to test the robustness of the results by repeating the analysis using different measures of effect size (RRs, ORs etc.) and different statistical models (fixed-effect and random-effects models).

Due to lack of data we only performed sensitivity analyses on some risk of bias.

RESULTS

Description of studies

See: Characteristics of included studies; Characteristics of excluded studies; Characteristics of studies awaiting classification.

Results of the search

The electronic searches identified 29,155 records. An additional 1107 records were identified from searches of conference abstracts/proceedings, systematic reviews and reference lists of included trials. We screened a total of 30,262 records after removal of duplicates. Three review authors (MG, CEW and CB) independently scanned titles and abstracts from the first two searches and the Co-ordinating Editor (Bernd Richter (BR)) and one review author

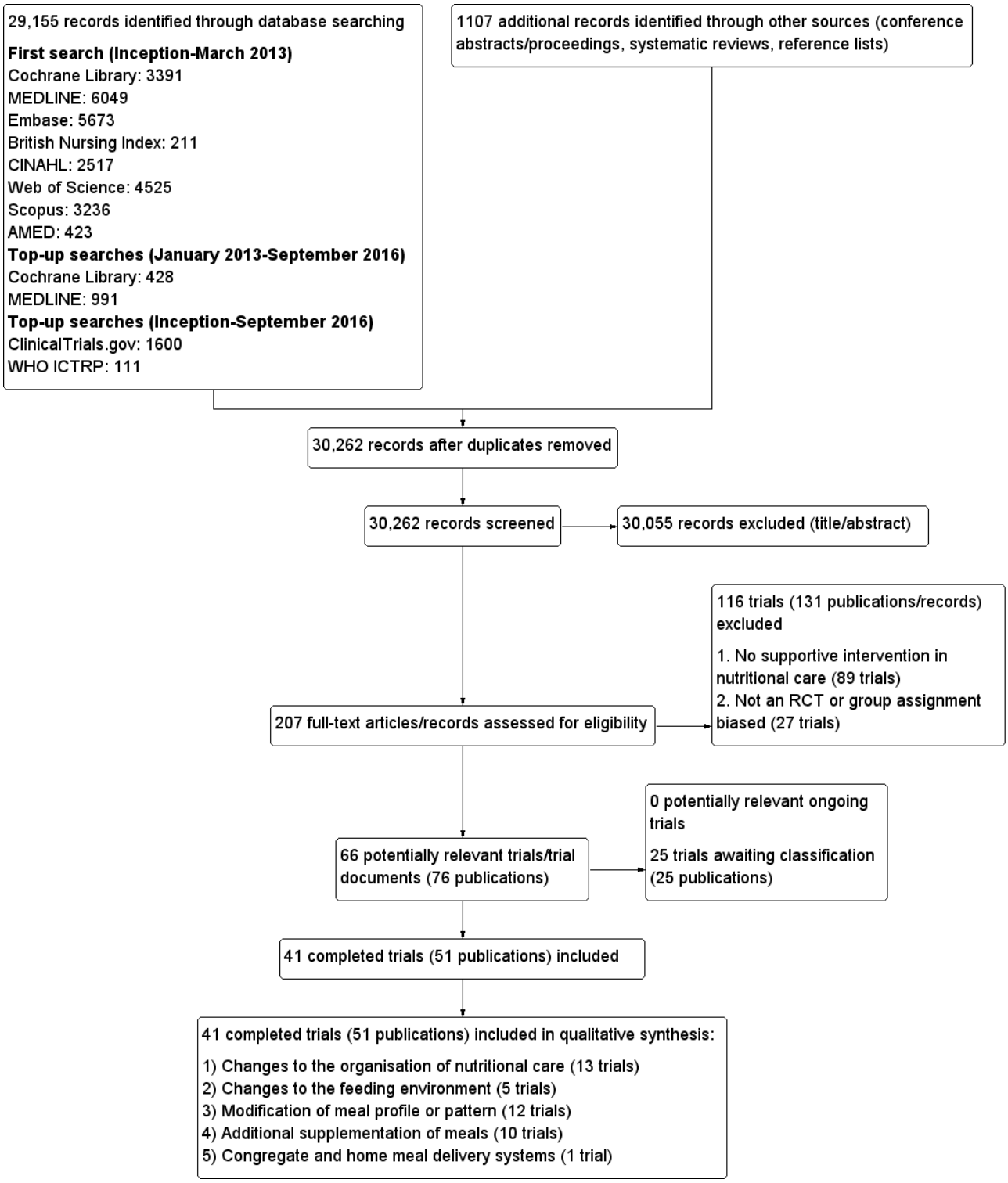
(CB) screened titles and abstracts from the third search and fourth search. We did not identify any ongoing trials.

Three review authors (CB, CEW and MG) and the Co-ordinating Editor (BR) assessed eligibility of trials against the inclusion criteria and grouped trials according to similar intervention categories. We identified a total of 41 randomised controlled trials (RCTs) for inclusion in the review (see Characteristics of included studies). The number of trials identified for each intervention category were as follows.

- Changes to the organisation of nutritional care (N = 13)
- Changes to the feeding environment (N = 5)
- Modification of meal profile or pattern (N = 12)
- Additional supplementation of meals (N = 10)
- Congregate and home meal delivery systems (N = 1)

A PRISMA flow-diagram of trial selection is shown in Figure 2.

Figure 2. Study flow diagram



Contact with authors

Of the 41 included trials, we requested additional information on outcomes of interest and quality from the authors of 31 trials, and obtained it for 15 (Barton 2000; Beck 2002, Bouillanne 2013; Bourdel-Marchasson 2000; Dennis 2005; Duncan 2006; Faxen-Irving 2011; Gaskill 2009; Germain 2006; Hickson 2004; Holyday 2012; Olofsson 2007; Simmons 2008; Simmons 2010; Smoliner 2008). For six of the 15 trials where the study authors responded, they were unable to provide the data requested, or the data were not usable in a meta-analysis (Barton 2000; Beck 2002; Bourdel-Marchasson 2000; Gaskill 2009; Simmons 2008; Simmons 2010). The authors of the remaining 16 trials did not respond (Castellanos 2009; Chang 2005; Essed 2007; Essed 2009; Hankey 1993; Johansen 2004; Kraft

2012; Larsson 1990; Lin 2010; Mathey 2001a; Mathey 2001b; Pivi 2011; Potter 2001; Salva 2011; Splett 2003; Van Ort 1995).

Missing data

Despite the comprehensive search strategies used to identify trials in this review, it is possible that we have missed additional trials (e.g. unpublished trials, those published in obscure places, or those inappropriately indexed in databases).

The largest source of missing data in this review arose from data on outcomes that were measured but reported in such a way that they were unusable for entry into a meta-analysis, because the data were reported as a median and interquartile range or were expressed as kcal/kg or the standard deviation (SD) of change was not reported. The details of the amount of missing data according to intervention group are given in Table 3; Table 4; Table 5; Table 6 and Table 7. We contacted study authors in an attempt to obtain any missing data. The reasons for contacting authors and the outcome of contacts are described in Table 8 and Appendix 11.

Where it was not possible to obtain original data from study authors, we either imputed data, for example, standard deviations, using methods described in the Cochrane Handbook for Systematic Reviews of Interventions (Higgins 2011c), or used formulae for combining groups as outlined in Table 8.

The majority of included trials did not report intention-to-treat analyses.

Dealing with duplicate publications/companion papers

Six trials included in this review had duplicate or companion publications (Essed 2007; Hickson 2004; Larsson 1990; Lin 2010; Nijs 2006; Potter 2001).

Included studies

This systematic review identified 41 randomised controlled trials, with a total of 10,681 randomised participants (ranging from 8 (Van Ort 1995) to 4023 (Dennis 2005)). One included trial is awaiting clarification of participant numbers from the study authors (Larsson 1990). This trial had several publications, which stated varying numbers of participants (435 to 501). The primary reference reported data on 435 participants and this is the number that we would use in any meta-analysis (Larsson 1990).

Participants were from a variety of countries including Australia, Brazil, CanadaDenmark, France, Germany, Netherlands, Spain, Sweden, Taiwan, , UK, and USA. Approximately 70% of participants were female (no information was provided for gender in three trials (Chang 2005; Larsson 1990; Simmons 2008). In those trials that reported ages in the intervention and usual care groups separately (N = 23), the mean age ranged from 62 to 87 years. Where the age of participants was reported for intervention and comparison groups separately, the mean age ranged from 75.2 to 87.3 (N = 11) (no data were provided for mean age in three trials (Kretser 2003; Potter 2001; Simmons 2008).

Altogether seven of the 41 included RCTs had a cross-over design (Barton 2000; Castellanos 2009; Essed 2009; Lin 2011; Silver 2008; Simmons 2008; Taylor 2006), 12 a cluster-randomised design (Bourdel-Marchasson 2000; Chang 2005; Gaskill 2009; Leslie 2012; Lin 2010; Lin 2011; Mathey 2001a; Nijs 2006; Salva 2011; Simmons 2008; Smoliner 2008; Splett 2003) and one was a factorial RCT (Essed 2007). Two trials had both a cluster-randomised and a cross-over design (Lin 2011; Simmons 2008). One large trial investigating a normal hospital diet plus oral nutritional supplements versus a normal hospital diet in participants with a recent stroke randomised 38% participants (4023/10,681) of all individuals in the 41 included trials (Dennis 2005).

Interventions were carried out in the hospital setting (described as elderly rehabilitation wards, intermediate care units, geriatric units, acute trauma wards, geriatric acute wards, geriatric orthopaedic wards, medicine for the elderly units and acute medical admissions) (N = 15), residential care homes (N = 21) and free-living or outpatient settings (N = 5) including neurology outpatients, and those enrolled at hospital discharge (see Table 9).

Nutritional status was reported in 27 trials, either because it was assessed at baseline or it was one of the criteria for inclusion in the trial (Beck 2002; Bouillanne 2013; Essed 2007; Essed 2009; Faxen-Irving 2011; Gaskill 2009; Germain 2006; Hickson 2004; Holyday 2012; Johansen 2004; Kraft 2012; Kretser 2003; Larsson 1990; Leslie 2012; Lin 2010; Lin 2011; Munk 2014; Nijs 2006; Mathey 2001b; Olofsson 2007; Potter 2001; Remsburg 2001; Salva 2011; Silver 2008; Smoliner 2008; Taylor 2006; Van den Berg 2015). The remaining trials did not assess nutritional status at trial inclusion but we judged them appropriate to be included in this review as the clinical background of trial participants meant that they could be considered to be at risk of malnutrition or the patients were described as frail or vulnerable. Ten of 16 trials used a score from the Mini Nutritional Assessment (MNA) tool of 17 to 23.5 or less than 17 (Beck 2002; Essed 2007; Essed 2009; Holyday 2012; Kretser 2003; Nijs 2006; Olofsson 2007; Salva 2011; Smoliner 2008; Taylor 2006), to indicate risk of malnutrition, one trial used the Subjective Global Assessment score (SGA) (Gaskill 2009), two used the Nutritional Risk Screening 2002 (NRS-2002) tool (Johansen 2004; Munk 2014), eight used only body mass index (BMI) (Faxen-Irving 2011; Hickson 2004; Leslie 2012; Lin 2010; Lin 2011; Mathey 2001b; Remsburg 2001; Silver 2008), four used a combination of indices with variable cut-offs (Bouillanne 2013; Germain 2006; Kraft 2012; Larsson 1990) and one used their own classification scoring system (Potter 2001). The average BMI measurements, in the trials that clearly reported BMI in all participants, ranged from less than 18.5 kg/m^2 (Kretser 2003) to 28.7 kg/m^2 (Nijs 2006)

The most commonly reported outcomes of interest to this review were nutritional intake (predominantly energy and protein), weight and mortality. These were reported in 27, 28 and 18 trials respectively. The three primary outcomes in the review, nutritional intake, health-related quality of life and morbidity and complications, were reported in 27, 5, and 5 trials respectively. Patient satisfaction, hospital admission and costs were reported for a limited number of trials (2, 2 and 3 respectively). Six trials reported no usable data for potential combination in a meta-analysis (Beck 2002; Castellanos 2009; Chang 2005; Gaskill 2009; Splett 2003; Van Ort 1995). We contacted the study authors who either were unable to provide the data requested, or failed to respond (see Table 8 and Appendix 11).

The outcomes reported in all intervention groups and those of use in this review, are summarised in Table 7.

Length of intervention and follow-up

Length of intervention and follow-up ranged from 'length of hospital stay' to 12 months in the included trials. In one trial, the length of intervention was unclear (Gaskill 2009). In 7 of 38 trials (Brouillette 1991; Dennis 2005; Duncan 2006; Gaskill 2009; Holyday 2012; Johansen 2004; Olofsson 2007) the follow-up period extended beyond the intervention from two weeks to six months.

Further results of the included trials are given in their individual intervention categories (see Appendix 3 for description of interventions).

Changes to the organisation of nutritional care

We identified 13 trials for this category (Chang 2005; Duncan 2006; Gaskill 2009; Hickson 2004; Holyday 2012; Johansen 2004; Kraft 2012; Lin 2010; Lin 2011; Olofsson 2007; Pivi 2011; Salva 2011; Splett 2003), (N = 3426, 32.4% of review participants). Participants either had dementia, hip fractures or were from a range of clinical backgrounds, living in residential care homes, hospital or their own homes. Interventions consisted of the use of dietetic assistants (Duncan 2006; Hickson 2004), multidisciplinary team care (Johansen 2004), specialised teaching and training (Chang 2005; Gaskill 2009; Lin 2010; Lin 2011; Pivi 2011; Salva 2011), protocol-driven nutrition care pathways (Holyday 2012; Splett 2003), multicomponent intervention (Olofsson 2007) and monitoring by telemedicine (Kraft 2012). Duration ranged from a few days of hospital stay to 12 months, and follow-up from 28 days to 12 months. We have summarised the outcomes reported, and those usable for this review, Table 4.

Changes to the feeding environment

We identified five trials for this category (Brouillette 1991; Mathey 2001a; Nijs 2006; Remsburg 2001; Van Ort 1995), (N = 351, 3.3% of review participants). All trials were conducted in elderly participants living in residential care homes. Interventions consisted of the use of osmotherapy (pre-meal sensory stimulation) (Brouillette 1991), improving mealtime ambience (Mathey 2001a), using family style meals (Nijs 2006), a buffet-style meal service (Remsburg 2001), and a contextual/behavioural intervention (Van Ort 1995). Duration of intervention ranged from 3 weeks to 12 months, and follow-up ranged from 4 weeks to 12 months. We have summarised the outcomes reported, and those usable for this review, in Table 4.

Modification of meal profile or pattern

We identified 12 trials for this category (Barton 2000; Bouillanne 2013; Castellanos 2009; Essed 2007; Essed 2009; Germain 2006; Leslie 2012; Mathey 2001b; Munk 2014; Silver 2008; Smoliner 2008; Taylor 2006), (N = 649, 6% of review participants). The trial by Barton 2000 included three groups, two of which were randomised to treatment or control and one other where it was unclear whether there was randomisation. Data have therefore only been included for those participants who were randomised to the treatment and usual care groups (N = 27). The trials included people from a range of clinical backgrounds who were in hospital (Barton 2000; Bouillanne 2013; Munk 2014), residential care homes (Castellanos 2009; Essed 2007; Essed 2009; Germain 2006; Leslie 2012; Mathey 2001b; Smoliner 2008; Taylor 2006), and free-living participants in receipt of home-delivered lunch meals (Silver 2008). Interventions consisted of altering portion sizes or fortifying meals, or both (Barton 2000; Castellanos 2009; Leslie 2012; Silver 2008), providing 78% of daily protein requirements at the lunch time meal, rather than spread evenly throughout the day (Bouillanne 2013), modifying the taste of foods previously identified as preferred (Essed 2007; Essed 2009; Mathey 2001b), modification of the appearance and presentation of pureed foods, thickened beverages, and dietary supplements (Germain 2006), the provision of an a la carte menu of enriched meals (Munk 2014) and altering meal pattern (Taylor 2006). We have summarised the outcomes reported, and those of use in this review, in Table 5.

Additional supplementation of meals

We identified 10 trials for this category (Beck 2002; Bourdel-Marchasson 2000; Dennis 2005; Faxen-Irving 2011; Hankey 1993; Larsson 1990; Potter 2001; Simmons 2008; Simmons 2010; Van den Berg 2015) (N = 6022, 56.4% of review participants). One trial did not state clearly the number of participants as additional publications appeared to include different numbers (Larsson 1990). As stated in the primary reference, 435 participants were therefore included in this review. The trial by Simmons 2008 was a two-phase crossover and cluster-randomised trial where residents were randomised only if they had a low oral food and fluid intake and were responsive to one of two feeding-assistance interventions. This randomised sub-group of intervention and control participants were then crossed over. We used data from the intervention and comparison groups prior to cross-over in this review, as additional participants were added to the trial at the crossover.

One trial (Dennis 2005) included only people who had had a stroke . Other trials included either mixed participants, or did not report diagnoses. The majority of participants were from the hospital setting (Bourdel-Marchasson 2000; Dennis 2005; Faxen-Irving 2011; Hankey 1993; Larsson 1990; Potter 2001; Van den Berg 2015), and only 168 were from residential care homes (Beck 2002; Simmons 2008; Simmons 2010). In nine RCTs participants were offered between 400 kcal/day to 685 kcal/day in the form of a protein-energy oral nutritional supplement, in addition to usual diet. In the other RCT participants were offered up to 420 kcal extra using 90 mL of fat emulsion/day (Faxen-Irving 2011). We have summarised the outcomes reported, and those of use in this review, in Table 6.

Congregate and home meal delivery systems

We identified one trial for this category (Kretser 2003), including 203 free-living participants (2% of review participants). Participants were offered modified home-delivered meals with a daily follow-up phone call. The outcomes of interest reported in this review included weight, clinical function, Activities of Daily Living score and number of deaths.

Excluded studies

Of the 182 trials/trial records after eligibility assessment, we excluded 27 trials as they were non-randomised controlled trials or the group assignment was made after randomisation, and 89 trials that did not describe supportive interventions in nutritional care. It was necessary for all four review authors to participate in discussion about the reasons for exclusion of trials from intervention category four, 'additional supplementation of meals'. Trials were excluded in this group for the following reasons.

- Participants were not from an institutionalised setting; therefore it was considered that they would have been given individualised advice on taking oral nutritional supplements.
- No clear organisational component to the intervention was described (for example when supplements were given without a clear description of delivery (i.e. administered at the same time as medication, or in place of usual morning/afternoon tea), or frequency of delivery).
- Trials with multi component interventions where it was not possible to extract data relating to the specific effect of nutritional intervention.

Twenty-four trials are awaiting assessment.

See Characteristics of excluded studies.

Risk of bias in included studies

The judgements made about risk of bias for individual trials are detailed in the 'risk of bias' section (Characteristics of included studies). A 'Risk of bias summary', and 'Risk of bias graph' are shown in Figure 3 and Figure 4. We judged the majority of criteria used in the assessment of risk of bias as unclear, indicating insufficient information to permit a full assessment of the risk of bias. The exceptions were attrition bias and reporting bias, where we judged the majority of trials (61% and 76% respectively) as being at low risk of bias (Figure 4).

Figure 3. Risk of bias summary: review authors' judgements about each risk of bias item for each included trial.

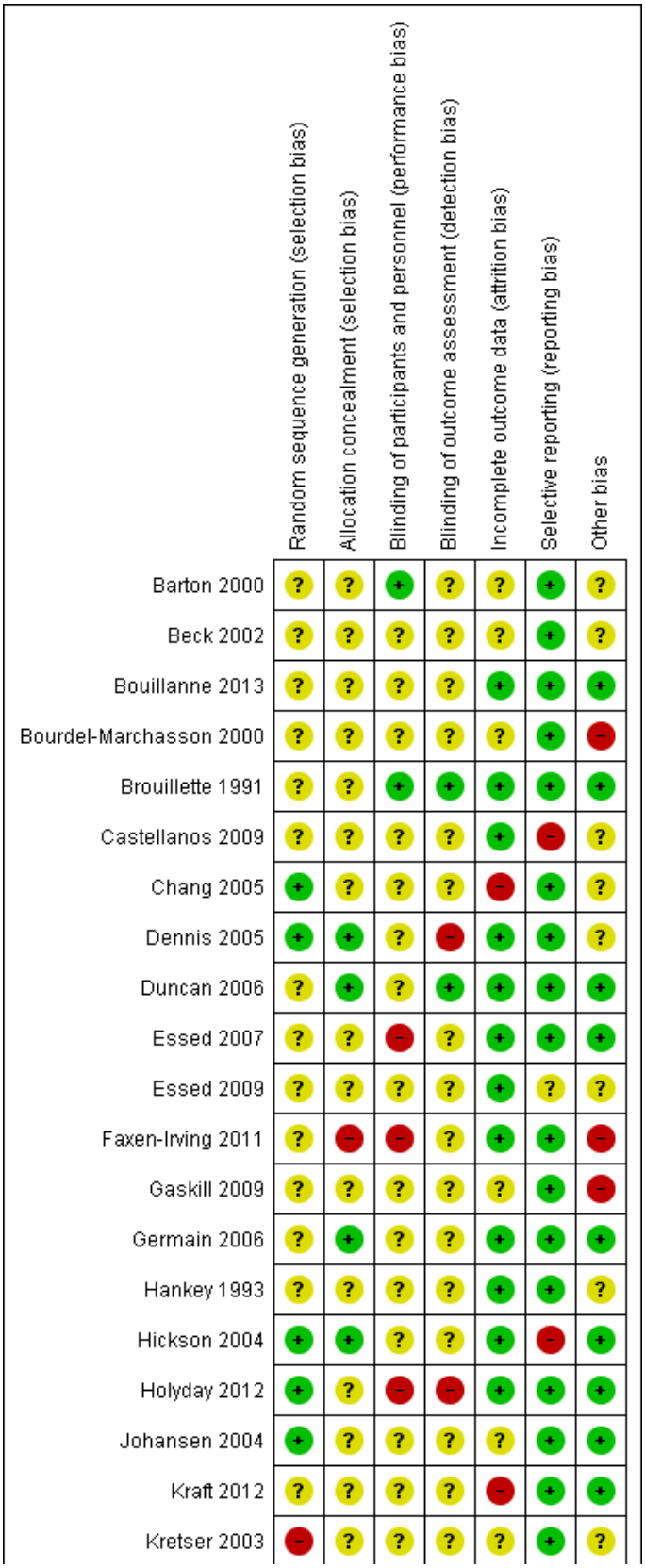


Figure 3. (Continued)

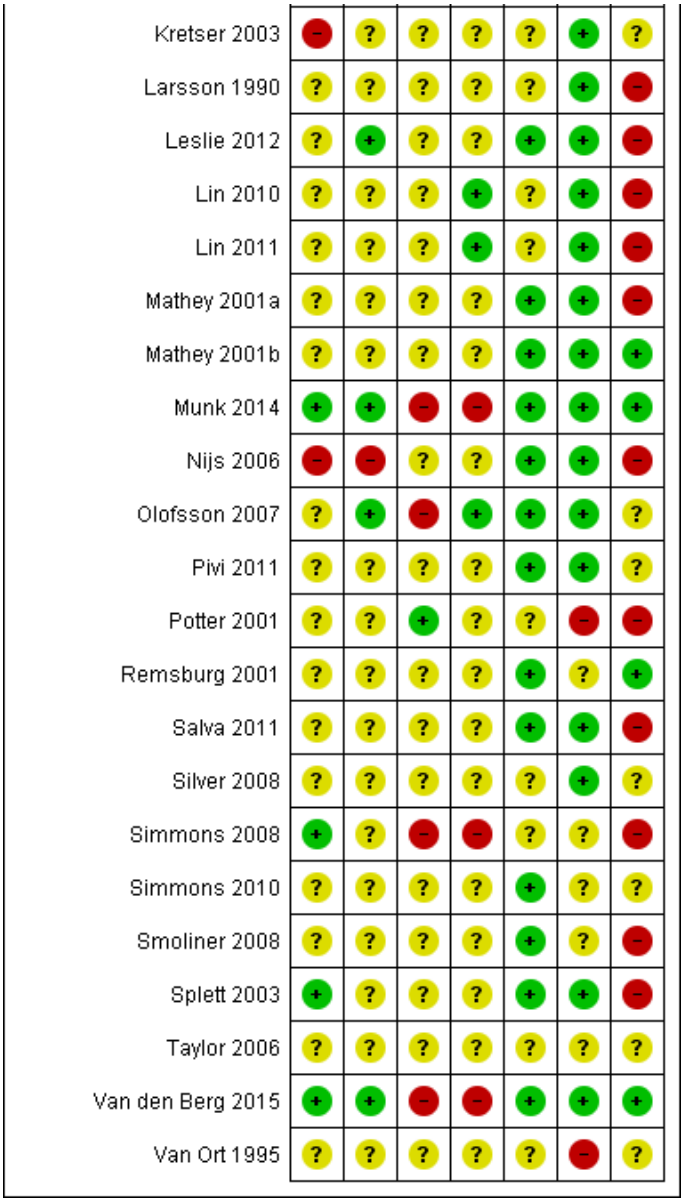
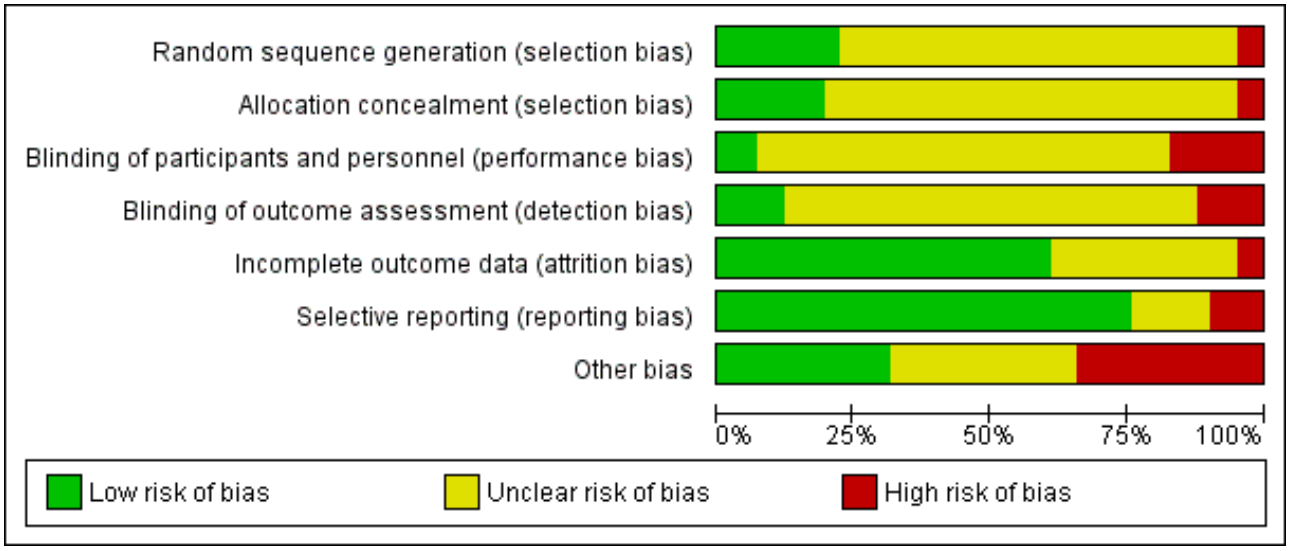


Figure 4. Risk of bias graph: review authors' judgements about each risk of bias item presented as percentages across all included trials.



Allocation

Generation of sequence

We assessed nine of 41 trials (Chang 2005; Dennis 2005; Hickson 2004; Holyday 2012; Johansen 2004; Munk 2014; Simmons 2008; Splett 2003; Van den Berg 2015), as being at low risk of bias for the method of random sequence generation. Two of these trials used the toss of a coin as a method of randomisation (Chang 2005; Simmons 2008), one used a sequence generated by a member of staff not involved in the trial (Munk 2014) and another used a random number table (Splett 2003). The other trials in this group used computer-generated randomisation methods.

Two of 41 trials (Kretser 2003; Nijs 2006) used inadequate methods of randomisation and we consequently gave them a high risk of bias. In another trial (Kretser 2003) the authors stated "randomised treatment assignment was followed with a few exceptions". When the participants were randomised to receive the new meals on wheels and refused, they were automatically placed on the traditional meals on wheels model. We therefore considered that allocation was made by preference of the participant. In the trial by Nijs 2006 the investigators described a non-random component in the sequence generation process, based on the name of the ward. This was therefore given a high risk of bias score.

One trial did not detail whether the third intervention group was randomised, and subsequently received an unclear risk of bias (Barton 2000). The remaining trials in the review provided insufficient information about the sequence generation process to permit judgement of low or high risk of bias. We therefore categorised them as unclear risk of bias.

Allocation concealment

We assessed eight of 41 trials (Dennis 2005; Duncan 2006; Germain 2006; Hickson 2004; Leslie 2012; Munk 2014; Olofsson 2007; Van den Berg 2015), as being at low risk of bias for allocation concealment , as they used sequentially numbered or opaque sealed envelopes opened by a member of staff not involved in the trial, or allocation was made by a statistician having no other contact with the participants. The trial by Faxen-Irving 2011 was considered to be at a high risk of allocation concealment, as they used sealed envelopes without describing the appropriate safeguards, for example, not sequentially numbered, or opaque. This suggested that participants, or investigators enrolling participants, could predict assignments, and thus introduce selection bias. Another trial used no concealment and therefore we judged it to be at a high risk of bias (Nijs 2006). The remaining trials included in the review we categorised as unclear risk of bias, as they provided insufficient information to permit a full assessment of the risk of bias.

Blinding

Blinding of participants and personnel (performance bias)

We judged three of 41 trials (Barton 2000; Brouillette 1991; Potter 2001) to be at a low risk of bias, as the trial participants were blind to group allocation or to what treatment they were receiving. We also judged that blinding was unlikely to have been broken throughout the trials. To give examples, in the trial by Barton 2000 the participants and staff were blinded to which menu they were following. In the trial by Brouillette 1991, the research assistant was unaware of group assignment. We awarded Potter 2001 a low risk of bias score, as researchers who knew the randomisation codes were not involved in outcome data collection or data entry.

We judged seven of 41 trials (Essed 2007; Faxen-Irving 2011; Holyday 2012; Munk 2014; Olofsson 2007; Simmons 2008; Van den Berg 2015) to be at high risk of bias, predominantly due to a lack of blinding of key trial personnel. In the trial by Essed 2007 there was incomplete blinding, as participants were blinded but the research personnel were not. In the trial by Faxen-Irving 2011, study nurses opened sealed envelopes, therefore would have been aware of group allocation. In the trial by Holyday 2012, the authors stated it was not possible to blind the clinical dietitian to group allocation. We therefore judged that the outcome was likely to be influenced by a lack of blinding of key trial personnel. Additionally, the trial by Olofsson 2007 stated that staff on the usual care ward were aware of a programme being implemented on another ward in the hospital. It was therefore judged that outcome assessment was likely to be

influenced by lack of blinding to these key trial personnel. The remaining trials in the review we categorised as unclear risk of bias, as insufficient information was provided to permit judgement.

Blinding of outcome assessment (detection bias)

We judged five of 41 trials (Brouillette 1991; Duncan 2006; Lin 2010; Lin 2011; Olofsson 2007) to be at low risk of bias. Researchers assessing outcomes were unaware of treatment allocation; therefore we judged that the blinding was unlikely to have been broken. We judged five of 41 trials (Dennis 2005; Holyday 2012; Munk 2014; Simmons 2008; Van den Berg 2015) as at high risk of bias, as outcome assessment was not blinded, and the outcome measurement was likely to be influenced by the lack of blinding. One trial stated, "as the outcomes are primarily objective measures, they are mostly not open to the influence of bias" (Holyday 2012). Additionally, the trial by Dennis 2005 stated "follow up was masked to treatment allocation except when patients or carers inadvertently divulged it to an interviewer, which was usually, but not systematically recorded". In the trial by Simmons 2008 outcomes were not assessed blinded to treatment and the outcomes were judged to be susceptible to detection bias. In the trial by Van Ort 1995, the research staff who observed videotapes were unaware of the trial hypothesis, but were aware of group allocation. We gave this trial, and the remaining 28 trials, an unclear risk of bias, as insufficient information was provided to permit judgement of the risk of bias.

Incomplete outcome data

The numbers of participants excluded from trials, along with reasons, were fully reported in 25 out of 41 trials and we judged these to have a low risk of bias. The number of participant exclusions ranged from 0% to 81%. The trial by Chang 2005 we judged to be at high risk of bias, because data were presented on only 20 of the 36 participants, without explanation. We judged another trial as high risk due to the high attrition rate in the intervention group (Kraft 2012). Here, eight participants out of 13 in the intervention group withdrew, and three out of 13 in the usual care group withdrew.

We included a total of 14 trials in the unclear risk of bias category. Three trials did not report exclusions (Barton 2000; Beck 2002; Simmons 2008). One of these is awaiting clarification from the trial author (Beck 2002), and another only reported participant exclusions in one of the intervention groups (Barton 2000). In a further three trials, the numbers of exclusions were unclear (Bourdel-Marchasson 2000; Gaskill 2009; Larsson 1990). Six trials only reported a total number finishing the trial, rather than a breakdown for the intervention and usual care groups separately (Johansen 2004; Kretser 2003; Lin 2010; Silver 2008; Taylor 2006; Van Ort 1995). Each of these trials stated why participants dropped out, however it was unclear which group they were allocated to. Simmons 2008 reported dropouts from each group, however only described mortality as the primary reason (58%). One trial did not describe attrition (Lin 2011), and another trial reported outcome in relation to BMI and triceps skinfold thickness (TSF), but not BMI and TSF alone (Potter 2001).

Selective reporting

Thirty-one of the 41 trials reported all outcomes as stated in the trial methodology, and we therefore judged them to be at low risk of bias. We categorised four trials as high risk of bias (Castellanos 2009; Hickson 2004; Potter 2001; Van Ort 1995). In the trial by Potter 2001, one or more outcomes of interest to the review were described as collected but were incompletely reported. In another trial, results for the whole group were not reported according to the initial randomisation (Castellanos 2009). In the trial by Hickson 2004, no data were reported on: use of service questionnaires, referral rate to therapists, readmission within six months, laxative use, pressure sores and economic analysis. In the trial by Van Ort 1995, outcomes were described in the methodology, however no quantitative data were reported. We categorised the remaining six trials as unclear risk of bias (Essed 2009; Remsburg 2001; Simmons 2008; Simmons 2010; Smoliner 2008; Taylor 2006), as insufficient information was provided in order to make a judgement on risk of bias.

Other potential sources of bias

We judged 13 of the 41 trials as low risk of bias, as intervention and usual care groups were comparable at baseline (Bouillanne 2013; Brouillette 1991; Duncan 2006; Essed 2007; Germain 2006; Hickson 2004; Holyday 2012; Johansen 2004; Kraft 2012; Mathey 2001b; Munk 2014; Remsburg 2001; Van den Berg 2015). In Hickson 2004, there were significantly more women in the intervention compared with the usual care group, but otherwise groups were comparable. Three parallel RCTs were judged at high risk of bias (Faxen-Irving 2011; Larsson 1990; Potter 2001). Faxen-Irving 2011 provided data only from those who completed the trial, potentially missing valuable data for those who dropped out. In the trial by Larsson 1990, there were significant differences between groups at baseline. TSF and weight index in men, and mid-arm circumference (MAC) in women were significantly lower in the intervention group than the control. The intervention group also had a significantly poorer mental condition as assessed using the modified Norton score on admission. In the trial by Potter 2001, only half of those in the 'well nourished' group were randomised, therefore bias was likely to have occurred. We categorised 14 trials as unclear risk of bias, as there was insufficient information to assess whether an important risk of bias existed.

We considered the following risk of bias criteria for the 12 cluster-RCTs (Bourdel-Marchasson 2000; Chang 2005; Gaskill 2009; Leslie 2012; Lin 2010; Lin 2011; Mathey 2001a; Nijs 2006; Salva 2011; Simmons 2008; Smoliner 2008; Splett 2003): (a) recruitment bias, (b) baseline imbalance, (c) loss of clusters, (d) incorrect analysis, and (e) comparability with individually randomised trials or different types of clusters as described in the Cochrane Handbook for Systematic Reviews of Interventions (Higgins 2011c). If any of the aforementioned criteria applied, we assigned a high risk of 'other bias'. Consequently, all included cluster RCTs had a high risk of bias. In the trial by Chang 2005 it was unclear whether randomisation occurred at the unit level (more probable) or the individual level. We therefore judged this trial to be an unclear risk of other bias.

Effects of interventions

See: **Summary of findings for the main comparison** Supportive interventions for enhancing dietary intake versus comparators in malnourished or nutritionally at-risk adults

We could not recalculate data taking into account the design effect for the 12 cluster RCTs (Bourdel-Marchasson 2000; Chang 2005; Gaskill 2009; Leslie 2012; Lin 2010; Lin 2011; Mathey

2001a; Nijs 2006; Salva 2011; Simmons 2008; Smoliner 2008; Splett 2003) because we did not have reliable information about intracluster correlation coefficients for our substantial heterogeneous populations in the included trials. Therefore, we did not establish meta-analyses by using both parallel and cluster RCTs but excluded the cluster RCTs from all meta-analyses. Also, cross-over trials did not contribute to the effect estimates established by meta-analyses.

Overview of all trials combined

Primary Outcomes

Nutritional intake

Data on this outcome were reported in 27 of 41 trials (Barton 2000; Beck 2002; Bouillanne 2013; Bourdel-Marchasson 2000; Brouillette 1991; Castellanos 2009; Chang 2005; Duncan 2006; Essed 2007; Essed 2009; Faxen-Irving 2011; Germain 2006; Hankey 1993; Hickson 2004; Johansen 2004; Leslie 2012; Lin 2010; Mathey 2001a; Mathey 2001b; Munk 2014; Nijs 2006; Potter 2001; Silver 2008; Simmons 2008; Simmons 2010; Taylor 2006; Van den Berg 2015).

The trials reporting on change in energy intake were in participants from a range of clinical backgrounds and healthcare settings and there were differences between trials in how energy intake was assessed (from observations of amounts eaten to detailed weighing and analysis). The majority of trials found no marked difference in energy intake between groups. One trial of assistance at mealtimes in hospitalised patients with hip fracture (Duncan 2006) reported a greater energy intake in the intervention group than in the usual care group (1105 kcal (SD 361) versus 759 (SD 399), P < 0.001) and a trial of a multidisciplinary team intervention in hospitalised patients (Johansen 2004) reported a higher intake in the intervention group than in the control group (Table 10). Two trials of fortification of meals (Barton 2000; Silver 2008) reported greater energy intakes in participants receiving the fortification than those receiving usual care (Table 15) and one trial of modifications to the appearance and presentation of foods to individuals with dysphagia (Germain 2006) reported a greater energy intake in the participants receiving the intervention (Table 15). Two of 10 trials of supplementation of meals with oral nutritional supplements (Hankey 1993; Van den Berg 2015) reported a higher energy intake in groups receiving the supplement, however the between-group differences were not reported (Table 19).

Health-related quality of life and patient satisfaction

Data on health-related quality of life were reported in five of 41 trials (Dennis 2005; Johansen 2004; Mathey 2001a; Nijs 2006; Smoliner 2008). Data were collected using different quality-of-life instruments; two trials used the Short Form-36 (SF-36) (Johansen 2004; Smoliner 2008), one trial used the Dutch quality of life of somatic nursing home residents questionnaire (Nijs 2006), one used the European Quality of Life Scale (EuroQOL-5D or EQ-5D) (Dennis 2005) and the final trial (Mathey 2001a) used the Sickness Impact Profile (SIP) and Philadelphia Geriatric Center Morale Scale (PGCMS, 17 items). The trials reporting on health-related quality of life included participants from a wide range of different clinical backgrounds. No marked differences between groups were found in four trials (Dennis 2005; Johansen 2004; Mathey 2001a; Smoliner 2008) (Table 11; Table 16; Table 23), the overall quality of evidence was low and two trials were cluster-randomised trials and therefore at high risk of bias (Mathey 2001a; Smoliner 2008). Nijs 2006 assessed health-related quality of life using a validated Dutch questionnaire (Van Campen 1998). This questionnaire consists of five sub-scales, each representing a quality-of-life dimension: sensory functioning (focusing on pain); physical functioning (perceived performance and self care); psychosocial functioning (depression or loneliness); perceived autonomy (freedom of movement); and perceived safety (feeling at home in the institution). The number of statements in the five sub-scales is not equal. The questionnaire consists of 50 statements, scored on a dichotomous scale (yes or no). Each sub-scale and the total questionnaire is computed to achieve a score from 0 to 100. A high score represents a high quality of life. The results were presented as difference in changes in overall quality of life between the groups and were reported as statistically significant (6.1 units, 95% confidence interval (CI) 2.1 to 10.3). The intervention group remained stable (0.4 units, 95% CI 1.8 to 2.5), whereas the usual care group declined (-0.5 units, 95% CI -9.4 to 0.6), although the overall changes were small and it is unclear if the observed differences were likely to be noticeable to participants (Table 16). Moreover, this trial was at high risk of bias. Therefore, all reported outcome measures of this trial must be interpreted with caution.

Data on patient satisfaction were reported in two trials (Duncan 2006; Salva 2011). Duncan 2006 assessed patient satisfaction using an unvalidated questionnaire with 10 questions about aspects of meals, diet and feeding. Participants answered yes or no, where yes = 1, no = -1 and NA = 0. Those participants who had received the support of the dietetic assistants showed greater satisfaction, with a median score of 6.5 (interquartile range (IQR) 2) compared to 3 (IQR 4) for participants receiving usual care (P < 0.0001) (Table 11). In the trial by Salva 2011 satisfaction of participants and their families was assessed by an unvalidated questionnaire which asked about the use of and perceived usefulness of five aspects of the overall programme. Families and carers were asked to indicate whether they had used the service and whether they had found it very useful, useful or not very useful. Information cards were used by 94.5% of families and rated the service as very useful (26%) or useful (67%). The nutrition course was used by 66% of families and rated as very useful (24%) and useful (65%). Weight curves were sent to 88% of families and rated as very useful (13%) and useful (78%). Information sessions were attended by 75% of families and rated as very useful (32%) and useful (61.5%). The hot line was used by 33% of families and rated as very useful (17%) and useful (51%).

Morbidity/complications

Data on this outcome were reported in seven of 41 trials (Bouillanne 2013; Bourdel-Marchasson 2000; Dennis 2005; Duncan 2006; Hickson 2004; Johansen 2004; Olofsson 2007). Complications were reported as either the number of participants experiencing any complication (Bouillanne 2013; Dennis 2005; Duncan 2006; Johansen 2004; Olofsson 2007), number of participants with pressure ulcers (Bourdel-Marchasson 2000; Dennis 2005) or the number of participants needing oral antibiotics (Hickson 2004). Trials were in participants from different clinical backgrounds, in different healthcare settings and receiving interventions that aimed to be supportive of improved nutritional intake, and varied widely. There were no marked differences in complication rates between groups reported in any trial (Table 11).

Meta-analysis of trials reporting number of participants experiencing any complication showed considerable inconsistency

(I^2 = 91%). Risk ratios ranged between 0.59 indicating benefit for supportive interventions, to 1.42 indicating benefit of control interventions (5 trials; 4015 participants; very low-quality evidence; Analysis 1.1).

Secondary Outcomes

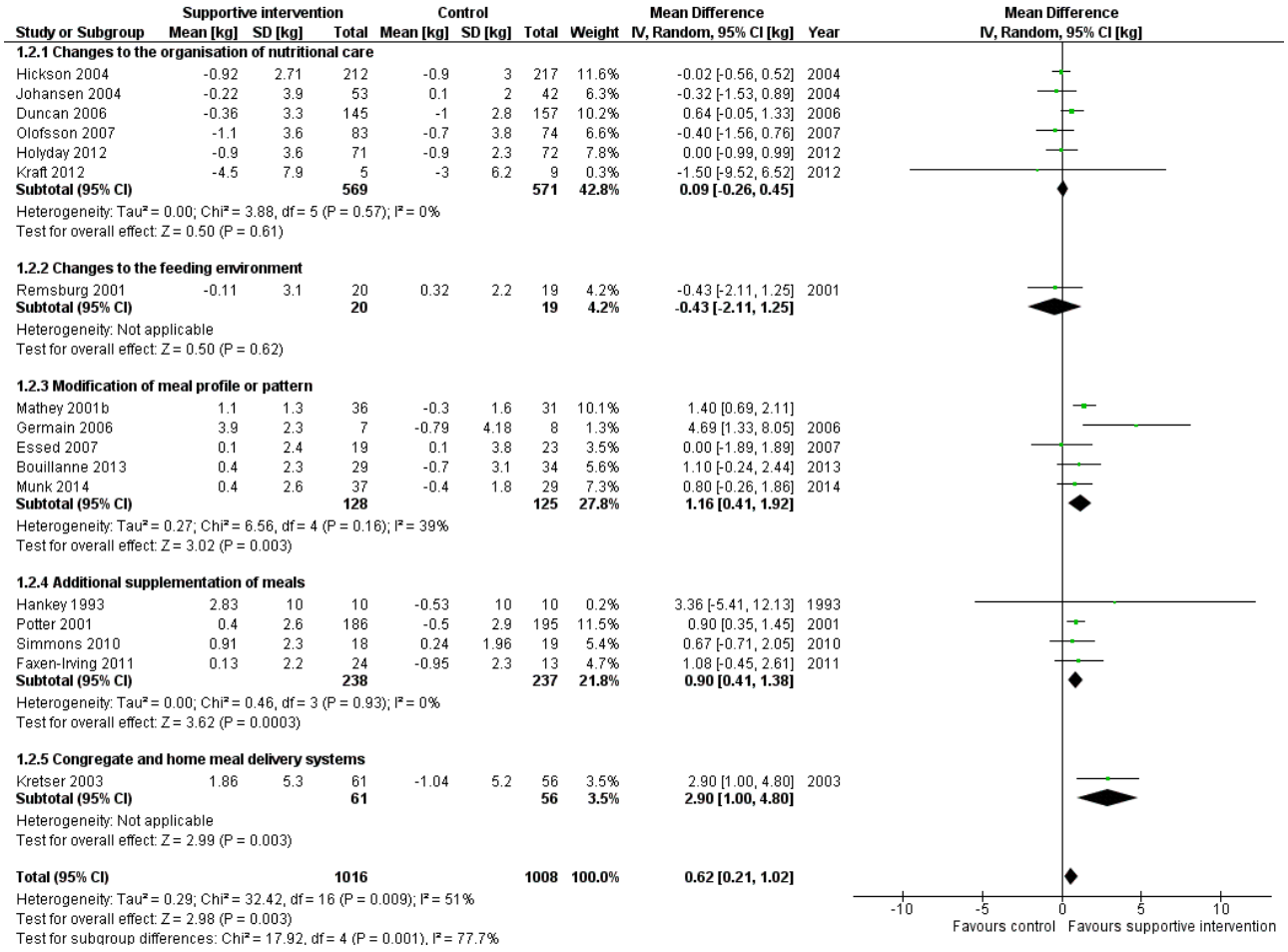
Nutritional status

Weight change

Data on this outcome were reported in 28 of 41 trials (Beck 2002; Bouillanne 2013; Chang 2005; Duncan 2006; Essed 2007; Faxen-Irving 2011; Germain 2006; Hankey 1993; Hickson 2004; Holyday 2012; Johansen 2004; Kraft 2012; Kretser 2003; Larsson 1990; Leslie 2012; Lin 2010; Mathey 2001a; Mathey 2001b; Munk 2014; Nijs 2006; Olofsson 2007; Pivi 2011; Potter 2001; Remsburg 2001; Salva 2011; Simmons 2008; Simmons 2010; Smoliner 2008). Trials were in participants from different clinical backgrounds, in different healthcare settings and receiving interventions which, although aiming to support improved nutritional intake, varied from one another in the nature of the intervention.

Meta-analysis across 17 trials with adequate data on weight change revealed an overall improvement in weight in favour of supportive interventions versus control: mean difference (MD) 0.6 kg (95% CI 0.21 to 1.02); P = 0.003; 2024 participants; moderate-quality evidence; Analysis 1.2. However, heterogeneity was moderate (I^2 = 51%). We excluded the trial by Pivi 2011 from this meta-analysis because missing SDs for weight change could not be reliably imputed. Trial authors reported a significant difference between intervention groups using a P value < 0.001. Using a P value of 0.0005 for imputation of SDs resulted in an SD of 3.3. Using these data did not substantially alter the effect estimate. Some other trials showed bias from different sources, however, exclusion of these trials did not substantially change the overall effect estimate. Also, elimination of any subtype of supportive intervention did not change the overall effect estimate in a substantial way. The body of evidence for this outcome consisted mainly of trials on change to the organisation of nutritional care (6 trials). However, the interaction test for subgroup differences was significant indicating the need to further investigate the various types of supportive interventions in future trials (Figure 5).

Figure 5. Forest plot of comparison: 1 Supportive interventions for enhancing dietary intake versus comparators, outcome: 1.2 Nutritional status (weight change) (kg)



Change in BMI

Data on change in BMI were reported in 12 of 41 trials (Faxen-Irving 2011; Germain 2006; Hickson 2004; Kraft 2012; Leslie 2012; Lin 2010; Lin 2011; Olofsson 2007; Pivi 2011; Salva 2011; Simmons 2008; Smoliner 2008). Trials were in participants from different clinical backgrounds, in different healthcare settings and receiving interventions that aimed to support improved nutritional intake

but varied from one another. The majority of trials reported no marked difference in BMI between groups. In the trial by Pivi 2011 participants receiving specialist training experienced an increase in BMI (1.2 kg/m^2 (SD 1)) and participants in the usual care group experienced a reduction in BMI (-2.2 kg/m^2 (SD 1)). However, the between-group difference and statistical tests were not reported. The trial by Germain 2006, which examined the effects of modifications to the presentation of meals to participants with dysphagia, and in the trial by Leslie 2012 of food fortification in residential care homes, the intervention group had a greater gain in BMI than the usual care group (Table 17). However, between-group differences with statistical tests were not reported. In the trial by Faxen-Irving 2011 BMI was reported according to group at the end of the intervention and there was no marked difference between groups, change from baseline and between-group differences were not reported. In the trial by Simmons 2008 the intervention group gained 0.7 kg/m^2 more than the usual care group (P < 0.009) (Table 24).

