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Environmental and behavioural modifications for improving food and fluid intake in people with dementia (Review)

Herke M, Fink A, Langer G, Wustmann T, Watzke S, Hanff AM, Burckhardt M

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[Intervention Review]

Environmental and behavioural modifications for improving food and fluid intake in people with dementia

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ABSTRACT

Background

Weight loss, malnutrition and dehydration are common problems for people with dementia. Environmental modifications such as, change of routine, context or ambience at mealtimes, or behavioural modifications, such as education or training of people with dementia or caregivers, may be considered to try to improve food and fluid intake and nutritional status of people with dementia.

Objectives

Primary: To assess the effects of environmental or behavioural modifications on food and fluid intake and nutritional status in people with dementia. Secondary: To assess the effects of environmental or behavioural modifications in connection with nutrition on mealtime behaviour, cognitive and functional outcomes and quality of life, in specific settings (i.e. home care, residential care and nursing home care) for different stages of dementia. To assess the adverse consequences or effects of the included interventions.

Search methods

We searched the Specialized Register of Cochrane Dementia and Cognitive Improvement (ALOIS), MEDLINE, Eembase, PsycINFO, CINAHL, ClinicalTrials.gov and the World Health Organization (WHO) portal/ICTRP on 17 January 2018. We scanned reference lists of other reviews and of included articles.

Selection criteria

We included randomised controlled trials (RCTs) investigating interventions designed to modify the mealtime environment of people with dementia, to modify the mealtime behaviour of people with dementia or their caregivers, or both, with the intention of improving food and fluid intake. We included people with any common dementia subtype.

Data collection and analysis

Two review authors independently selected studies, extracted data and assessed the risk of bias of included trials. We assessed the quality of evidence for each outcome using the GRADE approach.

Main results

We included nine studies, investigating 1502 people. Three studies explicitly investigated participants with Alzheimer's disease; six did not specify the type of dementia. Five studies provided clear measures to identify the severity of dementia at baseline, and overall very mild

to severe stages were covered. The interventions and outcome measures were diverse. The overall quality of evidence was mainly low to very low.

One study implemented environmental as well as behavioural modifications by providing additional food items between meals and personal encouragement to consume them. The control group received no intervention. Differences between groups were very small and the quality of the evidence from this study was very low, so we are very uncertain of any effect of this intervention.

The remaining eight studies implemented behavioural modifications.

Three studies provided nutritional education and nutrition promotion programmes. Control groups did not receive these programmes. After 12 months, the intervention group showed slightly higher protein intake per day (mean difference (MD) 0.11 g/kg, 95% confidence interval (CI) -0.01 to 0.23; n = 78, 1 study; low-quality evidence), but there was no clear evidence of a difference in nutritional status assessed with body mass index (BMI) (MD -0.26 kg/m^2 favouring control, 95% CI -0.70 to 0.19; n = 734, 2 studies; moderate-quality evidence), body weight (MD -1.60 kg favouring control, 95% CI -3.47 to 0.27; n = 656, 1 study; moderate-quality evidence), or score on Mini Nutritional Assessment (MNA) (MD -0.10 favouring control, 95% CI -0.67 to 0.47; n = 656, 1 study; low-quality evidence). After six months, the intervention group in one study had slightly lower BMI (MD -1.79 kg/m^2 favouring control, 95% CI -1.28 to -2.30; n = 52, 1 study; moderate-quality evidence) and body weight (MD -8.11 kg favouring control, 95% CI -2.06 to -12.56; n = 52, 1 study; moderate-quality evidence). This type of intervention may have a small positive effect on food intake, but little or no effect, or a negative effect, on nutritional status.

Two studies compared self-feeding skills training programmes. In one study, the control group received no training and in the other study the control group received a different self-feeding skills training programme. For both comparisons the quality of the evidence was very low and we are very uncertain whether these interventions have any effect.

One study investigated general training of nurses to impart knowledge on how to feed people with dementia and improve attitudes towards people with dementia. Again, the quality of the evidence was very low so that we cannot be certain of any effect.

Two studies investigated vocal or tactile positive feedback provided by caregivers while feeding participants. After three weeks, the intervention group showed an increase in calories consumed per meal (MD 200 kcal, 95% CI 119.81 to 280.19; n = 42, 1 study; low-quality evidence) and protein consumed per meal (MD 15g, 95% CI 7.74 to 22.26; n = 42, 1 study; low-quality evidence). This intervention may increase the intake of food and liquids slightly; nutritional status was not assessed.

Authors' conclusions

Due to the quantity and quality of the evidence currently available, we cannot identify any specific environmental or behavioural modifications for improving food and fluid intake in people with dementia.

PLAIN LANGUAGE SUMMARY

Environmental and behavioural modifications for improving food and fluid intake in people with dementia

What we wanted to know

Weight loss, malnutrition and dehydration are common problems for people with dementia and can occur at any stage of the illness. People with dementia often develop psychological symptoms or behaviours which cause them to eat or drink less. In the later stages of the illness, they become dependent on others to help them eat or drink. We wanted to investigate how to keep people with dementia eating and drinking as well as possible. We looked for studies which changed the way food and drink are presented to people with dementia, and for studies which attempted to change the behaviour of people with dementia or of those helping them to eat. We called these environmental and behavioural modifications respectively, though some interventions include aspects of both. We were mainly interested in the effect on how much people with dementia ate and drank and on measures of how well-nourished they were (e.g. body weight or body mass index (BMI)), but we also looked for effects on eating behaviour, symptoms of dementia and quality of life.

How we tried to answer the question

We searched for all the randomised controlled trials (RCTs) which were relevant to our question. In these trials, some people with dementia got an environmental or behavioural modification intended to improve their eating and drinking and were then compared with other people who had not had the intervention (the control group). Whether someone got the intervention or not was decided at random. We found nine RCTs to include in our review. In total, there were 1502 people in these trials. They had varying degrees of dementia, probably mostly due to Alzheimer's disease. Seven of the trials took place in care homes. In one trial, people were given extra snacks between meals and encouraged to eat them. In three trials, people with dementia were given education about diet and eating. In two trials, people with dementia were taught skills to help them to eat independently. In three trials, training was given to the carers responsible for helping people with dementia to eat.

What we found out

All the trials we found tested different interventions and measured their effects in different ways. Generally, the trials were small and there were problems with the way they were done, which reduced our confidence in the results. For some interventions, the quality of the evidence was so low that we could not draw any conclusions. For others, there was a mixture of positive and negative effects.

What we concluded

Because of the amount and quality of the evidence we found, we cannot at the moment, identify any specific environmental or behavioural modifications for improving food and fluid intake in people with dementia.

SUMMARY OF FINDINGS

Summary of findings for the main comparison. Summary of findings for additional food items between meals compared to usual care for people with dementia

Additional food items between meals compared with usual care for people with dementia

Patient or population: people with dementia

Settings: care facility

Intervention: additional food items between meals

Comparison: usual care

Outcomes	Relative effect (95% CI)	Mean of the control	No. of Participants (studies)	Quality of the evidence (GRADE)	Comments
Food and fluid intake, measured by calories consumed in total per day (kcal, follow-up 6 weeks)	The calories consumed per day in the intervention group were 181 kcal higher (103.08 lower to 465.08 higher)	1098 kcal	42 (1)	⊕⊖⊖⊖ **Very low**[a]	Simmons 2010a
Nutritional status, measured by body weight (kg, follow-up 6 weeks)	The body weight in the intervention group was 0.22 kg lower (1.25 lower to 0.81 higher)	Only change scores reported	42 (1)	⊕⊖⊖⊖ **Very low**[b]	Simmons 2010a
Mealtime behaviour not measured	-	-	-	-	-

CI: confidence interval;**kcal:** kilo calorie

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]Downgraded two levels due to serious risk of bias (allocation concealment was not specified, lack of blinding of participants and personnel, high number and unclear distribution of dropouts) and one level due to imprecision (wide confidence intervals, low number of participants).

[b]Downgraded two levels due to serious risk of bias (inadequately short follow-up of less than 16 weeks, compare Kondrup 2003, allocation concealment was not specified, lack of blinding of participants and personnel, high number and unclear distribution of dropouts) and one level due to imprecision (wide confidence intervals, low number of participants).

Summary of findings 2. Summary of findings for education and nutrition promotion programme compared to no intervention for people with dementia

Education and nutrition promotion programme compared with no intervention for people with dementia

Patient or population: people with dementia

Settings: any setting

Intervention: education and nutrition promotion programme

Comparison: no intervention

Outcomes	Relative effect (95% CI)	Mean of the control	No. of Participants (studies)	Quality of the evidence (GRADE)	Comments
Food and fluid intake, measured by total protein intake (g/kg of body weight, follow-up 12 months)	The total protein intake per kg of body weight in the intervention group was 0.11 g/kg higher (0.01 lower to 0.23 higher)	0.94 g/kg	78 (1)	⊕⊕⊖⊖ **Low**[a]	Suominen 2015
Nutritional status, measured by MNA (range 0-30, higher = better, follow-up 12 months)	The MNA score in the intervention group was 0.1 scale points lower (0.67 lower to 0.47 higher)	23.5	656 (1)	⊕⊕⊖⊖ **Low**[c]	Salva 2011
Nutritional status, measured by BMI (kg/m², follow-up 6 months)	The BMI in the intervention group was 1.79 lower (1.28 lower to 2.30 lower)	24.6 kg/m²	52 (1)	⊕⊕⊖⊖ **Low**[b]	Pivi 2011
Nutritional status, measured by BMI (kg/m², follow-up 12 months)	The BMI in the intervention group was 0.26 lower (0.70 lower to 0.19 higher)	26.8 kg/m²	734 (2)	⊕⊕⊕⊖ **Moderate**[b]	Salva 2011 Suominen 2015
Nutritional status, measured by body weight (kg, follow-up 6 months)	The body weight in the intervention group was 8.11 kg lower (3.66 lower to 12.56 lower)	60.3 kg	52 (1)	⊕⊕⊖⊖ **Low**[b]	Pivi 2011
Nutritional status, measured by body weight (kg, follow-up 12 months)	The body weight in the intervention group was 1.60 kg lower (3.47 lower to 0.27 higher)	65.5 kg	656 (1)	⊕⊕⊕⊖ **Moderate**[b]	Salva 2011
Mealtime behaviour, measured by the EBS (range 0-30, higher=better, follow-up 12 months)	The EBS score in the intervention group was 1.50 points lower (2.11 lower to 0.89 lower)	16.0	656 (1)	⊕⊕⊕⊖ **Moderate**[b]	Salva 2011

BMI: body mass index; **EBS:** Eating Behaviour Scale; **CI:** confidence interval; **kcal:** kilo calorie; **MNA:** Mini Nutritional Assessment

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]Downgraded one level due to risk of bias (allocation concealment was not specified, lack of blinding of participants and personnel, selective outcome reporting), and one level due to imprecision (wide confidence intervals).
[b]Downgraded two levels due to serious risk of bias (allocation concealment was not specified, lack of blinding of participants and personnel, selective outcome reporting).
[c]Downgraded one level due to risk of bias (allocation concealment was not specified, lack of blinding of participants and personnel, lack of blinding of outcome assessment).

Summary of findings 3. Summary of findings for spaced retrieval combined with errorless learning training programme for people with dementia compared to spaced retrieval only training programme for people with dementia

Spaced retrieval combined with errorless learning training programme for people with dementia compared with spaced retrieval only training programme for people with dementia

Patient or population: people with dementia

Settings: care facility

Intervention: spaced retrieval combined with errorless learning training programme for people with dementia

Comparison: spaced retrieval only training programme for people with dementia

Outcomes	Relative effect (95% CI)	Mean of the control	No. of Participants (studies)	Quality of the evidence (GRADE)	Comments
Food and fluid intake, measured with amount of served food eaten (percentage, follow-up 8 weeks)	The amount of served food eaten in the intervention group was 5.6 percentage points lower (11.70 lower to 0.50 higher)	90.8%	60 (1)[b]	⊕⊖⊖⊖ **Very low**[a]	Wu 2014
Nutritional status not measured	-	-	-	-	-
Mealtime behaviour not measured	-	-	-	-	-

CI: confidence interval

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]Downgraded two levels due to serious risk of bias (allocation concealment was not specified, lack of blinding of participants and personnel, and handling of incomplete data as well as elimination of outliers), indirectness (due to comparator intervention), and one level due to imprecision (wide confidence intervals).
[b]Effective sample size not corrected for clustering.

Summary of findings 4. Summary of findings for spaced retrieval training programme for people with dementia compared to no intervention for people with dementia

Spaced retrieval training programme for people with dementia compared with no intervention for people with dementia

Patient or population: people with dementia

Settings: care facility

Intervention: spaced retrieval training programme for people with dementia

Comparison: no intervention

Outcomes	Relative effect (95% CI)	Mean of the control	No. of Participants (studies)	Quality of the evidence (GRADE)	Comments
Food and fluid intake, measured by amount of served food eaten (percentage, follow-up 3 months)	The amount of served food eaten in the intervention group was 2.67 percentage points higher (5.22 lower to 10.56 higher)	88.1%	54 (1)[c]	⊕⊖⊖⊖ **Very low**[a]	Lin 2010
Nutritional status, measured by MNA (range 0-30, higher = better, follow-up 8 weeks)	The MNA score in the intervention group was 3.68 scale points higher (1.88 higher to 5.48 higher)	20.3	54 (1)[c]	⊕⊖⊖⊖ **Very low**[b]	Lin 2010
Nutritional status, measured by BMI (kg/m^2, follow-up 8 weeks)	The BMI in the intervention group was 1.73 higher (0.63 lower to 4.09 higher)	23.1 kg/m^2	33 (1)[d]	⊕⊖⊖⊖ **Very low**[b]	Lin 2010
Nutritional status, measured by body weight (kg, follow-up 8 weeks)	The body weight in the intervention group was 3.35 kg higher (2.72 lower to 9.42 higher)	54.9 kg	33 (1)[d]	⊕⊖⊖⊖ **Very low**[b]	Lin 2010

Mealtime behaviour, measured by EdFED scale (range 0-20, lower = better, 8 weeks)	The EdFED score in the intervention group was 1.67 scale points lower (2.34 lower to 1.00 lower)	5.0	54 (1)[c]	⊕⊖⊖⊖ **Very low**[a]	Lin 2010

BMI: body mass index; **CI:** confidence interval; **EdFED:** Edinburgh Feeding Evaluation in Dementia; **kcal:** kilo calorie, **MNA:** Mini Nutritional Assessment

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] Downgraded two levels due to serious risk of bias (allocation concealment was not specified, lack of blinding of participants and personnel, unclear distribution of dropouts, and differences at baseline) and one level due to imprecision (wide confidence intervals).
[b] Downgraded two levels due to serious risk of bias (inadequately short follow-up of less than 16 weeks, compare Kondrup 2003, allocation concealment was not specified, lack of blinding of participants and personnel, unclear distribution of dropouts, and differences at baseline) and one level due to imprecision (wide confidence intervals).
[c] Effective sample size not corrected for clustering.
[d] Effective sample size corrected for clustering using an ICC of 0.01.

Summary of findings 5. Summary of findings for Montessori-based activities training programme for people with dementia compared to no intervention for people with dementia

Montessori-based activities training programme for people with dementia compared with no intervention for people with dementia

Patient or population: people with dementia

Settings: care facility

Intervention: Montessori-based activities training programme for patients

Comparison: no intervention

Outcomes	Relative effect (95% CI)	Mean of the control	No. of Participants (studies)	Quality of the evidence (GRADE)	Comments
Food and fluid intake, measured by amount of served food eaten (percentage, 3 months)	The served food eaten in the intervention group was 9.69 percentage points lower (17.86 lower to 1.52 lower)	88.1%	54 (1)[c]	⊕⊖⊖⊖ **Very low**[a]	Lin 2010
Nutritional status measured with MNA (range 0-30, higher = better, follow-up 8 weeks)	The MNA score in the intervention group was 2.31 scale points lower (4.62 lower to 0.00 higher)	20.3	54 (1)[c]	⊕⊖⊖⊖ **Very low**[b]	Lin 2010

Nutritional status measured with BMI (kg/m², follow-up 8 weeks)	The BMI in the intervention group was 1.94 lower (3.95 lower to 0.07 higher)	23.1 kg/m²	33 (1)[d]	⊕⊖⊖⊖ **Very low**[b]	Lin 2010
Nutritional status measured with body weight (kg, follow-up 8 weeks)	The body weight in the intervention group was 3.93 kg lower (9.62 lower to 1.76 higher)	54.9 kg	33 (1)[d]	⊕⊖⊖⊖ **Very low**[b]	Lin 2010
Mealtime behaviour measured with EdFED scale (range 0-20, lower = better, follow-up 8 weeks)	The EdFED score in the intervention group was 1.5 scale points lower (2.16 lower to -0.84 lower)	5.0	54 (1)[c]	⊕⊖⊖⊖ **Very low**[a]	Lin 2010

BMI: body mass index; **CI:** confidence interval; **EdFED:** Edinburgh Feeding Evaluation in Dementia; **kcal:** kilo calorie, **MNA:** Mini Nutritional Assessment

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]Downgraded two levels due to serious risk of bias (allocation concealment was not specified, lack of blinding of participants and personnel, unclear distribution of dropouts, and differences at baseline) and one level due to imprecision (wide confidence intervals).
[b]Downgraded two levels due to serious risk of bias (inadequately short follow-up of less than 16 weeks, compared to Kondrup 2003, allocation concealment was not specified, lack of blinding of participants and personnel, unclear distribution of dropouts, and differences at baseline) and one level due to imprecision (wide confidence intervals).
[c]Effective sample size not corrected for clustering.
[d]Effective sample size corrected for clustering using an ICC of 0.01.

Summary of findings 6. Summary of findings for feeding skills training programme for nurses compared with no intervention for people with dementia

Feeding skills training programme for nurses compared with no intervention for people with dementia

Patient or population: people with dementia

Settings: long-term care

Intervention: feeding skills training programme for nurses

Comparison: no intervention

Outcomes	Relative effect (95% CI)	Mean of the control	No. of Participants (studies)	Quality of the evidence (GRADE)	Comments

Food and fluid intake, measured as amount of served food eaten (percentage, follow-up 3 months)	The amount of served food eaten in the intervention group was 9 percentage points lower (27.86 fewer to 9.86 higher)	94.0%	20 (1)	⊕⊖⊖⊖ **Very low**[a]	Chang 2005
Nutritional status not measured	-	-	-	-	-
Mealtime behaviour, measured with EdFED scale (range 0-20, lower = better, follow-up 3 months)	The EdFED score in the intervention group was 2.3 scale points higher (0.26 higher to 4.34 higher)	8.0	20 (1)	⊕⊖⊖⊖ **Very low**[a]	Chang 2005

CI: confidence interval; **EdFED:** Edinburgh Feeding Evaluation in Dementia

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]Downgraded two levels due to serious risk of bias (lack of allocation concealment, lack of blinding of participants and personnel to the intervention, lack of blinding of outcome assessment, and high number of unaddressed dropouts), and one level due to imprecision (wide confidence intervals, low number of participants).

Summary of findings 7. Summary of findings for verbal and physical encouragement by touch compared with only verbal encouragement during meals for people with dementia

Verbal encouragement and physical encouragement by touch compared with only verbal encouragement during meals for people with dementia

Patient or population: people with dementia

Settings: care facility

Intervention: verbal encouragement and physical encouragement by touch

Comparison: verbal encouragement

Outcomes	Relative effect (95% CI)	Mean of the control	No. of Participants (studies)	Quality of the evidence (GRADE)	Comments
Food and fluid intake, measured by calories consumed per meal (kcal, follow-up 3 weeks)	The caloric intake in kcal per meal in the intervention group was 200 kcal higher (119.81 higher to 280.19 higher)	562 kcal	42 (1)	⊕⊕⊖⊖ **Low**[a]	Eaton 1986

Food and fluid intake, measured by protein consumed per meal (grams, follow-up 3 weeks)	The protein intake in grams per meal in the intervention group was 15 grams higher (7.74 higher to 22.26 higher)	32 grams	42 (1)	⊕⊕⊖⊖ **Low**[a]	Eaton 1986
Nutritional status not measured	-	-	-	-	-
Mealtime behaviour not measured	-	-	-	-	-

CI: confidence interval; **kcal:** kilo calorie

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]Downgraded one level due to risk of bias (allocation concealment was not specified, lack of blinding of participants and personnel), and one level due to imprecision (wide confidence intervals, low number of participants).

BACKGROUND

Description of the condition

The world population is ageing (United Nations 2013). Age is the strongest risk factor for dementia, therefore the number of people living with dementia is increasing (WHO 2012). Today, more than 45 million people live with dementia (ADI 2015), and the World Health Organization (WHO) reports that 7.7 million more cases are identified each year (Prince 2013; Sosa-Ortiz 2012; WHO 2012). It is estimated that this number will nearly double within the next 20 years (ADI 2015), resulting in high costs (rising from USD 604 billion in 2010 to USD 818 billion in 2015; ADI 2015), and a considerable burden to individuals and society. Moreover, people with dementia are also now expected to live longer, after first being diagnosed, due to improvements in treatment and care (Wimo 2013). Recent research supports these predictions, as well as the increase in prevalence (Prince 2013); however this is mostly due to ageing. Other risk factors for dementia are declining, which could in turn lead to a decrease in prevalence (Larson 2013).

The term 'dementia' refers to a syndrome occurring in a group of diseases that are typically of a chronic or progressive nature. It involves disturbance of multiple higher cortical functions, such as memory, thinking, orientation, perception and behaviour, and it affects the ability to perform everyday activities. Deterioration in emotional control, social behaviour or motivation often precedes or accompanies cognitive decline. The most common form of dementia is Alzheimer's disease, which is involved in 60% to 70% of cases. Vascular dementia is also very common. Lewy body dementia and frontotemporal dementia are less frequent forms. However, mixed forms are common and subtypes are indistinct (ADI 2015).

In addition to higher age and genetic factors, there are other modifiable risk factors for dementia, which involve vascular disease and its contributing factors (WHO 2012). Diabetes (Lu 2009), midlife hypertension (Qiu 2005), obesity (Beydoun 2008), midlife hypercholesterolaemia (Anstey 2008), smoking (Lee 2013), stroke (Savva 2010), and physical inactivity (Hamer 2009), have been meta-analytically associated with an increased risk of dementia in general, and a higher incidence of Alzheimer's disease.

The effects of malnutrition and the so-called 'anorexia of ageing' have already been recognised as a problem amongst the older population in general, as well as the risk and prevalence of dehydration (Bunn 2016; Di Francesco 2007; Morley 1997), however these effects become more severe for those living with dementia. Weight loss and malnutrition are a common problem for people with dementia (ADI 2014), and malnutrition presents from the early to late stages of dementia (Olde Rikkert 2014; Pivi 2012). The onset of Alzheimer's disease is often preceded by several years of weight loss (Barrett-Connor 1996; Johnson 2006). With the progression of the condition, people with dementia can develop several symptoms that influence food and fluid intake, with several possible mechanisms. While damage to the brain tissue associated with appetite control can cause anorexia (Grundman 1996), other cognitive impairments can lead to forgetting of meals, impair the ability to make food choices or lead to an inability to communicate hunger and ask for food (Gillette-Guyonnet 2000). Psychologically, behavioural syndromes associated with physiological disturbance, such as apathy and depression, are common and associated with a decreased interest in food, but they can also cause agitation, aggressive behaviour or wandering, which can both have a negative impact on participation in mealtimes and increase energy expenditure. The senses are also affected, i.e. diminishing senses of smell and taste can reduce appetite (ADI 2014). In severe dementia, people can develop feeding problems and become dependent on feeding assistance. In addition to problems with motor skills, swallowing problems and an inability to use utensils for self-feeding, feeding problems can also include the patient refusing to eat, turning their head away while being fed, refusing to open their mouth, spitting out food, leaving the mouth open and allowing food to drop out, or refusing to swallow (Pivi 2012; Watson 1993). All of these factors contribute to the high risk of people with dementia becoming malnourished and dehydrated, which not only increases rates of complications, hospitalisation, morbidity and mortality, but also decreases their ability to conduct activities of daily life and thus, ultimately, quality of life (Rasheed 2013; Vetta 1999). People with dementia are ten times more likely than age-matched controls to be admitted to hospital because of dehydration and anorexia (Abdelhamid 2016; Natalwala 2008). These problems present regardless of the setting, i.e. community-dwelling people with dementia as well as those in institutionalised care can suffer from malnutrition (Roque 2013; Tamura 2013).

Description of the intervention

There are numerous interventions available that are designed to modify the mealtime environment of people with dementia, to modify the mealtime behaviour of people with dementia or their caregivers, or to integrate aspects of both with the intention of improving food and fluid intake and, subsequently, nutritional status, as previously identified by reviews with broader scopes (Abbott 2013; Liu 2014; Watson 2006; Whear 2014). Fixed criteria cannot be provided and many interventions qualify as complex (Craig 2008). Therefore we provided a more thorough description of the interventions under the description of studies using the Template for Intervention Description and Replication (TIDieR, Hoffmann 2014). For data synthesis we orientated ourselves by broader categories described by the Abbott 2013 and Whear 2014 studies, which are not conclusive but allow a rough classification.

- Environmental modifications
  - Change of routine
  - Change of context
  - Change of ambience
  - Others
- Behavioural modifications
  - Education or training of people with dementia
  - Education or training of caregivers
  - Others

Environmental modifications cover all changes to the physical surroundings, social context and timing of meals. Environmental modifications of the routine of mealtimes could either involve changing how the food is served or changing the times at which and for how long meals take place. Modifications to the context of mealtimes are aimed at which persons are present. This includes all persons present during mealtimes, such as other people with dementia, other residents in nursing facilities, family members and formal or informal caregivers. Modifications to the ambience of mealtimes are concerned with properties of the light, sound, smell or temperature of the immediate or possibly intermediate dining environment. Other examples of environmental modifications

could include providing a home-like environment by means of furniture and decoration or having tableware in high-contrast colours. Another modification could be to provide complementary food items that people with dementia can resort to if they so desire, either during or in between mealtimes.

Behavioural modifications cover all changes to knowledge, skill, attitude or habits pertaining to the nutrition of either the person with dementia or those in their immediate vicinity during mealtimes. Behavioural modifications to educate and train people with dementia relate to the knowledge people with dementia have about nutrition, their skills in self-feeding and their attitude and habits concerning mealtimes. Modifications to educate and train caregivers, on the other hand, are aimed at those providing assistance to people with dementia during mealtimes, but have similar objectives. Modifications that are not directly aimed at nutrition and mealtimes, but instead at, for example, oral hygiene, general motor skills or general knowledge of the condition would not be included.

We used TIDieR to provide a more comprehensive description of these complex interventions (Craig 2008; Hoffmann 2014). This template summarises information on why the intervention might work, what materials and procedures were employed by who and how, where and when the intervention took place, as well as details on possible tailoring and modification. Where applicable, we provided information on comparator interventions.

How the intervention might work

Environmental modifications that change the routine, as well as those that change the context, mostly address the important role of the internalised expectations, preferences and habits of the individual when experiencing mealtimes (Aselage 2010; Fjellström 2008; Fjellström 2010; Sidenvall 1994; Sidenvall 1999; Strathmann 2013). Meals are usually highly standardised and process oriented, especially in nursing care facilities. One extreme would be reheated food served in trays at set times every day in a large group of patients. Individual preferences on how and when food is served can rarely be addressed and mealtimes happen in relative anonymity, even though the aspects just described are important considerations for older people (Leslie 2011). Interventions that change these processes, for example by employing more family style mealtimes, by serving bulk food in a smaller group, are possibly more likely to cater to the habits, eating patterns and actual hunger of these individuals (Barnes 2013). Presented with this form of liberalisation and a more engaging social context, the overall quality of mealtimes for people with dementia might increase and with greater pleasure derived from this event, they are more likely to increase their food intake as they can choose their preferred food, serving size and time spent eating (Lorefalt 2012). Nonetheless, some form of help during mealtimes is often necessary and providing caregivers, or in the case of institutionalised care, improving the ratio of people with dementia to nurses can prove beneficial (Kayser-Jones 1997; Marshall 2013), and can be considered an environmental modification. The particular people present during mealtimes is an important aspect of context, be it other people with dementia, other residents of nursing facilities, family members and formal or informal caregivers. It is, however, a difficult balance to meet the personal preferences of the persons concerned and also the necessities of support. Environmental modifications that change ambience often address the importance of sensory stimuli for the activity levels and mood of the individual. In institutional care, people with dementia often experience insufficient sensory stimulation and might become prone to apathy, depression or generally decreased activity levels, which might negatively affect participation during mealtimes. An increase in lighting, bright colours or stimulating music might therefore increase activity levels (Forbes 2014). Music can either have the effect of raising levels of activity or a soothing effect to counter feelings of agitation (Vink 2003).