Change in TSF

Data on this outcome were reported in five of 41 trials (Duncan 2006; Hankey 1993; Hickson 2004; Larsson 1990; Pivi 2011). Trials were in participants receiving assistance during mealtimes (Duncan 2006; Hickson 2004), specialist training (Pivi 2011) and supplementation with oral nutritional supplement (Hankey 1993; Larsson 1990) in different healthcare settings. There were no marked differences in TSF reported between groups in the trials by Duncan 2006, Hickson 2004 and Pivi 2011. In the trials by Hankey 1993 and Pivi 2011 data were presented in figures with minimal description in the text. In the trial by Hankey 1993 the intervention group was described as experiencing a smaller decrease in TSF than the usual care group (6.6% versus 15.8%). In the trial by Larsson 1990 TSF decreased over the 26 weeks of follow-up in both groups with the greatest decrease occurring in the usual care group.

Change in MAC

Data on this outcome were reported in eight of 41 trials (Duncan 2006; Hankey 1993; Hickson 2004; Larsson 1990; Leslie 2012; Nijs 2006; Pivi 2011; Potter 2001). Trials were in participants from different clinical backgrounds, in different healthcare settings and receiving interventions which aimed to support improved nutritional intake but varied from one another. Three trials reported no marked difference in MAC between groups (Hickson 2004; Nijs 2006; Potter 2001). In the trial by Duncan 2006, the group that received assistance with eating had a smaller reduction in MAC of -0.9 cm (SD 2.2) compared with the group that received usual care, -1.3 (SD 1.5) (P = 0.002). One trial evaluating the impact of specialist training in free-living individuals (Pivi 2011) reported improvements in MAC in the intervention group of 1.9 cm (SD 2) compared with a reduction of -0.4 cm (SD 0.5) in the group receiving usual care. In the trial by Leslie 2012 of food fortification in residential care homes, participants in the intervention group had a greater improvement in MUAC than those in the control group but the between-group differences and statistical tests were not reported (Table 20) In the trial by Hankey 1993, the data were unavailable from the original trial report but we obtained them from a systematic review by Milne 2009. We read the figures for change from a graph, and we assumed the SD of change to be 10 cm for each group. MAC was described as improving in the intervention group (P < 0.05) but remaining unchanged in the usual care group. The changes were small and no between-group differences were reported (Table 24). In the trial by Larsson 1990 the data are presented in a figure with some description in the text, participants who were well nourished at the start of the trial and received supplementation of meals experienced less decrease in MAC at 26 weeks (P < 0.05) than those receiving usual care. In participants who were malnourished at the start of the trial both groups experienced a decrease in MAC at 26 weeks.

Clinical function

Data on this outcome were reported in nine of 41 trials (Bouillanne 2013; Duncan 2006; Faxen-Irving 2011; Hickson 2004; Kretser 2003; Munk 2014; Potter 2001; Salva 2011; Smoliner 2008). Trials were in participants from a variety of different clinical backgrounds, in different healthcare settings and were assessed using a variety of methods including handgrip strength, Barthel score, Activities of Daily Living (ADL), instrumental ADL (iADL) and peak flow.

Three trials assessed functional recovery using the Barthel score (Hickson 2004; Smoliner 2008; Potter 2001). The Barthel index consists of 10 items that measure a person's daily functioning, specifically the activities of daily living and mobility (Mahoney 1965). The items include feeding, moving from wheelchair to bed and return, grooming, transferring to and from a toilet, bathing, walking on level surface, going up and down stairs, dressing, continence of bowels and bladder. The items are weighted according to a scheme developed by the authors. The person receives a score based on whether they have received help while doing the task. The scores for each of the items are summed to create a total score. The higher the score the more 'independent' the person. Independence means that the person needs no assistance with any part of the task. There were no marked differences between groups in any trial. In the trial by Potter 2001 there was no marked difference in numbers achieving functional recovery assessed using the Barthel index in the group receiving supplementation compared with the usual care group (102/149 intervention versus 100/157 control, P = 0.38). However, more participants classified as severely undernourished experienced an improvement in their Barthel scores on supplementation compared with those that received usual care (17/25 intervention versus 11/28 control, P < 0.04).

Four trials assessed clinical function using the ADL and iADL scores (Bouillanne 2013; Faxen-Irving 2011; Kretser 2003; Salva 2011). Two main types of abilities are measured by these functional assessment scales. Basic ADL consist of activities that are performed daily, habitually and universally, such as dressing, bathing, and eating. In contrast, iADL requires organisation and planning, and includes such tasks as shopping, using transportation, preparing meals, handling finances, keeping the house, and using a telephone. The scores range from 0 to 100 and amount of functional impairment is then rated as ‘‘none to mild’’ (0 to 33), ‘‘moderate’’ (34 to 66), or ‘‘severe’’ (> 66). All trials reported no marked differences in ADL between the intervention and usual care groups. One trial used the iADL (Kretser 2003) to measure clinical function. There was a greater decline in iADL in those receiving traditional meals on wheels compared with those receiving modified meals on wheels at six months (P = 0.0494).

Five trials assessed clinical function using handgrip strength (Bouillanne 2013; Duncan 2006; Hickson 2004; Munk 2014; Smoliner 2008), and there were no marked differences in any trial between

the groups receiving the intervention and those receiving usual care (Table 13; Table 21).

In the trial by Smoliner 2008 clinical function was also measured using peak flow. Peak expiratory flow is the maximum flow generated during expiration performed with maximal force and started after a full inspiration. A decrease in peak flow rates indicates a deterioration in clinical function and vice versa. The peak flow in the intervention group increased from baseline to follow-up (12 weeks) (mean 152 mL/min (SD 105) to 186 mL/min (SD 140) whereas the usual care showed a decline (151 mL/min (SD90) to 150 mL/min (SD 67). The between-group difference was statistically significant (P = 0.039).

Hospitalisation and institutionalisation

Data on length of hospital stay were reported in 10 of 41 trials (Dennis 2005; Duncan 2006; Faxen-Irving 2011; Hickson 2004; Holyday 2012; Johansen 2004; Munk 2014; Olofsson 2007; Potter 2001; Van den Berg 2015). The trials were either of changes to the organisation of nutritional care (Duncan 2006; Hickson 2004; Holyday 2012; Johansen 2004; Olofsson 2007), fortification of meals in hospital (Munk 2014) or of supplementation of meals with oral nutritional supplements (Dennis 2005; Faxen-Irving 2011; Potter 2001: Van den Berg 2015). Nine trials reported no marked difference in length of hospital stay between groups (Dennis 2005; Duncan 2006; Faxen-Irving 2011; Hickson 2004; Holyday 2012; Johansen 2004; Munk 2014; Potter 2001; Van den Berg 2015). In the trial by Olofsson 2007 groups receiving a multidisciplinary team intervention had a shorter mean length of hospital stay (27.4 days (SD 15.9)) than groups receiving usual care (39.8 days (SD 41.9)) (P < 0.05) (Table 14).

Meta-analysis across five trials with adequate data on length of hospital stay showed a MD between intervention and comparator groups of -0.5 days (95% CI -2.6 to 1.6); P = 0.56; 667 participants; very low-quality evidence; Analysis 1.3.

Data on hospital readmissions were reported in two of 41 trials (Holyday 2012; Van den Berg 2015). In the trial by Holyday 2012 the groups receiving a protocol-driven pathway for the management of nutrition whilst in hospital had fewer hospital readmissions than the group receiving usual care (30/71 versus 37/72 respectively). However the between-group difference was not statistically significant. In the trial by Van den Berg 2015 there were more hospital readmissions in the group receiving an oral nutritional supplement four times daily than the groups receiving the supplement twice daily or the usual care group (24 versus 13 versus 15 respectively).

The trial by Potter 2001 reported the destination of participants at discharge according to group allocation. There was no marked difference between groups in the numbers of participants returning to their own home and those being discharged to an institution (Table 25).

Adverse events

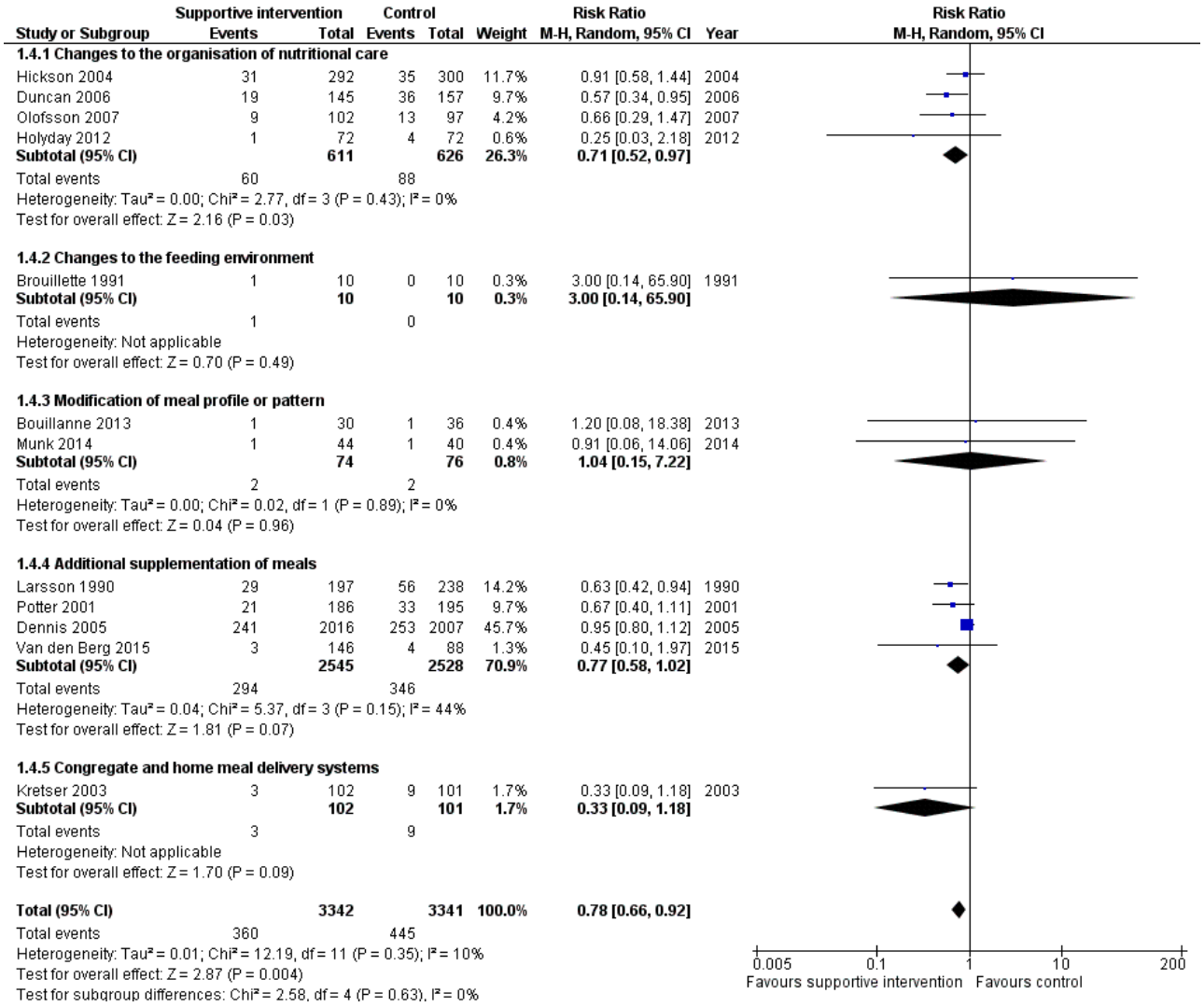
Three of 41 trials (Dennis 2005; Faxen-Irving 2011; Hankey 1993) reported on adverse events, all trials evaluating the impact of supplementation of meals with oral nutritional supplements. The overall quality of the evidence was very low. The trial by Faxen-Irving 2011 reported that 5 of 34 (15%) participants experienced intolerance to the supplement assessed as diarrhoea and vomiting. In the trial by Dennis 2005 565 of 2017 (28%) of participants stopped taking the oral nutritional supplement due to individuals' refusal or dislike of taste, unwanted weight gain, or feelings of nausea. The trials by Potter 2001 and Van den Berg 2015 reported that no adverse events occurred.

All-cause mortality

Adequate data were reported on this outcome in 12 out of 41 trials (Bouillanne 2013; Brouillette 1991; Dennis 2005; Duncan 2006; Hickson 2004; Holyday 2012; Kretser 2003; Larsson 1990; Munk 2014; Olofsson 2007; Potter 2001; Van den Berg 2015). Six cluster-RCTs could not be included in the meta-analysis (Bourdel-Marchasson 2000; Leslie 2012; Mathey 2001a; Nijs 2006; Salva 2011; Smoliner 2008).

Trials were in participants from a variety of clinical backgrounds and in a range of different healthcare settings, receiving interventions which were all supportive of improved nutritional intake but varied widely. Meta-analysis showed a RR of 0.78 (95% CI 0.66 to 0.92); P = 0.004; 12 trials; 6683 participants; moderate-quality evidence; Analysis 1.4 in favour of supportive interventions (Figure 6). The test for subgroup differences of the various supportive interventions did not indicate interaction. Subgroup analysis of longer-term trials (four months to one year) showed a RR of 0.73 (95% CI 0.55 to 0.98); 6 trials; 5200 participants. The sensitivity analysis after exclusion of the biggest trial, Dennis 2005, showed a RR of 0.67 (95% CI 0.54 to 0.82); 11 trials; 2660 participants.

Figure 6. Forest plot of comparison: 1 Supportive interventions for enhancing dietary intake versus comparators, outcome: 1.4 All-cause mortality



Economic costs

Data on this outcome were reported in three of 41 trials (Holyday 2012; Salva 2011; Simmons 2010). The overall quality of the evidence was very low. The trial by Holyday 2012 evaluated the impact of a protocol-driven pathway for the management of nutritional care in hospital patients and the trial by Salva 2011 evaluated the impact of specialist training for carers of free-living individuals with dementia. In the trial by Holyday 2012 the data on cost savings were based on reductions in the length of hospital stay. There was no marked difference in overall length of stay between groups. There was a shorter length of stay by eight days in the subgroup of 32 malnourished participants (12 days in the intervention group and 20 days in the usual care group). These data were used to estimate a cost saving of AUD 63,360 from treating malnutrition in the group of 12 malnourished participants based on the cost per hospital bed per day, the cost of the dietitians' time and the average cost of a commercial oral nutritional supplement. The trial by Salva 2011 collected data on resource utilisation but the data were not reported. The trial by Simmons 2010 evaluated the impact of a food-based and oral nutritional supplement-based intervention. In this trial a formal cost effectiveness analysis was not undertaken and reporting of the impact of the interventions on costs was limited to a report of the cost per serving of the oral nutritional supplement or food provided and an estimate of staff time required to encourage and assist consumption. The average costs (per person per day in USD) were significantly higher in groups receiving supplements and snacks compared with those in the usual care group (USD 2.10 versus, USD 2.06). None of the trials used accepted health economic methods and the reported data on both costs and effectiveness were generally poor.

Subgroup analyses

We carried out the first planned subgroup analysis 'intervention category'. Trials were grouped according to similar interventions into five categories. There were insufficient data to undertake further subgroup analyses.

Sensitivity analyses

We did not do any sensitivity analyses because of insufficient data.

Changes to the organisation of nutritional care

Primary outcomes

Nutritional intake

Data on energy intake were reported in five of 13 trials (Chang 2005; Duncan 2006; Hickson 2004; Johansen 2004; Lin 2010) (Table 10). Two trials used dietetic assistants in a hospital setting: one found a greater energy intake in groups receiving assistance than those receiving usual care (1105 kcal (SD 361) versus 759 kcal (SD 399), P < 0.001) (Duncan 2006), whereas in the other trial (Hickson 2004), which assessed between-group difference in intake in 37 of 592 participants, the difference in energy intake between the groups was 89 kcal, P < 0.538. Of the four trials that implemented specialist training in long-term care facilities, two reported data on energy intake as percentage of meals consumed (Chang 2005 ; Lin 2010). In one trial (Chang 2005), the intervention group experienced a reduction in percentage of meals consumed and the group receiving usual care increased their intake (P < 0.49). In the other trial (Lin 2010) there were small increases in percentage of meals consumed in all groups (Table 10). One trial providing multi-disciplinary team care in a hospital setting reported a greater energy intake in the intervention group compared with usual care (30 kcal/kg/d (standard error (SE) 1) versus 25 kcal/kg/d (SE 1) (Johansen 2004).

Health-related quality of life and patient satisfaction

Data on health-related quality of life were reported in one of 13 trials (Johansen 2004). Quality of life was assessed using the SF36 questionnaire (Ware 1992) which was completed by 57% participants. A dropout analysis showed responders and non-responders were similar in terms of baseline characteristics. There were no marked differences between the groups in both the physical and mental summary scores from baseline to follow-up (physical score mean 2.4 (SE 1.3) in the intervention versus mean 0.2 (SE 1.5) in the control; mental score mean 2.2 (SE 2.5) in the intervention versus mean 3.3 (SE 2) in the usual care) (Table 11).

Data on patient satisfaction were reported in two of 13 trials (Duncan 2006; Salva 2011). In the trial by Duncan 2006 patient satisfaction was assessed using an unvalidated questionnaire with 10 questions about aspects of meals, diet and feeding. Patients answered yes or no where yes = 1, no = -1 and NA = 0. Those participants who had received the support of the dietetic assistants showed greater satisfaction with a median score of 6.5 (IQR 2) compared to 3 (IQR 4) for participants receiving usual care (P < 0.0001) (Table 11). In the trial by Salva 2011 satisfaction of participants and their families was assessed using an unvalidated questionnaire which asked about the use of and perceived usefulness of five aspects of the overall programme. Families and carers were asked to indicate whether they had used the service and whether they had found it very useful, useful or not very useful. Information cards were used by 94.5% of families and rated as very useful (26%) and useful (67%). The nutrition course was used by 66% of families and rated as very useful (24%) and useful (65%). Weight curves were sent to 88% of families and rated as very useful (13%) and useful (78%). Information sessions were attended by 75% of families and rated as very useful (32%) and useful (62%). The hot line was used by 33% of families and rated as very useful (17%) and useful (51%).

Morbidity/complications

Data on complications were reported in four of 13 trials (Duncan 2006; Hickson 2004; Johansen 2004; Olofsson 2007), three of which reported the number of participants experiencing any complications (Dennis 2005; Johansen 2004; Olofsson 2007) and one trial (Hickson 2004) reported the number of participants receiving oral antibiotics. There were no marked between-group differences in any of the trials (Table 11).

Secondary outcomes

Nutritional status

Weight change

Data on this outcome were reported in 10 of 13 trials (Duncan 2006; Hickson 2004; Holyday 2012; Johansen 2004; Kraft 2012; Lin 2010; Olofsson 2007; Pivi 2011; Salva 2011; Splett 2003) (Table 12).

Two trials evaluated the impact of dietetic assistants in a hospital setting (Duncan 2006; Hickson 2004) and there were no marked differences in mean weight change between groups in either trial. One trial used specialist training in a residential care setting (Lin 2010) and there was no marked difference in mean weight change between the two groups. Two trials looked at specialist training for carers of free-living individuals with dementia (Pivi 2011; Salva 2011). In one trial the intervention group experienced a small weight gain of 1.2 kg whereas the usual care experienced a small weight loss of 2.2 kg (Pivi 2011). In the other trial (Salva 2011) there was no marked difference between the two groups in mean weight change. Two trials reported weight change for interventions consisting of a multi-disciplinary team approach to nutritional care (Johansen 2004; Olofsson 2007) and reported no marked differences between groups receiving intervention and those receiving usual care in either trial. One trial described a protocol-driven pathway of nutritional care in hospital (Holyday 2012) and reported no marked differences in weight change between the groups receiving the intervention and usual care. Another trial reported data using a protocol-driven care in a care home setting (Splett 2003). The authors did not report mean weight change but provided a narrative description of the proportions of participants maintaining or gaining weight. The percentage of participants maintaining or gaining weight during the trial was greater in the usual care group (57%) than in the intervention group (48%). One trial evaluated the impact of telemedicine in free-living individuals and reported no marked difference between the groups in mean weight change (Kraft 2012).

Change in BMI

Data on this outcome were reported in seven of 13 trials (Hickson 2004; Kraft 2012; Lin 2010; Lin 2011; Olofsson 2007; Pivi 2011; Salva 2011): two trials of specialist training in a residential care setting (Lin 2010; Lin 2011), two of specialist training of free-living individuals (Pivi 2011; Salva 2011), one of additional nutritional care from a trained health care assistant (Hickson 2004), one of multi-disciplinary team care in hospital (Olofsson 2007) and one of telemedicine (Kraft 2012). There were no marked differences in BMI change between groups in six of the seven trials (Table 12). In one trial (Pivi 2011) participants receiving specialist training experienced an increase in BMI (1.2 kg/m^2 (SD 1) and participants in the usual care group experienced a reduction in BMI (-2.2 kg/m^2 (SD 1). However, the between-group difference and statistical tests were not reported.

Change in TSF, MAMC and MUAC

Data on this outcome were reported in three of 13 trials (Duncan 2006; Hickson 2004; Pivi 2011). In the two trials that assessed the effects of using dietetic assistants in hospital (Duncan 2006; Hickson 2004) there were no marked differences in either TSF or MAMC between groups. In one trial (Hickson 2004) there was no marked difference in MAC between groups receiving assistance with eating and those receiving usual care, whereas in the other trial (Duncan 2006) the group that received assistance with eating had a smaller reduction in MAC (-0.9 cm (SD 2.2)) compared with the group that received usual care (-1.3 (SD 1.5), P < 0.002). One trial used specialist training in free-living individuals (Pivi 2011) and reported improvements in MAC in the intervention group of 1.9 cm (SD 2) compared with a reduction of 0.4 cm (SD 0.5) in the group receiving usual care, and no marked difference between the groups in TSF.

Overall the data across all interventions suggest that there is minimal impact on weight change and body composition from changes to the organisation of nutritional care across different healthcare settings.

Clinical function

Data on this outcome were reported in three of 13 trials (Duncan 2006; Hickson 2004; Salva 2011). The trials by Duncan 2006 and Hickson 2004 both assessed the effect of assistance with eating in people in hospital on handgrip strength. There were no marked differences in handgrip strength between the intervention and usual care groups in either trial (Table 13). The trial by Hickson 2004 also assessed functional recovery in participants using the Barthel score. There was no marked difference between groups' initial assessment to discharge from hospital (median score 2.0 (IQR 0 to 5) in the group receiving feeding assistance and 1.0 (IQR 0 to 4), P = 0.23 in the group receiving usual care). The trial by Salva 2011 measured change in ADL (Katz 1963), and iADL (Lawton 1969) in free-living individuals with dementia who had received specialist training on nutrition. There were no marked differences between the groups in either ADL or iADL at six and 24 months' follow-up.

Hospitalisation and institutionalisation

Data were reported on length of hospital stay in five of 13 trials (Duncan 2006; Hickson 2004; Holyday 2012; Johansen 2004; Olofsson 2007). Two trials evaluated the impact of dietetic assistants in a hospital setting (Duncan 2006; Hickson 2004), two evaluated a multi-disciplinary team intervention in hospital (Olofsson 2007; Johansen 2004) and one evaluated a protocol-driven pathway in hospital (Holyday 2012). There were no marked differences between groups in length of hospital stay in four trials (Duncan 2006; Hickson 2004; Holyday 2012; Johansen 2004). In the other trial (Olofsson 2007) the group receiving a multidisciplinary team intervention had a shorter mean length of hospital stay than the group receiving usual care (27.4 days (SD 15.9) in the intervention group and 39.8 days (SD 41.9) in the usual care group (P < 0.05) (Table 14). Data on hospital readmissions were reported in one of 13 trials (Holyday 2012). The group receiving a protocol-driven pathway for the management of nutrition whilst in hospital had fewer hospital readmissions than the group receiving usual care (30/71 (42%) versus 37/72 (51%) respectively) but the difference between the groups was not statistically significant.

Adverse events

No trial reported data on this outcome.

All-cause mortality

Data were reported on this outcome in five of 13 trials (Duncan 2006; Hickson 2004; Holyday 2012; Olofsson 2007; Salva 2011). Two trials evaluated the impact of dietetic assistants in a hospital setting (Duncan 2006; Hickson 2004), one evaluated specialist training for free-living individuals with dementia (Salva 2011), one evaluated a multi-disciplinary team intervention in hospital (Olofsson 2007) and one evaluated a protocol-driven pathway in hospital (Holyday 2012). There were no marked differences between groups in mortality in four trials (Hickson 2004; Holyday 2012; Olofsson 2007; Salva 2011), whereas in the other trial (Duncan 2006) there was a lower mortality at four months in the group receiving the intervention from dietetic assistants compared with the group receiving usual care (19/145 (13%) versus 36/157 (23%), P = 0.036) (Table 14).

Economic costs

Data on this outcome were reported in two of 13 trials (Holyday 2012; Salva 2011). One trial (Holyday 2012) evaluated the impact of a protocol-driven pathway for the management of nutritional care in hospital patients and the other trial (Salva 2011) evaluated specialist training for carers of free-living individuals with dementia. In one trial (Holyday 2012) the data on cost savings are based on reductions in length of stay achieved. There was no marked difference in length of stay overall between groups. There was a shorter length of stay by eight days in the subgroup of 32 malnourished participants (12 in the intervention group and 20 in the usual care group). These data were used to estimate a cost savings of AUD 63,360 from treating malnutrition in the group of 12 malnourished participants based on the cost per hospital bed per day, the cost of the dietitians' time and the average cost of a commercial oral nutritional supplement. The trial by Salva 2011 collected data on resource utilisation but the data were not reported. Neither trial used accepted health economic methods and the reported data on both costs and effectiveness were generally poor.

Changes to the feeding environment

Primary outcomes

Nutritional intake

Data were reported on energy intake in three of five trials (Brouillette 1991; Mathey 2001a; Nijs 2006). Two trials evaluated the impact of changes to the dining room environment (Mathey 2001a; Nijs 2006) and one evaluated a pre-meal sensory stimulation intervention (Brouillette 1991). All trials assessed energy intake and were conducted in people in residential care. There were no marked between-group differences in energy intake in any trial (Table 15).

Health-related quality of life and patient satisfaction

Data were reported on health-related quality of life in two of five trials (Mathey 2001a; Nijs 2006). One trial (Mathey 2001a) used the Sickness Impact Profile (SIP) (Gilson 1975), and Philadelphia Geriatric Center Morale Scale (PGCMS, 17 items) (Lawton 1972) to assess health-related quality of life.The SIP is a validated generic health status measure of change in behaviour as a consequence of illness . It includes 136 items describing activities of daily

living (ADL), divided into 12 categories: sleep and rest, eating, work, home management, recreation and pastimes, ambulation, mobility, body care and movement, social interaction, alertness behaviour, emotional behaviour, and communication. Patients endorse statements that best describe them that day and are related to their health. Items are scored on a numeric scale, with higher scores reflecting greater dysfunction. The mean SIP score in the usual care declined more (-13% (SD 12), P < 0.05) than in the experimental group (-2% (SD 11)). The PGCMS is a multidimensional approach to assessing the state of psychological well-being of older people. It measures perceived morale in elderly people through three factors: agitation, attitude toward own aging and 'lonely satisfaction'. Each high-morale response receives a score of '1' and each low-morale response a score of '0', so that the total score ranges from 0 to17. As a general guideline, scores between 13 to17 would be considered high scores on the morale scale, 10 to 12 fall within the mid-range and scores under 9 are at the lower end. Mean changes in the PGCMS scores were relatively stable for both groups with -2% (SD 19) for the usual care, and -3% (SD 20) for the experimental group. In the trial by Nijs 2006, health-related quality of life was assessed in a face-to-face interview using the Dutch health-related quality of life of somatic nursing home residents questionnaire which is a validated questionnaire consisting of five sub-scales, each representing a quality of life dimension: sensory functioning (focusing on pain); physical functioning (perceived performance and self-care); psychosocial functioning (depression or loneliness); perceived autonomy (freedom of movement); and perceived safety (feeling at home in the institution). The number of statements in the five sub-scales is not equal. The questionnaire consists of 50 statements, scored on a dichotomous scale (yes or no). Each sub-scale and the total questionnaire is computed to achieve a score from 0 to 100. A high score represents a high quality of life. There was a difference between groups in overall quality of life (6.1 units, 95% CI 2.1 to 10.3). The intervention group remained stable (0.4 units, 95% CI 1.8 to 2.5), whereas the usual care declined (-0.5 units, 95% CI -9.4 to 0.6), although the overall changes were small (Table 16).

No trial reported data on patient satisfaction.

Morbidity/complications

No trial reported data on this outcome.

Secondary outcomes

Nutritional status

Weight change

Data were reported on this outcome in three of five trials (Mathey 2001a; Nijs 2006; Remsburg 2001), all of which were trials evaluating the impact of changes to the dining environment. There were no marked differences between intervention and usual care groups in mean weight change in any of the trials (Table 17).

Change in BMI

No trial reported data on this outcome.

Change in TSF

No trial reported data on this outcome.

Change in MAC

Data were reported on this outcome in one of five trials (Nijs 2006). The trial evaluated the impact of providing family-style meals in residential care homes. There was no marked difference in change in MAC between the groups, MD between groups was 0.5 cm (95% CI -0.2 to 1.3)

Clinical function

No trial reported data on this outcome.

Hospitalisation and institutionalisation

No trial reported data on this outcome.

Adverse events

No trial reported data on this outcome.

All-cause mortality

Data were reported on this outcome in three of five trials (Brouillette 1991; Mathey 2001a; Nijs 2006). Two evaluated the impact of changes to the dining room environment (Mathey 2001a; Nijs 2006) and one of pre-meal sensory stimulation (Brouillette 1991). There were no marked differences between groups in death from any cause in any trial (Table 18).

Economic costs

No trial reported data on this outcome.

Modification of meal profile or pattern

Primary outcomes

Nutritional intake

Data were reported on energy intake in 11 of 12 trials (Barton 2000; Bouillanne 2013; Castellanos 2009; Essed 2007; Essed 2009; Germain 2006; Leslie 2012; Mathey 2001b; Munk 2014; Silver 2008; Taylor 2006). Four trials evaluated the impact of food fortification, two in hospital (Barton 2000; Munk 2014), one in a care home (Leslie 2012) and one in free-living individuals receiving home-delivered meals (Silver 2008), one trial evaluated the impact of modifications to meal delivery in an intermediate care home (Bouillanne 2013), two trials evaluated modifications to meal delivery in residential care homes (Germain 2006; Taylor 2006), and three evaluated flavour modification in residential care homes (Essed 2007; Essed 2009; Mathey 2001b). There were no marked differences in mean change in energy intake between groups in five trials (Bouillanne 2013; Essed 2007; Essed 2009; Mathey 2001b; Taylor 2006). Three trials reported higher energy intakes in the intervention group of between 300 to 500 kcal/day, two of which were trials of food fortification in either hospital or in free-living individuals (Barton 2000; Silver 2008) and one was of a modification to meal delivery involving improved presentation of pureed foods to participants with dysphagia (Germain 2006). In the randomised cross-over trial by Castellanos 2009, between-group differences were not reported however data were presented for a post hoc analysis of 'big' eaters (overall intake 1150 kcal or more a day) and 'small' eaters (overall intake less than 1150 kcal a day) (data not reported in the table). Data were presented as mean intake from both fortified and non-fortified food items at each meal under each of three menu conditions (Table 19).

Health-related quality of life and patient satisfaction

Data on health-related quality of life were reported in one trial (Smoliner 2008). The physical functioning component of the validated medical outcomes Study 36-item Short Form (SF-36) were reported (Ware 1992). The SF-36 is a participant-completed validated questionnaire to assess eight different domains of health (vitality, physical functioning, bodily pain, general health perception, physical function, emotional role function, social role function and mental health). The SF-36 consists of eight scaled scores, which are the weighted sums of the questions in their section. Each scale is directly transformed into a 0 to 100 scale on the assumption that each question carries equal weight. The lower the score the poorer the quality of life. The higher the score the better the quality of life, that is, a score of zero is equivalent to poorest quality of life and a score of 100 is equivalent to optimal quality of life.
Baseline to follow-up (12 weeks) score in the intervention group receiving the fortified diet changed from a mean of 17.1 (SD 22.7) at baseline to a mean of 10.7 (SD 15.6) at 12 weeks (P = 0.047), and in the usual care from 24 (SD 24.3) at baseline to 13.6 (SD 13.9) at 12 weeks (P < 0.0001), however the between-group differences were not statistically significant.

No trial reported data on patient satisfaction.

Morbidity/complications

Data on the number of participants experiencing complications were reported in one of twelve trials (Bouillanne 2013) which evaluated the impact of modifications to meal composition in people in intermediate care. There was no marked difference between the intervention and usual care in the number of infectious complications experienced by participants included in the intention-to-treat analysis (1 of 29 participants in the intervention group and 2 of 34 participants in the usual care group).

Secondary outcomes

Nutritional status

Weight change

Data on this outcome were reported in seven of 12 trials (Bouillanne 2013; Essed 2007; Germain 2006; Leslie 2012; Mathey 2001b; Munk 2014; Smoliner 2008). Three trials evaluated the impact of food fortification, one in hospital (Munk 2014) and two in a residential care home (Leslie 2012; Smoliner 2008), one evaluated modification to meal composition in an intermediate care setting (Bouillanne 2013), one evaluated modifications to the presentation of food in a residential care home (Germain 2006) and two evaluated flavour modifications in residential care homes (Essed 2007; Mathey 2001b). There were no marked differences in mean weight change between groups reported in three trials (Bouillanne 2013; Essed 2007; Smoliner 2008). Three trials reported higher weight gain in the intervention group compared with the usual care. One was a trial of food fortification in residential care (Leslie 2012) (1.3 kg (SE 0.53) in the intervention group versus -0.2 kg (SE 1.5) in the control group, P = 0.03. The second was a trial of modification to meal presentation (Germain 2006) (3.9 kg (SD 2.3) in the intervention group versus -0.8 kg (SD 4.2) in the usual care. The other trial evaluated the impact of flavour enhancement in people in a residential care home (Mathey 2001b) (1.1 kg (SD 1.3) in the intervention group versus -0.3 (1.6) in the usual care, P < 0.05) (Table 20).

Change in BMI

Data on this outcome were reported in three of 12 trials (Germain 2006; Leslie 2012; Smoliner 2008). One evaluated the impact of modification to meal presentation in people in residential care (Germain 2006) and the others evaluated food fortification in people in residential care (Leslie 2012; Smoliner 2008). In one trial (Smoliner 2008) there was no marked difference between the groups in change in BMI. The group receiving modification to the presentation of meals in Germain 2006 and the group receiving fortified meals in Leslie 2012 experienced a greater increase in BMI than those receiving usual care but the between-group difference was not reported (Table 20).

Change in TSF

No trial reported data on this outcome.

Change in MAC

One trial of meal fortification in people in residential care reported data on this outcome (Leslie 2012). Participants in the intervention group experienced a greater improvement in MUAC than those in the control group (mean change 0.4 mm (SE 0.16) in the intervention group and -0.1 mm (SE 0.3) in the control group, P = 0.019.

Clinical function

Data on handgrip strength were reported in three of 12 trials (Bouillanne 2013; Munk 2014; Smoliner 2008). One trial evaluated the impact of modification to meal composition in people in intermediate care (Bouillanne 2013) and the others evaluated food fortification in people in hospital (Munk 2014) and in residential care (Smoliner 2008). There were no differences between the intervention and usual care groups in either trial (Table 21). The trial by Bouillanne 2013 also assessed change in ADL score (Sonn 1996) and there was no marked difference between the groups (Table 21). In the trial by Smoliner 2008 clinical function was also assessed by peak flow and the Barthel index .The peak flow (L/min) in the intervention group increased from baseline to follow-up (12 weeks) in the intervention group (mean 152 (SD 105) to 186 (SD 140)) whereas the usual care group showed a decline (mean 151 (SD 90) to 150 (SD 67)). The differences observed between groups were statistically significant (P = 0.039). The mean change in Barthel score was -15.2 (SD 18.5) in the group receiving fortification of food and -7.5 (SD 10.4) in the group receiving usual care. The between-group differences were not statistically significant.

Hospitalisation and institutionalisation

One trial of food fortification of menu items provided via an a la carte menu reported data on length of hospital stay (Munk 2014). There were no differences in mean length of stay between groups in from trial inclusion to discharge from hospital (mean 10 days (SD 8) in the intervention group and mean 10 days (SD 8) in the control group, between-group difference, 0.6 days (95% CI -3 to 4, P = 0.73).

Adverse events

No trial reported data on this outcome.

All-cause mortality

Data on this outcome were reported in four of 12 trials (Bouillanne 2013; Leslie 2012; Munk 2014; Smoliner 2008). The number of

deaths were small in each trial and there were no marked differences between groups (Table 21).

Economic costs

No trial reported data on this outcome.

Additional supplementation of meals

Primary outcomes

Nutritional intake

Data were reported on energy intake in eight of 10 trials (Beck 2002; Bourdel-Marchasson 2000; Faxen-Irving 2011; Hankey 1993; Potter 2001; Simmons 2008; Simmons 2010; Van den Berg 2015). Three trials evaluated the impact of supplementation with food in residential care homes (Beck 2002; Simmons 2008; Simmons 2010), four evaluated supplementation with oral nutritional supplements in hospital (Bourdel-Marchasson 2000; Faxen-Irving 2011; Potter 2001; Van den Berg 2015) and two evaluated supplementation with oral nutritional supplements in residential care homes (Hankey 1993; Simmons 2010). One trial provided both a food-based intervention and oral nutritional supplements in participants in residential care homes (Simmons 2010). There were no marked differences reported in energy intake between groups in either the trials of food-based interventions or the trials of oral nutritional supplement-based interventions (Table 22). In the trial by (Hankey 1993) the group receiving oral nutritional supplements had an energy intake 600 kcal greater than the usual care group (1747 kcal (SD 273) versus 1147 kcal (SD 310) respectively), However, between-group statistical tests were not reported. In the trial by Van den Berg 2015 participants receiving oral nutritional supplements in four 62 mL portions during the drug round had a significantly higher energy intake than those receiving supplements in the conventional, between-meal style.

Health-related quality of life and patient satisfaction

Data on health-related quality of life were reported in one trial (Dennis 2005) undertaken in people with stroke supplemented with oral nutritional supplements during hospitalisation. Health-related quality of life was measured in 77% (N = 3086) of participants using EUROQoL score (EQ-5D) (EuroQol group 1990). The questionnaire comprises five questions on mobility, self-care, pain, usual activities and psychological status with three possible answers for each item (1 = no problems, 2 = moderate problems, 3 = severe problems). An overall utility score is calculated based on these domains, with a range score from 0 (worse health scenario) to a maximum of 1.0 (best health scenario). An additional visual analogue scale (VAS, scale 0 to 100) was used to assess general health status with 100 indicating the best health status. No marked differences were identified between the intervention and usual care groups (Table 23).

No trial reported data on patient satisfaction.

Morbidity/complications

The incidence of, and number of people with, pressure ulcers was reported in two trials (Bourdel-Marchasson 2000; Dennis 2005) and the total number of complications was reported in one trial (Dennis 2005). Both trials were of supplementation of participants with oral nutritional supplements in hospital. There was no marked difference between groups in cumulative incidence of, or number of participants with, pressure ulcers in either trial (Table 23). In the trial by Dennis 2005 there was no marked difference in total complications between groups (Table 23).

Secondary outcomes

Nutritional status

Weight change

Data on this outcome were reported in seven of 10 trials (Beck 2002; Faxen-Irving 2011; Hankey 1993; Larsson 1990; Potter 2001; Simmons 2008; Simmons 2010). Three trials evaluated the impact of supplementation with food in residential care settings (Beck 2002; Simmons 2008; Simmons 2010), two evaluated supplementation with oral nutritional supplements in hospital (Faxen-Irving 2011; Potter 2001) and three evaluated supplementation with oral nutritional supplements in long-term care settings (Hankey 1993; Larsson 1990; Simmons 2010), with the trial by Simmons 2010 providing data on both food and oral nutritional supplements. There were no marked differences in weight change between groups receiving food-based or oral nutritional supplement-based interventions in six trials (Beck 2002; Faxen-Irving 2011; Hankey 1993; Larsson 1990; Potter 2001; Simmons 2010). In two trials (Faxen-Irving 2011; Hankey 1993), the groups receiving oral nutritional supplements gained weight and the usual care group lost weight overall. However, the between-group differences and the results of statistical tests were not reported. In one trial (Simmons 2008) the intervention group gained 4 lbs more in weight than the group receiving usual care (P = 0.009) (Table 24).

Change in BMI

Data on this outcome were reported in two of 10 trials (Faxen-Irving 2011; Simmons 2008), both trials evaluated the impact of supplementation with oral nutritional supplements in hospital. In one trial (Faxen-Irving 2011) BMI was reported according to group at the end of the intervention and there was no marked difference between groups. Change from baseline and between-group differences were not reported. In the other trial by (Simmons 2008) the intervention group gained 0.72 kg/m^2 more than the group receiving usual care (P < 0.009) (Table 24).

Change in TSF

Data on this outcome were reported in two of 10 trials (Hankey 1993; Larsson 1990), both of which evaluated the impact of supplementation with oral nutritional supplements in long-term care settings. In each trial data were presented in figures with minimal description in the text. In one trial (Hankey 1993) the intervention group was described as experiencing a smaller decrease in TSF than the usual care group (6.6% versus 15.8%). In the other trial (Larsson 1990) TSF decreased over the 26 weeks of follow-up with the greatest decrease occurring in the usual care group. In another trial (Potter 2001) TSF is described as an outcome but the data were not reported.

Change in MACe

Data on this outcome were reported in three of 10 trials (Hankey 1993; Larsson 1990; Potter 2001), all of which evaluated the impact of supplementation with oral nutritional supplements in either hospital or long-term care settings. In one trial (Hankey 1993), the data were unavailable from the original trial report but we have obtained them from a systematic review by Milne 2009. We read the figures for change from a graph and assumed SD of change to be

10 cm for each group. MAC is described as improving statistically significantly in the intervention group (P < 0.05) but remaining unchanged in the usual care group. The changes are small and no between-group differences were reported (Table 24). In the trial by Larsson 1990 the data were presented in a figure with some description in the text, participants who were well nourished at the start of the trial and received supplementation of meals experienced less of a decrease in MAC at 26 weeks (P < 0.05) than those receiving usual care. In participants who were malnourished at the start of the trial both groups experienced a decrease in MAC to 26 weeks. In the final trial (Potter 2001), there was no marked difference between groups in MAC (Table 24).

Clinical function

Data on clinical function were reported in two of ten trials (Faxen-Irving 2011; Potter 2001), both evaluating the impact of supplementation with oral nutritional supplements in hospital. In one trial (Faxen-Irving 2011) the group receiving oral nutritional supplements changed from being dependent in all five functions to being dependent in only one function as assessed by ADL (Katz 1963). However, no marked change was identified in those receiving usual care (P = 0.011). Mean change (SD) in ADL score according to group was not markedly different between groups (2.95 (SD 2.2) intervention and 4.1 (SD 2.2) control, P = 0.09). In the other trial (Potter 2001) there was no statistically significant difference in numbers achieving functional recovery assessed using the Barthel index in the group receiving supplementation compared with the usual care group (102/149 (68%) intervention versus 100/157 (64%) control, P = 0.38). However, significantly more participants classified as severely undernourished experienced an improvement in their Barthel scores on supplementation compared with those who received usual care (17/25 (68%) intervention versus 11/28 (39%) control, P < 0.04).

Hospitalisation and institutionalisation

Data on length of hospital stay were reported in four of 10 trials (Dennis 2005; Faxen-Irving 2011; Potter 2001; Van den Berg 2015) all of which evaluated the impact of supplementation of meals with oral nutritional supplements in hospital. There were no marked differences in length of hospital stay between groups in any trial (Table 25).

One trial of supplementation with oral nutritional supplements in hospital reported data on hospital re-admissions (Van den Berg 2015). The number of re-admissions to hospital were higher in intervention group 2, but these data were not commented on by the trial authors (13 participants in intervention group 1, 24 participants in intervention group 2 and 15 participants in the control group being readmitted to hospital). One trial reported on the destination of participants at discharge according to group allocation (Potter 2001). There was no marked difference between groups in numbers of participants returning to their own home and those being discharged to an institution (Table 25).

Adverse events

Data on this outcome were reported in three of nine trials (Faxen-Irving 2011; Hankey 1993; Dennis 2005), one of which reported intolerance to the oral nutritional supplement (e.g. diarrhoea or vomiting, N = 5) (Faxen-Irving 2011). Another trial (Dennis 2005) reported that 28% stopped taking the oral nutritional supplement due to participant refusal or because of dislike of taste, unwanted weight gain, or feelings of nausea. The trials by Potter 2001 and Van den Berg 2015 reported no adverse events.

All-cause mortality

Data on this outcome were reported in five of 10 trials (Bourdel-Marchasson 2000; Dennis 2005; Larsson 1990; Potter 2001: Van den Berg 2015). Four trials evaluated the impact of supplementation with oral nutritional supplements in hospital (Bourdel-Marchasson 2000; Dennis 2005; Potter 2001; Van den Berg 2015) and one evaluated supplementation with oral nutritional supplements in a long-term care setting (Larsson 1990;). There was no marked difference in death from any cause between groups in any of the trials (Table 25).

Economic costs

Data on this outcome were reported in one trial (Simmons 2010). The cost effectiveness of the intervention was determined from data on cost per serving of the oral nutritional supplement or food provided and staff time to encourage and assist consumption. The average costs (per person per day) were significantly higher in groups receiving supplements and snacks compared with those in the usual care group (USD 2.10 versus USD 2.06 versus USD -0.03 respectively). The trial did not use accepted health economic methods and the reported data on both costs and effectiveness were generally poor.

Home meal delivery systems

Primary outcomes

Nutritional intake

No trial data were reported on this outcome.

Health-related quality of life and patient satisfaction

No trial data were reported on this outcome.

Morbidity/complications

No trial data were reported on this outcome.

Secondary outcomes

Nutritional status

Weight change

Data on this outcome were reported in the one trial in this group (Kretser 2003). The group receiving modified meals-on-wheels experienced a weight gain of 1.6 kg (SD 4.6) compared to the group receiving standard meals-on-wheels who had an overall weight gain of 0.7 kg (SD 3.3) (Table 26). No statistical tests were conducted on the between-group differences.

Change in BMI

No trial data were reported on this outcome.

Change in TSF

No trial data were reported on this outcome.

Change in MAC

No trial data were reported on this outcome.

Clinical function

The one trial in this group reported data on ADL and iADL (Kretser 2003). No marked differences were identified in the number experiencing a decline (4/22 versus 8/24) or improvement (3/22 versus 2/24) in ADL between groups receiving modified meals-on-wheels, and groups receiving traditional meals-on-wheels. However, there was a greater number of participants experiencing a decline in iADL in those receiving traditional meals on wheels (16/24) compared with those receiving modified meals on wheels (8/22) at six months (P = 0.0494).

Hospitalisation and institutionalisation

No trial data were reported on this outcome.

Adverse events

No trial data were reported on this outcome.

All-cause mortality

Data on this outcome were reported in the one trial in this group (Kretser 2003). The number of deaths from any cause were similar in each group (Table 26). No statistical tests were conducted on the between-group differences.

Economic costs

No trial reported data on this outcome.

DISCUSSION

Summary of main results

The aim of this review was to look for an effect of supportive interventions to enhance dietary intake in nutritionally vulnerable adults on patient-centred, nutritional, clinical and economic outcome. We identified 41 trials and categorised them into five broadly similar types of intervention. Meta-analysis was only possible for the outcome measures all-cause mortality, hospitalisation and nutritional status (weight change) showing a possible effect in favour of supportive dietary interventions for all-cause mortality and nutritional status. These findings should be interpreted with caution as few trials reported data on the outcomes of interest, and the quality of the evidence was between moderate to very low, depending on the outcome measurement. A number of patient-important outcomes were measured by just a few trials, for example, health-related quality of life and patient satisfaction. With regard to health-related quality of life only one of the five trials that reported this outcome suggested benefits associated with the intervention. Although the two trials that measured patient satisfaction reported benefits in those receiving the intervention it should be noted that both trials used unvalidated questionnaires and are potentially subject to the limitations inherent in collecting these types of data, for example, participants need to be literate to complete the questionnaire, blinding may not be possible.

Until there are more large trials of higher methodological quality, evaluating the impact of similar interventions in similar patient groups, the effects of supportive interventions on nutritional, clinical, patient-centred and healthcare outcomes cannot be fully evaluated.

Overall completeness and applicability of evidence

The trials identified for this review represent a wide range of interventions given with the aim of improving intake in nutritionally vulnerable individuals. Interventions took place in a variety of settings, residential care, hospital and outpatients. Although 21 of 41 included trials took place in residential care, the results of the meta-analyses were dominated by large trials conducted in hospitals. It is particularly important to consider that the relevance of different outcomes are likely to differ between settings; most of the data for the outcome of all-cause mortality came from trials recruiting hospital inpatients. Many of the interventions identified were similar to those recommended in policy and guideline documents on the prevention and management of malnutrition (BAPEN 2012; RCON 2008; The Malnutrition Task Force 2013). Despite the comprehensive range of interventions identified in this review, no RCTs were found for some widely used interventions, specifically protected meal times and the use of red trays to identify those requiring mealtime assistance. Examples of good practice reported in these key documents (BAPEN 2012; RCON 2008; The Malnutrition Task Force 2013) are frequently justified on the basis of their potential impact on patient experience and on staff awareness and motivation. These sorts of outcomes are rarely reported in trials, and therefore are not included in systematic reviews and meta-analyses. The key finding of this review is that there is a lack of evidence to support these interventions and good quality RCTs are urgently needed to inform the widespread implementation of these initiatives. While there is limited evidence on adverse events, nutritional interventions are generally assumed to be safe. However, the impact of implementing and maintaining such interventions at an organisational and unit level has not been evaluated. For example, there are likely to be significant costs in terms of finance, time and resources associated with setting up and maintaining a staff training programme, yet these data are rarely reported. In this review we found very limited data on costs and no formal health economic analyses from which to draw conclusions.

During searching for this review a number of trials were identified that met the inclusion criteria for types of participants and interventions, however they were non-randomised trials. The reasons for the weaker methodology used in many trials can only be speculated on, and may result from lack of funding, lack of research expertise, concern about the ethics of not providing all participants with an intervention perceived as 'beneficial', and practicalities related to the care setting. This underlines the need for adequate funding of trials with more robust designs (e.g. cluster-randomised controlled trials with adequate planning, analysis and data especially on intracluster correlation coefficients) to enable a fuller understanding of the potential impact of supportive interventions.

Quality of the evidence

The quality of evidence in this review is between moderate to very low, depending on the outcome measurement. The main issue regarding risk of bias was that although attrition was usually reported clearly and there was little evidence of selective reporting, random sequence generation, concealment of allocation and blinding were frequently unclear. Most trials were small and inadequately powered to answer the question. Although there was significant performance bias, the nature of the included interventions and the settings in which they were undertaken, primarily care homes and hospital wards, means that it is unlikely

that participants in the usual care arms were able to get access to the intervention. The possible exceptions to this are the trials by Pivi 2011 and Salva 2011, where a training intervention was provided to carers of people with Alzheimers disease living at home. In this case, it might have been possible for the carers allocated to the usual care group to seek out the information provided to those in the intervention group. Interestingly, the effect size in the trial by Pivi 2011, was significantly different from others in that grouping.

A meta-analysis and GRADE approach was only possible for the outcome measures all-cause mortality, length of hospital stay and weight change. These outcomes showed moderate-quality evidence (all-cause mortality, nutritional status) and very low-quality evidence (hospitalisation), mainly because of the small number of included trials and issues of imprecision and indirectness, as well as inconsistency.

Potential biases in the review process

The protocol developed prior to undertaking this review was followed closely, throughout the process and particularly during the trial selection stage when three review authors were involved in detailed discussion**.** The original search strategy for this review was comprehensive in that we searched 10 databases, including databases other than those most commonly used (Avenell 2001) and we did not place any language restrictions on searches. We undertook additional searching, for example hand searching of the abstracts of meetings, reference lists of identified trials and extensive searching of the reference lists of relevant systematic reviews. In addition, we made considerable efforts to contact authors of included studies, where clarification of data or methodology were required. However, we did not survey study authors to identify additional reports of trials that may have been missed, which has to be acknowledged as a potential source of bias.

There was considerable clinical heterogeneity across all trials contributing to the findings in this review. At the trial selection stage and during categorisation of trials into sub-groups, care was taken to group trials with similar interventions and populations together. It is possible that interventions judged to be similar, varied according to factors that are currently impossible to identify. For example, the trials evaluating the training of carers or dietetic assistants to deliver improved nutritional care resulted in different effects which may be attributable to a number of factors such as the quality of training, the level of attention provided by individual carers, constraints of the care setting, or indeed to the clinical characteristics of the trial populations. It was not possible to undertake many of the proposed subgroup analyses due to an absence of data. In addition, 12 of 41 (30%) trials included in this review were cluster-randomised trials. Inadequate analysis methods used in these trials, which failed to account for the likelihood of similarity of participants within clusters and correlation of observations within clusters meant that these trials were excluded from the meta-analyses. We cannot rule out the possibility that inclusion of data from these 12 trials in the meta-analyses might change the overall findings.

Agreements and disagreements with other studies or reviews

The authors are aware of four published reviews of similar interventions (Cole 2012; Lambert 2010; Silver 2009; Weekes 2009), two of which employed systematic search strategies to identify trials (Cole 2012; Weekes 2009). All of the reviews looked at similar groupings of interventions (e.g. feeding assistance, changes to eating environment, staff training) and indeed included some of the trials identified in this review. They also included trials of weaker methodological quality (e.g. non-randomised controlled trials), excluded from this review.

One review (Weekes 2009) arrived at a similar conclusion to this one, that there was a serious lack of evidence to support interventions designed to improve nutritional care. The other three focused on positive results from individual trials.

To the review authors' knowledge, this is the first attempt at a systematic review with meta-analyses, the results of which reveals lack of good evidence for supportive interventions. While the protocol specified outcome measures that are frequently assessed in nutrition intervention trials, the review authors question whether these are the most appropriate outcomes to assess the benefits of supportive interventions. Existing reports of supportive interventions similar to the ones identified in this review, have speculated on their benefits in terms of patient experience, staff awareness and motivation. These may be more relevant outcome measures for interventions of this type, which may explain the lack of trials for interventions such as the use of red trays, or protected meal times, since the primary intention was to improve the patient experience.

The review authors note however, that the explicit aim of all the trials included in this review was to increase dietary intake, and thus influence clinical outcome.

AUTHORS' CONCLUSIONS

Implications for practice

There is moderate-quality evidence that supportive interventions to improve nutritional care improve nutritional status such as minimal weight gain or energy intake. Moderate-quality evidence shows that supportive interventions can reduce the risk of all-cause mortality, based mainly on studies recruiting hospital inpatients. There was very low-quality evidence to suggest adverse effects maybe associated with the interventions. Therefore, whilst some of these interventions are advocated at a national level, clinicians should recognise the lack of clear evidence to support their role across different settings.

Implications for research

This review revealed a lack of good quality randomised controlled trials evaluating the effect of supportive interventions. However, even small effects such as a potential reduction in all-cause mortality could result in relevant public health effects given the number of affected malnourished or nutritionally at-risk individuals. As these interventions remain in common use and are actively promoted at a national level, research is urgently needed. This review has identified a range of interventions that may benefit nutritionally vulnerable individuals and highlights the importance of assessing patient-important outcomes in different healthcare settings in future research.

The nature of the interventions being examined in the studies included in this review means that cluster-randomised trials are likely to be the method of choice because of the need to study the effects of interventions in groups of patients rather than

individuals. Attention should be given to the reporting of cluster-randomised trials to take into consideration the correlation of observations within clusters and authors should account for the potential bias inherent in these trials when analysing and reporting results. Cluster level analyses, analyses of individual level data that are adjusted for the design effect, or regression analyses of individual level data using methods for clustered data are all valid approaches (McKenzie 2014).

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* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Barton 2000

Methods	**Cross-over randomised controlled clinical trial:** this trial included 3 groups, 2 of which were randomised to treatment or control and one other where it was unclear whether there was randomisation **Randomisation ratio:** not stated but appears to be 1:1 **Superiority design**
Participants	35 participants (27 randomised to intervention or control, 8 received cooked breakfast), 13 male, 22 female, mean age 75-78 depending on group; no details of nutritional status at baseline **Inclusion criteria**: not stated

Barton 2000 *(Continued)*

	Exclusion criteria: not stated **Diagnostic criteria**: elderly hospitalised patients in a rehabilitation ward, 19 of 35 had had a stroke
Interventions	Portion size decreased by 20% but fortified to achieve overall daily energy provision increased by 200 kcal versus normal hospital menu. An additional group given normal hospital menu plus cooked breakfast **Number of trial centres**: 1 **Treatment before trial:** not stated but assume normal hospital diet
Outcomes	**Outcomes reported in abstract of publication**: food wastage, energy and protein intake
Study details	**Location:** Nottingham, UK **Year:** unclear **Setting:** 22-bedded rehab ward **Was trial terminated early**: no
Publication details	**Language of publication:** English **Funding:** not stated **Publicaton status:** peer review journal
Stated aim for study	Quote from publication: "To compare food wastage and intake between the normal hospital menu and one where more energy dense, but smaller portions were provided"
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Quote from publicati**on: "randomly allocated to receive either normal menu or reduced portion fortified menu". **Comment:** no details whether the third group was included in the randomisation & insufficient detail provided of randomisation method
Allocation concealment (selection bias)	Unclear risk	**Comment:** no information provided
Blinding of participants and personnel (performance bias) All outcomes	Low risk	**Quote from publication:** "patients and staff were blind as to which menu each patient was following" **Comment:** those receiving the cooked breakfast rather than cereal could not have been blinded
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	**Comment:** no information provided
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	**Comment:** no detailed information provided. Data on 19 of 27 randomised participants provided but no information on attrition
Selective reporting (reporting bias)	Low risk	**Comment:** data presented on all three stated outcomes

Barton 2000 *(Continued)*

Other bias	Unclear risk	**Comment:** no information on baseline characteristics of populations apart from age and gender

Beck 2002

Methods	**Parallel randomised controlled clinical trial** **Randomisation ratio:** 1:1:1 **Superiority design**
Participants	36 care home residents; 14 male; 22 female; mean age 81 (range 76-86) years **Inclusion criteria**: resident in a care home; aged > 65 years **Exclusion criteria**: in terminal condition **Diagnostic criteria**: not specified
Interventions	Home-made oral supplement (240 kcal/serving) provided in the evening **Number of trial centres**: 1 **Treatment before trial:** none
Outcomes	**Outcomes reported in abstract of publication**: energy intake and body weight
Study details	**Run-in period:** none **Was trial terminated early**: no
Publication details	**Language of publication:** English **Funding:** non-commercial funding - Health Insurance Foundation Grant **Publication status:** peer review journal
Stated aim for study	Quote from publication: "To examine the effect of a home-made oral supplement on body weight and energy intake of old people residing in a nursing home with MNA scores less than or equal to 23.5"
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Quote from paper:** "Participants....were randomly allocated (block randomization) to two groups" **Comment:** insufficient detail of method provided
Allocation concealment (selection bias)	Unclear risk	**Comment:** not described
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	**Comment:** not described

Beck 2002 *(Continued)*

Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	**Comment:** not described
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	**Comment:** not fully described
Selective reporting (reporting bias)	Low risk	**Comment:** all outcomes reported
Other bias	Unclear risk	**Comment:** not fully described

Bouillanne 2013

Methods	**Parallel randomised controlled clinical trial** **Randomisation ratio:** 1:1 **Superiority design**
Participants	73 hospitalised elderly; 46 female; 27 male; mean age intervention 84.1 (95% CI 82 to 86); control 85.7 (95% CI 84 to 88) years **Inclusion criteria**: albumin 25-35 g/L; BMI < 22 kg/m^2 and/or weight loss > 10% in 6 months and/or MNA $\leq$ 23.5 **Exclusion criteria**: not specified **Diagnostic criteria**: admitted to geriatric intermediate care unit
Interventions	**Number of trial centres**: 1 **Treatment before trial:** none Pulse diet i.e. 78% daily protein requirements provided at noon meal
Outcomes	**Outcomes reported in abstract of publication**: body composition, handgrip strength and ADL score
Study details	**Run-in period:** none **Was trial terminated early**: no
Publication details	**Language of publication:** English **Funding:** non-commercial funding - French Ministry of Health **Publication status:** peer review journal
Stated aim for study	Quote from publication: "To evaluate the efficacy of a new nutritional strategy, termed protein pulse feeding"
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement

Bouillanne 2013 *(Continued)*

Random sequence generation (selection bias)	Unclear risk	**Quote from paper:** "A randomization procedure was used (EXCEL 2003....." **Comment:** insufficient detail of the method provided
Allocation concealment (selection bias)	Unclear risk	**Comment:** not described
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	**Comment:** not described
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	**Comment:** not described
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** all participants fully accounted for
Selective reporting (reporting bias)	Low risk	**Comment:** all outcomes fully reported
Other bias	Low risk	**Comment:** baseline characteristics fully compared; serum albumin higher and body cell mass index and skeletal muscle mass index are lower in the pulse diet group

Bourdel-Marchasson 2000

Methods	**Cluster-randomised controlled clinical trial** **Randomisation ratio:** 1:1 **Superiority design**
Participants	672 critically ill elderly participants; N = 295 intervention (199 female, 96 male); N = 377 control (238 female, 139 male). Mean age in intervention group = 83.6 yrs (SD 7.3) and mean age in the intervention group = 83.0 yrs (SD 7.1) **Inclusion criteria**: wards inclusion: > 40% of participants over age 65 yrs and nurses able to guarantee significant involvement in the trial. Older than 65 yrs, in acute phase of a critical illness, unable to move by themselves, unable to eat independently on admission **Exclusion criteria**: pressure ulcers at admission **Diagnostic criteria**: critically ill inpatients
Interventions	Intervention group received standard diet of 1800 kcal/day plus 2 oral nutritional supplements of 200 kcal each, one with breakfast and the other mid afternoon. Control group received standard diet of 1800 kcal/day **Number of trial centres**: unclear **Treatment before trial:** none
Outcomes	**Outcomes reported in abstract of publication**: energy and protein intakes; incidence of pressure ulcers; serum albumin; Kuntzmann score; Norton score; lower limb fracture

Bourdel-Marchasson 2000 *(Continued)*

Study details	**Run-in period:** none **Was trial terminated early**: no
Publication details	**Language of publication:** English **Funding:** non-commercial/other funding - Projet Hospitalier de Recherche Clinique, Ministere de la Sante et de l'Action Humanitaire, Direction Generale de la Sante and the Direction des Hopitaux **Publication status:** peer review journal
Stated aim for study	Quote from publication: "The purpose of the present study was to assess the effects of nutritional supplementation (400 kcal/day) for 15 days on dietary intake and on pressure ulcer development in critically ill older patients; 672 subjects older than 65 years were included"
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Quote from paper:** "Nineteen wards were then selected and stratified according their speciality....These wards were then randomised in two groups according to the nutritional intervention **Comment:** insufficient detail of method provided
Allocation concealment (selection bias)	Unclear risk	**Comment:** not described
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	**Comment:** not described
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	**Comment:** not described
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	**Comment:** 25 deaths in intervention group and 22 in the usual care. Other attrition not described
Selective reporting (reporting bias)	Low risk	**Comment:** all outcomes reported
Other bias	High risk	**Assessment of risk of bias in cluster-randomised trials** (1) Recruitment bias: unclear (2) Baseline imbalance: yes (serum albumin at baseline, weight, Norton score, Kuntzmann mean score) (3) Loss of clusters: unclear (4) Incorrect analysis: no (5) Comparability with individually randomised trials/different types of clusters: different types of clusters

Brouillette 1991

Methods	**Parallel randomised controlled clinical trial** **Randomisation ratio:** 1:1 **Superiority design**
Participants	16 participants; 14 female; 2 male; mean age Intervention 80 (SD 6.4); control 87 (SD 6.8) years **Inclusion criteria**: care home residents **Exclusion criteria**: cancer; severe GI disorder and/or oral disorder; extreme dietary restriction or other conditions that affect ability to eat or feed themselves **Diagnostic criteria**: not specified
Interventions	Exposure to olfactory stimuli prior to meals + other activities **Number of trial centres**: 1 **Treatment before trial:** none
Outcomes	**Outcomes reported in abstract of publication**: olfactory acuity and attention level
Study details	**Run-in period:** none **Was trial terminated early**: no
Publication details	**Language of publication:** English Funding**:** not stated **Publication status:** peer review journal
Stated aim for study	Quote from publication: "To test whether odours can influence the desire to eat and therefore increase caloric intake"
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Quote from publication**: "From the remaining pool, 20 subjects were selected for the research ... The 20 subjects were assigned randomly to either the experimental or control group" **Comment:** no details on randomisation procedure
Allocation concealment (selection bias)	Unclear risk	**Comment:** not described
Blinding of participants and personnel (performance bias) All outcomes	Low risk	**Comment:** during the research period it is stated that "the research assistant was unaware of group assignment"
Blinding of outcome assessment (detection bias)	Low risk	**Comment:** during the research period it is stated that "the research assistant was unaware of group assignment"

Brouillette 1991 *(Continued)*
All outcomes

Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** all dropouts fully accounted for
Selective reporting (reporting bias)	Low risk	**Comment:** all outcomes fully reported
Other bias	Low risk	**Comment:** baseline characteristics reported and groups comparable

Castellanos 2009

Methods	**Cross-over randomised controlled clinical trial:** each individual was tested under three menu conditions (2 different interventions and 1 control) **Randomisation ratio:** not stated **Superiority design**
Participants	39 participants (4 died and 2 withdrew before inclusion, complete data on 26 following attrition). 10 male, 23 female, mean age 87.3 (SD 8.6) years, mean BMI 25.1 (SD 3.6) **Inclusion criteria**: nursing home residents **Exclusion criteria**: < 60 years, hospice patients, on tube feeding, renal diet, pureed diet, thickened liquids, ate only in their room, required feeding assistance. **Diagnostic criteria**: nursing home residents
Interventions	2 breakfast and 2 lunch foods fortified to improve energy and protein content (hot cereal and juice breakfast, soup and side dish at lunch) versus 2 lunch foods only fortified versus normal menu **Number of trial centres**: 1 **Treatment before trial:** not stated, assume usual menu
Outcomes	**Outcomes reported in abstract of publication**: energy and protein intake
Study details	**Location:** Florida, USA **Year:** mid 2000's **Setting:** nursing home **Run-in period:** not stated **Was trial terminated early**: no
Publication details	**Language of publication:** English **Funding:** non-commercial - Retirement Research Foundation. **Other funding:** Juice drinks donated by Lyons Magnus, Fresno CA **Publication status:** peer review journal

Castellanos 2009 *(Continued)*

Stated aim for study	Quote from publication: "the study objective was to determine whether energy and protein enhancement of a small number of menu items would result in increased 3-meal (breakfast, lunch and supper) calorie and protein intakes in long term care residents"
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Quote from paper:** "Using a single blind randomised cross over design, each subject was tested under three menu conditions" **Comment:** insufficient details of method provided
Allocation concealment (selection bias)	Unclear risk	**Comment:** not stated
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	**Comment:** described as single blind, unclear whether residents or staff were blinded
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	**Comment:** not stated
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** complete data included in figure 1
Selective reporting (reporting bias)	High risk	**Comment:** results for the whole group are not reported according to initial randomisation. Only data for post hoc separation of the whole group into large (≥ 1150 kcal in 3 meals) and small eaters (< 1150 kcal in 3 meals) were reported. This excludes 7 participants with incomplete data
Other bias	Unclear risk	**Comment:** baseline characteristics reported in table 1 for large and smaller eaters but not for the whole group

Chang 2005

Methods	**Cluster-randomised controlled clinical trial** **Randomisation ratio:** 1:1 **Superiority design**
Participants	67 nursing assistants randomised, 36 nursing assistants took part in the observation of mealtimes part of the study; N = 20 intervention (all female); N = 16 control (14 female and 2 male) and 36 care home residents with dementia (mean age 84.2 (SD 4) intervention and 72 (SD 5.8) years in control) **Inclusion criteria**: nursing assistants had to have worked at least 6 months in the same long-term care facility and able to communicate in either Mandarin, Taiwanese or English. Residents diagnosed with dementia, having an eating problem and needing assistance **Exclusion criteria**: not stated

Chang 2005 *(Continued)*

	Diagnostic criteria: dementia
Interventions	Feeding skills training programme for nursing assistants versus usual care **Number of trial centres**: 1 **Treatment before trial:** not stated
Outcomes	**Outcomes reported in abstract of publication**: knowledge, attitude and behaviour of nursing assistants, Edinburgh Feeding Evaluation in Dementia Score; food intake and eating time of participants
Study details	**Run-in period:** not stated **Was trial terminated early**: no
Publication details	**Language of publication:** English **Funding:** commercial and non-commercial - Sigma Theta Tau International-Alpha Mu Chapter and the Alumni Association of the FPB School of Nursing and National health Research Institute **Publication status:** peer review journal
Stated aim for study	Quote from publication: "to provide a feeding skills training programme for nursing assistants in a Taiwanese dementia-specialised long term care facility and to test the effects of this feeding skills training programme on the outcomes of nursing assistants and dementia patients".
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	**Quote from paper:** "Two convenience-chosen, dementia-specialised, long-term care facilities in North Taiwan were randomly assigned into either a control or treatment group by flipping a coin" **Comment:** implies that the study may be cluster randomised but not clear from the information provided
Allocation concealment (selection bias)	Unclear risk	**Comment:** insufficient information to make a judgement
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	**Comment:** insufficient detail
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	**Comment:** insufficient detail
Incomplete outcome data (attrition bias) All outcomes	High risk	**Comment:** data not presented on 16/36 individuals with no reasons why
Selective reporting (reporting bias)	Low risk	**Comment:** all outcomes reported
Other bias	Unclear risk	**Comment:** insufficient data on baseline characteristics of nursing assistants and of participants; nursing assistants in usual care had significantly longer

Chang 2005 *(Continued)*

	work experience than in treatment group; intervention group participants were older than usual care. This trial probably was a cluster randomised trial

Dennis 2005

Methods	**Parallel randomised controlled clinical trial** **Randomisation ratio:** 1:1 **Superiority design**
Participants	4023 participants; N = 2016 intervention (47% female; mean age 71 (SD 12)); N = 2007 usual care (46% female; mean age 71 (SD 13)) **Inclusion criteria**: people admitted with recent stroke, (first or recurrent stroke no more than 7 days before admission), if they passed swallow screen, the responsible clinician was uncertain whether to use oral nutritional supplements and the participant or relative consented to enrolment **Exclusion criteria**: subarachnoid haemorrhage **Diagnostic criteria**: stroke patients
Interventions	Intervention group received normal hospital diet plus oral protein energy supplements (360 mL) prescribed on drug administration charts; usual care received normal hospital diet until discharge **Number of trial centres**: 125 hospitals in 15 different countries **Treatment before trial:** none
Outcomes	**Outcomes reported in abstract of publication**: death, poor outcome (modified Rankin scale grade 3-5)
Study details	**Run-in period:** not stated **Was trial terminated early**: no
Publication details	**Language of publication:** English **Funding:** commercial/other funding- Health Technology Assessment Board of NHS Research and Development in the UK, the Stroke Association, the Chief Scientist Office of the Scottish Executive, and Chest, Heart and Stroke, Scotland **Publication status:** peer review journal
Stated aim for study	Quote from publication: "to establish whether routine oral nutritional supplements improve outcome after stroke"
Notes	The FOOD (feed or ordinary diet) trials consisted of three RCTs, sharing the same randomisation, data collection, and follow-up systems, allowed co-enrolment, and aimed to compare the outcomes of stroke patients in hospital. Dysphagic patients were enrolled into one or both of two trials: (1) early enteral tube feeding versus avoidance of tube feeding for at least 7 days; and (2) tube feeding via percutaneous endoscopic gastrostomy versus nasogastric tube. For this systematic review we describe the outcomes of participants who were able to swallow

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**

Dennis 2005 *(Continued)*

Random sequence generation (selection bias)	Low risk	**Quote from publication**: "the computer allocated the feeding regimen". Also, "A computer generated minimisation algorithm" was used
Allocation concealment (selection bias)	Low risk	**Quote from publication**: "the computer allocated the feeding regimen" **Comment:** central allocation method ensured treatment allocation was concealed until intervention was given
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	**Quote from publication**: "Neither the randomising clinician, the clinical team, nor patients were unaware of treatment allocation; doing so would have been very difficult"
Blinding of outcome assessment (detection bias) All outcomes	High risk	**Quote from publication**: "Follow-up was masked to treatment allocation (except when patients or carers inadvertently divulged it to an interviewer, which was unusual but not systematically recorded)"
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** study attrition presented in a figure and all randomised participants accounted for
Selective reporting (reporting bias)	Low risk	**Comment:** all of the outcomes specified were reported
Other bias	Unclear risk	**Comment:** insufficient information to permit judgement of 'Low risk' or 'High risk'

Duncan 2006

Methods	**Parallel randomised controlled clinical trial** **Randomisation ratio:** not stated but assume 1:1 **Superiority design**
Participants	318 participants; 100% female; mean age intervention 83.5 and control 83.6 years **Inclusion criteria**: women > 65 years admitted with acute hip fracture **Exclusion criteria**: not stated **Diagnostic criteria**: acute non-pathological hip fracture
Interventions	**Intervention:** additional personal attention of a dietetic assistant **Control:** usual care **Number of trial centres**: 1 **Treatment before trial:** none
Outcomes	**Outcomes reported in abstract of publication**: **Primary:** post-operative mortality in the acute trauma unit **Secondary:** post-operative mortality at 4 months; length of hospital stay, energy intake and nutritional status
Study details	**Location:** Wales, UK

Duncan 2006 *(Continued)*

	Year: May-August 2003 **Setting:** acute trauma ward **Run-in period:** none **Was trial terminated early**: no
Publication details	**Language of publication:** English **Funding:** non-commercial funding - Womens Royal Volunteer Service + British Dietetic Association, Innovations in Care Shire Pharmaceuticals, Wales Office of Research & Development **Publication status:** peer review journal
Stated aim for study	Quote from publication: "To examine how improved attention to nutrition status and dietary intake achieved through the employment of dietetic assistants will affect post-operative clinical outcome among elderly women with hip fracture"
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Comment:** sequence generation not described
Allocation concealment (selection bias)	Low risk	**Quote from paper**: "sequentially numbered opaque sealed envelope method in blocks of 10, prepared by a member of staff not involved in the trial"
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	**Comment:** not described
Blinding of outcome assessment (detection bias) All outcomes	Low risk	**Comment:** assessments made by member of trial team blind to treatment allocation and independent of dietitian and dietetic assistants
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** fully described
Selective reporting (reporting bias)	Low risk	**Comment:** all specified outcomes reported
Other bias	Low risk	**Comment:** baseline characteristics show groups are comparable

Essed 2007

Methods	**Factorial randomised controlled clinical trial** **Randomisation ratio:** 1:1:1:1 **Superiority design**
Participants	97 participants (83 completed); mean age 84.9-85.6 years (SD 5.7-8.5); 58 female and 25 male

Essed 2007 *(Continued)*

	Inclusion criteria: aged 65 years or older; resident of nursing home for more than 3 months; no terminal disease; no allergy to MSG; consuming meals provided by the nursing home at least 5 days/week **Exclusion criteria**: **Diagnostic criteria**: not stated
Interventions	Four arms; food sprinkled with 1. MSG 2. Flavour 3. MSG + Flavour 4. Maltodextrin (placebo) **Number of trial centres**: 3 care homes in the Netherlands **Treatment before trial:** not stated
Outcomes	**Outcomes reported in abstract of publication**: energy intake and body weight
Study details	**Run-in period:** two weeks **Was trial terminated early**: no
Publication details	**Language of publication:** English **Funding:** non-commercial funding **Publication status:** peer review journal
Stated aim for study	Quote from publication: "To determine whether daily addition of flavour and/or MSG to the animal protein part of a cooked meal for 16 weeks leads to an increase in energy intake of the cooked meal and an increase in body weight"
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Quote from paper:** participants were reported as being "randomly assigned" **Comment:** insufficient detail of the method provided
Allocation concealment (selection bias)	Unclear risk	**Quote from paper:** "The residents were unaware to which group they were assigned". **Comment:** insufficient detail of the method provided
Blinding of participants and personnel (performance bias) All outcomes	High risk	**Comment:** single-blind i.e. participants were blinded but not research personnel
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	**Comment:** not stated
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** all participants accounted for
Selective reporting (reporting bias)	Low risk	**Comment:** all outcomes specified in the methods are reported in the results

Essed 2007 *(Continued)*

Other bias	Low risk	**Comment:** baseline characteristics comparable and reported in Table 1

Essed 2009

Methods	**Cross-over randomised controlled clinical trial** **Randomisation ratio:** 1:1 **Superiority design**
Participants	53 nursing home residents (13 male: 40 female); aged 85.8 (SD 5.2) years **Inclusion criteria**: > 65 years old; able to participate; good eyesight **Exclusion criteria**: allergy to MSG; on sodium restricted diet; on anti-depressants; terminal illness **Diagnostic criteria**: not stated
Interventions	**Intervention:** hot meal including three foods with added salt and MSG **Control:** usual hot meals **Number of trial centres**: 1 **Treatment before trial:** usual diet
Outcomes	**Outcomes reported in abstract of publication**: dietary intake
Study details	**Run-in period:** none **Was study terminated early**: not stated
Publication details	**Language of publication:** English **Funding:** non-commercial funding **Publication status:** peer review journal
Stated aim for study	Quote from publication: "To determine whether or not an optimal preferred MSG concentration in several foods increases intake in elderly people"
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Quote from paper:** described as: " .. in a random order" **Comment:** insufficient detail of the method provided
Allocation concealment (selection bias)	Unclear risk	**Quote from paper:** "The studies were carried out single blind" **Comment:** insufficient detail of the method provided
Blinding of participants and personnel (performance bias)	Unclear risk	**Comment:** not stated who was blinded

Essed 2009 *(Continued)*

All outcomes		
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	**Comment:** not stated
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** fully described
Selective reporting (reporting bias)	Unclear risk	**Comment:** insufficient information to judge
Other bias	Unclear risk	**Comment:** baseline characteristics reported

Faxen-Irving 2011

Methods	**Parallel randomised controlled clinical trial** **Randomisation ratio:** 1:1 **Superiority design**
Participants	71 recently admitted geriatric patients; N = 34 intervention; N = 37 control. Mean age of all participants = 84 (SD 7.1) **Inclusion criteria**: likelihood of hospital stay more than one week, > 65 years old and able to give informed consent **Exclusion criteria**: pancreatitis, fat malabsorption, BMI > 30 kg/m^2, and non-consent for participation **Diagnostic criteria**: not stated
Interventions	Intervention group received a daily dose of 3 x 30 mL fat emulsion at the same time as pharmaceutical prescriptions. The usual care received usual care **Number of trial centres**: 1 **Treatment before trial:** not stated
Outcomes	**Outcomes reported in abstract of publication**: food intake, self-rated appetite, NRS, serum lipids, fatty acid profiles
Study details	**Run-in period:** no **Was trial terminated early**: no
Publication details	**Language of publication:** English **Funding:** non-commercial/commercial funding- SHS International & Nutricia (Sweden) and the Regional Agreement on Medical Training & Clinical Research between Stockholm County Council and the Karolinska Institutet **Publicaton status:** peer review journal
Stated aim for study	Quote from publication: "the effects on an oleic acid rich formula on energy intake and appetite were studied"

Faxen-Irving 2011 *(Continued)*

Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Quote from paper:** "an open randomised controlled trial. Permutted blocks of 10 were employed for the randomisation. No stratification was used". **Comment:** insufficient detail of method provided
Allocation concealment (selection bias)	High risk	**Quote from publication**: "Sealed envelopes, opened by the study nurses after acceptance from the patients was received, were used to allocate individuals to intervention or control" **Comment:** sealed envelopes may have been used without appropriate safeguards, e.g. not sequentially numbered, nor opaque
Blinding of participants and personnel (performance bias) All outcomes	High risk	**Quote from publication**: "Sealed envelopes, opened by study nurses", therefore personnel aware of allocation. The study was also unblinded "open randomised controlled trial"
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	**Comment:** not described
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** no missing outcome data
Selective reporting (reporting bias)	Low risk	**Comment:** the study protocol is not available but it is clear that the published reports include all expected outcomes, including those that were pre-specified
Other bias	High risk	**Comment:** data provided from only those who completed the study (rather than all those initially randomised) - page 207

Gaskill 2009

Methods	**Cluster randomised controlled clinical trial** **Randomisation ratio:** 1:1 **Superiority design**
Participants	352 nursing home residents (245 female; 107 male); mean age 84.2 (SD 8.7) years **Inclusion criteria**: not stated **Exclusion criteria**: not stated **Diagnostic criteria**: not stated
Interventions	Nutrition education programme by nutrition coordinators compared with usual care **Number of trial centres**: 8 **Treatment before trial:** not stated

Gaskill 2009 *(Continued)*

Outcomes	**Outcomes reported in abstract of publication**: nutritional status (SGA)
Study details	**Run-in period:** no **Was trial terminated early**: no
Publication details	**Language of publication:** English **Funding:** non-commercial funding **Publication status:** peer review journal
Stated aim for study	Quote from publication: "To investigate the impact of implementing a train-the-trainer nutrition programme on the nutritional status of older adults residing in residential care."
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Quote from paper:** "Four of the eight Residential Aged Care Facilities were selected at random.." **Comment:** method used not described
Allocation concealment (selection bias)	Unclear risk	**Comment:** not described
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	**Comment:** not described
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	**Comment:** not described
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	**Comment:** insufficient reporting of attrition data
Selective reporting (reporting bias)	Low risk	**Comment:** reported all outcomes
Other bias	High risk	**Comment:** baseline characteristics reported for whole group rather than for intervention and control separately **Assessment of risk of bias in cluster-randomised trials** (1) Recruitment bias: unclear (2) Baseline imbalance: number of diagnoses (3) Loss of clusters: unclear (4) Incorrect analysis: yes (5) Comparability with individually randomised trials/different types of clusters: unclear

Germain 2006

Methods	**Parallel randomised controlled clinical trial** **Randomisation ratio:** 1:1 **Superiority design**
Participants	17 participants (10 female; 7 male); mean age 82.5 (SD 4.4) years intervention 84.6 (SD 3.8) years control **Inclusion criteria**: 60-95 years old; resident > 3 months in the centre; unintentional weight loss > 7.5% in previous 3 months or BMI < 24 kg/m^2 **Exclusion criteria**: active cancer or chronic intestinal disease or terminally ill **Diagnostic criteria**: dysphagia
Interventions	Re-formed foods, thickened beverages and dietary supplements as necessary compared with traditional modified texture diet (control) **Number of trial centres**: 1 **Treatment before trial:** not stated
Outcomes	**Outcomes reported in abstract of publication**: macro and micronutrient intake, weight and BMI
Study details	**Run-in period:** no **Was trial terminated early**: no
Publication details	**Language of publication:** English **Funding:** not stated **Publication status:** peer review journal
Stated aim for study	Quote from publication: "To evaluate to nutrient intake of frail institutionalised elderly persons with dysphagia, and to assess the impact of Sainte-Anne's Hospital Advanced Nutritional Care Programme, on dietary intake and weight"
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Quote from paper:** "Eligible subjects were randomly allocated..... using a blocked allocation strategy." **Comment:** insufficient detail of method provided
Allocation concealment (selection bias)	Low risk	**Quote from paper**: "sealed opaque envelopes indicating subject assignment were prepared off-site"
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	**Comment:** not stated
Blinding of outcome assessment (detection bias)	Unclear risk	**Comment:** not stated

Germain 2006 *(Continued)*
All outcomes

Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** all participants fully accounted for
Selective reporting (reporting bias)	Low risk	**Comment:** all outcomes reported
Other bias	Low risk	**Comment:** groups comparable at baseline; data reported in table 1 and text

Hankey 1993

Methods	**Parallel randomised controlled clinical trial** **Randomisation ratio:** 1:1 **Superiority design**
Participants	20 frail elderly people; N = 10 intervention; N = 10 control **Inclusion criteria**: frail elderly **Exclusion criteria**: not stated **Diagnostic criteria**: not stated
Interventions	The intervention group received Build Up drink (1 unit) daily during routine drug prescription, in addition to their normal hospital diet. The usual care received the standard hospital diet **Number of study centres**: 1 **Treatment before trial:** none described
Outcomes	**Outcomes reported in abstract of publication**: food intake, glucose polymer intake, anthropometric measurements (TSF, MAMC)
Study details	**Run-in period:** none **Was trial terminated early**: no
Publication details	**Language of publication:** English **Funding:** not stated **Publicaton status:** peer review journal
Stated aim for study	Quote from publication: "the effectiveness of dietary supplements for frail elderly subjects in continuing care"
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Quote from paper:** "...subjects were randomised to control or supplemented groups"

Hankey 1993 *(Continued)*

		Comment: insufficient detail of method provided
Allocation concealment (selection bias)	Unclear risk	**Comment:** not stated
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	**Comment:** not stated
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	**Comment:** not stated
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** no missing outcome data
Selective reporting (reporting bias)	Low risk	**Comment:** the study protocol is not available but it is clear that the published reports include all expected outcomes, including those that were pre-specified
Other bias	Unclear risk	**Comment:** insufficient information to assess whether an important risk of bias exists

Hickson 2004

Methods	**Parallel randomised controlled clinical trial** **Randomisation ratio:** 1:1 **Superiority design**
Participants	**Inclusion criteria**: > 65 years old; admitted to medicine for the elderly wards **Exclusion criteria**: unable to take food orally; not expected to survive the admission; planned discharge within 4 days; readmitted if already recruited into the trial **Diagnostic criteria**: acutely ill with a range of clinical conditions
Interventions	**Number of trial centres**: 1 **Treatment before trial:** none
Outcomes	**Outcomes reported in abstract of publication**: nutritional status, mortality, length of stay, grip strength, Barthel score, intravenous antibiotic prescription
Study details	**Run-in period:** none **Was trial terminated early**: no
Publication details	**Language of publication:** English **Funding:** non-commercial funding **Publication status:** peer review journal
Stated aim for study	Quote from publication: "to examine whether healthcare assistants trained to provide additional support with feeding will improve acutely ill elderly inpatients clinical outcomes"

Hickson 2004 *(Continued)*

Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	**Quote from paper:** stratified by ward and achieved using "computer generated random numbers tables"
Allocation concealment (selection bias)	Low risk	**Quote from paper:** "using sealed, opaque envelopes prepared by an independent group"
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	**Comment:** insufficient information
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	**Comment:** insufficient information
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** fully described
Selective reporting (reporting bias)	High risk	**Comment:** no data reported on the following outcomes: use of services questionnaire, referral rate to therapists, readmission within 6 months, laxative use, pressure sores, economic analysis
Other bias	Low risk	**Comment:** significantly more women in the intervention group otherwise both groups comparable at baseline

Holyday 2012

Methods	**Parallel randomised controlled clinical trial** **Randomisation ratio:** 1:1 **Superiority design**
Participants	143 hospitalised patients (61 male: 82 female); age intervention 83.7 (SE 0.8) control 83.4 (SE 0.9) years **Inclusion criteria**: all patients admitted under the care of a Geriatrician to an acute geriatric medicine ward **Exclusion criteria**: expected length of stay < 72 h; palliative care; unable to be nutritionally assessed; not speaking English; severe dementia or confusion; non-cooperation **Diagnostic criteria**: acute geriatric medicine
Interventions	Malnutrition Care Pathway (modification of hospital meals; prescription of nutritional supplements or snacks; flagging for feeding assistance; education of participants and carers; referral to other health professionals and discharge planning) versus usual care **Number of trial centres**: 1 **Treatment before trial:** not specified

Holyday 2012 *(Continued)*

Outcomes	**Outcomes reported in abstract of publication**: length of hospital stay; readmissions; weight change; number of malnourished participants identified without routine nutrition screening
Study details	**Run-in period:** none **Was trial terminated early**: no
Publication details	**Language of publication:** English **Funding:** commercial and non-commercial funding - The Gut Foundation + Pharmatel Fresenius Kabi PTY Ltd. **Publication status:** peer review journal
Stated aim for study	Quote from publication: "To examine the prevalence of malnutrition in acutely ill older patients and to assess the impact of malnutrition screening and early dietetic intervention on weight, length of hospital stay, hospital costs and subsequent emergency presentations and hospital readmissions in geriatric patients at risk of malnutrition using a randomised controlled trial"
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	**Quote from paper:** "randomly allocated by computerised random number generator"
Allocation concealment (selection bias)	Unclear risk	**Comment:** not described
Blinding of participants and personnel (performance bias) All outcomes	High risk	**Quote from publication**: "not possible to blind the clinical dietitian to group allocation"
Blinding of outcome assessment (detection bias) All outcomes	High risk	**Quote from publication**: "as the outcomes are primarily objective measures they are mostly not open to the influence of bias"
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** all deaths and dropouts fully accounted for
Selective reporting (reporting bias)	Low risk	**Comment:** all outcomes fully reported
Other bias	Low risk	**Comment:** baseline characteristics similar between groups

Johansen 2004

Methods	**Parallel randomised controlled clinical trial** **Randomisation ratio:** 1:1 **Superiority design**

Johansen 2004 *(Continued)*

Participants	**Inclusion criteria**: NRS-2000 score > 3 on admission to hospital **Exclusion criteria**: predicted admission < 4 days; < 18 years old; < 1 month expected survival; ability to understand Danish; previously included participants; patients next to another participant; pregnant and lactating; psychiatric disorder; haemodialysis; patients receiving or planned to receive EN or PN **Diagnostic criteria**: varied
Interventions	Received daily attention from the nutrition team (nurse and dietitian); motivation of participant and staff; daily monitoring and adjustment of nutrition care plan; secured supply of ordered food **Number of trial centres**: 3 hospitals in Denmark **Treatment before trial:** not described
Outcomes	**Outcomes reported in abstract of publication**: length of stay; nutrition discharge index; health-related quality of life (Short Form -36 health survey)
Study details	**Run-in period:** no **Was trial terminated early**: no
Publication details	**Language of publication:** English **Funding:** non-commercial funding - Danish Ministry of Health + participating Hospitals **Publication status:** peer review journal
Stated aim for study	Quote from publication: "To evaluate the clinical benefits of nutritional intervention in a random sample of all patients at nutritional risk according to Nutritional Risk Score -2002 from three different hospital levels"
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	**Quote from paper**: participants selected "by a random numbers system" **Comment:** suggests that random sequence appropriate
Allocation concealment (selection bias)	Unclear risk	**Comment:** not described
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	**Comment:** not described
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	**Comment:** assessment of complications undertaken by a member of the investigation team blinded to allocation
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	**Comment:** clearly described in the results; intention-to-treat analysis undertaken, however they do not report which group participants dropped out of

Johansen 2004 *(Continued)*

Selective reporting (reporting bias)	Low risk	**Comment:** all outcomes specified in the methods fully reported
Other bias	Low risk	**Comment:** baseline characteristics fully described; intervention and usual cares comparable

Kraft 2012

Methods	**Parallel randomised controlled clinical trial** **Randomisation ratio:** 1:1 **Superiority design**
Participants	26 participants; mean age 79.8 (SD 7.3) years; 10 male; 16 female **Inclusion criteria**: weight loss > 10% in previous 6 months; BMI < 21 kg/m^2; albumin < 35g/L **Exclusion criteria**: malignancy, dementia, liver cirrhosis, dialysis-dependent kidney insufficiency; insufficient cognitive ability; receiving professional care at home or living in a nursing home **Diagnostic criteria**: malnourished on discharge from hospital
Interventions	Intervention group received an oral nutritional supplement and telemedicine monitoring comprising daily assessment of weight, compliance with supplement prescription and state of health. Responses triggered a range of nutritional management actions by a nurse employed by the tele-medicine centre **Number of trial centres**: 1 **Treatment before trial:** not stated
Outcomes	**Outcomes reported in abstract of publication**: weight and BMI
Study details	**Run-in period:** none **Was trial terminated early**: no
Publication details	**Language of publication:** English **Funding:** non-commercial and commercial funding - Ministry of Social Affairs and Health, Western Pomerania, Germany and Nutricia (Germany) **Publication status:** peer review journal
Stated aim for study	Quote from publication: "To evaluate the feasibility and explore the patients acceptance of the tele-medical concept"
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Quote from paper:** "Patients were randomized consecutively into the intervention and control group" **Comment:** insufficient details of the method provided

Kraft 2012 *(Continued)*

Allocation concealment (selection bias)	Unclear risk	**Comment:** not described
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	**Comment:** not described
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	**Comment:** not described
Incomplete outcome data (attrition bias) All outcomes	High risk	**Comment:** high risk because of high attrition rate in the intervention group i.e. intervention (N = 13) 8 withdrew; control (N = 13) 3 withdrew; all withdrawals accounted for
Selective reporting (reporting bias)	Low risk	**Comment:** all outcome measures reported
Other bias	Low risk	**Comment:** baseline characteristics fully described; intervention and usual cares comparable

Kretser 2003

Methods	**Parallel randomised controlled clinical trial** **Randomisation ratio: 1:1** **Superiority design**
Participants	203 participants; 144 female: 59 male **Inclusion criteria**: people on a waiting list or referred on hospital discharge for meals on wheels or responding to local advertisements **Exclusion criteria**: MNA score > 22.5; self-reported terminal illness; medical conditions that precluded the meal being adequate or food allergy; previously received meals on wheels **Diagnostic criteria**: not stated
Interventions	21 meals and 14 snacks consisting of frozen meals, nutritional supplements and shelf-stable and frozen food items. Menus provided 100% macro and micronutrient requirements for people over the age of 50 years. Daily phone call from older adult volunteer to provide safety and socialisation. Control = one hot meal five days a week at lunchtime **Number of trial centres**: not relevant (all at home) **Treatment before trial:** none
Outcomes	**Outcomes reported in abstract of publication**: weight, MNA, functional status
Study details	**Run-in period:** none **Was trial terminated early**: no
Publication details	**Language of publication:** English **Commercial/non-commercial/other funding:** not stated

Kretser 2003 *(Continued)*

	Publication status: peer review journal
Stated aim for study	Quote from publication: "To compare a traditional meals on wheels (MoW) programme consisting of one hot meal delivered daily, Monday through Friday, versus a new MoW programme consisting of 21 meals and 14 snacks that required some preparation delivered weekly"
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	**Quote from publication**: "Randomized treatment assignment was followed with a few exceptions...Participants who were offered the new MoW model and refused, were placed in the traditional MoW model" **Comment:** insufficient detail of method provided as well as patients moving between groups as above
Allocation concealment (selection bias)	Unclear risk	**Comment:** not described
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	**Comment:** not described
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	**Comment:** not described
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	**Comment:** overall attrition reported but not from which groups they dropped out
Selective reporting (reporting bias)	Low risk	**Comment:** all outcomes fully reported
Other bias	Unclear risk	**Comment:** traditional MoW group had significantly lower functional ability (instrumental ADL) and lower education attainment

Larsson 1990

Methods	**Parallel randomised controlled clinical trial** **Randomisation ratio:** 1:1 **Superiority design**
Participants	**Inclusion criteria**: people with an expected hospital stay of more than 3 weeks, admitted consecutively to a long-term medical care clinic **Exclusion criteria**: not stated **Diagnostic criteria**: diagnosis of participants included: malignancy, endocrine, neurological, heart, vascular, respiratory, musculoskeletal, fracture

Larsson 1990 *(Continued)*

Interventions	Intervention group received nutritional supplementation (400 kcal) in the morning and afternoon between meals, when all patients on the ward were routinely supplied with drinks, as well as standard hospital diet. The usual care received standard hospital diet alone **Number of trial centres**: 1 **Treatment before trial:** none described
Outcomes	**Outcomes reported in abstract of publication**: anthropometry, serum protein analysis, delayed hypersensitivity skin test, mobility, general physical condition, food intake
Study details	**Run-in period:** none **Was trial terminated early**: no
Publication details	**Language of publication:** English **Funding:** commercial/other funding - Swedish Medical Research Council, Research Fund of the County of Ostergotland, Kabi Nutrition **Publication status:** peer review journal
Stated aim for study	Quote from publication: "to investigate the relationship between nutritional state and the development and healing of pressure sores in patients in a long term care clinic" (page 245). Larsson: "to evaluate the effect of dietary supplements on clinical outcome and nutritional status in a large group of geriatric patients" (Ek 1991)
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Quote from publication:** "Randomisation was carried out by means of sealed envelopes containing group designation". **Comment:** insufficient information provided about the sequence generation process
Allocation concealment (selection bias)	Unclear risk	**Comment:** insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	**Comment:** insufficient information to permit judgement
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	**Comment:** insufficient information to permit judgement
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	**Comment:** number of study dropouts presented in figure but unclear which group they belong to and the reason
Selective reporting (reporting bias)	Low risk	**Comment:** data not reported at all time points for all outcomes
Other bias	High risk	**Comment:** significant differences between groups at baseline in TSF and weight index in men, and AMC in women were significantly lower in experi-

Larsson 1990 *(Continued)*

	mental than the usual care. The supplemented group also had a significantly lower mental score on admission (Unosson 1992)

Leslie 2012

Methods	**Cluster-randomised controlled trial** **Randomisation ratio:** 1:1 **Superiority design**
Participants	41 people living in residential care homes, 36 female, 5 male, mean age 91(SD 7) years **Inclusion criteria**: BMI < 18.5 kgm^2, without acute disease **Exclusion criteria**: not described **Diagnostic criteria**: mixed diagnoses, people living in residential care homes
Interventions	Provision of energy enriched meals vs usual care **Number of trial centres**: 21 residential care homes **Treatment before trial:** not described
Outcomes	**Outcomes reported in abstract of publication**: energy intake, weight and BMI
Study details	**Run-in period:** no **Was trial terminated early**: no
Publication details	**Language of publication:** English **Funding:** commercial funding - GlaxoSmithKline **Publication status:** peer review journal
Stated aim for study	Quote from publication: "To examine whether the nutritional status of aged undernourished residents in care could be improved through dietary modification to increase energy intake but not portion size"
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Quote from publication**: "Random permuted block design, stratified by home type (dementia/no dementia) by a statistician who had no contact with the homes" **Comment:** insufficient detail of method provided
Allocation concealment (selection bias)	Low risk	**Quote from publication**: "Allocation made post recruitment and baseline screening by a statistician who had no contact with the homes"
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	**Comment:** not mentioned. As energy enrichment was of usual meals it would have been possible to blind participants to the intervention

Leslie 2012 *(Continued)*

Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	**Comment:** not mentioned. Assessment of weight and food intake might have been influenced by knowing the study group
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** the number of participants that dropped out and the reasons are given
Selective reporting (reporting bias)	Low risk	**Comment:** all specified outcomes are reported
Other bias	High risk	**Assessment of risk of bias in cluster-randomised trials** (1) Recruitment bias: no (2) Baseline imbalance: unclear (3) Loss of clusters: unclear (4) Incorrect analysis: no (5) Comparability with individually randomised trials/different types of clusters: different types of clusters

Lin 2010

Methods	**Cluster-randomised controlled clinical trial** **Randomisation ratio:** 1:1:1 **Superiority design**
Participants	**Inclusion criteria**: diagnosis of dementia; EdFed score ≥ 2; able to stay in institution for duration of study; Mini Mental State Examination score 10-23 **Exclusion criteria**: not described **Diagnostic criteria**: diagnosis of dementia
Interventions	**Number of trial centres**: 3 **Treatment before trial:** not described
Outcomes	**Outcomes reported in abstract of publication**: EdFed score; frequency of physical and verbal assistance provided; nutritional status
Study details	**Run-in period:** no **Was trial terminated early**: no
Publication details	**Language of publication:** English **Funding:** non-commercial funding - National Health Research Insitute **Publication status:** peer review journal
Stated aim for study	Quote from publication: "To investigate the effectiveness of training of spaced-retrieval and Montessori-based activities in decreasing feeding difficulty and nutritional status for residents with dementia"

Lin 2010 *(Continued)*

Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Quote from paper:** "To avoid confounding, the three institutes were randomly assigned ...." **Comment:** insufficient detail of method provided
Allocation concealment (selection bias)	Unclear risk	**Comment:** nature of blinding not described
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	**Comment:** not described
Blinding of outcome assessment (detection bias) All outcomes	Low risk	**Quote from publication**: "The data collectors did not know which group the subjects belonged to".
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	**Comment:** state reason for dropouts, but unclear which groups they dropped out of
Selective reporting (reporting bias)	Low risk	**Comment:** all outcomes fully reported
Other bias	High risk	**Comment:** baseline characteristics reported; significant difference in ADL observed. **Assessment of risk of bias in cluster-randomised trials** (1) Recruitment bias: no (2) Baseline imbalance: frail status (3) Loss of clusters: no (4) Incorrect analysis: no (5) Comparability with individually randomised trials/different types of clusters: different types of clusters

Lin 2011

Methods	**Cluster- and cross-over randomised controlled clinical trial** **Randomisation ratio:** 1:1 **Superiority design**
Participants	29 participants; mean age 82.9 (SD 6.0) years; 17 male: 12 female with dementia in care home. Appear to be identical to participants in Group 2 in Lin 2010; No response from study author **Inclusion criteria**: diagnosis of dementia ; ≥ 2 Edinburgh Feeding Evaluation in Dementia scale (EdFed); MMSE score = 10-23