Behavioural modifications to educate and train people with dementia are often designed to improve their abilities to feed themselves. With progressive cognitive decline, basic motor skills and hand-eye co-ordination suffer. By training people, these skills might be maintained for a longer period of time as the dementia progresses, or lost skills might be regained. Although the degeneration of brain tissue is irreversible, training in specific skills to strengthen their neural representation might delay their loss. Higher dependency in activities of daily living is strongly associated with lower quality of life (Beerens 2013), which in turn affects symptoms like agitation or depression. In general, increased activities outside of mealtimes can decrease agitation (Livingston 2014), which in turn can improve mealtime behaviour. Furthermore, training can aim to support people with dementia in their ability to recognise the context of mealtimes and act accordingly (Cleary 2012). While forgetfulness may lead to skipping of meals, impaired decision making, slow food choice and reduced intake, training regarding mealtime schedules or a choice of menus can help to preserve healthy mealtime habits. Behavioural modifications to educate or train caregivers of people with dementia could address their feeding skills or their interaction with the people they care for during mealtimes. Some assistance will always be necessary, depending on the severity of symptoms and mealtime difficulties, so interventions are not a matter of whether or not assistance is provided, but whether caregivers are trained to cater for people with dementia who have the aforementioned problems (Simmons 2004). This training could be as simple as ensuring that the same caregiver is present during all or most mealtimes of a given patient, which accommodates the social aspect of mealtimes. In most societies, eating is a social activity and people with dementia are often excluded from this. This is further emphasised when social contacts change during each mealtime, which is often the case in nursing facilities. Individualised feeding assistance can provide a better social experience during mealtimes and thus increase its overall quality, length, enjoyment and also food intake. Other skills, including touch, guidance and redirection, or simple verbal cues and even simple scripted conversation, can result in greater satisfaction, resulting in more time spent on mealtimes and fewer complications (Amella 2004; Woods 2005).

A brief rationale of how the intervention is intended to work is given within the Template for Intervention Description and Replication (TIDieR, Hoffmann 2014), which is provided in the Included studies section.

Why it is important to do this review

Environmental and behavioural nutritional interventions are non-pharmacological interventions available to people with dementia who are living at home or in institutions. Nutritional aspects of care are often difficult or lacking. There is widespread interest in improving the quality of life, activities of daily living, well-being and health of people with dementia, and in decreasing the burden for

family and professional caregivers. In this review, we systematically examine the evidence on the efficacy of environmental and behavioural interventions intended to increase the food and fluid intake of people with dementia.

OBJECTIVES

Primary

To assess the effects of environmental or behavioural modifications on food and fluid intake and nutritional status in people with dementia.

Secondary

To assess the effects of environmental or behavioural modifications in connection with nutrition on mealtime behaviour, cognitive and functional outcomes and quality of life, in specific settings (i.e. home care, residential care and nursing home care) for different stages of dementia.

To assess the adverse consequences or effects of the included interventions.

METHODS

Criteria for considering studies for this review

Types of studies

We included all relevant published and unpublished randomised controlled trials (RCTs), including cluster-randomised trials. We included randomised cross-over trials if the first period data were available separately.

Types of participants

We included individuals diagnosed with Alzheimer's disease, vascular dementia, Lewy body dementia, Parkinson's disease dementia and frontotemporal dementia. The diagnosis of dementia should be made in accordance with accepted guidelines, namely the Diagnostic and Statistical Manual of Mental Disorders (DSM; APA 2013), the International Classification of Diseases (ICD; WHO 2010), the National Institute of Neurological and Communicative Disorders and Stroke and the Alzheimer's Disease and Related Disorders Association (NINCDS-ADRDA) Alzheimer's criteria (McKhann 1984), and the National Institute of Neurological Disorders and Stroke and the Association Internationale pour la Recherche et l'Enseignment en Neurosciences (NINDS-AIREN) criteria for the diagnosis of vascular dementia (Román 1993). We considered any stage and setting of the aforementioned types of dementia. Alzheimer's disease and vascular dementia are the most common types of dementia (WHO 2012), therefore we also included studies which cover individuals diagnosed with dementia, even if the types of dementia were not specified or if diagnostics did not follow strictly specified criteria or guidelines. We also included studies not exclusively investigating participants with dementia, as long as people with dementia make up at least 50% of the participants or we could analyse data from participants with dementia separately.

We excluded other types of dementia. While the aforementioned types of dementia show a great overlap in symptoms, other types (e.g. from infections such as Creutzfeldt-Jacob, tumours, psychological disorders, heavy metal poisoning or drug abuse) show very different progressions and complications, which is why we excluded them. Where it was not possible to exclude the data from participants with other types of dementia and these participants made up more than 50% of the total, we excluded the study. We also excluded data from individuals receiving parenteral nutrition or being tube-fed, because the interventions in this review are not, or are only partially designed for these participants. If it is not possible to exclude the data from tube-fed participants, and this group makes up more than 50% of the participants, we will exclude the study.

Types of interventions

Experimental interventions

We included studies using behavioural or environmental modifications as interventions to increase food intake in people with dementia. As we could not compile a definitive list of interventions, we grouped the interventions using the categorisation presented above. In the cases of studies with several arms, at least one arm had to be an environmental or behavioural modification, as defined above, for the study to be eligible for this review.

Comparator interventions

Three kinds of comparator interventions were eligible for this review.

- Usual care or optimised usual care (for example, APA 2007 or Fletcher 2012).
- Any other intervention included in this review.
- Any non-specific intervention.

Exclusions

Although it is arguably part of the mealtime environment, we considered all interventions exclusively modifying what food is actually served to be out of the scope of this review. This includes modification of diet, texture, seasoning or composition, as well as use of oral nutritional supplements.

We excluded any intervention using one of the following.

- Parenteral nutrition.
- Tube feeding.
- Modifying food for swallowing difficulties.
- Drugs.

The modification of consistency of food and fluids for swallowing difficulties in dementia is covered in another Cochrane Review (Flynn 2014).

Types of outcome measures

We only considered participant-relevant outcomes. We excluded outcomes relevant only to other stakeholders (e.g. relatives or health professionals) and biomarkers.

Primary outcomes

Intake of food and liquids

- Energy intake, measured in calories or joules
- Food intake, measured in portion sizes or composition and weight

- Fluid intake, measured in volume.

We accepted prospective, professionally conducted (e.g. dietician, nurse) dietary protocols. Intake should be measured in portions or calories (or both), if possible assessed in relation to professionally estimated nutritional requirements.

There is no consensus on the content and duration of dietary protocols. Systematic and measurement errors are possible due to the different methods used (Kirkpatrick 2014), and to the functional and cognitive abilities of people with dementia. To establish stable changes in mealtime behaviour and thus intake of food and liquids, studies should have a follow-up of at least four days. We considered shorter follow-up to be of lower validity.

Nutritional status

- Nutritional status and body composition, measured by absolute or relative change in weight or body mass index (BMI).
- Nutritional status and malnutrition, measured with validated tools for the assessment or screening of malnutrition, such as the Mini Nutritional Assessment (MNA; Vellas 1999).

Based on common risk indicators for malnutrition (Kondrup 2003), studies investigating the maintenance or improvement of nutritional status should have had a follow-up of at least 16 weeks or else these measures have to be considered to be of lesser validity.

Secondary outcomes

Mealtime behaviour, measured by validated tools

For example:

- Edinburgh Feeding Evaluation in Dementia Scale (EdFED; Watson 1994).

As above, to establish stable changes in mealtime behaviour, studies should have a follow-up of at least four days. We considered shorter follow-up to be of lower validity.

Changes in global and specific cognitive function, measured by validated tools

For example:

- Alzheimer's Disease Assessment Scale-Cognitive subscale (ADAS-Cog; Rosen 1984).
- Mini-Mental State Examination (MMSE; Folstein 1975).

The European Medicines Agency (EMA) suggests a follow-up of at least six months to demonstrate short-term effects on cognitive outcomes (EMA 2008). However, interventions within the scope of this review are not subject to the same extensive regulatory requirements as drugs. Therefore, following the approach of the German Institute of Quality and Efficiency in Health Care (IQWIG 2008), studies investigating cognitive outcomes should have had a follow-up of at least three months.

Changes in functional outcomes (e.g. activities of daily living (ADL)), measured by validated tools

For example:

- Alzheimer's Disease Activities of Daily Living International Scale (ADL-IS; Galasko 1997).
- Gottfries-Bråne-Steen scale, activities of daily living subscale (GBS-ADL; Bråne 2001).

Changes in quality of life (QoL), measured by validated tools

For example:

- Dementia quality of life questionnaire (DEMQOL or DEMQOL-Proxy, Smith 2005).

Others

- Global change in symptoms and performance (measured by validated global scales), compliance with intervention, entry to institutional care or any other reported participant-relevant outcome.
- Psychological or behavioural events, such as depression or agitation.
- Adverse effects, such as aspiration-related pneumonia or death.

The lists of instruments shown are not fully comprehensive.

Search methods for identification of studies

Electronic searches

We searched ALOIS, the register of Cochrane Dementia and Cognitive Improvement (CDCI). We used the following search terms: behavio*, environment*, food*, meal*, *nutrition*, beverage*, *feeding*, eating, ingestion, cooking, dinner, dining, supper.

ALOIS is maintained by the Information Specialist and contains dementia and cognitive improvement studies identified from:

- monthly searches of a number of major healthcare databases: MEDLINE, Embase, CINAHL, PsycINFO and Lilacs;
- monthly searches of a number of trial registers: *meta*Register of Controlled Trials; UMIN Clinical Trials Register (Japan); the World Health Organization (WHO) portal (which covers ClinicalTrials.gov; International Standard Randomised Controlled Trial Number (ISRCTN); Chinese Clinical Trials Register; German Clinical Trials Register; Iranian Registry of Clinical Trials and the Netherlands National Trials Register, plus others);
- quarterly searches of the Cochrane Central Register of Controlled Trials (CENTRAL);
- six-monthly searches of a number of grey literature sources: ISI Web of Knowledge Conference Proceedings; Index to Theses; Australasian Digital Theses.

To view a list of all sources searched for ALOIS see About ALOIS on the ALOIS website.

We ran additional searches on 17 January 2018 in MEDLINE, Embase, PsycINFO, CINAHL, ClinicalTrials.gov, and the WHO portal/ International Clinical Trials Registry Patform (ICTRP), to ensure that the search was as comprehensive and as up-to-date as possible. Appendix 1 shows the sources searched and the search strategies.

Searching other resources

We reviewed reference lists from included studies and relevant reviews.

Data collection and analysis

Selection of studies

We obtained the lists of references and merged these, using EndNote X5 (EndNote 2011), to check for duplicates.

Two review authors (MH and MB or MH and AF or AF and AH) independently examined titles and abstracts from all search results to identify eligible studies. Where it was not possible to discern the eligibility of a study from the title alone or from the title and abstract alone, we tried to obtain a copy of the report to make a decision. We resolved differences on the eligibility of studies by discussion to reach consensus and, where necessary, by involving a third review author (AF or MB). For all full texts of studies eligible for inclusion, we also acquired all errata and supplementary data. According to our protocol, we planned to translate full texts that are not in English or German. This was not necessary.

We linked together multiple reports of the same study. Two review authors (MH and MB or MH and AF or AF and AH) evaluated the full texts of relevant articles independently, according to the eligibility criteria. They were not blinded to the study data. We resolved possible disagreement by discussion and, where necessary, by involving a third review author (AF or MB). We listed final decisions on the exclusion of articles that were retrieved in full text. We documented the selection process, as suggested in the PRISMA statement (Liberati 2009).

Data extraction and management

Two authors (MH and MB or MH and AF or AF and AH) independently read and extracted the data from each included study. Where discrepancies occurred, we involved a third review author (AF or MB) to resolve the matter.

We used an electronic data extraction form, including source, eligibility, methods, participants, interventions, comparators, outcomes, results and miscellaneous notes according to the *Cochrane Handbook for Systematic Reviews of Interventions* (Chapter 7.3; Higgins 2011). Additionally, we assessed details of funding source, declaration of interests of the primary investigators and methods used to control possible conflicts of interests. Two review authors (MH and MB) pretested the form using two studies and we adapted the form where necessary.

For continuous data, we extracted means, mean differences (MDs), standard deviations (SDs), standardised mean differences (SMDs), and the number of participants (n) used to measure the outcome for each group.

For dichotomous outcomes, we extracted the numbers of outcomes and participants. Where the data provided were insufficient, we tried to complete them with the help of the authors of the report (see the section Dealing with missing data). If this proved impossible, we tried to deduce the numerical data from sample sizes and the given percentages.

If only MD between the groups for continuous data or odds ratio (OR) or risk ratio (RR) for dichotomous data, as well as corresponding standard errors or equivalent measures of uncertainty were reported, and in case the study in question is eligible for meta-analysis, we would then use the generic inverse variance method.

One review author (MH) entered the data into Review Manager 5 (Review Manager 2014); another review author (MB) checked the data for accuracy.

Where study protocols were published, we also extracted data from ongoing studies, including study name, methods, participants, interventions, outcomes, starting date, contact information and notes.

Assessment of risk of bias in included studies

Two review authors (MH and MB or MH and AF or AF and AH) independently assessed the risk of bias for each study, using the Cochrane 'Risk of bias' tool (Chapter 8.5; Higgins 2011). We resolved any disagreements by discussion to reach consensus and, where necessary, by involving a third review author (AF or MB). We described the risk of bias of all the included studies in tables and narratively. Additionally, we provided an overall judgement about the included studies in the 'Risk of bias' tables and 'Risk of bias' charts.

Measures of treatment effect

We used the MD or SMD with 95% confidence interval (CI) for continuous outcomes and the RR with 95% CI for the analysis of dichotomous outcomes. Where we encountered any relevant ordinal outcome, we only considered this if we could justifiably treat it as a continuous variable or sensibly dichotomise it. As there are no definite guidelines on how to handle these measurements, we reported on our decision, which we reached in discussion with at least two review authors (MH and MB).

Unit of analysis issues

The unit of analysis is the individual with dementia. We accounted for any unit of analysis errors stemming from the study design. For cross-over trials we only used first period data. For studies with multiple treatment arms, we combined comparable groups. Where the outcome was measured at more than one time point, we conducted several meta-analyses of the results from comparable time points (± one week) and addressed this in the sensitivity analysis. For cluster-randomised studies that did not account for clustering in their analyses, we tried to identify information on the intraclass correlation coefficient (ICC) for each outcome in order to adjust the standard errors.

Dealing with missing data

When data from a study were missing and could not be derived from other statistics given, we tried to contact the trial authors to obtain the data. For this, we made at least two contact attempts over six weeks, checking for alternate contact information when the first attempt failed. When we could not retrieve complete data, we reported this in our assessment of bias and addressed missing outcomes and summary data as a source of bias in data analysis.

Assessment of heterogeneity

We evaluated clinical heterogeneity by examining the data extraction tables and considering between-study variability with respect to participants, interventions, outcome measurements and study durations. When we could pool data, we also assessed statistical heterogeneity.

Assessment of reporting biases

We tried to minimise reporting bias by the inclusion of published and unpublished trials. We compared conference abstracts and available trial protocols for the included studies. Due to a small number of included studies, we did not use funnel plots and Egger's test for asymmetry to detect possible reporting bias (Egger 1997), but this might be applicable to future updates.

Data synthesis

We performed all statistical analyses using Review Manager 5 (Review Manager 2014). We performed meta-analyses for the primary and secondary outcomes where there were sufficient data from the included studies to estimate an overall treatment effect of comparable interventions, comparators and outcomes. Therefore, we considered all primary and secondary outcomes listed for data synthesis.

We judged the appropriateness of conducting a meta-analysis by discussion, considering the clinical and statistical heterogeneity and the number of studies. We presented the results of each study in a forest plot without estimating an overall effect, as meta-analysis was not possible because of significant heterogeneity, except for one comparison and outcome provided in two comparable studies. We provided a narrative account of the results.

Subgroup analysis and investigation of heterogeneity

Except for the case of one outcome represented in two comparable studies, the differences in comparisons used in studies, in study durations and in outcomes did not allow for meta-analyses. It was not possible to conduct subgroup analyses for different types, stages or settings of dementia for any comparison or outcome.

Sensitivity analysis

For the meta-analysis conducted, we explored the differences between the fixed-effect and random-effects models. We chose not to impute data in the data synthesis, but as most findings were based on single studies, we considered the risk of bias given for each study in the evaluation and did not employ imputation methods.

Summarising and interpreting results

We used the GRADE approach to assess the overall quality of evidence for each outcome and (Guyatt 2011), and presented a summary of the intervention effect and a measure of quality for each of the outcomes in 'Summary of findings' tables, as recommended by Cochrane (Schünemann 2011). The GRADE approach uses five considerations (study limitations, consistency of effect, imprecision, indirectness and publication bias) to assess the quality of the body of evidence for each outcome. The evidence can be downgraded from 'high quality' by one level for serious (or by two levels for very serious) limitations, depending on assessments for risk of bias, indirectness of evidence, serious inconsistency, imprecision of effect estimates or potential publication bias. We prioritised the review outcomes before the literature search. We included the primary outcomes, food and fluid intake and nutritional status, as well as the secondary outcome mealtime behaviour in the 'Summary of findings' tables. We used the RevMan 5 table editor to create 'Summary of findings' tables following the instructions of GRADEpro GDT (GRADEpro GDT 2015). These included for each outcome: the estimate of the treatment effect, the quantity of supporting evidence and the quality of that evidence assessed using the GRADE approach (Guyatt 2011).

RESULTS

Description of studies

Results of the search

The electronic searches from March 2015, February 2016, November 2016 and January 2018 retrieved 9739 results after de-duplication by Anna Noel-Storr, Information Specialist of Cochrane Dementia and Cognitive Improvement (CDCI). One review author (MH) identified two additional sources by literature research. After additional manual de-duplication by one review author (MH), 9737 results were left for assessment. Two review authors (MH and MB or MH and AF or AF and AH) independently assessed references for relevance. We discarded 9684 references that were not relevant. Two review authors (MH and MB or MH and AF or AF and AH) independently assessed 53 articles, conference abstracts and trial registrations for eligibility. Thirty-six articles and two registered trials did not meet our inclusion criteria (see Characteristics of excluded studies and Characteristics of ongoing studies tables). We included 14 articles referring to nine studies (Chang 2005; Coyne 1997; Eaton 1986; Lin 2010; Pivi 2011; Salva 2011; Simmons 2010a; Suominen 2015; Wu 2014). The selection process is presented in the PRISMA diagram (Liberati 2009; see Figure 1).

Figure 1. Study flow diagram.

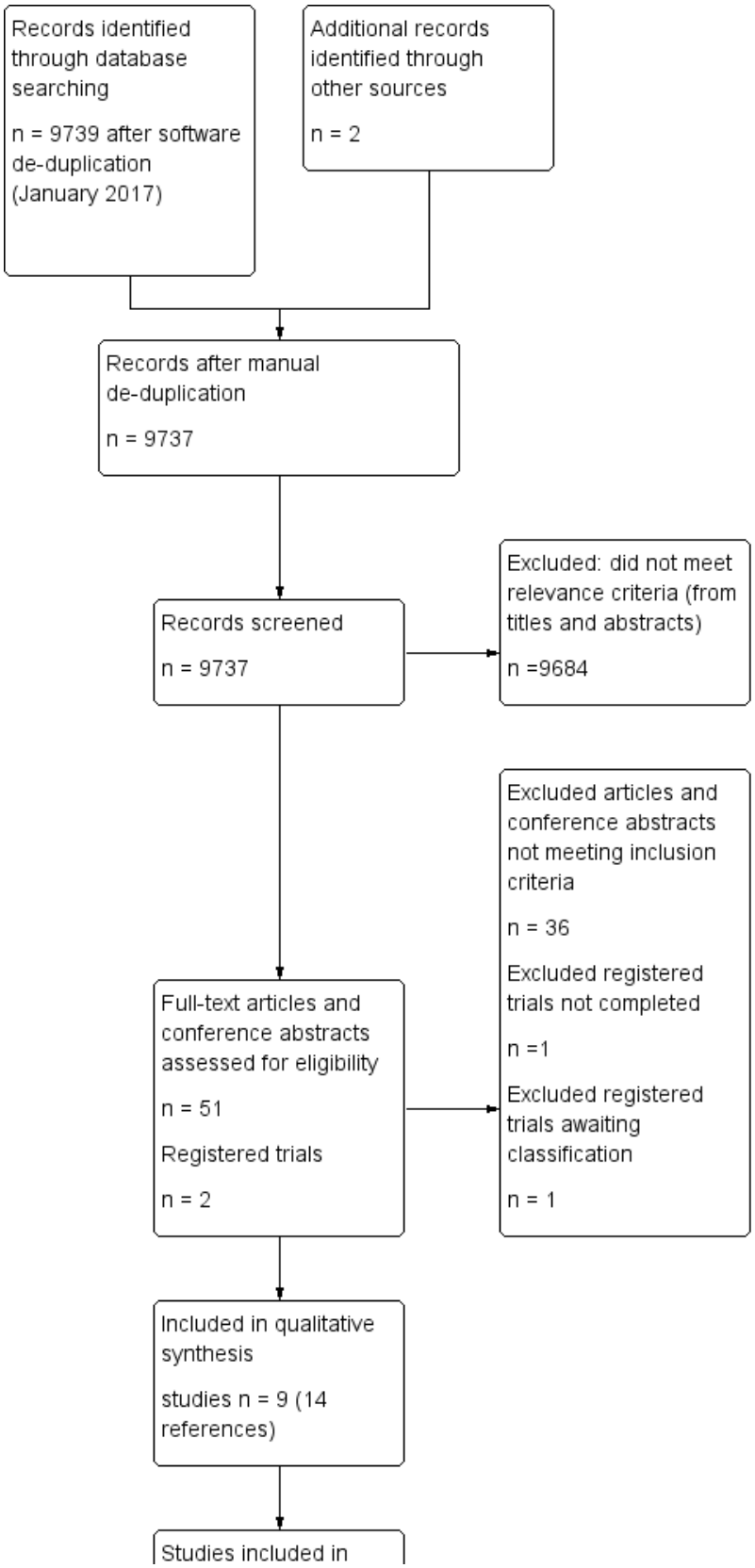
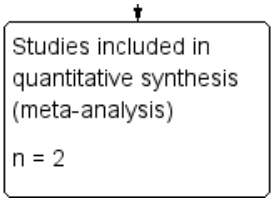


Figure 1. (Continued)



Included studies

Nine studies with 1502 randomised participants met the inclusion criteria for this review (Chang 2005; Coyne 1997; Eaton 1986; Lin 2010; Pivi 2011; Salva 2011; Simmons 2010a; Suominen 2015; Wu 2014). Clinically, the studies were very heterogeneous with respect to the participants, the interventions and the outcomes examined. Five studies randomised individuals (Coyne 1997; Eaton 1986; Pivi 2011; Simmons 2010a; Suominen 2015), and four used cluster randomisation (Chang 2005; Lin 2010; Salva 2011; Wu 2014). The durations ranged from three weeks to 12 months. The two shortest studies had a duration of three weeks (Coyne 1997; Eaton 1986), two studies lasted a full year (Salva 2011; Suominen 2015), and the remaining lasted from six weeks to six months. We present an overview of the study characteristics in Table 1. Three of the studies took place in Taiwan (Chang 2005; Lin 2010; Wu 2014), three in the US (Coyne 1997; Eaton 1986; Simmons 2010a), and one each in Brazil (Pivi 2011), Finland (Suominen 2015), and Spain (Salva 2011).

Participants

A total of 1502 participants were randomised. The largest study had 946 participants (Salva 2011). The other studies included from 24 to 99 participants. Eight studies only included participants with dementia. One allowed for long-stay nursing home residents without dementia to be enrolled and only 54% of its participants were diagnosed with dementia (Simmons 2010a). The mean age of the participants ranged from 75.8 to 86.9 years. The proportion of female participants in the studies ranged from 50% to100%. Of the nine studies, only three explicitly stated that the participants had to be diagnosed with Alzheimer's disease or probable Alzheimer's disease according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) or National Institute of Neurological and Communicative Disorders and Stroke and the Alzheimer's Disease and Related Disorders Association (NINCDS-ADRDA) Alzheimer's criteria (Pivi 2011; Salva 2011; Suominen 2015). Few studies explicitly mentioned the severity of dementia, but where specified, it was very mild to severe according to the Clinical Dementia Rating (CDR) in two studies (Salva 2011; Suominen 2015), mild to moderate according to the Mini-Mental State Examination (MMSE) in one study (Lin 2010), or mild to severe again according to the CDR in two studies (Salva 2011; Wu 2014). Two studies included participants living at home (Salva 2011; Suominen 2015), while all other studies took place among residents of regular long-term care facilities or units specialising in care of people with dementia, or specialised hospital units. The units of randomisation were the participants in five of the studies (Coyne 1997; Eaton 1986; Pivi 2011; Simmons 2010a; Suominen 2015), two to four dementia special care units in three studies (Chang 2005; Lin 2010; Wu 2014), and 11 outpatient clinics or daycare hospitals in one study (Salva 2011). All studies either explicitly excluded participants receiving parenteral nutrition or being tube-fed, or implicitly excluded them, as the intervention would not have been applicable. We present an overview of the main baseline characteristics in Table 1.

Interventions

The Characteristics of included studies provides a detailed summary of the interventions using the Template for Intervention Description and Replication (TIDieR) statement (Hoffmann 2014). Usual care or optimised usual care was the comparator in most studies, but no study provided a description of usual care, such as described in APA 2007 or Fletcher 2012. The interventions could be divided into four of the categories given above.

- Three studies targeted the feeding skills or behaviours of caregivers, when assisting participants during mealtimes (Chang 2005; Coyne 1997; Eaton 1986). The Chang 2005 study employed general training of nurses to impart knowledge of how to feed participants and improve attitudes, with the comparison group having nurses not receiving this training. The Coyne 1997 study had nurses in the intervention group give specific vocal feedback and positive encouragement to people with dementia, compared to nurses not giving these verbal prompts. The Eaton 1986 study had specific vocal and tactile feedback given to people with dementia by the nurses during mealtimes, compared to nurses only giving the vocal feedback.
- Two studies implemented a training programme to improve self-feeding skills of participants (Lin 2010; Wu 2014). The Lin 2010 study employed specialised training programmes with either spaced retrieval or Montessori-based activities for people with dementia, with the control not receiving any training. The Wu 2014 study employed a training programme combining Montessori-based activities with the technique of errorless learning for people with dementia, with the control only receiving the basic Montessori-based activities training programme.
- Three studies provided an educational programme for participants (Pivi 2011; Salva 2011; Suominen 2015). These studies employed classes for people with dementia, either individually or in groups, held by dieticians and nutritionists, providing general and individualised information about nutrition, or even providing nutrition plans, in each case comparing people with dementia receiving the educational programme to a control group who did not.
- All aforementioned studies examined behavioural modifications. Only one study implemented an environmental modification, accompanied by a smaller behavioural modification, namely a change in routine (Simmons 2010a). This study employed the provision of additional food items between meals and encouragement to consume them by the research staff, with the control receiving neither.

We present a brief overview of the interventions in Table 1.

Outcome measures

The included studies used the following outcome measures relevant to this review. Table 1 summarises their use in the included studies.

Primary Outcomes

Intake of food and liquids

- Calories consumed in kcal per meal, as deduced from the amount of food eaten, with known caloric content, served within the context of care facilities and standardised meals.
- Protein consumed in grams per meal, as deduced either from the amount of food eaten, with known protein content, served within the context of care facilities and standardised meals or a three-day food diary.
- Food intake as a percentage of the served food consumed per meal.

Nutritional status

- The Mini Nutritional Assessment (MNA, Vellas 1999) is a well-validated tool to assess nutritional status. It consists of a screening stage to indicate probable malnutrition, followed by a full assessment. The six items from the screening stage cover changes in weight, body mass index (BMI) and eating behaviour in the last three months, mobility, acute sickness or stress and dementia. The 12 items of the full assessment cover the number of meals, choice of food items, frequency of fruit and vegetable consumption, fluid intake, feeding assistance and self-reported measures of overall health and body composition. If the total of screening and assessment is less than 17 scale points, the participants are classified as malnourished; between 17 and 23.5 they are at risk of malnutrition; and between 24 and 30 they have a good nutritional status.
- BMI measured in kg/m^2.
- Body weight measured in kg.
- Other biometrical measures, such as arm circumference, arm muscle circumference and triceps skinfold measured in cm.