Lin 2011 *(Continued)*

	Exclusion criteria: not stated **Diagnostic criteria**: dementia
Interventions	Montessori intervention including sensory stimulation, procedural movements (e.g. hand eye co-ordination) and extension and conclusion activities **Number of trial centres**: 2 **Treatment before trial:** none
Outcomes	**Outcomes reported in abstract of publication**: EdFed score; Eating Behaviours score; MNA score; self-feeding frequency and self-feeding time
Study details	**Run-in period:** 2-week wash out between cross-over Was study terminated early: no
Publication details	Language of publication**:** English **Funding:** non-commercial funding - National Health Research Inistitute (Taiwan) **Publication status:** peer review journal
Stated aim for study	Quote from publication: "To investigate the efficacy of a Montessori intervention in improving the eating ability and nutritional status of residents with dementia in long term care facilities"
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Quote from paper:** "To avoid contamination among participants .....the two demential special care units were randomly assigned....." **Comment:** insufficient information provided to permit judgement
Allocation concealment (selection bias)	Unclear risk	**Comment:** not described
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	**Comment:** described as not blinded, lack of blinding therefore may have influenced participant responses
Blinding of outcome assessment (detection bias) All outcomes	Low risk	**Comment:** outcome assessors blind to allocation
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	**Comment:** not described
Selective reporting (reporting bias)	Low risk	**Comment:** all outcomes fully reported
Other bias	High risk	**Comment:** baseline data suggest considerable variation in length of institutionalisation and length of time diagnosed with dementia

Lin 2011 *(Continued)*

	Assessment of risk of bias in cluster-randomised trials (1) Recruitment bias: no (2) Baseline imbalance: frail status (3) Loss of clusters: no (4) Incorrect analysis: no (5) Comparability with individually randomised trials/different types of clusters: different types of clusters

Mathey 2001a

Methods	**Cluster randomised controlled clinical trial** **Randomisation ratio:** 1:1 **Superiority design**
Participants	**Inclusion criteria**: > 65 years old; resident in nursing home for > 3 months **Exclusion criteria**: parenteral nutrition; terminal phase of disease; severe anaemia **Diagnostic criteria**: varied
Interventions	**Number of trial centres**: 1 **Treatment before trial:** not stated
Outcomes	**Outcomes reported in abstract of publication**: weight; dietary intake; biochemical indicators; health-related quality of life (SIP); life satisfaction score (PGCMS)
Study details	**Run-in period:** no **Was trial terminated early**: no
Publication details	**Language of publication:** English **Funding:** not stated **Publication status:** peer review journal
Stated aim for study	Quote from publication: "To determine the effect of an improved ambience of food consumption on health and nutritional status of Dutch nursing home elderly residents"
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Quote from paper:** "Four wards, each with 15 residents and comparable for diseases and treatment were randomly assigned to be in either the control (two wards) or the experimental group (two wards)." **Comment:** insufficient detail of method provided

Mathey 2001a *(Continued)*

Allocation concealment (selection bias)	Unclear risk	**Comment:** no details provided
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	**Comment:** not stated
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	**Comment:** not stated
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** attrition fully reported
Selective reporting (reporting bias)	Low risk	**Comment:** all outcomes fully reported
Other bias	High risk	**Comment:** baseline characteristics fully reported (including dropouts); control and intervention groups comparable at baseline **Assessment of risk of bias in cluster-randomised trials** (1) Recruitment bias: no (2) Baseline imbalance: frail status (3) Loss of clusters: no (4) Incorrect analysis: no (5) Comparability with individually randomised trials/different types of clusters: different types of clusters

Mathey 2001b

Methods	**Parallel randomised controlled clinical trial** **Randomisation ratio:** 1:1 **Superiority design**
Participants	67 elderly care home residents; mean age intervention 84.6 (SD 6.1) years; control 83 (SD 5.5) years; 54 female: 13 male **Inclusion criteria**: > 65 years, resided in care home > 3 months and consuming cooked meal provided by care home kitchen at least 5 days/week **Exclusion criteria**: dementia, hospitalised, depression; in terminal phase; allergy to MSG **Diagnostic criteria**: not specified
Interventions	Four flavour powders to enhance the cooked meal (chicken, beef, turkey or lemon) using 1 (± 0.2) g flavour powder **Number of trial centres**: 1 **Treatment before trial:** not stated

Mathey 2001b *(Continued)*

Outcomes	**Outcomes reported in abstract of publication**: body weight, energy intake and hunger
Study details	**Run-in period:** one **Was trial terminated early**: no
Publication details	**Language of publication:** English **Funding:** commercial funding - flavours donated by IFF BV; funding from Friesland Coberco Research and the Suikerstichting **Publication status:** peer review journal
Stated aim for study	Quote from publication: "To determine whether the addition of flavour enhancers to the cooked meals over 16 weeks would lead to an increase in food consumption and thereby provide nutritional benefits to elderly nursing home residents"
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Quote from paper:** "subjects were randomly assigned to be in the control group ..or the flavour group.." **Comment:** insufficient detail of the method provided
Allocation concealment (selection bias)	Unclear risk	**Comment:** not described
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	**Comment:** not described
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	**Comment:** not described
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** all dropouts fully accounted for
Selective reporting (reporting bias)	Low risk	**Comment:** all outcomes specified in the methods fully reported
Other bias	Low risk	**Comment:** baseline characteristics fully reported; control and intervention groups comparable at baseline

Munk 2014

Methods	**Parallel randomised controlled clinical trial** **Randomisation ratio:** 1:1 **Superiority design**

Munk 2014 *(Continued)*

Participants	84 people newly admitted to hospital; mean age intervention 75 (SD 10) years; control 74 (SD 11) years; 47 female, 34 male *(data on those that completed the study)* **Inclusion criteria**:**n**ew admissions to hospital, ≥ 18 years old and at nutritional risk according to NRS-2002, able to eat orally, anticipated length of stay > 3 days, sufficient language proficiency **Exclusion criteria**: dysphagia, food allergy or intolerance, anatomical obstruction preventing food intake, receiving enteral or parenteral nutrition, judged to be terminally ill **Diagnostic criteria**: admitted to oncology, orthopaedics or urology wards
Interventions	An a la carte menu of small dishes enriched with natural energy-dense ingredients and supplemented with protein powder **Number of trial centres**: 1 **Treatment before trial:** not stated
Outcomes	**Outcomes reported in abstract of publication**: percent reaching their calculated energy and protein requirements, mean energy and protein intake, body weight, handgrip strength, LOS, mortality
Study details	**Run-in period:** 5 weeks to ensure optimal staff training. Recruitment started at the end of the run-in **Was trial terminated early**: no
Publication details	**Language of publication:** English **Funding:** commercial funding - protein powder donated by Toft Care System, Copenhagen, Denmark. Study funded by Herlev University Hospital Research Unit **Publication status:** peer review journal
Stated aim for study	Quote "to investigate whether a novel food service concept with protein supplementation would increase protein and energy intake in hospitalised patients at nutritional risk".
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	**Quote from paper:** "The allocation sequence was generated by a secretary who was not otherwise involved in the trial"
Allocation concealment (selection bias)	Low risk	**Quote from paper:** "using sealed opaque envelopes, with a total of 9 blocks each with 10 envelopes"
Blinding of participants and personnel (performance bias) All outcomes	High risk	**Comment:** participants and study personnel were not blinded to group allocation. Blinding of participants would not be possible due to the nature of the intervention
Blinding of outcome assessment (detection bias) All outcomes	High risk	**Comment:** data assessors were not blinded to group allocation. Blinding of the assessors was judged by the authors to be difficult as participants were likely to reveal their group allocation. The analyses were conducted blinded to group allocation
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** three participants did not receive the intervention and so not included in the study

Munk 2014 *(Continued)*

Selective reporting (reporting bias)	Low risk	**Comment:** all outcomes specified in the methods reported
Other bias	Low risk	**Comment:** baseline characteristics fully reported; control and intervention groups comparable at baseline

Nijs 2006

Methods	**Cluster-randomised controlled clinical trial** **Randomisation ratio:** 1:1 **Superiority design**
Participants	**Inclusion criteria**: nursing homes: medium sized, with a general population, two wards for people with chronic somatic diseases, long-term or permanent stay, located in different parts of the country, similar for staff numbers, disciplines, education levels of carers, newness of infrastructure, location and residents' activities **Exclusion criteria**: not stated **Diagnostic criteria**: not stated
Interventions	**Number of trial centres**: 5 **Treatment before trial:** none
Outcomes	**Outcomes reported in abstract of publication**: dietary intake, MNA score
Study details	**Run-in period:** 2-month run-in to allow nurses to accommodate the change in organisation **Was trial terminated early**: no
Publication details	**Language of publication:** English **Funding:** non-commercial funding **Publication status:** peer review journal
Stated aim for study	Quote from publication: "to investigate the effect of family-style meals on energy intake and the risk of malnutrition in Dutch nursing home residents"
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	**Quote from paper:** "The wards' name with the initial letter occurring first in the alphabet became the intervention ward". **Comment:** the randomisation was based on the ward name and therefore predictable
Allocation concealment (selection bias)	High risk	**Comment:** no concealment

Nijs 2006 *(Continued)*

Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	**Comment:** not done, but probably not possible to do
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	**Comment:** not stated
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** all participants are fully accounted for
Selective reporting (reporting bias)	Low risk	**Comment:** all outcomes reported
Other bias	High risk	**Assessment of risk of bias in cluster-randomised trials** (1) Recruitment bias: unclear (2) Baseline imbalance: age, sex (3) Loss of clusters: unclear (4) Incorrect analysis: no (5) Comparability with individually randomised trials / different types of clusters: unclear

Olofsson 2007

Methods	**Parallel randomised controlled clinical trial** **Randomisation ratio:** 1:1 **Superiority design**
Participants	**Inclusion criteria**: femoral neck fracture; > 70 years old; admitted to orthopaedic wards **Exclusion criteria**: severe rheumatoid arthritis, hip osteoarthritis or renal failure or metastatic fracture and bed-ridden before the injury **Diagnostic criteria**: femoral neck fracture
Interventions	**Number of trial centres**: 1 **Treatment before trial:** none **Complex intervention:** staff education; team work, individual care planning; prevention and treatment of delirium and complications; nutrition; rehabilitation; secondary prevention of falls and fractures; osteoporosis prophylaxis
Outcomes	**Outcomes reported in abstract of publication**: days of delirium; decubitus ulcers; length of stay; BMI, body weight; MNA score
Study details	**Run-in period:** none **Was trial terminated early**: no
Publication details	**Language of publication:** English

Olofsson 2007 *(Continued)*

	Funding: non-commercial funding - Borgerskapt in Umea Research Foundation; the Dementia Fund; the Vardal foundation; the Joint committee of the Northern Health Region of Sweden; the JC Kempe Memorial Foundation; the Foundation for the Medical Faculty, University of Umea, local councils and the Swedish Research Council **Publication status:** peer review journal
Stated aim for study	Quote from publication: "To investigate whether a nutritional intervention which was part of a multi-factorial intervention programme for old women and men with a femoral neck fracture had any effect on post-operative complications during hospitalisation and on nutritional status at four months follow-up"
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Quote from paper:** "Patients were randomised to post op care in a geriatric ward with a special intervention programme or to conventional care in the orthopaedic department. All participants received an envelope while in the emergency room, but it was not opened until immediately before surgery...." **Comment:** insufficient detail of method provided
Allocation concealment (selection bias)	Low risk	**Comment:** "sealed opaque envelopes stratified by operation"; envelopes opened by a nurse not involved in the study
Blinding of participants and personnel (performance bias) All outcomes	High risk	**Comment:** not blinded; staff on the control ward knew that a new programme was being implemented on another ward in the hospital
Blinding of outcome assessment (detection bias) All outcomes	Low risk	**Comment:** assessments on the intervention ward were carried out by a nurse on the control ward and vice versa. A specialist in geriatric medicine who was not working in either of the two departments, and did not know which groups the patients were randomised to, analysed all the outcomes
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** fully described
Selective reporting (reporting bias)	Low risk	**Comment:** all outcomes fully reported
Other bias	Unclear risk	**Comment:** baseline characteristics reported; groups comparable apart from prevalence of heart failure

Pivi 2011

Methods	**Parallel randomised controlled clinical trial** **Randomisation ratio:** 1:1:1 **Superiority design**
Participants	**Inclusion criteria**: > 65 years old with probable Alzheimer's disease (AD)

Pivi 2011 *(Continued)*

	Exclusion criteria: other forms of dementia; receiving tube feeding; diabetes or renal disease **Diagnostic criteria**: Alzheimer's disease
Interventions	**Number of trial centres**: 1 **Treatment before trial:** no
Outcomes	**Outcomes reported in abstract of publication**: weight; BMI; MAC and ;MAMC; TSF; total protein; total lymphocyte count
Study details	**Run-in period:** none **Was trial terminated early**: no
Publication details	**Language of publication:** English **Funding:** commercial/non-commercial funding - Ministry of Education; Abbott Laboratories **Publication status:** peer review journal
Stated aim for study	Quote from publication: "To determine if there is any difference between oral nutritional supplementation and nutrition education on the nutritional status of patients with AD"
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Quote from paper:** "subjects were randomised into three groups....." **Comment:** insufficient detail of method provided
Allocation concealment (selection bias)	Unclear risk	**Comment:** not described
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	**Comment:** not described
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	**Comment:** not described
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** fully described
Selective reporting (reporting bias)	Low risk	**Comment:** fully reported
Other bias	Unclear risk	**Comment:** baseline characteristics reported; groups comparable

Potter 2001

Methods	**Parallel randomised controlled clinical trial**

Potter 2001 *(Continued)*

	Randomisation ratio: 1:1 **Superiority design**
Participants	**Inclusion criteria**: emergency admissions to medicine for the elderly unit (aged over 60), emergency admissions from home, ability to gain consent from participants or relatives, no known malignancy, ability to swallow, non obesity, BMI < 75th percentile. **Exclusion criteria**: overweight (BMI >75th percentile), in terminal stage of illness, or had swallow difficulty preventing oral intake **Diagnostic criteria**: unwell elderly people
Interventions	Intervention group received 120 mL sip feed 3 x daily throughout hospitalisation. The usual care received normal ward diet **Number of trial centres**: 1 - medicine for the elderly unit in a Scottish Hospital **Treatment before trial:** none
Outcomes	**Outcomes reported in abstract of publication**: anthropometry, mortality, length of hospital stay, functional recovery, rates of institutionalisation, patient compliance with supplement, total energy intake, nursing staff views of the method
Study details	**Run-in period:** no **Was trial terminated early**: no
Publication details	**Language of publication:** English **Funding:** commercial/other funding - Chief Scientist's Office of Scottish Office, and Frusenius UK **Publication status:** peer review journal
Stated aim for study	Quote from publication: "to assess whether prescription of oral sip-feed supplements in small quantities in the medicine prescription chart and distribution at medication rounds could increase total energy intake and provide sufficient energy to prevent nutritional decline" (Roberts 2003)
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Quote from paper:** "Patients were assigned to the intervention arm randomly..." **Comment:** not described in sufficient detail
Allocation concealment (selection bias)	Unclear risk	**Quote from paper:** "using sealed envelopes containing allocation specification" **Comment:** insufficient detail provided of sequential numbering or whether envelopes were opaque
Blinding of participants and personnel (performance bias) All outcomes	Low risk	**Quote from publication**: "Supplement prescription was done by researchers who knew the randomisation codes, and were not involved in outcome data collection, nor data entry to allow blinding"

Potter 2001 *(Continued)*

Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	**Quote from publication**: "The researchers who performed the anthropometry and assessed the clinical outcomes, were blinded to the intervention status of the patients"
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	**Comment:** outcomes reported in relation to BMI and TSF, but not BMI and TSF data alone
Selective reporting (reporting bias)	High risk	**Comment:** one or more outcomes of interest to the review were reported incompletely, so they could not be entered into the meta-analysis
Other bias	High risk	**Comment:** in the well-nourished group, only 1/2 were sequentially randomised

Remsburg 2001

Methods	**Parallel randomised controlled clinical trial** **Randomisation ratio:** 1.1 **Superiority design**
Participants	**Inclusion criteria**: older than 65 years, on a soft or normal diet **Exclusion criteria**: medically unstable, active malignancy or HIV, creatinine > 260 micromols/L, complex dietary needs **Diagnostic criteria**: nursing home residents
Interventions	**Number of trial centres**: 1 **Treatment before trial:** none specific
Outcomes	**Outcomes reported in abstract of publication**: no abstract
Study details	**Run-in period:** none **Was trial terminated early**: no
Publication details	**Language of publication:** English **Funding:** non-commercial funding - Johns Hopkins University Fund for Geriatric Medicine and Nursing **Publication status:** peer review journal
Stated aim for study	Quote from publication: "To determine the feasibility of implementing a comprehensive buffet-style dining program and to determine the impact of the program on weight and biochemical indicators of nutritional status among nursing home residents..."
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Quote from paper:** described as "subjects were randomised to participate"

Remsburg 2001 *(Continued)*

		Comment: no details of procedure provided
Allocation concealment (selection bias)	Unclear risk	**Comment:** no detail
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	**Comment:** no information
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	**Comment:** no information
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** reported in footnotes of table 2
Selective reporting (reporting bias)	Unclear risk	**Comment:** insufficient information to judge
Other bias	Low risk	**Comment:** baseline characteristics comparable. Significantly more men in the usual care

Salva 2011

Methods	**Cluster-randomised controlled clinical trial** **Randomisation ratio:** 1:1 **Superiority design**
Participants	946 participants with dementia; mean age 79 (SD 7.3) years; 644 female: 302 male **Inclusion criteria**: diagnosis of mild-moderate dementia; MMSE ≤ 26; living at home; ambulatory with identified care giver **Exclusion criteria**: MMSE > 26; residents in an institution; nasogastric feeding; terminal care; already participating in a nutrition intervention study **Diagnostic criteria**: dementia (diagnosed using DSM4 criteria)
Interventions	A standardised protocol for feeding and nutrition comprising 5 components; personalised information pack handed to participants and carers, 4 training sessions given by a dietitian to families and caregivers, support in monitoring weight, periodic information for families, standardised action protocols **Number of trial centres**: 11 outpatient clinics and day hospital units (intervention N = 6; control N = 5) **Treatment before trial:** none
Outcomes	**Outcomes reported in abstract of publication**: ADL; MNA; Caregiver Burden Scale
Study details	**Run-in period:** none **Was trial terminated early**: no
Publication details	**Language of publication:** English **Funding:** commercial funding - Nestec Limited

Salva 2011 *(Continued)*

	Publication status: peer review journal
Stated aim for study	Quote from publication: "To assess the effectiveness of a health and nutrition programme (NurtiALZ) versus usual care on functional level in elderly people with dementia living at home, as well as on clinical practice related to nutrition and on the caregivers burden"
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Quote from paper:** "The unit of randomisation was the medical centres..." **Comment:** insufficient detail of the method provided
Allocation concealment (selection bias)	Unclear risk	**Comment:** not described
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	**Comment:** not described
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	**Comment:** not described
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** all participants and dropouts fully accounted for
Selective reporting (reporting bias)	Low risk	**Comment:** all fully reported
Other bias	High risk	**Assessment of risk of bias in cluster-randomised trials** (1) Recruitment bias: no (2) Baseline imbalance: frail status (3) Loss of clusters: no (4) Incorrect analysis: no (5) Comparability with individually randomised trials/different types of clusters: different types of clusters

Silver 2008

Methods	**Cross-over randomised controlled clinical trial** **Randomisation ratio:** 1:1 **Superiority design**
Participants	**Inclusion criteria**: greater than 60 years and receiving home-delivered lunch meals

Silver 2008 *(Continued)*

	Exclusion criteria: chewing or swallowing dysfunction, need for feeding assistance, an eating disorder, depression, impaired functional status, dementia, BMI $\leq$ 30 kg/m^2, medically-restricted diet on oral nutritional supplements, on orexigenic aids, regularly skip meals, smoke, more than 1 alcoholic drink per day **Diagnostic criteria**: not stated
Interventions	**Number of trial centres**: not applicable, participants are free-living **Treatment before trial:** not stated
Outcomes	**Outcomes reported in abstract of publication**: energy intake, key macro-nutrients and micronutrients are mentioned but data not presented
Study details	**Run-in period:** none **Was trial terminated early:** no
Publication details	**Language of publication:** English **Funding:** non-commercial funding - Retirement research Foundation, Chicago, Illinois **Publication status:** peer review journal
Stated aim for study	Quote from publication: "To determine whether enhancing the energy density of food items regularly served in a home delivered meals programme would increase lunch and 24 hour energy and nutrient intakes"
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Quote from paper:** "The experiment used a randomized crossover within-subjects design" **Comment:** insufficient detail of method provided
Allocation concealment (selection bias)	Unclear risk	**Comment:** no detail
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	**Comment:** no information
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	**Comment:** no information
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	**Comment:** 7 participants dropped out but reasons not given, and unclear from which group they dropped out
Selective reporting (reporting bias)	Low risk	**Comment:** the outcomes specified in the methods are reported in the results

Silver 2008 *(Continued)*

Other bias	Unclear risk	**Comment:** no table of baseline characteristics. The information on need for assistance with shopping and preparation of food and recent weight loss suggests heterogeneity in the population

Simmons 2008

Methods	**Cluster- and cross-over randomised controlled clinical trial** **Randomisation ratio:** 1:1 **Superiority design**
Participants	**Inclusion criteria**: long-stay residents in a care home; free of feeding tube, not receiving palliative care, not on planned weight loss diet **Exclusion criteria**: not explicitly stated **Diagnostic criteria**: not stated
Interventions	**Number of trial centres**: 4 care homes **Treatment before trial:** not stated
Outcomes	**Outcomes reported in abstract of publication**: energy intake, weight change; staff time to provide interventions
Study details	At baseline all eligible participants were assessed for responsiveness (15% increase in energy intake) to one of 2 interventions (i.e. feeding assistance or between-meal snacks). This was a 2-phase cross-over trial where residents not eligible in the first phase were re-evaluated for possible inclusion in the second phase and residents included in the first phase were re-evaluated and could become ineligible for the second phase (based on adequacy of energy intake) **Run-in period:** not stated **Was trial terminated early**: no
Publication details	**Language of publication:** English **Funding:** non-commercial funding - National Institute of Aging and National Institute of Health, University of California, LA **Publication status:** peer review journal
Stated aim for study	Quote from publication: "To evaluate the effect of two feeding assistance interventions (meal time assistants and between meal snack delivery) on residents oral food and fluid intake, BMI and weight status when maintained by research staff for 24 weeks"
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	**Quote from publication**: "Participants were randomised at the facility level..., the four nursing homes were identified as intervention or control (in pairs of two) using a toss of the coin...."

Simmons 2008 *(Continued)*

Allocation concealment (selection bias)	Unclear risk	**Comment:** not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	**Comment:** no blinding and outcome likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) All outcomes	High risk	**Comment:** no blinding and outcome likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	**Comment:** numbers are described in text and appendix. Mortality given as a reason for most dropouts (58%), but the remaining reasons are not described.
Selective reporting (reporting bias)	Unclear risk	**Comment:** insufficient information to judge
Other bias	High risk	**Comment:** baseline characteristics presented for total numbers of participants in each group (phase 1 and 2 combined) **Assessment of risk of bias in cluster-randomised trials** (1) Recruitment bias: no (2) Baseline imbalance: frail status (3) Loss of clusters: no (4) Incorrect analysis: no (5) Comparability with individually randomised trials/different types of clusters: different types of clusters

Simmons 2010

Methods	**Parallel randomised controlled clinical trial** **Randomisation ratio:** 1:1:1 **Superiority design**
Participants	**Inclusion criteria**: long stay residents; free of feeding tube; not receiving hospice care; identified for nutritional supplementation **Exclusion criteria**: not stated **Diagnostic criteria**:
Interventions	**Number of trial centres**: 3 **Treatment before trial:** not stated
Outcomes	**Outcomes reported in abstract of publication**: energy intake, staff time and costs
Study details	**Run-in period:** not stated **Was trial terminated early**: no

Simmons 2010 *(Continued)*

Publication details	**Language of publication:** English **Funding:** non-commercial funding - National Alzheimer's Association and National Institute for Aging **Publication status:** peer review journal
Stated aim for study	Quote from publication: "To determine the cost effectiveness of supplements relative to offering residents snack foods and fluids between meals to increase caloric intake"
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Quote from paper:** "Participants....were randomised into one of three groups" **Comment:** insufficient detail of method provided
Allocation concealment (selection bias)	Unclear risk	**Comment:** no detail provided
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	**Comment:** insufficient detail
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	**Comment:** insufficient detail
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** fully reported
Selective reporting (reporting bias)	Unclear risk	**Comment:** insufficient detail to judge
Other bias	Unclear risk	**Comment:** baseline characteristics reported for whole study population and not according to group allocation

Smoliner 2008

Methods	**Cluster-randomised controlled clinical trial** **Randomisation ratio:** 1:1 **Superiority design**
Participants	**Inclusion criteria**: MNA score ≤ 23.5 points **Exclusion criteria**: MNA >23.5 points, severe cognitive impairment, on enteral feeding, hospital stay ≥ 6 days during the study period **Diagnostic criteria**: not stated
Interventions	**Number of trial centres**: 3 care homes

Smoliner 2008 *(Continued)*

	Treatment before trial: not stated
Outcomes	**Outcomes reported in abstract of publication**: protein and energy intake, nutritional status and body composition, muscle function and physical function
Study details	**Run-in period:** not stated **Was trial terminated early**: no
Publication details	**Language of publication:** English **Funding:** commercial funding - Schubert Holding Ag & Co, KG **Publication status:** peer review journal
Stated aim for study	Quote from publication: "To evaluate the effect of a 12 week nutritional intervention with protein and energy enriched food and snacks on nutritional and functional status in elderly nursing home residents at risk of malnutrition"
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Quote from paper:** "Randomisation was done according to ward...." **Comment:** insufficient detail of the method provided
Allocation concealment (selection bias)	Unclear risk	**Comment:** no detail
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	**Comment:** no information
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	**Comment:** no information
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** fully described and figure 1
Selective reporting (reporting bias)	Unclear risk	**Comment:** no protocol available
Other bias	High risk	**Assessment of risk of bias in cluster-randomised trials** (1) Recruitment bias: unclear (2) Baseline imbalance: length of stay, number of medications, SF-36 physical functioning score (3) Loss of clusters: unclear (4) incorrect analysis: yes (5) Comparability with individually randomised trials/different types of clusters: unclear

Splett 2003

Methods	**Cluster-randomised controlled clinical trial** **Randomisation ratio:** 1:1 **Superiority design**
Participants	**Inclusion criteria**: people entering residential care facilities with service provided by a dietitian **Exclusion criteria**: people entering a hospice or respite care programme or those expected to have a stay < 30 days **Diagnostic criteria**: varied
Interventions	**Number of trial centres**: 29 **Treatment before trial:** 57% intervention group and 61% usual care had previous dietary modification and 25% intervention and 35% control received help at mealtimes
Outcomes	**Outcomes reported in abstract of publication**: rate of unintentional weight loss, weight status 90 days after admission and weight status 90 days after identification of unintentional weight loss
Study details	**Run-in period:** none **Was trial terminated early**: no
Publication details	**Language of publication:** English **Funding:** not stated **Publication status:** peer review journal
Stated aim for study	Quote from publication: "To assess the effectiveness of a new medical nutrition therapy protocol for the prevention and treatment of unintentional weight loss and describe nutrition assessment and intervention activities of dietitians"
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	**Quote from publication: ".. ** facilities were randomly assigned to either the medical nutrition therapy protocol care group (MNTPC) or the usual care (UC) group using a random numbers table"
Allocation concealment (selection bias)	Unclear risk	**Comment:** not described
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	**Comment:** not described
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	**Comment:** not described

Splett 2003 *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** fully described
Selective reporting (reporting bias)	Low risk	**Comment:** all outcomes reported
Other bias	High risk	**Assessment of risk of bias in cluster-randomised trials** (1) Recruitment bias: unclear (2) Baseline imbalance: number of diagnoses (3) Loss of clusters: unclear (4) Incorrect analysis: yes (5) Comparability with individually randomised trials/different types of clusters: unclear

Taylor 2006

Methods	**Cross-over randomised controlled clinical trial** **Randomisation ratio:** 1:1 **Superiority design**
Participants	**Inclusion criteria**: aged ≥ 65 years; dysphagia (diagnosed by swallowing team); receiving a texture modified diet **Exclusion criteria**: tube-fed; medically unstable; receiving a diabetic diet **Diagnostic criteria**: not stated
Interventions	**Number of trial centres**: 1 **Treatment before trial:** not stated
Outcomes	**Outcomes reported in abstract of publication**: energy and fluid intakes
Study details	**Run-in period:** not stated **Was trial terminated early**: no
Publication details	**Language of publication:** English **Funding:** non-commercial funding - Canadian Foundation for Dietetic Research **Publication status:** peer review journal
Stated aim for study	Quote from publication: "To determine whether serving a 5 meal pattern versus a traditional 3 meal pattern would improve energy intake among elderly, extended care residents with dysphagia"
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement

Taylor 2006 *(Continued)*

Random sequence generation (selection bias)	Unclear risk	**Quote from paper:** "Participants were randomly assigned to one of two groups." **Comment:** insufficient detail of method provided
Allocation concealment (selection bias)	Unclear risk	**Comment:** not reported
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	**Comment:** not reported
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	**Comment:** not reported
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	**Comment:** reason for dropouts reported, however unclear from which groups they dropped out
Selective reporting (reporting bias)	Unclear risk	**Comment:** insufficient information to judge
Other bias	Unclear risk	**Comment:** baseline characteristics reported in the text; homogeneous population

Van den Berg 2015

Methods	**Parallel randomised controlled clinical trial** **Randomisation ratio: 2:1** (2 intervention groups and 1 control) **Superiority design**
Participants	834 people newly admitted to hospital; mean age intervention 1: 70.5 (SD 15) years, intervention 2: 72.6 (SD 10) years; control 70.4 (SD 13) years; 105 female: 129 male **Inclusion criteria**: new admissions to internal medicine and surgical wards, ≥ 18 years old scoring ≥ 3 on the SNAQ, who were advised to take ONS by the dietitian **Exclusion criteria**: < 18 years old, dysphagia, end-stage renal disease, people receiving enteral or parenteral nutrition, or with an expected length of stay < 3 days **Diagnostic criteria**: internal medicine**(**oncology, nephrology, cardiology, pulmonary disease, internal gastroenterology, gynaecology, urology wards, neurology & geriatrics & surgical (orthopaedics, gastroenterology, vascular and trauma)
Interventions	ONS offered during the medication rounds either 125 mL twice a day or 62 mL four times a day vs usual care (125 mL ONS offered during meals) **Number of trial centres**: 1 **Treatment before trial:** none stated
Outcomes	**Outcomes reported in abstract of publication**: percentage of participants consuming at least 75% of prescribed ONS, mean intake (mL) of ONS

Van den Berg 2015 *(Continued)*

Study details	**Run-in period: n**one **Was trial terminated early**: no
Publication details	**Language of publication:** English **Funding:** Study funded by Deventer Hospital, the Netherlands. (No commercial funding and the ONS was not donated) **Publication status:** peer review journal
Stated aim for study	Quote "to investigate whether the distribution of ONS during medication rounds, either in 2 higher volumes or in 4 lower volumes, would increase the intake of the supplements and to evaluate its effects on patient compliance with consumption of the ONS
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	**Quote from publication**: "Computerised random number system"
Allocation concealment (selection bias)	Low risk	**Quote from publication**: "concealed blinded envelopes"
Blinding of participants and personnel (performance bias) All outcomes	High risk	**Quote from publication**: "it is not possible to perform a blinded study for nutritional support" **Comment**: the participants and personnel were not blinded to intervention group
Blinding of outcome assessment (detection bias) All outcomes	High risk	**Comment:** outcomes were not assessed blinded to study group
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** attrition fully described, 31 patients refused the ONS during the study but were included in the analysis, 42 patients were discharged within 2 days of follow-up and were excluded from analyses
Selective reporting (reporting bias)	Low risk	**Comment:** all specified outcomes were reported
Other bias	Low risk	**Comment:** baseline characteristics fully reported and groups similar at baseline

Van Ort 1995

Methods	**Parallel randomised controlled clinical trial** **Randomisation ratio:** 1:1 **Superiority design**
Participants	**Inclusion criteria**: required feeding assistance by a caregiver (nurse and/or nursing assistant), were able to sit in a chair for feeding, were responsive to human interaction, were not usually restrained during feeding, were not usually combative

Van Ort 1995 *(Continued)*

	Exclusion criteria: not given **Diagnostic criteria**: not stated
Interventions	2 treatments were applied to the intervention group (contextual intervention and behavioural intervention). It was unclear whether interventions were given together, or given one after the other. 2 complete lunches and two dinners in week 1, and 3 lunches and dinners in week 2 were video tape-recorded **Number of trial centres**: 1 **Treatment before trial:** none
Outcomes	**Outcomes reported in abstract of publication**: no abstract
Study details	**Run-in period:** no **Was trial terminated early**: no
Publication details	**Language of publication:** English **Funding:** non-commercial funding; "This study was supported by a 1991 Christian P. Voltz Memorial Pilot Grant Award from the Alzheimers Association" **Publication status:** peer review journal
Stated aim for study	Quote from publication: "the interventions were designed to first create a feeding context or environment that promoted function by being as "near normal" as possible and by removing barriers to function, and second to provide randomly selected patients with behavioural prompts, cues and reinforcements for self feeding approximations"
Notes	-

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Quote from paper:** "Then four of the eight subjects were randomly selected to receive the intervention...." **Comment:** insufficient details of the procedure
Allocation concealment (selection bias)	Unclear risk	**Comment:** insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	**Comment:** insufficient information to permit judgement - study stated "the project research associates were blind to the specific study hypothesis", however their role in the study unclear
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	**Comment:** the research associates were responsible for implementing the behavioural intervention. On analysing the video tapes, they were blinded to the study hypotheses, however no statement to say they were blinded to the study interventions
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	**Comment:** insufficient reporting of attrition/exclusions to permit judgement. The number of dropouts were stated, however it was unclear from which group

Van Ort 1995 *(Continued)*

Selective reporting (reporting bias)	High risk	**Comment:** the study report failed to include results for key outcomes that would be expected to have been reported for such a study - the study does not provide any data
Other bias	Unclear risk	**Comment:** no baseline characteristics reported, therefore insufficient information to assess whether an important risk of bias exists

ADL: activities of daily living; BMI: body mass index; EdFED: Edinburgh Feeding Evaluation in Dementia; HIV: human immunodeficiency virus; MAC: mid-arm circumference; MAMC: mid-arm muscle circumference; MMSE: Mini Mental State Examination; MNA: Mini Nutritional Assessment; MoW: meals on wheels; MSG: monosodium glutamate; MUAC: mid upper-arm circumference; NRS: Nutritional Risk Screening; ONS: oral nutritional supplement; PGCMS: Philadelphia Geriatric Centre Morale Scale; SD: standard deviation; SE: standard error; SGA: subjective global assessment; SIP: sickness impact profile; SNAQ: Simplified Nutritional Appetite Questionnaire; TSF: triceps skin fold

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Aleman-Mateo 2012	Not a supportive intervention in nutritional care; intervention included individual advice on taking ONS as participants were free-living
Allman 1990	Not a supportive intervention in nutritional care; ONS prescribed on an individualised basis, as dietary advice was given, and participants had to follow instructions to take ONS at home
Arias 2008	Not a supportive intervention; intervention is an ONS with no mention of supportive strategy to support administration
Asplund 2000	Not a supportive intervention in nutritional care; looked at the effect of residence in an acute geriatrics-based ward, outcomes not relevant to this review
Baldwin 2011	Not a supportive intervention in nutritional care; individualised interventions therefore participants were required to understand and follow instructions
Banerjee 1978	Not a supportive intervention in nutritional care; intervention was described, however no clear organisational component to the intervention was given
Bauer 2005	Not a supportive intervention in nutritional care; intervention was described, however no clear organisational component to the intervention was given. The intervention was also micronutrient-specific
Beattie 2000	Not a supportive intervention in nutritional care; no clear organisational component to the intervention was described, and the intervention was continued post hospital discharge, therefore participants would have been given individual advice on taking ONS
Beck 2008	Not a supportive intervention in nutritional care; but a multicomponent intervention, therefore unable to extract specific effect of nutrition component
Benati 2001	The intervention included supplementation with ONS but there was no indication that a supportive protocol was used to support the intervention
Bonjour 2011	Not a supportive intervention in nutritional care; intervention involved calcium and vitamin D supplementation
Bonjour 2012	Not a supportive intervention in nutritional care; unclear nutritional risk of participants
Bonnefoy 2003	Not a supportive intervention in nutritional care but a multicomponent intervention, therefore unable to extract specific effect of nutrition component

Study	Reason for exclusion
Bos 2001	Not a RCT
Botella-Carretero 2008	Not a supportive intervention in nutritional care; intervention continued post hospital discharge, therefore participants would have been given individual advice on taking ONS
Botella-Carretero 2010	Not a supportive intervention in nutritional care; ONS prescribed on an individualised basis, and tailored to texture and estimated nutritional requirements
Boudville 2003	Not a supportive intervention in nutritional care; intervention given to outpatients, therefore participants would have been given individual advice on taking ONS
Bunout 1989	Not a supportive intervention in nutritional care; ONS tailored to body weight/nutritional requirements, therefore prescribed on an individualised basis
Bunout 2001	Not a randomised control trial; the nutritional intervention was not randomised but the exercise intervention was
Carlsson 2011	Not a supportive intervention in nutritional care but a multicomponent intervention, therefore unable to extract specific effect of nutrition component
Carnaby 2006	Not a supportive intervention in nutritional care; intervention specific to stroke participants with dysphagia hence scope not considered broad enough to be a supportive intervention in nutritional care
Charlin 2002	Not a supportive intervention in nutritional care; intervention given to outpatients, therefore participants would have been given individual advice on taking ONS
Charras 2010	Not a randomised controlled trial
Chernoff 1990	Not a supportive intervention in nutritional care; artificial support was given via non oral route, enteral tube feeding
Chin 2001	Not a supportive intervention in nutritional care; micronutrient supplementation study; usual care had non-enriched 'product'
Collins 2005	Not a supportive intervention in nutritional care; intervention given to outpatients, therefore participants would have been given individual advice on taking ONS
Dangour 2011	Not a supportive intervention in nutritional care; intervention given to outpatients, therefore participants would have been given individual advice on taking an ONS
De Jong 1999	Not a supportive intervention in nutritional care; a micronutrient enrichment intervention
de Sousa 2012	Not a supportive intervention in nutritional care; intervention was described, however no clear organisational component to the intervention was given
Delmi 1990	Not a supportive intervention in nutritional care; intervention was described, however no clear organisational component to the intervention was given
Dhanraj 1997	Not a supportive intervention in nutritional care; artificial support was given via non oral route (nasogastric feeding); no usual care comparison; some participants < 18 yrs; individualised nutritional care given
Dillabough 2011	Not a RCT; article describing a pilot quality improvement project

Study	Reason for exclusion
Edington 2004	Not a supportive intervention in nutritional care; ONS tailored to individual estimated nutritional requirements, therefore prescribed on an individualised basis
Elkort 1981	Not a supportive intervention in nutritional care; ONS tailored to individual estimated nutritional requirements, therefore prescribed on an individualised basis
Endevelt 2011	Not a supportive intervention in nutritional care; intervention was individualised
Eneroth 2004	Not a supportive intervention in nutritional care; intervention given to outpatients, therefore participants would have been given individual advice on taking ONS
Espaulella 2000	Not a supportive intervention in nutritional care; intervention was described, however no clear organisational component to the intervention was given
Fiatarone 1994	Not a supportive intervention in nutritional care but a multicomponent intervention, therefore unable to extract specific effect of nutrition component
Forster 2005	Not a supportive intervention in nutritional care; intervention was described, however no clear organisational component to the intervention was given
Gall 1998	Not a RCT; controlled trial
Gariballa 1998	Not a supportive intervention in nutritional care; intervention was described, however no clear organisational component to the intervention was given
Gazzotti 2003	Not a supportive intervention in nutritional care; intervention continued post hospital discharge, therefore participants would have been given individual advice on taking ONS.
Gegerle 1986	Not a RCT; a dietary survey
Gil Gregorio 2003	Not a supportive intervention in nutritional care; intervention was described, however no clear organisational component to the intervention was given; unclear what the usual care received
Goris 2003	Not a supportive intervention in nutritional care; intervention continued post hospital discharge, therefore participants would have been given individual advice on taking ONS.
Hogarth 1996	Not a supportive intervention in nutritional care; intervention was described, however no clear organisational component to the intervention was given
Hopkinson 2010	Not a supportive intervention in nutritional care; study not aimed at increasing intake as related to psychological/coping mechanisms
Houles 2010	Not a supportive intervention in nutritional care but a multicomponent intervention, therefore unable to extract specific effect of nutrition component
Hubbard 2008	Not a supportive intervention in nutritional care; intervention was on dietary advice vs ONS, so no usual care comparison was given
Hubsch 1992	Not a supportive intervention in nutritional care; intervention was described, however no clear organisational component to the intervention was given
Huisman 2012	Not a supportive intervention in nutritional care; dietary counselling intervention
Isenring 2003	Not a supportive intervention in nutritional care; dietary counselling intervention
Isenring 2004	Not a supportive intervention in nutritional care; dietary counselling intervention

Study	Reason for exclusion
Jahnavi 2010	Not a supportive intervention in nutritional care; individualised intervention
James 2006	Not a supportive intervention in nutritional care; participants consumed ONS at will, intervention not identical for all participants
Johnson 1993	Not a RCT; retrospective case control study
Keele 1997	Not a supportive intervention in nutritional care; intervention continued post hospital discharge, therefore participants would have been given individual advice on taking ONS
Kikutani 2006	Not a supportive intervention in nutritional care; no usual care comparison was described; ONS intervention compared with oral functional training
Knowles 1988	Not a supportive intervention in nutritional care; intervention given to outpatients, therefore participants would have been given individual advice on taking ONS; intervention was tailored and targeted at increasing intake by 50% above normal
Krondl 1999	Not a supportive intervention in nutritional care; intervention given to outpatients, therefore participants would have been given individual advice on taking ONS
Kruizenga 2004	Not a RCT
Kuhlmann 1997	Not a supportive intervention in nutritional care; intervention given to outpatients, therefore participants would have been given individual advice on taking ONS
Kwok 2001	Not a supportive intervention in nutritional care; intervention was described, however no clear organisational component to the intervention was given
Kwok 2012	Not a supportive intervention in nutritional care; examined whether dietary interventions promoting intakes of fruit, vegetable, fish and lower salt, intake were effective in preventing cognitive decline in older people
Lauque 2000	Not a supportive intervention in nutritional care; intervention was described, however no clear organisational component to the intervention was given; intervention not identical for all participants, variety of oral nutritional support offered and dietitian visited sites regularly to direct product distribution and intake, hence likely tailoring
Lauque 2004	Not a supportive intervention in nutritional care; intervention not identical for all participants, variety of ONS offered ranging between 300-500 kcal therefore likely tailoring
Lawson 2000	Not a RCT
Le Cornu 2000	Not a supportive intervention in nutritional care; intervention given to outpatients, therefore participants would have been given individual advice on taking ONS
Lee 2013	Participants were selected for the intervention after group allocation on the basis of their nutritional status rather than before intervention, or by restricting the inclusion to malnourished participants only
Leon 2001	Not a supportive intervention in nutritional care; individualised intervention
Leon 2006	Not a supportive intervention in nutritional care; individualised intervention
Locher 2011	Not a supportive intervention in nutritional care; dietary advice intervention

Study	Reason for exclusion
MacFie 2000	Not a supportive intervention in nutritional care; intervention given initially to outpatients, therefore participants would have been given individual advice on taking ONS
Mamhidir 2007	Not an RCT
Manders 2006	Not a supportive intervention in nutritional care; intervention was described, however no clear organisational component to the intervention was given
McEvoy 1982	Not a supportive intervention in nutritional care; intervention was described, however no clear organisational component to the intervention was given
McMurdo 2009	Not a supportive intervention in nutritional care; intervention given to participants on discharge from hospital, therefore would have been given individual advice on taking ONS
Moretti 2009	Not a supportive intervention in nutritional care; intervention was given to outpatients, therefore participants would have been given individual advice on taking ONS
Navrátilová 2007	Not a supportive intervention in nutritional care; intervention was described, however no clear organisational component to the intervention was given
Nayel 1992	Not a supportive intervention in nutritional care; ONS tailored/individually prescribed according to requirements (deficit between requirements and intake)
Olin 1996	Not a RCT
Otte 1989	Not a supportive intervention in nutritional care; intervention given to community-dwelling participants, therefore would have been given individual advice on taking ONS
Payette 2002	Not a supportive intervention in nutritional care; intervention included individualised dietary counselling
Price 2005	Not a supportive intervention in nutritional care; intervention given to participants on discharge from hospital, therefore would have been given individual advice on taking ONS
Rana 1992	Not a supportive intervention in nutritional care; intervention not identical for all participants; participants were allowed to consume ONSat will hence not provided in controlled, routine fashion
Richeson & Neil 2004	Not a RCT; quasi-experimental time series
Roberts 2013	Not a RCT; the protocol for a controlled trial
Robinson 2002	Not a RCT
Rosendahl 2006	Not supportive intervention in nutritional care; but a multicomponent intervention, therefore unable to extract specific effect of nutrition component
Roy 2006	Not randomised control trial; quasi experimental design with an untreated usual care
Rypkema 2004	Not a RCT
Saudny-Unterberger 1997	Not supportive intervention in nutritional care; oral nutritional support tailored to nutritional requirements
Shinnar 1983	Not a RCT; observational study
Simmons 2004	Not a RCT; participants allocated according to ability to respond to individualised assistance

Study	Reason for exclusion
Smedley 2004	Not a supportive intervention in nutritional care; intervention not the same for all participants; participants encouraged to consume oral nutritional supplements at will hence not provided in controlled, routine fashion
Somanchi 2011	Not a RCT
Soneff 1994	Not a supportive intervention in nutritional care; outcomes reported at facility level, not participant level
Southgate 2010	Not a supportive intervention in nutritional care; personalised dietetic intervention
Starke 2011	Not a supportive intervention in nutritional care; individualised intervention
Stauffer 1986	Not a RCT: a prospective observational study
Steiner 2003	Not a supportive intervention in nutritional care; intervention was given to outpatients, therefore participants would have been given individual advice on taking ONS
Stotts 2009	Not a supportive intervention in nutritional care; intervention involved administration of supplemental fluid
Teixido-Planas 2005	Not a supportive intervention in nutritional care; intervention was given to outpatients, therefore participants would have been given individual advice on taking ONS
Tkatch 1992	Not a supportive intervention in nutritional care; intervention was described, however no clear organisational component to the intervention was given
Vetter 1992	Not a supportive intervention in nutritional care; multicomponent intervention; difficult to extract specific effect of nutrition component; included dietary advice
Vlaming 2001	Not a supportive intervention in nutritional care; intervention was described, however no clear organisational component to the intervention was given
Watanabe 2010	Not a RCT; appears to be a matched cohort
Williams 1989	Not a RCT
Wong 2010	Not a RCT
Woo 1994	Not a supportive intervention in nutritional care; intervention was given on hospital discharge, therefore participants would have been given individual advice on taking ONS
Wouters-Wesseling 2002	Not a supportive intervention in nutritional care; intervention was described, however no clear organisational component to the intervention was given
Wright 2006	Not a RCT; quasi-experimental
WY Lin 2010	Not a supportive intervention in nutritional care; multicomponent intervention; difficult to extract specific effect of nutrition component; the presence of a dietitian in the multidiciplinary team was the only difference between the two groups
Yamaguchi 1998	Not a supportive intervention in nutritional care; intervention was given to outpatients, therefore participants would have been given individual advice on taking ONS
Young 2004	Not a RCT

Study	Reason for exclusion
Ödlund Olin 2003	Not a RCT

ONS: oral nutritional supplement; RCT: randomised controlled trial

Characteristics of studies awaiting assessment *[ordered by study ID]*

Allen 2014

Methods	RCT
Participants	Participants with long-standing cognitive impairment in hospital or living in a residential care home
Interventions	Oral nutritional supplement drink provided 3 times a day in a glass/beaker or consumed through a straw inserted directly into the container
Outcomes	Amount of nutritional supplement drink consumed
Notes	Full data extraction has not yet been undertaken and will be completed at the next update

Borges 2003

Methods	
Participants	
Interventions	
Outcomes	
Notes	Requires translation, unable to locate abstract

Burns 1998

Methods	
Participants	
Interventions	
Outcomes	
Notes	Requires translation, unable to locate abstract

Deutz 2016

Methods	Randomised, placebo-controlled, double-blind trial

Deutz 2016 *(Continued)*

Participants	Older (> 65 years), malnourished adults hospitalised for congestive heart failure, acute myocardial infarction, pneumonia or chronic obstructive pulmonary disease
Interventions	Standard-of-care plus a high-protein oral nutritional supplement or a placebo supplement
Outcomes	Primary composite endpoint: 90-day postdischarge incidence of death or nonelective readmission; other endpoints: 30- and 60-day postdischarge incidence of death or readmission, length of stay, malnourishment class ()SGA, body weight, and ADL
Notes	Full data extraction has not yet been undertaken and will be completed at the next update

Ekinci 2016

Methods	RCT
Participants	Older female participants with a hip fracture
Interventions	The intervention group received an enteral product containing 3 g calcium beta-hydroxy-beta-methylbutyrate, 1000 IU vitamin D and 36 g protein, in addition to standard postoperative nutrition. The control group received standard postoperative nutrition
Outcomes	Wound-healing period, shortening of immobilisation period, muscle strength, BMI
Notes	Full data extraction has not yet been undertaken and will be completed at the next update

ISRCTN04327195

Methods	RCT
Participants	Undernourished geriatric inpatients
Interventions	Intervention group: energy dense, small volume oral nutritional supplements; control group: fortified foods
Outcomes	Primary outcome measure: number of participants achieving an extra intake of 450 kcal per day; secondary outcome measures: recommended energy and protein intakes, length of hospital stay, antibiotic usage
Notes	Retrospectively registered; trial end date: 15 May 2010

ISRCTN96923961

Methods	RCT
Participants	Malnutrition in the elderly
Interventions	Standard dietary care versus a high-energy supplement versus a high-energy supplement plus micronutrients
Outcomes	Primary outcome measure: nutrient intake; secondary outcome measures: gastro-intestinal tolerance, product compliance, appetite, anthropometry (weight and BMI), muscle function, measured

ISRCTN96923961 *(Continued)*

	by hand grip dynamometry, quality of life, measured using EuroQol EQ-5D questionnaire, blood lipids and micronutrients, safety, falls assessment measured using Berg Balance Scale
Notes	Retrospectively registered; trial end date: 30 December 2007

Jobse 2015

Methods	RCT
Participants	Nursing home residents with malnutrition or at risk of malnutrition
Interventions	Intervention group received 2 x 125 mL oral nutritional supplements for 12 weeks, and the control group received usual care
Outcomes	Body weight change, BMI, upper arm and calf-circumferences, MNA score
Notes	Full data extraction has not yet been undertaken and will be completed at the next update

Lee 2015

Methods	RCT
Participants	Older people living in a nursing home
Interventions	Each participant in the intervention group received a 50 g/day soy-protein-based nutritional supplement when he/she was rated as undernourished; all participants including those who were in the control group received the same normal meals and a light afternoon snack daily
Outcomes	Handgrip strength, Barthel index, anthropometric and biochemical indicators
Notes	Full data extraction has not yet been undertaken and will be completed at the next update

Leslie 2013

Methods	Cluster-randomised trial in 21 residential care homes
Participants	Undernourished residents with a BMI <18.5 kg/m^2
Interventions	Enrichment of meals to increase energy density
Outcomes	Nutritional intake, body weight, MUAC, BMI, mortality
Notes	Full data extraction has not yet been undertaken and will be completed at the next update

Luna-Ramos 2016

Methods	RCT

Luna-Ramos 2016 *(Continued)*

Participants	Elderly fragile, hospitalised participants
Interventions	Polymeric diet versus standard diet
Outcomes	Nutritional status, BMI, body weight
Notes	Full data extraction has not yet been undertaken and will be completed at the next update

Madigan 1994

Methods	Unclear
Participants	Elderly participants with fractured neck of femur
Interventions	Oral feed with protein and energy vs normal ward diet, followed up for 3 months post hospital discharge
Outcomes	Mortality, length of hospital stay, postoperative functional status, dietary intake, compliance
Notes	Unable to locate dissertation

Moore 2010

Methods	RCT
Participants	Older people with dementia living in a residential care home and an assisted living facility
Interventions	A 25-min activity offered 30 min before meal times (aiming to reduce apathy and agitation and to increase eating ability and intake
Outcomes	Apathy, agitation, eating ability, dietary intake
Notes	Full data extraction has not yet been undertaken and will be completed at the next update

Parsons 2016

Methods	RCT
Participants	Malnourished, care home residents
Interventions	Oral nutritional supplements or dietary advice
Outcomes	Health-related quality of life, nutritional intake
Notes	Full data extraction has not yet been undertaken and will be completed at the next update

Pouyssegur 2015

Methods	A multicentre RCT
Participants	Malnourished older adults living in nursing homes
Interventions	In addition to usual meals, the provision of eight cookies (30 kcals and 1.44 g protein) throughout the day
Outcomes	Body weight, appetite, occurrence of pressure ulcers, diarrhoea
Notes	Full data extraction has not yet been undertaken and will be completed at the next update

Scorer 1990

Methods	
Participants	
Interventions	
Outcomes	
Notes	Unable to locate paper

Simmons 2013

Methods	RCT
Participants	People living in residential care homes
Interventions	Staff training to improve feeding assistance
Outcomes	Mealtime feeding assistance, body weight
Notes	Full data extraction has not yet been undertaken and will be completed at the next update

Simmons 2015

Methods	RCT
Participants	Long-stay residents with orders for nutrition supplementation
Interventions	Usual care control group verus an oral liquid nutrition supplement intervention group, or a snack intervention group
Outcomes	Body weight, food, beverage and supplement intake and the amount of staff time spent providing assistance, cost-effectiveness
Notes	Full data extraction has not yet been undertaken and will be completed at the next update

Stelten 2015

Methods	Single-blind RCT
Participants	Acutely ill elderly participants admitted to hospital
Interventions	Protein-enriched bread and drinking yoghourt
Outcomes	Protein intake
Notes	Full data extraction has not yet been undertaken and will be completed at the next update

Stow 2015

Methods	Cluster-RCT
Participants	Care home residents with or at risk of malnutrition
Interventions	Standard care, food-based intervention or oral nutritional supplement intervention
Outcomes	Anthropometry, dietary intake, healthcare resource usage and participant-reported outcome measures
Notes	Registered trial: ISRCTN38047922 Full data extraction has not yet been undertaken and will be completed at the next update

Sutton 2006

Methods	
Participants	
Interventions	
Outcomes	
Notes	Unable to locate paper

Turano 1999

Methods	
Participants	
Interventions	
Outcomes	
Notes	Requires translation

White 1999

Methods	
Participants	
Interventions	
Outcomes	
Notes	Unable to locate paper

Zhong 2016

Methods	RCT and economic evaluation
Participants	Malnourished older hospitalised participants
Interventions	Nutrient-dense ONS, containing high protein and beta-hydroxy-beta-methylbutyrate versus placebo
Outcomes	Health-care costs, measured as the product of resource use and per unit cost, quality-adjusted life-years (QALYs), life-years saved and the incremental cost-effectiveness ratio
Notes	Full data extraction has not yet been undertaken and will be completed at the next update

ADL: activities of daily living; BMI: body mass index; MNA: Mini Nutritional Assessment; MUAC: mid upper-arm circumference; ONS: oral nutritional supplement; SGA: subjective global assessment

DATA AND ANALYSES

Comparison 1. Supportive interventions for enhancing dietary intake versus comparators

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 No. of participants with complications	5	4702	Risk Ratio (M-H, Random, 95% CI)	1.11 [0.86, 1.42]
1.1 Changes to the organisation of nutritional care	3	624	Risk Ratio (M-H, Random, 95% CI)	1.12 [0.76, 1.67]
1.2 Modification of meal profile or pattern	1	63	Risk Ratio (M-H, Random, 95% CI)	0.59 [0.06, 6.14]
1.3 Additional supplementation of meals	1	4015	Risk Ratio (M-H, Random, 95% CI)	1.14 [1.02, 1.28]
2 Nutritional status (weight change)	17	2024	Mean Difference (IV, Random, 95% CI)	0.62 [0.21, 1.02]

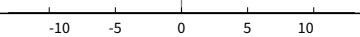
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
2.1 Changes to the organisation of nutritional care	6	1140	Mean Difference (IV, Random, 95% CI)	0.09 [-0.26, 0.45]
2.2 Changes to the feeding environment	1	39	Mean Difference (IV, Random, 95% CI)	-0.43 [-2.11, 1.25]
2.3 Modification of meal profile or pattern	5	253	Mean Difference (IV, Random, 95% CI)	1.16 [0.41, 1.92]
2.4 Additional supplementation of meals	4	475	Mean Difference (IV, Random, 95% CI)	0.90 [0.41, 1.38]
2.5 Congregate and home meal delivery systems	1	117	Mean Difference (IV, Random, 95% CI)	2.90 [1.00, 4.80]
3 Hospitalisation	5	667	Mean Difference (IV, Random, 95% CI)	-0.48 [-2.56, 1.59]
3.1 Changes to the organisation of nutritional care	3	515	Mean Difference (IV, Random, 95% CI)	-2.08 [-6.75, 2.58]
3.2 Modification of meal profile or pattern	1	81	Mean Difference (IV, Random, 95% CI)	0.0 [-3.48, 3.48]
3.3 Additional supplementation of meals	1	71	Mean Difference (IV, Random, 95% CI)	0.20 [-2.26, 2.66]
4 All-cause mortality	12	6683	Risk Ratio (M-H, Random, 95% CI)	0.78 [0.66, 0.92]
4.1 Changes to the organisation of nutritional care	4	1237	Risk Ratio (M-H, Random, 95% CI)	0.71 [0.52, 0.97]
4.2 Changes to the feeding environment	1	20	Risk Ratio (M-H, Random, 95% CI)	3.00 [0.14, 65.90]
4.3 Modification of meal profile or pattern	2	150	Risk Ratio (M-H, Random, 95% CI)	1.04 [0.15, 7.22]
4.4 Additional supplementation of meals	4	5073	Risk Ratio (M-H, Random, 95% CI)	0.77 [0.58, 1.02]
4.5 Congregate and home meal delivery systems	1	203	Risk Ratio (M-H, Random, 95% CI)	0.33 [0.09, 1.18]

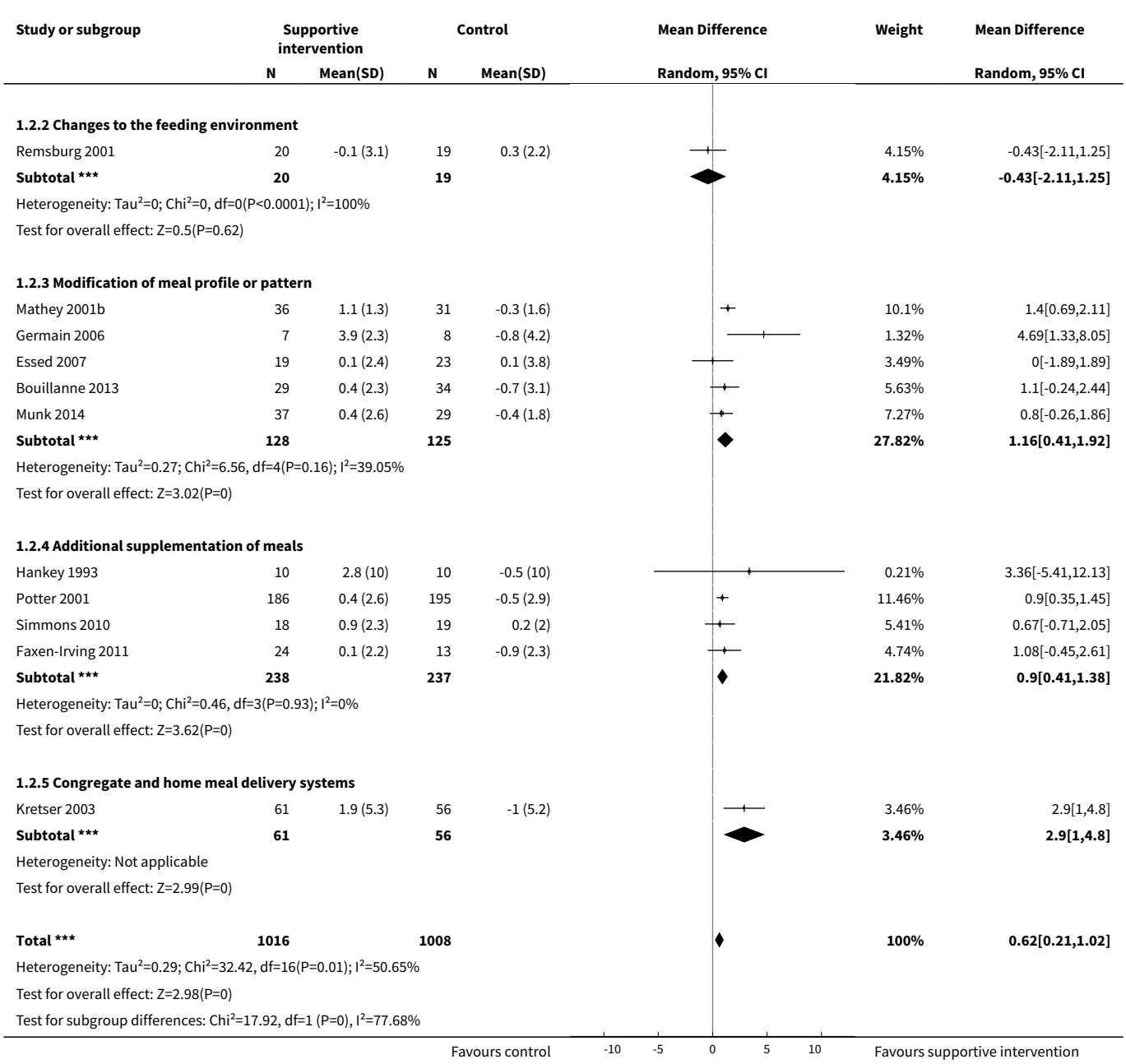
Analysis 1.1. Comparison 1 Supportive interventions for enhancing dietary intake versus comparators, Outcome 1 No. of participants with complications.

Study or subgroup	Supportive intervention n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
1.1.1 Changes to the organisation of nutritional care					
Johansen 2004	34/108	23/104		15%	1.42[0.9,2.24]
Duncan 2006	84/125	79/130		25.78%	1.11[0.92,1.33]
Olofsson 2007	81/83	74/74		29.77%	0.98[0.94,1.02]
Subtotal (95% CI)	**316**	**308**		**70.56%**	**1.12[0.76,1.67]**
Total events: 199 (Supportive intervention), 176 (Control)					
Heterogeneity: Tau^2=0.1; Chi^2=28.12, df=2(P<0.0001); I^2=92.89%					
Test for overall effect: Z=0.58(P=0.56)					
1.1.2 Modification of meal profile or pattern					
Bouillanne 2013	1/29	2/34		1.09%	0.59[0.06,6.14]
Subtotal (95% CI)	**29**	**34**		**1.09%**	**0.59[0.06,6.14]**
Total events: 1 (Supportive intervention), 2 (Control)					
Heterogeneity: Not applicable					
Test for overall effect: Z=0.45(P=0.66)					
1.1.3 Additional supplementation of meals					
Dennis 2005	515/2014	448/2001		28.35%	1.14[1.02,1.28]
Subtotal (95% CI)	**2014**	**2001**		**28.35%**	**1.14[1.02,1.28]**
Total events: 515 (Supportive intervention), 448 (Control)					
Heterogeneity: Not applicable					
Test for overall effect: Z=2.36(P=0.02)					
Total (95% CI)	**2359**	**2343**		**100%**	**1.11[0.86,1.42]**
Total events: 715 (Supportive intervention), 626 (Control)					
Heterogeneity: Tau^2=0.05; Chi^2=45.82, df=4(P<0.0001); I^2=91.27%					
Test for overall effect: Z=0.82(P=0.41)					
Test for subgroup differences: Chi^2=0.31, df=1 (P=0.85), I^2=0%					

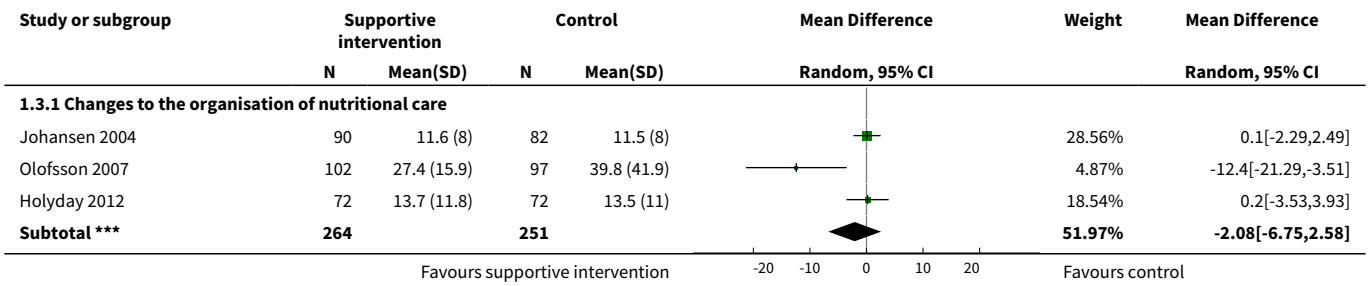
Analysis 1.2. Comparison 1 Supportive interventions for enhancing dietary intake versus comparators, Outcome 2 Nutritional status (weight change).

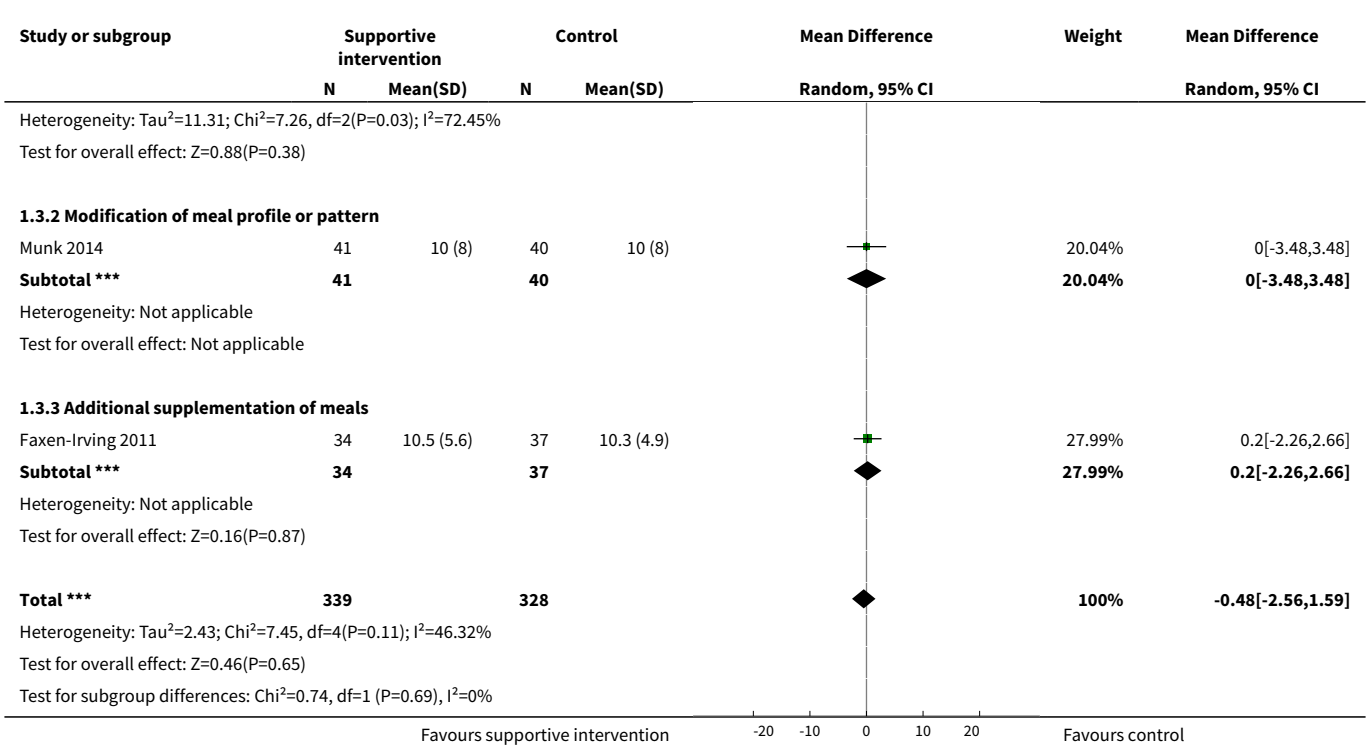
Study or subgroup	Supportive intervention N	Supportive intervention Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
1.2.1 Changes to the organisation of nutritional care							
Hickson 2004	212	-0.9 (2.7)	217	-0.9 (3)		11.56%	-0.02[-0.56,0.52]
Johansen 2004	53	-0.2 (3.9)	42	0.1 (2)		6.32%	-0.32[-1.53,0.89]
Duncan 2006	145	-0.4 (3.3)	157	-1 (2.8)		10.21%	0.64[-0.05,1.33]
Olofsson 2007	83	-1.1 (3.6)	74	-0.7 (3.8)		6.63%	-0.4[-1.56,0.76]
Holyday 2012	71	-0.9 (3.6)	72	-0.9 (2.3)		7.78%	0[-0.99,0.99]
Kraft 2012	5	-4.5 (7.9)	9	-3 (6.2)		0.25%	-1.5[-9.52,6.52]
Subtotal ***	**569**		**571**			**42.75%**	**0.09[-0.26,0.45]**
Heterogeneity: Tau^2=0; Chi^2=3.88, df=5(P=0.57); I^2=0%							
Test for overall effect: Z=0.5(P=0.61)							



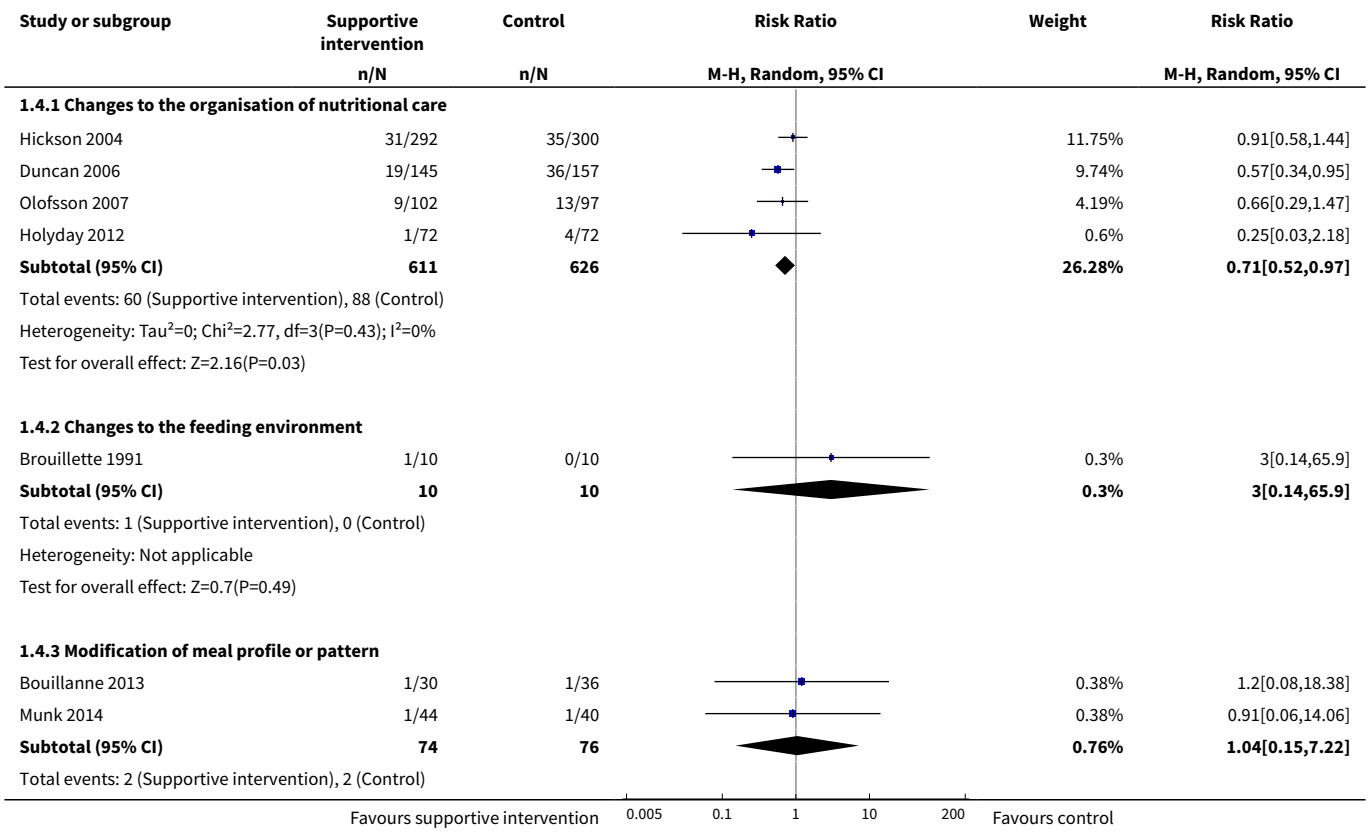


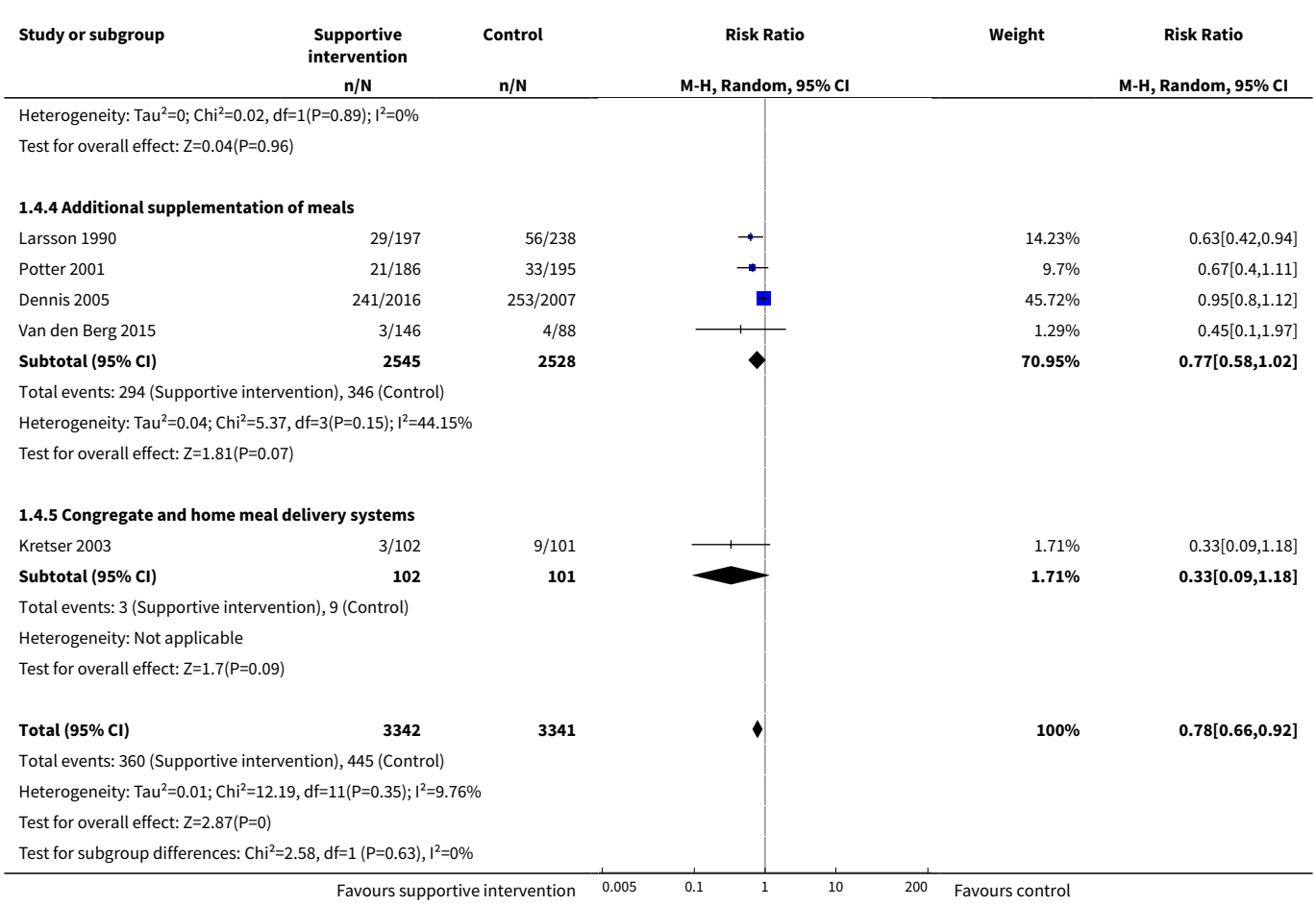
Analysis 1.3. Comparison 1 Supportive interventions for enhancing dietary intake versus comparators, Outcome 3 Hospitalisation.





Analysis 1.4. Comparison 1 Supportive interventions for enhancing dietary intake versus comparators, Outcome 4 All-cause mortality.





ADDITIONAL TABLES

Table 1. Intervention subcategories

Supportive nutritional care intervention Broad intervention category	Examples
1. Changes to the organisation of nutritional care	• Use of dietetic or healthcare assistants • Targeted staff training in nutritional care • Monitoring and documentation of nutritional care • Implementation of nutritional care pathways/protocols • Identification of nutritionally at-risk individuals (e.g. red trays, mandatory nutrition screening)
2. Changes to the feeding environment	• Changes to dining arrangements/style/setting • Protected meal times • Feeding assistance
3. Modification of meal profile or pattern	• Changes to meal pattern (e.g. 5 small meals/day) • Manipulating energy/nutrient density of foods (e.g. food fortification • Changes to the taste, flavour, appearance of foods, or a combination

Table 1. Intervention subcategories *(Continued)*

4. Additional supplementation of meals	• Between-meal snacks, drinks or both • Supplementation with oral nutritional supplements (e.g. routinely provided to entire ward, not individually prescribed)
5. Congregate and home meal delivery systems	• Home meal delivery systems • Community lunch clubs

Table 2. Overview of study populations

	Intervention(s) and comparator(s)	Screened/eligible (N)	Randomised (N)	ITT (N)	Finishing trial (N)	Randomised finishing trial (%)	Follow-up
Barton 2000[a2] (modification of meal profile or pattern)	I1: reduced portion size, fortified menu	-	13	-	b	70[c]	56 days
	I2: cooked breakfast		(8 not randomised)				
	C: normal hospital diet with usual portion size		14				
	total:		**27[a]**		-	-	
Beck 2002[a1] (additional supplementation of meals)	I1: homemade oral supplement (A)	-	-	-	-	-	2 months
	I2: homemade oral supplement (B)						
	C: usual diet						
	total:		**36**		-	-	
Bouillane 2013[a1] (modification of meal profile or pattern)	I: 78% protein at lunch	-	30	-	30	88	6 weeks
	C: usual diet (protein distributed between meals)		36		23	79	
	total:		**66**		63	96	
Bourdel-Marchasson 2000[a3] (additional supplementation of meals)	I: 2 oral nutritional supplements		295	-	-	-	15 days or until hospital discharge
	C: usual care		377				
	total:		**672**		-	-	
Brouillette1991[a1] (changes to the feeding environment)	I: osmotherapy + activities	-	10	-	9	90	4 weeks
	C: activities only		10		7	70	

Table 2. Overview of study populations *(Continued)*

	total:		**20**		16	80	
Castellanos 2009[a2] (modification of meal profile or pattern)	I1: fortified breakfast and lunch menu		39		d	e	2 days of the study
	I2: fortified lunch menu		39				
	C: usual menu		39				
	total:		**39[a]**		33	85	
Chang 2005[a3] (changes to the organisation of nutritional care)	I: training in feeding skills	-	31	-	12	60	Quote: "Data collection was from February 2004 to May 2004" Comment: implies 4 months of data collection, following training but not clearly stated
	C: no training		36		8	50	
	total:		**67**		20[f]	56	
Dennis 2005[a1] (additional supplementation of meals)	I: oral nutritional supplement + normal diet		2016	-	-	-	6 months
	C: normal hospital diet		2007				
	total:		**4023**		-	-	
Duncan 2006[a1] (changes to the organisation of nutritional care)	I: dietetic assistant	363	153	-	145	95	4 months
	C: usual care		165		157	95	
	total:		**318**		302	95	
Essed 2007[a4] (modification of meal profile or pattern)	I1: monosodium glutamate	-	-	-	19	N/A	16 weeks
	I2: flavour				19		

Table 2. Overview of study populations *(Continued)*

	I3: monosodium glutamate + flavour				22		
	C: maltodextrin (placebo)				23		
	total:		**97**		83	86	
Essed 2009[a2] (modification of meal profile or pattern)	I: monosodium glutamate + NaCl	-	59	-	53	90	4 weeks
	C: usual hot meal		59		53	90	
	total:		**59[a]**		53	90	
Faxen-Irving 2011[a1] (additional supplementation of meals)	I: 30 mL of fat emulsion 3 x per day	107	34	-	24	71	Median 8 days
	C: usual care		37		27	73	
	total:		**71**		51	72	
Gaskill 2009[a3] (changes to the organisation of nutritional care)	I: nutrition education programme	377	-	-	-	-	6 months
	C: usual care						
	total:		**352**		-	-	
Germain 2006[a1] (modification of meal profile or pattern)	I: re-formed foods	93	8	-	7	88	12 weeks
	C: usual diet		9		8	89	
	total:		**17**		15	88	
Hankey 1993[a1] (additional supplementation of meals)	I: supplemented with nutritionally complete drink in addition to normal hospital diet	-	10	-	7	70	8 weeks
	C: standard hospital food		10		7	70	
	total:		**20**		14	70	

Table 2. Overview of study populations *(Continued)*

Hickson 2004[a1] (changes to the organisation of nutritional care)	I: feeding assistance	1776	292	292	250	86	Duration of hospital stay
	C: usual care		300	300	259	86	
	total:		**592**	592	509	86	
Holyday 2012[a1] (changes to the organisation of nutritional care)	I: malnutrition care plan	-	71	71	71	100	Duration of hospital stay
	C: usual care		72	72	72	100	
	total:		**143**	143	143	100	
Johansen 2004[a1] (changes to the organisation of nutritional care)	I: nutrition team	7468	-	-	108	N/A	Duration of hospital stay
	C: usual care				104		
	total:		**215**		212	99	
Kraft 2012[a1] (changes to the organisation of nutritional care)	I: oral nutritional supplement + telemedicine monitoring	87/50	13	5	1	8	6 months
	C: usual care		13	9	4	31	
	total:		**26**	14	5	19	
Kretser 2003[a1] (congregate and home meal delivery systems)	I: modified meals on wheels	324	102	-	-	-	26 weeks
	C: traditional meals on wheels		101				
	total:		**203**		60	30	
Larsson 1990[a1] (additional supplementation of meals)	I: oral nutritional supplement + normal hospital diet	-	197	-	-	-	26 weeks
	C: normal hospital diet		238				
	total:		**435**		-	-	
Leslie 2012[a3] (modification of meal profile or pattern)	I: energy enriched usual meals	445	22		16	73	12 weeks
	C: usual care		19		16	84	

Table 2. Overview of study populations *(Continued)*

	total:		**41**				
Lin 2010[a3] (changes to the organisation of nutritional care)	I1: spaced-retrieval[g]	-	32	-	-	-	8 weeks
	I2: Montessori[h]		29				
	C: usual care		24				
	total:		**85**		82	97	
Lin 2011[a2, a3] (changes to the organisation of nutritional care)	I: Montessori		-	-	-	-	8 weeks
	C: usual care						
	total:		**29[a]**		29	100	
Mathey 2001a[a3] (changes to the feeding environment)	I: improved meal ambiance	60	21	-	12	57	12 months
	C: usual care		17		10	59	
	total:		**38**		22	58	
Mathey 2001b[a1] (changes to the feeding environment)	I: flavour enhancement	-	-	-	31	N/A	16 weeks
	C: usual care				36		
	total:		**71**		67	94	
Munk 2014[a1] (modification of meal profile or pattern)	I: energy and protein enriched foods provided via a la carte menu in addition to hospital food		44		41	96	Duration of hospital stay
	C: usual care		40		40		
	total:		**84**				
Nijs 2006[a3] (changes to the feeding environment)	I: family-style meals	282	133	-	95	71	6 months
	C: usual care		112		83	74	
	total:		**245**		178	73	

Table 2. Overview of study populations *(Continued)*

Olofsson 2007[a1] (changes to the organisation of nutritional care)	I: multi-component intervention (including nutrition)	353	102	-	83	81	4 months
	C: usual care		97		74	76	
	total:		**199**		157	79	
Pivi 2011[a1] (changes to the organisation of nutritional care)	I1: nutrition education	-	-	-	25	N/A	6 months
	I2: oral nutritional supplements				26		
	C: usual care				27		
	total:		**90**		78	87	
Potter 2001[a1] (additional supplementation of meals)	I: oral nutritional supplement + normal hospital diet	618	186	-	186	100	Duration of hospital stay
	C: normal hospital diet		195		195	100	
	total:		**381**		381	100	
Remsburg 2001[a1] (changes to the feeding environment)	I: buffet-style meals	62	20	-	20	100	3 months
	C: usual care		20		19	95	
	total:		**40**		39	98	
Salva 2011[a3] (changes to the organisation of nutritional care)	I: teaching and training	-	448	448	300	67	12 months
	C: usual care		498	498	368	74	
	total:		**946**	946	668	71	
Silver 2008[a2] (modification of meal profile or pattern)	I: fortified home-delivered lunch	-	-	-	-	-	7 months
	C: usual home-delivered lunch						
	total:		**52**		45	87	

Table 2. Overview of study populations *(Continued)*

Simmons 2008[a2, a3] (additional supplementation of meals)	I: feeding assistance and/or snacks	173	30	-	28	88	24 weeks
	C: usual diet		34		32	94	
	total:		**64[a]**	-	60	94	
Simmons 2010[a1] (additional supplementation of meals)	I1: snacks	280	-	-	25	N/A	6 weeks
	I2: additional supplementation of meals				18		
	C: usual care				20		
	total:		**86**		63	73	
Smolliner 2008[a3] (modification of meal profile or pattern)	I: fortified meals and snacks	295/92	-	-	22	N/A	12 weeks
	C: usual diet				30		
	total:		**65**		52	80	
Splett 2003[a3] (changes to the organisation of nutritional care)	I: medical nutrition therapy	394	223	-	200	90	19-180 days
	C: usual care		171		164	96	
	total:		**394**		364	92	
Taylor 2006[a2] (modification of meal profile or pattern)	I: 5-meal menu	66	-	-	-	-	2 periods of 4 days
	C: usual (3-meal menu)						
	total:		**31[a]**		31	100	
Van den Berg 2015[a1] (additional supplementation of meals	I1: offered 125 mL ONS daily with medication rounds	885	88		75	85	Maximum period 30 days
	I2: offered 62 mL ONS daily with medication rounds		66		51	77	
	C: offered 125 mL ONS twice daily in between meals		80		66	83	

Table 2. Overview of study populations *(Continued)*

	total:		**234**				
Van Ort 1995[a1] (changes to the feeding environment)	I: contextual and behavioural intervention	8	-	-	-	-	1 month to 6 weeks
	C: usual care						
	total:		**8**		7	88	
Grand total	***All interventions[i]***						
	All controls[i]						
	All interventions and controls		***10,681***				

[a1]Parallel RCT; [a2]cross-over RCT; [a3]cluster RCT; [a4] factorial RCT
[b]Data presented on 19 participants who had at least 3 days on each menu
[c]Of those randomised to normal or fortified menu, not stated for those receiving cooked breakfast
[d]Data analysed for 26 participants with complete data
[e]Data were reported on 67% of those who consented
[f]Data on knowledge and attitude of staff to nutrition available on all 67 staff. Data on actual practice at mealtimes from observation available on 20 staff
[g]Method to enhance learning, retention and recall of information
[h]Method capable of stopping or reducing residents' problem behaviours
[i]Assmumed 30 per group, two groups included in this review
[j]No details because of substantial number of trials not providing data
C: comparator; I: intervention; ITT: intention-to-treat

Table 3. Summary of outcomes reported in intervention category 1: changes to the organisation of nutritional care

Outcome measure	No. of studies reporting outcome	No. of participants	Studies potentially with data for meta-analysis
Energy intake	5	666	1
Health-related quality of life	1	220	0
Patient satisfaction	2	1105	0
Complications	4	1263	3
Nutritional status: weight	10	2184	9
BMI	7	1537	6
TSF	3	536	3
MAC	3	568	3
Length of stay	5	1256	3
Hospital admission	1	143	1
Mortality	5	2182	5
Costs	2	1089	0

BMI: body mass index; MAC: mid-arm circumference; TSF: triceps skinfold thickness

Table 4. Summary of outcomes reported in intervention category 2: changes to the feeding environment

Outcome measure	No. of studies reporting outcome	No. of participants (treatment/control)	Studies with data for meta-analysis
Energy intake	3	216	3
Health-related quality of life	2	200	0
Nutritional status: weight	3	239	3
MAC	1	178	1
Clinical function	3	1664	2
Mortality	3	236	3

MAC: mid-arm circumference

Table 5. Summary of outcomes reported in intervention category 3: modification of meal profile or pattern

Outcome measure	No. of studies reporting outcome	No. of participants	Studies potentially with data for meta-analysis
Energy intake	11	506	7
Health-related quality of life	1	52	0
Complications	1	66	1
Nutritional status: weight	7	387	7
BMI	3	98	3
MAC	1	32	1
Clinical function	3	200	3
Length of stay	1	81	1
Mortality	4	243	4

BMI: body mass index; MAC: mid-arm circumference

Table 6. Summary of outcomes reported in intervention category 4: additional supplementation of meals

Outcome measure	No. of studies reporting outcome	No. of participants	Studies potentially with data for meta-analysis
Energy intake	8	1469	7
Health-related quality of life	1	4023	0
Complications	2	4695	1
Nutritional status: weight	7	605	4
BMI	2	102	1
TSF	2		0
MAC	3		1
Clinical function	2	618	0
Length of stay	4	4689	1
Mortality	5	5745	5
Costs	1	63	0

BMI: body mass index; MAC: mid-arm circumference; TSF: triceps skinfold thickness

Table 7. Summary of outcomes reported in all interventions

Outcome measure	No. of studies reporting outcome	No. of participants (treatment/control)	Studies included in the meta-analysis
Energy intake	27	2857	0
Health-related quality of life	5	4495	0
Patient satisfaction	2	1105	0
Complications	7	6024	5
Nutritional status: weight	28	3618	24
BMI	12	1737	0
TSF	5	-	0
MAC	8	-	0
Clinical function	9	2746	0
Length of hospital stay	10	6026	5
Hospital admissions	2	389	0
Mortality	18	8690	17
Economic costs	3	1152	0

BMI: body mass index; MAC: mid-arm circumference; TSF: triceps skinfold thickness

Table 8. Reasons for contacting authors, and outcomes of contact with authors

	Outcome	Reason the data were not usable	Contact with author	Outcome of contact with author	Action taken
1. Organisational change					
Chang 2005	Energy intake	Data reported as amount eaten in ¼, ½, ¾	Yes	No response	Data reported in structured narrative summary
Duncan 2006	Complications	Reported as a median and IQR	Yes	Data provided	Data used
	Length of stay	Reported as median and IQR	Yes	Confirmed data skewed	Data reported in structured narrative summary
Gaskill 2009	Measured prevalence of malnutrition with SGA	Not an outcome of interest for this review	Yes, to request weight data (a component of SGA)	Unable to provide data	Data not reported

Table 8. Reasons for contacting authors, and outcomes of contact with authors *(Continued)*

Hickson 2004	Energy intake	Not measured at baseline, only at follow-up	Yes, to confirm interpretation of data	Data not measured at baseline	Data reported in structured narrative summary
	Complications (antibiotic prescription)	Reported as median and IQR	Yes, to request complications according to group allocation	No. complications according to group allocation was provided	Data reported in structured narrative summary
	Hospital admission	States in protocol these are collected, but not reported	Yes, to request data	Author unable to recall what happened with data	Data not reported
Holyday 2012	Costs	An estimate based on local prices, not a complete cost analysis	No, judged unlikely to be available	N/A	Data not reported
	Hospital admission	Presented as a frequency	Yes, to request total number of readmissions	Data provided	Data reported in structured narrative summary
Johansen 2004	Energy intake	Reported as kJ/kg/day	Yes, for mean change	No response	Data not reported
Kraft 2012	BMI	Presented as mean and SD at baseline and follow-up, but no mean change	Yes	No response	Data not reported
Lin 2010	Energy intake	'Amount of each meal consumed' was reported as % eaten	Yes	No response	Data reported in structured narrative summary
	Weight	Reported as mean and SD pre and post intervention/control	Yes, to request mean change	No response	Calculated mean change, and imputed the SD of change from Salva 2011
	BMI	Reported as mean and SD pre and post intervention/control	Yes, to request mean change	No response	Calculated mean change, and imputed the SD of change from Salva 2011
Olofsson 2007	Weight	Reported as mean and SD pre and post intervention/control	Yes, to request mean change and SD	Data provided	Data reported in structured narrative summary
	BMI	Reported as mean and SD pre and post intervention/control	Yes, to request mean change and SD	Data provided	Data reported in structured narrative summary
	Complications	Reported as no. falls in men and women	Yes, to request total complications per group	Data provided	Data reported in structured narrative summary
Pivi 2011	Weight	Reported as mean and SD pre and post intervention/control	Yes, to request mean change	No response	Calculated mean change, and imputed

Table 8. Reasons for contacting authors, and outcomes of contact with authors *(Continued)*

					the SD of change using the P value
	BMI	Reported as mean and SD pre and post intervention/control	Yes, to request mean change	No response	Calculated mean change, and imputed the SD of change from Salva 2011
	TSF	Reported as mean and SD pre and post intervention/control	Yes, to request mean change	No response	Calculated mean change, and imputed the SD of change from Salva 2011
	MAC	Reported as mean and SD pre and post intervention/control	Yes, to request mean change	No response	Calculated mean change, and imputed the SD of change
Salva 2011	MAC	Methodology reported this was an outcome measured, but not reported in results	Yes	No response	Data not used
	Costs	Described as data to be collected, but reported that analysis was not undertaken	No		Not reported
Splett 2003	Intake	Food intake is documented as a nutrition assessment activity	Yes, to request mean energy intake per group	Unable to provide data	Not reported
	Weight	Methodology reports this was an outcome measured, but reported in a format not usable	Yes	Unable to provide data	Not reported
2. Feeding environment					
Brouilette 1991	Energy	Reported pre and post intervention data, but no SD of change	No, as no author contact details and study published in 1991	N/A	Imputed the SD from Nijs 2006
Van Ort 1995	Weight change	No figures reported	Yes, to request data on mean and SD of change for each group	Waiting response	Not used
	Intervention group clarification	Were the behavioural and contextual intervention received at the same time	Yes, to request this detail	Waiting response	Assumed the two interventions were given at the same time
3. Meal modification					
Bouillanne 2013	Weight	Did not report weight, but assumed they had the data as Full Body Composition was used	Yes, to request data	Data provided	Data reported
	Energy intake	Reported as kcal/kg/day	Yes, to request data	Data provided	Data reported

Table 8. Reasons for contacting authors, and outcomes of contact with authors *(Continued)*

	Hand grip strength	Reported data as mean/median and 95% CI of the median	Yes, to request data	Provided mean and SD of change	Data reported
	ADL	Reported data as mean/median and 95% CI of the median	Yes, to request data	Data provided	Data reported
Castellanos 2009	Energy intake	Results were not analysed according to groups randomised, but regrouped subjects into small eaters and large eaters	Yes, to ask for data on mean and SD of change for each group	No response	Data reported
Germain 2006	BMI	They reported the mean BMI rather than mean change	Yes, for mean and SD of change	Data provided	Data reported
Smolliner 2008	Weight change	Reported mean and SD at baseline and end of intervention	Yes, for mean change and SD	Data provided	Data reported
	BMI	Reported mean and SD at baseline and end of intervention	Yes, for mean change and SD	Data provided	Data reported
	Handgrip strength	Reported mean and SD at baseline and end of intervention	Yes, for mean change and SD	Data provided	Data reported
	health-related quality of life	Reported mean and SD at baseline and end of intervention	Yes, for mean change and SD	Data provided	Data reported
4. Supplementation of meals					
Beck 2002	Weight	Reported as median change with 95% CI	Yes, for mean change and SD	Response received but data not available	Data reported in structured narrative summary
	Energy intake	Reported as median change with 95% CI	Yes, for mean change and SD	Response received but data not available	Data reported in structured narrative summary
Bourdel- Marchasson 2000	Pressure ulcers	Data given as percentage per group	Yes, for number per group	Data provided	Data reported in structured narrative summary
	Weight	Data given for baseline only	Yes, for change in weight from baseline to follow-up	Yes, author stated she did not find the analysis of discharge weight, probably due to the low quality of this data (too many missing data)	Data not reported

Table 8. Reasons for contacting authors, and outcomes of contact with authors *(Continued)*

Dennis 2005	Complications	Data given as percentages	Yes for data on total complications per group	Data provided	Data reported in structured narrative summary
	Health-related quality of life score	Differences between means provided	Yes, to request mean and SD of changes	Unable to provide data, as EuroQol was only measured at follow-up	Data reported in structured narrative summary
Faxen-Irving 2011	Energy intake	Data given in a graph, no numbers available	Yes, for mean and SD of change in energy intake, between the control and intervention groups from baseline to the 2nd registration	Data provided	Data reported in structured narrative summary
	Length of stay	Data provided at baseline, not follow-up	Yes, for mean and SD	Data provided	Data reported in structured narrative summary
	Infection	Data provided at baseline, not follow-up	Yes, for mean and SD	Unable to provide data	Data not reported
	BMI	Data provided at baseline, not follow-up	Yes, for mean and SD	Data provided	Not reported in the summary because few studies measured this outcome
	ADL	Data provided at baseline, not follow-up	Yes, for mean and SD	Data provided	Not reported in the summary because few studies measured this outcome
Hankey 1993	Weight	Presented in graphs, no numbers given	Yes, for mean and SD	Unable to provide data but suggested using data from the review by Milne 2009 which included these data	Data obtained from systematic review by Milne 2009
	MAC	Presented in graphs, no numbers given	Yes, for mean and SD	Unable to provide data but suggested using data from the review by Milne 2009 which included these data	Data obtained from systematic review by Milne 2009 but not reported as few studies measured this outcome
	TSF	Presented in graphs, no numbers given	Yes, for mean and SD	Unable to provide data but suggested using data from the review by	Not reported in the summary because few studies measured this outcome

Table 8. Reasons for contacting authors, and outcomes of contact with authors *(Continued)*

			Milne 2009 which included these data		
	Energy and protein intake	Presented in graphs, no numbers given	Yes, for mean and SD	Unable to provide data	Data not reported
Larsson 1990	Energy intake	Data included in Modified Norton Scale	Yes, data for change in energy intake between groups (mean and SD)	No response	Data not reported
	Weight	Data provided as 'weight index'	Yes, for change in weight between groups (mean and SD)	No response	Data not reported
	TSF	Data provided as differences between men and women, and non-PEM and PEM groups	Yes, for change between groups (mean and SD)	No response	Data not reported
	MAC	Data provided as differences between men and women, and non-PEM and PEM groups	Yes, for change between groups (mean and SD)	No response	Data not reported
	Length of stay	Not given	Yes, for mean and SD between groups	No response	Data not reported
	Total number of eligible participants	Unclear across all 4 duplicates of this study	Yes, for a clear number of randomised participants, no finishing study, and deaths	No response	Data not reported
Potter 2001	Length of stay	Provided as median with a range	Yes, for mean and SD between groups	No response	Data reported in structured narrative summary
	ADL	Stated as an outcome measure in methodology, then not reported in results	Yes, for mean and SD between groups	No response	Not reported in the summary because few studies measured this outcome
	BMI	Stated as an outcome measure in methodology, then not reported in results	Yes, for mean and SD between groups	No response	Not reported in the summary because few studies measured this outcome
	TSF	Stated as an outcome measure in methodology, then not reported in results	Yes, for mean and SD between groups	No response	Not reported in the summary because few studies measured this outcome
Simmons 2008	Weight	Data presented as phase 1 and 2 cross-over combined. The data from phase 1 was needed for this review	Yes, for the phase 1 data	Yes, responded but unable to provide data	Data reported in structured narrative summary