Secondary Outcomes

Mealtime behaviour

- The Edinburgh Feeding Evaluation in Dementia scale (EdFED) was designed to assess the feeding difficulty of older people with dementia (Watson 1994). This instrument consists of 10 items addressing 10 specific mealtime behaviours and how often either assistance is needed or functional and cognitive decline impact eating. A score of zero indicates no problems in self-feeding; the maximum score of 20 indicates the likely need for wholly compensatory assistance.
- The Level of Eating Independence scale (LEI) was developed by the investigator of one study (Coyne 1997), and adapted from the Klein-Bell Activities of Daily Living Scale (Klein 1982). It covers the consumption of solid foods with five items and liquids with four items. The highest combined score of 36 indicates full independence from physical assistance or verbal prompting from another person, the lowest score of 15 indicates full dependency on physical assistance by a caregiver.
- The Eating Behaviour Scale (EBS) was designed to measure functional ability during meals (Tully 1997). A score of zero indicates the most problems in self-feeding and dependence on assistance; the maximum of 30 indicates the greatest independence in eating.

Global and specific cognitive function measures

- The Mini-Mental State Examination (MMSE) evaluates severity and progression of cognitive impairment in the five areas of orientation, immediate recall, attention and calculation, delayed recall, and language (Folstein 1975). The test score ranges from zero to 30 with higher scores representing better cognitive function. The severity of cognitive impairment is usually classified by MMSE score points such as 20 to 26 indicating mild, 10 to 19 indicating moderate, and less than 10 indicating severe impairment (Hulstaert 2009).

Functional outcome measures (e.g. self-feeding behaviour, activities of daily living)

- The Alzheimer's Disease Cooperative Study - Activities of Daily Living (ADCS-ADL) was specifically designed as part of a comprehensive test battery to assess activities of daily living in people with Alzheimer's disease in clinical trials (Galasko 1997). It consists of 23 criteria comprising simple everyday skills and complex activities, which are rated based on an interview with an informant who knows the affected study participant well. The range is from zero to 78, with a higher score indicating a lower interference.
- The Lawton Instrumental Activities of Daily Living (IADL) assesses independent living skills and considers more complex skills covering eight areas, such as the ability to use a telephone, food preparation, housekeeping, laundry or handling of finances, with 31 items in total (Lawton 1969). The lowest score of zero indicates the highest level of dependence on assistance, the maximum score of eight the highest independence.

Overall dementia severity measures

- The Clinical Dementia Rating - Sum of Boxes (CDR-SOB) is a semi-structured interview of people with dementia and informants for the assessment of cognition (memory, orientation, judgement/problem solving) and function (community affairs, home/hobbies, personal care) (O'Bryant 2008). The CDR-SOB total score ranges from zero to 18 with scores around 3 to 15.5 indicating mild to moderate dementia (O'Bryant 2008). A Clinical Dementia Rating - Global score can be derived from the box scores.

Measures of symptoms associated with dementia

- The 10-item Neuropsychiatric Inventory (NPI) evaluates neuropsychiatric disturbance common in dementia and associated with mental health: delusions, hallucinations, dysphoria, anxiety, agitation/aggression, euphoria, disinhibition, irritability/lability, apathy and aberrant motor activity (Cummings 1994). Scores range from zero (normal) to 120 (severely disturbed). The 12-item extension also assesses night-time behavioural disturbances, appetite and eating abnormalities (score range 0 to 144) (Cummings 1997). The information is obtained from a person familiar with the patient's behaviour.

Quality of life

- The 15D questionnaire is an instrument to assess health-related quality of life (HRQoL), covering 15 areas from mobility, vision, hearing, breathing, sleeping, eating, speech, elimination,

usual activities, mental function, discomfort and symptoms, depression, distress, vitality, to sexual activity. The total score ranges from zero to one with one indicating no problems on any dimensions and the lowest score of zero only achievable in death (Sintonen 2001).

Others

- Incidence of falling, measured as the number of falls of a participant within the last year, as reported by the participants or their spouses.

Excluded studies

We excluded 30 studies and presented the reasons for exclusion in the Characteristics of excluded studies table. Twelve studies were not RCTs (Anon 2011; de Sousa 2012; Lin 2011; NCT01780402; Remsburg 2001; Riebandt 2011; Ritchie 2005; Riviere 2001; Syme 1995; Wu 2013; Wu 2015; Young 2004). Five studies did not provide an intervention within the scope of this review (Beck 2010; Liu 2016; Moore 2010; Narme 2015; Simmons 2010b). Eight studies had fewer than 50% of participants diagnosed with dementia and did not provide separate information on these participants, or randomised nursing staff and did not report outcomes for the people with dementia (Aselage 2011; Chang 2006; Endevelt 2011; Nijs 2006; Shipley 2010; Simmons 2008; Solomon 2014; van Ort 1995). Four studies used an ineligible study design (Riviere 2001; Wu 2013; Wu 2015; Young 2004). Three studies were either a study on feasibility of an intervention (Batchelor-Murphy 2015), or did not include any relevant outcome (Chenoweth 2011; Hanson 2011).

Ongoing studies

We identified one ongoing study, which is registered and has a published protocol (Douma 2016). See Characteristics of ongoing studies table.

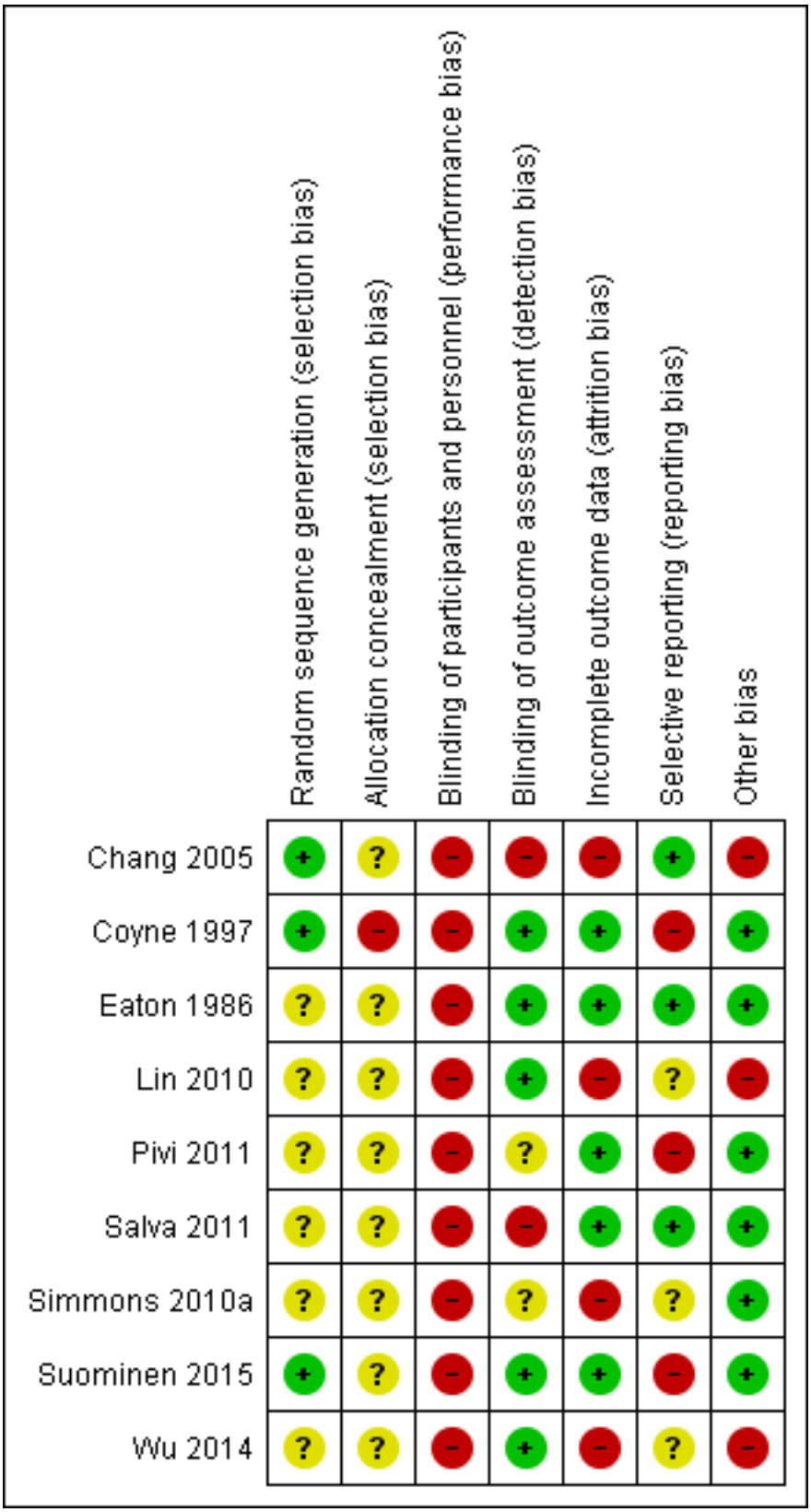
Studies awaiting classification

We identified one study, which we are not yet able to classify. The study has been completed but has not yet published any data (NCT02269956). See Characteristics of studies awaiting classification table.

Risk of bias in included studies

Overall, we judged all of the included trials to be at high risk of bias in at least one domain (see Figure 2). There are some methodological limitations that might have an impact on the results (see Characteristics of included studies).

Figure 2. Risk of bias summary: review authors' judgements about each risk of bias item for each included study.



Allocation

Only three studies reported an adequate method of sequence generation either by computer-generated random numbers or using a coin (Chang 2005; Coyne 1997; Suominen 2015). Six studies mentioned randomisation, but did not provide any detail about how it was implemented (Eaton 1986; Lin 2010; Pivi 2011; Salva 2011; Simmons 2010a; Wu 2014).

One study reported using a coin toss to allocate the two clusters and thus implicitly concealed the allocation sequence, as it was not predictable, but also reported indications for enrolling participants after cluster allocation (Chang 2005). One study reported the use of a random number table without concealment of the allocation sequence (Coyne 1997). No other study reported on allocation concealment.

Blinding

No study reported any blinding of the participants to the intervention. Due to the nature of the interventions, blinding often is not possible or feasible. This may however introduce bias, because either the participants in the intervention group may react to receiving a special treatment over those in the control group, or the personnel administering the intervention or control might attempt to change their performance.

Five studies reported an appropriate blinding of the outcome assessment, usually by having the outcomes assessed by other researchers or specially trained nursing staff blind to the intervention (Coyne 1997; Eaton 1986; Lin 2010; Suominen 2015; Wu 2014). Two studies did not provide enough information on the blinding of outcome assessment (Pivi 2011; Simmons 2010a), and two studies had the outcomes either measured by those providing the intervention (Chang 2005), or employed a cluster design, by which the blinding of the assessors was deemed broken (Salva 2011).

Incomplete outcome data

We judged five studies as having appropriately addressed incomplete outcome data, either by not having any missing data (Coyne 1997; Eaton 1986), showing that no differences turned up between an intention-to-treat analysis and a per-protocol analysis (Salva 2011), or having a small number of dropouts while providing enough information on the causes and distribution to justify the risk of bias being considered low (Pivi 2011; Suominen 2015). We judged four studies to have a high risk of bias. They performed per-protocol analyses while either having a high number of dropouts, without providing detailed information on them, or by having an unclear distribution of dropouts over groups (Chang 2005; Lin 2010; Simmons 2010a; Wu 2014).

Selective reporting

We judged three studies to have low risk of bias for selective reporting, as they fully reported results for the outcomes mentioned in the publications (Chang 2005; Eaton 1986; Salva 2011). We judged three studies to be at high risk (Coyne 1997; Pivi 2011; Suominen 2015). The Coyne 1997 study reported no time points and no effect sizes, only reported measures of certainty from ANOVA-Analyses, and provided no study protocol. The Pivi 2011 study reported the results of analyses of differences in change from baseline scores, which for some outcomes provided results strongly contradicting analyses of differences in endpoint scores, and the Salva 2011 study did not provide measurements, as detailed in the protocol for this study. We judged the risk of bias in this domain to be unclear for the remaining three studies due to insufficient information (Lin 2010; Simmons 2010a; Wu 2014).

Other potential sources of bias

Other sources of bias in the included studies stem from additional methodological shortcomings. We judged the Lin 2010 study to be at high risk of bias due to differences between the intervention and the control group at baseline, which are not addressed appropriately in the analysis. We judged the Chang 2005 study to be at high risk of bias due to recruitment bias, as it was likely that the recruitment of participants happened after the randomisation of facilities in this cluster-randomised study. Furthermore, we judged the Chang 2005, Lin 2010, and Wu 2014 studies to be at high risk of bias as none of these cluster-randomised studies adjusted for clustering in their analyses.

Effects of interventions

See: **Summary of findings for the main comparison** Summary of findings for additional food items between meals compared to usual care for people with dementia; **Summary of findings 2** Summary of findings for education and nutrition promotion programme compared to no intervention for people with dementia; **Summary of findings 3** Summary of findings for spaced retrieval combined with errorless learning training programme for people with dementia compared to spaced retrieval only training programme for people with dementia; **Summary of findings 4** Summary of findings for spaced retrieval training programme for people with dementia compared to no intervention for people with dementia; **Summary of findings 5** Summary of findings for Montessori-based activities training programme for people with dementia compared to no intervention for people with dementia; **Summary of findings 6** Summary of findings for feeding skills training programme for nurses compared with no intervention for people with dementia; **Summary of findings 7** Summary of findings for verbal and physical encouragement by touch compared with only verbal encouragement during meals for people with dementia

Due to the heterogeneity in participants, interventions and outcomes, as well as study durations, the studies are difficult to compare and we pooled data for only one analysis. We report mean differences (MDs) and the corresponding 95% confidence intervals (CIs) for the number of participants (n).

Environmental modifications

The Simmons 2010a study examined environmental modifications, accompanied by smaller behavioural modifications, to improve food and fluid intake in people with dementia.

Changing routine by provision of additional food items

The Simmons 2010a study employed the provision of additional food items between meals and encouragement to consume them by the research staff. The control group received the usual care.

Primary outcomes

Intake of food and liquids

The Simmons 2010a study assessed food intake and examined the calories consumed. After six weeks, people with dementia in

the intervention group, who were served additional food items between meals and encouraged to consume them, consumed slightly fewer calories per meal than those in the control group, who received no additional food items (MD -50.00, 95% CI -286.41 to 186.41; n = 42, 1 study; Analysis 1.1). Also, after six weeks, people with dementia in the intervention group consumed more calories between meals than those in the control group (MD 231 kcal, 95% CI 123.98 to 338.02; n = 42, 1 study; Analysis 1.2). Overall, after six weeks, people with dementia in the intervention group consumed more calories per day than those in the control group (MD 181 kcal, 95% CI -103.08 to 465.08; n = 42, 1 study; Analysis 1.3). We considered the quality of evidence to be very low, downgraded two levels due to serious risk of bias (allocation concealment not specified, lack of blinding of participants and personnel, high numbered and unclear distribution of dropouts) and one level due to imprecision (wide CIs and low number of participants). We therefore cannot be certain whether serving additional food items between meals affects the intake of food and liquids (as measured by calories consumed). See Summary of findings for the main comparison.

Nutritional status

The Simmons 2010a study assessed nutritional status by examination of body weight. After six weeks, people with dementia in the intervention group, who were served additional food items between meals and encouraged to consume them, had a minimally lower body weight of 0.22 kg than those in the control group, who received no additional food items (MD -0.22 kg, 95% CI -1.25 to 0.81; n = 42, 1 study; Analysis 1.4). We downgraded the quality of the evidence to very low, two levels due to serious risk of bias (inadequately short follow-up of less than 16 weeks, allocation concealment not specified, lack of blinding of participants and personnel, and high number and unclear distribution of dropouts) and one level due to imprecision (wide CIs and low number of participants). We are uncertain whether serving additional food items between meals improves nutritional status (as measured by body weight in kg). See Summary of findings for the main comparison.

Behavioural modifications

The Chang 2005, Coyne 1997, Eaton 1986, Lin 2010, Pivi 2011, Salva 2011, Suominen 2015 and Wu 2014 studies examined behavioural modifications to improve food and fluid intake in people with dementia.

Nutritional education and nutrition promotion for people with dementia

The Pivi 2011, Salva 2011 and Suominen 2015 studies provided classes for people with dementia, either individually or in groups. Dieticians and nutritionists offered education programmes and nutrition counselling either individually (i.e. by nutrition plans) or in groups. Dieticians and nutritionists also provided general or individualised information and guidance about nutrition and the prevention of weight loss. In each case the control group received the usual care and no educational training programme or counselling.

Primary outcomes

Intake of food and liquids

The Suominen 2015 study assessed the intake of foods and liquids by examination of the total protein consumed per kg of body weight per day. After 12 months, people with dementia in the intervention group, who received nutritional training and counselling, consumed 0.11 g of protein per kg of body weight more per meal than those in the control group, who received no training or counselling (MD 0.11 g/kg, 95% CI -0.01 to 0.23; n = 78, 1 study; Analysis 2.1). We downgraded the quality of evidence to low, downgraded one level due to risk of bias (allocation concealment was not specified, lack of blinding of participants and personnel, selective outcome reporting), and one level due to imprecision (wide confidence intervals). Nutritional training and counselling programmes may increase the intake of food and liquids slightly (as measured by protein by body weight consumed per day). See Summary of findings 2.

Nutritional status

The Pivi 2011, Salva 2011 and Suominen 2015 studies all assessed nutritional status or body composition.

The Salva 2011 study assessed nutritional status using the Mini Nutritional Assessment (MNA). After 12 months, people with dementia in the intervention group, who received a nutritional education and nutrition promotion programme, had an MNA score 0.10 points lower than those in the control group, who underwent no programme (MD -0.10, 95% CI -0.67 to 0.47; n = 656, 1 study; Analysis 2.2). We downgraded the quality of evidence to low; two levels due to serious risk of bias (allocation concealment not specified, lack of blinding of participants and personnel, and lack of blinding of outcome assessment). The MNA is a 30-point scale. We considered a difference of 0.10 points unlikely to be of clinical importance. Nutritional education and nutrition promotion programmes may lead to little or no difference in nutritional status (as measured by the MNA). See Summary of findings 2.

The Pivi 2011, Salva 2011 and Suominen 2015 studies all assessed nutritional status using the body mass index (BMI). The Pivi 2011 study found that after six months, people with dementia in the intervention group, who received a nutritional education programme, had a lower BMI than those in the control group, who underwent no programme (MD -1.79 kg/m^2, 95% CI -2.30 to -1.28; n = 52, 1 study; Analysis 2.3). We considered the quality of this evidence to be low, downgraded two levels due to risk of bias (allocation concealment was not specified, lack of blinding of participants and personnel, and selective outcome reporting). This six-month intervention may lead to a worse nutritional status (as measured by BMI). In a meta-analysis of the Salva 2011 and Suominen 2015 studies, after 12 months, people with dementia in the intervention group, who received a nutritional education and nutrition promotion programme or nutritional counselling, had a slightly lower BMI than those in the control group, who underwent no programme, but the result was consistent with a small effect in either direction (MD -0.26 kg/m^2, 95% CI -0.70 to 0.19; n = 734, 2 studies; Analysis 2.4). We considered this to be moderate quality evidence; downgraded one level due to risk of bias (allocation concealment not specified, and lack of blinding of participants and personnel). These 12-month education and nutrition promotion programmes probably lead to little or no difference in nutritional status (as measured by BMI). See Summary of findings 2.

The Pivi 2011 and Salva 2011 studies also reported body weight in kg. The Pivi 2011 study found that after six months, people with dementia in the intervention group, who received a nutritional education programme, had a considerably lower body weight than those in the control group, who underwent no programme (MD -8.11 kg, 95% CI -12.56 to -3.66; n = 52, 1 study; Analysis 2.5). We downgraded the quality of evidence to low; two levels due to risk of bias (allocation concealment not specified, lack of blinding of participants and personnel, and selective outcome reporting). This six-month nutritional education programme may lead to a worse nutritional status (as measured by body weight in kg). The Salva 2011 study found that after 12 months, people with dementia in the intervention group, who received a nutritional education and nutrition promotion programme, had a slightly lower body weight than those in the control group, who underwent no programme, although there was uncertainty associated with this result (MD -1.60 kg, 95% CI -3.47 to 0.27; n = 656, 1 study; Analysis 2.6). We downgraded the quality of evidence to moderate; one level due to risk of bias (allocation concealment not specified, lack of blinding of participants and personnel, and selective outcome reporting). This 12-month nutritional education and nutrition promotion programme probably leads to little or no difference in nutritional status (as measured by body weight). See Summary of findings 2.

The Pivi 2011 study also used the biometric measures arm circumference, arm muscle circumference and triceps skinfold in cm to assess nutritional status. After six months, people with dementia in the intervention group, who received a nutritional education programme, had a slightly smaller arm muscle circumference than those in the control group, who underwent no programme (MD -1.30 cm, CI -1.78 to -0.82; n = 52, 1 study; Analysis 2.7), a slightly greater arm circumference than those in the control group (MD 0.24 cm, 95% CI 0.12 to 0.36; n = 52, 1 study; Analysis 2.8), and a slightly smaller triceps skinfold (MD -0.46 cm, 95% CI -2.67 to 1.75; n = 52, 1 study Analysis 2.9).

Secondary outcomes

Mealtime behaviour

The Salva 2011 study assessed mealtime behaviour using the Eating Behaviour Scale (EBS). After 12 months, people with dementia in the intervention group, who received a nutritional education and nutrition promotion programme, showed a higher dependency on eating assistance than those in the control group, which underwent no programme (MD -1.50, 95% CI -2.11 to -0.89; n = 656, 1 study; Analysis 2.10). We downgraded the quality of evidence to moderate; one level due to risk of bias (allocation concealment not specified, lack of blinding of participants and personnel, and selective outcome reporting). This 12-month nutritional education and nutrition promotion programmes probably leads to worse mealtime behaviour (as measured by the EBS). See Summary of findings 2.

Global and specific cognitive function measures

Salva 2011 assessed cognition using the Mini-Mental State Examination (MMSE). After 12 months, people with dementia in the intervention group, who received a nutritional education and nutrition promotion programme, showed more cognitive impairment than those in the control group (MD -1.50, 95% CI -2.52 to -0.48, n = 656, 1 study; Analysis 2.11).

Functional outcome measures

The Salva 2011 study assessed functional outcomes via activities of daily living (ADL) and instrumental activities of daily living (IADL). After 12 months, people with dementia in the intervention group, who received a nutritional education and nutrition promotion programme, showed slightly higher dependence on help in their ADL (MD -0.65, 95% CI -0.93 to -0.37; 1 study, n = 656) and in their IADL (MD -0.45, 95% CI -0.80 to -0.10; 1 study, n = 656) than those in the control group (Analysis 2.12; Analysis 2.13).

Overall dementia severity measures

The Salva 2011 study assessed the Clinical Dementia Rating - Sum of Boxes (CDR-SOB). After 12 months, people with dementia in the intervention group, who received a nutritional education and nutrition promotion programme, showed slightly more severe symptoms of dementia, compared to the control group, which underwent no programme (MD 0.13, 95% CI 0.02 to 0.24, 1 study, n = 656; Analysis 2.14).

Measures of symptoms associated with dementia

The Salva 2011 study assessed the 10-item Neuropsychiatric Inventory (NPI). After 12 months, people with dementia in the intervention group, who received a nutritional education and nutrition promotion programme, showed a slight increase in symptoms associated with dementia than those in the control group receiving no training or counselling (MD 0.70, 95% CI -0.12 to 1.52; 1 study, n = 656; Analysis 2.15).

Health-related quality of life

The Suominen 2015 study assessed health-related quality of life (HRQoL). After 12 months, people with dementia in the intervention group, who received nutritional training and counselling, reported almost no difference in HRQoL, compared to the control group (MD 0.02, 95% CI -0.02 to 0.06; 1 study, n = 78; Analysis 2.16).

Others

The Suominen 2015 study assessed the rate of falls. After 12 months, people with dementia in the intervention group, who received nutritional training and counselling, experienced fewer falls within the last year than those in the control group, but the difference was very small (MD -0.84 falls per person per year, 95% CI -1.31 to -0.37; 1 study, n = 78; Analysis 2.17).

Self-feeding skills promotion by spaced retrieval, Montessori-based activities or errorless learning

The Lin 2010 and Wu 2014 studies used specialised training programmes incorporating spaced retrieval, Montessori-based activities and errorless learning. The Lin 2010 study used specialised training programmes with either spaced retrieval or Montessori-based activities for people with dementia, with the control receiving usual care and no training of any kind. The Wu 2014 study used a training programme combining Montessori-based activities with the technique of errorless learning for people with dementia, with the control only receiving the basic Montessori-based activities training programme. Neither the Lin 2010 nor Wu 2014 studies accounted for clustering in their analyses. Where available, we used intraclass correlation coefficients (ICCs) from other sources in order to calculate a 'design effect' for these studies to reduce the effective sample size. We could not identify reliable ICCs for measures of food and fluid intake or mealtime

behaviour and therefore report uncorrected measures. For these outcomes, the CIs are likely to be too narrow.

Primary outcomes

Intake of food and liquid

The Lin 2010 and Wu 2014 studies assessed intake of food and liquids.

The Wu 2014 study assessed the intake of food and liquids by the amount of food eaten as a percentage. After eight weeks, people with dementia in the intervention group, who received self-feeding skills training by spaced retrieval and errorless learning, consumed 5.60% less of their meals than those in the control group, who received self-feeding skills training by spaced retrieval only (MD -5.60%, 95% CI -11.70 to 0.50; n = 60, 1 study, effective sample size not corrected to account for clustering; Analysis 3.1). We downgraded the quality of evidence to very low; one level due to serious risk of bias (allocation concealment was not specified, lack of blinding of participants and personnel, and handling of incomplete data, as well as elimination of outliers), one level due to indirectness (due to comparator intervention), and one level due to imprecision (wide CIs). We are uncertain whether self-feeding skills promotion by spaced retrieval and errorless learning, compared to a programme using spaced retrieval only, increases the intake of food and liquids (as measured by the amount of served food eaten). See Summary of findings 3.

The Lin 2010 study also assessed the intake of food and liquids by the amount of food eaten as a percentage. After eight weeks, people with dementia in the intervention group which received self-feeding skills training by spaced retrieval, consumed 2.67% more of their meals than those in the control group, who received no training (MD 2.67%, 95% CI -5.22 to 10.56; n = 54, 1 study, effective sample size not corrected to account for clustering'; Analysis 4.1). Also, after eight weeks, people with dementia in the intervention group which received self-feeding skills training by Montessori-based activities, consumed 9.69% less of their meals than those in the control group, who received no training (MD -9.69%, 95% CI -17.86 to -1.52; n = 51, 1 study, effective sample size not corrected to account for clustering; Analysis 5.1). We downgraded the quality of the evidence to very low for both interventions; two levels due to risk of bias (allocation concealment was not specified, lack of blinding of participants and personnel, unclear distribution of dropouts, and differences at baseline) and one level due to imprecision (wide CIs). Self-feeding skills promotion by spaced retrieval may lead to little or no difference in the intake of food and liquids, but Montessori-based activities may lead to a lower intake of food and liquids (as measured by the amount of served food eaten). See Summary of findings 4 and Summary of findings 5.

We could not identify reliable ICCs for measures of food and fluid intake to correct the standard errors and therefore the CIs for these effect estimates may be too narrow.

Nutritional status

The Lin 2010 study assessed nutritional status using the Mini Nutritional Assessment (MNA). After eight weeks, people with dementia in the intervention group which received self-feeding skills training by spaced retrieval, had an MNA score 3.68 points higher than those in the control group, who received no training (MD 3.68, 95% CI 1.88 to 5.48; n = 54, 1 study, effective sample size corrected to account for clustering; Analysis 4.2). Also, after eight weeks, people with dementia in the intervention group which received self-feeding skills training by Montessori-based activities, had an MNA 2.31 points lower than those in the control group, who received no training (MD -2.31, -4.62 to -0.00; n = 54, 1 study, effective sample size corrected to account for clustering; Analysis 5.2). We downgraded the quality of evidence to very low for both interventions; two levels due to serious risk of bias (inadequately short follow-up of less than 16 weeks, allocation concealment not specified, lack of blinding of participants and personnel, unclear distribution of dropouts, and differences at baseline) and one level due to imprecision (wide CIs and low number of participants). We are uncertain whether self-feeding skills promotion by spaced retrieval or Montessori-based activities improve nutritional status (as measured by the MNA). See Summary of findings 4 and Summary of findings 5.