Table 8. Reasons for contacting authors, and outcomes of contact with authors *(Continued)*

	BMI	Data presented as phase 1 and 2 cross-over combined. The data from phase 1 was needed for this review	Yes, for the phase 1 data	Yes, responded but unable to provide data	Not reported in the summary because few studies measured this outcome
	Energy intake	Presented as pre- and post intervention	Yes, for mean and SD of change	Yes, responded but unable to provide data	Imputed SD from Nijs 2006
Simmons 2010	Energy	Reported as mean difference without the SD	Yes, requested SD for mean change	Yes, responded but unable to provide data	Imputed SD from Nijs 2006
5. Home meal delivery systems					
Kretser 2003	Weight	Reported separately for participants at risk of malnutrition, and those malnourished	No, failed to find contact information for the author	N/A	Combined the mean change data using the formulae for combining groups

ADL: activities of daily living; BMI: body mass index; CI: confidence interval; EuroQol: European Quality of Life Scale; IQR: interquartile range; MAC: midarm muscle circumference; N/A: not applicable; PEM: protein-energy malnutrition; SD: standard deviation; SGA: subjective global assessment; TSF: triceps skinfold thickness

Table 9. No. participants identified in each setting from included studies

Setting	No. participants [N/N (%)]	No. studies
Hospital	7591/10,681 (71.1)	15
Residential care home	1731/10,681 (16.2)	21
Free-living/outpatient setting	1305/10,681 (12.2)	5

Table 10. Effects of changes to the organisation of nutritional care on nutritional intake

	Outcome	(N)	Results		P Value
			Intervention	Control	
Dietetic assistants (Hospital)					
Duncan 2006	Mean (SD) energy intake (kcal/day)	275 (total N = 302)	1105 (361)	756 (399)	< 0.001
Hickson 2004	Between-group difference (kcal)	37 (total N = 592)	89		0.538
Specialist training (residential care settings)					
Chang 2005	% (SD) meals consumed	67	Pre: 90 % (22) Post: 85 (25)	Pre: 78 % (34) Post: 94 % (18)	0.49

Table 10. Effects of changes to the organisation of nutritional care on nutritional intake *(Continued)*

Lin 2010	% (SD) meals consumed	85	Spaced retrieval (SR) Pre: 85 % (11) Post: 91 % (9) Montessori (MON) Pre: 75 % (23) Post 78 % (10)	Pre: 79 % (19) Post: 88 % (18)	SR vs control = NS MON vs control < 0.05
Multi-disciplinary team (hospital)					
Johansen 2004	kcal/kg body weight per day (SE)	202 (total N = 212)	30 (SE 1)	25 (SE 1)	< 0.005

kcal: kilocalorie; SD: standard deviation; SE: standard error

Table 11. Effects of changes to organisation of nutritional care on health-related quality of life, patient satisfaction and morbidity and complications

	Outcome	(N)	Results		P Value
			Intervention	Control	
Patient satisfaction					
Dietetic assistants (hospital)					
Duncan 2006	Median score (IQR)	159	6.5 (2)	3.0 (4)	0.0001
Health-related quality of life					
Multi-disciplinary team (hospital)					
Johansen 2004	Change in physical score (SF-36)	110	2.4 (1.3)	0.2 (1.5)	NS
	Change in mental score (SF-36)	110	2.2 (2.5)	3.3 (2)	NS
Number of complications					
Dietetic assistants (hospital)					
Duncan 2006	Total number of participants with complications	302	84/125 (67%)	79/130 (61%)	0.29
Hickson 2004	Number of participants receiving oral antibiotics	592	142/292 (49%)	150/300 (50%)	0.67
Multi-disciplinary team (hospital)					
Johansen 2004	Total number of participants with complications	212	34/108 (31%)	23/104 22%)	NS

Table 11. Effects of changes to organisation of nutritional care on health-related quality of life, patient satisfaction and morbidity and complications *(Continued)*

Olofsson 2007	Total number of participants with complications	157	81/83 (98%)	74/74 (100%)	

IQR: interquartile range; NS: not significant; SF-36: short form-36

Table 12. Effects of changes to organisation of nutrition care on nutritional status

	Outcome	(N)	Results		P Value
			Intervention	Control	
Dietetic assistants (hospital)					
Duncan 2006	Mean change (SD)	(total N = 302)	-0.36 (3.3)	-1.0 (2.8)	0.16
	Weight (kg)	170	-0.9 (2.2)	-1.3 (1.5)	0.002
	MAC (cm)	230	-0.88 (2.6)	-1.23 (3.2)	0.087
	TSF (mm)	205			
Hickson 2004	Mean change (SD)	(total N = 592)	-0.92 (2.71)	-0.9 (3)	0.23
	Weight (kg)	191	-0.3 (1)	-0.3 (1)	0.65
	MAC (cm)	286	-0.4 (1.8)	-0.4 (1.7)	0.86
	TSF (mm)	279	-0.1 (-0.8-0.4)	-0.1 (-0.5-0.3)	0.84
	Median (IQR)	429	-0.04 (1.1)	-0.25 (1.18)	0.68
	MAMC	254			
	BMI (kg/m^2)				
Specialist training (residential care settings)					
Lin 2010	Mean change (SD)	85	Spaced retrieval	-0.09 (0.57)	NS
	Weight (kg)		-0.07 (0.57)	-0.03 (1)	NS
	BMI (kg/m^2)		Montessori		
			-0.15 (0.57)		
			Spaced retrieval		
			0.1 (1.0)		
			Montessori		
			-0.06 (1.0)		
Lin 2011	BMI	29	-0.26 (0.73)	-0.09 (0.85)	0.245
Specialist training (free-living individuals)					
Pivi 2011	Mean change (SD)	52	1.19 (imputed SD: 3.3)	-2.2 (imputed SD: 3.3)	Reported as between-group
	Weight (kg)		1.87 (2)		

Table 12. Effects of changes to organisation of nutrition care on nutritional status *(Continued)*

	MAC (cm)		2.3 (5.4)	-0.4 (0.46)	differences for 4 groups
	TSF (mm)		1.19 (1)	2.2 (5.3)	
	BMI (kg/m²)			-2.21 (1)	
Salva 2011	Mean change (SD)	946	0.26 (0.7)	0.09 (0.5)	0.598
	Weight (kg)		-0.01 (2.2)	-0.06 (3.2)	0.843
	BMI (kg/m²)				
Multi-disciplinary team (hospital)					
Johansen 2004	Mean change (SD)	(total N = 212)	-0.22 (3.9)	0.1 (2)	NS
	Weight (kg)	95			
Olofsson 2007	Mean change (SD)	(total N = 199)	-1.1 (3.6)	-0.7 (3.8)	0.05
	Weight (kg)	157	-0.45 (1.3)	-0.3 (1.5)	0.05
	BMI (kg/m²)	157			
Protocol-driven pathway (hospital)					
Holyday 2012	Mean change (SD)	(total N = 143)	-0.9 (3.6)	-0.9 (2.3)	0.98
	Weight (kg)	69			
Protocol-driven pathway (residential care settings)					
Splett 2003	Weight	364	No wt loss at baseline: 95% maintained wt. Wt loss at baseline: 48% maintained or gained wt.	No wt loss at baseline: 58% maintained wt. Wt loss at baseline: 57% maintained or gained wt.	
Telemedicine (free-living individuals)					
Kraft 2012	Mean change (SD)	26	-4.5 (7.9)	-3 (6.2)	NS
	Weight (kg)	14	Baseline 24.5 (5.1)	Baseline 23.9 (4.4)	NS
	BMI (kg/m²)		Follow-up 23.0 (4.2)	Follow-up 22.8 (4.3)	

BMI: body mass index; IQR: interquartile range; MAC: mid-arm circumference; MAMC: mid-arm muscle circumference; NS: not significant; SD: standard deviation; TSF: triceps skinfold thickness; wt: weight

Table 13. Effects of changes to the organisation of nutritional care on handgrip strength

	Outcome	(N)	Results		P Value
			Intervention	Control	
Handgrip strength					

Table 13. Effects of changes to the organisation of nutritional care on handgrip strength *(Continued)*

Dietetic assistants (Hospital)					
Duncan 2006	Mean change (SD)	126 (total N = 302)	2.2 (10.7)	0.16 (11.8)	0.32
Hickson 2004	Median change (IQR) (kg)	(total N = 592)	0.8 (-1.4 to 2.5)	0.7 (-1.5 to 3)	0.85

IQR: interquartile range; SD: standard deviation

Table 14. Effects of changes to the organisation of nutritional care on hospitalisation, institutionalisation and death from any cause

	Outcome	(N)	Results		P Value
			Intervention	Control	
Mortality					
Dietetic assistants (Hospital)					
Duncan 2006	4-month mortality	(total N = 302)	19/145 (13%)	36/157 (23%)	0.036
Hickson 2004	In-hospital mortality	(total N = 592)	31/292 (11%)	35/300 (12%)	0.69
Specialist training (free-living individuals)					
Salva 2011	12-month mortality	946	43/448 (10%)	29/498 (6%)	NR
Multi-disciplinary team (hospital)					
Olofsson 2007	4-month mortality	199	9/102 (9%)	13/97 (13%)	NR
Protocol-driven pathway (hospital)					
Holyday 2012	Not reported	143	1/72 (1%)	4/71 (6%)	0.21
Length of stay in hospital					
Dietetic assistants (hospital)					
Duncan 2006	Median (IQR) (days)	167	34 (48)	32 (49)	0.81
Hickson 2004	Median (IQR) (days)	592	21(13-36)	23(14-39)	0.41
Multi-disciplinary team (hospital)					
Johansen 2004	Mean (SD) LOS to 28 days	197	11.6 (8)	11.5(8)	NS
Olofsson 2007	Mean (SD) (days)	157	27.4 (15.9)	39.8 (41.9)	< 0.05
Protocol-driven pathway (hospital)					
Holyday 2012	Mean (SD) (days)	143	13.7 (11.8)	13.5 (11)	0.85

Table 14. Effects of changes to the organisation of nutritional care on hospitalisation, institutionalisation and death from any cause *(Continued)*

Hospital readmissions					
Protocol-driven pathway (hospital)					
Holyday 2012	Number of readmissions at 6 months		30/71	37/72	NR

IQR: interquartile range; LOS: length of stay; SD: standard deviation

Table 15. Effects of changes to the feeding environment on nutritional intake

	Outcome	(N)	Results		P Value	
			Interven-tion	Control		
Changes to the dining room environment						
Mathey 2001	Mean change (SD) energy intake (kcal)	22	199 (406)	185(247)	NR	
Nijs 2006	Mean change (SD) energy intake (kcal)	178	116 (456)	-100 (357)		
	Mean difference (95% CI)	178	235 (83-268)			Described as significantly different but no P value reported
Remsburg 2001	NR					
Sensory stimulation						
Brouillette 1991	Mean change (SD) in intake of lunch meal (kcal)	16	-1.6 (450)	11.14 (360)	0.49	

CI: confidence interval; NR: not reported; SD: standard deviation

Table 16. Effects of changes to the feeding environment on health related quality of life

	Outcome	(N)	Results		P Value
			Intervention	Control	
Changes to the dining room environment					
Mathey 2001a	Sickness Impact Profile, mean change (SD) in score	16/2	-2 (11)	-13 (12)	NR

Table 16. Effects of changes to the feeding environment on health related quality of life *(Continued)*

Nijs 2006	Overall QOL mean change (95% CI) in score	178	0.4 (-1.8 to 2.5)	-5 (-9.4 to -0.6)	NR
	Mean difference (95% CI)	178	6.1 (2.1 to 10.3)		Described as significantly different but no P value reported
	Physical performance, mean change (95% CI) in score	178	0.2 (-2.3 to 2.7)	-2.2 (-4.1 to -0.4)	NR
	Mean difference (95% CI)	178	3.2 0.9 to 5.5)		Described as significantly different but no P value reported

CI: confidence interval; NR: not reported; QOL: quality of life; SD: standard deviation

Table 17. Effects of changes to the feeding environment on nutritional status

	Outcome	(N)	Results		P Value
			Intervention	Control	
Weight					
Changes to the dining room environment					
Mathey 2001a	Mean change (SD) (kg)	22	3.3 (5)	-0.4 (4)	I: < 0.05; C: 0.78
Nijs 2006	Mean change (SD) (kg)	178	0.5 (3.9)	-1.1 (3.7)	NR
	Mean difference (95% CI)	178	1.5 (0.6 to 2.4)		Described as significantly different but no P value reported
Remsburg 2001	Mean change (SD) (kg)	39	-0.11 (3.1)	0.32 (2.2)	0.638

C: control; I: intervention; NR: not recorded; SD: standard deviation

Table 18. Effects of changes to the feeding environment on death from any cause

	Outcome	(N)	Results		P Value
			Intervention	Control	
Changes to the dining room environment					
Mathey 2001a	Mortality	38	7/21 (33%)	5/17 (29%)	NR
Nijs 2006	Mortality	178	18/112 (16%)	16/133 (12%)	NR
Sensory stimulation					

Table 18. Effects of changes to the feeding environment on death from any cause *(Continued)*

Brouillette 1991	Mortality	20	1/10 (10%)	0/10 (0%)	NR

NR: not reported

Table 19. Effects of modification to meals on nutritional intake

	Outcome		(N)	Results		P Value
				Intervention	Control	
Fortification of food (studies in hospital)						
Barton 2000	Total energy intake (kcal/d)		36	1711 (195)	1425 (136)	< 0.001
Munk 2014	Mean (SD) intake (kj/d)		81	5843 (1660)	5149 (1832)	
	Mean (95% CI) difference between groups			693 (-80 to 1466)		0.08
Fortification of food (studies in residential care homes)						
Leslie 2012	mean (SEM) change in energy intake (baseline to week 12) (kcal/d)		16	133 (89)	-36 (84)	0.154
Food fortification (studies in free-living individuals)						
Silver 2008	Total energy intake (kcal/d)		45	1876 (543)	1423 (422)	< 0.001
Modifications to meal composition (studies in intermediate care)						
Bouillane 2013	Change in energy intake (kcal)	63		50.9 (458)	39.2 (401)	NR
Modifications to meal delivery (studies in residential care homes)						
Germain 2006	Change in energy intake (kcal)	15		611 (408)	81 (169)	0.03
Taylor 2006	Total energy intake (kcal/d)	31		1342 (177)	1325 (207)	0.565
Modifications to flavour (studies in residential care homes)						
Essed 2007	Change in energy intake (kcal)	83		Flavour: -17 (445) Flavour + MSG: 78 (352) MSG: -32 (28)	102 (452)	NR
Essed 2009	Energy intake from modified meal (kcal)	53		420 (211)	424 (216)	0.896

Table 19. Effects of modification to meals on nutritional intake *(Continued)*

Mathey 2001b	Change in energy intake (kcal)	67	-50 (267)	-115 (298)	Baseline to end of intervention I: NR, C: < 0.05

C: control; I: intervention; MSG: monosodium glutamate; NR: not recorded; SD standard deviation; SEM standard error of the mean; CI confidence interval

Table 20. Effects of modifications to meals on nutritional status

	Outcome	(N)	Results		P Value
			Intervention	Control	
Weight and BMI (mean change (SD))					
Fortification of food (studies in hospital)					
Munk 2014	Mean (SD) within-group change in weight (kg)	66	0.4 (2.6)	-0.4 (1.8)	0.17
	Mean (95% CI) between-group difference in weight (kg)		-0.8 (-1.9 to 0.3)		
Fortification of food (studies in residential care homes)					
Leslie 2012	Mean (SD) within-group weight change (kg)	31	1.3 (0.53)*	-0.2 (1.5)**	*0.03 **0.536
	Mean (SD) within-group change in BMI (kg/m^2)	31	0.5 (0.25)*	-0.1 (0.4)**	*0.042 **0.517
	Mean (SD) within-group change in MUAC (mm)	32	0.4 (0.16)*	-0.1 (0.3)**	*0.019 **0.691
Smolliner 2008	Mean (SD) change weight (kg)	52	2 (2.1)	1.6 (2)	NS
	BMI change (kg/m^2)	52	0.77 (1.5)	0.45 (1.1)	Between-group difference NS
Modifications to meal composition (studies in intermediate care)					
Bouillanne 2013	Mean (SD) change weight (kg)	63	0.4 (2.3)	-0.7 (3.1)	NR
Modifications to meal delivery (studies in residential care homes)					
Germain 2006	Mean (SD) change weight (kg)	15	3.9 (2.3)	-0.8 (4.2)	0.02
	BMI change (kg/m^2)	15	1.51 (1.16)	0.27 (1.46)	Data provided by study author P value NR
Modifications to flavour (studies in residential care homes)					
Essed 2007	Mean (SD) change weight (kg)	83	Flavour: 0.1 (2.4)	0.1 (3.8)	NR

Table 20. Effects of modifications to meals on nutritional status *(Continued)*

			Flavour + MSG: -0.8 (3.3) MSG: - 0.7 (3.6)		
Mathey 2001b	Mean (SD) change weight (kg)	67	1.1 (1.3)	-0.3 (1.6)	< 0.05

BMI: body mass index; CI: confidence interval; MSG: monosodium glutamate; MUAC: mid-upper arm circumference; NR: not reported; NS: not significant; SD: standard deviation

Table 21. Effects of modifications to meals on clinical function, hospitalisation and death from any cause

	Outcome	(N)	Results		P Value
			Intervention	Control	
Mortality					
Fortification of food (studies in hospital)					
Munk 2014	Mortality	81	1/44	1/40	NR
Fortification of food (studies in residential care homes)					
Leslie 2012	Mortality	32	2/19	5/22	NR
Smolliner 2008	Mortality	65	2/31	1/34	NR
Modifications to meal composition (studies in intermediate care)					
Bouillane 2013	Mortality	66	1/30 (3%)	1/36 (3%)	NR
Length of hospital stay					
Fortification of food (studies in hospital)					
Munk 2014	Days from study inclusion to discharge	81	10 (8)	10 (8)	0.73
Handgrip strength					
Fortification of food (studies in hospital)					
Munk 2014	Mean change (SD) baseline to day 3 (kg)	76	-0.1 (2.9)	-0.4 (4.3)	0.76
	Mean difference (95% CI) between I & C		-0.3 (-1.9 to -1.4)		0.95
Fortification of food (studies in residential care homes)					
Smolliner 2008	Mean change (SD) (kg)	61	-0.81 (3.12)	-1.29 (3)	NR
Modifications to meal composition (studies in intermediate care)					

Table 21. Effects of modifications to meals on clinical function, hospitalisation and death from any cause *(Continued)*

Bouillane 2013	Mean change (SD) (N)	63	-0.5 (41.7)	14 (45.1)	0.411 (ANCOVA 0.271)
Bouillane 2013	Change in ADL score (mean (SD)	63	-0.02 (1.6)	0.54 (1.7)	0.125 (ANCOVA 0.118)

ADL: activities of daily living; ANCOVA: analysis of covariance; N: Newtons; NR: not reported; SD: standard deviation
I: intervention; C: control

Table 22. Effects of supplementation of meals on nutritional intake

	Outcome	(N)	Results		P Value
			Intervention	Control	
Supplementation with food (residential care homes)					
Beck 2002	Change in energy intake (kcal/d) (median 95% CI)	16	-24 (-454 to 860)	24 (-167 to 478)	NS
Simmons 2008	Change in energy intake kcal/ (mean SD)	64	302 (450)	127 (360)	Baseline to 6 months I: = 0.000; C: NS
Simmons 2010	Change in energy intake (mean SD)	43	-65 (450)	67 (360)	NS
Supplementation with ONS (in hospital) (reported as mean (SD)					
Bourdel-Marchasson 2000	Total energy intake (kcal/d)	672	1188 (613)	1102 (503)	0.13
Faxen-Irving 2011	Change in energy intake (kcal/d)	38	94 (350)	6.5 (358)	NR
Potter 2001	Total energy intake (kcal/d)	381	1409 (448)	1090 (417)	S
Van den Berg 2015	Mean (SD) energy intake from ONS (kcal/d)	192	I1:343 (172)* I2: 469 (111)**	389 (162)	*0.289 **0.006
Supplementation with ONS (long-term/residential care settings)					
Hankey 1993	Total energy intake (kcal/d)	21	1747 (273)	1147 (310)	Baseline to wk 8, I: 0.01; C: NS
Simmons 2010	Change in energy intake	42	28 (450)	67 (360)	0.14

C: control; CI: confidence interval; I: intervention; NS: not significant; NR: not reported; ONS: oral nutritional supplement; S: significant; SD: standard deviation; wk: week

Table 23. Effects of supplementation of meals on health-related quality of life, morbidity/complications

	Outcome	(N)	Results		P Value
			Intervention	Control	

Table 23. Effects of supplementation of meals on health-related quality of life, morbidity/complications *(Continued)*

Incidence of pressure ulcers					
Supplementation with ONS (in hospital)					
Bourdel-Marchasson 2000	Cumulative incidence at end of follow-up (%)	672	40	48	NR
	Number of participants with pressure ulcers at day 15		101/295	164/37	NR
Dennis 2005	Number of participants with pressure ulcers	4023	15/2016	26/2007	0.0507
Total complications					
Supplementation with ONS (in hospital)					
Dennis 2005	All in-hospital complications	4023	515/2014 (26%)	448/2001 (22%)	NR
Health-related quality of life					
Supplementation with ONS (in hospital)					
Dennis 2005	Utilitiy (median (IQR)) (EUROQoL)	3086	Median group difference 0.52 (0.03 to 0.74)		0.96

EUROQol: European Quality of Life Scale; IQR: interquartile range; NR: not reported; ONS: oral nutritional supplement

Table 24. Effects of supplementation of meals on nutritional status

	Outcome	(N)	Results		P Value
			Intervention	Control	
Supplementation with food (residential care homes)					
Beck 2002	Change in weight (median 95% CI)	16	1.3 (-1 to 3)	1.5 (-2.3 to 9)	NS
Simmonds 2008	Mean change (SD) weight (kg)	64	The intervention group gained 4 lbs more	NR	0.009
	Mean (SD) change in BMI			NR	0.009
			The intervention group gained 0.72 kg/m^2 than the usual care		
Simmonds 2010	Mean change (SD) weight (kg)	43	0.02 (1.1)	0.21 (1.7)	NS
Supplementation with ONS (in hospital)					
Faxen-Irving 2011	Mean change (SD) weight (kg)	38	0.13 (2.2)	-0.95 (2.3)	NR
	Mean (SD) BMI at follow-up (kg/m2)	38	20.4 (3.7)	20.4 (3.7)	0.17
				21.9 (3.8)	

Table 24. Effects of supplementation of meals on nutritional status *(Continued)*

Potter 2001	Mean change in weight (kg)	381	0.4 (2.6)	-0.5 (2.9)	0.003
	Mean change (SD) MAC (cm)	381	-0.1 (1.3)	-0.4 (1.2)	NS
Supplementation with ONS (long-term care settings)					
Hankey 1993	Mean change (SD) weight (kg)	21	2.83 (10)	-0.53 (10)	NR - data from Milne 2009
	Mean change (SD) MAC	21	-1 (10)	0.6 (10)	NR data from Milne 2009
Simmons 2010	Mean change in weight (kg)	42	0.91 (2.3)	0.24 (1.96)	NS

BMI: body mass index; CI: confidence interval; MAC: mid-arm circumference; NR: not reported; NS: not significant; ONS: oral nutritional supplement; SD: standard deviation

Table 25. Effects of supplementation of meals on hospitalisation, institutionalisation and death from any cause

	Outcome	(N)	Results		P Value
			Intervention	Control	
Mortality					
Supplementation with ONS (in hospital)					
Bourdel-Marchasson 2000	Mortality	672	25/295 (8%)	22/377 (6%)	0.18
Dennis 2005	Mortality	4023	241/2016 (12%)	253/2007 (13%)	0.7
Potter 2001	Mortality	381	21/186 (11%)	33/195 (17%)	0.117
Supplementation with ONS (long-term care settings)					
Larsson 1990	Mortality	435	29/197 (15%)	56/238 (24%)	0.13
Length of stay					
Supplementation with ONS (in hospital)					
Faxen-Irving 2011	Length of hospital stay (days)	51	10.5 (SD 5.6)	10.3 (SD 4.9)	NS
Dennis 2005	Length of hospital stay (days) Median (IQR)	4023	16 (IQR 7–44)	16 (IQR 7–41)	NS
Potter 2001	Length of hospital stay (median (range))	381	16 (3-141)	18 (2-76)	0.31
Van den Berg 2015	Length of hospital stay (median (range))	234	I1: 10 (3-63) I2: 10 (3-27)	11 (4-71)	NR

Table 25. Effects of supplementation of meals on hospitalisation, institutionalisation and death from any cause *(Continued)*

Hospital readmissions & discharge destination					
Supplementation with ONS (in-hospital)					
Potter 2001	Discharge to home	381	131/186	127/195	NS
	Discharge to institution	381	31/186	33/195	
Van den Berg 2015	Hospital readmissions	246	I1: 13 I2: 24	15	NR

IQR: interquartile range; NR not reported; NS: not significant; ONS: oral nutritional supplement

Table 26. Effects of home meal delivery systems on nutritional status and death from any cause

	Outcome	(N)	Results		P Value
			Intervention	Control	
Weight change					
Kretser 2003	Mean change in weight (kg)	163	1.86 (5.3)	-1,04 (5.2)	0.0062
Mortality					
Kretser 2003	Mortality	203	3/102 (3%)	9/101 (9%)	NR

NR: not reported

APPENDICES

Appendix 1. Search strategies (inception to March 2013)

Cochrane Library
#1 food* OR meal* OR snack* OR drink* OR feed*: ti,ab #2 nutri* OR diet*: ti,ab #3 dining*: ti,ab #4 screening OR monitoring: ti,ab #5 documentation OR communication: ti,ab #6 time* OR timing OR pattern OR style OR arrangement* OR environment*: ti,ab #7 staff* OR train*: ti,ab #8 nurs*: ti,ab #9 healthcare OR health care: ti,ab #10 cater*: ti,ab #11 flavo?r* OR taste: ti,ab #12 content OR composition OR density: ti,ab #13 appear* OR presentation:ti,ab #14 size OR portion OR amount: ti,ab #15 protected meal*: ti,ab #16 red tray*: ti,ab #17 fortif*:ti,ab

(Continued)

#18 supplement*: ti,ab
#19 ((supportive OR nutrition* OR diet*) NEAR/3 intervention):ti,ab
#20 (assist* OR help* OR support*):ti,ab
#21 (add* OR extra):ti,ab
#22 (alter* OR chang* OR new OR enhance* OR modif* OR increas* OR decreas* OR improv* OR reduc* OR target*):ti,ab
#23 (food* OR meal* OR snack* OR drink* OR feed*) NEAR/3 ((time* OR timing OR pattern OR style OR arrangement* OR environment*) OR (flavour* OR flavor* OR taste) OR (content OR composition OR density) OR (appear* OR presentation) OR (size OR portion OR amount) OR (fortif*) OR (supplement*) OR (assist* OR help* OR support*) OR (add* OR extra) OR (alter* OR chang* OR new OR enhance* OR modif* OR increas* OR decreas* OR improv* OR reduc* OR target*)):ti,ab
#24 (nutri* OR diet*) NEAR/4 ((content OR composition OR density) OR (fortif*) OR (supplement*) OR (add* OR extra) OR (alter* OR chang* OR new OR enhance* OR modif* OR increas* OR decreas* OR improv* OR reduc* OR target*)):ti,ab
#25 dining* NEAR/4 ((time* OR timing OR pattern OR style OR arrangement* OR environment*) OR (alter* OR chang* OR new OR enhance* OR modif* OR increas* OR decreas* OR improv* OR reduc* OR target*)):ti,ab
#26 (screening OR monitoring) NEAR/4 ((nutri* OR diet*) OR (assist* OR help* OR support*) OR (add* OR extra) OR (alter* OR chang* OR new OR enhance* OR modif* OR increas* OR decreas* OR improv* OR reduc* OR target*)):ti,ab
#27 (documentation OR communication) NEAR/4 (alter* OR chang* OR new OR enhance* OR modif* OR increas* OR decreas* OR improv* OR reduc* OR target*):ti,ab
#28 (staff* OR train*) NEAR/4 ((nurs*) OR (healthcare OR health care) OR (cater*) OR (assist* OR help* OR support*) OR (add* OR extra) OR (alter* OR chang* OR new OR enhance* OR modif* OR increas* OR decreas* OR improv* OR reduc* OR target*)):ti,ab
#29 supplement* NEAR/5 (add* OR extra):ti,ab
#30 (assist* OR help* OR support*) NEAR/4 ((nurs*) OR (healthcare OR health care) OR (cater*)):ti,ab
#31 (#15 OR #16 OR #19)
#32 (#23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29 OR #30 OR #31)
#33 (low BMI OR low body mass index):ti,ab
#34 (low weight OR underweight OR under-weight):ti,ab
#35 (maln*):ti,ab
#36 (nutritional risk OR (risk NEAR/4 maln*)):ti,ab
#37 (poor nutr* OR undernourish* OR under-nourish*):ti,ab
#38 ((poor OR inadequate OR suboptimal) NEAR/5 intake*):ti,ab
#39 (institutionali?ed):ti,ab
#40 (elderly):ti,ab
#41 (homebound OR home-bound OR housebound OR house-bound):ti,ab
#42 ((extended OR longterm OR long-term OR community) NEAR/1 care):ti,ab
#43 ((nursing OR care OR residential) NEAR/1 home):ti,ab
#44 (inpatient* OR hospitali?* OR hospital patient*):ti,ab
#45 exp Nutritional Status/
#46 exp Nutrition Disorders/
#47 exp Nutrition Assessment/
#48 exp Nutritional Support/
#49 exp Nutrition Policy/
#50 exp Malnutrition/
#51 diet/
#52 dietetics/
#53 hospital food service/
#54 energy intake/
#55 fortified food/
#56 #33 OR #34 OR #35 OR #36 OR #37 OR #38 OR #39 OR #40 OR #41 OR #42 OR #43 OR #44 OR #45 OR #46 OR #47 OR #48 OR #49 OR #50 OR #51 OR #52 OR #53 OR #54 OR #55
#57 32 AND 56
#58 exp Pregnancy/
#59 pregnan*:kw,ti
#60 #58 OR #59
#61 #57 NOT #60
#62 (child* OR infant OR paediatric OR pediatric):kw,ti
#63 #61 NOT #62
#64 (animal OR rat OR mouse OR guinea pig OR primate OR monkey OR cat OR dog):kw,ti
#65 #63 NOT #64

MEDLINE + OLDMEDLINE

(Continued)

#1 (food* OR meal* OR snack* OR drink* OR feed*).ab,ti.
#2 (nutri* OR diet*).ab,ti.
#3 "dining*".ab,ti.
#4 (screening OR monitoring).ab,ti.
#5 (documentation OR communication).ab,ti.
#6 (time* OR timing OR pattern OR style OR arrangement* OR environment).ab,ti.
#7 (staff* OR train*).ab,ti.
#8 "nurs*".ab,ti.
#9 (healthcare OR health care).ab,ti.
#10 "cater*".ab,ti.
#11 (flavo?r* OR taste).ab,ti.
#12 (content OR composition OR density).ab,ti.
#13 (appear* OR presentation).ab,ti.
#14 (size OR portion OR amount).ab,ti.
#15 "protected meal*".ab,ti.
#16 "red tray*".ab,ti.
#17 "fortif*".ab,ti.
#18 "supplement*".ab,ti.
#19 ((supportive OR nutrition* OR diet*) ADJ3 intervention).ab,ti.
#20 (assist* OR help* OR support*).ab,ti.
#21 (add* OR extra).ab,ti.
#22 (alter* OR chang* OR new OR enhance* OR modif* OR increas* OR decreas* OR improv* OR reduc* OR target*).ab,ti.
#23 1 ADJ3 (6 OR 11 OR 12 OR 13 OR 14 OR 17 OR 18 OR 20 OR 21 OR 22)
#24 2 ADJ4 (12 OR 17 OR 18 OR 21 OR 22)
#25 3 ADJ4 (6 OR 22)
#26 4 ADJ4 (2 OR 21 OR 22)
#27 5 ADJ4 22
#28 7 ADJ4 (8 OR 9 OR 10 OR 20 OR 21 OR 22)
#29 18 ADJ5 21
#30 20 ADJ4 (8 OR 9 OR 10)
#31 15 OR 16 OR 19
#32 23 OR 24 OR 25 OR 26 OR 27 OR 28 OR 29 OR 30 OR 31
#33 (low bmi OR low body mass index).ab,ti.
#34 (low weight OR underweight OR under-weight).ab,ti.
#35 "maln*".ab,ti.
#36 (nutritional risk OR (risk ADJ4 maln*)).ab,ti.
#37 (poor nutr* OR undernourish* OR under-nourish*).ab,ti.
#38 ((poor OR inadequate OR suboptimal) adj5 intake*).ab,ti.
#39 institutionali?ed.ab,ti.
#40 elderly.ab,ti.
#41 (homebound OR home-bound OR housebound OR house-bound).ab,ti.
#42 ((extended OR longterm OR long-term OR community) ADJ1 care).ab,ti.
#43 ((nursing OR care OR residential) ADJ1 home).ab,ti.
#44 (inpatient* OR hospitali?* OR hospital patient*).ab,ti.
#45 exp Nutritional Status/
#46 exp Nutrition Disorders/dh, th [Diet Therapy, Therapy]
#47 nutrition assessment.sh.
#48 nutritional support.sh.
#49 nutrition policy.sh.
#50 exp Malnutrition/dh, th [Diet Therapy, Therapy]
#51 *diet/
#52 *dietetics/
#53 *food service, hospital/
#54 *energy intake/
#55 *food, fortified/
#56 33 OR 34 OR 35 OR 36 OR 37 OR 38 OR 39 OR 40 OR 41 OR 42 OR 43 OR 44 OR 45 OR 46 OR 47 OR 48 OR 49 OR 50 OR 51 OR 52 OR 53 OR 54 OR 55
#57 32 AND 56
#58 randomized controlled trial.pt.
#59 controlled clinical trial.pt.

(Continued)

#60 randomi?ed.ab.
#61 placebo.ab.
#62 clinical trials as topic.sh.
#63 randomly.ab.
#64 trial.ti.
#65 58 OR 59 OR 60 OR 61 OR 62 OR 63 OR 64
#66 meta-analysis.pt
#67 exp technology assessment, biomedical/
#68 exp meta-analysis/
#69 exp meta-analysis as topic/
#70 hta.tw, ot.
#71 (health technology ADJ6 assessment$).tw,ot.
#72 (meta analy$ OR metaanaly$ or meta?analy$).tw,ot.
#73 ((review$ OR search$) ADJ10 (literature$ OR medical database$ OR medline OR pubmed OR embase OR cochrane OR cinahl OR psycinfo OR psyclit OR healthstar OR biosis OR current content$ OR systemat$)).tw,ot.
#74 66 OR 67 OR 68 OR 69 OR 70 OR 71 OR 72 OR 73
#75 65 OR 74
#76 (comment OR editorial OR historical-article).pt.
#77 75 NOT 76
#78 57 AND 77
#79 (animals NOT (animals AND humans)).sh.
#80 78 NOT 79
#81 exp Pregnancy/
#82 pregnan*.tw,ot.
#83 81 OR 82
#84 80 NOT 83
#85 limit 84 to "all adult (19 plus years)"

MEDLINE in-process & other non-indexed citations

#1 (food* OR meal* OR snack* OR drink* OR feed*).ab,ti.
#2 (nutri* OR diet*).ab,ti.
#3 "dining*".ab,ti.
#4 (screening OR monitoring).ab,ti.
#5 (documentation OR communication).ab,ti.
#6 (time* OR timing OR pattern OR style OR arrangement* OR environment).ab,ti.
#7 (staff* OR train*).ab,ti.
#8 "nurs*".ab,ti.
#9 (healthcare OR health care).ab,ti.
#10 "cater*".ab,ti.
#11 (flavo?r* OR taste).ab,ti.
#12 (content OR composition OR density).ab,ti.
#13 (appear* OR presentation).ab,ti.
#14 (size OR portion OR amount).ab,ti.
#15 "protected meal*".ab,ti.
#16 "red tray*".ab,ti.
#17 "fortif*".ab,ti.
#18 "supplement*".ab,ti.
#19 ((supportive OR nutrition* OR diet*) ADJ3 intervention).ab,ti.
#20 (assist* OR help* OR support*).ab,ti.
#21 (add* OR extra).ab,ti.
#22 (alter* OR chang* OR new OR enhance* OR modif* OR increas* OR decreas* OR improv* OR reduc* OR target*).ab,ti.
#23 1 ADJ3 (6 OR 11 OR 12 OR 13 OR 14 OR 17 OR 18 OR 20 OR 21 OR 22)
#24 2 ADJ4 (12 OR 17 OR 18 OR 21 OR 22)
#25 3 ADJ4 (6 OR 22)
#26 4 ADJ4 (2 OR 21 OR 22)
#27 5 ADJ4 22
#28 7 ADJ4 (8 OR 9 OR 10 OR 20 OR 21 OR 22)
#29 18 ADJ5 21
#30 20 ADJ4 (8 OR 9 OR 10)

(Continued)

#31 15 OR 16 OR 19
#32 23 OR 24 OR 25 OR 26 OR 27 OR 28 OR 29 OR 30 OR 31
#33 (low bmi OR low body mass index).ab,ti.
#34 (low weight OR underweight OR under-weight).ab,ti.
#35 "maln*".ab,ti.
#36 (nutritional risk OR (risk ADJ4 maln*)).ab,ti.
#37 (poor nutr* OR undernourish* OR under-nourish*).ab,ti.
#38 ((poor OR inadequate OR suboptimal) adj5 intake*).ab,ti.
#39 institutionali?ed.ab,ti.
#40 elderly.ab,ti.
#41 (homebound OR home-bound OR housebound OR house-bound).ab,ti.
#42 ((extended OR longterm OR long-term OR community) ADJ1 care).ab,ti.
#43 ((nursing OR care OR residential) ADJ1 home).ab,ti.
#44 (inpatient* OR hospitali?* OR hospital patient*).ab,ti.
#45 33 OR 34 OR 35 OR 36 OR 37 OR 38 OR 39 OR 40 OR 41 OR 42 OR 43 OR 44
#46 32 AND 45
#47 (random* OR rct*).tw,ot.
#48 “single blind*”.tw, ot.
#49 “double blind*”.tw, ot.
#50 ((triple OR treble) AND blind*).tw,ot.
#51 ((control* AND trial*) OR (clinical ADJ4 trial*) OR trial*).tw,ot.
#52 (systematic* review*).tw,ot.
#53 hta.tw, ot.
#54 (health technology ADJ6 assessment$).tw,ot.
#55 (meta analy$ OR metaanaly$ or meta?analy$).tw,ot.
#56 ((review$ OR search$) ADJ10 (literature$ OR medical database$ OR medline OR pubmed OR embase OR cochrane OR cinahl OR psycinfo OR psyclit OR healthstar OR biosis OR current content$ OR systemat$)).tw,ot.
#57 47 OR 48 OR 49 OR 50 OR 51 OR 52 OR 53 OR 54 OR 55 OR 56
#58 (comment OR editorial OR historical-article).pt.
#59 57 NOT 58
#60 46 AND 59
#61 pregnan*.tw,ot.
#62 60 NOT 61

Embase + Embase classic

#1 (food* OR meal* OR snack* OR drink* OR feed*).ab,ti.
#2 (nutri* OR diet*).ab,ti.
#3 "dining*".ab,ti.
#4 (screening OR monitoring).ab,ti.
#5 (documentation OR communication).ab,ti.
#6 (time* OR timing OR pattern OR style OR arrangement* OR environment).ab,ti.
#7 (staff* OR train*).ab,ti.
#8 "nurs*".ab,ti.
#9 (healthcare OR health care).ab,ti.
#10 "cater*".ab,ti.
#11 (flavo?r* OR taste).ab,ti.
#12 (content OR composition OR density).ab,ti.
#13 (appear* OR presentation).ab,ti.
#14 (size OR portion OR amount).ab,ti.
#15 "protected meal*".ab,ti.
#16 "red tray*".ab,ti.
#17 "fortif*".ab,ti.
#18 "supplement*".ab,ti.
#19 ((supportive OR nutrition* OR diet*) ADJ3 intervention).ab,ti.
#20 (assist* OR help* OR support*).ab,ti.
#21 (add* OR extra).ab,ti.
#22 (alter* OR chang* OR new OR enhance* OR modif* OR increas* OR decreas* OR improv* OR reduc* OR target*).ab,ti.
#23 1 ADJ3 (6 OR 11 OR 12 OR 13 OR 14 OR 17 OR 18 OR 20 OR 21 OR 22)
#24 2 ADJ4 (12 OR 17 OR 18 OR 21 OR 22)

(Continued)

#25 3 ADJ4 (6 OR 22)
#26 4 ADJ4 (2 OR 21 OR 22)
#27 5 ADJ4 22
#28 7 ADJ4 (8 OR 9 OR 10 OR 20 OR 21 OR 22)
#29 18 ADJ5 21
#30 20 ADJ4 (8 OR 9 OR 10)
#31 15 OR 16 OR 19
#32 23 OR 24 OR 25 OR 26 OR 27 OR 28 OR 29 OR 30 OR 31
#33 (low bmi OR low body mass index).ab,ti.
#34 (low weight OR underweight OR under-weight).ab,ti.
#35 "maln*".ab,ti.
#36 (nutritional risk OR (risk ADJ4 maln*)).ab,ti.
#37 (poor nutr* OR undernourish* OR under-nourish*).ab,ti.
#38 ((poor OR inadequate OR suboptimal) adj5 intake*).ab,ti.
#39 institutionali?ed.ab,ti.
#40 elderly.ab,ti.
#41 (homebound OR home-bound OR housebound OR house-bound).ab,ti.
#42 ((extended OR longterm OR long-term OR community) ADJ1 care).ab,ti.
#43 ((nursing OR care OR residential) ADJ1 home).ab,ti.
#44 (inpatient* OR hospitali?* OR hospital patient*).ab,ti.
#45 exp Nutritional Status/
#46 exp Nutritional Disorder/dh, th [Therapy]
#47 nutrition assessment.sh.
#48 nutritional support.sh.
#49 health care policy.sh.
#50 exp Malnutrition/dh, th [Therapy]
#51 *diet/
#52 *dietetics/
#53 *food service, hospital/
#54 *energy intake/
#55 *food, fortified/
#56 33 OR 34 OR 35 OR 36 OR 37 OR 38 OR 39 OR 40 OR 41 OR 42 OR 43 OR 44 OR 45 OR 46 OR 47 OR 48 OR 49 OR 50 OR 51 OR 52 OR 53 OR 54 OR 55
#57 32 AND 56
#58 (random* OR rct*).tw,ot.
#59 “single blind*”.tw, ot.
#60 “double blind*”.tw, ot.
#61 ((triple OR treble) AND blind*).tw,ot.
#62 ((control* AND trial*) OR (clinical ADJ4 trial*) OR trial*).tw,ot.
#63 (systematic* review*).tw,ot.
#64 hta.tw, ot.
#65 (health technology ADJ6 assessment$).tw,ot.
#66 (meta analy$ OR metaanaly$ or meta?analy$).tw,ot.
#67 ((review$ OR search$) ADJ10 (literature$ OR medical database$ OR medline OR pubmed OR embase OR cochrane OR cinahl OR psycinfo OR psyclit OR healthstar OR biosis OR current content$ OR systemat$)).tw,ot.
#68 58 OR 59 OR 60 OR 61 OR 62 OR 63 OR 64 OR 65 OR 66 OR 67
#69 (comment OR editorial OR historical-article).pt.
#70 68 NOT 69
#71 57 AND 70
#72 exp Pregnancy/
#73 pregnan*.tw,ot.
#74 72 OR 73
#75 71 NOT 74
#76 limit 75 to (human and (adult <18 to 64 years> or aged <65+ years>))

AMED

#1 (food* OR meal* OR snack* OR drink* OR feed*).ti,ab
#2 (nutri* OR diet*).ti,ab
#3 "dining*".ti,ab

(Continued)

#4 screening OR monitoring).ti,ab
#5 documentation OR communication).ti,ab
#6 time* OR timing OR pattern OR style OR arrangement* OR environment).ti,ab
#7 staff* OR train*).ti,ab
#8 nurs*".ti,ab
#9 healthcare OR “health care”).ti,ab
#10 cater*".ti,ab
#11 flavo?r* OR taste).ti,ab
#12 content OR composition OR density).ti,ab
#13 appear* OR presentation).ti,ab
#14 size OR portion OR amount).ti,ab
#15 protected meal*".ti,ab
#16 red tray*".ti,ab
#17 fortif*".ti,ab
#18 "supplement*".ti,ab
#19 ((supportive OR nutrition* OR diet*) ADJ3 intervention).ti,ab
#20 (assist* OR help* OR support*).ti,ab
#21 (add* OR extra).ti,ab
#22 alter* OR chang* OR new OR enhance* OR modif* OR increas* OR decreas* OR improv* OR reduc* OR target*).ti,ab
#23 1 DJ3 (6 OR 11 OR 12 OR 13 OR 14 OR 17 OR 18 OR 20 OR 21 OR 22)
#24 2 ADJ4 (12 OR 17 OR 18 OR 21 OR 22)
#25 3 ADJ4 (6 OR 22)
#26 4 ADJ4 (2 OR 21 OR 22)
#27 5 ADJ4 22
#28 7 ADJ4 (8 OR 9 OR 10 OR 20 OR 21 OR 22)
#29 18 ADJ5 21
#30 20 ADJ4 (8 OR 9 OR 10)
#31 15 OR 16 OR 19
#32 23 OR 24 OR 25 OR 26 OR 27 OR 28 OR 29 OR 30 OR 31
#33 (“low bmi” OR “low body mass index”).ti,ab
#34 (“low weight” OR underweight OR under-weight).ti,ab
#35 "maln*".ti,ab
#36 (“nutritional risk” OR (risk ADJ4 maln*)).ti,ab
#37 (“poor nutr*” OR undernourish* OR under-nourish*).ti,ab
#38 ((poor OR inadequate OR suboptimal) ADJ5 intake*).ti,ab
#39 institutionali?ed.ti,ab
#40 elderly.ti,ab
#41 (homebound OR home-bound OR housebound OR house-bound).ti,ab
#42 ((extended OR longterm OR long-term OR community) ADJ1 care).ti,ab
#43 ((nursing OR care OR residential) ADJ1 home).ti,ab
#44 (inpatient* OR hospitali?* OR hospital patient*).ti,ab
#45 33 OR 34 OR 35 OR 36 OR 37 OR 38 OR 39 OR 40 OR 41 OR 42 OR 43 OR 44
#46 2 AND 45
#47 (random* OR rct*).ti,ab
#48 “single blind*”.ti,ab
#49 “double blind*”.ti,ab
#50 ((triple OR treble) AND blind*).ti,ab
#51 ((control* AND trial*) OR (clinical ADJ4 trial*) OR trial*).ti,ab
#52 (systematic* review*).ti,ab
#53 (“health technology” ADJ6 assessment$).ti,ab
#54 hta.ti,ab
#55 (“meta analy$” OR metaanaly$ or meta?analy$).ti,ab
#56 47 OR 48 OR 50 OR 51 OR 52 OR 53 OR 54 OR 55
#57 46 AND 56
#58 (comment OR editorial OR historical-article).pt.
#59 57 NOT 58
#60 (animal OR rat OR mouse OR guinea pig OR primate OR monkey OR cat OR dog).ti,ab
#61 9 NOT 60
#62 regnan*.ti,ab
#63 61 NOT 62
#64 (child* OR infant OR paediatric OR pediatric).ti,ab

(Continued)

#65 63 NOT 64

British Nursing Index

#1 (food* OR meal* OR snack* OR drink* OR feed*).ab,ti.
#2 (nutri* OR diet*).ab,ti.
#3 "dining*".ab,ti.
#4 (screening OR monitoring).ab,ti.
#5 (documentation OR communication).ab,ti.
#6 (time* OR timing OR pattern OR style OR arrangement* OR environment).ab,ti.
#7 (staff* OR train*).ab,ti.
#8 "nurs*".ab,ti.
#9 (healthcare OR health care).ab,ti.
#10 "cater*".ab,ti.
#11 (flavo?r* OR taste).ab,ti.
#12 (content OR composition OR density).ab,ti.
#13 (appear* OR presentation).ab,ti.
#14 (size OR portion OR amount).ab,ti.
#15 "protected meal*".ab,ti.
#16 "red tray*".ab,ti.
#17 "fortif*".ab,ti.
#18 "supplement*".ab,ti.
#19 ((supportive OR nutrition* OR diet*) ADJ3 intervention).ab,ti.
#20 (assist* OR help* OR support*).ab,ti.
#21 (add* OR extra).ab,ti.
#22 (alter* OR chang* OR new OR enhance* OR modif* OR increas* OR decreas* OR improv* OR reduc* OR target*).ab,ti.
#23 1 ADJ3 (6 OR 11 OR 12 OR 13 OR 14 OR 17 OR 18 OR 20 OR 21 OR 22)
#24 2 ADJ4 (12 OR 17 OR 18 OR 21 OR 22)
#25 3 ADJ4 (6 OR 22)
#26 4 ADJ4 (2 OR 21 OR 22)
#27 5 ADJ4 22
#28 7 ADJ4 (8 OR 9 OR 10 OR 20 OR 21 OR 22)
#29 18 ADJ5 21
#30 20 ADJ4 (8 OR 9 OR 10)
#31 15 OR 16 OR 19
#32 23 OR 24 OR 25 OR 26 OR 27 OR 28 OR 29 OR 30 OR 31
#33 (low bmi OR low body mass index).ab,ti.
#34 (low weight OR underweight OR under-weight).ab,ti.
#35 "maln*".ab,ti.
#36 (nutritional risk OR (risk ADJ4 maln*)).ab,ti.
#37 (poor nutr* OR undernourish* OR under-nourish*).ab,ti.
#38 ((poor OR inadequate OR suboptimal) adj5 intake*).ab,ti.
#39 institutionali?ed.ab,ti.
#40 elderly.ab,ti.
#41 homebound OR home-bound OR housebound OR house-bound).ab,ti.
#42 ((extended OR longterm OR long-term OR community) ADJ1 care).ab,ti.
#43 ((nursing OR care OR residential) ADJ1 home).ab,ti.
#44 (inpatient* OR hospitali?* OR hospital patient*).ab,ti.
#45 33 OR 34 OR 35 OR 36 OR 37 OR 38 OR 39 OR 40 OR 41 OR 42 OR 43 OR 44
#46 32 AND 45
#47 (random* OR rct*).tw,ot.
#48 “single blind*”.tw, ot.
#49 “double blind*”.tw, ot.
#50 ((triple OR treble) AND blind*).tw,ot.
#51 ((control* AND trial*) OR (clinical ADJ4 trial*) OR trial*).tw,ot.
#52 (systematic* review*).tw,ot.
#53 hta.tw, ot.
#54 (health technology ADJ6 assessment$).tw,ot.
#55 (meta analy$ OR metaanaly$ or meta?analy$).tw,ot.