The Lin 2010 study assessed body mass index (BMI). After eight weeks, people with dementia in the intervention group which received self-feeding skills training by spaced retrieval, had a higher BMI than those in the control group, which received no training (MD 1.73 kg/m^2, 95% CI -0.63 to 4.09; 1 study, n = 33, effective sample size corrected to account for clustering; Analysis 4.3). Also, after eight weeks, people with dementia in the intervention group which received self-feeding skills training by Montessori-based activities, had a lower BMI than those in the control group, who received no training (MD -1.94 kg/m^2, 95% CI -3.95 to 0.07, 1 study, n = 31, effective sample size corrected to account for clustering; Analysis 5.3). We downgraded the quality of evidence to very low; two levels due to serious risk of bias (inadequately short follow-up of less than 16 weeks, allocation concealment was not specified, lack of blinding of participants and personnel, unclear distribution of dropouts, and differences at baseline) and one level due to imprecision (wide CIs and low number of participants). We are uncertain whether self-feeding skills promotion by spaced retrieval or Montessori-based activities improve nutritional status (as measured by BMI). See Summary of findings 4 and Summary of findings 5.

The Lin 2010 study assessed body weight in kg. After eight weeks, people with dementia in the intervention group which received self-feeding skills training by spaced retrieval, had a higher body weight than those in the control group, which received no training (MD 3.35 kg, 95% CI -2.72 to 9.42; n = 33, 1 study, effective sample size corrected to account for clustering; Analysis 4.4). Also, after eight weeks, people with dementia in the intervention group which received self-feeding skills training by Montessori-based activities, had a lower body weight than those in the control group, who received no training (MD -3.93 kg, 95% CI -9.62, 1.76; n = 31, 1 study, effective sample size corrected to account for clustering; Analysis 5.4). We downgraded the quality of evidence to very low; two levels due to serious risk of bias (inadequately short follow-up of less than 16 weeks, allocation concealment was not specified, lack of blinding of participants and personnel, unclear distribution of dropouts, and differences at baseline) and one level due to imprecision (wide CIs, low number of participants). We are uncertain whether self-feeding skills promotion by spaced retrieval or Montessori-based activities improves nutritional status (as measured by body weight). See Summary of findings 4 and Summary of findings 5.

For measures of nutritional status we used an ICC of 0.025, which we averaged from information on ICCs for body weight and BMI in

institutionalised settings (Elley 2007; Parker 2005), to correct for the clustering effect.

Secondary outcomes

Mealtime behaviour

The Lin 2010 study assessed mealtime behaviour using the Edinburgh Feeding Evaluation in Dementia scale (EdFED). After eight weeks, people with dementia in the intervention group which received self-feeding skills training by spaced retrieval, showed better self-feeding ability than those in the control group, who received no training (MD -1.67, 95% CI -2.34 to -1.00; n = 54, 1 study, effective sample size not corrected to account for clustering; Analysis 4.5). Also, after eight weeks, people with dementia in the intervention group which received self-feeding skills training by Montessori-based activities, showed poorer self-feeding ability than those in the control group, who received no training (MD -1.50, 95% CI -2.16 to -0.84, n = 54, 1 study, effective sample size not corrected to account for clustering; Analysis 5.5). We downgraded the quality of evidence to very low; two levels due to serious risk of bias (allocation concealment was not specified, lack of blinding of participants and personnel, unclear distribution of dropouts, and differences at baseline) and one level due to imprecision (wide CIs). We are uncertain whether self-feeding skills training by spaced retrieval or by Montessori-based activities improve self-feeding ability (as measured by the EdFED). See Summary of findings 4 and Summary of findings 5.

We could not identify reliable ICCs for measures of mealtime behaviour to correct the standard errors and therefore the CIS for these effect estimates may be too narrow.

Global and specific cognitive function measures

The Wu 2014 study assessed global cognitive function using the Mini-Mental State Examination (MMSE). After eight weeks, people with dementia in the intervention group, who received self-feeding skills training by spaced retrieval and errorless learning, showed less cognitive impairment than those in the control group, who received only self-feeding skills training by spaced retrieval (MD 2.50, 95% CI -0.46 to 5.46; n = 60, 1 study, effective sample size corrected to account for clustering; Analysis 3.2).

For the MMSE we used an ICC of 0.01, as suggested by Smeeth 2002, to correct for the clustering effect.

Feeding skills training programme for nurses

The Chang 2005 study trained nurses in order to impart knowledge of how to feed people with dementia and to improve attitudes towards people with dementia. The nurses in the comparison group did not receive this training. The Chang 2005 study also did not account for clustering. We could not identify reliable ICCs for these measures. The CIs for the effect estimates reported here are therefore likely to be too narrow.

Primary outcomes

Intake of food and liquids

The Chang 2005 study assessed the amount of food eaten as a percentage of the food served. After three months, they found that people with dementia in the intervention group, whose nurses received a feeding skills training programme, consumed 9% less food than those in the control group, whose nurses received no training (MD -9%, 95% CI -27.86 to 9.86; n = 20, 1 study, effective sample size not corrected to account for clustering; Analysis 6.1). We downgraded the quality of evidence to very low; two levels due to risk of bias (lack of allocation concealment, lack of blinding of participants and personnel to the intervention, lack of blinding of outcome assessment, and high number of unaddressed dropouts), and one level due to imprecision (wide CIs and low number of participants). We are uncertain whether a feeding skills training programme for nurses increases the intake of food and liquids (as measured by the amount of served food eaten). See Summary of findings 6.

Nutritional status

No study employing a feeding skills training programme for nurses assessed nutritional status.

Secondary outcomes

Mealtime behaviour

The Chang 2005 study assessed mealtime behaviour using the Edinburgh Feeding Evaluation in Dementia scale (EdFED). After three months, they found people with dementia in the intervention group, whose nurses received a feeding skills training programme, had worse self-feeding abilities than those in the control group, whose nurses received no training (MD 2.30, 95% CI 0.26 to 4.34; n = 20, 1 study, effective sample size not corrected to account for clustering; Analysis 6.2). We downgraded the quality of evidence to very low; two levels due to serious risk of bias (lack of allocation concealment, lack of blinding of participants and personnel to the intervention, lack of blinding of outcome assessment, high number of unaddressed dropouts) and one level due to imprecision (wide CIs and low number of participants). We are uncertain whether a feeding skills training programme for nurses has any effect on mealtime behaviour (as measured by the EdFED). See Summary of findings 6.

Other interventions aimed at improving feeding skills or behaviour of nurses

The Coyne 1997 and Eaton 1986 studies tested procedures for vocal or tactile positive feedback to be given by the nurses while feeding people with dementia. The Coyne 1997 study had nurses in the intervention group give specific vocal feedback and positive encouragement to people with dementia, compared to nurses not giving these verbal prompts. The Eaton 1986 study had specific vocal and tactile feedback given to people with dementia by the nurses during mealtimes, compared to nurses only giving the vocal feedback.

Primary outcomes

Intake of food and liquids

The Eaton 1986 study assessed the calories consumed. After three weeks, people with dementia in the intervention group, who were given verbal and physical encouragement by caregivers, consumed on average 200 kcal more per meal, than those in the intervention group, where caregivers only gave verbal encouragement (95% CI 119.81 to 280.19; n = 42, 1 study; Analysis 7.1). We downgraded the quality of evidence to low; one level due to risk of bias (allocation concealment was not specified, and lack of blinding of participants and personnel), and one level due to imprecision (low number of participants). Verbal and physical encouragement probably

increases the intake of food and liquids slightly (as measured by the calories consumed per meal). See Summary of findings 7.

The Eaton 1986 study assessed the amount of protein consumed per meal. After three weeks, people with dementia in the intervention group, who were given verbal and physical encouragement by caregivers, consumed on average 15g of protein more per meal than those in the control group, where caregivers only gave verbal encouragement (MD 15g, 95% CI 7.74 to 22.26; n = 42, 1 study; Analysis 7.2). We downgraded the quality of evidence to low; one level due to risk of bias (allocation concealment was not specified, and lack of blinding of participants and personnel), and one level due to imprecision (low number of participants). Verbal and physical encouragement may increase the intake of food and liquids slightly (as measured by the protein consumed per meal). See Summary of findings 7.

Nutritional status

No study employing vocal or tactile positive feedback assessed nutritional status.

Secondary outcomes

Mealtime behaviour

The Coyne 1997 study assessed mealtime behaviour using the Level of Eating Independence scale (LEI) and used an analysis of variance to test the interaction of group allocation and time. After 20 days, people with dementia in the intervention group, who were given verbal prompts and positive reinforcement by caregivers, were reported to be more independent when eating solid foods than those in the control group, whose caregivers did not give these verbal prompts or positive reinforcements (MD 3.5, P = 0.044, n = 24, 1 study; Analysis 8.1). After 20 days, there was no significant difference between the groups when drinking liquids (MD 2.4, P > 0.05, n = 24, 1 study, no exact P value reported; Analysis 8.2).

Effects on subgroups

The data were not sufficient to perform our predefined subgroup analyses by dementia stage and nutritional status.

Sensitivity analysis

Only a single meta-analysis was possible. We pooled data on BMI from Salva 2011 and Suominen 2015. The result was not affected when we used a random-effects rather than a fixed-effect model.

DISCUSSION

Summary of main results

This review includes nine studies, involving 1502 participants, most of them with Alzheimer's disease. The interventions and outcome measures are diverse and the overall quality of the evidence is mostly low to very low, and in exceptional cases moderate. This is due to problems with study methods, leading to risk of bias, and the small sample size of studies, leading to imprecise effect estimates. We therefore, have limited or little confidence in most of the results.

Of the studies aiming at improving the feeding skills or behaviours of caregivers (Chang 2005; Coyne 1997; Eaton 1986), only the Eaton 1986 study found evidence of a beneficial effect on our primary outcomes. Positive reinforcement by verbal and physical prompts given by the caregivers during meals might slightly increase calorie and protein intake. The intervention in the Chang 2005 study aimed to improve overall feeding skills of caregivers, but the quality of the evidence for all outcomes was very low, and we could not draw conclusions about the effect of the intervention.

The two similar studies implementing training programmes to improve self-feeding skills of participants (Lin 2010; Wu 2014), showed mixed findings. The spaced retrieval training programme showed some beneficial effect on nutritional status, but training with Montessori-based activities seemed mostly disadvantageous and was associated with worse food intake and nutritional status, although both interventions showed beneficial effects for self-feeding abilities. Due to low- and very low-quality evidence, we were very uncertain about these results.

The three studies employing educational programmes (Pivi 2011; Salva 2011; Suominen 2015), showed mixed findings. The Pivi 2011 study reported a decrease in nutritional status in the intervention group. The Suominen 2015 study reported a small benefit in food intake in the intervention group. The Salva 2011 study on the other hand, only found negative effects for mealtime behaviour, cognition, function, and dementia severity for those receiving the intervention. Due to low- and moderate-quality evidence, we were uncertain about these results.

One study employed an environmental as well as a smaller behavioural modification by changing the routine, providing additional food items between meals and encouragement to consume these (Simmons 2010a), but the quality of the evidence for all outcomes was very low and we could not draw conclusions about the effect of the intervention.

Overall completeness and applicability of evidence

All trials covered some of the important outcomes used to evaluate the efficacy of the interventions in people with dementia, but no outcome was covered by all relevant studies. The studies include people with Alzheimer's disease or unspecified types of dementia. We found no trial specifically investigating types of dementia other than Alzheimer's disease. Most trials were conducted in long-term care facilities; only two studies recruited people with dementia who lived at home throughout the study (Salva 2011; Suominen 2015).

This review covers a wide range of possible interventions. The included studies investigate a variety of interventions, but by no means all feasible behavioural and environmental modifications which might affect the food and fluid intake of people with dementia. Randomised controlled trials (RCTs) investigating environmental modifications are largely absent.

Quality of the evidence

We analysed all the data from either RCTs or cluster-RCTs. By using the GRADE approach, we rated the quality of evidence for most outcomes as very low or low, and only in a few cases as moderate. In the definition of the GRADE Working Group, this means, that 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 (Balshem 2011). The main factors affecting our GRADE ratings were high risks of bias of the included studies (beyond the general lack of blinding of the intervention) and imprecision (wide confidence intervals (CIs) and small sample sizes). Three studies did not adjust for clustering and the precision of some of the effect estimates might be overestimated, because the CIs

might be too narrow. We adjusted some of the effects with data on probable intraclass correlation coefficients (ICCs) taken from external sources.

Synthesising findings from the studies was not feasible, because of variation in the populations, interventions and outcomes studied. The most comparable studies were the Lin 2010 and Wu 2014 studies, which investigated the effects of similar training programmes to improve self-feeding abilities, and the studies from Salva 2011 and Suominen 2015, which investigated the effects of year-long nutritional education programmes. However, even within these studies, there are no consistent findings to report. Most of the evidence provided here is only based on single studies.

Potential biases in the review process

This review addresses clear research questions and uses predefined inclusion criteria to select eligible studies. We used strict criteria and only included RCTs, although during the review process it became clear, that the vast majority of studies on this topic do not employ this study design. We conducted extensive searches, but the possibility of publication bias remains. The majority of studies we found were small and the evidence was of low quality. Furthermore, most comparisons could only be supported by a single study. This itself is not necessarily a source of bias, but of imprecision and the possible false estimation of effects due to outliers.

Agreements and disagreements with other studies or reviews

This review is in line with several other systematic and non-systematic reviews also covering the effect of environmental and behavioural modifications for improving food and fluid intake (Abbott 2013; Liu 2014; Watson 2006; Whear 2014), which report few and sometimes inconsistent findings and limitations in study quality.

AUTHORS' CONCLUSIONS

Implications for practice

Due to the quantity and quality of the evidence currently available, we cannot identify any specific environmental or behavioural modifications for improving food and fluid intake in people with dementia.

Implications for research

We believe further studies of the behavioural and environmental strategies included in this review, and others, are warranted. However, future studies might want to address and avoid sources of bias and other limitations prevalent in many of the currently available studies.

Study design should consider the duration necessary to reliably detect changes in the primary outcomes. To establish stable changes in food and fluid intake, studies should have a follow-up of at least four days (Kirkpatrick 2014). To establish stable changes in nutritional status, studies should have a follow-up of at least 16 weeks (Kondrup 2003).

Participants' characteristics should be clearly described, including the type of dementia and stage of dementia, and the diagnostic criteria used. More studies with participants in nursing homes might be especially warranted, as people in later stages of dementia, and therefore in greater need of support in self-feeding, are more likely to have been admitted into long-term care facilities.

Interventions in many studies can be expected to be complex (Craig 2008), and if so, should be described more comprehensively, e.g. by using guidelines such as the Template for Intervention Description and Replication (TIDieR) checklist (Hoffmann 2014). Control interventions should be described more comprehensively as well. Furthermore, more emphasis should be placed on describing and evaluating the usual care provided, as well as the environment and context where that care is provided.

Outcomes should include measures of both food and fluid intake and nutritional status.

Possible sources of bias should be addressed more thoroughly. Random sequence and allocation concealment can be improved upon with little effort. Blinding of participants and personnel to the intervention is, in many cases not achievable, due to the nature of the interventions. Blinding of outcome assessment, dealing with incomplete data and clustered data might be improved upon as well, as these were common sources of possible bias in the available studies.

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* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

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

Chang 2005

Methods	• **Design:** cluster-RCT, single-blinded • **Duration:** three months, from February 2004 to May 2004.

Participants	• **Country:** Taiwan
	• **Setting:** two long-term care facilities, specialised in dementia
	• **Diagnosis:** dementia (diagnostic criteria not specified)
	• **Inclusion criteria:** for nursing assistants: having worked at least six months in the same long-term care facilities, caring for people with dementia and able to communicate in Mandarin, Taiwanese or English, for participants: diagnosed with dementia, type or diagnosis criteria not specified
	• **Exclusion criteria:** not reported
	• **Unit of randomisation:** two long-term care facilities specialised in dementia
	• **Number of participants:** total: 67 nursing assistants and 67 participants; intervention: 31, control: 36
	• **Dropouts:** total: 47 (70.1%); intervention: 23 (74.2%); control: 24 (66.7%)
	• N**umber analysed:** per-protocol analysis, 20 matched nursing assistants and participants; intervention: 8; control: 12
	• **Baseline characteristics of participants**
	  * **Sex:** not reported
	  * **Age (SD):** intervention: 84.2 (4.0); control: 72.0 (5.8)
	  * **Stage of dementia:** not reported

Interventions	• **Intervention:** feeding skills training programme for nursing assistants
	  * **Why:** training programme to impart new knowledge of how to feed people with dementia safely and with dignity to nursing assistants to change their attitudes and behaviours during feeding. Changing the nursing assistants' feeding behaviour is associated with changing the outcome of people with dementia, including total eating time, food intake, and extent of feeding difficulty.
	  * **What:** material: a protocol for feeding people with dementia regarding how to manage feeding problems of people with dementia, including preparation of mealtime environment, interactions between caregivers and people with dementia, and how to deal with food refusal. Procedures: classes were taught during working hours and over two days by the principal investigator. Chinese and English versions of the training programme were provided. Both versions quote: "were reviewed by a gerontological expert to determine the appropriate content and meaning and equivalence between the two versions" (P. 2 (1187) "Immediately following the in-service, hands-on training was provided to enhance the effectiveness of the programme. The hands-on training used one-to-one teaching and provided nursing assistants opportunities to practice or give feedback. The principal investigator followed each nursing assistant during one entire meal lasting approximately one hour." P. 2 (1187)
	  * **Who:** the principal investigator provided the in-service training and hands-on training afterwards
	  * **How:** the training was provided in person by the principal investigator. It is unclear whether the in-service classes were one-to-one or in groups. The hands-on training was provided individually.

Chang 2005 *(Continued)*

	Quote: "The nursing assistants had opportunities to feed several dementia patients at one mealtime and deal with different feeding problems of dementia patients." P. 2 (1187) * **Where:** the place of the in-service classes is unclear, the hands-on training was provided within the care facilities * **When:** the time of the in-service classes is unclear, the hands-on training was provided during mealtimes * **How much:** the in-service classes lasted for three hours over two days, the hands-on training lasted for one hour during mealtimes * **Tailoring:** not reported * **Modifications:** not reported • **Control:** usual care, the nursing assistants in the control group received no intervention and did not partake in any training programmes
Outcomes	• Feeding difficulty: equivalence tested Chinese version (Lin 2003) of the EdFED (Watson 1994) • Food intake: percentage of food that has been eaten during mealtime, measured in 25%, 50%, 75% or 100%
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	The two clusters were randomised using an appropriate measure: a coin toss Quote: "Two convenience-chosen, dementia-specialized, long-term care facilities in North Taiwan were randomly assigned into either a control or a treatment group by flipping a coin." P. 3 (1187)
Allocation concealment (selection bias)	Unclear risk	Not mentioned
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding Quote: "Nursing assistants who were in the treatment group received a feeding skills training programme including three hours of in-service classes and one hour of hands-on training. Those in the control group did not receive any training programmes." P. 3 (1187)
Blinding of outcome assessment (detection bias) All outcomes	High risk	No concealment of allocation or blinding of any kind mentioned Quote: "Nursing assistants who were in the treatment group received a feeding skills training programme including three hours of in-service classes and one hour of hands-on training. Those in the control group did not receive any training programmes." P. 3 (1187)
Incomplete outcome data (attrition bias) All outcomes	High risk	High number of dropouts and no means of addressing missing data
Selective reporting (reporting bias)	Low risk	Results provided as outlined
Other bias	High risk	Recruitment bias: it seems that nurses were allocated to control or treatment centre after randomisation. Details of participant and nurse selection is not described. They observed a selected sample of nurses and participants, which was not further described, rather than the whole randomised sample. There are also unclear exclusion criteria mentioned in discussion.

Chang 2005 *(Continued)*

	Quote: “Due to shift, 36 nursing assistants and the same number of dementia patients were observed during mealtimes.” P. 3 (1187) Quote: “Thus, there were complete data on 67 nursing assistants, who were divided into two groups: 31 in the treatment group and 36 in the control group." P. 3 (1187) Quote: “Additionally, there were numbers of foreign-born nursing assistants enrolled in the control group. Even though they did not receive the feeding training programme in this study, […]" P. 5 (1189) Incorrect analysis: no correction for clustering in the statistical analyses

Coyne 1997

Methods	• **Design:** RCT, single-blinded • **Duration:** 20 days

Participants	• **Country:** USA
	• **Setting:** 60-bed dementia unit of a 230-bed skilled nursing facility
	• **Diagnosis:** dementia (diagnostic criteria not specified)
	• **Inclusion criteria:** diagnosis of dementia (chronic organic brain syndrome, Alzheimer's disease, multi-infarct-dementia), consume three meals in the communal dining room and eat at least half of their meals without staff assistance, eligible participants had five to ten errors on the Short Portable Mental Status Questionnaire, with five to seven errors indicating moderate intellectual impairment and 8-10 errors indicative of severe intellectual impairment, the subjects demonstrated the ability to follow verbal eating instructions
	• **Exclusion criteria:** receiving nutrition by invasive methods, that is, nasogastric, intravenous or gastrostomy feedings or if they had ill-fitting dentures that might hinder eating performance
	• **Unit of randomisation:** 24 participants
	• **Number of participants:** total: 24; intervention: 12; control: 12
	• **Dropouts:** total: 0 (0%)
	• **Number analysed:** total: 24; intervention: 12; control: 12
	• **Baseline characteristics:**
	  * **Sex:** intervention: 100% female; control: 100% female
	  * **Mean age (range):** intervention: 83.4 (68-96) years, control: 84.9 (68-96) years
	  * **Length of stay in dementia unit in months (range):** intervention: 22.2 (6-68); control: 40.3 (15-72)
	  * **Short Portable Mental Status Questionnaire:** intervention: 9.4; control: 9.7
	  * **Stage of dementia:** not reported

Interventions	• **Intervention:** directed verbal prompts and positive reinforcements
	  * **Why:** quote: "Staff attitudes towards patients with dementia and their disabilities play a critical role in managing activities of daily living (ADL). [...] Although there is no cure for dementia, this diagnosis should not preclude the possibility that some lost ADL skills may be reacquired or that existing ADL skills may be improved. [...] Several researchers suggest that interventions with patients with dementia should begin using the least-restrictive approach of verbal prompts and then proceed, as necessary, to using partial physical assistance." P. 2 (276)
	  * **What:** materials: standardised sets of verbal prompts and reinforcements. Procedures: Direct verbal prompts to initiate or during eating tasks and positive reinforcement, when an eating task was completed. A set of standardised phrases was used as verbal prompts, e.g. "Pick up the [name of utensil]" or "Pour the [fluid] in your mouth". Positive reinforcements were standardised phrases as well, e.g. "Correct", "That's right" and "Good". The first prompt was given one minute after food trays were prepared for the participants and at 1-minute intervals thereafter, with up to six prompts and according reinforcements.
	  * **Who:** prompts and reinforcements were given by an investigator or research assistant

Coyne 1997 *(Continued)*

	* **How:** the intervention was given personally to small groups of six participants each, situated at a common dining table * **Where:** a dining room of the nursing facility, separated from the control group * **When:** three daily meals * **How much:** the intervention was administered at days three, four and five of the study * **Tailoring:** not reported * **Modifications:** not reported • **Control:** usual care
Outcomes	• Feeding difficulty: LEI scale, subscale solid foods • Feeding difficulty: LEI scale, subscale liquids
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: “Subjects were randomly assigned […] using a table of random numbers” P. 5 (279)
Allocation concealment (selection bias)	High risk	The allocation sequence is not implemented properly to avoid foreknowledge of the allocation. Because of the small number of participants, divided in six groups and the open randomisation method using a table of random numbers, it is not impossible that personnel or participants might have foreseen assigned groups. Quote: “subjects were randomly assigned […] using a table of random numbers” P. 5 (279)
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Quote: “Observers were not informed of subjects' assignment to groups or of Intervention strategies, rotated between groups, and did not work in the same pairs." P. 5 (279)
Incomplete outcome data (attrition bias) All outcomes	Low risk	No dropouts
Selective reporting (reporting bias)	High risk	No time points reported, no effect size reported, only measures of certainty from ANOVA-analyses reported, and no study protocol provided
Other bias	Low risk	No indication for other bias

Eaton 1986

Methods	• **Design:** RCT, single-blinded • **Duration:** three weeks
Participants	• **Country:** USA • **Setting:** a skilled care facility

Eaton 1986 *(Continued)*

- **Diagnosis:** dementia or chronic organic brain syndrome (diagnostic criteria not specified)
- **Inclusion criteria:** being able to feed themselves
- **Unit of randomisation:** 42 participants
- **Number of participants:** total: 42; intervention: 21; control: 21
- **Dropouts:** total: 0 (0%)
- **Number analysed:** total: 42; intervention: 21; control: 21
- **Baseline characteristics**
  - **Sex:** intervention: 95.2% female; control: 95.2% female
  - **Age (SD):** intervention: 84.9 (6.4); control: 85.4 (6.2)
  - **Length of institutionalisation in months (SD):** intervention: 35.9 (22.9); control: 38.9 (18.0)
  - **Stage of dementia:** not reported

Interventions

- **Intervention:** verbal encouragement and physical encouragement through touch
  - **Why:** quote: "Touch can be a particularly important means of interacting with others for individuals who are confused or suffer sensory inadequacies. Tactile receptivity may be retained while other senses deteriorate. Lynch et al. (1974) reported dramatic cardiovascular effects of touch on curarized patients who were paralyzed and maintained on life support systems. Preston (1973) found that organically brain-damaged patients' responses to nonverbal communication were automatic and proposed touching as a new approach for treating chronic organic brain syndrome patients. She hypothesized that touch may reach COBS patients who are often disoriented and help them focus on the task to be done." P. 2 (612)
  - **What:** procedures: during mealtimes, all patients (including non-participants) were verbally encouraged to eat for the full duration of the study. The experimental intervention consisted of the addition of touch. During treatment, the participants were touched lightly on the forearm while being verbally encouraged to eat. Each participant was touched briefly five times during a meal, for a total of approximately one minute of physical encouragement within a one hour period.
  - **Who:** a single investigator provided the physical encouragement by touch. Regular nursing staff provided the verbal encouragement
  - **How:** face-to-face during mealtimes
  - **Where:** a communal dining room containing eight to ten tables in groups of four to eight people per table, where participants of both groups and non-participants intermingled
  - **When:** during mealtimes
  - **How much:** mealtimes on days three, four and five of the study period
  - **Tailoring:** not reported
  - **Modifications:** not reported
- **Control:** verbal encouragement only
  - **Why:** see above
  - **What:** procedures - during mealtimes, all patients (including non-participants) were verbally encouraged to eat for the full duration of the study
  - **Who:** regular nursing staff provided the verbal encouragement
  - **How:** face-to-face during mealtimes
  - **Where:** a communal dining room containing 8 to 10 tables in groups of 4 to 8 people per table, where participants of both groups and non-participants intermingled
  - **When:** during mealtimes
  - **How much:** during the full study period
  - **Tailoring:** not reported
  - **Modifications:** not reported

Outcomes

- Food intake: calories consumed in each meal
- Food intake: protein consumed in each meal

Notes

Risk of bias

Eaton 1986 *(Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not described sufficiently Quote: “Each patient was randomly assigned to either the experimental (n = 21) or the control (n = 21) group.” P. 2 (612)
Allocation concealment (selection bias)	Unclear risk	Not mentioned
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding Quote: “Each group was divided into three subgroups for observation of food intake during communal meals. Subgroups were established because only one person [...] was performing the experimental procedure. Thus the single investigator who was present during all observed meals was not required to attend to more than 14 people at any time. Participants in one experimental and one control subgroup comprised a cohort that was studied simultaneously. The three subgroups were studied in succession.” P. 2 (612) Quote: "[...] control and experimental participants were in view of each other and non-participants during the entire study." P. 2 (612)
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Quote: "One week prior to the beginning of the study, sample plates were prepared to train the nurses and nurses aids for food quantification. Interrater reliability of .80 was obtained after three training sessions [...]. Staff, who had been previously instructed in assessment of amount of food remaining, were blind to both the hypothesis and group (treatment or control) assignment." P. 3 (613)
Incomplete outcome data (attrition bias) All outcomes	Low risk	No dropouts
Selective reporting (reporting bias)	Low risk	Results provided as outlined
Other bias	Low risk	No indication for bias