(Continued)

#56 (review$ OR search$) ADJ10 (literature$ OR medical database$ OR medline OR pubmed OR embase OR cochrane OR cinahl OR psycinfo OR psyclit OR healthstar OR biosis OR current content$ OR systemat$)).tw,ot.
#57 47 OR 48 OR 49 OR 50 OR 51 OR 52 OR 53 OR 54 OR 55 OR 56
#58 (comment or editorial or historical-article).pt.
#59 57 NOT 58
#60 46 AND 59
#61 pregnan*.tw,ot.
#62 60 NOT 61

CINAHL

#1 (TI (food* OR meal* OR snack* OR drink* OR feed*)) OR (AB (food* OR meal* OR snack* OR drink* OR feed*))
#2 (TI (nutri* OR diet*)) OR (AB (nutri* OR diet*))
#3 (TI dining*) OR (AB dining*)
#4 (TI (screening OR monitoring)) OR (AB (screening OR monitoring))
#5 (TI (documentation OR communication)) OR (AB (documentation OR communication))
#6 (TI (time* OR timing OR pattern OR style OR arrangement* OR environment*)) OR (AB (time* OR timing OR pattern OR style OR arrangement* OR environment*))
#7 (TI (staff* OR train*)) OR (AB (staff* OR train*))
#8 (TI nurs*) OR (AB nurs*)
#9 (TI (healthcare OR health care)) OR (AB (healthcare OR health care))
#10 (TI cater*) OR (AB cater*)
#11 (TI (flavo?r* OR taste)) OR (AB (flavo?r* OR taste))
#12 (TI (content OR composition OR density)) OR (AB (content OR composition OR density))
#13 (TI (appear* OR presentation)) OR (AB (appear* OR presentation))
#14 (TI (size OR portion OR amount)) OR (AB (size OR portion OR amount))
#15 (TI (protected meal*)) OR (AB (protected meal*))
#16 (TI (red tray*)) OR (AB (protected meal*))
#17 (TI fortif*) OR (AB fortif*)
#18 (TI supplement*) OR (AB supplement*)
#19 (TI ((supportive OR nutrition* OR diet*) N3 intervention)) OR (AB ((supportive OR nutrition* OR diet*) N3 intervention))
#20 (TI (assist* OR help* OR support*)) OR (AB (assist* OR help* OR support*))
#21 (TI (add* OR extra)) OR (AB (add* OR extra))
#22 (TI (alter* OR chang* OR new OR enhance* OR modif* OR increas* OR decreas* OR improv* OR reduc* OR target*)) OR (AB (alter* OR chang* OR new OR enhance* OR modif* OR increas* OR decreas* OR improv* OR reduc* OR target*))
#23 (TI (food* OR meal* OR snack* OR drink* OR feed*) N3 ((time* OR timing OR pattern OR style OR arrangement* OR environment*) OR (flavour* OR flavor* OR taste) OR (content OR composition OR density) OR (appear* OR presentation) OR (size OR portion OR amount) OR (fortif*) OR (supplement*) OR (assist* OR help* OR support*) OR (add* OR extra) OR (alter* OR chang* OR new OR enhance* OR modif* OR increas* OR decreas* OR improv* OR reduc* OR target*))) OR (AB (food* OR meal* OR snack* OR drink* OR feed*) N3 ((time* OR timing OR pattern OR style OR arrangement* OR environment*) OR (flavour* OR flavor* OR taste) OR (content OR composition OR density) OR (appear* OR presentation) OR (size OR portion OR amount) OR (fortif*) OR (supplement*) OR (assist* OR help* OR support*) OR (add* OR extra) OR (alter* OR chang* OR new OR enhance* OR modif* OR increas* OR decreas* OR improv* OR reduc* OR target*)))
#24 (TI (nutri* OR diet*) N4 ((content OR composition OR density) OR (fortif*) OR (supplement*) OR (add* OR extra) OR (alter* OR chang* OR new OR enhance* OR modif* OR increas* OR decreas* OR improv* OR reduc* OR target*))) OR (AB (nutri* OR diet*) N4 ((content OR composition OR density) OR (fortif*) OR (supplement*) OR (add* OR extra) OR (alter* OR chang* OR new OR enhance* OR modif* OR increas* OR decreas* OR improv* OR reduc* OR target*)))
#25 (TI dining* N4 ((time* OR timing OR pattern OR style OR arrangement* OR environment*) OR (alter* OR chang* OR new OR enhance* OR modif* OR increas* OR decreas* OR improv* OR reduc* OR target*))) OR (AB dining* N4 ((time* OR timing OR pattern OR style OR arrangement* OR environment*) OR (alter* OR chang* OR new OR enhance* OR modif* OR increas* OR decreas* OR improv* OR reduc* OR target*)))
#26 (TI (screening OR monitoring) N4 ((nutri* OR diet*) OR (assist* OR help* OR support*) OR (add* OR extra) OR (alter* OR chang* OR new OR enhance* OR modif* OR increas* OR decreas* OR improv* OR reduc* OR target*))) OR (AB (screening OR monitoring) N4 ((nutri* OR diet*) OR (assist* OR help* OR support*) OR (add* OR extra) OR (alter* OR chang* OR new OR enhance* OR modif* OR increas* OR decreas* OR improv* OR reduc* OR target*)))
#27 (TI (documentation OR communication) N4 ((alter* OR chang* OR new OR enhance* OR modif* OR increas* OR decreas* OR improv* OR reduc* OR target*))) OR (AB (documentation OR communication) N4 ((alter* OR chang* OR new OR enhance* OR modif* OR increas* OR decreas* OR improv* OR reduc* OR target*)))
#28 (TI (staff* OR train*) N4 ((nurs*) OR (healthcare OR health care) OR (cater*) OR (assist* OR help* OR support*) OR (add* OR extra) OR (alter* OR chang* OR new OR enhance* OR modif* OR increas* OR decreas* OR improv* OR reduc* OR target*))) OR (AB (staff*

(Continued)

OR train*) N4 ((nurs*) OR (healthcare OR health care) OR (cater*) OR (assist* OR help* OR support*) OR (add* OR extra) OR (alter* OR chang* OR new OR enhance* OR modif* OR increas* OR decreas* OR improv* OR reduc* OR target*)))
#29 (TI (supplement* N5 (add* OR extra))) OR (AB (supplement* N5 (add* OR extra)))
#30 (TI (assist* OR help* OR support*) N4 ((nurs*) OR (healthcare OR health care) OR (cater*))) OR (AB (assist* OR help* OR support*) N4 ((nurs*) OR (healthcare OR health care) OR (cater*)))
#31 (S15 OR S16 OR S19)
#32 S23 OR S24 OR S25 OR S26 OR S27 OR S28 OR S29 OR S30 OR S31
#33 (TI (low BMI OR low body mass index)) OR (AB (low BMI OR low body mass index))
#34 (TI (low weight OR underweight OR under-weight)) OR (AB (low weight OR underweight OR under-weight))
#35 (TI maln*) OR (AB maln*)
#36 (TI (nutritional risk OR (risk N4 maln*))) OR (AB (nutritional risk OR (risk N4 maln*)))
#37 (TI (poor nutr* OR undernourish* OR under-nourish*)) OR (AB (poor nutr* OR undernourish* OR under-nourish*))
#38 TI (poor OR inadequate OR suboptimal) N5 intake*) OR (AB (poor OR inadequate OR suboptimal) N5 intake*)
#39 (TI (institutionali?ed)) OR (AB (institutionali?ed))
#40 (TI elderly) OR (AB elderly)
#41 (TI (homebound OR home-bound OR housebound OR house-bound)) OR (AB (homebound OR home-bound OR housebound OR house-bound))
#42 (TI ((extended OR longterm OR long-term OR community) N1 care)) OR (AB ((extended OR longterm OR long-term OR community) N1 care))
#43 (TI ((nursing OR care OR residential) N1 home)) OR (AB ((nursing OR care OR residential) N1 home))
#44 (TI (inpatient* OR hospitali?* OR hospital patient*)) OR (AB (inpatient* OR hospitali?* OR hospital patient*))
#45 SU Nutritional Status
#46 SU Nutrition Disorders
#47 SU Nutritional Assessment
#48 SU Nutritional Support
#49 SU Nutrition Policy
#50 SU Malnutrition
#51 SU Diet
#52 SU Dietetics
#53 SU Hospital Food Service
#54 SU Energy Intake
#55 SU Fortified Food
#56 S33 OR S34 OR S35 OR S36 OR S37 OR S38 OR S39 OR S40 OR S41 OR S42 OR S43 OR S44 OR S45 OR S46 OR S47 OR S48 OR S49 OR S50 OR S51 OR S52 OR S53 OR S54 OR S55
#57 S32 AND S56
#58 (TI (random* OR rct*)) OR (TX (random* OR rct*))
#59 (TI single blind*) OR (TX single blind*)
#60 (TI double blind*) OR (TX double blind*)
#61 (TI ((triple OR treble) AND blind*)) OR (TX ((triple OR treble) AND blind*))
#62 (TI ((control* AND trial*) OR (clinical N4 trial*) OR trial*)) OR (TX ((control* AND trial*) OR (clinical N4 trial*) OR trial*))
#63 (TI systematic* review*) OR (TX systematic* review*)
#64 (TI hta) OR (TX hta)
#65 (TI (health technology N6 assessment*)) OR (TX (health technology N6 assessment*))
#66 (TI (meta analy* OR metaanaly* or meta?analy*)) OR (TX (meta analy* OR metaanaly* or meta?analy*))
#67 (TI ((review* OR search*) N10 (literature* OR medical database* OR medline OR pubmed OR embase OR cochrane OR cinahl OR psycinfo OR psyclit OR healthstar OR biosis OR current content* OR systemat*))) OR (TX ((review* OR search*) N10 (literature* OR medical database* OR medline OR pubmed OR embase OR cochrane OR cinahl OR psycinfo OR psyclit OR healthstar OR biosis OR current content* OR systemat*)))
#68 S58 OR S59 OR S60 OR S61 OR S62 OR S63 OR S64 OR S65 OR S66 OR S67
#69 PT (comment OR editorial OR historical-article)
#70 S68 NOT S69
#71 SU Pregnancy
#72 (TI pregnan*) OR (TX pregnan*)
#73 S71 OR S72
#74 S70 NOT S73
#75 S57 AND S74
Limiters - Human; Age Groups: Adult: 19-44 years, Aged: 65+ years

SCOPUS

(Continued)

#1
((TITLE-ABS-KEY((food* W/3 time*) OR (food* W/3 timing) OR (food* W/3 pattern) OR (food* W/3 style) OR (food* W/3 arrangement*)OR (food*W/3 environment) OR (food* W/3 flavour) OR (food* W/3 taste) OR (food* W/3 content) OR (food* W/3 composition) OR (food* W/3 density) OR (food* W/3 appear*) OR (food* W/3 presentation) OR (food* W/3 size) OR (food* W/3 portion) OR (food* W/3 amount) OR (food* W/3 fortifi*) OR (food* W/3 supplement*) OR (food* W/3 assist*) OR (food* W/3 help*) OR (food* W/3 support*) OR (food* W/3 add*) OR (food* W/3 extra) OR (food* W/3 alter*) OR (food* W/3 chang*) OR (food* W/3 new) OR (food* W/3 enhance*) OR (food* W/3 modif*) OR (food* W/3 increas*) OR (food W/3 decreas*) OR (food* W/3 improv*) OR (food* W/3 reduc*) OR (food* W/3 target*))) OR (TITLE-ABS-KEY((meal* W/3 time*) OR (meal* W/3 timing) OR (meal* W/3 pattern) OR (meal* W/3 style) OR (meal* W/3 arrangement*)OR (meal*W/3 environment) OR (meal* W/3 flavour) OR (meal* W/3 taste) OR (meal* W/3 content) OR (meal* W/3 composition) OR (meal* W/3 density) OR (meal* W/3 appear*) OR (meal* W/3 presentation) OR (meal* W/3 size) OR (meal* W/3 portion) OR (meal* W/3 amount) OR (meal* W/3 fortifi*) OR (meal* W/3 supplement*) OR (meal* W/3 assist*) OR (meal* W/3 help*) OR (meal* W/3 support*) OR (meal* W/3 add*) OR (meal* W/3 extra) OR (meal* W/3 alter*) OR (meal* W/3 chang*) OR (meal* W/3 new) OR (meal* W/3 enhance*) OR (meal* W/3 modif*) OR (meal* W/3 increas*) OR (food W/3 decreas*) OR (meal* W/3 improv*) OR (meal* W/3 reduc*) OR (meal* W/3 target*))) OR (TITLE-ABS-KEY((snack* W/3 time*) OR (snack* W/3 timing) OR (snack* W/3 pattern) OR (snack* W/3 style) OR (snack* W/3 arrangement*)OR (snack*W/3 environment) OR (snack* W/3 flavour) OR (snack* W/3 taste) OR (snack* W/3 content) OR (snack* W/3 composition) OR (snack* W/3 density) OR (snack* W/3 appear*) OR (snack* W/3 presentation) OR (snack* W/3 size) OR (snack* W/3 portion) OR (snack* W/3 amount) OR (snack* W/3 fortifi*) OR (snack* W/3 supplement*) OR (snack* W/3 assist*) OR (snack* W/3 help*) OR (snack* W/3 support*) OR (snack* W/3 add*) OR (snack* W/3 extra) OR (snack* W/3 alter*) OR (snack* W/3 chang*) OR (snack* W/3 new) OR (snack* W/3 enhance*) OR (snack* W/3 modif*) OR (snack* W/3 increas*) OR (food W/3 decreas*) OR (snack* W/3 improv*) OR (snack* W/3 reduc*) OR (snack* W/3 target*))) OR (TITLE-ABS-KEY((drink* W/3 time*) OR (drink* W/3 timing) OR (drink* W/3 pattern) OR (drink* W/3 style) OR (drink* W/3 arrangement*)OR (drink*W/3 environment) OR (drink* W/3 flavour) OR (drink* W/3 taste) OR (drink* W/3 content) OR (drink* W/3 composition) OR (drink* W/3 density) OR (drink* W/3 appear*) OR (drink* W/3 presentation) OR (drink* W/3 size) OR (drink* W/3 portion) OR (drink* W/3 amount) OR (drink* W/3 fortifi*) OR (drink* W/3 supplement*) OR (drink* W/3 assist*) OR (drink* W/3 help*) OR (drink* W/3 support*) OR (drink* W/3 add*) OR (drink* W/3 extra) OR (drink* W/3 alter*) OR (drink* W/3 chang*) OR (drink* W/3 new) OR (drink* W/3 enhance*) OR (drink* W/3 modif*) OR (drink* W/3 increas*) OR (food W/3 decreas*) OR (drink* W/3 improv*) OR (drink* W/3 reduc*) OR (drink* W/3 target*))) OR (TITLE-ABS-KEY((feed* W/3 time*) OR (feed* W/3 timing) OR (feed* W/3 pattern) OR (feed* W/3 style) OR (feed* W/3 arrangement*) OR (feed* W/3 environment) OR (feed* W/3 flavour) OR (feed* W/3 taste) OR (feed* W/3 content) OR (feed* W/3 composition) OR (feed* W/3 density) OR (feed* W/3 appear*) OR (feed* W/3 presentation) OR (feed* W/3 size) OR(feed* W/3 portion) OR(feed* W/3 amount) OR(feed* W/3 fortifi*) OR (feed* W/3 supplement*) OR (feed* W/3 assist*) OR(feed* W/3 help*) OR (feed* W/3 support*) OR (feed* W/3 add*) OR (feed* W/3 extra) OR (feed* W/3 alter*) OR(feed* W/3 chang*) OR (feed* W/3 new) OR (feed* W/3 enhance*) OR (feed* W/3 modif*) OR (feed* W/3 increas*) OR (food W/3 decreas*) OR (feed* W/3 improv*) OR (feed* W/3 reduc*) OR (feed* W/3 target*))))
#2
OR ((TITLE-ABS-KEY((nutri* W/3 content) OR (nutri* W/3 composition)OR (nutri* W/3 density))) OR (TITLE-ABS-KEY((diet* W/3 content) OR (diet* W/3 composition)OR (diet* W/3 density))) OR (TITLE-ABS-KEY(nutri* W/3 fortifi*)) OR (TITLE-ABS-KEY(diet* W/3 fortifi*)) OR (TITLE-ABS-KEY(nutri* W/3 supplement*)) OR (TITLE-ABS-KEY(diet* W/3 supplement*)) OR (TITLE-ABS-KEY(nutri* W/3 add*) OR (nutri* W/3 extra)) OR (TITLE-ABS-KEY((diet* W/3 add*) OR (diet* W/3 extra))))
#3
OR ((TITLE-ABS-KEY((dining* W/3 time*) OR (dining* W/3 timing) OR (dining* W/3 pattern) OR (dining* W/3 style) OR (dining* W/3 arrangement*)OR (dining* W/3 environment))) OR (TITLE-ABS-KEY((dining* W/3 alter*) OR (dining* W/3 chang*) OR (dining* W/3 new) OR (dining* W/3 enhance*) OR (dining* W/3 modif*) OR (dining*W/3 increas*) OR (food W/3 decreas*) OR (dining* W/3 improv*) OR (dining* W/3 reduc*) OR (dining* W/3 target*))))
#4
OR ((TITLE-ABS-KEY((screening W/3 nutri*) OR (screening W/3 diet*))) OR (TITLE-ABS-KEY((monitoring W/3 nutri*) OR (monitoring W/3 diet*))) OR (TITLE-ABS-KEY((screening W/3 add*) OR (screening W/3 extra))) OR (TITLE-ABS-KEY((monitoring W/3 add*) OR (monitoring W/3 extra))) OR (TITLE-ABS-KEY((screeningW/3 alter*) OR (screening W/3 chang*) OR (screening W/3 new) OR (screening W/3 enhance*) OR (screeningW/3 modif*) OR (screening W/3 increas*) OR (food W/3 decreas*) OR (screening W/3 improv*) OR (screening W/3 reduc*) OR (screening W/3 target*))) OR (TITLE-ABS-KEY((monitoring W/3 alter*)OR (monitoringW/3 chang*)OR (monitoringW/3 new)OR (monitoringW/3 enhance*)OR (monitoringW/3 modif*)OR (monitoringW/3 increas*)OR (foodW/3 decreas*)OR (monitoringW/3 improv*)OR (monitoringW/3 reduc*)OR (monitoringW/3 target*))))
#5
OR ((TITLE-ABS-KEY((documentation W/3 alter*) OR (documentation W/3 chang*) OR (documentation W/3 new) OR (documentation W/3 enhance*) OR (documentation W/3 modif*) OR (documentation W/3 increas*) OR (food W/3 decreas*) OR (documentation W/3 improv*)OR (documentation W/3 reduc*)OR (documentation W/3 target*))) OR (TITLE-ABS-KEY((communication W/3 alter*)OR (communicationW/3 chang*) OR (communication W/3 new) OR (communication W/3 enhance*) OR (communication W/3 modif*) OR (communication W/3 increas*) OR (food W/3 decreas*) OR (communication W/3 improv*) OR (communication W/3 reduc*) OR (communication W/3 target*))))
#6
OR ((TITLE-ABS-KEY((staff* W/3 nurs*)OR (train* W/3 nurs*))) OR (TITLE-ABS-KEY((staff* W/3 healthcare)OR (train*W/3 healthcare)OR (staff* W/3 health care) OR (train* W/3 healthcare))) OR (TITLE-ABS-KEY(staff* W/3 cater*)) OR (TITLE-ABS-KEY((staff* W/3 assist*) OR

(Continued)

(train* W/3 assist) OR (staff* W/3 help*) OR (train* W/3 help*) OR (staff* W/3 support*) OR (train*W/3 support*) OR (staff* W/3 add*) OR (train* W/3 add*) OR (staff* W/3 extra) OR (train* W/3 extra))) OR (TITLE-ABS-KEY((staff* W/3 alter*) OR (staff* W/3 chang*) OR (staff* W/3 new) OR (staff* W/3 enhance*)OR (staff* W/3 modif*)OR (staff* W/3 increas*)OR (food W/3 decreas*)OR (staff* W/3 improv*)OR (staff* W/3 reduc*)OR (staff* W/3 target*))) OR (TITLE-ABS-KEY((train* W/3 alter*) OR (train* W/3 chang*) OR (train* W/3 new) OR (train* W/3 enhance*)OR (train* W/3 modif*)OR (train* W/3 increas*)OR (food W/3 decreas*)OR (train* W/3 improv*)OR (train* W/3 reduc*)OR (train* W/3 target*))))

#7

OR (TITLE-ABS-KEY((supplement* W/3 add*) OR (supplement* W/3 extra)))))

#8

(((((((TITLE-ABS-KEY((assist* W/3 nurs*) OR (assist* W/3 healthcare) OR (assist* W/3 healthcare) OR(assist* W/3 cater*))) OR (TITLE-ABS-KEY((help* W/3 nurs*) OR (help* W/3 healthcare)OR (help* W/3 health care) OR (help* W/3 cater*))) OR (TITLE-ABS-KEY((support* W/3 nurs*) OR (support* W/3 healthcare) OR (support* W/3 health care) OR (support* W/3 cater*))))

#9

OR (TITLE-ABS-KEY(("protected meal" OR "red tray")) OR ((supportive W/3 intervention) OR (nutrition* W/3intervention) OR (diet* W/3intervention)))

#10

#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9

#11

OR (TITLE-ABS-KEY("low BMI" OR "low body mass index"))

#12

OR (TITLE-ABS-KEY("low weight" OR underweightOR "under-weight"))

#13

OR (TITLE-ABS-KEY(maln*))

#14

OR (TITLE-ABS-KEY(("nutritional risk") OR (risk W/3 maln*)))

#15

OR (TITLE-ABS-KEY("poor nutr*"OR undernourish* OR "under-nourish*"))

#16

OR (TITLE-ABS-KEY((poor W/3 intake*) OR (inadequateW/3 intake*) OR (suboptimal W/3 intake*)))

#17

OR (TITLE-ABS-KEY(institutionali?ed OR elderly))

#18

OR (TITLE-ABS-KEY(homebound OR "home bound" OR housebound OR "house bound"))

#19

OR (ABS((extended W/1care) OR(longterm W/1care) OR("long term" W/1 care) OR (community W/1 care)))

#20

OR (ABS((nursing W/1 home)OR (care W/3 home) OR (residential W/3 home)))

#21

OR (ABS(inpatient* OR hospitali?* OR "hospital patient*"))

#22

OR (ABS("nutritional status" OR "nutrition disorder*" OR "nutrition assessment*" OR "nutritional support*" OR "nutrition policy"))

#23

OR (ABS(diet* OR "food service" OR "energy intake" OR "fortified food"))

#24

#11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17

#25

#18 OR #19 OR #20 OR #21 OR #22 OR #23

#26

#24 OR #25

#27

#10 AND #26

#28

((ABS("controlled trial*" OR "controlled clinical trial*" OR "clinical trial*")) OR (ABS(random* ORplacebo)) OR (ABS("meta-analys*" OR metaanalys* OR hta OR "health technology assessment")) OR (ABS(literature* OR "medical database*" OR medline OR pubmed OR embase OR cochrane OR cinahl OR psycinfo OR psyclit OR healthstar OR biosis OR "current content*" OR "systematic review*")))

#29

#27 AND #28

#30

(ABS(adult*))

#31

#29 AND #30

(Continued)

#32
(ABS(pregnan*))
#33
#31 AND NOT #32
#34
(ABS(animal*))
#35
#33 AND NOT #34

ISI Web of Science

#1 TS=((food* OR meal* OR snack* OR drink* OR feed*) NEAR/3 (time* OR timing OR pattern OR style OR arrangement* OR environment OR flavor OR taste OR content OR composition OR density OR appear* OR presentation OR size OR portion OR amount OR fortifi* OR supplement* OR assist* OR help* OR support* OR add* OR extra OR alter* OR chang* OR new OR enhance* OR modif* OR increas* OR decreas* OR improv* OR reduc* OR target*))
2 TS=((nutri* OR diet*) NEAR/3 (content OR composition OR density OR fortfi* OR supplement* OR add* OR extra OR alter* OR chang* OR new OR enhance* OR modif* OR increas* OR decreas* OR improv* OR reduc* OR target))
3 TS=((dining*) NEAR/3 (time* OR timing OR pattern OR style OR arrangement* OR environment OR alter* OR chang* OR new OR enhance* OR modif* OR increas* OR decreas* OR improv* OR reduc* OR target*))
4 TS=((screening OR monitoring) NEAR/3 (nutri* OR diet* OR add* OR extra OR alter* OR chang* OR new OR enhance* OR modif* OR increas* OR decreas* OR improv* OR reduc* OR target*))
5 TS=((documentation OR communication) NEAR/3 (alter* OR chang* OR new OR enhance* OR modif* OR increas* OR decreas* OR improv* OR reduc* OR target*))
6 TS=((staff* OR train*) NEAR/3 (nurs* OR healthcare OR "health care" OR cater* OR assist* OR help* OR support* OR add* OR extra OR alter* OR chang* OR new OR enhance* OR modif* OR increas* OR decreas* OR improv* OR reduc* OR target*))
7 TS=((supplement*) NEAR/6 (add* OR extra))
8 TS=((assist* OR help* OR support*) NEAR/3 (nurs* OR healthcare OR "health care" OR cater*))
9 TS=(("protected meal" OR "red tray") OR ((supportive OR nutrition* OR diet*) NEAR/3 intervention*))
10 #9 OR #8 OR #7 OR #6 OR #5 OR #4 OR #3 OR #2 OR #1
11 TS=(("low bmi" OR "low body mass index"))
12 TS=(("low weight" OR underweight OR "under-weight"))
13 TS=(maln*)
14 TS=("nutritional risk" OR (risk NEAR/3 maln*))
15 TS=(("poor nutr*" OR undernourish* OR "under nourish*"))
16 TS=((poor OR inadequate OR suboptimal) NEAR/6 intake*)
17 TS=((institutionali?ed OR elderly))
18 TS=((homebound OR "home bound" OR housebound OR "house bound"))
19 TS=((extended OR longterm OR "long term" OR community) NEAR/1 care)
20 TS=((nursing OR care OR residential) NEAR/1 home)
21 TS=((inpatient* OR hospitali?* OR "hospital patient*"))
22 TS=(nutritional status)
23 TS=(nutrition disorder*)
24 TS=(("nutrition assessment*" OR "nutritional support*"OR "nutrition policy"))
25 TS=((diet* OR "food service" OR "energy intake" OR "fortified food"))
26 #25 OR #24 OR #23 OR #22 OR #21 OR #20 OR #19 OR #18 OR #17 OR #16 OR #15 OR #14 OR #13 OR #12 OR #11
27 #26 AND #10
28 TS=("controlled trial*" OR "controlled clinical trial*" OR "clinical trial*")
29 TS=(random* OR placebo)
30 TS=("meta-analys*" OR metaanalys* OR hta OR "health technology assessment")
31 TS=((literature* OR "medical database*" OR medline OR pubmed OR embase OR cochrane OR cinahl OR psycinfo OR psyclit OR healthstar OR biosis OR "current content*" OR "systematic review*"))
32 #31 OR #30 OR #29 OR #28
33 #32 AND #27
34 TS=(adult*)
35 #34 AND #33
36 TS=(pregnan*)
37 #35 NOT #36
38 TS=(animal*)
39 #37 NOT #38

Appendix 2. Search strategies (January 2013 to September 2016)

Cochrane Library (Wiley)
I: Population
1. [mh ^Stroke] or stroke:ti,ab
2. [mh ^"Alzheimer Disease"] or alzheimer:ti,ab
3. [mh ^Dementia] or dement*:ti,ab
4. [mh ^"Mild Cognitive Impairment"] or "cognitive impairment":ti,ab
5. [mh "Hip Fractures"] or ("hip fracture*" or "femoral neck fracture*"):ti,ab
6. [mh ^"Nursing Homes"] or [mh ^"Homes for the Aged"] or ("nursing home*"):ti,ab
7. (residents or residential):ti,ab
8. [mh ^"Aged"] or [mh ^"Aging"] or aged:ti,ab
9. [mh ^"Frail Elderly"] or (elder or elders or elderly):ti,ab
10. (older or geriatric):ti,ab
11. [mh ^"Inpatients"] or inpatients:ti,ab
12. [mh ^"Outpatients"] or outpatients:ti,ab
13. [mh ^"Institutionalization"] or institutionali*:ti,ab
14. [mh ^"Hospitalization"] or (hospitali?ed or hospitali?ation):ti,ab
15. {or #1-#14}
II: Condition
16. [mh ^"Malnutrition"] or [mh ^"Protein-Energy Malnutrition"]
17. (malnourish* or malnutrition):ti,ab
18. [mh ^"Nutrition Assessment"]
19. [mh ^"Nutritional Status"] or "nutritional status":ti,ab
20. [mh ^"Nutritional Requirements"]
21. [mh ^"Nutrition Disorders"]
22. [mh ^"Nutritional Support"]
23. ((nutritional or nutrition or nutritionally) near/2 risk):ti,ab
24. ((unintentional or risk) near/2 "weight loss"):ti,ab
25. (undernutrition or undernourished or hyponutrition):ti,ab
26. [mh ^"Elder Nutritional Physiological Phenomena"]
27. [mh ^"Energy Intake"]
28. [mh ^"Feeding Behavior"] or [mh ^"Feeding Methods"]

(Continued)

29. ("Mini Nutritional Assessment" or "Eating Behaviour Scale" or "Edinburgh Feeding Evaluation" or "Malnutrition Universal Screening Tool"):ti,ab

30. ((improve* or increase* or inadequate) near/3 ("nutrient intake" or "energy intake" or "dietary intake" or "food intake")):ti,ab

31. {or #16-#30}

32. #15 and #31

33. #32 not (child* or infant* or pregnan*):ti,ab,kw

34. Publication Year from 2013 to 2016

MEDLINE (Ovid SP)

I: Population

1. Stroke/ or stroke.tw.

2. Alzheimer Disease/ or alzheimer.tw.

3. Dementia/ or dement*.tw.

4. Mild Cognitive Impairment/ or cognitive impairment.tw.

5. exp Hip Fractures/ or (hip fracture? or femoral neck fracture?).tw.

6. Nursing Homes/ or Homes for the Aged/ or (nursing home?).tw.

7. (residents or residential).tw.

8. Aged/ or Aging/ or aged.tw.

9. Frail Elderly/ or (elder or elders or elderly).tw.

10. (older or geriatric).tw.

11. Inpatients/ or inpatients.tw.

12. Outpatients/ or outpatients.tw.

13. Institutionalization/ or institutionali*.tw.

14. Hospitalization/ or (hospitali?ed or hospitali?ation).tw.

15. or/1-14

II: Condition

16. Malnutrition/ or Protein-Energy Malnutrition/

17. (malnourish* or malnutrition).tw.

18. Nutrition Assessment/

19. Nutritional Status/ or nutritional status.tw.

20. Nutritional Requirements/

21. Nutrition Disorders/

22. Nutritional Support/

23. ((nutritional or nutrition or nutritionally) adj2 risk).tw.

24. ((unintentional or risk) adj2 weight loss).tw.

(Continued)

25. (undernutrition or undernourished or hyponutrition).tw.

26. Elder Nutritional Physiological Phenomena/

27. Energy Intake/

28. Feeding Behavior/ or Feeding Methods/

29. (Mini Nutritional Assessment or Eating Behaviour Scale or Edinburgh Feeding Evaluation or Malnutrition Universal Screening Tool).tw.

30. ((improve* or increase? or inadequate) adj3 (nutrient intake or energy intake or dietary intake or food intake)).tw.

31. or/16-30

32. 15 and 31

III. [Cochrane Handbook 2008 RCT filter - sensitivity and precision max. version]

33. randomized controlled trial.pt.

34. controlled clinical trial.pt.

35. randomi?ed.ab.

36. placebo.ab.

37. clinical trials as topic/

38. randomly.ab.

39. trial.ti.

40. or/33-39

41. exp animals/ not humans/

42. 40 not 41

43. 32 and 42

44. 43 not (child* or infant* or pregnan*).tw.

45. limit 44 to yr="2013-Current"

ClinicalTrials.gov (Advanced search)

Search Terms: malnourished OR malnutrition OR undernourished OR undernutrition OR "under nutrition" OR "poor nutritional status" OR "nutritional risk" OR "inadequate nutrient intake"

Study Type: Interventional Studies

Age Group: Adult (18–65), Senior (66+)

WHO ICTRP (Standard search)

malnourished AND elder* OR

malnutrition AND elder* OR

undernourished AND elder* OR

undernutrition AND elder* OR

malnourished AND aged OR

(Continued)

malnutrition AND aged OR

undernourished AND aged OR

undernutrition AND aged OR

malnourished AND geriatric OR

malnutrition AND geriatric OR

undernourished AND geriatric OR

undernutrition AND geriatric

Appendix 3. Description of interventions

	Intervention(s)	Type of intervention(s)[a]	Comparator(s)
Barton 2000	I1: portion size decreased by 20% but fortified to achieve overall daily energy provision increased by 200 kcal (randomised)	Modification of meal profile or pattern	Normal hospital menu (randomised group)
	I2: normal hospital menu plus cooked breakfast (not randomised group)		
Beck 2002	I1: homemade oral supplement (group A, not randomised)	Additional supplementation of meals	Usual diet
	I2: homemade oral supplement (group B)		
Bouillanne 2013	'Pulse diet': 78% of daily protein requirements provided at lunch (no change to energy and protein)	Modification of meal profile or pattern	'Spread diet': usual diet (daily protein requirements distributed between meals)
Bourdel-Marchasson 2000	Oral supplementation in addition to standard diet	Additional supplementation of meals	Standard diet
Brouillette 1991	Osmotherapy (use of aromas to stimulate appetite) + activities	Changes to the feeding environment	Activities only
Castellanos 2009	I1: two breakfast and two lunch foods fortified to improve energy and protein content (hot cereal and juice breakfast, soup and side dish at lunch)	Modification of meal profile or pattern	Routine care, no meals enhanced
	I2: two lunch foods only fortified versus normal menu		
Chang 2005	Training in feeding skills (feeding skills training programme for nursing assistants)	Changes to the organisation of nutritional care	No training
Dennis 2005	Normal hospital diet plus oral nutritional supplements	Additional supplementation of meals	Normal hospital diet
Duncan 2006	Additional personal attention of a dietetic assistant e.g. checking personal food preferences, assisting with food choice, provision of appropriate feeding aids, feeding as-	Changes to the organisation of nutritional care	Routine care

(Continued)

	sistance and collecting information to aid nutritional assessment		
Essed 2007	Food sprinkled with 1 g (+ 0.2 g) of intervention + maltodextrin carrier I1: monosodium glutamate I2: flavour I3: monosodium glutamate + flavour	Modification of meal profile or pattern	Maltodextrin (placebo)
Essed 2009	Three foods (previously identified as preferred), i.e. mashed potato (0.2 g NaCl/100 g + 0.5% monosodium glutamate), mince meat (0.37 g NaCl/100 g + 2% monosodium glutamate and spinach (0.25 g NaCl/100 g + 2% monosodium glutamate)	Modification of meal profile or pattern	Usual hot meal
Faxen-Irving 2011	A daily dose of 3 x 30 mL fat emulsion distributed at the same time as pharmaceutical prescriptions	Additional supplementation of meals	Standard care
Gaskill 2009	Nutrition education programme	Changes to the organisation of nutritional care	Usual care
Germain 2006	Re-formed foods, thickened beverages and dietary supplements as necessary	Modification of meal profile or pattern	Traditional modified texture diet
Hankey 1993	Supplements in addition to their normal hospital diet	Additional supplementation of meals	Standard hospital food
Hickson 2004	Additional nutritional care from a trained health care assistant	Changes to the organisation of nutritional care	Usual care
Holyday 2012	Malnutrition care plan; screening, assessment and intervention tailored to individuals requirements (including texture modification, fortification, oral nutritional supplements, snacks, assistance)	Changes to the organisation of nutritional care	Usual care
Johansen 2004	Nutrition team (dietitian + nurse)	Changes to the organisation of nutritional care	Usual care
Kraft 2012	Oral nutritional supplements + monitoring using telemedicine	Changes to the organisation of nutritional care	Usual care
Kretser 2003	Modified meals on wheels system (21 meals + 14 snacks) and daily phone call	Congregate and home meal delivery systems	Traditional meals on wheels (one hot meal delivered five days a week at lunch)
Larsson 1990	Oral nutritional supplements plus normal hospital diet	Additional supplementation of meals	Normal hospital diet
Leslie 2012	Energy enriched usual meals	Modification of meal profile or pattern	Usual care
Lin 2010	I1: spaced-retrieval - a method to enhance learning, retention and recall of information	Changes to the organisation of nutritional care	Usual care

(Continued)

	I2: Montessori intervention - a method capable of stopping or reducing residents problem behaviours		
Lin 2011	Montessori intervention - designed to manage eating difficulties	Changes to the organisation of nutritional care	Usual care
Mathey 2001a	Improved meal ambiance comprising improvements to physical environment, meal service and organisation of assistance	Changes to the feeding environment	Usual care
Mathey 2001b	Creating a better ambience during food consumption	Changes to the feeding environment	Usual care
Munk 2014	Energy and protein enriched foods provided in addition to the hospital food via an a la carte menu	Modification of meal profile or pattern	Usual care
Nijs 2006	Family-style meals comprising table dressing, food service, staff protocols, residents protocol and a meal-time protocol, meal choice at the time of meal	Changes to the feeding environment	Individual pre-plated meal service, meal chosen 2 weeks in advance.
Olofsson 2007	Multi-component intervention (including nutrition)	Changes to the organisation of nutritional care	Usual care
Pivi 2011	I1: nutrition education for caregivers and participants	Changes to the organisation of nutritional care	Usual care
	I2: oral nutritional supplements (two cartons daily for six months)		
Potter 2001	Oral nutritional supplement + normal hospital diet	Additional supplementation of meals	Normal hospital diet
Remsburg 2001	Buffet style dining programme for supper only	Changes to the feeding environment	Usual care, tray-style meal served by nursing home staff
Salva 2011	Teaching and training intervention to improve nutrition care	Changes to the organisation of nutritional care	Usual care
Silver 2008	Home-delivered fortified lunch once weekly for 7 months	Modification of meal profile or pattern	Home delivered usual lunch once weekly for 7 months
Simmons 2008	Mealtime feeding assistance and/or between meal snacks	Additional supplementation of meals	Usual care
Simmons 2010	I1: snacks between meal snacks	Additional supplementation of meals	Usual care
Smolliner 2008	I2: oral nutritional supplements		
	Protein and energy-enriched soups and sauces and two additional snacks high in protein and energy	Modification of meal profile or pattern	Usual diet
Splett 2003	Medical nutrition therapy (protocol-driven nutritional assessment and intervention activities carried by dietitians)	Changes to the organisation of nutritional care	Usual care by dietitians

(Continued)

Taylor 2006	5-meal menu pattern with energy content similar to existing 3-meal menu	Modification of meal profile or pattern	3-meal menu (usual care)
Van den Berg 2015	I1: offered 125 mL ONS twice daily with medication rounds	Additional supplementation of meals	Usual care (125 mL ONS offered in between meals)
	I2: offered 62 mL ONS four times daily with medication rounds		
Van Ort 1995	I2: offered 62 mL ONS daily with medication rounds	Changes to the feeding environment	Usual care

[a]Numbers refer to intervention sub-categories: (1) changes to the organisation of nutritional care, (2) changes to the feeding environment, (3) modification of meal profile or pattern, (4) additional supplementation of meals, (5) congregate and home meal delivery systems - see Table 1

C: comparator; I: intervention; ONS: oral nutritional supplement

Appendix 4. Baseline characteristics (I)

	Intervention(s) and comparator(s)	Participants (N)	Description of participants (trial design)	Country	Setting	Sex N (female %)	Age mean years (SD)/range)
Barton 2000	I1: reduced portion fortified menu	13	Elderly hospitalised individuals (cross-over RCT)	UK	Elderly rehab ward	6 (46)	77 (8)
	I2: normal menu plus cooked breakfast	8 (non-randomised)				5 (63) (non-randomised)	78 (9) (non-randomised)
	C: normal hospital menu	14				11 (79)	75 (11)
Beck 2002	I1: homemade oral supplement	36	Nursing home residents > 65 years (parallel RCT)	Denmark	Residential care home	22 (61)	81 (76-86)
	I2: homemade oral supplement (B)						
	C: usual diet						
Bouillanne 2013	I: pulse diet (78% protein at lunch)	66	Hospitalised elderly individuals (parallel RCT)	France	Intermediate care unit	46 (70)	84.1 (6)
	C: usual diet (protein distributed between meals)						85.7 (6.3)
Bourdel-Marchasson 2000	I: oral supplementation + standard diet	295	Critically ill elderly participants (cluster-RCT)	France	Hospital wards & geriatric units	199 (67.5)	83.6 (7.3)
	C: standard diet	377				238 (63.1)	83.0 (7.1)
Brouillette 1991	I: osmotherapy + activities	10	Nursing home residents (parallel RCT)	USA	Residential care home	14 (88) of those that completed the trial	80 (6.4)
	C: activities only	10					87 (6.8)
Castellanos 2009	I1: fortified breakfast and lunch menu	39	Nursing home residents (cross-over RCT)	USA	Residential care home	23/33 finishing (70)	87.3 (8.6)
	I2: fortified lunch menu	39					

(Continued)

	C: usual menu	39					
Chang 2005	I: training in feeding skills	20	Nursing assistants and nursing home residents with dementia (cluster RCT)	Taiwan	Residential care home	-	-
	C: no training	16					
Dennis 2005	I: nutritional supplement + normal hospital diet	2016	Participants with recent stroke (parallel RCT)	15 different countries	Hospital	945 (47)	71 (12)
	C: normal hospital diet	2007				929 (46)	71 (13)
Duncan 2006	I. dietetic assistant	153	Women > 65 years admitted with acute hip fracture (parallel RCT)	UK	Acute trauma ward	318 (100)	83.6
	C: usual care	165					83.5
Essed 2007	I1: monosodium glutamate	19	Residents of nursing home ≥ 65 years (factorial RCT)	Netherlands	Residential care home	58 (70)	84.9 (5.7)
	I2: flavour	19					85.4 (6.7)
	I3: monosodium glutamate + flavour	22					84.9 (6.2)
	C: maltodextrin	23					85.6 (8.5)
Essed 2009	I: monosodium glutamate + NaCl	53	Nursing home residents > 65 years (cross-over RCT)	Netherlands	Residential care home	40 (76)	85.8 (6.2)
	C: usual hot meal	53					
Faxen-Irving 2011	I: 3 x 30 mL of fat emulsion daily	34	Recently admitted geriatric persons > 65 years (parallel RCT)	Sweden	Geriatric acute ward	(61)	82.7 (7.5) - data from those who completed the trial only (N = 24)
	C: usual care	37				(49)	85.1 (6.7) - data from those who completed the trial only (N = 27)
Gaskill 2009	I: nutrition education programme	352	Nursing home residents (cluster-RCT)	Australia	Residential care home	245 (70)	84.2 (8.7)

(Continued)

	C: usual care						
Germain 2006	I: re-formed foods	8	Frail institutionalised elderly people with dysphagia (parallel RCT)	Canada	Residential care home	5 (63)	82.5 (4.4)
	C: usual diet	9				5 (56)	84.6 (3.8)
Hankey 1993	I: oral nutritional supplement	7	Frail elderly persons in continuing care (parallel RCT)	UK	Hospital	11 (79)	81 (1.6)
	C: standard hospital diet	7					
Hickson 2004	I: feeding assistance	292	Acutely ill elderly inpatients (parallel RCT)	UK	Elderly medicine ward	200 (69)	82 (76 - 86)
	C: usual care	300				173 (58)	82 (77 - 87)
Holyday 2012	I: malnutrition care plan	71	Acutely ill elderly inpatients (parallel RCT)	Australia	Acute geriatric medicine ward	43 (61)	83.7 (6.7)
	C: usual care	72				39 (54)	83.4 (7.6)
Johanssen 2004	I: nutrition team	108	Nutritional risk score 2000 > 3 on admission to hospital (parallel RCT)	Denmark	Hospital, three different levels	54 (50)	62 (1.6)
	C: usual care	104				56 (54)	62.4 (1.7)
Kraft 2012	I: ONS + telemedicine monitoring	13	Malnourished geriatric home-dwelling persons (parallel RCT)	Germany	Hospital discharge and tele-medicine monitoring	7 (54)	80.7 (5.6)
	C: usual care	13				9 (69)	78.8 (8.8)
Kretser 2003	I: modified meals on wheels	102	Homebound older adults at nutritional risk (parallel RCT)	USA	Home care	70 (69)	(60-90)
	C: traditional meals on wheels	101				74 (73)	
Larsson 1990	I: ONS plus normal hospital diet	435	Older people admitted to a long-term medical care clinic (parallel RCT)	Sweden	Hospital	Unclear - varies between papers, authors to be contacted	80.1 (8.5)
	C: normal hospital diet						
Leslie 2012	I: energy enriched meals	22	People living in residential care homes (cluster-RCT)	UK	Residential care home	36 (88%)	90.9 (77-105)
	C; usual care	19					90.3 (70-100)

(Continued)

Lin 2010	I1: spaced-retrieval	32	Residents with dementia (cluster-RCT)	Taiwan	Residential care home	18 (56)	76.7 (6.1)
	I2: Montessori	29				12 (41)	82.9 (6.0)
	C: usual care	24				15 (63)	81.1 (7.0)
Lin 2011	I: Montessori	29	Residents with dementia (cluster RCT & cross-over RCT)	Taiwan	Residential care home	12 (41)	82.9 (6.0)
	C: usual care						
Mathey 2001a	I: improved meal ambiance	21	Nursing home residents > 65 years (cluster-RCT)	Netherlands	Residential care home	25 (66)	82.2 (7.9)
	C: usual care	17					
Mathey 2001b	I: flavour enhancement	36	Nursing home residents > 65 years (parallel RCT)	Netherlands	Residential care home	29 (74)	84.6 (6.1)
	C: usual care	31				25 (81)	83.0 (5.5)
Munk 2014	I: energy and protein enriched foods provided via a la carte menu in addition to hospital food	41 (number completing the trial)	New admissions to hospital ward (oncology, orthopaedics or urology) (parallel RCT)	Denmark	Hospital	25 (61)	75 (10
	C: usual care	40				22 (55)	74 (11)
Nijs 2006	I: family-style meals	94	Nursing home residents (cluster-RCT)	Netherlands	Residential care home	70 (74)	78 (11.1)
	C: usual care	84				55 (65)	75 (9.9)
Olofsson 2007	I: multi-component intervention (including nutrition)	102	People > 70 years with femoral neck fracture (parallel RCT)	Sweden	Geriatric orthopaedic ward	62 (75)	82.1 (6.8)
	C: usual care	97				57 (77)	82.2 (5.6)
Pivi 2011	I1: nutrition education	25	Individuals > 65 years old with Alzheimer's disease (parallel RCT)	Brazil	Neurology outpatients	53 (68)	75.2
	I2: oral nutritional supplements	26					
	C: usual care	27					

(Continued)

Potter 2001	I: oral nutritional supplement + normal hospital diet	186	Unwell elderly people (parallel RCT)	Scotland, UK	Medicine for the elderly unit	140 (75)	Median 83 (61-79)
	C: normal hospital diet	195				139 (71)	
Remsburg 2001	I: buffet-style meals	20	Nursing home residents > 65 years (parallel RCT)	USA	Residential care home	19 (95)	80 (6)
	C: usual care	20				13 (65)	80 (8)
Salva 2011	I: teaching and training	448	People with dementia (cluster RCT)	Spain	Home care	300 (67)	79.4 (7)
	C: usual care	498				344 (69)	78.6 (7.5)
Silver 2008	I: fortified home delivered lunch	-	Adults > 60 years receiving home-delivered lunch meals (cross-over RCT)	USA	Home care	31(69) of those who completed the trial (N = 45)	84.4 (1) of those who completed the trial (N = 45)
	C: usual home delivered lunch						
Simmons 2008	I: feeding assistance and/or snacks	35	Nursing home residents (cluster-RCT & cross-over RCT)	USA	Residential care home	Reported for the total group, and not the subgroup to be used in this review	Reported for the total group, and not the subgroup to be used in this review
	C: usual diet	34					
Simmons 2010	I1: snacks	25	Nursing home residents (parallel RCT)	USA	Residential care home	39 (62)	86.9 (11.3)
	I2: supplements	18					
	C: usual care	20					
Smolliner 2008	I: fortified meals and snacks		Elderly nursing home residents (cluster RCT)	Germany	Residential care home	17 (77)	82.2 (9.5)
	C: usual diet					21 (70)	84.7 (9.5)
Splett 2003	I: medical nutrition therapy	223	Frail elderly nursing home residents (cluster-RCT)	USA	Residential care home	143 (67)	Male 79.2 (9.7); Female 82.8 (8.7)
	C: usual care	171				125 (73)	

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Taylor 2006	I: 5-meal menu	31	Elderly nursing home residents with dysphagia (cross-over RCT)	Canada	Residential care home	26 (84)	85 (6.4)
	C: usual (3-meal menu)						
Van den Berg 2015	I1: 125 mL ONS twice daily with medication round		Patients newly admitted to medical and surgical wards (parallel RCT)	The Netherlands	Hospital	34 (52)	70.5 (15)
	I2: 62 mL ONS four times daily with medication round					37 (46)	72.6 (10)
	C: usual care (125 mL ONS offered in between meals)					34 (39)	70.4 (13)
Van Ort 1995	I: contextual and behavioural intervention	4	Nursing home residents requiring feeding assistance (parallel RCT)	USA	Residential care home	6 (75)	(65-93)
	C: usual care	4					

- denotes not reported

C: comparator; I: intervention; ONS: oral nutritional supplement; RCT: randomised controlled trial

Appendix 5. Baseline characteristics (II)