Lin 2010

Methods	• **Design:** cluster-RCT, single-blinded • **Duration:** eight weeks
Participants	• **Country:** Taiwan • **Setting:** dementia special care units at three long-term care facilities in Metropolitan Taipei • **Diagnosis:** dementia (type or diagnostic criteria not specified) • **Inclusion criteria:** diagnosis with dementia (not specified). EdFED of two or higher. Able to stay in the institution for the study duration. Initial MMSE of ten to 23 • **Unit of randomisation:** three dementia special care units in different long-term care facilities • **Number of participants:** total: 85; intervention 1: 32; intervention 2: 29; control: 24 • **Dropouts:** total: 3 (3.5%); distribution unclear • N**umber analysed:** per-protocol analysis; total: 82; distribution unclear

Lin 2010 *(Continued)*

- **Baseline characteristics**
  - **Sex:** intervention 1: 56.3% female; intervention 2: 41.4% female; control: 62.5% female
  - **Age (SD):** intervention 1: 79.7 (6.1); intervention 2: 82.9 (6.0); control: 81.1 (6.9)
  - **MMSE (SD):** intervention 1: 13.6 (5.1); intervention 2: 10.8 (4.9); control: 10.5 (8.0)
  - **Barthel Activities of Daily Living scale (SD):** intervention 1: 69.5 (26.5); intervention 2: 48.3 (31.1); control: 55.8 (25.4)
  - **Length of institutionalisation in months (SD):** intervention 1: 22.0 (21.8); intervention 2: 25.5 (19.3); control: 28.9 (29.5)
  - **Time since being diagnosed with dementia in months (SD):** intervention 1: 32.9 (32.0); intervention 2: 25.3 (19.3); control: 37.0 (32.2)
  - **Stage of dementia:** mild to moderate (MMSE of 10 to 23)

Interventions

- **Intervention 1:** spaced retrieval
  - **Why:** quote: “Spaced retrieval (SR) training is regarded as one method for patients with dementia that can enhance learning and retention of information by recalling that information To enhance learning and retention of information by recalling that information over increasingly longer periods of time." P. 2 (954)
  - **What:** material: intervention protocol. Procedures: the training consisted of the two dimensions eating procedure and eating behaviour. Spaced retrieval used immediate, one, two, four, eight, 16, and 32 minute time interval trials to train subjects in each dimension.
  - **Who:** two research assistants in doctoral/master programmes and experienced with research on dementia residents completed basic training in SR and Montessori-based activities. The training manual for SR was constructed by the research team who then trained the research assistants with demonstration and return demonstration of SR and Montessori-based activities. After finishing the two-day trainer course, the two research assistants were requested to lead spaced retrieval or Montessori-based activities at an institution for eight days. The principal investigator evaluated the two research assistants’ skills in spaced retrieval and Montessori-based activities during this period.
  - **How:** sessions provided in person
  - **Where:** dementia special care units at three long-term facilities in Metropolitan Taipei (Taiwan)
  - **When:** not reported
  - **How much:** 35–40 min sessions, three times per week, for eight weeks
  - **Tailoring:** the content of the training manual consisted of the categories of memory, errorless learning, definition of spaced retrieval, implementation of spaced retrieval, a videotape, and demonstration and return demonstration
  - **Modifications:** after feedback from multidisciplinary experts, some changes were implemented, quote: "[...] such as using real fruits instead of pictures of fruits during intervention sessions to enhance motivation, and buying desserts, which the residents had no opportunity to eat after admission to the facility, as a reward for participating at each intervention session."
- **Intervention 2:** Montessori-based activities
  - **Why:** quote: "Montessori methods are regarded as capable of stopping or reducing residents' problem behaviours when residents participated in Montessori-based programming." P. 2 (954)
  - **What:** material: intervention protocol. Procedures: the Montessori-based activities programme covered training in hand-eye co-ordination, scooping, pouring, and squeezing
  - **Who:** two research assistants in doctoral/master programmes and experienced with research on dementia residents completed basic training in spaced retrieval and Montessori-based activities. The training manual for spaced retrieval was constructed by the research team who then trained the research assistants with demonstration and return demonstration of spaced retrieval and Montessori-based activities. After finishing the two-day trainer course, the two research assistants were requested to lead spaced retrieval or Montessori-based activities at an institution for eight days. The principal investigator evaluated the two research assistants’ skills in spaced retrieval and Montessori-based activities during this period.
  - **How:** sessions provided in person
  - **Where:** dementia special care units at three long-term facilities in Metropolitan Taipei (Taiwan)
  - **When:** not reported
  - **How much:** 35–40 min sessions, three times per week, for eight weeks

Lin 2010 *(Continued)*

	* **Tailoring:** the Montessori-based activities programme for persons with dementia was developed by Camp 2001, but only hand-eye co-ordination, scooping, pouring, and squeezing were employed. Matching and differentiating of edible and not-edible items were added to the programme * **Modifications:** not reported • **Control:** usual routine according to institution's schedule
Outcomes	• Feeding behaviour: equivalence tested Chinese version (Lin 2003) of the EdFED(Watson 1994) • Body composition: MNA, Chinese version • Body composition: BMI • Body composition: body weight • Food intake: eating amount (percentage of meal)
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not described sufficiently Quote: "To avoid residents confounding, the three institutes were randomly assigned to the SR, Montessori-based activity, and control groups." P. 2 (954)
Allocation concealment (selection bias)	Unclear risk	Not mentioned
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Outcome assessed before and after intervention, not in between Quote: "The data collectors did not know which group the subjects belonged to." P. 3 (955)
Incomplete outcome data (attrition bias) All outcomes	High risk	Group allocation of dropouts unclear
Selective reporting (reporting bias)	Unclear risk	No study protocol available
Other bias	High risk	Incorrect analysis: no correction for clustering in the statistical analyses Baseline imbalance: significant difference between groups in the Barthel scale for activities of daily living at baseline, indicating differences in dependence on help and physical abilities

Pivi 2011

Methods	• **Design:** RCT • **Duration:** six months
Participants	• **Country:** Brazil

Pivi 2011 *(Continued)*

- **Setting:** clinic of the Behavioural Neurology Sector, in the Neurology and Neurosurgery Department of Universidade Federal Sao Paulo
- **Diagnosis:** probable Alzheimer's disease according to DSM IV
- **Inclusion criteria:** at least 65 years old, CDR of one to three
- **Exclusion criteria:** other forms of dementia, alternative feeding requirement (e.g. tube feeding), type 1 or type 2 diabetes mellitus, renal diseases
- **Unit of randomisation:** 90 participants
- **Number of participants:** total: 90, intervention 1: 29, intervention 2: 30, control: 31
- **Dropouts:** total: 12 (13.3%); intervention 1: 4 (13.8%); intervention 2: 4 (13.3%); control: 4 (12.9%)
- **Number analysed:** per-protocol analysis, total: 78; intervention 1: 27; intervention 2: 25; control: 26
- **Baseline characteristics (SDs not reported)**
  - **Sex:** not reported
  - **Age:** intervention 1: 75.9; intervention 2: 76.4; control: 75.2
  - **MMSE:** intervention 1: 12.8; intervention 2: 11.6; control: 12.6
  - **School in years:** intervention 1: 5.4; intervention 2: 4.6; control: 3.4
  - **Stage of dementia:** mild to severe (CDR of 1 to 3)

Interventions

- **Intervention 1:** education
  - **Why:** quote: "Some strategies can be adopted to improve the nutritional status of [patients with Alzheimer's disease]. These strategies include patient nutrition education programs, and the use of oral nutritional supplements, which can significantly impact nutritional status." P. 1
  - **What:** material: slides to support educational classes. Procedures: an educational programme consisting of ten classes. Classes were developed to include topics relevant to nutritional interventions in Alzheimer's disease, such as the importance of nutrition in disease, behavioural changes during meals, attractive meals, constipation, hydration, administration of drugs, swallowing, food supplementation, lack of appetite or clarification of doubt.
  - **Who:** not reported
  - **How:** face-to-face in classes with up to ten participants (caregivers and patients)
  - **Where:** Clinic of the Behavioural Neurology Sector, in the Neurology and Neurosurgery Department of Universidade Federal Sao Paulo
  - **When:** not reported
  - **How much:** 10 classes, not further specified
  - **Tailoring:** not reported
  - **Modifications:** not reported
- **Intervention 2:** Supplementation.
  - **Why:** quote: "Some strategies can be adopted to improve the nutritional status of [patients with Alzheimer's disease]. These strategies include patient nutrition education programs, and the use of oral nutritional supplements, which can significantly impact nutritional status." P. 1
  - **What:** material: oral Nutritional supplement (Ensure®, Abbott Nutrition), two servings provide 680 kcal and 25.6 gr of protein, procedure: Two servings were provided daily
  - **Who:** not reported
  - **How:** not reported
  - **Where:** Clinic of the Behavioural Neurology Sector, in the Neurology and Neurosurgery Department of Universidade Federal Sao Paulo
  - **When:** not reported
  - **How much:** two servings daily for six months
  - **Tailoring:** not reported
  - **Modifications:** not reported
- **Control:** usual care, no intervention was administered, the participants were assessed over the study period

Outcomes

- Body composition: body weight
- Body composition: BMI
- Body composition: arm circumference

Pivi 2011 *(Continued)*

- Body composition: arm muscle circumference
- Body composition: triceps skinfold

Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information Quote: "A randomized, 6-month, prospective study was conducted [...]". P. 2
Allocation concealment (selection bias)	Unclear risk	Insufficient information
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Insufficient information
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups, with similar reasons for missing data across groups Quote: “Twelve subjects were included in the study but not in the statistical analysis: 3 subjects from CG and 4 from EG had difficulty in being transported to the hospital; 3 subjects from SG and 1 from CG died; 1 subject from SG needed tube feeding.” P. 2
Selective reporting (reporting bias)	High risk	Even though there were no significant differences at baseline reported, the study reports analyses of differences of differences which strongly favours the intervention, whereas analyses of mean differences would favour the control for some outcomes.
Other bias	Low risk	No indication for bias

Salva 2011

Methods	• **Design:** cluster-RCT • **Duration:** 12 months, from July 2005 to July 2006
Participants	• **Country:** Spain • **Setting:** 11 outpatient clinics and day hospital care centres in Barcelona • **Diagnosis:** Alzheimer's disease according to DSM IV criteria • **Inclusion criteria:** diagnosed with dementia. Mild to moderate dementia with MMSE less than or equal to 26. Only ambulatory subjects living at home and who had an identified caregiver • **Exclusion criteria:** MMSE over 26. Residence in an institution, nasal-gastric tube feeding, terminal situation, participation in another nutritional intervention study • **Unit of randomisation:** 11 outpatient clinics and day hospital care centres • **Number of participants:** total: 946, intervention: 448, control: 498 • **Dropouts:** total: 290 (30.7%); intervention: 157 (35.0%); control: 133 (26.7%)

Salva 2011 *(Continued)*

- **Number analysed:** per-protocol analysis, total: 656; intervention: 291; control: 365
- **Baseline characteristics**
  - **Sex:** intervention: 67.0% female; control: 69.1% female
  - **Age (SD):** intervention: 79.4 (7.0); control: 78.6 (7.5)
  - **MMSE (SD):** intervention: 14.7 (6.0); control: 16.0 (6.25)
  - **CDR global score (SD):** intervention: 1.8 (0.8); control: 1.7 (0.8)
  - **MNA score (SD):** intervention: 22.3 (3.8); control: 24.0 (3.0)
  - **ADL score (SD):** intervention: 3.75 (1.8); control: 4.2 (1.7)
  - **IADL score (SD):** intervention: 2.2 (2.1); control: 2.5 (2.3)
  - **NPI-Q score (SD):** intervention: 4.7 (2.6); control: 4.2 (2.6)
  - **Eating behaviour scale Score (SD):** intervention: 15.5 (3.8); control: 16.4 (3.5)
  - **Cornell scale of depression score (SD):** intervention: 9.9 (6.6); control: 7.1 (5.4)
  - **Weigh, kg (SD):** intervention: 63.5 (12.5); control: 65.1 (12.5)
  - **BMI (SD):** intervention: 26.6 (4.4); control: 27.3 (4.6)
  - **Stage of dementia:** very mild to moderate (CDR 0.5 to 3)

Interventions

- **Intervention:** education/nutrition promotion programme
  - **Why:** quote: "[P]ublic healthcare program for weight loss prevention including extensive nutrition education and counselling and a short physical activity program may yield a significant improvement in Alzheimer patient autonomy." P. 1 (822)
  - **What:** materials: personalised presentation. A briefcase with booklets on Alzheimer's disease, nutrition for participants with Alzheimer's disease, physical exercise and detailed information about the programme. Participants were voluntarily supported in weight monitoring by postal reminders and the families were voluntarily provided with information. Procedures: training was given in sessions with the following topics: General presentation (topics included the programme, weight loss with Alzheimer's disease, nutrition schedules, weight monitoring),Lifestyle habits (balanced diet, creation of menus, cooking methods and others), eating behaviour problems, and general review and practical examples.
  - **Who:** sessions were held by dieticians. Support in health monitoring and information was provided by the Aging Institute (Autonomous University of Barcelona)
  - **How:** sessions were given face-to-face in the centres. Weight monitoring support and information was provided postal. A hotline and a nutrition programme newsletter provided further information on demand
  - **Where:** sessions were held in the medical centres
  - **When:** not reported
  - **How much:** participants were requested to attend at least four of the educational sessions
  - **Tailoring:** voluntary participation in weight monitoring support and family information dispatch
  - **Modifications:** not reported
- **Control:** no intervention was administered, the participants were assessed over the study period and were not allowed to participate in other intervention studies

Outcomes

- Feeding behaviour: EBS
- Cognition: MMSE
- Cognition: CDR
- Cognition: NPI-Q
- Function: ADL
- Function: IADL
- Body composition: body weight
- Body composition: BMI
- Body composition: MNA

Notes

Risk of bias

Salva 2011 *(Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Unspecified but weighted mechanism of randomisation Quote: "To prevent the potential of cross-influence due to the intervention training of the different healthcare professionals, randomization was done by centre taking into account the centre speciality (neurology, geriatrics and psychiatry)." P. 2 (823)
Allocation concealment (selection bias)	Unclear risk	Insufficient information
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) All outcomes	High risk	Due to cluster randomisation by centre and the knowledge of participants and providers, it has to be assumed that the assessing study nurses were not blinded either
Incomplete outcome data (attrition bias) All outcomes	Low risk	Quote: "Primary analysis was done on Intention-to-treat population (ITT) (i.e. including all randomized participants) and protocol population (PP) (i.e. all subjects included in the study without major protocol deviation). For clarity of presentation only ITT population results are presented; no difference in outcomes results was observed between ITT and PP populations." P. 3 (824) Mixed covariance analysis using SAS
Selective reporting (reporting bias)	Low risk	Results provided as outlined
Other bias	Low risk	No indication for bias

Simmons 2010a

Methods	• **Design:** RCT • **Duration:** six weeks
Participants	• **Country:** USA • **Diagnosis:** more than 50% of participants were diagnosed with dementia (not specified) • **Inclusion criteria:** participants had to be long-stay residents in the nursing homes or veteran affairs medical center.ave an order for nutritional supplementation • **Unit of randomisation:** 86 participants • **Number of participants:** total: 86; intervention 1: unclear; intervention 2: unclear; control: unclear • **Dropouts:** total: 23 (26.7%). Intervention 1: unclear; intervention 2: unclear; control: unclear • **Number analysed:** per-protocol analysis. Total: 61; intervention 1: 24; intervention 2: 19; control: 18

Simmons 2010a *(Continued)*

- **Baseline characteristics:**
  - **Sex:** female 62%
  - **Age (SD):** total: 86.9 (11.3)
  - **Dementia:** total: 54%
  - **Depression:** total: 68%
  - **MMSE (SD):** total: 14.1 (8.9)
  - **BMI lower than 20:** total: 24%
  - **Intake lower than estimated resting energy expenditure:** total: 56%
  - **Special diet order (e.g. no added salt, no added sugars):** total: 84%
  - **Stage of dementia:** not reported

Interventions	• **Intervention 1:** snacks * **Why:** assistance and encouragement to promote food and fluid intake in nursing home residents with varying levels of cognitive impairment and physical dependency * **What:** a variety of foods (e.g. yogurts, puddings, fruits) and fluids (e.g. assorted juices) * **Who:** research staff * **How:** research staff offered the additional food items * **Where:** nursing homes (not specified) * **When:** twice daily between meals around 10am and 2pm * **How much:** five week days per weeks for six weeks * **Tailoring:** snack items were provided consistent with patient's recorded diet specifications * **Modifications:** not reported • **Intervention 2:** supplementation * **Why:** supplements are supposed to improve caloric intake and appetite through consistent delivery multiple times per day between meals * **What:** supplements in different flavours * **Who:** research staff * **How:** research staff offered supplements * **Where:** nursing homes (not specified) * **When:** twice daily between meals around ten am and two pm * **How much:** five week days per weeks for six weeks * **Tailoring:** supplements were provided consistent with patient's recorded diet specifications * **Modifications:** not reported • **Control:** usual nursing home care, no intervention was administered, the participants were assessed over the study period
Outcomes	• Food intake: calories during meals • Food intake: calories between meals • Food intake: calories total • Body composition: BMI
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information
Allocation concealment (selection bias)	Unclear risk	Insufficient information

Simmons 2010a *(Continued)*

Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Quote: "Research staff recorded each food and fluid item offered and the amount consumed using percentage estimates and fluid ounce measures. In addition, a digital camera was used to take photographs of residents' trays before and after a sample of served meals (1–2 meals per participant at each assessment point) to determine the inter-rater reliability of the percentage estimates. Research staff different from the observer(s) and blind to group assignment estimated intake based on the photographs." P. 3 Not blinded and blinded research staff both assessed outcomes, but it is not mentioned whose measures were used or if this was only for testing of inter-rater-reliability
Incomplete outcome data (attrition bias) All outcomes	High risk	Per protocol analysis and 27% dropout rate, group allocation of dropouts unclear
Selective reporting (reporting bias)	Unclear risk	Inconsistent reporting of outcomes and erroneous tables
Other bias	Low risk	No indication for bias

Suominen 2015

Methods	• **Design:** RCT • **Duration:** 12 months
Participants	• **Country:** Finland • **Diagnosis:** Alzheimer's disease according to NINCDS-ADRDA Alzheimer's criteria • **Inclusion criteria:** person with Alzheimer's disease living with a spouse, over 64 years old; able to reach study place by taxi, able to stand on a scale, residency in the Helsinki metropolitan area, absence of terminal disease, expected life expectancy of at least half a year • **Unit of randomisation:** 99 participants • **Number of participants:** total: 99; intervention: 50; control: 49 • **Dropouts:** total: 21 (21.2%); intervention: 10 (20.0%); control: 11 (22.4%) • **Number analysed:** per-protocol analysis; total: 78; intervention: 40; control: 38 • **Baseline characteristics:** * **Sex:** intervention: 47% female; control: 53% female * **Age (SD):** intervention: 78.2 (5.5); control: 76.8 (5.9) * **MMSE (SD):** intervention: 18.8 (6.4); control: 20.2 (4.7) * **MNA below 17 points: i**ntervention: 0%, control: 0% * **MNA 17 to 23.5 points:** intervention: 43%; control: 37% * **MNA above 23.5 points:** intervention: 57%; control: 63% * **Weight in kg (SD):** intervention: 75.4 (14.4); control: 74.0 (9.3) * **BMI (SD):** intervention: 26.3 (3.6); control: 25.9 (2.9) * **IADL (SD):** intervention: 3.8 (2.2); control: 4.0 (1.9) * **HRQoL (SD):** intervention: 0.76 (0.11); control: 0.77 (0.14) * **Stage of dementia:** very mild to moderate (CDR of 0.5 to 3)

Suominen 2015 *(Continued)*

Interventions	• **Intervention:** nutritional guidance
	  * **Why:** assessments of the nutritional needs of home-dwelling persons with Alzheimer's disease and tailored intervention based on everyday food may yield beneficial impact on weight, nutritions and health-related quality-of-life for people with Alzheimer's disease
	  * **What:** materials: brochures, food diaries, nutrition plan, oral nutritional supplements. Procedures: teaching and discussing nutrition matters, individual nutrition counselling and preparing a nutrition plan in home visits and group meetings
	  * **Who:** nutritionist
	  * **How:** research staff offered supplements
	  * **Where:** in the participants home
	  * **When:** not reported
	  * **How much:** home visits: at least three visits within the 12 months study period. Group meetings: one to two times for each couple
	  * **Tailoring:** additional telephone contact or home visits (maximum of eight times) when needed
	  * **Modifications:** not reported
	• **Control: r**eceived usual care and a written guide about nutrition for older adults

Outcomes	• Body composition: BMI • Food intake: protein intake • Function: HRQoL • Function: rates of falls (Incidence rate)
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "[…]the couples who met all the inclusion criteria (n = 99) were randomly allocated to the intervention (n = 50) and control (n = 49) groups according to a computer generated, blocked randomisation list. The block size was six, and the randomisation took place between August 2010 and January 2011. A person unrelated to the investigation and unfamiliar with the procedure performed the randomisation." P. 3 (903)
Allocation concealment (selection bias)	Unclear risk	Insufficient information
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Quote: "The study assistant performing the 12-month assessment was unrelated to the intervention, and therefore had no idea of what was happening in the intervention." P. 2 (902)
Incomplete outcome data (attrition bias) All outcomes	Low risk	Dropouts adequately addressed, per protocol analysis
Selective reporting (reporting bias)	High risk	One outcome not reported but mentioned in the paper and other outcomes from protocol not reported
Other bias	Low risk	No indication for bias

Wu 2014

Methods	• **Design:** cluster-RCT • **Duration:** eight weeks
Participants	• **Country:** Taiwan • **Clusters:** dementia special care units located in four nursing and veteran homes • **Diagnosis:** dementia • **Inclusion criteria:** diagnosis of dementia (not specified), MMSE between six and 23, passing a screening for spaced retrieval ensuring participants can remember trainer's name for at least 30 seconds, no visual, hearing or upper limb impairments, no history of stroke, speaks mandarin Chinese • **Unit of randomisation:** four dementia special care units in different nursing and veteran homes • **Number of participants:** total: 63; intervention 32; control 31 • **Dropouts:** total: 2 (3.2%). Intervention: 0 (0%); control: 2 (6.5%) • **Number analysed:** per-protocol analysis; total: 61; intervention: 32; control: 29 • **Baseline characteristics:** * **Sex:** not reported * **Age (SD):** total: 79.9 (7.3), intervention: 80.2 (8.1), control: 79.7 (6.4) * **Education: illiterate:** total: 8.2%; intervention: 9.3%; control: 6.9%; **primary School:** total: 37.7%; intervention: 34.4%; control: 41.4%; **high School:** total: 44.3%; intervention: 46.9%. Control: 41.4%; **college or better:** total: 9.8%; intervention: 9.4%; control: 10.3% * **Stage of dementia:** mild to severe (CDR of 1 to 3) * **Mild dementia:** total: 34.4%, intervention: 37.5%; control: 31.0% * **Moderate dementia:** total: 37.7%; intervention: 34.4%; control: 41.4% * **Severe dementia:** total: 27.9%; intervention: 28.1%; control: 27.6%
Interventions	• **Intervention:** spaced retrieval combined with errorless learning * **Why:** in spaced retrieval, the repeated recalling of information with increasing time intervals builds on the retrieval effect, whereupon such information is more strongly encoded and available as new memories. The principle of errorless learning is introduced by supplementary cues, quote: "[...] which favour the elimination or reduction of incorrect or inappropriate responses in retrieval trials." (P. 1, P. 333) * **What:** materials: a spaced retrieval training protocol consisting of eight learning items for eating procedures and feeding behaviours. Each item was followed by a corresponding prompt, e.g. a recognizable piece of classical music. For each learning item, a three-step, graded cue was provided. A picture or motion related to the learning item on level one, a forced-choice recognition card, in which the correct item was matched with a distractor on level two and another forced-choice recognition card, where the item was heavily emphasised and paired with a smaller distractor on level three. Procedures: in each training session, participants were trained in one learning item. In spaced retrieval, for each item, participants were required to recall information after increasing time intervals of up to 32 minutes in the second or third session. Participants with no or low errors were given special rules to increase difficulty. Combined with errorless learning the additional cues were provided if participants could not recall the information, beginning with the level one cue * **Who:** the principal investigator and two nursing graduate students * **How:** the sessions were provided in person * **Where:** dementia special care units at four long-term facilities in Metropolitan Taipei (Taiwan) * **When:** Mondays, Wednesdays and Fridays of each week, with one session per day * **How much:** 35- to 40-minute sessions. One item per week over eight weeks * **Tailoring:** not reported * **Modifications:** not reported • **Control:** spaced retrieval only * **Why:** see above, but excluding the supplementary cues of errorless learning * **What:** materials: a spaced retrieval training protocol consisting of eight learning items for eating procedures and feeding behaviours. Each item was followed by a corresponding prompt, e.g. a recognizable piece of classical music. Procedures: In each training session, participants were trained

Wu 2014 *(Continued)*

	in one learning item. In spaced retrieval, for each item, participants were required to recall information after increasing time intervals of up to 32 minutes in the second or third session. Participants with no or low errors were given special rules to increase difficulty. * **Who:** the principal investigator and two nursing graduate students * **How:** the sessions were provided in person * **Where:** dementia special care units at four long-term facilities in Metropolitan Taipei (Taiwan) * **When:** Mondays, Wednesdays and Fridays of each week, with one session per day * **How much:** 35- to 40-minute sessions. One item per week over eight weeks * **Tailoring:** not reported * **Modifications:** not reported
Outcomes	• Cognition: Mini-Mental State Examination (MMSE) • Food intake: percentage of food that has been eaten during mealtime, measured in 25%, 50%, 75% or 100%
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information
Allocation concealment (selection bias)	Unclear risk	Insufficient information
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Quote: „(...) 4 research assistants were trained and blinded to collect outcome measures in both groups at the pretest and posttest stages.“ P. 2 (334)
Incomplete outcome data (attrition bias) All outcomes	High risk	Per protocol analysis No informations about reasons for dropouts. Only 2 dropouts are unlikely to increase bias significantly The following is highly problematic: quote: “As for the MMSE scores and food intake, only the normality of the change of food intake for the SR/EL group (n = 32) was rejected by the Kolmogorov-Smirnov test (P = 0.03). After excluding an outlier whose value of food intake at posttest was not within mean±3 SD, the change of food intake for the SR/EL group (n = 31) presented a normal distribution (Kolmogorov-Smirnov = 0.154, P = 0.06). Thus, the independent sample t tests (2-tailed) was used, respectively, to compare the changes of the MMSE scores and food intake between the SR/EL and SR-only groups.” P. 4 (336)
Selective reporting (reporting bias)	Unclear risk	No study protocol available
Other bias	High risk	Incorrect analysis: no correction for clustering in the statistical analyses

ADL: Activities of Daily Living; BMI: body mass index; CDR: Clinical Dementia Rating; DSM: Diagnostic and Statistical Manual of Mental Disorders; EBS: Eating Behaviour Scale; EdFED: Edinburgh Feeding Evaluation in Dementia scale; HRQoL: health-related quality of life; IADL: Instrumental Activities of Daily Living; LEI: Level of Eating Independence scale; MMSE: Mini-Mental-State Examination; MNA: Mini Nutritional Assessment; NINCDS-ADRDA: National Institute of Neurological and Communicative Disorders and Stroke and the Alzheimer's Disease and Related Disorders Association; NPI-Q: neuropsychiatric inventory questionnaire; RCT: randomised controlled trial; SD: standard deviation

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

Study	Reason for exclusion
Anon 2011	Design: not RCT
Aselage 2011	Participants: randomised nursing home staff and information on participants missing, outcome: no relevant outcomes reported
Batchelor-Murphy 2015	Design: feasibility study
Beck 2010	Intervention: oral nutritional supplement
Chang 2006	Participants: nursing home staff, outcome: no patient-related outcomes reported
Chenoweth 2011	Outcome: no relevant outcomes reported
de Sousa 2012	Design: not RCT
Endevelt 2011	Participants: no participants with dementia
Hanson 2011	Outcome: no relevant outcomes reported
Lin 2011	Design: not RCT
Liu 2016	Intervention: not directly aimed at nutrition or mealtimes, outcome: no relevant outcomes reported
Moore 2010	Intervention: not directly aimed at nutrition or mealtimes, outcome: insufficient times of measurement
Narme 2015	Intervention: not directly aimed at nutrition or mealtimes
NCT01780402	Design: not RCT
Nijs 2006	Participants: no participants with dementia
Remsburg 2001	Design: not RCT
Riebandt 2011	Design: not RCT
Ritchie 2005	Design: not RCT
Riviere 2001	Design: no randomisation
Shipley 2010	Participants: less than 50% of participants with dementia
Simmons 2008	Participants: less than 50% of participants with dementia
Simmons 2010b	Intervention: interventions that modify food items

Study	Reason for exclusion
Solomon 2012	Focus on prevention of dementia
Solomon 2014	Participants: no people with dementia
Sousa 2012	Intervention: oral nutritional supplement
Syme 1995	Design: no RCT
van Ort 1995	Participants: no people with dementia
Wu 2013	Design: not RCT
Wu 2015	Design: not RCT
Young 2004	Design: not RCT

RCT: randomised controlled trial

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

NCT02269956

Methods	Allocation: randomised Endpoint classification: efficacy study Intervention model: parallel assignment Masking: open-label Primary Purpose: Supportive Care
Participants	**Inclusion criteria** Nursing home staff participants must be: • 18 years of age or older • able to read and write English • willing to sign informed consent • employed as a Registered Nurse, Licensed Practical Nurse, or Certified Nursing Assistant Persons with dementia participants must be: • A resident (> six weeks) of a nursing home • 60+ years of age; • Able to speak English in order to give assent • Have a positive minimum data set 3.0 for: active disease diagnosis of Alzheimer's disease or dementia • Require extensive assistance to total dependence for eating; • Have a Brief Interview for Mental Status score ranging from 0-12 (lower score indicates greater cognitive impairment) • Have a legally authorised representative able to read English in order to provide informed consent for the people with dementia **Exclusion criteria** • Positive for: HIV infection, Parkinson's disease, and/or traumatic brain injury • Any swallowing disorder • Parental or intravenous feedings, or presence of a feeding tube

NCT02269956 *(Continued)*	
	• Any significant auditory or visual impairment that would prevent the people with dementia from hearing/seeing verbal/visual cues
Interventions	Behavioural: 12-week feasibility study: at baseline, weeks six and 12, dementia feeding skills knowledge and self-efficacy tests will be administered, meal observations of nursing staff assisting PWD with meals will be video recorded for three meals over two days, and a medical record review will be conducted to ascertain technical and adaptive interventions also in place for the people with dementia (e.g. high density protein supplements, appetite stimulant medications, weighing, diet texture modifications); after baseline data is collected, the training programme will delivered in five weekly modules with group coaching sessions completed the same week
Outcomes	Primary outcome measures • Edinburgh Feeding in Dementia scale Secondary outcome measures • Change in feeding skills knowledge • Change in feeding skills self-efficacy • Functional rating scale for symptoms in dementia • Brief inventory of mental status
Notes	www.clinicaltrials.gov/show/NCT02269956 The study has been completed but we found no published results neither within the electronic search for this review nor in separate searches on the study title or the principal investigator.

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

Douma 2016	
Trial name or title	The effects of video observation of chewing during lunchtime, on mastication, food intake, cognition, activities of daily living, depression, and quality of life in older adults with dementia
Methods	Randomised controlled trial
Participants	**Inclusion criteria** • Having a diagnosis of dementia (as stated in the medical status of the person) • Mini-Mental State Examination score of max. 25 • Age: at least 70 years **Exclusion criteria** • History of alcoholism • Cerebral trauma • Hydrocephalus • Visual impairments • Neoplasm • History of depression • Personality disorders, other than those based on dementia • Disturbances of consciousness • Dysphagia

Douma 2016 *(Continued)*

Interventions	The experimental group watches videos of people eating/chewing, and the control group watches videos of nature and buildings, both groups watch these videos for three months, five days a week, during lunchtime, videos are shown on tablet personal computers
Outcomes	**Primary outcome** • Masticatory ability • Two-colour chewing gum test **Secondary outcomes** • Food intake • Weighed inventory method • Cognition • Mini-Mental State Examination (this is the only cognitive test that is administered for participants with an Mini-Mental State Examination score <15) • Eight words test (subtest Amsterdam Dementia Screening) • Picture completion (subtest Geriatric Intelligence Test) • Letter fluency test • Digit span (subtest Wechsler Adult Intelligence Scale-III) • Face recognition and picture recognition (subtest Rivermead Behavioural Memory Test) • Category fluency tests (subtest Geriatric Intelligence Test) • Visual memory span (subtest Wechsler Memory Scales) • Activities of daily living • Katz index • Depression • Cornell Scale for Depression in Dementia • Quality of life • Dementia quality of life questionnaire • Quality of life measure for people with dementia
Starting date	2 April 2013
Contact information	Douma JG, MSc, VU University, Department of Clinical Neuropsychology, Van der Boechorststraat 1, 1081 BT Amsterdam, the Netherlands, j.g.douma@vu.nl
Notes	www.trialregister.nl/trialreg/admin/rctview.asp?TC=5124

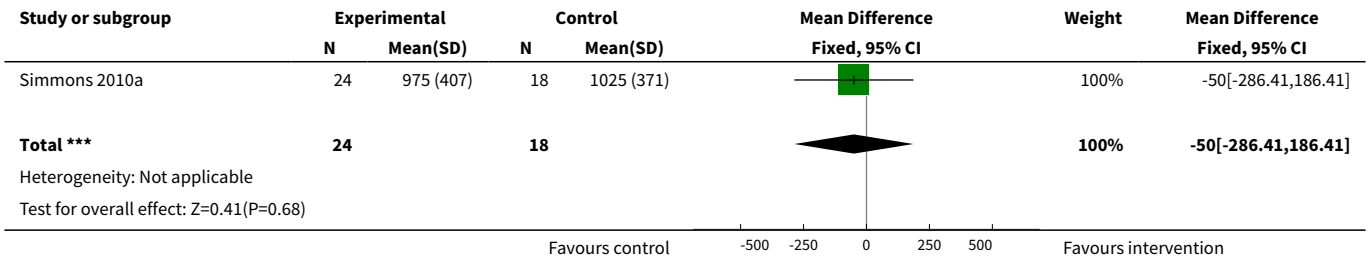
DATA AND ANALYSES

Comparison 1. Additional food items between meals versus usual care (Simmons 2010)

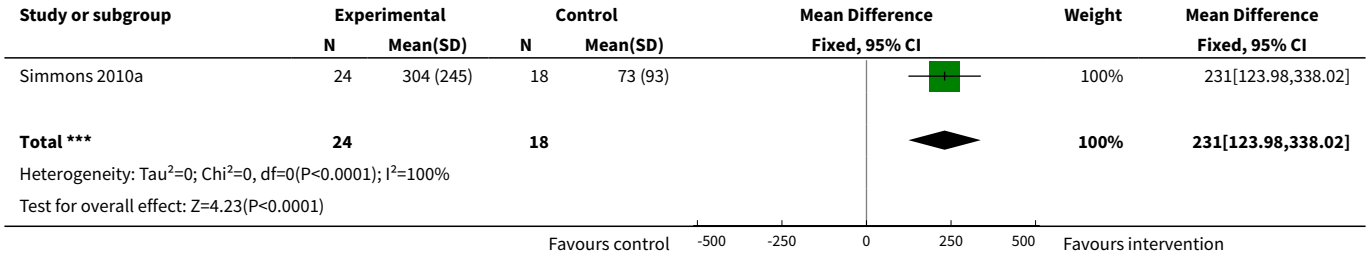
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Calories consumed per meal (kcal, 6 weeks, PP)	1	42	Mean Difference (IV, Fixed, 95% CI)	-50.0 [-286.41, 186.41]
2 Calories consumed between meals (kcal, 6 weeks, PP)	1	42	Mean Difference (IV, Fixed, 95% CI)	231.00 [123.98, 338.02]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
3 Calories consumed in total (kcal, 6 weeks, PP)	1	42	Mean Difference (IV, Fixed, 95% CI)	181.0 [-103.08, 465.08]
4 Body weight (kg, 6 weeks, change scores, PP)	1	42	Mean Difference (IV, Fixed, 95% CI)	-0.22 [-1.25, 0.81]

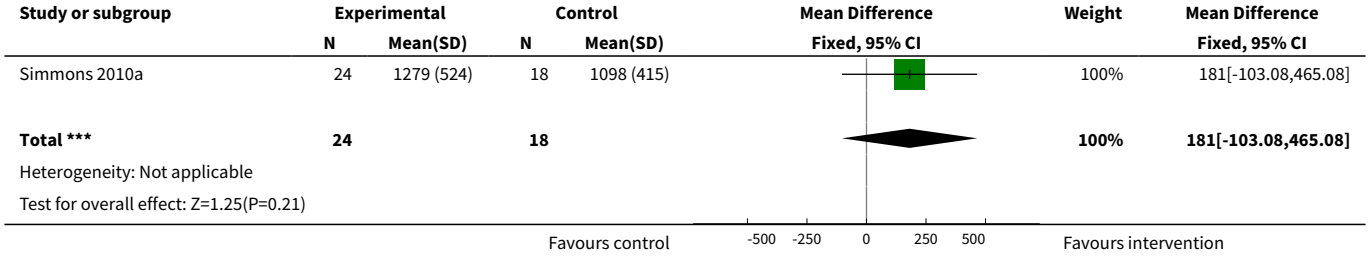
Analysis 1.1. Comparison 1 Additional food items between meals versus usual care (Simmons 2010), Outcome 1 Calories consumed per meal (kcal, 6 weeks, PP).



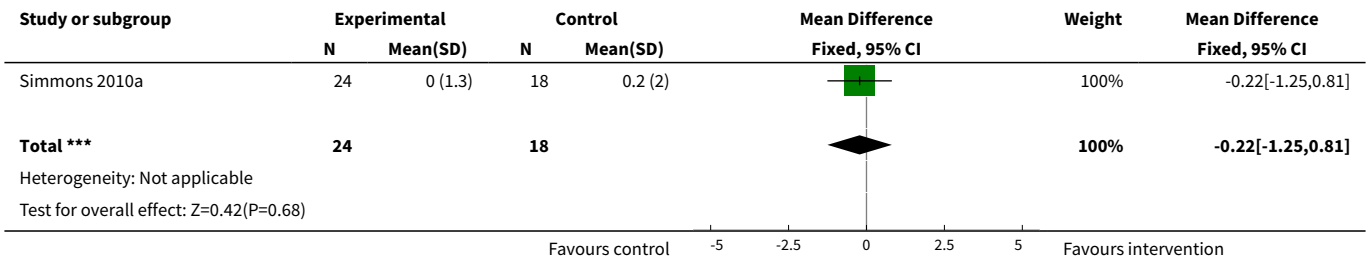
Analysis 1.2. Comparison 1 Additional food items between meals versus usual care (Simmons 2010), Outcome 2 Calories consumed between meals (kcal, 6 weeks, PP).



Analysis 1.3. Comparison 1 Additional food items between meals versus usual care (Simmons 2010), Outcome 3 Calories consumed in total (kcal, 6 weeks, PP).



Analysis 1.4. Comparison 1 Additional food items between meals versus usual care (Simmons 2010), Outcome 4 Body weight (kg, 6 weeks, change scores, PP).

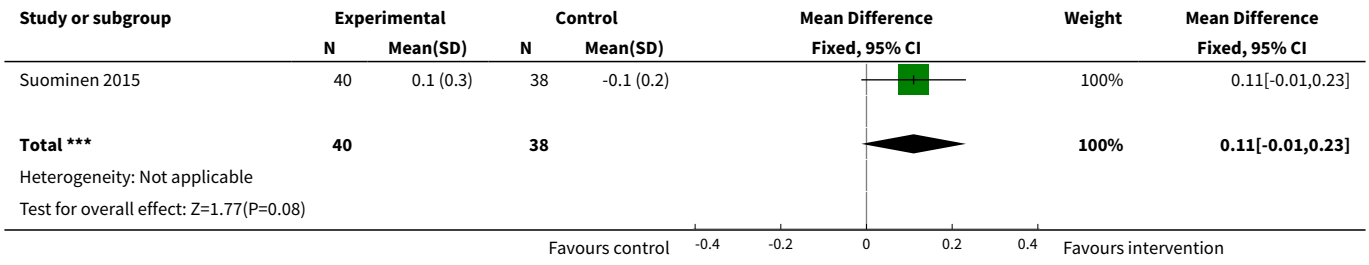


Comparison 2. Education and nutrition promotion programme versus no intervention (Pivi 2011, Salva 2011, Suominen 2015)

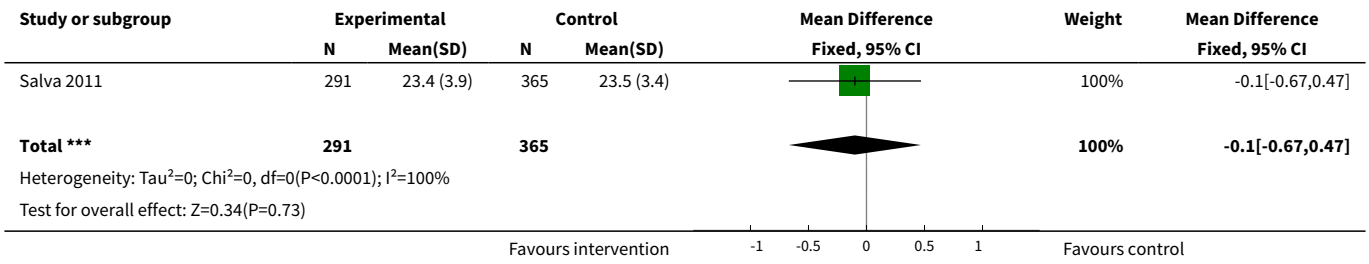
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Total protein intake (g/kg of body weight, change scores, 12 months, PP)	1	78	Mean Difference (IV, Fixed, 95% CI)	0.11 [-0.01, 0.23]
2 Mini Nutritional Assessment (MNA, range 0-30, higher = better, 12 months, PP)	1	656	Mean Difference (IV, Fixed, 95% CI)	-0.10 [-0.67, 0.47]
3 Body Mass Index (BMI, 6 months, change scores, PP)	1	52	Mean Difference (IV, Fixed, 95% CI)	-1.79 [-2.30, -1.28]
4 Body Mass Index (BMI, 12 months, absolute and change scores, PP)	2	734	Mean Difference (IV, Fixed, 95% CI)	-0.26 [-0.70, 0.19]
5 Body weight (kg, 6 months, change scores, PP)	1	52	Mean Difference (IV, Fixed, 95% CI)	-8.11 [-12.56, -3.66]
6 Body weight (kg, 12 months, PP)	1	656	Mean Difference (IV, Fixed, 95% CI)	-1.60 [-3.47, 0.27]
7 Arm muscle circumference (cm, 6 months, change scores, PP)	1	52	Mean Difference (IV, Fixed, 95% CI)	-1.30 [-1.78, -0.82]
8 Arm circumference (cm, 6 months, change scores, PP)	1	52	Mean Difference (IV, Fixed, 95% CI)	0.24 [0.12, 0.36]
9 Triceps skinfold change scores (cm, 6 months, change scores, PP)	1	52	Mean Difference (IV, Fixed, 95% CI)	-0.46 [-2.67, 1.75]
10 Eating Behaviour Scale (EBS, range 0-30, higher = better, 12 months, PP)	1	656	Mean Difference (IV, Fixed, 95% CI)	-1.5 [-2.11, -0.89]
11 Mini Mental State Examination (MMSE, 12 months, PP)	1	656	Mean Difference (IV, Fixed, 95% CI)	-1.5 [-2.52, -0.48]
12 Activities of Daily Living scale (ADL, range 0-78, higher = better, 12 months, PP)	1	656	Mean Difference (IV, Fixed, 95% CI)	-0.65 [-0.93, -0.37]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
13 Instrumental Activities of Daily Living (IADL, range 0-8, higher = better, 12 months, PP)	1	656	Mean Difference (IV, Fixed, 95% CI)	-0.45 [-0.80, -0.10]
14 Clinical Dementia Rating global score (CDR, 12 months, PP)	1	656	Mean Difference (IV, Fixed, 95% CI)	0.13 [0.02, 0.24]
15 Neuropsychiatric Inventory Questionnaire (NPI-Q, range 0-120, lower = better, 12 months, PP)	1	656	Mean Difference (IV, Fixed, 95% CI)	0.70 [-0.12, 1.52]
16 Health-related quality of life (HRQoL, range 0-1, higher = better 12 months, change scores, PP)	1	78	Mean Difference (IV, Fixed, 95% CI)	0.02 [-0.02, 0.06]
17 Falls per year (falls/person, 12 months, PP)	1	78	Mean Difference (IV, Fixed, 95% CI)	-0.84 [-1.31, -0.37]

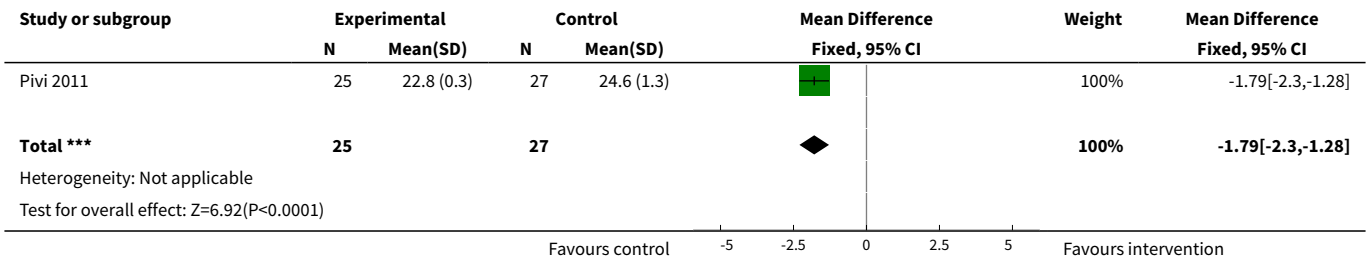
Analysis 2.1. Comparison 2 Education and nutrition promotion programme versus no intervention (Pivi 2011, Salva 2011, Suominen 2015), Outcome 1 Total protein intake (g/kg of body weight, change scores, 12 months, PP).



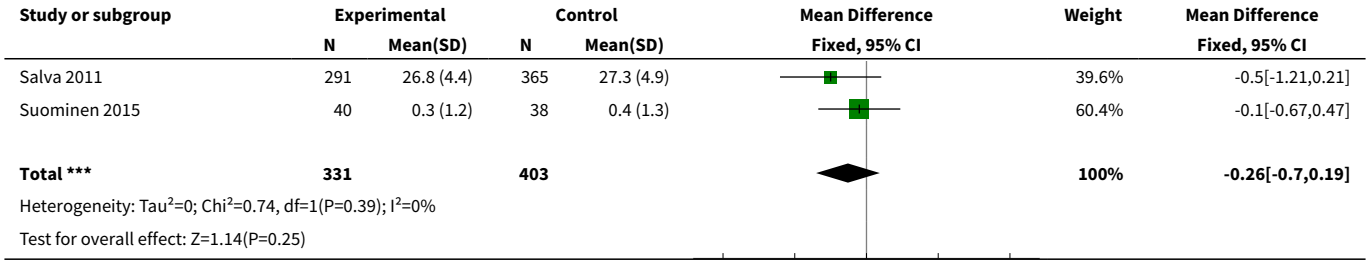
Analysis 2.2. Comparison 2 Education and nutrition promotion programme versus no intervention (Pivi 2011, Salva 2011, Suominen 2015), Outcome 2 Mini Nutritional Assessment (MNA, range 0-30, higher = better, 12 months, PP).



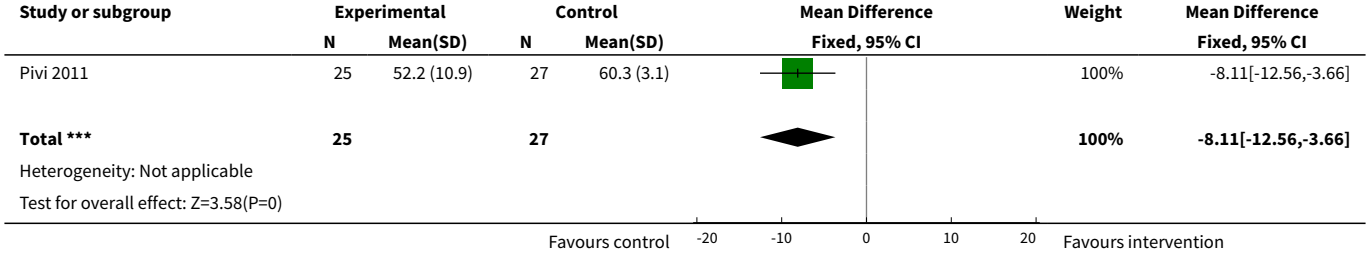
Analysis 2.3. Comparison 2 Education and nutrition promotion programme versus no intervention (Pivi 2011, Salva 2011, Suominen 2015), Outcome 3 Body Mass Index (BMI, 6 months, change scores, PP).



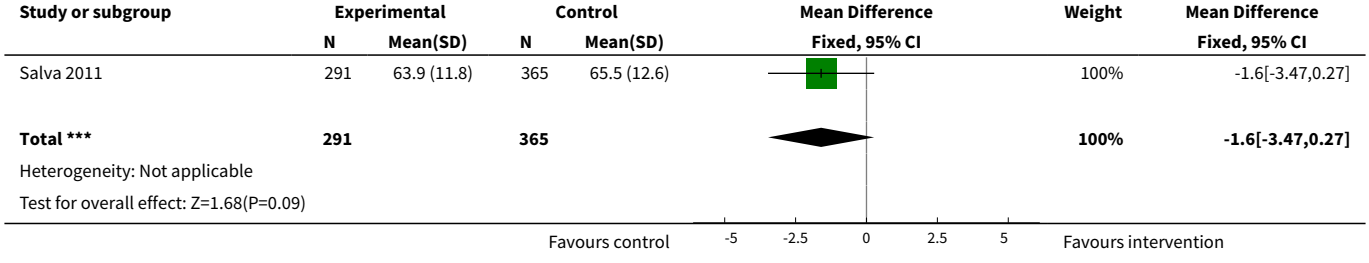
Analysis 2.4. Comparison 2 Education and nutrition promotion programme versus no intervention (Pivi 2011, Salva 2011, Suominen 2015), Outcome 4 Body Mass Index (BMI, 12 months, absolute and change scores, PP).



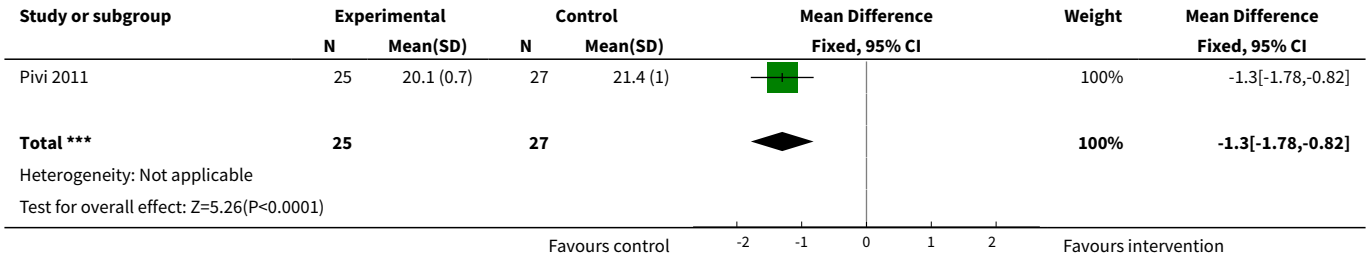
Analysis 2.5. Comparison 2 Education and nutrition promotion programme versus no intervention (Pivi 2011, Salva 2011, Suominen 2015), Outcome 5 Body weight (kg, 6 months, change scores, PP).



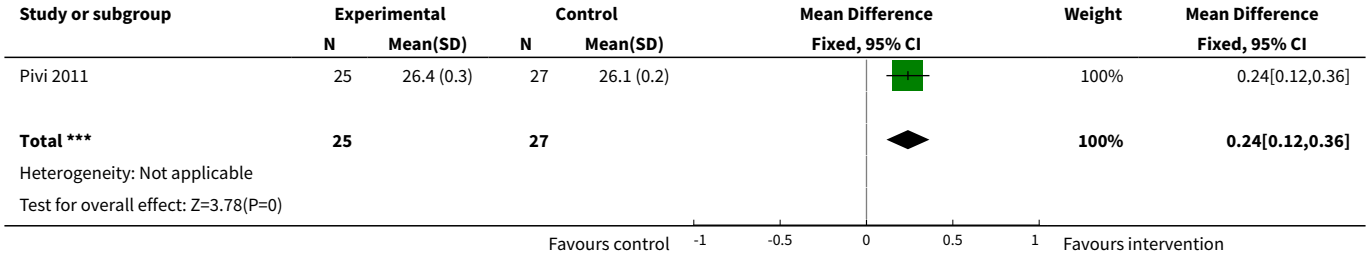
Analysis 2.6. Comparison 2 Education and nutrition promotion programme versus no intervention (Pivi 2011, Salva 2011, Suominen 2015), Outcome 6 Body weight (kg, 12 months, PP).



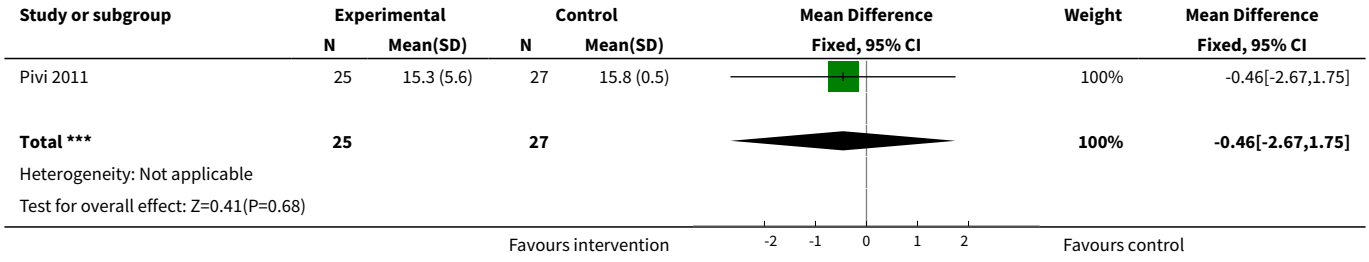
Analysis 2.7. Comparison 2 Education and nutrition promotion programme versus no intervention (Pivi 2011, Salva 2011, Suominen 2015), Outcome 7 Arm muscle circumference (cm, 6 months, change scores, PP).



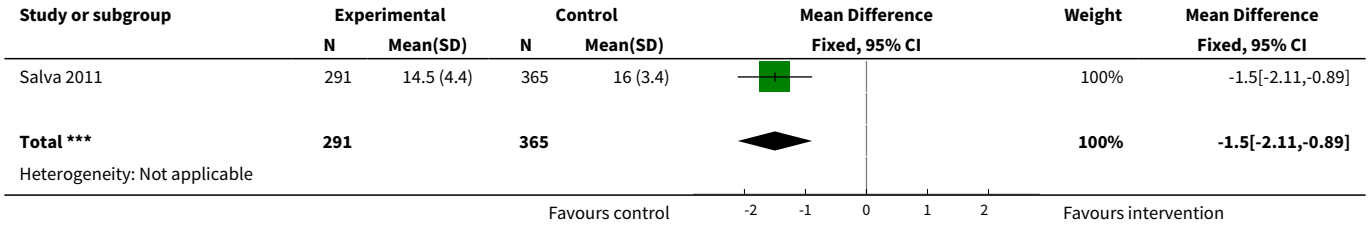
Analysis 2.8. Comparison 2 Education and nutrition promotion programme versus no intervention (Pivi 2011, Salva 2011, Suominen 2015), Outcome 8 Arm circumference (cm, 6 months, change scores, PP).



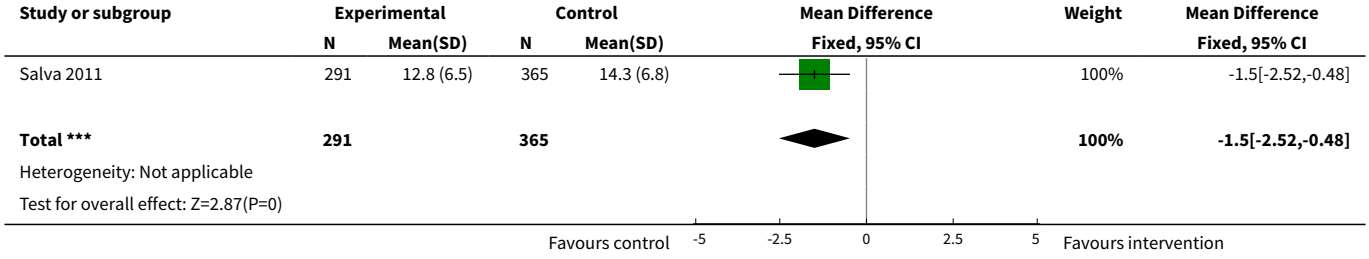
Analysis 2.9. Comparison 2 Education and nutrition promotion programme versus no intervention (Pivi 2011, Salva 2011, Suominen 2015), Outcome 9 Triceps skinfold change scores (cm, 6 months, change scores, PP).