	Intervention(s) and comparator(s)	Ethnic groups	Baseline nutritional status (N (%))	BMI (mean kg/m² (SD), range)	Duration of intervention (duration of follow-up)	Comedications/cointerventions	Comorbidities (N or %)
Barton 2000	I1: reduced portion fortified menu	-	-	-	Maximum of 56 d	-	-
	I2: normal menu plus cooked breakfast						
	C: normal hospital menu						
Beck 2002	I1: homemade oral supplement (A)	-	Mini Nutritional Assessment score 17-23.5 (increased risk of malnutrition)	22.8 (21.3 - 26.1)	2 mo (2 mo)	-	-
	I2: homemade oral supplement (B)						
	C: usual diet						
Bouillanne 2013	I: pulse diet (78% protein at lunch)	-	Albumin 25-35 g/L; BMI < 22 kg/m² and/or weight loss > 10% in 6 months and/or MNA ≤ 23.5	Median 20.7 (95% CI 20-23.2)	6 wk (6 wk)	-	-
	C: usual diet (protein distributed between meals)	-		Median 20.9 (95% CI 20-25)			
Bourdel-Marchasson 2000	I: oral supplementation + standard diet	-	-	-	15 d or until discharge (15 d or until discharge)	-	-
	C: standard diet						
Brouillette 1991	I: osmotherapy + activities	-	-	-	3 wk (4 wk)	-	-
	C: activities only						
Castellanos 2009	I1: fortified breakfast and lunch menu	-		-	2 d (-)	-	-
	I2: fortified lunch menu						

(Continued)

	C: usual menu						
Chang 2005	I: training in feeding skills C: no training	-	-	-	Intervention: 3 hours "in-service" within 2 days + 1 h "hands-on" instruction (-)	-	-
Dennis 2005	I: nutritional supplement + normal hospital diet C: normal hospital diet	-	-	-	Duration of hospital stay (6 mo)	-	-
Duncan 2006	I. dietetic assistant C: usual care	-	-	-	Duration of hospital stay (4 mo)	-	-
Essed 2007	I1: monosodium glutamate I2: flavour I3: monosodium glutamate + flavour C: maltodextrin	-	22 (27) at increased risk of malnutrition by MNA	-	16 wk (16 wk)	-	-
Essed 2009	I: monosodium glutamate + NaCl C: usual hot meal	-	8 (15) at increased risk of malnutrition by MNA	26.5 (4.2)	4 wk (4 wk)	-	-
Faxen-Irving 2011	I: 3 x 30 mL of fat emulsion daily C: usual care	-	-	20.4 (3.5) 22.2 (3.7)	Median 8 d (median 8 d)	-	Comorbidities related to anorexia were cancer (N = 6), liver disease (N = 1) and renal failure (N = 1) - in both groups
Gaskill 2009	I: nutrition education programme C: usual care	-	171 (49) moderately or severely malnourished by SGA	-	6 mo (6 mo)	-	-

(Continued)

Germain 2006	I: re-formed foods	-	17 (100) unintentional weight loss > 7.5% in previous 3 mo or BMI < 24 kg/m²	22.4 (3.9)	12 wk (12 wk)	-	-
	C: usual diet			21.2 (2.3)			
Hankey 1993	I: ONS	-	-	-	8 wk (8 wk)	-	-
	C: standard hospital diet						
Hickson 2004	I: feeding assistance	282 (96.6) white ethnic group		21.7 (18.6-25.3)	Duration of hospital stay (duration of hospital stay)	-	-
	C: usual care	286 (95.3) white ethnic group		21.8 (19.1-25.7)			
Holyday 2012	I: malnutrition care plan	-	119 (83) malnourished or at risk of malnutrition by MNA score	23.8 (5.9)	Duration of hospital stay (duration of hospital stay)	-	-
	C: usual care			23.3 (5.9)			
Johansen 2004	I: nutrition team	-	212 (100) ESPEN 2002 NRS (score > 3 nutritionally at risk)	21.2 (0.5)	Duration of hospital stay (duration of hospital stay)	-	-
	C: usual care	-		21.8 (0.5)			
Kraft 2012	I: ONS + telemedicine monitoring	-	26 (100) weight loss > 10% in 6 months, BMI < 21 kg/m², albumin < 35 g/L	23.4 (3.7)	6 mo (6 mo)	Number of medications: 7.5 (SD 4.2)	-
	C: usual care			23.4 (4.5)		Number of medications: 8.2 (SD 3.4)	
Kretser 2003	I: modified meals on wheels	45 (44) white	97 (96) at risk or malnourished according to MNA	14 (14%) BMI < 18.5	26 wk (26 wk)	-	A variety of self-reported health problems reported
	C: traditional meals on wheels	38 (58) white	95 (95) at risk or malnourished	9 (9%) BMI < 18.5			
Larsson 1990	I: ONS plus normal hospital diet	-	(28.5) malnourished	-	26 wk (26 wk)	-	-

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	C: normal hospital diet						
Leslie 2012	I: energy enriched meals	-	100% malnourished (BMI < 18.5 kg/m^2	17.1 (1.5)	12 wk (12 wk)	-	6 participants with dementia
	C; usual care			17.3 (1.4)			
Lin 2010	I1: spaced-retrieval	-	-	24.7 (4.3)	8 wk (8 wk)	-	-
	I2: Montessori			21.2 (3.4)			
	C: usual care			23.1 (2.7)			
Lin 2011	I: Montessori	-	-	21.4 (3.5)	8 wk (8 wk)	-	-
	C: usual care						
Mathey 2001a	I: improved meal ambiance	-	-	-	12 mo (12 mo)	-	-
	C: usual care						
Mathey 2001b	I: flavour enhancement	-	-	28.4 (7.1)	16 wk (16 wk)	Number of medicines/day 2.1 (1.8)	-
	C: usual care			28.1 (7.0)		Number of medicines/day 2.1 (1.6)	
Munk 2014	I: energy and protein enriched foods provided via a la carte menu in addition to hospital food	-	NRS score 0 = 1, 1 = 10, 2 = 18, 3 = 12	21(4)	Duration of hospital stay (duration of hospital stay)	-	Disease severity score: 0 = 2; 1 = 30; 2 = 8; 3 = 1
	C: usual care		NRS score 0 = 0, 1 = 15, 2 = 17, 3 = 8	22(4)			Disease severity score: 0 = 3; 1 = 34; 2 = 3; 3 = 0
Nijs 2006	I: family-style meals	-	17 (18) MNA score < 17	28.7 (6.8)	6 mo (6 mo)	-	CVA: 57%
	C: usual care		13 (13) MNA score < 17	28.4 (5.8)			CVA: 50%

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Olofsson 2007	I: multi-component intervention (including nutrition)	-	48 (58) malnourished or at risk by MNA score	25.1 (4.1)	Duration of hospital stay (4 mo)	Staff education; team work, individual care planning; prevention and treatment of delirium and complications; nutrition; rehabilitation; secondary prevention of falls and fractures; osteoporosis prophylaxis	-
	C: usual care		47 (57) malnourished or at risk by MNA score	23.3 (4.0)		-	
Pivi 2011	I1: nutrition education	-	-	-	6 mo (6 mo)	-	-
	I2: ONS						
	C: usual care						
Potter 2001	I: ONS + normal hospital diet	-	Adequately nourished: 62/186 (33); moderately malnourished: 90/186 (48); severely malnourished: 34/186 (18)	-	Duration of hospital stay (duration of hospital stay)	-	-
	C: normal hospital diet		Adequately nourished: 68/195 (35); moderately malnourished: 87/195 (45); severely malnourished: 40/195 (21)				

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Remsburg 2001	I: buffet-style meals	17 (85) white ethnic group	-	24.4 (6.1)	3 mo (3 mo)	-	CVA: 6 (30%) CVD: 13 (65%)
	C: usual care	15 (75) white ethnic group		24.3 (5.8)			CVA: 10 (50%) CVD: 12 (60%)
Salva 2011	I: teaching and training	-	(7.8) malnourished (51.5) or at risk by MNA	26.6 (4.4)	12 mo (12 mo)	Number of co-morbidities 4.6 (SD 2.2)	-
	C: usual care		(2.8) malnourished (34.5) or at risk by MNA	27.3 (4.6)		Number of co-morbidities 4.2 (SD 2.6)	
Silver 2008	I: fortified home-delivered lunch	-	-	24.2 (7)	7 mo (7 mo)	-	-
	C: usual home-delivered lunch						
Simmons 2008	I: feeding assistance and/or snacks	-	-	-	2 x/d for 5 days/ week and 24 wk (24 wk)	-	-
	C: usual diet						
Simmons 2010	I1: snacks	-	-	-	6 wk (6 wk)	-	-
	I2: supplements						
	C: usual care						
Smolliner 2008	I: fortified meals and snacks	-	22 (100) by MNA score indicating at risk or malnourished	21.6 (3.6)	12 wk (12 wk)	Number of prescriptions median 4 (IQR 2-6.5)	GDS: 6.7 (SD 2.9)
	C: usual diet		30 (100) by Mini Nutritional Assessment score indicating at risk or malnourished	22.5 (3.4)		Number of prescriptions median 6 (IQR 3.8-7)	GDS: 7.5 (SD 3)
Splett 2003	I: medical nutrition therapy	-	-	-	19-180 d (19-180 d)	-	Dementia: 24%

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							congestive heart failure: 25% depression: 19% Alzheimer's disease: 14% bone/hip fracture: 15% chronic obstructive: 10% pulmonary disease cancer: 5% pneumonia: 4% dehydration: 1%
	C: usual care						Dementia: 34% congestive heart failure: 26% depression: 32% Alzheimer's disease: 21% bone/hip fracture: 19% chronic obstructive: 17% pulmonary disease cancer: 12% pneumonia: 6% dehydration: 4%
Taylor 2006	I: 5-meal menu	-	31 (100) mean MNA score 16.3	20.4 (3.4)	2 x 4 d, separated by 4 wk) (2 x 4 d, separated by 4 wk)	-	-
	C: usual (3-meal menu)						

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Van den Berg 2015	I1: 125 mL ONS twice daily with medication round	-	SNAQ score 1 or 2 = 6, 3 = 13, 4 or 5= 6, 6 or 7 = 41	25 (4.3)	median 5 (range 1-17)	-	-
	I2: 62 mL ONS four times- daily with medication round		SNAQ score 1 or 2 = 6, 3 = 13, 4 or 5= 12, 6 or 7 = 49	23.8 (3.9)	median 5 (range 1-15)	-	-
	C: usual care (125 mL ONS offered in between meals)		SNAQ score 1 or 2 = 5, 3 = 13, 4 or 5 = 18, 6 or 7 = 52	24.3 (4.7)	median 6 (range 1-30)	-	-
Van Ort 1995	I: contextual and behavioural intervention	-	-	-	2 wk (6 wk, 1 mo after intervention)	-	-
	C: usual care						

'-' denotes not reported

BMI: body mass index; C: comparator; CI: confidence interval; CVA: cerebrovascular accident; CVD: cardiovascular diagnosis; d: days; GDS: geriatric depression scale; I: intervention; IQR: interquartile range; mo: month(s); MNA: mini nutritional assessment; NRS: nutritional risk score; ONS: oral nutritional supplement; SD: standard deviation; SGA: subjective global assessment; SNAQ: Simplified Nutritional Appetite Questionnaire; wk: week(s)

Appendix 6. Matrix of study endpoints (publications and trial documents)

	Endpoints quoted in trial document(s) (ClinicalTrials.gov, FDA/ EMA document, manufacturer's website, published design paper)[a]	Trial results/ publications available in trials register	Endpoints quoted in publication(s)[b,c]	Endpoints quoted in abstract of publication(s)[b,c]
Bouillanne 2013	**Source:** NCT00135590 **Primary outcome measure(s)**: • lean mass (dual energy X-ray absorptiometry (dexa) and bioelectrical-impedance analysis (bia)) - time frame: 42 days	No/Yes (last verified: November 2004)	**Primary outcome measure(s)**: • lean mass (total lean soft-tissue mass (LM) index, appendicular muscle mass (ASMM) index or body cell mass (BCM) index, which is the metabolically active compartment))	**Primary outcome measure(s)**: • body composition ((lean mass (LM), appendicular skeletal muscle mass (ASMM), and body cell mass (BCM) indices, measured by X-ray absorptiometry combined with bioelectrical impedance analysis)
	Secondary outcome measure(s): • immune functions - time frame: 42 days • hand-grip strength - time frame: 42 days • biological nutritional parameters - time frame: 42 days • mortality and morbidity (infections and bedsores) - time frame: 42 days • ADL - time frame: 42 days • plasmatic amino acid levels - time frame: 42 days		**Secondary outcome measure**(s): • hand grip strength • ADL score	**Secondary outcome measure**(s): • hand grip strength • ADL score
	Other outcome measure(s): -		**Other outcome measure(s)**: • albumin • transthyretin • C-reactive protein • prognostic inflammatory and nutritional index (PINI)	**Other outcome measure(s)**: -
	History of changes: 6 documented changes			
Faxen-Irving 2011	**Source:** NCT01042340	No/Yes	**Primary outcome measure(s)**: -	**Primary outcome measure(s)**: -

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	Primary outcome measure(s): • to detect a significant difference in energy intake of 48 kj/200 kcal between the groups at 5% significance level and with 80% power - time frame: 5 days to 3 weeks intervention	(last verified: December 2009)		
	Secondary outcome measure(s): • effects on serum lipids and appetite - time frame: 5 days to 3 weeks treatment		**Secondary outcome measure**(s): • acceptance and compliance of the concept by the participants at the ward	**Secondary outcome measure**(s): -
	Other outcome measure(s): -		**Other outcome measure(s)**: • sample size calculation was performed: to detect a significant difference in energy intake of 200 kcal between the groups at 5% significance level and with 80% power, 27 participants in each group were needed. To allow for dropouts this was increased to 35 participants in each group • nutritional assessment, by the Nutritional Risk Screening (NRS-2002) form: evaluation of BMI, weight loss, reduced dietary intake, age 70 and presence of severe illness and a sum score (0-7 points) was calculated • biochemical indicators of nutritional status serum levels of albumin, transthyretin and insulin-like growth factor-1 (IGF-1) • C-reactive protein (CRP) • total cholesterol, high-density lipoprotein (HDL) and low-density lipoprotein (LDL) cholesterol, fasting serum triglyceride concentrations • fatty acid (FA) profiles were measured in serum phospholipids • function as determined by ADL according to the Katz ADL index	**Other outcome measure(s)**: • food intake and self-rated appetite • Nutritional risk screening (NRS) 2000 • serum lipids and fatty acid profiles
	History of changes: 1 documented change			
Holyday 2012	**Source:** NCT01179321 **Primary outcome measure(s)**: length of stay	No/No (last verified: March 2006)	**Primary outcome measure(s)**: -	**Primary outcome measure(s)**: -

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	Secondary outcome measure(s): -		**Secondary outcome measure**(s): -	**Secondary outcome measure**(s): -
	Other outcome measure(s): -		**Other outcome measure(s)**: • pre-study power analysis based on the average length of stay (LOS) of the trial population (11 d) with 0.80 power using a test with significance of 0.05, would require at least 50 participants in each group to detect a reduction in LOS of 20% • the number of participants seen by a clinical dietitian, number of consults per participant and total consultation time per participant was captured from the hospital's computerised dietitians' statistics system • timeliness of intervention was counted as days between date of admission to the ward and the date seen by the clinical dietitian • weight change over the course of admission was calculated from the weight on admission and the weight at discharge • deaths during admission • number of presentations to emergency and number of hospital readmissions • cost of hospital admission, additional costs of a screening and nutritional intervention programme	**Other outcome measure(s)**: • length of stay LOS) • weight change • frequency of readmission to hospital
	History of changes: 0 documented changes			
Munk 2014	**Source:** NCT01415635 **Primary outcome measure(s)**: • Percentage of participants reaching > 75% of their calculated energy and protein requirements	No/No (last verified: December 2012)	**Primary outcome measure(s)**: • Percentage of participants reaching > 75% of their calculated energy and protein requirements	**Primary outcome measure(s)**: • Percentage of participants reaching > 75% of their calculated energy and protein requirements
	Secondary outcome measure(s): • handgrip strength • daily energy and protein intake • use of tube feeding • use of parenteral nutrition • length of stay		**Secondary outcome measure**(s): • Mean daily energy and protein intake • body weight • handgrip strength • Length of stay • number of participants receiving enteral or parenteral feeding	**Secondary outcome measure**(s): • Mean daily energy and protein intake • body weight • handgrip strength • Length of stay

(Continued)

	Other outcome measure(s): none provided		**Other outcome measure(s)**: number of participants receiving ONS	**Other outcome measure(s)**: -
	History of changes: 1 documented change			
Nijs 2006	**Source:** NCT00114582 **Primary outcome measure:** • nutritional status, quality of life, physical performance	No/Yes (last verified: February 2009)	**Primary outcome measure(s)**: • quality of life	**Primary outcome measure(s)**: -
	Secondary outcome measure(s): -		**Secondary outcome measure**(s): -	**Secondary outcome measure**(s): -
	Other outcome measure(s): -		**Other outcome measure(s)**: • physical performance • body weight • energy intake	**Other outcome measure(s)**: • quality of life (perceived safety; autonomy; and sensory, physical, and psychosocial functioning) • gross and fine motor function • body weight
	History of changes: 4 documented changes			
Salva 2011	**Source:** NCT00479843 **Primary outcome measure(s)**: • evaluation of the effectiveness of the intervention - the main evaluation criteria which would allow the effectiveness of this intervention to be evaluated were the reduction in the loss of autonomy measured by the ADL/iADL scale - time frame: baseline, 6 months, 12 months	No/Yes (last verified: January 2014)	**Primary outcome measure(s)**: -	**Primary outcome measure(s)**: • main outcome measure was the reduction in the loss of autonomy ((ADL/IADL) scales) assessed at 6 and 12 months
	Secondary outcome measure(s): • improvement in the participant's state of nutrition - reducing the burden on carers with the Zarit scale		**Secondary outcome measure**(s): • improvement in nutritional state of the participant evaluated by their change in weight, BMI and MNA • reduction in burden on caregiver (ZARIT scale)	**Secondary outcome measure**(s): • improvement in nutritional status (Mini Nutritional Assessment (MNA),

(Continued)

	• evaluation of the use of healthcare and social resources with the RUD scale • improvement of medical practice regarding nutrition (time frame: baseline, 6 months, 12 months)		• reduction in the use of healthcare and social resources (RUD scale)	BMI, and weight changes) • caregiver burden (Zarit scale)
	Other outcome measure(s): -		**Other outcome measure(s)**: • our primary hypothesis was that participants in the intervention group would achieve a lower level of dependency compared with participants in the usual care-control group at 12 months. We considered a significant benefit in the intervention group to be a reduction of 30% in the proportion of participants who lost more than 0.5 points according to the ADL score (loss of autonomy) over one year	**Other outcome measure(s)-**
	History of changes: 2 documented changes			
Van den Berg 2015	**Source:** NTR2535 **Primary outcome measure(s)**: proportion of participants who received their treatment goal. The treatment goal was to receive at least 75% of the prescribed volume of ONS during admission	No (last verified 19 Nov 2010)	**Primary outcome measure(s)**:the percentage of participants who reached the treatment objective of at least 75% of the prescribed volume of ONS during admission	**Primary outcome measure(s)**: The percentage of participants who consumed at least 75% of the prescribed volume of ONS
	Secondary outcome measure(s): intake (mL of ONS) (nurses and food assistants read the amount of ONS left in the bottle)		**Secondary outcome measure**(s): Mean intake of ONS per day in mL and energy and protein	Not stated
	Other outcome measure(s):-		**Other outcome measure(s)**: length of hospital stay, hospital readmissions, time to intervention, duration of intervention, mortality	Median time of taking ONS
	History of changes: No documented changes			

'-' denotes not reported

[a]Trial document(s) refers to all available information from published design papers and sources other than regular publications (e.g. FDA/EMA documents, manufacturer's websites, trials registers)
[b]Publication(s) refers to trial information published in scientific journals (primary reference, duplicate publications, companion documents or multiple reports of a primary trial)

(Continued)

[c]Other outcome measures refer to all outcomes not specified as primary or secondary outcome measures

ADL: activities of daily living; BMI: body mass index; EMA: European Medicines Agency; FDA: Food and Drug Administration (US); mo: month(s); N/A: not applicable; N/T: no trial document available; yr: year(s); wk: week(s); ONS oral nutritional supplement

Appendix 7. High risk of outcome reporting bias according to ORBIT classification

	Outcome	High risk of bias (category A)[a]	High risk of bias (category D)[b]	High risk of bias (category E)[c]	High risk of bias (category G)[d]
Barton 2000	Energy intake	Yes			
	Food wastage	Yes			
	Protein intake	Yes			
Beck 2002	N/D				
Bouillanne 2013	N/D				
Bourdel-Marchasson 2000	Energy intake	Yes			
	Incidence of death	Yes			
	Pressure ulcer developments			Yes (40% in intervention group, 48% in control; no further analysis)	
Castellanos 2009	3 meal energy intake		Yes		
	3 meal protein intake		Yes		
Chang 2005	N/D				
Dennis 2005	Death or poor outcome	Yes			
	Death	Yes			
	Complications: pneumonia, UTI, pressure sores	Yes			
	Length of stay	Yes			
	Discharge destination	Yes			
	EUROQoL	Yes			
Duncan 2006	N/D				

(Continued)

Essed 2007	Pleasantness	Yes			
	Olfactory sensitivity		Yes (analysed but reported as correlation with energy intake)		
	Appetite, hunger and sensory perception	Yes			
	GDS		Yes		
Essed 2009	N/D				
FaYesen-Irving 2011	Energy intake	Yes			
	Body mass index	Yes			
	Activities of Daily Living	Yes			
	Length of stay	Yes			
	Appetite				
	Fatty acid profiles (myristic acid, margarinic acid, stearic acid, oleic acid, alpha-linoleic acid, eicosapentaenoic acid)	Yes			
	Pentadecanoic acid			Yes	
Gaskill 2009	Subjective global assessment		Yes		
Germain 2006	N/D				
Hankey 1993	Anthropometry: TSF, MAC weight	Yes			
	Serum albumin	Yes			
	Fiber intake	Yes			
Hickson 2004	Serum albumin	Yes			
	Barthel score	Yes			
	Cognition and depression score (BASDEC)			Yes	
	Pressure sore incidence				Yes
	Laxative use				Yes
	Artificial nutrition use				Yes
	Economic analysis				Yes

(Continued)

	Dietary intake			
	In-hospital mortality			
	Grip strength			
Holyday 2012	N/D			
Johansen 2004	N/D			
Kraft 2012	N/D			
Kretser 2003	Satisfaction with programme			Yes
Larsson 1990	Nutritional assessment (TSF, MAC)	Yes		
	Serum protein analysis	Yes		
	Acute phase reactants (antitrypsin, orosomucoid)	Yes		
	Length of stay		Yes	
Leslie 2012	N/D			
Lin 2010	Eating time		Yes	
Lin 2011	N/D			
Mathey 2001a	Health-related quality of life	Yes (P < 0.05 stated for intervention but no P value for control)		
	Philadelphia Geriatric Center Morale Scale		Yes (no P values reported)	
Mathey 2001b	N/D			
Munk 2014	N/D			
Nijs 2006	N/D			
Olofsson 2007	N/D			
Pivi 2011	N/D			
Potter 2001	Anthropometry: TSF, BMI		Yes	
	Arm muscle circumference	Yes		
	Mortality	Yes (significant result when severely under-		

(Continued)

		nourished analysed in isolation)		
	Functional recovery (Barthel ADL index)	Yes (significant result when severely undernourished analysed in isolation)		
	Discharge placement	Yes		
	Length of hospital stay	Yes		
Remsburg 2001	N/D			
Salva 2012	Health and social care costs (Resource Utilisation in Dementia (RUD) scale)		Yes	
Silver 2008	Confounding effect of age, sex and BMI on meal treatment order, total energy, energy density and macronutrients	Yes		
Simmons 2008	N/D			
Simmons 2010	Weight	Yes		
Smolliner 2008	N/D			
Splett 2003	N/D			
Taylor 2006	N/D			
Van den Berg 2015	N/D			
Van Ort 1995	Nutritional status (weight change)			Yes
	Feeding related interpersonal contact between residents and feeder			Yes
	Functional ability of subject, and level of assistance offered by feeder			Yes

[a]Clear that outcome was measured and analysed; trial report states that outcome was analysed but only reports that result was not significant
(Classification 'A', table 2, Kirkham 2010)
[b]Clear that outcome was measured and analysed; trial report states that outcome was analysed but no results reported
(Classification 'D', table 2, Kirkham 2010)
[c]Clear that outcome was measured; clear that outcome was measured but not necessarily analysed; judgement says likely to have been analysed but not reported because of non-significant results
(Classification 'E', table 2, Kirkham 2010)

(Continued)

[d]Unclear whether the outcome was measured; not mentioned but clinical judgement says likely to have been measured and analysed but not reported on the basis of non-significant results
(Classification 'G', table 2, Kirkham 2010)

ADL: activities of daily living; BMI: body mass index; EuroQol: European Quality of Life Scale; GDS: geriatric depression scale; mo: months; N/D: none detected; ORBIT: Outcome Reporting Bias In Trials; TSF: triceps skinfold thickness

Appendix 8. Definition of endpoint measurement (I)

	Nutritional intake	Health-related quality of life/patient satisfaction	Mortality	Morbidity/complications	Nutritional status
Barton 2000	Energy intake (kcal), protein intake (g), food wastage (%)	-	-	-	-
Beck 2002	Energy intake (MJ)	-	-	-	Weight (kg)
Bouillanne 2013	-	-	Yes	Infections	Body composition
Bourdel-Marchasson 2000	Energy intake (kcal), protein intake (g)	-	Yes	-	-
Brouillette 1991	Energy intake (kcal), % food consumed	-	Yes	-	-
Castellanos 2009	Energy intake (kcal), protein intake (g)	-		-	-
Chang 2005	% meal eaten	-	-	-	-
Dennis 2005	-	Quality of life (EUROQoL)	Yes	Incidence of pneumonia, UTI and pressure sores	-
Duncan 2006	Dietary intake records on day 3-6	-	-	Records of medical and surgical complications	Weight, MAMC, TSF, HGS
Essed 2007	Energy intake (kJ), protein, fat and CHO (g)	-	-	-	Weight (kg), BMI, body composition
Essed 2009	Energy intake (kJ)	-	-	-	-
Faxen-Irving 2011	Energy intake (kcal/kg body weight/day)	-	Yes	-	Weight, appetite, BMI
Gaskill 2009	SGA	-	-	-	-
Germain 2006	Dietary intake, energy (kcal), other nutrients (g/mg)	-	Yes	-	Weight, BMI

(Continued)

Hankey 1993	Energy intake (kj/24hours), protein intake (g/24hours)	-	-	-	Weight, TSF, MAC, AMC, serum albumin
Hickson 2004	Energy intake (J), protein (g)	EQ-5D	Yes	Antibiotics prescribed (N), days on antibiotics	Weight, BMI, MAC, TSF, MAMC,
Holyday 2012	-	-	Yes	-	Weight
Johansen 2004	Energy intake (kJ/kg and % requirements), protein intake (g/kg and % requirements)	SF-36	Yes	Infectious and other complications graded into major and minor (using Buzby et al 1988 and CDC definitions)	Weight change (kg)
Kraft 2012	_	-	-	-	Weight change (kg)
Kretser 2003	-	-	Yes	-	Weight, weight change (lb)
Larsson 1990	Encompassed in the Modified Norton Scale	-	Yes	-	Weight index, TSF, MAC, AMC
Leslie 2012	Dietary intake, 3 day weighed records	-	Yes	-	Weight change, change in BMI & MUAC
Lin 2010	Eating amount (unit unclear)	-	No	-	MNA and BMI
Lin 2011	-	-	No	-	MNA and BMI
Mathey 2001a	Macro- and micronutrient intakes	SIP, PGCMS	Yes	No	Weight
Mathey 2001b	Energy intake	_	No	no	Weight
Munk 2014	Percent of participants meeting > 75% of their energy and protein requirements. Mean daily energy and protein intake	-	Yes	-	Weight
Nijs 2006	Energy intake (kcal), macronutrient (g)	Dutch QOL nursing home residents questionnaire	Yes	-	Weight (kg, calf circumference (cm), MAC (cm), MNA score
Olofsson 2007	-	-	Yes	Infectious and non-infectious complications during hospital stay	Weight, BMI, MNA
Pivi 2011	-	-	Yes	-	Weight, BMI, MAC, MAMC, TSF

(Continued)

Potter 2001	Total energy intake (kcal)	-	Yes	-	Weight, AMC, TSF, BMI
Remsburg 2001	-	-	Yes	-	Weight (kg)
Salva 2011	-	-	Yes	-	Weight (kg), BMI, MNA
Silver 2008	Total energy (kcal), energy density (kcal/g), macronutrient's (g), micronutrients	-	-	-	-
Simmons 2008	Total energy (kcal)	-	-	-	Weight (lb), BMI
Simmons 2010	Energy intake (kcal)	-	Yes	-	Weight (lb)
Smolliner 2008	Energy (kcal and kcal/kg body weight), protein (g and g/kg body weight)	-	Yes	-	Weight, BMI, MNA score, fat-free mass
Splett 2003	-	-	Yes	-	Weight
Taylor 2006	Energy intake (kcal/day), fluid intake (mL/day)	-	-	-	-
Van den Berg 2015	Energy intake from ONS (kcal/day)	-	Yes		
Van Ort	-	-	-	-	Weight

ADL: activities of daily living; AMC: arm muscle circumference; BMI: body mass index; CDC: Centre for Disease Control; CDR: clinical dementia rating scale; CHO: carbohydrate; d: day; EQ-5D/EuroQol: European Quality of Life Scale; HGS: handgrip strength; iADL: instrumental Activities of Daily Living; MAC: mid-arm circumference; MAMC: mid-arm muscle circumference; MJ: mega joules; MMSE: Mini Mental State Examination; MNA: Mini Nutritional Assessment; NPIQ: Neuropyschiatric Inventory Question; PGCMS: Philadelphia Geriatric Centre Morale Scale; QOL: quality of life; RUD: reduction in use of health and social care scale; SF-36: Short Form - 36; SGA: subjective global assessment; SIP: sickness impact profile; TSF: triceps skinfold thickness

Appendix 9. Definition of endpoint measurement (II)

	Functional status	Clinical function	Hospitalisation/ institutionalisation	Severe/serious adverse events	Economic costs
Barton 2000	-	-	-	-	-
Beck 2002	-	-	-	-	-
Bouillanne 2013	Handgrip strength, ADL score	Biochemical data	-	-	-
Bourdel-Marchasson 2000	-	Pressure ulcer development	-	-	-

(Continued)

Brouillette 1991	-	-	-	-	-
Castellanos 2009		-	-	-	-
Chang 2005	-	-	-	-	-
Dennis 2005	-	-	Discharge destination	-	-
Duncan 2006	-	-	Length of stay in acute unit and in hospital (days)	-	-
Essed 2007	-	-	-	-	-
Essed 2009	-	-	-	-	-
Faxen-Irving 2011	-	Serum/plasma proteins, serum lipids, fatty acid profiles, ADLs	Length of stay	-	-
Gaskill 2009	-	-	-	-	-
Germain 2006	-	-	-	-	-
Hankey 1993	-	-	-	-	-
Hickson 2004	Grip strength	-	Length of stay (d), volume of fluids given	-	-
Holyday 2012	-	-	Length of stay, readmissions	Estimated	
Johansen 2004	-	-	Length of stay (LOS_{28}) = LOS from admission to inclusion + LOS from inclusion to discharge (maximum 28 days) LOS_{NDI} = LOS 28 - number of final days with NDI = 3) NDI = index of mobility, infections and complications	-	-
Kraft 2012	-	-	-	-	-
Kretser 2003	iADL, ADL, dependence	-	-	-	-
Larsson 1990	Encompassed in the Modified Norton Scale	-	-	-	-
Leslie 2012	-	-	Yes	-	-

(Continued)

Lin 2010	Eating function (need for verbal and/or physical assistance or feeding + eating time)	-	-	-	-
Lin 2011	Eating function (need for verbal and/or physical assistance or feeding + eating time)	-	-	-	-
Mathey 2001a	-	Biochemical data	_	_	_
Mathey 2001b	Hunger, appetite and sensory perception	-	-	-	-
Munk 2014	Handgrip strength		Length of hospital stay	-	-
Nijs 2006	Motor function (nursing home physical performance test)	-	-	-	-
Olofsson 2007	-	-	Length of hospital stay	-	-
Pivi 2011	-	Biochemical data	-	-	-
Potter 2001	Functional recovery (20-point Barthel ADL index)	-	Length of hospital stay, discharge placement	-	-
Remsburg 2001	-	Biochemical status	-	-	-
Salva 2011	ADL, iADL scores	MMSE, CDR, NPIQ	-	-	RUD score
Silver 2008	-	-	-	-	-
Simmons 2008	-	-	-	-	-
Simmons 2010	-	-	-	-	Cost-effectiveness
Smolliner 2008	Handgrip strength, peak flow, Barthel score, SF-36 (physical function only)	-	-	-	-
Splett 2003	-	-	Hospital admissions	-	-
Taylor 2006	-	-	-	-	-
Van den Berg 2015			Length of stay	Stated as none but not defined	-
Van Ort	Functional ability of participant	-	-	-	-

(Continued)

ADL: activities of daily living; AMC: arm muscle circumference; BMI: body mass index; CDC: Centre for Disease Control; CDR: clinical dementia rating scale; CHO: carbohydrate; d: day; EQ-5D/EuroQol: European Quality of Life Scale; HGS: handgrip strength; iADL: instrumental Activities of Daily Living; MAC: mid-arm circumference; MAMC: mid-arm muscle circumference; MJ: mega joules; MMSE: Mini Mental State Examination; MNA: Mini Nutritional Assessment; NPIQ: Neuropyschiatric Inventory Question; PGCMS: Philadelphia Geriatric Centre Morale Scale; QOL: quality of life; RUD: reduction in use of health and social care scale; SF-36: Short Form - 36; SGA: subjective global assessment; SIP: sickness impact profile; TSF: triceps skinfold thickness

Appendix 10. Adverse events

	Intervention(s) and comparator(s)	Deaths (N/N (%))	Participants with adverse events (N/N (%))	Participants with severe/serious adverse events (N/N (%))	Participants discontinuing trial due to adverse event (N/N (%))
Barton 2000	I1: reduced portion fortified menu	-	-	-	-
	I2: normal menu plus cooked breakfast	-	-	-	
	C: normal hospital menu	-	-	-	-
Beck 2002	I1: homemade oral supplement (A)	-	-	-	-
	I2: homemade oral supplement (B)				
	C: usual diet	-	-	-	-
Bouillanne 2013	I: pulse diet (78% protein at lunch)	1/30 (3.3)	-	-	-
	C: usual diet (protein distributed between meals)	1/36 (2.8)	-	-	-
Bourdel-Marchasson 2000	I: oral supplementation + standard diet	25/295 (8.5)	-	-	-
	C: standard diet	22/377 (5.8)	-	-	-
Brouillette 1991	I: osmotherapy + activities	1/10 (10)	-	-	-
	C: activities only	0/10 (0)	-	-	-
Castellanos 2009	I1: fortified breakfast and lunch menu	-	-	-	-
	I2: fortified lunch menu	-	-	-	-
	C: usual menu	-	-		-
Chang 2005	I: training in feeding skills	-	-	-	-
	C: no training	-	-	-	-
Dennis 2005	I: nutritional supplement + normal hospital diet	241/2016 (12)	138/4023 (3.4)	-	-

(Continued)

	C: normal hospital diet	253/2007 (12.6)		-	-
Duncan 2006	I. dietetic assistant	19/145 (13.1)	-	-	-
	C: usual care	36/157 (22.9)	-	-	-
Essed 2007	I1: monosodium glutamate	-	-	-	-
	I2: flavour	-	-	-	-
	I3: monosodium glutamate + flavour	-	-	-	-
	C: maltodextrin	-	-	-	-
Essed 2009	I: monosodium glutamate + NaCl	-	-	-	-
	C: usual hot meal	-	-	-	-
Faxen-Irving 2011	I: 3 x 30 mL of fat emulsion daily	-	5/34 (14.7)	-	5/34 (14.7)
	C: usual care	2/37 (5.4)	-	-	-
Gaskill 2009	I: nutrition education programme	-	-	-	-
	C: usual care	-	-	-	-
Germain 2006	I: re-formed foods	-	-	-	-
	C: usual diet	-	-	-	-
Hankey 1993	I: oral nutritional supplement	-	3/10 (30)	-	-
	C: standard hospital diet	-	3/10 (30)	-	-
Hickson 2004	I: feeding assistance	31/292 (10.6)	-	-	
	C: usual care	35/300 (11.7)	-	-	-
Holyday 2012	I: malnutrition care plan	1/72 (1.4)	-	-	-
	C: usual care	4/72 (5.6)	-	-	-
Johansen 2004	I: nutrition team	-	-	-	-
	C: usual care	-	-	-	-
Kraft 2012	I: oral nutritional supplement + telemedicine monitoring	-	-	-	2/13 (15.4)
	C: usual care	-	-	-	-
Kretser 2003	I: modified meals on wheels	3/102 (2.9)	-	-	-
	C: traditional meals on wheels	9/101 (8.9)	-	-	-

(Continued)

Larsson 1990	I: oral nutritional supplement plus normal hospital diet	29/197 (14.7)	-	-	-
	C: normal hospital diet	56/238 (23.5)	-	-	-
Leslie 2012	I: energy enriched meals	2/19 (10.5)	-	-	
	C: usual care	5/22 (22.7)	-	-	-
Lin 2010	I1: spaced-retrieval	-	-	-	-
	I2: Montessori	-	-	-	-
	C: usual care	-	-	-	-
Lin 2011	I: Montessori	-	-	-	-
	C: usual care	-	-	-	-
Mathey 2001a	I: improved meal ambiance	7/21 (33.3)	-	-	-
	C: usual care	5/17 (29.4)	-	-	-
Mathey 2001b	I: flavour enhancement	-	-	-	-
	C: usual care	-	-	-	-
Munk 2014	I: energy and protein enriched foods provided via a la carte menu in addition to hospital food	1/44 (2.2)	-		
	C: usual care	1/40 (2.5)	-		
Nijs 2006	I: family-style meals	18/112 (16.1)		-	-
	C: usual care	16/133 (12.0)	-	-	-
Olofsson 2007	I: multi-component intervention (including nutrition)	9/102 (8.8)	-	-	-
	C: usual care	13/97 (13.4)	-	-	-
Pivi 2011	I1: nutrition education	-	-	-	-
	I2: oral nutritional supplements	-	-	-	-
	C: usual care	-	-	-	-
Potter 2001	I: oral nutritional supplement + normal hospital diet	21/186 (11.3)	Reported "no serious adverse events"	-	-
	C: normal hospital diet	33/195 (16.9)		-	-
Remsburg 2001	I: buffet-style meals	-	-	-	-
	C: usual care	-	-	-	-

(Continued)

Salva 2011	I: teaching and training	43/448 (9.6)	-	-	-
	C: usual care	29/498 (5.8)	-	-	-
Silver 2008	I: fortified home-delivered lunch	-	-	-	-
	C: usual home-delivered lunch	-		-	-
Simmons 2008	I: feeding assistance and/or snacks	-	-	-	-
	C: usual diet	-	-	-	-
Simmons 2010	I1: snacks	-	-	-	-
	I2: supplements	-	-	-	-
	C: usual care	-	-	-	-
Smolliner 2008	I: fortified meals and snacks	2/31 (6.5)	-	-	-
	C: usual diet	1/34 (2.9)	-	-	-
Splett 2003	I: medical nutrition therapy	-	-	-	-
	C: usual care	-	-	-	-
Taylor 2006	I: 5-meal menu	-	-	-	-
	C: usual (3-meal menu)	-	-	-	-
V an den Berg 2015	I1: 125 mL ONS twice daily with medication round	1/66 (1.5)	Reported "no serious adverse events"		11/88 (12.5) (refused further ONS)
	I2: 62 mL ONS four times daily with medication round	2/80 (2.5)			9/66 (13.6) (refused further ONS)
	C: usual care (125 mL ONS offered in between meals)	4/88 (4.5)			11/80 (13.8) (refused further ONS)
Van Ort 1995	I: contextual and behavioural intervention	-	-	-	-
	C: usual care	-	-	-	-

C: comparator, I: intervention; ONS: oral nutritional supplement

Appendix 11. Survey of authors' providing information on trials

	Trial author contacted	Trial author replied	Trial author provided data	Comments

(Continued)

Barton 2000	Yes	Yes	Yes	Additional data not used
Beck 2002	Yes	Yes	Yes	Additional data not used
Bourdel-Marchasson 2000	Yes	Yes	Yes	Not used, and unable to provide data requested on weight
Bouillanne 2013	Yes	Yes	Yes	Data received on weight and energy intake
Brouillette 1991	No	N/A	N/A	
Castellanos 2009	Yes	No	N/A	
Chang 2005	Yes	No	N/A	
Dennis 2005	Yes	Yes	Yes	Information used on complication rates
Duncan 2006	Yes	Yes	Yes	Awaiting data on length of stay
Essed 2007	Yes	No	N/A	
Essed 2009	Yes	No	N/A	
Faxen-Irving 2011	Yes	Yes	Yes	Data on energy intake, length of stay, BMI and ADLs provided. No data available on infections
Gaskill 2009	Yes	Yes	No	Assume unable to provide data
Germain 2006	Yes	Yes	Yes	Data provided for BMI mean and SD of change
Hankey 1993	Yes	No	N/A	
Hickson 2004	Yes	Yes	Yes	Author unable to provide this data on energy intake and hospital readmission as it was not measured, therefore not usable. Data provided on complications as requested
Holyday 2012	Yes	Yes	Yes	Data obtained and used for hospital readmission rates
Johansen 2004	Yes	No	N/A	Data not used
Kraft 2012	Yes	No	N/A	
Kretser 2003	No	N/A	N/A	Unable to find contact for author
Larsson 1990	Yes	No	N/A	Data not used
Lin 2010	Yes	No	N/A	
Lin 2011	No	N/A	N/A	
Mathey 2001a	Yes	No	N/A	

(Continued)

Mathey 2001b	Yes	No	N/A	
Nijs 2006	No	N/A	N/A	
Olofsson 2007	Yes	Yes	Yes	Data used for BMI, weight and complications
Pivi 2011	Yes	No	N/A	
Potter 2001	Yes	No	N/A	
Remsburg 2001	No	N/A	N/A	
Salva 2011	Yes	No	N/A	
Silver 2008	No	N/A	N/A	
Simmons 2008	Yes	Yes	No	Data not available
Simmons 2010	Yes	Yes	No	Data not available
Smolliner 2008	Yes	Yes	Yes	Data provided for mean and SD of change for weight, BMI, handgrip, and QoL
Splett 2003	Yes	No	N/A	
Taylor 2006	No	N/A	N/A	
Van Ort 1995	Yes	No	N/A	
Leslie 2012	No	N/A	N/A	
Munk 2014	No	N/A	N/A	
V an den Berg 2015	Yes	Yes	Yes	The clinical trial register number did not allow the trial to be identified within the register. The authors provided a link to the trial protocol via the WHO International Clinical Trials Registry Platform.

ADL: activities of daily living; BMI: body mass index; N/A: not applicable; QoL: (health-related) quality of life; SD: standard deviation: WHO World Health Organisation

Appendix 12. Checklist to aid consistency and reproducibility of GRADE assessments

		(1) All-cause mortality	(2) Morbidity/complications: number of participants with complications (any/pressure ulcers/needing oral antibiotics)	(3) Health-related quality of life and patient satisfaction	(4) Hospitalisation and institutionalisation	(5) Adverse events	(6) Nutritional status (weight change)	(7) Economic costs
Trial limitations (risk of bias)[a]	Was random sequence generation used (i.e. no potential for selection bias)?	Unclear	Unclear	Unclear	Yes	Unclear	Unclear	Unclear
	Was allocation concealment used (i.e. no potential for selection bias)?	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear
	Was there blinding of participants and personnel (i.e. no potential for performance bias) or outcome not likely to be influenced by lack of blinding?	Unclear	Unclear	Unclear	No (↓)	Unclear	Unclear	No (↓)
	Was there blinding of outcome assessment (i.e. no potential for detection bias) or was outcome measurement not likely to be influenced by lack of blinding?	Unclear	Unclear	No (↓)	Unclear	No (↓)	Unclear	No (↓)
	Was an objective outcome used?	Yes	No (↓)	No (↓)	Yes	No (↓)	Yes	Yes
	Were more than 80% of participants enrolled in trials included in the analysis (i.e. no potential reporting bias)?[e]	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Were data reported consistently for the outcome of interest (i.e. no potential selective reporting)?	Yes	Yes	Yes	Yes	Unclear	Yes	Yes
	No other biases reported (i.e. no potential of other bias)?	Yes	Yes	No (↓)	Yes	Yes	Yes	No (↓)

(Continued)

	Did the trials end up as scheduled (i.e. not stopped early)?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Inconsistency[b]	Point estimates did not vary widely?	Yes	No (↓)	N/A	Yes	N/A	Yes	N/A
	To what extent did confidence intervals overlap (substantial: all confidence intervals overlap at least one of the included studies point estimate; some: confidence intervals overlapped but not all overlapped at least 1 point estimate; no: at least 1 outlier: where the confidence interval of some of the studies did not overlap with those of most included studies)?	Substantial	Some	N/A	Substantial	N/A	Substantial	N/A
	Was the direction of effect consistent?	Yes	No (↓)	N/A	Yes	N/A	Yes	N/A
	What was the magnitude of statistical heterogeneity (as measured by I^2) - low (I^2 < 40%), moderate (I^2 40%-60%), high I^2 > 60%)?	Low	High (↓)	N/A	Moderate	N/A	Moderate	N/A
	Was the test for heterogeneity statistically significant (P < 0.1)?	Not statistically significant	Statistically significant (↓)	N/A	Not statistically significant	N/A	Statistically significant (↓)	N/A
Indirectness[a]	Were the populations in included studies applicable to the decision context?	Highly applicable	Highly applicable	Highly applicable	Highly applicable	Highly applicable	Highly applicable	Highly applicable
	Were the interventions in the included studies applicable to the decision context?	Highly applicable	Highly applicable	Highly applicable	Highly applicable	Highly applicable	Highly applicable	Highly applicable
	Was the included outcome not a surrogate outcome?	Yes	Yes	Yes and unclear	Yes	Yes	Yes	Yes
	Was the outcome timeframe sufficient?	Sufficient	Sufficient	Sufficient	Sufficient	Sufficient	Sufficient	Sufficient
	Were the conclusions based on direct comparisons?	Yes	Yes	N/A	Yes	Yes	Yes	Yes
Imprecision[c]	Was the confidence interval for the pooled estimate not consistent with benefit and harm?	Yes	No (↓)	N/A	No (↓)	N/A	Yes	N/A
	What is the magnitude of the median sample size (high: 300 participants, intermedi-	Intermediate to high	Intermediate	Intermediate	Intermediate	Intermediate	Low	Intermediate

(Continued)

	ate: 100-300 participants, low: < 100 participants)?[e]							
	What was the magnitude of the number of included studies (large: > 10 studies, moderate: 5-10 studies, small: < 5 studies)?[e]	Large	Moderate	Moderate	Moderate	Small (↓)	Large	Small (↓)
	Was the outcome a common event (e.g. occurs more than 1/100)?	Yes	Yes	N/A	N/A	Yes	N/A	N/A
Publication bias[d]	Was a comprehensive search conducted?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Was grey literature searched?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Were no restrictions applied to study selection on the basis of language?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	There was no industry influence on studies included in the review?	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear
	There was no evidence of funnel plot asymmetry?	Unclear	Unclear	N/A	Unclear	Unclear	Unclear	N/A
	There was no discrepancy in findings between published and unpublished trials?	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear

[a]Questions on risk of bias are answered in relation to the majority of the aggregated evidence in the meta-analysis rather than to individual trials
[b]Questions on inconsistency are primarily based on visual assessment of forest plots and the statistical quantification of heterogeneity based on I^2

[c]When judging the width of the confidence interval it is recommended to use a clinical decision threshold to assess whether the imprecision is clinically meaningful
[d]Questions address comprehensiveness of the search strategy, industry influence, funnel plot asymmetry and discrepancies between published and unpublished trials
[e]Depends on the context of the systematic review area

(↓): key item for possible downgrading the quality of the evidence (GRADE) as shown in the footnotes of the 'Summary of finding' table(s); GRADE: Grading of Recommendations Assessment, Development and Evaluation; N/A: not applicable

CONTRIBUTIONS OF AUTHORS

All authors have read, commented and contributed to the preparation of review manuscripts.

Michelle Gibbs (MG): protocol draft, search strategy development, acquisition of copies of trials, trial selection, data extraction, and future review updates.

Katherine Kimber (KK): trial selection, data extraction, data analyses, data interpretation, and future review updates.

Christine Baldwin (CB): protocol draft, trial selection, data extraction, data analysis, data interpretation and completed revision of the review following peer review, and future review updates.

Christine Elizabeth Weekes (CEW): protocol draft, trial selection, data extraction, data analysis, data interpretation and completed revision of the review following peer review, and future review updates.

DECLARATIONS OF INTEREST

Michelle Gibbs: this work was financially supported by a grant from the British Dietetic Association.

Katherine Kimber: none known.

Christine Baldwin: some of the early work on this review was funded by an educational grant from the British Dietetic Association. The grant was used to support the salary of two research assistants who contributed to the searching, study selection and writing of the review.

Christine Elizabeth Weekes: none known.

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- British Dietetic Association, UK.

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DIFFERENCES BETWEEN PROTOCOL AND REVIEW

Katherine Kimber began work on this review after publication of the protocol. At the protocol stage it was anticipated that searching of Greynet would be undertaken but this was not done and so the sections on electronic searching and searching other resources have been amended.

Since the publication of the protocol of this review and the final review draft a considerable time has elapsed which demanded a number of changes to the protocol such as specification of a number of additional secondary outcomes (which are mandatory within the CMED Group), specification of outcomes for the 'Summary of findings' table and specification of timing of outcome measurement. Also the updated search strategy was focused on major databases and differed slightly from the older versions mainly due to changes in the database structure over time.

We could not investigate a number of prespecified subgroup and sensitivity analyses because of lack of data. Also, cross-over trials did not contribute to the effect estimates established by meta-analyses because data were not available from baseline to the end of phase 1 of the cross-over trials to be included in meta-analyses.

NOTES

Portions of the methods sections, the appendices, additional tables and figures 1 to 3 of this review are based on a standard template established by Cochrane Metabolic and Endocrine Disorders.

INDEX TERMS

Medical Subject Headings (MeSH)

*Dietary Supplements [adverse effects]; *Meals; Cause of Death; Dietary Proteins [administration & dosage]; Energy Intake; Environment; Hospitalization [statistics & numerical data]; Malnutrition [*diet therapy] [mortality]; Nutritional Status; Quality of Life; Randomized Controlled Trials as Topic

MeSH check words

Adult; Humans