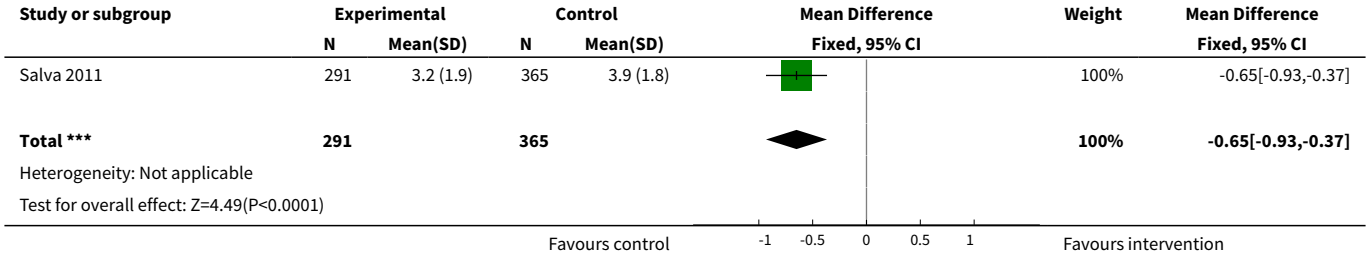
Analysis 2.10. Comparison 2 Education and nutrition promotion programme versus no intervention (Pivi 2011, Salva 2011, Suominen 2015), Outcome 10 Eating Behaviour Scale (EBS, range 0-30, higher = better, 12 months, PP).



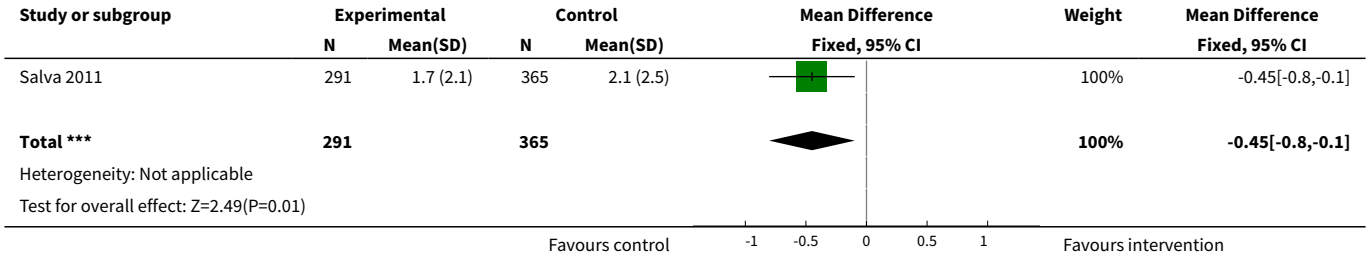
Analysis 2.11. Comparison 2 Education and nutrition promotion programme versus no intervention (Pivi 2011, Salva 2011, Suominen 2015), Outcome 11 Mini Mental State Examination (MMSE, 12 months, PP).



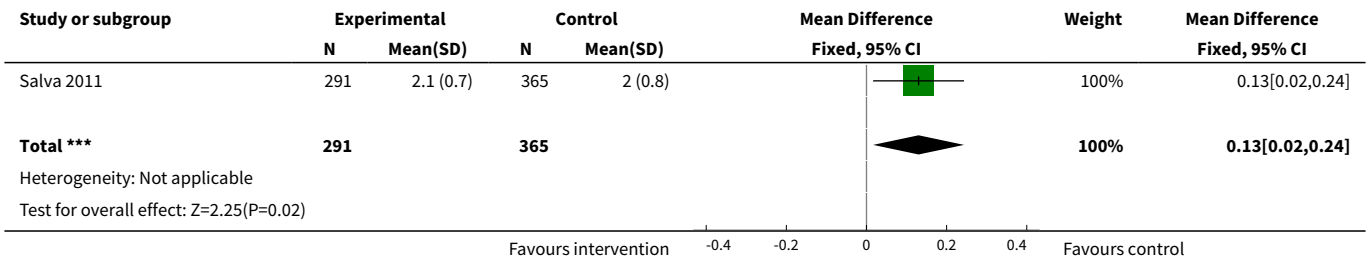
Analysis 2.12. Comparison 2 Education and nutrition promotion programme versus no intervention (Pivi 2011, Salva 2011, Suominen 2015), Outcome 12 Activities of Daily Living scale (ADL, range 0-78, higher = better, 12 months, PP).



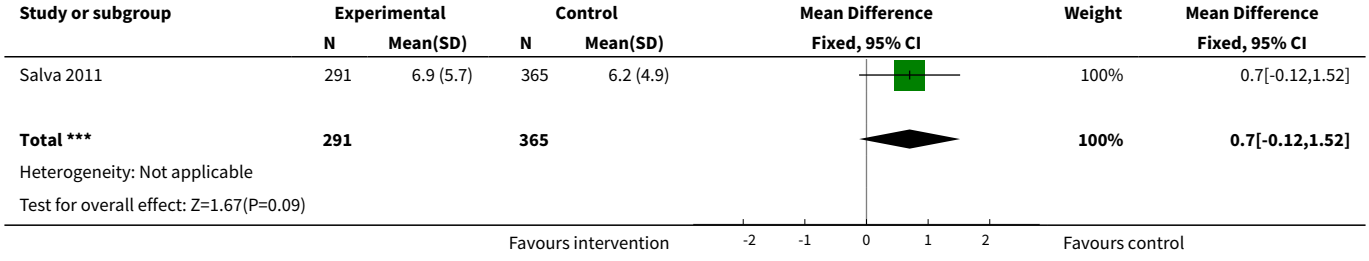
Analysis 2.13. Comparison 2 Education and nutrition promotion programme versus no intervention (Pivi 2011, Salva 2011, Suominen 2015), Outcome 13 Instrumental Activities of Daily Living (IADL, range 0-8, higher = better, 12 months, PP).



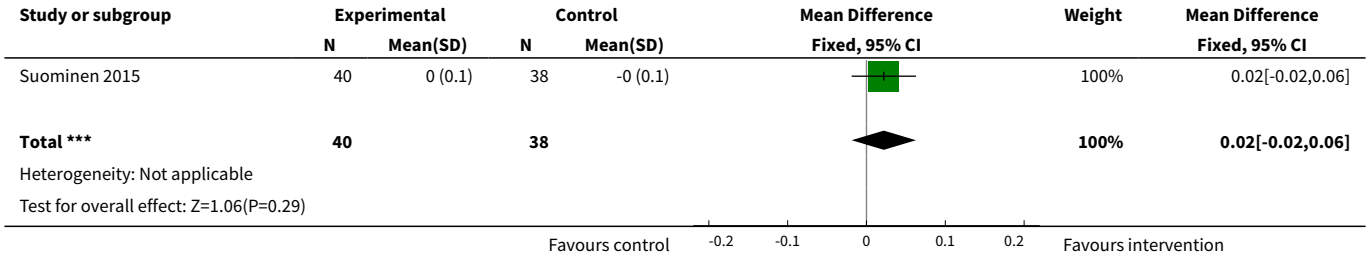
Analysis 2.14. Comparison 2 Education and nutrition promotion programme versus no intervention (Pivi 2011, Salva 2011, Suominen 2015), Outcome 14 Clinical Dementia Rating global score (CDR, 12 months, PP).



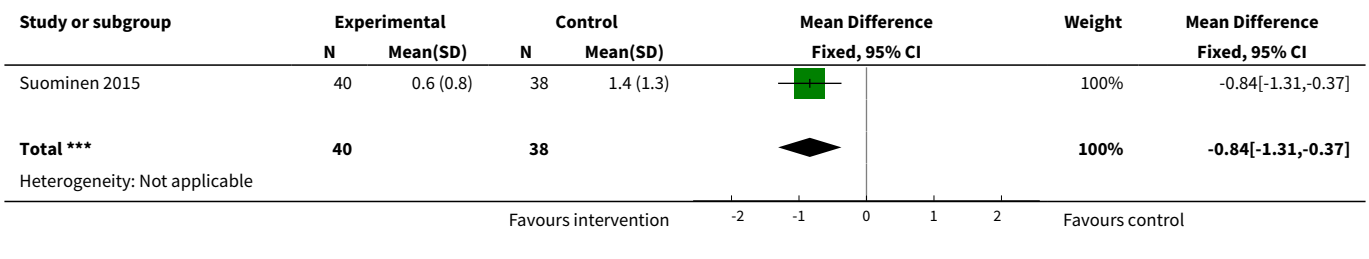
Analysis 2.15. Comparison 2 Education and nutrition promotion programme versus no intervention (Pivi 2011, Salva 2011, Suominen 2015), Outcome 15 Neuropsychiatric Inventory Questionnaire (NPI-Q, range 0-120, lower = better, 12 months, PP).

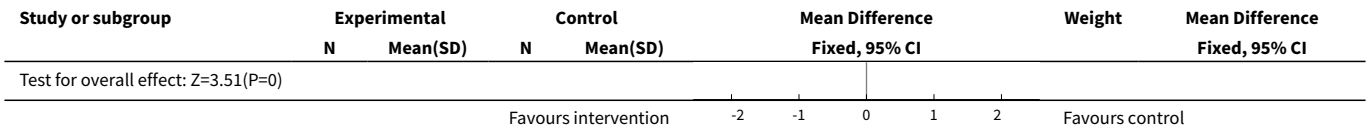


Analysis 2.16. Comparison 2 Education and nutrition promotion programme versus no intervention (Pivi 2011, Salva 2011, Suominen 2015), Outcome 16 Health-related quality of life (HRQoL, range 0-1, higher = better 12 months, change scores, PP).



Analysis 2.17. Comparison 2 Education and nutrition promotion programme versus no intervention (Pivi 2011, Salva 2011, Suominen 2015), Outcome 17 Falls per year (falls/person, 12 months, PP).

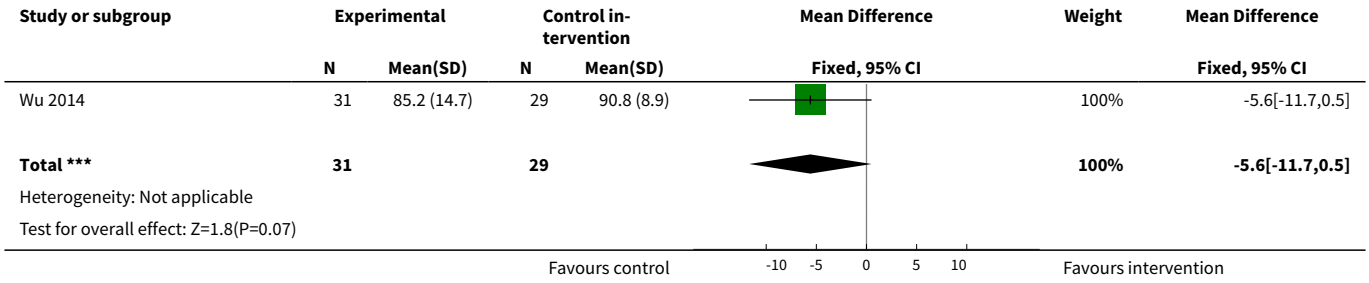




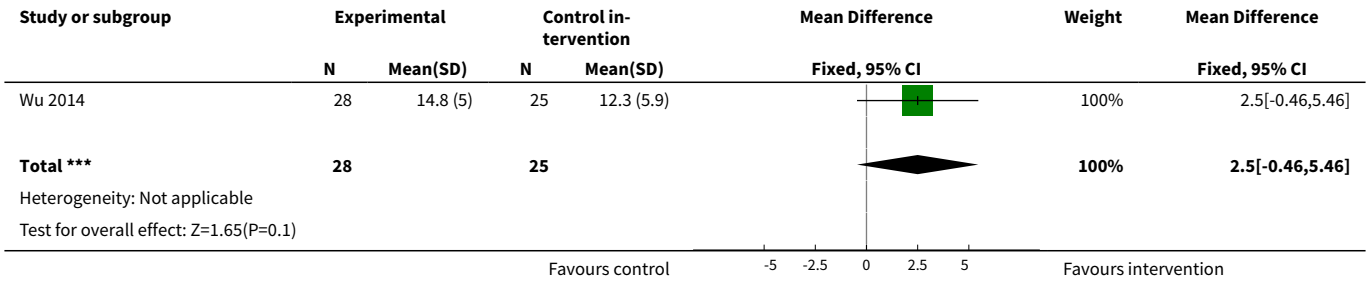
Comparison 3. Spaced retrieval combined with errorless learning training programme for patients versus spaced retrieval only training programme for patients (Wu 2014)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Amount eaten (percentage, 8 weeks, PP)	1	60	Mean Difference (IV, Fixed, 95% CI)	-5.60 [-11.70, 0.50]
2 Mini Mental State Examination (MMSE, range 0-30, higher = better, 8 weeks, PP)	1	53	Mean Difference (IV, Fixed, 95% CI)	2.5 [-0.46, 5.46]

Analysis 3.1. Comparison 3 Spaced retrieval combined with errorless learning training programme for patients versus spaced retrieval only training programme for patients (Wu 2014), Outcome 1 Amount eaten (percentage, 8 weeks, PP).



Analysis 3.2. Comparison 3 Spaced retrieval combined with errorless learning training programme for patients versus spaced retrieval only training programme for patients (Wu 2014), Outcome 2 Mini Mental State Examination (MMSE, range 0-30, higher = better, 8 weeks, PP).

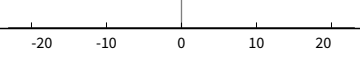


Comparison 4. Spaced retrieval training programme for patients versus no intervention (Lin 2010)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Amount eaten (percentage, 3 months, PP)	1	54	Mean Difference (IV, Fixed, 95% CI)	2.67 [-5.22, 10.56]
2 Mini Nutritional Assessment (MNA, range 0-30, higher = better, 8 weeks, PP)	1	33	Mean Difference (IV, Fixed, 95% CI)	3.68 [1.88, 5.48]
3 Body Mass Index (BMI, 8 weeks, PP)	1	33	Mean Difference (IV, Fixed, 95% CI)	1.73 [-0.63, 4.09]
4 Body weight (kg, 8 weeks, PP)	1	33	Mean Difference (IV, Fixed, 95% CI)	3.35 [-2.72, 9.42]
5 Edinburgh Feeding Evaluation in Dementia scale (EdFED, range 0-22, lower = better, 8 weeks, PP)	1	54	Mean Difference (IV, Fixed, 95% CI)	-1.67 [-2.34, -1.00]

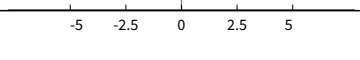
Analysis 4.1. Comparison 4 Spaced retrieval training programme for patients versus no intervention (Lin 2010), Outcome 1 Amount eaten (percentage, 3 months, PP).

Study or subgroup	Experimental N	Experimental Mean(SD)	Control N	Control Mean(SD)	Mean Difference Fixed, 95% CI	Weight	Mean Difference Fixed, 95% CI
Lin 2010	31	90.7 (8.8)	23	88.1 (17.8)		100%	2.67[-5.22,10.56]
Total ***	**31**		**23**			**100%**	**2.67[-5.22,10.56]**
Heterogeneity: Not applicable							
Test for overall effect: Z=0.66(P=0.51)							

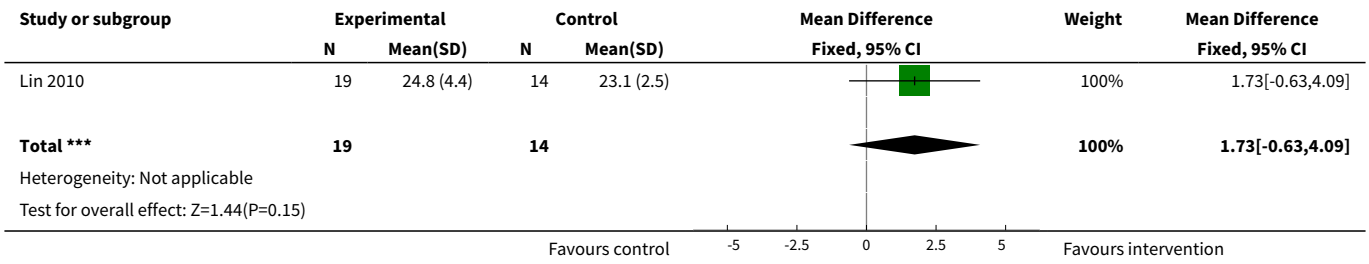


Analysis 4.2. Comparison 4 Spaced retrieval training programme for patients versus no intervention (Lin 2010), Outcome 2 Mini Nutritional Assessment (MNA, range 0-30, higher = better, 8 weeks, PP).

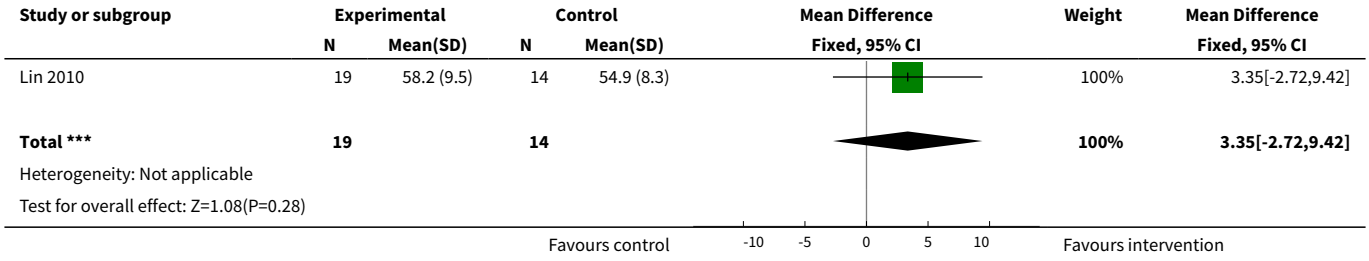
Study or subgroup	Experimental N	Experimental Mean(SD)	Control N	Control Mean(SD)	Mean Difference Fixed, 95% CI	Weight	Mean Difference Fixed, 95% CI
Lin 2010	19	24 (2.1)	14	20.3 (2.9)		100%	3.68[1.88,5.48]
Total ***	**19**		**14**			**100%**	**3.68[1.88,5.48]**
Heterogeneity: Tau^2=0; Chi^2=0, df=0(P<0.0001); I^2=100%							
Test for overall effect: Z=4.01(P<0.0001)							



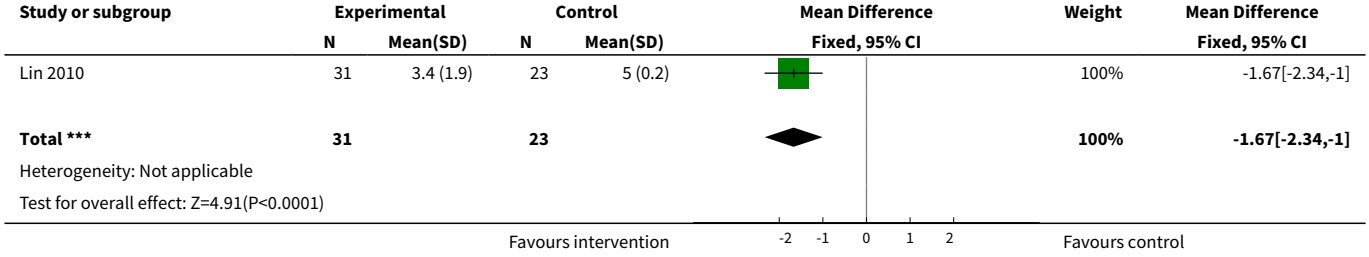
Analysis 4.3. Comparison 4 Spaced retrieval training programme for patients versus no intervention (Lin 2010), Outcome 3 Body Mass Index (BMI, 8 weeks, PP).



Analysis 4.4. Comparison 4 Spaced retrieval training programme for patients versus no intervention (Lin 2010), Outcome 4 Body weight (kg, 8 weeks, PP).



Analysis 4.5. Comparison 4 Spaced retrieval training programme for patients versus no intervention (Lin 2010), Outcome 5 Edinburgh Feeding Evaluation in Dementia scale (EdFED, range 0-22, lower = better, 8 weeks, PP).



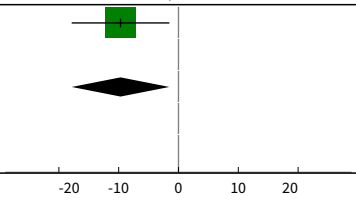
Comparison 5. Montessori-based activities training programme for patients versus no intervention (Lin 2010)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Amount eaten (percentage, 3 months, PP)	1	51	Mean Difference (IV, Fixed, 95% CI)	-9.69 [-17.86, -1.52]
2 Mini Nutritional Assessment (MNA, range 0-30, higher = better, 8 weeks, PP)	1	31	Mean Difference (IV, Fixed, 95% CI)	-2.31 [-4.62, 0.00]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
3 Body Mass Index (BMI, 8 weeks, PP)	1	31	Mean Difference (IV, Fixed, 95% CI)	-1.94 [-3.95, 0.07]
4 Body weight (kg, 8 weeks, PP)	1	31	Mean Difference (IV, Fixed, 95% CI)	-3.93 [-9.62, 1.76]
5 Edinburgh Feeding Evaluation in Dementia scale (EdFED, range 0-22, lower = better, 8 weeks, PP)	1	51	Mean Difference (IV, Fixed, 95% CI)	-1.5 [-2.16, -0.84]

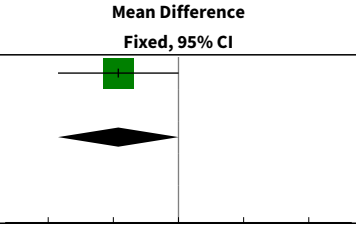
Analysis 5.1. Comparison 5 Montessori-based activities training programme for patients versus no intervention (Lin 2010), Outcome 1 Amount eaten (percentage, 3 months, PP).

Study or subgroup	Experimental N	Experimental Mean(SD)	Control N	Control Mean(SD)	Mean Difference Fixed, 95% CI	Weight	Mean Difference Fixed, 95% CI
Lin 2010	28	78.4 (10.1)	23	88.1 (17.8)		100%	-9.69[-17.86,-1.52]
Total ***	**28**		**23**			**100%**	**-9.69[-17.86,-1.52]**
Heterogeneity: Not applicable							
Test for overall effect: Z=2.33(P=0.02)							



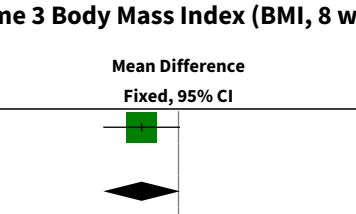
Analysis 5.2. Comparison 5 Montessori-based activities training programme for patients versus no intervention (Lin 2010), Outcome 2 Mini Nutritional Assessment (MNA, range 0-30, higher = better, 8 weeks, PP).

Study or subgroup	Experimental N	Experimental Mean(SD)	Control N	Control Mean(SD)	Mean Difference Fixed, 95% CI	Weight	Mean Difference Fixed, 95% CI
Lin 2010	17	18 (3.7)	14	20.3 (2.9)		100%	-2.31[-4.62,0]
Total ***	**17**		**14**			**100%**	**-2.31[-4.62,0]**
Heterogeneity: Not applicable							
Test for overall effect: Z=1.96(P=0.05)							

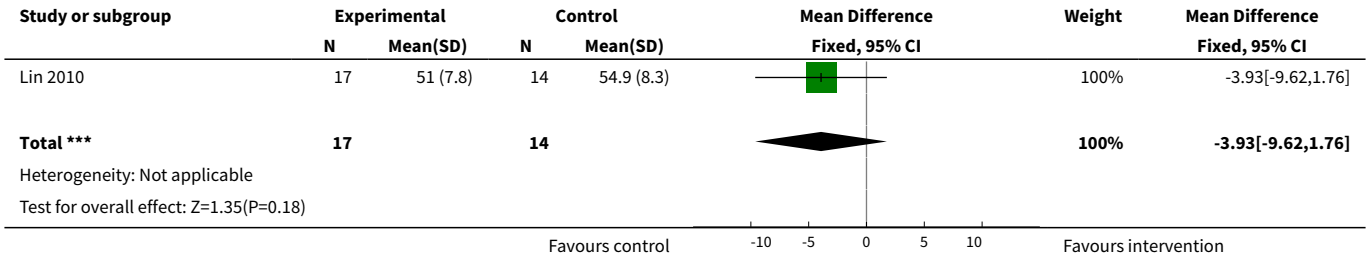


Analysis 5.3. Comparison 5 Montessori-based activities training programme for patients versus no intervention (Lin 2010), Outcome 3 Body Mass Index (BMI, 8 weeks, PP).

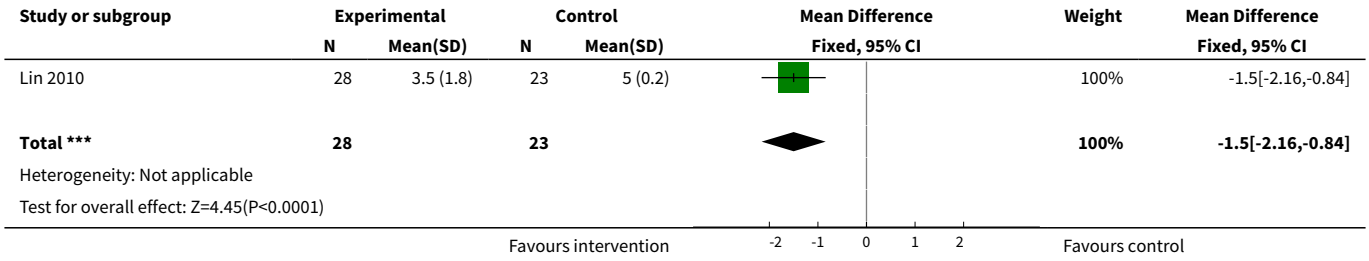
Study or subgroup	Experimental N	Experimental Mean(SD)	Control N	Control Mean(SD)	Mean Difference Fixed, 95% CI	Weight	Mean Difference Fixed, 95% CI
Lin 2010	17	21.1 (3.2)	14	23.1 (2.5)		100%	-1.94[-3.95,0.07]
Total ***	**17**		**14**			**100%**	**-1.94[-3.95,0.07]**
Heterogeneity: Not applicable							
Test for overall effect: Z=1.89(P=0.06)							



Analysis 5.4. Comparison 5 Montessori-based activities training programme for patients versus no intervention (Lin 2010), Outcome 4 Body weight (kg, 8 weeks, PP).



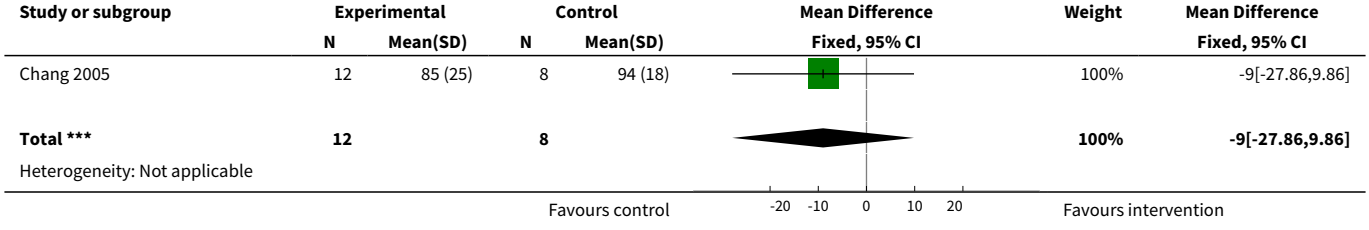
Analysis 5.5. Comparison 5 Montessori-based activities training programme for patients versus no intervention (Lin 2010), Outcome 5 Edinburgh Feeding Evaluation in Dementia scale (EdFED, range 0-22, lower = better, 8 weeks, PP).

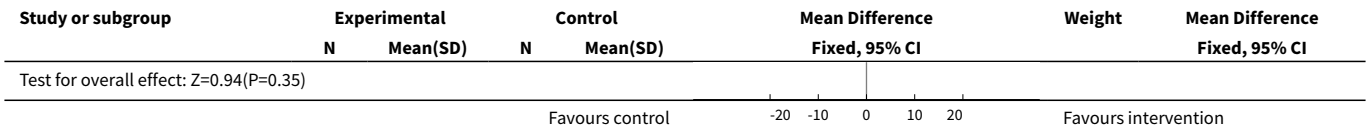


Comparison 6. Feeding skills training programme for nurses versus no intervention (Chang 2005)

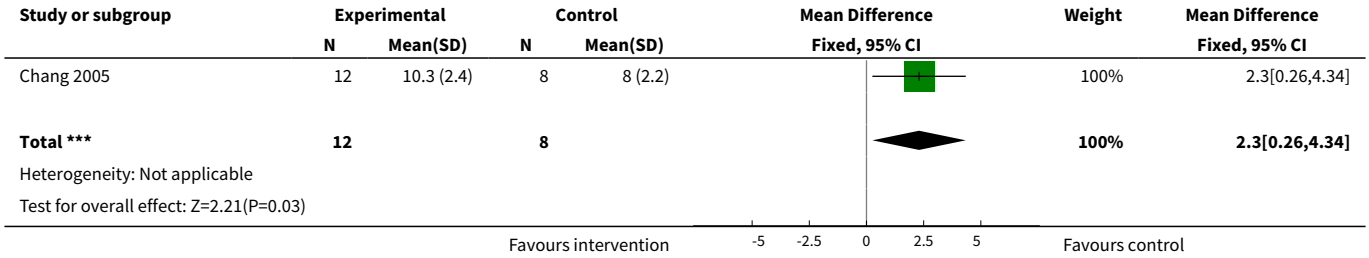
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Amount eaten (percentage, 3 months, PP)	1	20	Mean Difference (IV, Fixed, 95% CI)	-9.0 [-27.86, 9.86]
2 Edinburgh Feeding Evaluation in Dementia scale (EdFED, range 0-22, lower = better, 3 months, PP)	1	20	Mean Difference (IV, Fixed, 95% CI)	2.30 [0.26, 4.34]

Analysis 6.1. Comparison 6 Feeding skills training programme for nurses versus no intervention (Chang 2005), Outcome 1 Amount eaten (percentage, 3 months, PP).





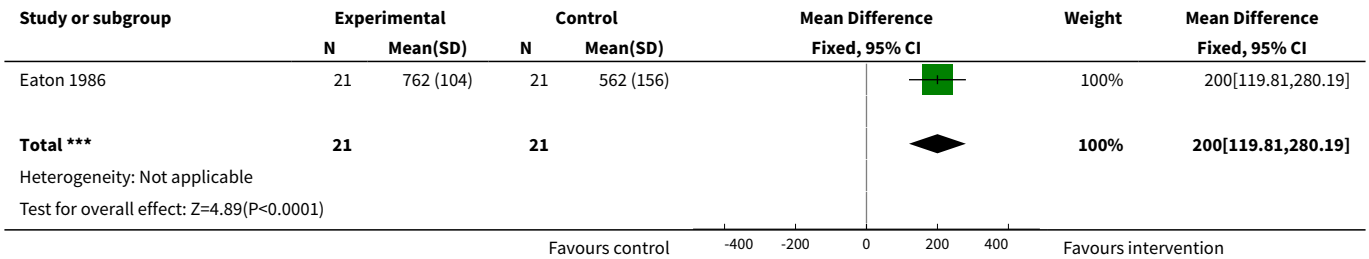
Analysis 6.2. Comparison 6 Feeding skills training programme for nurses versus no intervention (Chang 2005), Outcome 2 Edinburgh Feeding Evaluation in Dementia scale (EdFED, range 0-22, lower = better, 3 months, PP).



Comparison 7. Verbal encouragement and physical encouragement by touch versus verbal encouragement (Eaton 1986)

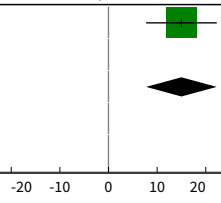
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Calories consumed per meal (kcal, 3 weeks, ITT)	1	42	Mean Difference (IV, Fixed, 95% CI)	200.0 [119.81, 280.19]
2 Protein consumed per meal (grams, 3 weeks, ITT)	1	42	Mean Difference (IV, Fixed, 95% CI)	15.0 [7.74, 22.26]

Analysis 7.1. Comparison 7 Verbal encouragement and physical encouragement by touch versus verbal encouragement (Eaton 1986), Outcome 1 Calories consumed per meal (kcal, 3 weeks, ITT).



Analysis 7.2. Comparison 7 Verbal encouragement and physical encouragement by touch versus verbal encouragement (Eaton 1986), Outcome 2 Protein consumed per meal (grams, 3 weeks, ITT).

Study or subgroup	Experimental N	Experimental Mean(SD)	Control N	Control Mean(SD)	Mean Difference Fixed, 95% CI	Weight	Mean Difference Fixed, 95% CI
Eaton 1986	21	47 (10.3)	21	32 (13.5)		100%	15[7.74,22.26]
Total ***	**21**		**21**			**100%**	**15[7.74,22.26]**
Heterogeneity: Not applicable							
Test for overall effect: Z=4.05(P<0.0001)							



Comparison 8. Directed verbal prompts and positive reinforcements versus usual care (Coyne 1997)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Level of Eating Independence scale for solid food (LEI, range 8-20, higher = better, 20 days, ITT, ANOVA group*time)			Other data	No numeric data
2 Level of Eating Independence scale for liquids (LEI, range 7-16, higher = better, 20 days, ITT, ANOVA group*time)			Other data	No numeric data

Analysis 8.1. Comparison 8 Directed verbal prompts and positive reinforcements versus usual care (Coyne 1997), Outcome 1 Level of Eating Independence scale for solid food (LEI, range 8-20, higher = better, 20 days, ITT, ANOVA group*time).

Level of Eating Independence scale for solid food (LEI, range 8-20, higher = better, 20 days, ITT, ANOVA group*time)

Study	Mean intervention	Mean control	F-value (degrees of freedom)	P value	Comments
Coyne 1997	16.6	13.1	3.36 (2, 44)	0.044	Only results of ANOVAs were provided.

Analysis 8.2. Comparison 8 Directed verbal prompts and positive reinforcements versus usual care (Coyne 1997), Outcome 2 Level of Eating Independence scale for liquids (LEI, range 7-16, higher = better, 20 days, ITT, ANOVA group*time).

Level of Eating Independence scale for liquids (LEI, range 7-16, higher = better, 20 days, ITT, ANOVA group*time)

Study	Mean intervention	Mean control	F-value (degrees of freedom)	P value	Comment
Coyne 1997	13.8	11.4	Not reported	>0.05	Only results of ANOVAs were provided. F-value for not significant result was not reported.

ADDITIONAL TABLES

Table 1. Baseline characteristics of participants and main interventions of included studies

Study	Number randomised and duration	Diagnosis and severity of disease	Age (SD), MMSE (SD), and BMI (SD)	Intervention and comparator	Outcomes relevant to this review
Chang 2005	67 (2 clusters), 3 months	Dementia (type or diagnostic criteria not reported), stage not reported	AGE: IG 84.2 (4.0)/CG 72.0 (5.8); MMSE: not reported at baseline; BMI: not reported at baseline	Feeding skills training programme for nursing assistants versus no training programme	• Food intake • EdFED
Coyne 1997	24, 20 days	Dementia (COBS, AD, multi-infarct-dementia, diagnostic criteria not reported), stage not reported	Age: IG 83.4 (-) CG 84.9 (-); MMSE: not reported at baseline; BMI: not reported at baseline	Verbal prompts and positive reinforcement from caregiver during meals versus no verbal prompts and positive reinforcements from caregiver during meals	• LEI for solids • LEI for liquids
Eaton 1986	42, 3 weeks	Dementia (COBS, diagnostic criteria not reported), stage not reported	Age: IG 84.9 (6.4)/CG 85.4 (6.2); MMSE: not reported at baseline; BMI: not reported at baseline	Verbal encouragement and physical encouragement through touch by caregiver during meals versus only verbal encouragement by caregivers during meals	• Calories consumed • Proteins consumed
Lin 2010	85 (3 clusters), 8 weeks	Dementia (type or diagnostic criteria not reported), mild to moderate (MMSE of 10 to 23)	Age; IG1 79.7 (6.1)/IG2 82.9 (6.0)/CG 81.1 (6.9); MMSE: IG1 13.6 (5.1)/ IG2 10.8 (4.9)/CG 10.5 (8.0); BMI: not reported at baseline	IG1: self-feeding skills training by spaced retrieval for people with dementia IG2: self-feeding skills training by Montessori-based activities for people with dementia CG: no training of self-feeding skills for people with dementia	• EdFED • Food intake • MNA • BMI • Body weight
Pivi 2011	90, 6 months	AD (according to DSM IV), mild to severe (CDR of 1 to 3)	Age: IG1 75.9 (-)/IG2 76.4 (-)/CG 75.2 (-); MMSE: IG1 12.8 (-)/IG2 11.6 (-)/CG 12.6 (-); BMI: not reported at baseline	IG1: education programme on nutrition for people with dementia IG2: supplementation CG: no education programme on nutrition for people with dementia and no supplementation	• Body weight • BMI • Arm circumference • Arm muscle circumference • Triceps skinfold
Salva 2011	946 (11 clusters), 12 months	AD (according to DSM IV), very mild to moderate (CDR of 0.5 to 3)	Age: IG 79.4 (7.0)/CG 78.6 (7.5); MMSE: IG 13.6 (5.1)/CG 10.5 (8.0); BMI: IG 26.6 (4.4)/CG 27.3 (4.6)	Education programme on nutrition for people with dementia versus no education programme on nutrition for people with dementia	• EBS • MMSE • CDR-global score • NPI-Q • ADL • IADL • Body weight • BMI • MNA

Table 1. Baseline characteristics of participants and main interventions of included studies *(Continued)*

Simmons 2010a	86, 6 weeks	54% of participants with dementia (type or diagnostic criteria not reported), stage not reported	Age: 86.9 (11.3); MMSE: 14.1 (8.9); BMI below 20: 24%	IG1: additional between-meal snacks IG2: supplementation CG: no additional snacks or supplementation	• Calories during meals • Calories between meals • Calories total • BMI
Suominen 2015	99, 12 months	AD (diagnostic criteria not reported), very mild to moderate (CDR of 0.5 to 3)	Age: IG 78.2 (5.5)/CG: 76.8 (5.9); MMSE: IG 18.8 (6.4)/CG 20.2 (4.7); BMI: IG 26.3 (3.6)/CG 25.9 (2.9)	Education programme on nutrition for people with dementia versus no education programme on nutrition for people with dementia	• BMI • Protein intake • Health-related quality of life • Rates of falls
Wu 2014	63 (4 clusters), 8 weeks	Dementia (type or diagnostic criteria not reported), mild to severe (CDR of 1 to 3)	Age: 79.9 (7.3); MMSE: not reported at baseline, but severity classified by CDR: mild dementia (CDR of 1) 34.4%, moderate dementia (CDR of 2) 37.7%, severe dementia (CDR of 3) 27.9%; BMI: not reported at baseline	Self-feeding skills training by spaced retrieval combined with errorless learning for people with dementia versus self-feeding skills training by spaced retrieval without errorless learning for people with dementia	• MMSE • Food intake

AD: Alzheimer's disease; **ADL:** Activities of Daily Living; **BMI:** body mass index; **CDR:** Clinical Dementia Rating; **CG:** control group; **COBS:** chronic organic brain syndrome; **DSM:** Diagnostic and Statistical Manual of Mental Disorders; **EBS:** Eating Behaviour Scale; **EdFED:** Edinburgh Feeding Evaluation in Dementia; **IADL:** Instrumental Activities of Daily Living; **IG:** intervention group; **LEI:** Level of Eating Independence scale; **MMSE:** Mini-Mental-State Examination; **MNA:** Mini Nutritional Assessment; **NPI-Q:** Neuropsychiatric Inventory Questionnaire; **SD:** standard deviation

APPENDICES

Appendix 1. Sources searched and search strategies

Source	Search strategy	Hits retrieved
ALOIS (www.medicine.ox.ac.uk/alois) but searched via the offline CRS [Date of most recent search 17 January 2018]	food OR fluid OR environment OR feeding OR meal OR mealtimes OR feeding OR appetite OR eating OR diet OR dietary	Mar 2015: 358 Feb 2016: 0 Nov 2016: 0 Jan 2018: 0

(Continued)

MEDLINE In-process and other non-indexed citations and MEDLINE 1950-present (Ovid SP) [Date of most recent search 17 January 2018]	1. exp Dementia/	Mar 2015: 3876
	2. Delirium/	Feb 2016: 327
	3. Wernicke Encephalopathy/	Nov 2016: 356
	4. Delirium, Dementia, Amnestic, Cognitive Disorders/	Jan 2018: 917
	5. dement*.mp.	
	6. alzheimer*.mp.	
	7. (lewy* adj2 bod*).mp.	
	8. (chronic adj2 cerebrovascular).mp.	
	9. ("organic brain disease" or "organic brain syndrome").mp.	
	10. "benign senescent forgetfulness".mp.	
	11. (cerebr* adj2 deteriorat*).mp.	
	12. (cerebral* adj2 insufficient*).mp.	
	13. or/1-12	
	14. (environment* and (modif* or chang* or improv*)).ti,ab.	
	15. (routine* and (modif* or chang* or improv* or alter*)).ti,ab.	
	16. (ambience or atmosphere).ti,ab.	
	17. (context* and (modif* or chang* or improv* or alter*)).ti,ab.	
	18. (behavio?r* and (modif* or chang* or improv*)).ti,ab.	
	19. (education* and (food or diet*)).ti,ab.	
	20. (training and (food or diet*)).ti,ab.	
	21. *Health Education/	
	22. exp *Feeding Behavior/ or exp *Behavior/	
	23. (food or "fluid* intak*").ti,ab.	
	24. appetite.ti,ab.	
	25. exp *Appetite/	
	26. exp *Feeding Methods/ or exp *Feeding Behavior/	
	27. (meal* adj3 environment*).ti,ab.	
	28. (meal* adj3 behav*).ti,ab.	
	29. *Food/ or *Food Assistance/ or *Food Habits/	
	30. or/14-29	
	31. randomized controlled trial.pt.	
	32. controlled clinical trial.pt.	
	33. random*.ab.	
	34. placebo.ab.	

(Continued)

	35. trial.ab. 36. groups.ab. 37. or/31-36 38. (animals not (humans and animals)).sh. 39. 37 not 38 40. 13 and 30 and 39	
EMBASE 1974-2015 March 10 (Ovid SP) [Date of most recent search 17 January 2018]	1. exp dementia/ 2. dement*.ti,ab. 3. alzheimer*.ti,ab. 4. (lewy* adj2 bod*).ti,ab. 5. (chronic adj2 cerebrovascular).ti,ab. 6. ("organic brain disease" or "organic brain syndrome").ti,ab. 7. "benign senescent forgetfulness".ti,ab. 8. (cerebr* adj2 deteriorat*).ti,ab. 9. or/1-8 10. (environment* and (modif* or chang* or improv*)).ti,ab. 11. (routine* and (modif* or chang* or improv* or alter*)).ti,ab. 12. (ambience or atmosphere).ti,ab. 13. (context* and (modif* or chang* or improv* or alter*)).ti,ab. 14. (behavio?r* and (modif* or chang* or improv*)).ti,ab. 15. (education* and (food or diet*)).ti,ab. 16. (training and (food or diet*)).ti,ab. 17. health education/ 18. exp *feeding behavior/ 19. (food or "fluid* intak*").ti,ab. 20. appetite.ti,ab. 21. exp *appetite/ 22. food intake/ 23. fluid intake/ 24. (meal* adj3 environment*).ti,ab. 25. (meal* adj3 behav*).ti,ab. 26. *food/ 27. *food assistance/ 28. or/10-27	Mar 2015: 1871 Feb 2016: 252 Nov 2016: 179 Jan 2018: 435

(Continued)

	29. controlled clinical trial/	
	30. randomized controlled trial/	
	31. randomly.ab.	
	32. (random* adj2 (allocat* or assign*)).ti,ab.	
	33. randomi?ation.ab.	
	34. ((double or single) adj (blind or blinded or masked)).ti,ab.	
	35. parallel group*.ti,ab.	
	36. (controlled adj4 (study or design or trial)).ti,ab.	
	37. or/29-36	
	38. 9 and 28 and 37	
PSYCINFO 1806-March week 1 2015 (Ovid SP) [Date of most recent search 17 January 2018]	1. exp Dementia/	Mar 2015: 1650
	2. dement*.ti,ab.	Feb 2016: 192
	3. alzheimer*.ti,ab.	Nov 2016: 114
	4. exp Alzheimer's Disease/	Jan 2018: 343
	5. (lewy* adj2 bod*).mp.	
	6. (chronic adj2 cerebrovascular).mp.	
	7. ("organic brain disease" or "organic brain syndrome").mp.	
	8. "benign senescent forgetfulness".mp.	
	9. (cerebr* adj2 deteriorat*).mp.	
	10. (cerebral* adj2 insufficient*).mp.	
	11. or/1-10	
	12. (environment* and (modif* or chang* or improv*)).ti,ab.	
	13. (routine* and (modif* or chang* or improv* or alter*)).ti,ab.	
	14. (ambience or atmosphere).ti,ab.	
	15. (context* and (modif* or chang* or improv* or alter*)).ti,ab.	
	16. (behavio?r* and (modif* or chang* or improv*)).ti,ab.	
	17. (education* and (food or diet*)).ti,ab.	
	18. (training and (food or diet*)).ti,ab.	
	19. exp Health Education/	
	20. exp Food Intake/ or exp Eating Behavior/	
	21. (food or "fluid* intak*").ti,ab.	
	22. appetite.ti,ab.	
	23. exp Appetite/	
	24. exp Eating Behavior/	

(Continued)

	25. (meal* adj3 environment*).ti,ab. 26. (meal* adj3 behav*).ti,ab. 27. exp Food/ 28. exp Fluid Intake/ 29. or/12-28 30. exp Clinical Trials/ 31. random*.ab. 32. placebo.ab. 33. trial.ab. 34. groups.ab. 35. ((double or single) adj (blind or blinded or masked)).ti,ab. 36. randomi?ation.ab. 37. (random* adj2 (allocat* or assign*)).ti,ab. 38. randomi?ed.ab. 39. (controlled adj4 (study or design or trial)).ti,ab. 40. or/30-39 41. 11 and 29 and 40	
CINAHL (EBSCOhost) [Date of most recent search 17 January 2018]	S1 (MH "Dementia+") S2 (MH "Delirium") or (MH "Delirium, Dementia, Amnestic, Cognitive Disorders") S3 (MH "Wernicke's Encephalopathy") S4 TX dement* S5 TX alzheimer* S6 TX lewy* N2 bod* S7 TX deliri* S8 TX chronic N2 cerebrovascular S9 TX "organic brain disease" or "organic brain syndrome" S10 TX "normal pressure hydrocephalus" and "shunt*" S11 TX "benign senescent forgetfulness" S12 TX cerebr* N2 deteriorat* S13 TX cerebral* N2 insufficient* S14 TX pick* N2 disease S15 TX creutzfeldt or jcd or cjd S16 TX huntington*	Mar 2015: 250 Feb 2016: 21 Nov 2016: 12 Jan 2018: 43

(Continued)

S17 TX binswanger*

S18 TX korsako*

S19 S1 or S2 or S3 or S4 or S5 or S6 or S7 or S8 or S9 or S10 or S11 or S12 or S13 or S14 or S15 or S16 or S17 or S18

S20 TX environment* N3 modif*

S21 TX environment* N3 chang*

S22 TX environment* N3 improv*

S23 TX routine* N3 improv*

S24 TX routine* N3 modif*

S25 TX routine* N3 chang*

S26 (MH "Eating Behavior")

S27 TX eat* N2 behav*

S28 TX ambience OR atmosphere

S29 TX (education AND (food OR diet*))

S30 TX (training AND (food OR diet*))

S31 TX appetite

S32 (MH "Appetite")

S33 TX meal N3 environment*

S34 TX meal N3 behav*

S35 (MH "Food") OR (MH "Food Assistance") OR (MH "Food Preferences")

S36 TX "fluid intake"

S37 S20 OR S21 OR S22 OR S23 OR S24 OR S25 OR S26 OR S27 OR S28 OR S29 OR S30 OR S31 OR S32 OR S33 OR S34 OR S35 OR S36

S38 S19 AND S37

S39 (MH "Randomized Controlled Trials")

S40 TX randomly

S41 TX "double blind*"

S42 TX "single blind*"

S43 TX placebo

S44 TX randomised

S45 TX randomized

S46 TX "parallel group*"

S47 TX RCT

S48 TX "controlled clinical trial"

S49 S39 OR S40 OR S41 OR S42 OR S43 OR S44 OR S45 OR S46 OR S47 OR S48

(Continued)

	S50 S38 AND S49	
ISI Web of Knowledge – all databases [includes: Web of Science (1945-present); BIOSIS Previews (1926-present); MEDLINE (1950-present); Journal Citation Reports] [Date of most recent search 17 January 2018]	(dement* OR alzheimer* OR "lewy bod*" OR DLB OR "vascular cognitive impairment*" OR FTD OF FTLD OR "cerebrovascular insufficienc*") *AND* **TOPIC:** ("food intak*" OR "feeding behaviour*" OR "feeding behaviour*" OR "modif* behav*" OR "environment* modif*" OR appetite OR "feeding method*" OR "fluid intake" OR meal* OR "food assistance" OR "food habit*") *AND* **TOPIC:** (randomly OR randomised OR randomized OR placebo OR "double-blind*" OR trial OR RCT OR CCT)	Mar 2015: 297 Feb 2016: 27 Nov 2016: 27 Jan 2018: 55
LILACS (BIREME) [Date of most recent search 17 January 2018]	dementia OR demencia OR alzheimers OR alzheimer [Words] and food OR meal OR mealtime OR appetite OR "fluid intake" [Words] and randomly OR randomised OR randomized OR RCT OR "controlled trial" OR "double blind$" OR placebo [Words]	Mar 2015: 2 Feb 2016: 0 Nov 2016: 0 Jan 2018: 0
CENTRAL (*The Cochrane Library*) (Issue 1 of 12, Oct 2018) [Date of most recent search 17 January 2018]	#1 dement* #2 alzheimer* #3 "lewy bod*" #4 "vascular cognit*" #5 DLB #6 MeSH descriptor: [Dementia] explode all trees #7 MeSH descriptor: [Delirium, Dementia, Amnestic, Cognitive Disorders] explode all trees #8 "organic brain disease" or "organic brain syndrome" #9 cerebro* N2 deteriorat* #10 cerebro* N2 insuffic* #11 #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 #12 (environment* and (modif* or chang* or improv*)) #13 (routine* and (modif* or chang* or improv* or alter*)) #14 (ambience or atmosphere) #15 (context* and (modif* or chang* or improv* or alter*)) #16 (behavior* and (modif* or chang* or improv*)) #17 (behaviour* and (modif* or chang* or improv*)) #18 (education* and (food or diet*)) #19 (training and (food or diet*)) #20 MeSH descriptor: [Health Education] explode all trees #21 MeSH descriptor: [Feeding Behavior] explode all trees #22 food or "fluid* intak*"	Mar 2015: 2065 Feb 2016: 0 Nov 2016: 80 Jan 2018: 808

(Continued)

	#23 appetite #24 MeSH descriptor: [Appetite] explode all trees #25 MeSH descriptor: [Feeding Methods] explode all trees #26 MeSH descriptor: [Feeding Behavior] explode all trees #27 meal* N3 environment* #28 meal* N3 behav* #29 MeSH descriptor: [Food] explode all trees #30 MeSH descriptor: [Food Assistance] explode all trees #31 MeSH descriptor: [Food Habits] explode all trees #32 #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20 or #21 or #22 or #23 or #24 or #25 or #26 or #27 or #28 or #29 or #30 or #31 #33 #32 and #11 in Trials	
Clinicaltrials.gov (www.clinicaltrials.gov) [Date of most recent search 17 January 2018]	[Search terms: food OR meals OR meal OR mealtime OR appetite OR "fluid intake" OR "feeding behavior" OR "eating behavior"] AND [Conditions: dementia OR alzheimer's OR alzheimer OR alzheimers OR lewy] AND Interventional Studies	Mar 2015: 70 Feb 2016: 0 Nov 2016: 4 Jan 2018: 4
ICTRP Search Portal (http://apps.who.int/trialsearch) [includes: Australian New Zealand Clinical Trials Registry; ClinicalTrilas.gov; ISRCTN; Chinese Clinical Trial Registry; Clinical Trials Registry – India; Clinical Research Information Service – Republic of Korea; German Clinical Trials Register; Iranian Registry of Clinical Trials; Japan Primary Registries Network; Pan African Clinical Trial Registry; Sri Lanka Clinical Trials Registry; The Netherlands National Trial Register] [Date of most recent search 17 January 2018]	[Search terms: food OR meals OR meal OR mealtime OR appetite OR "fluid intake" OR "feeding behavior" OR "eating behavior"] AND [Conditions: dementia OR alzheimer's OR alzheimer OR alzheimers OR lewy] AND Interventional Studies	Mar 2015: 18 Feb 2016: 0 Nov 2016: 0 Jan 2018: 23
TOTAL before de-duplication		Mar 2015: 10,460 Feb 2016: 821 Nov 2016: 772

(Continued)

	Jan 2018: 2628
TOTAL after software de-duplication	Mar 2015: 7,206 Feb 2016: 394 Nov 2016: 510 Jan 2018: 1629 **TOTAL: 9739**

CONTRIBUTIONS OF AUTHORS

MH: correspondence; drafting protocol; drafting review versions; selection of randomised controlled trials (RCTs); extraction of data; assessing risk of bias; data entry; data analysis; GRADE; interpretation of data/analyses.

AF: drafting protocol; selection of RCTs; extraction of data; assessing risk of bias; data entry; data analysis; GRADE; interpretation of data/analyses.

GL: correspondence; drafting protocol.

TW: 'Description of condition' section; drafting protocol.

SW: 'Description of condition' section; drafting protocol.

AH: selection of RCTs; extraction of data; assessing risk of bias; data entry; data analysis; interpretation of data/analyses.

MB: drafting protocol; selection of RCTs; extraction of data; assessing risk of bias; interpretation of data/analyses.

DECLARATIONS OF INTEREST

MH: None known.

AF: None known.

GL: None known.

TW: None known.

SW: None known.

AH: None known.

MB: None known.

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Internal sources

- Wilhelm-Roux Programme at the Medical Faculty of the Martin-Luther-University Halle-Wittenberg, Germany.

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- NIHR, UK.

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DIFFERENCES BETWEEN PROTOCOL AND REVIEW

We updated and extended the Background to include newer literature, to put more emphasis on the aspect of dehydration and fluid intake, to add a reference regarding complex interventions, to clarify a few sentences on our framework to classify interventions, and to put more emphasis on the importance of this review for the quality of care as well as caregiver burden. We clarified under Types of outcome measures, for studies eligible for inclusion, that inadequately short follow-up times for measures of food and fluid intake or nutritional status are not an exclusion criteria, but instead are indicative of lower-quality evidence, and that outcomes for mealtime behaviour should have a certain length of follow-up as well.

Because all, apart from one of the findings, were based on single studies, we considered the risk of bias given for each study in the evaluation and did not employ imputation methods, and also did not assess statistical heterogeneity.

We intended to perform intention-to-treat (ITT) analysis, but recognised that this was most likely not possible without some sort of imputation strategy to deal with missing data. Statistical analysis compensating for missing data is always based on assumptions that can rarely be verified and can thus itself be a source of bias (Unnebrink 2001). When data were not sufficient for a proper ITT analysis, we instead reverted to an available case analysis, included the absence of ITT analysis in the study as a source of bias and considered strategies to compensate for missing data to enable ITT in the sensitivity analysis.

Anne-Marie Hanff joined the team as an author during the review process. She supported the team as outlined under Contributions of authors.

INDEX TERMS

Medical Subject Headings (MeSH)

*Meals; *Patient Education as Topic; Alzheimer Disease [complications] [psychology]; Dementia [*complications] [psychology]; Dietary Proteins [administration & dosage]; Energy Intake; Nutrition Disorders [*diet therapy]; Nutritional Status; Randomized Controlled Trials as Topic; Time Factors

MeSH check words

Humans